



Edwards Aquifer Habitat Conservation Plan
Applied Research Work Group

Report of the 2015 Applied Research Work Group

October 16, 2015

Introduction

The Edwards Aquifer Habitat Conservation Plan (EAHCP) calls for the Applied Research Program to build knowledge about the Covered Species, and to facilitate the collection of data for the Ecological Model. This effort provides the EAHCP with a more accurate understanding of the ecological dynamics of the Comal and San Marcos spring systems, particularly under low-flow conditions. The Applied Research Program is an important component of the EAHCP as it helps build information necessary for meeting the Biological Objectives and Goals.

In early 2015, the EAHCP received the first report of the National Academy of Sciences (NAS), where NAS provided recommendations towards all EAHCP programs, including the Applied Research Program. From these recommendations, a robust list of possible studies was compiled and presented to the NAS Recommendation Review Work Group (RRWG).

For the NAS recommendations pertaining to the EAHCP Applied Research Program, the RRWG recognized that the EAHCP program had completed many of the NAS recommendations for the EAHCP Applied Research Program, or was currently in the process of incorporating them. These determinations are documented in the RRWG's *Prioritization Matrix* (Appendix I), as presented in the RRWG final report. The RRWG recommended the creation of an Applied Research Work Group (ARWG) to establish a research project schedule for the remainder of Phase I of the EAHCP. As identified in Chapter 7 of the EAHCP, funding for the Applied Research Program is limited to Phase 1 (2013 through 2019) only. The RRWG stated that the ARWG should start work as soon as possible to allow for potential inclusion of 2016 research projects in the prioritization process.

Specifically, the RRWG recommended the following issues be addressed by the ARWG: (1) Determining if additional applied research studies are needed; and (2) Developing a research plan that prioritizes the numerous studies recommended by NAS, the Science Committee, the Implementing Committee, and independent subject matter experts.

Based on the recommendation of the RRWG, the EAHCP Implementing Committee created the ARWG at its August 20, 2015 meeting, approving its charge "to recommend a holistic Applied Research Project Schedule that takes into account currently identifiable research necessary to better understand EAHCP's Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. This schedule will be used to develop, review, and assess the Work Plans for the Applied Research Program in 2016 through 2019.

The Implementing Committee appointed the following individuals to the ARWG at its August, 20 meeting: Tom Arsuffi (Texas Tech University), Janis Bush (University of Texas at San Antonio), Bob Hall (Edwards Aquifer Authority), Chad Norris (Texas Parks & Wildlife Department), and Kenneth Ostrand (United States Fish & Wildlife Service. Dr. Tom Arsuffi was elected as the Work Group Chair at the first meeting of the Work Group. The Work Group held a total of three meetings during September and October 2015.

Appended to this report are the *Recommendations Review Work Group Prioritization Matrix* (Appendix I), the *2016-2019 Applied Research Project Schedule* (Appendix II), the *2016-2019 Applied Research Project Prioritization Matrix* (Appendix III), the Charge of the 2015 ARWG (Appendix IV), and the ARWG's meeting agendas and minutes (Appendix V).

NAS Applied Research Recommendations

As previously mentioned, the RRWG recommended that an ARWG be convened to determine (1) if additional applied research studies are needed, and (2) to develop a research plan that prioritizes the numerous studies that have been recommended by NAS, the Science Committee, the Implementing Committee, and independent subject matter experts. Ultimately, the ARWG determined that input from independent subject matter experts was not needed to complete its charge.

Reflecting the recommendation by the RRWG, a comprehensive list of the studies recommended by NAS was presented for consideration by the ARWG from the first meeting onwards as part of a proposed draft Applied Research Project Schedule. These NAS-recommended studies appear in blue on the *2016-2019 Applied Research Project Schedule* (Appendix II). Four NAS studies (three studies on the Comal Springs Riffle Beetle (CSRB) and one study on the effects from phosphorus on the ecosystems) were not recommended for implementation because it was believed necessary to first determine the CSRB sampling techniques—scheduled for 2016—and/or because the studies are more appropriate for the EAHCP Refugia program, or do not contribute to the overall achievement of the EAHCP Biological Goals and Objectives. These four studies appear at the bottom of the *Project Schedule*.

This strategy enabled the ARWG to take all NAS recommendations under consideration, so that NAS' contributions to the Applied Research Program could be duly incorporated into the final draft Applied Research Project Schedule as deemed appropriate by the ARWG.

Categories of Applied Research

In its first meeting, the ARWG identified categories of Applied Research on which to focus. The identification of these categories was based on the ARWG's review of to-be-conducted Applied Research studies identified to-date, including a comprehensive list of the studies recommended by NAS (as mentioned above), as well as studies recommended by the Science Committee and the Implementing Committee.

From this holistic review process, the ARWG identified five final categories, which are listed below along with a short description:

- 1. Conservation measures**

Assessing the holistic practical benefits of EAHCP Conservation Measures to the Species, and the effectiveness of the Conservation Measures in achieving Biological Objectives & Goals.

2. **Standard sampling methods**

Establishing reliable sampling methods for the Species to ensure they permit evaluation of trends over time, including standardization as an important goal; and that they are consistent with Biological Objectives & Goals.

3. **Habitat quality, quantity, and requirements**

Evaluating the habitat requirements of the Species, including the assessment of whether habitat is of sufficient quality and quantity, and validating HCP's assumptions related to habitat, consistent with Biological Objectives & Goals.

4. **System memory/Disturbance ecology**

Measuring the effects of disturbance (e.g., drought, scouring floods, etc.) on the system, and the response (i.e., resilience and/or resistance) of the system post-disturbance as it relates to Biological Objectives & Goals.

5. **Data**

Data management considerations relevant to existing and future data to be collected, as well as applications for analysis of existing data relevant to Biological Objectives & Goals.

Besides the above, four additional categories were discussed and identified as important, but did not fit in the Applied Research Program due to logistical and/or programmatic factors. These additional categories of research will be covered by other EAHCP programs. These categories are listed below, along with a short description and mention of what other EAHCP Program they fall under.

1. **Study reaches**

Evaluating the appropriateness of study reaches in the Comal and San Marcos systems will be conducted by the Biological Monitoring Work Group.

2. **Water quality**

Assessing water quality issues for the Comal and San Marcos systems, including watershed concerns and tailoring programs to the needs of species, will be conducted by the Water Quality Monitoring Work Group.

3. **Eco-model**

Validating the eco-model and other research applications related to the eco-model will be conducted within the scope of the EAA's modeling program.

4. **Basic biology of Species**

Starting in 2017, studies related to aspects of the basic biology of Species will be conducted through the Refugia Research Program.

Applied Research Project Prioritization Matrix

The *Applied Research Project Prioritization Matrix* (Appendix III) was developed at the request of the ARWG. This matrix was used by the Work Group as a reference for prioritizing projects within different Applied Research categories.

Within each of the five Applied Research categories listed on the matrix, the Work Group identified logical subcategories corresponding to that category. For example, projects fitting in the “Conservation measures” category are organized by subcategories corresponding to the various EAHCP Conservation Measures in the San Marcos and Comal Springs systems. Similarly, in the case of projects fitting in the “System memory/Disturbance ecology” category, the Work Group identified subcategories corresponding to the System and Reach where projects would be located.

Within each category, the Work Group prioritized specific projects.

Applied Research Project Schedule

The following section of this report is a summary of the *2016-2019 Applied Research Project Schedule* as recommended by the ARWG. This summary provides a narrative description of the studies which the ARWG recommends to constitute the EAHCP Applied Research Program over the next four years.

2016

Three of the five projects lined up for 2016 will consist of studies concerning the basic biology of the Comal Springs Riffle Beetle (CSRB). The efficacy of different sampling techniques for the CSRB will also be studied in a fourth, separate project, representing a standard sampling method study.

The fifth remaining project in 2016 will be database creation and management, including compiling and formatting data, creating standard data templates, and normalizing data for all EAHCP applied research conducted to date.

2017

Six studies were identified for 2017, including the second phase of a two-year evaluation of the life history of the CSRB. Two habitat projects will investigate 1) the suitability of submerged aquatic vegetation types for Fountain Darter habitat, and 2) the effects of sedimentation on submerged aquatic vegetation (SAV), the Fountain Darter, and the CSRB, respectively. A fourth study will evaluate the efficacy of different sampling techniques for the Comal Springs Dryopid Beetle. Rounding out the project schedule for the year, two projects will develop additional study questions to further explore biological objectives and statistically analyze existing EAHCP data concerning system memory/disturbance ecology and species-specific questions.

2018

For 2018, four studies will be conducted. One will evaluate the efficacy of different sampling techniques for the Peck's Cave Amphipod. The remaining three will investigate the effectiveness of Conservation Measures, with one evaluating success of SAV restoration and Texas Wild-rice enhancement, and the other confirming EAHCP Tables 4-1 and 4-21. A contingency "slot" has been left open in the Project Schedule to accommodate an additional project if need arises.

2019

In 2019, two studies were identified to be included on the Applied Research Project Schedule, including an evaluation of the success of removal of invasive animal species and an evaluation of the success of Sessom Creek sandbar removal and general sediment removal efforts in both systems. Like 2018, a contingency "slot" has been left open in the Project Schedule for 2019 to accommodate an additional project if need arises.

Role of the Science Committee in Relation to the Applied Research Program

The role of the Science Committee in the Applied Research Program is determined by the *Funding and Management Agreement* (FMA). Following the framework established by the FMA, the Implementing Committee adopted a process whereby the Science Committee plays a role in establishment of Scopes of Work for Applied Research projects. In keeping with the FMA, as the governing document for the EAHCP program, and the Implementing Committee's request, the following is the role of the Science Committee in the Applied Research Program:

1. Per the FMA and Implementing Committee-adopted process, the Science Committee will assist in developing the study questions for Applied Research projects; reviewing offerors' Scopes of Work for scientific merit; and reviewing the proposed methodology in the awarded offeror's study plan.
2. As specifically requested by Implementing Committee Chairman, the Science Committee will provide comments on the *Report of the 2015 Applied Research Work Group*, and, if agreeable, an endorsement of the report. Science Committee comments provided will be kept independent of the report, allowing the Implementing Committee to consider all perspectives.
3. The Science Committee will receive presentations by Applied Research Program contractors providing final scientific reports concerning the data and results of studies conducted in support of the EAHCP.

In addition to the official role of the Science Committee as described above, the ARWG also recommends for consideration by the Implementing Committee that the Science Committee exercise oversight in the following additional instances:

4. Evaluating the completion and success of studies conducted in support of the EAHCP to determine whether a given study was completed in an acceptable fashion by scientific standards, or whether it needs to be repeated or expanded upon in some fashion to

adequately supply desired information necessary to meet EAHCP Biological Objectives and Goals.

5. Given the significant complexity of the Applied Research Program, the ARWG also recommends that a Science Committee workshop be held to provide the Science Committee with an adequate forum to evaluate the progress to date of the Applied Research Program, with an eye to the coming four years of the program as laid out in the *2016-2019 Applied Research Project Schedule*.

Conclusion

At their final meeting on October 16, 2015, the ARWG unanimously approved this draft *Report of the 2015 Applied Research Work Group*, including the draft versions of the *2016-2019 Applied Research Project Schedule* and the *2016-2019 Applied Research Project Prioritization Matrix* appended herein. The ARWG recommends these documents to the Implementing Committee as its final deliverables for approval and adoption.

Prioritization Status: Done, Continual or In-Progress					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
Done	Hydrologic Model	Don't use the term "verification" when describing model runs with changing parameters.	None	Use the correct terminology in future discussions and reports.	EAA should draft a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models.
Done	Ecological Model	Develop an ecosystem-based conceptual model.	None	N/A	Already Done - 2010 EARIP Influence Diagrams: facilitated by Jean Cochrane
Done	Ecological Model	Develop a conceptual model that shows how water quality and quantity, other biota and restoration and mitigation activities are expected to interact with the indicator species.	None	N/A	Already Done - 2010 EARIP Influence Diagrams: facilitated by Jean Cochrane
Done	Ecological Model	In developing the fountain darter model, pay attention to movement, density dependence and other topics.	None	N/A	These studies were conducted through the Applied Research Program and results were incorporated into the Ecological Model
Done	Ecological Model	Include intermediate products in the development of the fountain darter model.	None	N/A	These analyses were performed as the first steps in the Ecological Model development.
Done	Ecological Model	Use the habitat suitability analyses for the fountain darter as "back-up" to individual-based modeling.	None	N/A	Early on in the development of the Ecological Model, the Ecological Model team developed a habitat suitability analyses for the fountain darter. This analyses could be used as a back-up to the Ecological Model if needed.
Done	Ecological Model	Revisit the estimation fountain darter suitability curves.	None	N/A	*These curves are the first step in creating the Ecological Model. If to be used for the development of the Ecological Model, we are past that point. *If the Fountain Darter module fails or does not calibrate, then suitability curves should be revisited.
Done	Applied Research	Conduct a follow-up fountain darter movement study.	None	N/A	A Fountain Darter movement study was conducted in 2014. NAS did not have the benefit of seeing these results prior to putting forth this recommendation.
Done	Applied Research	Increase transparency in prioritizing and funding research projects.	None	N/A	*In 2014 and 2015, EAHCP staff modified the Applied Research prioritization process to be more transparent, solicit additional proposals from new proposers, solicit more input from the Science Committee on the technical merits of proposals, solicit key elements from the Science Committee to be included in the RFP's, and generally increase the role of the Science Committee in the process.
Done	Overarching Issues	Future scenario planning: Think how possible worst case scenarios would impact both modeling and HCP implementation (provided 6 scenarios).	None	N/A	1. The impacts from increasing pumping levels from exempt well owners is being addressed by the Edwards Aquifer Authority during their annual operational planning process; 2. A drought, worse than the Drought of Record, has been addressed in Chapter 8 of the EAHCP; 3. The risk to the Covered Species because of the mismatch between hydrologic changes and conservation triggers will be addressed during Phase II of the EAHCP; 4. Impacts from Climate Change have been addressed by a shortened term limit (15 years) of the Incidental Take Permit; 5. The impacts from the federal court ruling on the Bragg constitutional taking decision are not within the jurisdiction of the EAHCP and; 6. The impacts from Whooping Crane ESA issues has been previously addressed through the EARIP planning process.
1. Done 2. Yes 3. In Progress - partner not host	Overarching Issues	Increase project integration through three steps: 1. Develop an overall conceptual model of the Edwards system. 2. Develop a unified data management system. 3. Convene an annual Science Meeting to discuss all relevant topics.	Yes	*Two of the specific recommendations identified (conceptual model and data integration) have been addressed in other sections of this implementation plan. *The third recommendation to hold a Annual Science meeting may be covered by the proposed Bio Monitoring, Water Quality and Applied Research work groups.	*A EAHCP Conceptual Model was created by EAHCP staff and share with Implementing Committee in 2014. *The Annual Science meeting covering the Edwards Aquifer appears to be a good idea. But not sure it is the EAHCP that should host, rather the EAHCP should be a participant.
Continual- thru the end of the ITP	Hydrologic Model	Do not compare results from MODFLOW and FEFLOW.	None	*EAA will not perform a head to head comparison of model results, but will rather utilize each model for specific purposes. *There has been much discussion by the IC and Stakeholders as to the purpose of having two models. Many have publically supported the use of both since they are now close to ready for utilization.	*Calibration of the models is not sufficient for a head to head comparison . *EAA should draft a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models.
Continual	Hydrologic Model	Consider MODFLOW as a work in progress and not a final product.	Funding is allocated in the EAA operational budget	Continue to update the MODFLOW model as additional data/information is realized.	*EAA has been committed to an iterative modeling process since the creation of the MODFLOW model; continuously improving and updating the model. The next iteration could be Modflow USG. *EAA should draft a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models.
Continual	Ecological Model	Improve the habitat suitability analyses for Texas wild rice.	Funding is allocated in the CoSM/TXSTATE work plan budget	Field Verification and Observation	*TWR has been extremely successful to date; therefore additional TWR work is not needed at this point. *The Meadows Center has been collecting this information as Applied Research imbedded in their TWR restoration work. Habitat suitability has taken the form of applied verification in the field.
Continual	Ecological Model	Test the robustness of the current habitat suitability analysis for Texas wild-rice.	Funding is allocated in the CoSM/TXSTATE work plan budget	Field Verification and Observation	*TWR has been extremely successful to date; therefore additional TWR work is not needed at this point. *The Meadows Center has been collecting this information as Applied Research imbedded in their TWR restoration work. Habitat suitability has taken the form of applied verification in the field.
Continual	Biological Monitoring	Continue monitoring index reaches.	Funding is allocated in the Biological Monitoring work plan budget	Implement the Biological Monitoring work plan	This is already part of the Bio Monitoring work plan and program. Recommend to establish a Biological Monitoring Work Group to do a holistic review of the biological monitoring program and its integration with the water quality monitoring program.

In Progress- short time-frame	Hydrologic Model	Continue development and testing of the Hydrological Simulation Program (HSPF) for estimating recharge.	Funding is allocated in the EAA operational budget	Conduct comparison between Puente method, HSPF, and other estimations.	*EAA has been committed to an iterative modeling process since the creation of the HSPF models; continuously improving and updating the models. *Refinement of Recharge Estimates are a goal of the EAA strategic plan. *EAA should draft a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models. *Recharge is a major source of uncertainty.
In Progress	Hydrologic Model	Quantitatively assess model uncertainty.	Funding is allocated in the EAA operational budget	Have technical consultants conduct uncertainty analysis. EAA is already working on a Scope of Work for this evaluation.	This is already included in Model development by EAA staff. However there is merit to having a 3rd party perform this analysis. The Work Group unanimously recommended the EAA to perform this analysis (6/26).
In Progress	Hydrologic Model	Move toward a single model.	None	N/A	*There seems to be support for this from both the technical perspective and political perspective. *Participants in the workshop noted that a Cost/Benefit analysis of one model vs two should be conducted.
In Progress	Ecological Model	Develop a phased strategy for testing individual components in the submerged aquatic vegetation (SAV) model.	Funding is allocated in the Ecological Modeling work plan budget.	Conduct Analysis	The Ecological Model Team is already planning to perform this verification.
In Progress	Ecological Model	Make the Applied Research program more robust with quantitative projections of Comal Springs riffle beetle (CSRB) habitat.	Funding is allocated in the Applied Research work plan budget.	In 2015 and 2016, the Applied Research Program is focusing on the Comal Springs riffle beetle.	However, the CSRB is no longer a module in the Ecological Model, therefore the data collected will only be utilized if the CSRB is added to the model at some point in the future.
In Progress	Ecological Model	Ensure proper interpretation of the ongoing effort to build an individual-based model for fountain darter.	Funding is allocated in the Ecological Modeling work plan budget.	N/A	The Ecological Modeling team already plans to conduct verification testing.
In Progress	Applied Research	Increase competition and collaboration with outside scientific experts.	None	N/A	*For 2016 Applied Research solicitations, EAHCP staff referenced literature cited reports and bibliographies of researchers that performed similar research or are familiar with the EAHCP Covered Species, EAHCP staff will reach out to these identified researchers and ensure they are aware of the EAHCP research projects. * Additionally, for 2016 research solicitations, EAHCP staff will utilize numerous posting boards.
In Progress	Applied Research	Increase transparency of research results.	TBD - depends on method utilized for formatting, storage and access/dissemination.	*Develop a data management plan. *Utilize a data manager (consultant or staff) or staff scientific Ph. D to establish a required data format for contractors to adhere to, reformat and organize existing data.	*It is recommended that a scientific Ph. D be added to the HCP staff to assist with the creation and implementation of a data management plan, if determined it is needed to achieve compliance. *This recommendation seems to lead one to believe that there is a lack of transparency in the research process or that data generated through the EAHCP is not made available to other entities. However, all reports, results and data are posted on the EAHCP website and provided to any requestor. *The NAS RSWG discussed that the purpose of data generated within the EAHCP is for the purpose of building the Ecological Model or providing information to the Implementing Committee to make decisions. The purpose is not to ensure the data is in a usable format for another program/entity to utilize. If it is not in a usable format for a requesting program/entity to use, it should be the responsibility of the requestor to format for their purposes.
In progress	Overarching Issues	Conduct performance-based monitoring of the minimization/mitigation measures.	None	EAHCP staff has already begun to develop a tracking matrix of all M&M measures, how to measure success/completion and their status (% completion as measured against the Biological Goals).	This matrix should be completed late-summer 2015.
In Progress	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
In Progress	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
In Progress	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
In Progress	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
Prioritization Status: Yes to be Implemented w/ no budget impact					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
Yes	Hydrologic Model	Display error bars on MODFLOW data.	Funding is allocated in the EAA operational budget	These error bars will be established by the Uncertainty Analysis being conducted by EAA	*The error bars will be most useful on the act of forbearance. *EAA has a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models.
Yes	Ecological Model	Clarify the goal of the submerged aquatic vegetation (SAV) model.	None	Require the Ecological Modeling team to provide a clear and concise goal of the SAV model.	

Yes	Applied Research	Remove Literature Review tasks	None - if any, could result in cost savings.	Request literature reviews with the proposal, rather than as a deliverable of the contract.	<p>*Thus far Literature Review has been conducted by all selected contractors and represents a very minor expense. Proposers should do their background work (literature review) prior to submitting, but what is the harm in requesting to see their lit review if selected.</p> <p>*As most of the Applied Research in the HCP has been conducted or determined to not be needed, and new projects and topics are recommended for research by NAS and the Science Committee, a Applied Research work group should be formed to review completed research and establish a new research plan moving forward.</p> <p>*In Table 7.1, applied research funding ends in 2019; with identified additional research needs and continuing unknowns, the Implementing Committee might consider extending applied research funding through the duration of the ITP. This additional funding would need to be reallocated from another HCP activity to applied research.</p> <p>*Additionally, it is recommended that a scientific Ph. D be added to the HCP staff to assist with workgroup facilitation, analysis and resulting implementation. Additionally, this staff person could assist in review of the research proposals, selecting contractors, and facilitating the research prioritization process and QA/QC of research conductance.</p>
Yes - as allowed for by the FMA	Applied Research	Offer longer-term projects.	None - the Applied Research budget is capped at \$450,000 annually	The FMA and budgeting cycle should be explored to identify opportunities to create multiple year research projects. Recommended as a critical component by the Work Group	<p>*The Science Committee has echoed the same recommendation for longer and on-going studies. However, that remains a challenge within the current planning and budgeting framework.</p> <p>*The NAS RRRWG supported this as an important step in increasing the number of potential bidders to projects. All opportunities to implement this recommendation should be explored.</p>
Future Goal	Hydrologic Model	Include conduits in the development of the Hydrologic Model.	Funding is allocated in the EAA operational budget	Will require additional hydrologic research and data collection.	<p>*Workshop participants generally supported modeling of conduits; however, many cautioned about the limited modeling capabilities to achieve this and the lack of data needed.</p> <p>*EAA has a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models.</p>
Future Goal	Hydrologic Model	Move toward making predictions on a daily time scale.	Funding is allocated in the EAA operational budget	Will require additional hydrologic research and data collection.	<p>*This would require outside consultation and expertise if established.</p> <p>*EAA has a multi-year modeling plan that outlines future modeling efforts that will effect/be utilized by the EAHCP. This plan should be comprehensive to all models.</p>
Prioritization Status: Yes or TBD w/ budget impact					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
Yes	Overarching Issues	A comprehensive information management plan.	Significant - initial setup of a comprehensive data management plan would likely require engaging a consultant and require purchase of additional software/hardware. Currently, there is no identified budget for this activity.	In the immediate future, staff will internally implement a data mgmt effort that focuses on security of data, format of newly collected data, backing up all data, and ensuring there is a transparent process in place to provide data to others.	<p>*It is anticipated that newly proposed Director of Refugia and Covered Species could assist with implementation of this recommendation.</p> <p>*The purpose of data generated within the EAHCP is for the purpose of building the Ecological Model or providing information to the Implementing Committee to make decisions. The purpose is not to ensure the data is in a usable format for another program/entity to utilize. If it is not in a usable format for a requesting program/entity to use, it should be the responsibility of the requestor to format for their purposes.</p>
TBD- by the Implementing Committee	Overarching Issues	Conduct rigorous statistical data analysis.	Significant - this analysis would be performed by a contractor. Currently, there is no identified budget for this activity.	Staff will first work with the SC to determine if any additional information can be gained to further compliance with the ITP from additional data analysis; this will be formatted in the form of questions to be answered by the analysis. Staff will then provide the Implementing Committee with a proposal for rigorous statistical data analysis, allowing the Implementing Committee to decide at that point if the effort is necessary or desired.	<p>*Before implementation of this recommendation, the Science Committee should be utilized to identify questions that should be answered through the additional data analysis. These questions should be directly tied to achieving compliance or furthering accomplishment of the Biological Goals.</p> <p>*Utilize a data manager (consultant or staff) to facilitate a Science Committee discussion to explore what, if any, questions should be answered by additional data analysis.</p>
Prioritization Status: Yes/No to be Implemented and Prioritized by the Water Quality Work Group					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
Yes	Biological and Water Quality Monitoring	Increase coordination and integration of the biological monitoring and water quality monitoring programs.	None	Create a Water Quality monitoring work group and a Biological monitoring work group to develop a strategy to implement this recommendation.	It is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.
Yes - ask the Water Quality work group for concurrence	Water Quality Monitoring	Enhance nutrient sampling.	Currently, there is no identified budget for this activity. For this sampling to be added, another component of equal or greater cost would need to be dropped.	Create a Water Quality monitoring work group to develop a strategy to implement this recommendation.	<p>*As several years of data have been collected under the HCP Water Quality program and much has been learned, it is time to take a step back and revisit the Water Quality monitoring program from a holistic approach. It is recommended that a work group be formed to consider all NAS Water Quality monitoring recommendations and look for needed modifications based on data collected.</p> <p>*Additionally it is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.</p>
Yes - ask the Water Quality work group for concurrence	Water Quality Monitoring	Conduct additional residential herbicide, residential chemicals, and personal care product testing.	Currently, there is no identified budget for this activity. For this sampling to be added, another component of equal or greater cost would need to be dropped.	Create a Water Quality monitoring work group to develop a strategy to implement this recommendation.	<p>*As several years of data have been collected under the HCP water quality monitoring program and much has been learned, it is time to take a step back and revisit the water quality monitoring program from a holistic approach. It is recommended that a work group be formed to consider all NAS water quality monitoring recommendations and look for needed modifications based on data collected.</p> <p>*Additionally it is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.</p>
Prioritization Status: Yes/No to be Implemented and Prioritized by the Biological Monitoring Work Group					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
Yes	Biological and Water Quality Monitoring	Increase coordination and integration of the biological monitoring and water quality monitoring programs.	None	Create a Water Quality monitoring work group and a Biological monitoring work group to develop a strategy to implement this recommendation.	It is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.

TBD	Biological Monitoring	Provide a clear mechanism to scale results to the entire spring and reach system.	Currently, there is no identified budget for this activity. For this sampling to be added, another component of equal or greater cost would need to be dropped.	Create a Biological monitoring work group to develop a strategy to implement this recommendation.	*The NAS RRRWG discussed that the purpose of expanding the index reaches to representative reaches (system wide representation) has not been determined. If this is considered, a rationale as to why a system wide representation is needed for ITP compliance should be developed. *The Biological Goals and Objectives are tied to the previously identified reaches, not the entire river system. * NAS themselves comments that this is necessary only if desired.
No - ask the Biological Monitoring work group for concurrence	Biological Monitoring	Increase the frequency of sampling in Comal Springs system.	Currently, there is no identified budget for this activity. For this sampling to be added, another component of equal or greater cost would need to be dropped.	Create a Biological monitoring work group to develop a strategy to implement this recommendation.	*Originally, the Variable Flow sampling was conducted 4 times a year. It has since been reduced to twice a year as it was determined there was no additional advantage to sampling a higher frequency. *The NAS RRRWG discussed the consistency in data sets and lack of variability in most parameters, leading to the questioning of why implementation of this recommendation would be needed.
Prioritization Status: Yes/No to be Implemented and Prioritized by the Applied Research Work Group					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
Yes	Ecological Model	Develop a much deeper understanding of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	The workshop participants generally supported more CSRB research. However, there was discussion about if the CSRB should be used as an indicator species, as it is assumed the CSRB simply retreats into subterranean habitat.
Yes	Biological Monitoring	Develop quantitative sampling methods for the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	*The Science Committee has been discussing this topic at recent meetings. This recommendation should complement their discussions. *Workshop participants generally supported establishment of new methods. *This research would specifically look at methods other than use of the "cotton lure"; but also could be designed to include an "Optimization Study" for the cotton lure. *This research could also be used to determine the composition of the biofilm; or if already established by other researchers, could determine the utilization of the biofilm by the CSRB.
TBD	Applied Research	Fountain Darter: Conduct additional studies on movement, preferably allowing for Lagrangian tracks to be estimated.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	Applies to Applied Research Recommendations 41-58 *As most of the Applied Research in the HCP has been conducted or determined to not be needed, and new projects and topics are recommended for research by NAS and the Science Committee, a Applied Research work group should be formed to review completed research and establish a new research plan moving forward.
TBD	Applied Research	Fountain Darter: Confront the persistent lack of a relationship found between flow and fountain darter metrics...it is critical to refine the relationship at low to moderate flows and also at high flows (scour events).	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	*In Table 7.1, applied research funding ends in 2019; with identified additional research needs and continuing unknowns, the Implementing Committee might should consider extending applied research funding through the duration of the ITP. This additional funding would need to be reallocated from another HCP activity to applied research.
TBD	Applied Research	Fountain Darter: Obtain measurements related to individual fountain darter health that go beyond the densities and lengths of individuals measured in the current bio monitoring.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	*Additionally, it is recommended that a scientific Ph. D be added to the HCP staff to assist with workshop facilitation, analysis and resulting implementation. Additionally, this staff person could assist in review of the research proposals, selecting contractors, and facilitating the research prioritization process and QA/QC of research conductance.
TBD	Applied Research	Submerged Aquatic Vegetation: Supply data on SAV growth, dispersal, and recolonization for those SAV species that are the best habitat for the fountain darter.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	*Recommendations 47-50 refer directly to Texas wild-rice studies that are being conducted as an ongoing effort in the San Marcos System.
TBD	Applied Research	Submerged Aquatic Vegetation: Determine if the fountain darters are using SAV for protection, to find food, and/or as a nursery area for young.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Submerged Aquatic Vegetation: Determine why the fountain darters prefer bryophytes and filamentous algae, which are not vascular plants.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Understand the life history, life cycle and spatial distribution for better modeling of this species.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Determine the representativeness of Cotton Lure sampling	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Comal Springs riffle beetle: Determine its status as an indicator species.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	
TBD	Applied Research	Determine the effects from phosphorus sources, cycling, and availability on the productivity of the ecosystems.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	

TBD	Ecological Model	Include more field studies in the Applied Research program to assess silt impacts and critical life history and habitat assessment of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	However, the CSRB is no longer a module in the Ecological Model, therefore the data collected will only be utilized if the CSRB is added to the model at some point in the future. Need to address the concerns related to siltation through Applied Research program.
In Progress - consider next steps	Biological Monitoring	Measure the distribution of the CSRB.	The Applied Research budget is capped at \$450,000 annually through 2019, allowing for approximately 4-5 research studies annually.	Utilize the Applied Research work group to establish a prioritized research plan for the remainder of Phase I.	This study was conducted in 2014 by ZARA environmental as part of the Applied Research program. The study established a distribution during a low flow year, but did not establish a population estimate with confidence. This study could be expanded by conducting again during a normal flow year or attempting to establish a population estimate. It could be done through the 2016 Applied Research program.
Prioritization Status: No, not recommended for Implementation					
Status	Report Category	Recommendation	Fiscal Impacts	Implementation Strategy	Comments
No	Ecological Model	Add nutrient limitation to the submerged aquatic vegetation (SAV) model formulation.	No - no funding to conduct the extensive research that would be needed.	N/A	*Nutrients are not a limiting factor, except to algae (presence/absence). Algae is not in the Ecological Model. *The SAV model is tied to Fountain Darter habitat, so therefore this is not necessary.
No	Biological Monitoring	Conduct special studies on the fountain darter.	No - the Bio Monitoring Budget is already maxed out. For this sampling to be added, another component would need to be dropped.	If this recommendation was implemented, it should be prioritized by the Science Committee as part of the regular Applied Research program.	*The purpose of expanding the index reaches to representative reaches (system wide representation) has not been determined. If this is considered, a rationale as to why a system wide representation is needed for ITP compliance should be developed. *The Biological Goals and Objectives are tied to the previously identified reaches, not the entire river system. * NAS themselves comments that this is necessary only if desired.
No	Biological Monitoring	Expand macro invertebrate surveys.	No - the Bio Monitoring Budget is already maxed out. For this sampling to be added, another component would need to be dropped.	Create a Biological monitoring work group to develop a strategy to implement this recommendation.	*The participants in the NAS Report #1 workshop supported this recommendation, but did not identify how it contributed to compliance or the Biological Goals. *Macroinvertebrate sampling is typically performed to monitor the health of an aquatic system; the health of the Comal and San Marcos system is being monitored by other components of the monitoring programs. *Macroinvertebrate sampling in the HCP was to originally performed to populate the Ecological model. That effort is now close to complete, and new data would not be generated in time to be used by the modeling team.
No	Applied Research	Develop a general conceptual model for the Comal and San Marcos springs ecosystem.	Yes	N/A	Since influence diagrams were created during the EARIP process and were used as conceptual models to develop the Ecological Model, at this time, the EAHCP does not need to re-create them.

Hydrological Model
Ecological Model
Bio and WQ Monitoring
Applied Research
Overarching Issues

EAHCP 2016-2019 APPLIED RESEARCH PROJECT SCHEDULE



YEAR	Applied Research Program			Other Research Programs & Contracts			
	Research Categories	Research Projects	Biological Goal Reference & Rationale	Salvage Refugia	Refugia	EAA Modeling Plan	Eco Modeling
2013	1. EcoModel SAV	1. pH Drift				1. Develop FE Model	1. Develop EcoModel
		2. Low flow effects on native vegetation (NAS 49)				2. Develop ModFlow Model	
		3. Field vs. lab Study					
	2. EcoModel FD	1. Low flow effects on food source (NAS 44, 45)					
2014	1. EcoModel FD	1. Low flow effects on FD fecundity (NAS 44)				1. Develop FE Model	1. Develop EcoModel
		2. Effects of predation on FD (NAS 44, 45)				2. Develop ModFlow Model	
		3. FD movement under low flow (NAS 41)					
	2. Basic Biology of Species (CSRB)	1. Baseline distribution (NAS 51)					
		2. Plastron functionality					
2015		3. Low flow effects on survival (NAS 54)					
	1. Basic Biology of Species (CSRB)	1. Habitat connectivity		1. Training at SMARC		1. Complete FE Model	1. Develop EcoModel
	2. EcoModel SAV	1. Algae dynamics		2. Produce F ¹ TX Blind Salamander		2. Complete ModFlow Model	
		2. <i>Ludwigia</i> interference (NAS 44)		3. Work w/ TXSTATE and SMARC researchers			
2016		3. Sediment (recreation/turbidity) impacts on TWR (NAS 49, 50)		4. Obtain property access for collection research			
	1. Basic Biology of Species (CSRB)	1. CSRB tolerances of elevated temperature & low DO* (NAS 54)	Water quality, habitat quality	1. Collection methods/location for TX Blind Salamander		1. FE Model verification	1. Complete EcoModel
		2. Evaluate CSRB life history Phase I* (NAS 51, 52, 53, 54)	Population	2. Collection methods for CSDB		2. ModFlow Model verification	2. FD Random Drop Netting (NAS 42, 44)
		3. CSRB Trophic level & functional feeding group categorization* (NAS 51, 55)	Population	3. Establish suitable surrogates		3. Hardy Thermal Model verification**	3. FD Mortality in Adverse Conditions (NAS 41)
	2. Standard Sampling Methods	1. CSRB quantitative sampling techniques (NAS 55) (#2 Priority)	Population			4. Recharge modeling	
2017	3. Data	1. Compile data, format, template, normalization; IC consideration in Dec 2015 (#1 Priority)					
	1. Basic Biology of Species (CSRB)	1. Evaluate CSRB life history Phase II* (NAS 51, 52, 53, 54)	Population		Refugia research will accomplish the below deliverables for each species; moving onto the next step, only when the previous has been concluded for all listed species.	1. EcoModel verification***	
	2. Habitat Quality, Quantity, & Requirements	1. SAV as FD habitat (shelter, prey habitat) (NAS 45, 46)	Habitat based population			2. Recharge modeling	
		2. Effects of sedimentation on SAV, FD and CSRB (NAS 56)	Habitat, water quality (silt free)				
	3. Standard Sampling Methods	1. CS Dryopid Beetle quantitative sampling techniques	Population				
2018	4. Data	1. Statistical analysis of data (System Memory/Disturbance Ecology)					
		2. Statistical analysis of data (Species)					
	1. Habitat Quality & Requirements	1. Peck's Amphipod quantitative sampling techniques	Population		1. Collection methods and locations		
	2. Conservation Measures	1. Evaluate success of SAV restoration & TWR enhancement (coincides w/ 5 yr SAV mapping) (NAS 44, 47, 48)	Habitat		2. General husbandry (feeding, density, etc.)		
		2. Confirm species-specific Tables 4-1, 4-21	Habitat		3. Propagation techniques (egg to adult)	1. HydroModel Runs	
2019		3. Evaluate success of flow-split management	Habitat		4. Reintroduction/genetics	2. EcoModel Runs	
	3. TBD	1. TBD/Contingency	TBD		Evaluate Life Histories of Covered Species	3. Recharge modeling	
	1. Conservation Measures	1. Evaluate success of removal of invasive animal species and reduction of introduction	Habitat			1. HydroModel Runs	
2019		2. Evaluate success of Sessom Creek sand bar removal and sediment removal efforts	Habitat			2. EcoModel Runs	
	2. TBD	1. TBD/Contingency	TBD				

Legend/Footnotes

* RFP developed and posted for solicitation

** Use low flow data from 2013 and 2014 for verification of model (desktop exercise)

** May require contract w/ Meadows

*** Use data collected in 2016 to perform a verification analysis

NAS-recommended projects

Funding to be allocated/Research yet TBD

NAS Projects Not Recommended for Implementation

1. Determine the effects from phosphorus sources, cycling, and availability on the productivity of the ecosystems (NAS 58)

2. CSRB population (quantitative) and distribution in Comal (NAS 55)

3. CSRB population (quantitative) and distribution in San Marcos (NAS 55)

4. Evaluate CSRB status as an indicator species (NAS 57)

EAHCP 2016-2019 APPLIED RESEARCH PROJECT PRIORITIZATION MATRIX

Measures	Both Systems								Comal			San Marcos	Flow Protection Measures			
	Mgmt. Golf Course	Mgmt. Public Recreation	Control Litter & Floating Veg	Control Non-Native Plant Species/Control Non-Native Harmful/Predator Species	Riparian Restoration	SAV Restoration, Maintenance, & TWR Enhancement & Restoration	Invasive Animal Removal/Reduce Non-Native Introduction	Sediment Removal & Sessom Creek Sand Bar Removal	Flow-Split	Decaying Veg Removal & DO Mgmt.	Gill Parasites	Designation of Permanent Access Points/Bank Stabilization	VISPO & ASR	RWCP	Critical Period	
1. Conservation measures	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	Evaluate success?	
	Maybe	Yes	No	No	Maybe	Yes	Yes	Yes	Yes	Maybe	No	Maybe	Hydro Modeling	Hydro Modeling	Hydro Modeling	
		Establishing the effectiveness of SSAs would provide support for Comal efforts		As long as captured under other Conservation Measures...	Western shoreline--spring run 3...cost effectiveness? Not all riparian areas created equally	Confirm species-specific Tables 4-1, 4-21?	Modeling to project necessary intensity of removal efforts, identify trigger thresholds	But--sedimentation a natural process...sort out anthropogenic sources.	Maybe in Bio-Monitoring Program	Beyond HCP Needs		Construction Impacts on Species				
						Is TWR expanding on its own? Indirect benefits may offset need for gardening efforts...		Cost-effectiveness if Sand Bar Returns Cyclically...Bio Gain?								
Species	Inverts - Spring Dwellers			Invertebrates - Aquifer Dwellers			Salamanders			Fish		Flora				
	Comal Springs Riffle Beetle	Peck's Cave Amphipod	Comal Springs Dryopid Beetle	Texas Troglobitic Water Slater	Edwards Aquifer Diving Beetle	Texas Blind Salamander	Comal Springs Salamander	San Marcos Salamander	San Marcos Gambusia	Fountain Darter	Texas Wild-rice					
2. Standard sampling methods	Yes	Yes	Yes	No	No	Yes	No	Yes	No	No	No					
Species	Comal Springs Riffle Beetle	Peck's Cave Amphipod	Comal Springs Dryopid Beetle	Texas Troglobitic Water Slater	Edwards Aquifer Diving Beetle	Texas Blind Salamander	Comal Springs Salamander	San Marcos Salamander	San Marcos Gambusia	Fountain Darter	Texas Wild-rice					
3. Habitat quality, quantity, and requirements	Little known--but in progress	"Some" known	Very little known	Very little known	Very little known	Many gaps in knowledge	Many gaps in knowledge	Fewer gaps in knowledge	N/A	Much is known	Much is known					
Species	Comal Springs Riffle Beetle	Peck's Cave Amphipod	Comal Springs Dryopid Beetle	Texas Troglobitic Water Slater	Edwards Aquifer Diving Beetle	Texas Blind Salamander	Comal Springs Salamander	San Marcos Salamander	San Marcos Gambusia	Fountain Darter	Texas Wild-rice					
4. Data analysis	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?					
	Yes	Yes	Yes	No	No	Yes	No	Yes	No	Yes	Yes					
System/Reaches	San Marcos				New Braunfels											
	Rio Vista to IH 35	Below Sewell	Above Sewell	Spring Lake	New Channel	Old Channel	Landa Lake	Upper Spring Run	Spring Runs 1-3							
5. System memory/Disturbance ecology	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?	Stat analysis?							
		Yes	Yes			Yes	Yes		CSRB high priority, as impacted first, and most frequently							

Legend
Indicates project is high priority.

2015 Implementing Committee

Applied Research Work Group

Charge:

The Edwards Aquifer Habitat Conservation Plan (EAHCP) calls for the Applied Research program to build knowledge about the Covered Species and to facilitate the collection of data for the Ecological Model. This effort provides the EAHCP with a more accurate understanding of the ecological dynamics of the Comal and San Marcos springs, particularly under low-flow conditions.

In early 2015, the EAHCP received the first report of the National Academy of Sciences (NAS) where they provided recommendations towards all EAHCP programs including Applied Research. From these recommendations a robust list of possible projects were collected and presented to the NAS Recommendation Review Work Group (RRWG).

Based on the recommendation of the RRWG, the Implementing Committee created the Applied Research Work Group at their August 20, 2015 meeting.

The purpose of the 2015 Implementing Committee Applied Research Work Group is to recommend a holistic Applied Research Project Schedule that will take into account all possible research necessary to better understand our Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. This schedule will be used to develop the Work Plans for the Applied Research program in 2016 through 2019.

Committee Membership and Meeting Organization:

The Implementing Committee will appoint the membership at its meeting on August 20, 2015.

If desired, a Work Group Chair will be nominated and elected. The Work Group will develop the Applied Research Project Schedule through a consensus decision making process and will prioritize the Project Schedule according to subject need for developing research projects in the years from 2016 through 2019.

The Work Group will hold all meetings between September and October 2015. The final Applied Research Project Schedule will be presented to the Implementing Committee for approval at their November 19, 2015 meeting.



NOTICE OF OPEN MEETING

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As requested by the EAHCP Implementing Committee, the **Applied Research Work Group** has been formed to recommend a holistic Applied Research Project Schedule that will take into account all possible research necessary to better understand our Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. The Applied Research Work Group is comprised of representatives from throughout the Edwards Aquifer Region. A meeting of this Work Group for the Edwards Aquifer Habitat Conservation Plan Program is scheduled for **Friday, September 11, 2015, at 9 a.m. at the San Marcos Recreation Hall (Lions Club Tube Rental at City Park), 170 Charles Austin Dr., San Marcos, Texas, 78666.** Lunch will not be provided; the meeting is expected to end before lunchtime. Please RSVP to dlarge@edwardsaquifer.org.

Members of this Work Group include Tom Arsuffi (Texas Tech University), Janis Bush (The University of Texas at San Antonio), Bob Hall (Edwards Aquifer Authority), Chad Norris (Texas Parks & Wildlife Department), and Ken Ostrand (San Marcos Aquatic Resource Center).

At this meeting, the following business may be considered and recommended for Work Group action:

1. Call to Order.
2. Public Comment.
3. Possible nomination and election of the Work Group Chair.
Purpose: To discuss the need for and elect a Work Group Chair.
Action: To unanimously elect a Chair for the Work Group, if necessary.
4. Presentation of Work Group Charge (Attachment 1).
Purpose: Presentation of the Charge to the Work Group.
Action: None.
5. Consideration and adoption of a Work Group timeline, strategy, and deliverable format. (Attachment 2).
Purpose: To establish a Work Group timeline, strategy, and deliverable format.
Action: To adopt a Work Group timeline, strategy, and deliverable format.
6. Present background of Applied Research Program (Attachment 3).
Purpose: Presentation of the Applied Research Program background.
Action: None.
7. Review Biological Objectives and Goals (Attachments 4 and 5).
Purpose: Presentation of the Biological Objectives and Goals to the Work Group.
Action: None.

8. Presentation of Applied Research categories (Attachment 6).
Purpose: To discuss the presented Applied Research categories and determine whether more are needed to comprise the Applied Research Project Schedule.
Action: To obtain feedback on Applied Research categories and initiate discussion on whether any additional categories are needed.
9. Identify what additional stakeholder and/or expert input (e.g., agencies, committees, permittees) is desired to be solicited for informing Work Group proceedings.
Purpose: To determine whom to reach out to for soliciting Applied Research Work Group input.
Action: To recommend a list of stakeholders and/or experts to solicit for Applied Research Work Group input.
10. Future agenda items.
 - Finalize a list of Applied Research categories
 - Begin listing possible Applied Research projects
 - Evaluate stakeholder and/or expert input (if applicable)
11. Questions and comments from the public.
12. Adjourn.



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MINUTES

As requested by the EAHCP Implementing Committee, the **Applied Research Work Group** has been formed to recommend a holistic Applied Research Project Schedule that will take into account all possible research necessary to better understand our Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. The Applied Research Work Group is comprised of representatives from throughout the Edwards Aquifer Region. A meeting of this Work Group for the Edwards Aquifer Habitat Conservation Plan Program is scheduled for **Friday, September 11, 2015, at 9 a.m. at the San Marcos Recreation Hall (Lions Club Tube Rental at City Park), 170 Charles Austin Dr., San Marcos, Texas, 78666**. Lunch will not be provided; the meeting is expected to end before lunchtime. Please RSVP to dlarge@edwardsaquifer.org.

Members of this Work Group include Tom Arsuffi (Texas Tech University), Janis Bush (The University of Texas at San Antonio), Bob Hall (Edwards Aquifer Authority), Chad Norris (Texas Parks & Wildlife Department), and Ken Ostrand (San Marcos Aquatic Resource Center).

All members were present.

At this meeting, the following business may be considered and recommended for Work Group action:

1. Call to Order.
9:09 a.m.
2. Public Comment.
None.
3. Possible nomination and election of the Work Group Chair.
The Work Group unanimously elected Dr. Arsuffi as the Work Group Chair.
4. Presentation of Work Group Charge.
No comment or question with regards to the Charge; however, the Work Group requested a copy of National Academy of Sciences Report 1 for its reference for this Work Group.
5. Consideration and adoption of a Work Group timeline, strategy, and deliverable format.
All proposed dates work for the Work Group members, with the exception that Drs. Arsuffi and Bush cannot make the October 9th meeting. October 16th was proposed to reschedule this meeting; Dr. Arsuffi stated he would check his schedule and notify EAHCP staff whether this date will work for him.
6. Present background of Applied Research Program.
This item was not discussed; it is deferred for discussion until the next meeting.

7. Review Biological Objectives and Goals.

Attachments were reviewed. Mr. Nathan Pence, EAHCP Program Manager, explained that the Work Group should ensure recommendations for Applied Research should further our understanding of EAHCP's Biological Objectives and Goals. No comments or questions.

8. Presentation of Applied Research categories.

Applied Research categories emerging from the Work Group's discussion are provided below. EAHCP staff informed the Work Group that they would refine the list and provide a copy to the Work Group for reference by Monday of the following week.

Categories of Research:

- 1. Measuring the success of the conservation measures; including consideration of indirect effects of species manipulation (+ and - ; e.g., elephant ear evapotranspiration)*
- 2. Basic research on biology of Covered Species, particularly invertebrates, not otherwise covered by refugia research program*
- 3. Suitability of relative indicators of trends relevant to Biological Goals and Objectives over time, including the representativeness of study sites and the representativeness of methodologies, such as sampling techniques*
- 4. Water quality as impacted by watershed-level human influences*
- 5. Habitat quality – HCP has goals for species*
- 6. Disturbance ecology/System memory – floods, recreation, etc.; what is the ability for the species to resist, respond, and rebound to short and long-term events?*
- 7. Data management, to include database creation, statistical analysis of data, and long-term data format/template and maintenance considerations*
- 8. Eco-model verification and/or validation (to end after 2016)*
- 9. Subaquatic vegetation (SAV) restoration, including effects of sedimentation; evaluation of SAV restoration success; and confirmation of Table 4.1 in HCP (FD density per SAV species)*

9. Identify what additional stakeholder and/or expert input (e.g., agencies, committees, permittees) is desired to be solicited for informing Work Group proceedings.

Dr. Ostrand stated he would like time to revisit the discussion from this meeting, review National Academy of Sciences Report 1 recommendations, and the draft Applied Research Project Schedule before he would feel comfortable recommending individuals from whom to solicit feedback. Dr. Bush agreed. Mr. Norris stated he already feels comfortable recommending soliciting feedback Dr. Weston Nowlin and Ed Oborny (Bio-West) for their expertise respective of EAHCP invertebrate research.

Mrs. Reinmund-Martinez mentioned the need to revisit past research studies to examine recommendations for future directions made by study authors in their final reports.

10. Future agenda items.

- Finalize a list of Applied Research categories
- Begin listing possible Applied Research projects
- Evaluate stakeholder and/or expert input (if applicable)

11. Questions and comments from the public.

Ken Diehl (San Antonio Water Systems): Mr. Diehl asked about the statistical analysis project referenced during the Work Group discussion on Applied Research categories. Mr. Diehl asked whether existing EAHCP data was so complex that it actually warranted this type of investigation.

12. Adjourn.
11:49 a.m.



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As requested by the EAHCP Implementing Committee, the **Applied Research Work Group** has been formed to recommend a holistic Applied Research Project Schedule that will take into account all possible research necessary to better understand our Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. The Applied Research Work Group is comprised of representatives from throughout the Edwards Aquifer Region. A meeting of this Work Group for the Edwards Aquifer Habitat Conservation Plan Program is scheduled for **Friday, September 25, 2015, at 9 a.m. at the Dunbar Recreation Center, 801 Martin Luther King Drive, San Marcos, Texas 78666**. Lunch will not be provided; the meeting is expected to end before lunchtime. Please RSVP to dlarge@edwardsaquifer.org.

Members of this Work Group include Tom Arsuffi (Texas Tech University), Janis Bush (The University of Texas at San Antonio), Bob Hall (Edwards Aquifer Authority), Chad Norris (Texas Parks & Wildlife Department), and Ken Ostrand (San Marcos Aquatic Resource Center).

At this meeting, the following business may be considered and recommended for Work Group action:

1. Call to Order.
2. Public Comment.
3. Approval of Minutes (Attachment 1).
4. Program Manager Update:
 - Draft Applied Research Work Group Report (Attachment 2)
 - Updated Workgroup Timeline & Strategy (Attachment 3)
5. Presentation of Applied Research categories (Attachment 4).
Purpose: To discuss the presented Applied Research categories and determine whether more are needed to comprise the Applied Research Project Schedule.
Action: To obtain feedback on Applied Research categories and initiate discussion on whether any additional categories are needed.
6. Presentation of revised EAHCP Applied Research Project Schedule (Attachments 5 and 6).
Purpose: To discuss the presented version of the revised Applied Research Project Schedule.
Action: To obtain feedback on revised Schedule.
7. Presentation of Applied Research Project Matrix (Attachment 7).
Purpose: To discuss Applied Research projects needed for each category.
Action: To recommend and prioritize Applied Research projects in each category.

8. Identify what additional stakeholder and/or expert input (e.g., agencies, committees, permittees) is desired to be solicited for informing Work Group proceedings.

Purpose: To determine whom to reach out to for soliciting Applied Research Work Group input.

Action: To recommend a list of stakeholders and/or experts to solicit for Applied Research Work Group input.

9. Future agenda items.
 - Discuss possible Applied Research projects
 - Receive input from experts

10. Questions and comments from the public.

11. Adjourn.



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MINUTES – REVISED PER ARWG 10/16 INPUT

As requested by the EAHCP Implementing Committee, the **Applied Research Work Group** has been formed to recommend a holistic Applied Research Project Schedule that will take into account all possible research necessary to better understand our Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. The Applied Research Work Group is comprised of representatives from throughout the Edwards Aquifer Region. A meeting of this Work Group for the Edwards Aquifer Habitat Conservation Plan Program is scheduled for **Friday, September 25, 2015, at 9 a.m. at the Dunbar Recreation Center, 801 Martin Luther King Drive, San Marcos, Texas 78666**. Lunch will not be provided; the meeting is expected to end before lunchtime. Please RSVP to dlarge@edwardsaquifer.org.

Members of this Work Group include Tom Arsuffi (Texas Tech University), Janis Bush (The University of Texas at San Antonio), Bob Hall (Edwards Aquifer Authority), Chad Norris (Texas Parks & Wildlife Department), and Ken Ostrand (San Marcos Aquatic Resource Center).

All members were present.

At this meeting, the following business may be considered and recommended for Work Group action:

1. Call to Order.
9:05 a.m.
2. Public Comment.
Mr. Steven Bereyso explained that he may need to take personal calls during the meeting. He apologized for the inconvenience, and for the interruption this may cause.
3. Approval of Minutes (Attachment 1).
The minutes were approved without discussion.
4. Program Manager Update:
 - Draft Applied Research Work Group Report (Attachment 2)
Mr. Bob Hall requested for the report to be revised to state "all currently identifiable research" rather than "all possible research." Staff will circulate a Word file copy of the draft report for the Work Group's input.
 - Updated Workgroup Timeline & Strategy (Attachment 3)
No discussion.
5. Presentation of Applied Research categories (Attachment 4).
Applied Research Categories

- *Recommended to rephrase “Quantitative sampling methods” to “Standard sampling methods;” also recommended to rephrase “Habitat quality” as “Habitat quality and requirements.”*
- *Dr. Arsuffi recommends reviewing literature for precedents related to data management. Staff will follow-up with him concerning an article he found discussing data management issues similar to those faced by EAHCP.*

Categories Not Fitting

- *Regarding reaches, point made that study reaches may not link up with Species issues. Also, only if species’ distribution extends beyond reaches may there be some merit to extrapolating to greater segments of the system. Arsuffi states reaches cannot be extrapolated unless done as stratified random sampling.*
 - *For bio monitoring, Arsuffi suggests additional locations for sampling to be replicated might be worthwhile to identify whether restoration is having “trickle down” effects in non-restored parts of the system.*
 - *Dr. Ostrand emphasized that it will be extremely important to confirm links between water quality and stream species—without that direct link, people will continue to throw stones at glass house.*
 - *No comments on “Eco-model” or “Basic biology...” categories.*
6. Presentation of revised EAHCP Applied Research Project Schedule (Attachments 5 and 6).
No discussion.
7. Presentation of Applied Research Project Matrix (Attachment 7).
Presented project matrix; group discussed each category and particular focuses for each.
- *Gill parasite is not a huge focus right now. Parasites are not as detrimental to species as once thought.*
 - *TWR enhancement program is doing well. Chad asked whether we know which plants have been planted vs. gardened, etc. Nathan replied that we do have GIS data on planted species. Ken Ostrand commented on the long-term research that other agencies are doing with TWR. The goal is to maintain genetic diversity. Ostrand mentioned the increase of surface area of TWR. There are still differences in mapping methods. Either way, there is a positive trend.*
 - *Access points...Chad stated the need to continue to watch construction impacts to TWR. Wants construction to be completed and done. Ostrand asked what the goal for the species was in relation to the access points. Nathan answered that we want to remove the impacts to the banks caused by recreation.*
 - *Sessom’s Creek sand bar removal...Nathan felt it was important to evaluate the effects of the removal of the sand bar. Sand bar is still coming back. Upstream causes need to be addressed. No consensus on why it had to be done. Not sure that the money spent was worth the benefit to the species.*
 - *Non-native removal...lots of things to consider. Arsuffi wondered if TWR or other species expanding or improving due to other habitat restoration projects.*
 - *Mgmt. of public recreation...Nathan stated that existing mapping probably picked up impact to SSAs. Chad asked how we are demonstrating improvement since mapping did not take place prior to HCP?*
 - *Invasive animal removal...lots of positive impacts to species removal. Ostrand suggested modeling effort to measure impacts to native spp. Arsuffi said that each species will react differently to improvements. Suggested determining threat thresholds that are fixed or capped.*
 - *Control on non-native plant spp...Nathan felt that those spp are monitored thru existing programs*
 - *Riparian restoration...difficult to measure. Chad stated that western shoreline is very difficult to improve due to existing habitat. Nathan asked about other measures (e.g., terracing,*

- sediment traps, watering, etc.) Arsuffi cautioned against comparing western shoreline riparian system against other systems. Not all are the same.*
- *Litter and floating veg...no response.*
 - *Mgmt. of golf course...really related to water quality and runoff, etc.*
 - *Sediment removal...definitely yes to evaluate success. Arsuffi again cautioned against the issue of natural runoff vs. anthropogenic sediment increases.*
 - *Quantitative sampling or standard sampling methods...need to do it for CPRB, not for Gambusia or non-listed spp. At some point it's important to do it for all species, but right now would focus on listed first.*
 - *Ostrand wanted to know the goal...Nathan related existing goals. HCP doesn't require physical numbers. Arsuffi questioned the take estimate vs. populations. Feels that take is or should be based on population estimates. HCP doesn't have a pop. metric requirement. Discussion followed. Norris felt that some invertebrates could be "clumped" together in pop estimates. Ostrand disagreed. Bob Hall asked that collection of Comal or SM salamanders is known, but not much is known about blind salamanders. Need categories and which spp need to be worked on. SC can assist in furthering the sampling methods.*
 - *Habitat quality...maybe we need to determine the criteria that defines habitat quality. Need to create habitat for each spp using things like temp, DO, flow rate, etc. Some spp are well known, but still a lot of gaps in data.*
 - *Data analysis...funds dependent. Need to prioritize, especially for listed spp. Long-term trend analysis is needed.*
 - *Arsuffi wanted categories... long-term and short-term analysis of specific questions. Ostrand wanted to address standard methods. Is sampling method effective or not?*
 - *Arsuffi – mentioned control or reference sites. Difficult to find a reference site that hasn't been manipulated. Ostrand mentioned a stat method called BACI to use when there is no define control. Norris wants to study spring runs. Ostrand commented that riffle beetle still the priority research spp.*
 - *Nathan summarized what would be provided to the group.*
8. Identify what additional stakeholder and/or expert input (e.g., agencies, committees, permittees) is desired to be solicited for informing Work Group proceedings.
- *Weston Nowlin, Randy Gibson, and Ed Oborny were mentioned as experts to consult regarding riffle beetle research; however, Dr. Arsuffi suggested it may be inappropriate to tap Nowlin or Oborny due to conflicts of interest as they are contractors.*
 - *Arsuffi would like to obtain a report by Cindy Loeffler regarding the NAS Recommendations Review Work Group's recommendations. Nathan offers presentation on NAS RRRWG instead.*
 - *Andy Gluesenkamp suggested (salamanders); discussion followed.*
 - *Group will evaluate spreadsheet and send suggestions to Nathan, who will then later be invited to answer questions. Asks group to e-mail specific questions they wish to ask which experts before next time.*
9. Future agenda items.
- Discuss possible Applied Research projects
 - Receive input from experts
- Dr. Ostrand stated he did not think it would be appropriate to invite outside experts until the fourth meeting to ask questions about specific projects.*
10. Questions and comments from the public.
- None.*
11. Adjourn. - 11:39 a.m.



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Members of this Work Group include Tom Arsuffi (Texas Tech University), Janis Bush (The University of Texas at San Antonio), Bob Hall (Edwards Aquifer Authority), Chad Norris (Texas Parks & Wildlife Department), and Ken Ostrand (San Marcos Aquatic Resource Center).

At this meeting, the following business may be considered and recommended for Work Group action:

1. Call to Order.
2. Public Comment.
3. Approval of Minutes (Attachment 1).
4. Program Manager Update:
 - Draft Applied Research Work Group Report (Attachment 2)
 - Applied Research Categories Listing (Attachment 3)
5. Explanation of the incorporation of NAS Applied Research Recommendations into the Applied Research Project Schedule and to Applied Research Work Group deliberations.
Purpose: To discuss the incorporation of NAS Applied Research Recommendations into the Applied Research Work Group's process.
Action: To inform the Work Group about the incorporation of the NAS Applied Research Recommendations into the ARWG process.
6. Presentation of revised Applied Research Project Prioritization Matrix and revised EAHCP Applied Research Project Schedule (Attachments 4, 5, and 6).
Purpose: To discuss the presented version of the revised Applied Research Project Schedule.
Action: To obtain feedback on revised Schedule.
7. Consideration of the approval of final deliverables, including draft Report of the 2015 Applied Research Work Group, draft 2016-2019 Applied Research Project Schedule, and draft Applied Research Project Prioritization matrix.

Purpose: To, discuss final Work Group approval, or identify the next steps needed to proceed with final Work Group approval, of the aforementioned deliverables.

Action: To possibly approve, or identify next steps needed for approval, of the final Work Group deliverables.

8. Consider future meetings, dates, locations, and agendas. – October 23, 2015, 9-12 p.m., Dunbar Center (if applicable).
9. Questions and comments from the public.
10. Adjourn.



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MINUTES

As requested by the EAHCP Implementing Committee, the **Applied Research Work Group** has been formed to recommend a holistic Applied Research Project Schedule that will take into account all possible research necessary to better understand our Covered Species in order to achieve the EAHCP's Biological Goals and Objectives. The Applied Research Work Group is comprised of representatives from throughout the Edwards Aquifer Region. A meeting of this Work Group for the Edwards Aquifer Habitat Conservation Plan Program is scheduled for **Friday, October 16, 2015, at 9 a.m. at the Dunbar Recreation Center, 801 Martin Luther King Drive, San Marcos, Texas 78666**. Lunch will not be provided; the meeting is expected to end before lunchtime. Please RSVP to dlarge@edwardsaquifer.org.

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All Work Group members were present.

At this meeting, the following business may be considered and recommended for Work Group action:

1. Call to Order.
9:05 a.m.
2. Public Comment.
No comment.
3. Approval of Minutes (Attachment 1).
Janis Bush motioned to approve with the change of "thresholds" phrase to state "*threat thresholds*;" Accepted with motion as changed; motion was seconded by Chad Norris with no opposition.
4. Program Manager Update:
 - Draft Applied Research Work Group Report (Attachment 2)
 - Regarding the "Conservation measures" category, Ostrand objected to the phrase "the efficiencies of the benefits to the Species;" it was decided to rephrase this description to state, "Assessing the effectiveness of EAHCP Conservation Measures, and the holistic practical benefits to the Species, in achieving Biological Objectives and Goals."
 - Regarding "Standard sampling methods, Arsuffi recommended to delete the word "valid" in the description (i.e., "*Ensuring sampling methods are reliable measures for Species*" rather than "Ensuring sampling methods are reliable, valid measures for Species").

- Regarding the “Habitat quality and requirements” category, Bush recommended for the language to be revised to include the concept of habitat “*quantity*” in addition to habitat quality in the title and the description of the category.
- Regarding the “Water quality” category, Ostrand objected to the phrase “not typical human health measures,” it was decided to leave this phrase out since the description already specifies “tailoring to the needs of species.”
- Regarding the “System memory/Disturbance ecology” category, Arsuffi recommended to replace “and the resilience” with “*and the response (i.e., resilience and/or resistance) of the system post-disturbance*”
- For the section of the report titled “Applied Research Project Schedule,” Norris recommended that the language be amended to clarify that other, additional projects may be identified in the future in response to changes in circumstance.
- Applied Research Categories Listing (Attachment 3)
 - Tom Arsuffi expressed concern regarding overlap between “not fitting” categories and the applied research program—specifically the eco-model and study reaches—his question being, since ARWG has commented on this, will their input be considered by the Science Committee (SC)? Norris echoes the sentiment related to basic biology studies.
 - Arsuffi feels SC needs to have input regarding the work groups—and recommendation oversight over their recommendations. Ken Ostrand also agrees with the process of having the SC review WG recommendations before the IC.
 - Alicia Reinmund-Martinez states she will work with Arsuffi to present the recommendations of the ARWG at the November 10 SC meeting.
- 5. Explanation of the incorporation of NAS Applied Research Recommendations into the Applied Research Project Schedule and to Applied Research Work Group deliberations.
 - With regards to the draft Project Schedule’s listing of studies completed in prior years, Norris raised the issue that sometimes “done” does not mean “done well,” and that in some cases “completed” studies should nevertheless be readdressed due to deficiencies in what the investigators were able to accomplish. with a particular example of this scenario
 - In stating this, Norris explains that one study that most comes to his mind is the baseline distribution of the CSRB study, which he feels needs to be done again due to issues with study methodology. With regards to this point, Bob Hall shared that internally, EAHCP had already planned to improve on this prior study once the CSRB sampling study has been completed as a first step.
 - The point was made that reevaluating completion of existing studies that are supposed to be “finished” raises issues related to peer review, and whether anything can ever be deemed completely “finished”—but ultimately, the criterion of this exercise would be to formally determine whether a given study was completed in an acceptable fashion by scientific standards, and that the job of determining whether a study is done or not would be most appropriately done by the Science Committee.

- The group agreed in recommending for the SC to take on this task, with a first step being to develop a formal process for evaluating whether past projects are complete, valid, and whether they need to be repeated in some fashion. This will be added as a section to the draft ARWG report, to be drafted internally, coordinated with Arsuffi, and distributed to the remaining ARWG members.
 - Additionally, it was recommended that the role of the SC relative to future work groups (i.e., Biological Monitoring, etc.) be well defined.
6. Presentation of revised Applied Research Project Prioritization Matrix and revised EAHCP Applied Research Project Schedule (Attachments 4, 5, and 6).
- Bush makes the point that leaving in TBD/contingency into the schedule is a good strategy for accommodating future studies that may not yet be on our radar.
 - Arsuffi makes the point that for some projects, such as evaluating the success of invasive species removal, planning needs to start happening soon (early next year at the latest) to facilitate a successful study.
 - The point is made that future studies may rely on data being collected now to make necessary evaluations; hence, the work groups, such as the Bio Monitoring Work Group, need to take ARWG-recommended future studies into account in their recommendations to ensure that programs are collecting this data now to facilitate later analysis.
 - The point was also made that accepted baselines for various measures need to be identified. Baselines can be developed through existing data, suggested Arsuffi. It may be helpful to have the Bio-Monitoring Work Group incorporate consideration of baselines as well, or to incorporate this into the statistical analysis of existing EAHCP data.
 - The Work Group recommends for Science Committee workshop to evaluate the ARWG-recommended Applied Research Project Schedule studies in the context of the program in general. Comprehensively vetting the schedule taking into account NAS' involvement, program deadlines, and the role of workgroups will help minimize risk of needing to repeat these studies in the future. This would be a good time to plan for adaptive management—to stop, take stock, see where the HCP is going. Now is a good time for this to be efficient and cost effective. Arsuffi offers for this workshop to take place at the Llano River Field Station in Junction, Texas.
7. Consideration of the approval of final deliverables, including draft Report of the 2015 Applied Research Work Group, draft 2016-2019 Applied Research Project Schedule, and draft Applied Research Project Prioritization matrix.
- Arsuffi moved to approve the final deliverables amended to reflect recommended changes, Ostrand seconds, with no opposition.
8. Consider future meetings, dates, locations, and agendas. – October 23, 2015, 9-12 p.m., Dunbar Center (if applicable).
Today's October 16 meeting was determined to be the final meeting of the 2015 ARWG given approval of final deliverables.
9. Questions and comments from the public.

None.

10. Adjourn.
10:46 a.m.