Edwards Aquifer Habitat Conservation Plan

Report of the 2018 Phase II Work Plan Work Group

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Phase II Work Plan Work Group Meeting:

Overview:

At the October 18, 2018 EAHCP Joint Stakeholder and Implementing Committee meeting, the EAHCP Program Manager called for the creation of a Work Group to review and discuss a draft of the Comprehensive Phase II Work Plan. This initial assessment was a precursor to the review required by the EAHCP Implementing Committee (FMA § 4.3). The charge of the Phase II Work Plan Work Group ("Work Group") consisted of the following tasks (Appendix A):

- To review the draft Comprehensive Phase II Work Plan.
- To participate in coordination conference calls and attend Work Group meetings.
- To provide comments and recommendations on the draft Comprehensive Phase II Work Plan to the EAHCP Program Manager.
- To review and approve the Phase II Work Group Report.

On November 29, 2018, a meeting of the Edwards Aquifer Habitat Conservation (EAHCP) Phase II Work Group was held to review and discuss the draft Comprehensive Phase II Work Plan.

A second Phase II Work Group meeting was held on December 5, 2018 as a continuation of the draft Phase II Work Plan review and to address the comments and recommendations made during the initial Work Group meeting.

Members of the Phase II Work Group include:

- Cindy Loeffler, Texas Parks and Wildlife Department (Chair)
- Mark Enders, City of New Braunfels (Co-Chair)
- Patrick Shriver, San Antonio Water System
- Melani Howard, City of San Marcos
- Nathan Pence, Guadalupe-Blanco River Authority
- Julia Carrillo, Edwards Aquifer Authority

The Work Group operated by consensus and attendees actively participated in the discussion. The agendas, meeting materials and presentations are included as appendices to this report. The Work Group's comments and recommendations to the draft Comprehensive Phase II Work Plan are summarized below.

Work Group Discussion:

The EAHCP Strategic Adaptive Management Process (SAMP), as defined in the Funding and Management Agreement (FMA), represents the transition from Phase I (2013-2020) to Phase II (2020-2028) of the program and associated Incidental Take Permit (ITP). The purpose of the SAMP is to identify

specific Conservation Measures to be implemented during Phase II of the ITP (FMA § 7.6.3). In other words, SAMP is defined as the formal use of adaptive management (FMA § 7), as the EAHCP transitions from Phase I to Phase II, to answer the following questions (FMA § 7.13.7):

- Are any of the current Biological Objectives not necessary to meet the Biological Goals?
- Are the current Biological Objectives adequate to meet the Biological Goals?
- Are any of the current Phase I Conservation Measures not necessary to meeting the Biological Objectives?
- Are the current Phase I Conservation Measures meeting the Biological Objectives?

EAHCP staff and the Phase II Work Group utilized the National Academy of Sciences' *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3* (hereafter referred to as *Report 3)*, the EAA Drought of Record MODFLOW simulations, and the first six years of EAHCP monitoring and management experience to resolve those questions.

As identified by the EAHCP Strategic Adaptive Management Process whitepaper (Appendix D), four potential outcomes guide the direction of the Phase II Conservation Measures.

1. Continuation of Phase I Conservation Measures without change.
2. Continuation of Phase I Conservation Measures with changes or expansion.
3. Continuation of Phase I Conservation Measures, plus new Phase II Conservation Measures.
4. Continuation of Phase I Conservation Measures with changes, plus a new Phase II Conservation Measure.

The members of the Work Group agreed that the development of the Phase II Work Plan will consist of the second potential outcome, the "continuation of Phase I Conservation Measures with changes or expansion."

This determination was followed by a discussion of the predominant conclusions identified in the National Academy of Sciences' (NAS) *Report 3*. The Science Review Panel reviewed the effectiveness of EAHCP Conservation Measures meeting the Biological Objectives and the likelihood of the Biological Objectives meeting the long-term biological goals. In summation, the findings of the NAS consensus report determined the following: 1) Phase I Conservation Measures and activities are achieving the biological goals; and 2) the Science Review Panel was unable to reach a determination on the effectiveness of the Conservation Measures relating to the Comal Springs riffle beetle.

In regard to the Funding and Management Agreement, the outcome of the Science Review Panel's (SRP) assessment of EAHCP activities subscribed to the following actions:

- **If Phase I Measures are Achieving Objectives:** FMA § 7.13.7 (d)

If the SRP determines that the Scientific Record establishes the Phase I Conservation Measures are achieving the Biological Objectives, then neither the Presumptive Phase II Conservation Measure nor any other Phase II Conservation

Measure will be pursued.

- **If Review Fails or is Inconclusive:** FMA § 7.13.7 (f)

If, contrary to its duties as set out in Subsection 7.10.3, the SRP fails to make a determination or determines that the Scientific Record is inconclusive about whether the Phase I Conservation Measures are achieving the Biological Objectives*, the Implementing Committee will coordinate with the Service as part of the AMP, and attempt to reach a conclusion that the Presumptive Phase II Conservation Measure or another Phase II Conservation Measure either is or is not necessary to achieve the Biological Objectives.*

The Work Group agreed by consensus that the actions defined in the FMA will be used to dictate the direction of the Conservation Measures and management activities described in the draft Comprehensive Phase II Work Plan.

Additionally, EAHCP staff presented a summary of the draft MODFLOW simulation results to the Work Group. Results of the draft MODFLOW Drought of Record (DOR) simulations – with EAHCP activities "as implemented" and VISPO forbearance – demonstrated 29.6 cfs springflow at the Comal Springs, which is short of the 30.0 cfs target. However, the final MODFLOW DOR simulations and conclusions are to be completed in Spring 2019 and will be presented at that point.

One item important to note, as described in *Report 3*, the Science Review Panel arrived at an 'effective' ranking for the ability of the springflow protection measures to meet the springflow objectives. This evaluation was provided given the examination of aquifer and springflow response during the 2013-2014 drought, the conservative nature of the MODFLOW model and the review of the MODFLOW DOR, calibration and validation. The Additional Concerns and Considerations portion of this report includes the Work Groups concerns regarding the outcome of the MODFLOW simulations.

<u>Review of the Draft Phase II Work Plan</u>

A review of the draft Comprehensive Phase II Work Plan was included in the charge of the Work Group. EAHCP staff provided the initial draft and used the NAS consensus report, draft MODFLOW model, FMA and EAHCP program management experience to revise and/or update the Phase I Conservation Measures for Phase II implementation. Furthermore, in the event that the comprehensive Work Plan conflicts with the EAHCP, the EAHCP stands as the binding document.

The following Conservation Measures were completed during Phase I or determined not pertinent to Phase II implementation; therefore, not included in the draft Phase II Work Plan:

- Science Review Panel (FMA § 7.10) – Completed; *Report 3* submitted in Fall 2018.
- Ecological Modeling (EAHCP § 6.3.3) – Completed; Ecological Model submitted in Spring 2018.
- Groundwater Modeling (EAHCP § 6.3.2) – Will be completed in Spring 2019.

- Applied Research Facility Experimental Channel at the USFWS National Fish Hatchery and Technology Center (EAHCP § 6.3.4) – Determined not pertinent to Phase II implementation.

- Sessom Creek Sand Bar Removal (EAHCP § 5.4.6) – Removed through nonroutine adaptive management. Funding has been transferred to implement the Impervious Cover and Water Quality Protection Conservation Measure in San Marcos (EAHCP § 5.7.6).

Table 1 is a summary of the comments and revisions provided by the Work Group on the draft Phase II Work Plan Conservation Measures.

Table 1
Work Group Comments on Phase II Work Plan and EAHCP Responses.

Item	EAHCP Section Number*	Conservation Measure	Work Group Comment	EAHCP Response
1	6.3.1	Biological Monitoring	EAA biological monitoring should include invasive species monitoring to address NAS concerns on Zebra Mussels and other non-native invasive species.	Added invasive species monitoring to biological monitoring.
2	6.3.1	Biological Monitoring	Based on NAS recommendations, issues with the Comal Springs Riffle Beetle should be addressed.	Included the efforts of the Comal Spring Riffle Beetle Work Group to address NAS concerns.
3	5.2.3	Management of Public Recreational Use of Comal Springs and River Ecosystems	Add Certificate of Inclusions (COI) and indicate that is a "voluntary effort".	Voluntary language included in the COI initiative.
4	5.2.5	Control of Harmful Non-Native Animal Species	Add language to incorporate removal of non-native animal species not otherwise noted.	Added "including, but not limited to" language to be more inclusive of non-native animals species not noted in the conservation measure.
5	5.2.6	Monitoring and Reduction of Gill Parasites	Reduce the effort of gill parasite monitoring.	Cited BIO-WEST research on the effects of gill parasites on fountain darters in the Comal watershed. Increased monitoring will occur during low flow conditions (<100 cfs).
6	5.2.8	Native Riparian Habitat Restoration (Comal Springs Riffle Beetle)	Fine sediment removal covering the springs will occur in coordination with TPWD, as necessary.	Added language to address Work Group's comment.
7	5.2.9	Reduction of Non-native Species Introduction and Live Bait Prohibition	Include outreach and education as a component in the effort to reduce non-native species.	Added language to address Work Group's comment.
8	5.7.1	Native Riparian Habitat Restoration	Coordination with private landowers should occur on a volunteer basis.	Added language to address Work Group's comment.
9	5.3.2, 5.4.2	Management of Recreation in Key Areas	Include establishment of access points on the east and west banks of the San Marcos River near Spring Lake Dam; update conservation crew efforts to occur "as needed"; include installation and maintenance of exclusion barriers by conservation crew	Added language to address Work Group's comments.
10	5.3.2.1	Management of Public Recreational Use of San Marcos Springs and River Ecosystem	Add Certificate of Inclusions and indicate that is a "voluntary effort"	Voluntary language included in the COI initiative.
11	5.7.6	Impervious Cover/Water Quality Protection	Include tracking the efforts of BMPs and LID to determine the efficacy of WQPP and Impervious Cover projects	Added language to address Work Group's comments.
12	5.4.3.1	Management of Submerged and Floating Aquatic Vegetation in Spring Lake	Include tracking SAV maintenance around spring orifices in Spring Lake to address NAS concern.	Added language to address Work Group's comments.
13	5.5.1	Use of SAWS ASR for Springflow Protection	Work Group provided language referencing the Interlocal Agreement between EAA and SAWS.	Added the language provided to the Work Plan draft.
14	5.5.1	Use of SAWS ASR for Springflow Protection	The Work Group requested to confirm the frequency of the Regional Advisory Group meetings.	EAHCP Staff confirmed, with Regional Advisory Group documents, that the group is to convene annually, or as needed.
15	5.6	State Scientific Areas	Include the creation of a state scientific area in the Comal Springs ecosystem, if necessary.	Added language to address Work Group's comments.
16	N/A	N/A	Use common names to identify species	Common names of species have been included in the Work Plan.

* EAHCP section numbers correspond to the section numbers used in the draft Phase II work plan.

Additional Considerations:

In addition to commenting on the Conservation Measures presented in the draft Phase II Work Plan, the Phase II Work Plan Work Group discussed the following concerns for EAHCP Committees to consider throughout their review of the draft Work Plan:

- The costs associated with each Conservation Measure during Phase I (EAHCP § 7.1) were utilized as the basis for Phase II cost estimates. The Work Group suggests a formal review of the Phase II Work Plan costs by the EAHCP Budget Work Group, under the direction of the Implementing Committee.

- EAHCP staff provided a matrix summarizing the National Academy of Sciences' (NAS) third and final review of the program. EAHCP staff presented the NAS *Report 3* matrix to the Work Group and provided an open discussion on each issue. The matrix also included EAHCP plans to address each NAS concern. The Work Group provided comments and made recommendations on the NAS summary. The matrix was updated as a product of that discussion (Appendix E).

- Research indicates that gill parasites (*C. formosanus*) are not a significant threat to fountain darter populations (BIO-WEST, 2017). Based on this report and program management experience, the significance of the "Monitoring and Reduction of Gill Parasites" Conservation Measure in the City of New Braunfels work plan (EAHCP § 5.2.6) should be reevaluated during the transition to the second EAHCP Incidental Take Permit.

- Activity under the "Minimizing Impact of Contaminated Runoff" (EAHCP § 5.7.4) Conservation Measure in the City of San Marcos work plan will likely be completed before the final Phase II Work Plan is approved. The Work Group suggests summarizing the work completed under this measure throughout Phase I or removing it from the Phase II Work Plan.

- In addition to reviewing the National Academy of Sciences' concerns regarding the Comal Springs riffle beetle (CSRB), the Phase II Work Group recommends that the CSRB Work Group include a discussion to incorporate quantitative monitoring of native habitat restoration and sedimentation rates in the efforts to improve the Conservation Measures relating to the Comal Springs riffle beetle.

- The Work Group discussed concerns of the springflow deficit between the draft MODFLOW simulations and the 30 cfs minimum springflow target requirement for Comal Springs. The Work Group considered this an issue to the development of the Phase II Work Plan and the springflow protection measures. EAHCP staff are investigating additional springflow forbearance scenarios to meet the minimum springflow targets for Comal Springs.

APPENDIX A

WORK GROUP CHARGE

Charge of the Comprehensive Phase II Work Plan Work Group ("Phase II Work Group")

November 21, 2018

Overview

Pursuant to the Funding and Management Agreement (Section 4.3), the Implementing Committee will develop and approve a Comprehensive Phase II Work Plan ("Work Plan"). The EAHCP Program Manager will produce the Work Plan to be presented to Implementing Committee for approval in Spring 2019. The Work Plan will be provided a comment period in early 2019 that will seek specific input from members of the Implementing Committee, Stakeholder Committee, Science Committee, and general public.

As a precursor to this public comment phase, the EAHCP Program Manager has called for a work group to be formed that will review and provide comment to the draft Comprehensive Phase II Work Plan. The Phase II Work Group will be made up of members from the Report 2 NAS Work Group and two additional members from the City of San Marcos and the Guadalupe Blanco River Authority.

Work Group Charge

The Phase II Work Group's charge consists of the following tasks:

- Review the draft Comprehensive Phase II Work Plan
- Participate in coordination conference calls and attend Work Group coordination meetings
- Provide comments and recommendations to the EAHCP Program Manager
- Review and approve the Phase II Work Group Report

Work Group Administration

The Work Group will be constituted of the following individuals: Cindy Loeffler (Texas Parks & Wildlife Department), Mark Enders (City of New Braunfels), Patrick Shriver (San Antonio Water System), Julia Carrillo (Edwards Aquifer Authority), Nathan Pence (Guadalupe Blanco River Authority), and Melani Howard (City of San Marcos). Ms. Loeffler and Mr. Enders will serve as co-chairs of the Phase II Work Group.

The Work Group will operate by consensus. In the event that consensus is not reached in proposing specific recommendations to the EAHCP Program Manager, the opposing rationales will be identified and recorded for incorporation into a Phase II Work Group Report.

The Work Group will hold their first meeting on November 29, 2018 and a second meeting on December 5, 2018. The intent will be to have a set of recommendations and guidance comments by December 7, 2018 that will be developed into the Phase II Work Group Report. The approval of the Phase II Work Group Report will be targeted for late December 2018.

The draft Phase II Work Plan, that includes the Work Group's comments and recommendations, will be presented to the Implementing and Stakeholder Committee on January 24, 2019. A public comment period will begin on January 24, 2019 and extend until February 15, 2019. The final Comprehensive

Phase II Work Plan is proposed to be presented to the Implementing Committee for approval on March 21, 2019.

APPENDIX B

WORK GROUP MEETING AGENDAS

As requested by the EAHCP Program Manager, the **2018 EAHCP Comprehensive Phase II Work Plan Work Group** ("Phase II Work Group") has been formed to review and provide comments regarding the EAHCP Draft Comprehensive Phase II Work Plan. A meeting of this Phase II Work Group is scheduled for **Thursday, November 29, 2018 from 12:00pm – 5:00pm at the Edwards Aquifer Authority, 900 E. Quincy St. San Antonio, TX 78215.**

Members of this work group include: Cindy Loeffler (TPWD), Mark Enders (City of New Braunfels), Melani Howard (City of San Marcos), Patrick Shriver (SAWS), Julia Carrillo (EAA), Nathan Pence (GBRA)

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

1. Call to order - Establish that all members are present or represented.

2. Phase II Work Group Introduction.

3. Presentation of the draft EAHCP Comprehensive Phase II Work Plan
   Purpose: To provide an overview of the draft Phase II Work Plan to the Work Group for comment and recommendations.
   Action: No action required.

4. Consider future meetings, dates, locations, and agendas.
   - The next Phase II Work Group meeting is scheduled for December 5, 2018 at the Edwards Aquifer Authority.

5. Questions and comments.

6. Adjourn.

As requested by the EAHCP Program Manager, the **2018 EAHCP Comprehensive Phase II Work Plan Work Group** ("Phase II Work Group") has been formed to review the and provide comments regarding the content and direction of EAHCP Draft Comprehensive Phase II Work Plan. A meeting of this Phase II Work Group is scheduled for **Wednesday, December 5, 2018 from 10:00 a.m. – 3:00 p.m. at the Edwards Aquifer Authority, 900 E. Quincy St. San Antonio, TX 78215.**

Members of this work group include: Cindy Loeffler (TPWD), Mark Enders (City of New Braunfels), Melani Howard (City of San Marcos), Patrick Shriver (SAWS), Julia Carrillo (EAA), Nathan Pence (GBRA)

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

1. Call to order - Establish that all members are present or represented.

2. Presentation of the revised draft EAHCP Comprehensive Phase II Work Plan.
   Purpose: To provide an overview of the comments and recommendations made to the revised draft Phase II Work Plan.
   Action: No action required.

3. Presentation of the recommendations provided by the National Academies of Sciences' (NAS) and EAHCP Staff analysis of NAS considerations.
   Purpose: To provide the analysis and overview of the recommendations provided by NAS in Report 3.
   Action: No action required.

4. Consider future meetings, dates, locations, and agendas.

5. Questions and comments.

6. Adjourn.

APPENDIX C

PRESENTATIONS

Comprehensive Phase II Work Plan Work Group

EAHCP Staff ◆ November 29, 2018

Phase II Work Group Charge

- The Phase II Work Group's charge consists of the following tasks:
  - Review the draft Comprehensive Phase II Work Plan
  - Participate in coordination conference calls and attend Work Group coordination meetings
  - Provide comments and recommendations to the EAHCP Program Manager
  - Review and approve the Phase II Work Group Report

What is the Phase II Work Plan?

- "… Phase II Work Plan, which will include descriptions, schedules, and cost estimates for ongoing Phase I Conservation Measures, for Phase II Conservation Measures, and for all Program activities … from January 1, 2020 until expiration of the permit (FMA 4.3)"
- The Comprehensive Phase II Work Plan will be approved by the Implementing Committee by March 1, 2019*.

*requirement of the FMA

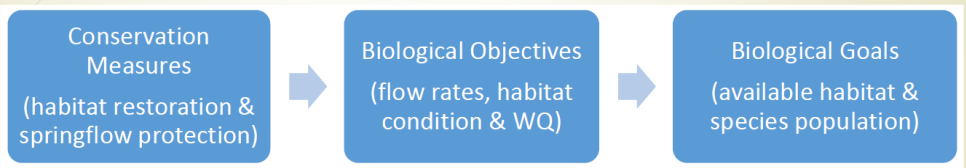
Phase II Work Plan

- Pence (5-11-2019), identified four potential outcomes during the Strategic Adaptive Management Process leading to development of the Phase II Workplan:
  1. Continuation of Phase I CMs without change
  2. Continuation of Phase I CMs with changes or expansion
  3. Continuation of Phase I CMs, plus a new Phase II CM(s)
  4. Continuation of Phase I CMs with changes, plus a new Phase II CM(s)

Phase II Work Plan Development

- Three primary pieces of information were used in developing the draft Phase II Work Plan.
  - National Academies of Sciences' Consensus report
  - EAA Drought of Record MODFLOW simulations
  - The first 6 years of program management experience

NAS Consensus Report



- FMA 7.13.7 covers actions on Science Review Panel determinations.
  - If some Objectives not necessary (7.13.7a)
  - If Objectives are not adequate (7.13.7b)
  - If Conservation Measures not needed (7.13.7c)
  - If Phase I Measures are achieving objectives (7.13.7d)
  - If Phase I Measures are not achieving objectives (7.13.7e)
  - If review fails or is inconclusive (7.13.7f)

NAS Consensus Report

Conservation Measures		Biological Objectives
Springflow Protection	Effective →	• Minimum spring flows or higher • Minimal water quality deviation • Establish restoration reaches
Water Quality Protection	Somewhat Effective →	• Minimum spring flows or higher • Minimal water quality deviation • Restore native SAV
Submerged Aquatic Vegetation (SAV) Management	Effective →	• Minimum spring flows or higher • Minimal water quality deviation • Restore riparian habitat
Recreation Management	Effective →	• Minimum spring flows or higher • Acreage during Drought of Record • Recreation awareness • Recreational control at low flow
Riparian Management	Effective/ Unable to determine →	• Minimum spring flows or higher • Recreational control below • Spring Lake Dam • Riparian protection

NAS Consensus Report

Biological Objectives

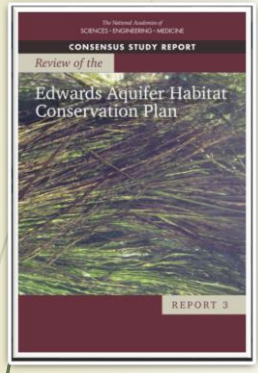
- Flow
- Water Quality
- Habitat

Likely, Somewhat Likely

Long-Term Biological Goals

- Habitat
- Population

NAS Consensus Report

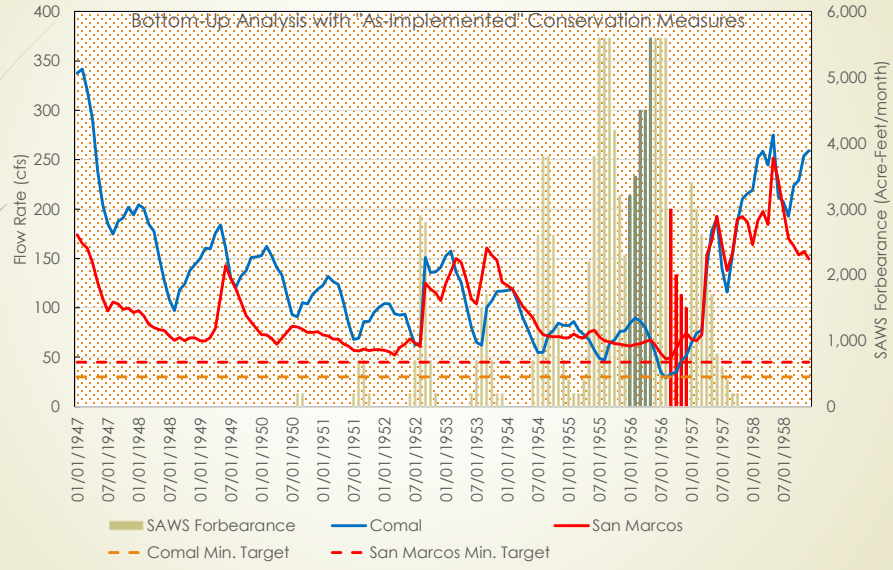


- The National Academies of Sciences' Consensus report did not find any:
  - Objectives not necessary (7.13.7a) or not adequate (7.13.7b)
  - Phase I Measures not achieving objectives (7.13.7d) or Phase I Measures not needed (7.13.7c)
- The National Academies of Sciences' Consensus report did find:
  - Phase I Measures are achieving goals (7.13.7e)
  - Failure to make a determination (7.13.7f) on the Comal Springs riffle beetle

MODFLOW Simulations

- Results of the MODFLOW DOR simulations with the HCP 'as-implemented' and VISPO forbearance of 40,921 acre-feet :
  - 29.6 cfs at Comal Springs
  - 48.3 cfs at San Marcos Springs
- Pence 6-21-18 and Winterle 10-18-18 detail model assumptions

MODFLOW Simulations



MODFLOW Simulations

- NAS arrived at an 'effective' ranking for the ability of the flow protection measures to meet the springflow objectives given the:
  - Examination of aquifer and springflow response during 2013-2014.
  - Examination of MODFLOW DOR, calibration, and validation simulations.
  - The conservative nature of the MODFLOW model.

"Underprediction of the indicator well levels and prediction of a slower recovery during wet periods means that the model is conservative – in the sense of protecting the listed species and the spring ecosystems – because it overpredicts the impacts of dry conditions on water levels in the wells."

Phase II Work Plan decision point

1. Continuation of Phase I CMs without change
2. Continuation of Phase I CMs with changes or expansion
3. Continuation of Phase I CMs, plus a new Phase II CM(s)
4. Continuation of Phase I CMs with changes, plus a new Phase II CM(s)

*Review of the Riffle Beetle was inconclusive.

EAA Phase II Work Plan
Conservation Measures

- San Marcos Aquatic Resources Center and Uvalde National Fish Hatchery– Refugia (§ 5.1.1)
- Voluntary Irrigation Suspension Program Option (§ 5.1.2)
- Regional Water Conservation Program (§ 5.1.3)
- Critical Period Management – Stage V (§ 5.1.4)

EAA Phase II Work Plan
Conservation Measures

- Expanded Water Quality Monitoring (§ 5.7.2)
- Recharge Monitoring (§ 6.2.3)
- Biological Monitoring (§ 6.3.1)
- Coal Tar Sealants (§ 5.7.6)

CONB Phase II Work Plan

- Flow-Split Management in the Old and New Channel (§ 5.2.1)
- Native Aquatic Vegetation Restoration and Maintenance (§§ 5.2.2; 6.3.4.3)
- Management of Public Recreational Use of Comal Springs and River Ecosystems (§ 5.2.3)
- Decaying Vegetation Removal and Dissolved Oxygen Management (§ 5.2.4)
- Control of Harmful Non-Native Animal Species (§ 5.2.5)
- Monitoring and Reduction of Gill Parasites (§ 5.2.6)
- Prohibition of Hazardous Materials Transport Across the Comal River and Its Tributaries (§ 5.2.7)

CONB Phase II Work Plan

- Native Riparian Habitat Restoration (Comal Springs riffle beetle) (§ 5.2.8)
- Reduction of Non-Native Species Introduction and Live Bait Prohibition (§ 5.2.9)
- Litter Collection and Floating Vegetation Management (§ 5.2.10)
- Management of Golf Course Diversions and Operations (§ 5.2.11)
- Management of Household Hazardous Wastes (§ 5.7.5)
- Impervious Cover/Water Quality Protection (§ 5.7.6)
- Native Riparian Habitat Restoration (§ 5.7.1)

TXST/COSM Phase II Work Plan

- Texas Wild-Rice Enhancement and Restoration (§§ 5.3.1, 5.4.1)
- Management of Recreation in Key Areas (§§ 5.3.2, 5.4.2)
- Native Riparian Habitat Restoration (§ 5.7.1)
- Control of Non-Native Plant Species (§§ 5.3.8, 5.4.12)
- Control of Harmful Non-Native and Predator Species (§§ 5.3.9, 5.4.13)
- Reduction of Non-Native Species Introduction (§§ 5.3.5, 5.4.11)
- Sediment Removal below Sewell Park (§§ 5.3.6, 5.4.4)

COSM Phase II Work Plan

- Minimizing Impacts of Contaminated Runoff (§ 5.7.4)
- Management of Public Recreational Use of San Marcos Springs and River Ecosystem (§ 5.3.2.1)
- Management of Aquatic Vegetation and Litter below Sewell Park (§ 5.3.3)
- Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (§ 5.3.4)
- Designation of Permanent Access Points/Bank Stabilization (§ 5.3.7)
- Septic System Registration and Permitting Program (§ 5.7.3)
- Management of Household Hazardous Wastes (§ 5.7.5)
- Impervious Cover/Water Quality Protection (§ 5.7.6)

TXST Phase II Work Plan

- Management of Submerged and Floating Aquatic Vegetation in Spring Lake (§ 5.4.3.1)
- Management of Aquatic Vegetation from Sewell Park to City Park (§ 5.4.3.2)
- Diversion of Surface Water (§ 5.4.5)
- Diving Classes in Spring Lake (§ 5.4.7)
- Research Programs in Spring Lake (§ 5.4.8)
- Boating in Spring Lake and Sewell Park (§ 5.4.10)

SAWS Phase II Work Plan

- Use of the SAWS ASR for Springflow Protection (§ 5.5.1)

TPWD Phase II Work Plan

- State Scientific Areas (§ 5.6)

How are we addressing NAS/MODFLOW comments

- Abiding by FMA § 7.13.7 on the "Action of Science Review Panel Determinations". Objectives and Conservation measures were all achieving, or in the case of the CSRB, 'cannot be determined'.
- The EAA has engaged with the USGS to determine the uncertainty surrounding the MODFLOW model.
- The EAHCP program has identified issues with SAV, Salamander, and LTBGs.

Comprehensive Phase II Work Plan Timeline

- **November 29Th:** Phase II Work Group *(Part 1)*
- **December 5th:** Phase II Work Group *(Part 2)*
- **December 7th:** Final comments from the Work Group submitted to EAHCP Program Manager.
- **January 24th:** Draft Phase II Work Plan presented to the Implementing Committee. Public comment period begins.
- **February 15th:** Public comment period ends.
- **March 21st:** Implementing Committee approval of final Comprehensive Phase II Work Plan

Comprehensive Phase II Work Plan Work Group

EAHCP Staff ◆ December 5, 2018

Phase II Work Group Charge

- The Phase II Work Group's charge consists of the following tasks:
  - Review the draft Comprehensive Phase II Work Plan
  - Participate in coordination conference calls and attend Work Group coordination meetings
  - Provide comments and recommendations to the EAHCP Program Manager
  - Review and approve the Phase II Work Group Report

EAA – Biological Monitoring – (pg. 3)

A comprehensive biological monitoring plan (Variable Flow Study) was established by the EAA in 2000 to gather baseline and critical period data to fill important gaps in the ecological condition of the Comal and San Marcos springs and river ecosystems. The EAA will continue this comprehensive sampling plan for the term of the Incidental Take Permit and provide a means of monitoring changes to habitat availability and the population abundance of the Covered Species that may result from Covered Activities. Presently, the Biological Monitoring program contains the following components:

- Aquatic vegetation mapping for select reaches
- Fountain darter sampling
- San Marcos salamander sampling
- Texas wild-rice physical observations and annual mapping
- Comal Springs riffle beetle monitoring
- Comal invertebrate sampling
- Comal Springs salamander sampling
- Invasive species monitoring

EAA – Biological Monitoring

The scope of the Biological Monitoring Program can be modified on a yearly basis, as provided in the FMA with agreement with the USFWS.

The National Academies of Sciences' Consensus report was unable to determine whether riparian management related conservation measures will contribute to achieving the biological objectives of the Comal Springs riffle beetle. This finding was directly related to the lack of quantitative population monitoring undertaken as part of the Biological Monitoring Program. In 2018, the EAHCP formed a Work Group to examine the methodology surrounding the CSRB biological monitoring in addition to other CSRB management issues. The Work Group is anticipated to conclude in 2019, and the final product will likely result in changes to the monitoring methodology of the CSRB conducted during Biological Monitoring surveys.

CONB – Management of Public Recreation – (pg. 4)

3. Management of Public Recreational Use of Comal Springs and River Ecosystems (§ 5.2.3)

Phase II efforts to minimize and mitigate the impacts of recreation will continue to include the management of recreational use of the Comal Springs and Comal River ecosystem by the City of New Braunfels through two methods:~~.~~

1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce local regulations, including:

   a. Limiting recreation on Landa Lake to Paddle Boats;
   b. Prohibiting recreational access to the Spring Runs in Landa Park and to the Wading Pool in Spring Run 2; and,
   c. Prohibiting on water recreation on the Old Channel; with the exception of Schlitterbahn operations within its present location.

2) Pursuant to Section 9.2 of the IA, the City of New Braunfels will issue, on a volunteer basis, Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in this section.

CONB – Decaying Vegetation Removal and DO Management – (pg. 5)

4. Decaying Vegetation Removal and Dissolved Oxygen Management (§ 5.2.4)

~~I~~n 2017, the City of New Braunfels adopted the *Landa Lake and Dissolved Oxygen Management Plan* to be implemented ~~if~~ during low-flow conditions (<100cfs) and/ or when dissolved oxygen data indicates ~~water quality concerns during periods of low springflow and when vegetation is decaying (<80cfs)~~ a potential threat to fountain darter populations (AquaStrategies, BIO-WEST, 2017). Dissolved oxygen management strategies include continuous monitoring of DO concentrations during low-flow conditions and displacement and/ or removal of ~~.~~ decaying vegetation and algal mats within Landa Lake. During low-flow conditions, nine additional DO sensors will be installed throughout Landa Lake, Upper Spring Run, Old Channel ERPA and near Spring Island to collect continuous DO data. Additionally, floating vegetation, decaying vegetation and algal mats will be removed, as necessary, to prevent vegetation impacts on fountain darter habitat. ~~If appropriate, the program may also include removal of decaying vegetation. Removal techniques for decaying vegetation may include using rakes/pitch forks and a jon boat to transfer material to the banks for subsequent disposal.~~

CONB - Control of Harmful Non-Native Animal Species – (pg. 5)

5. Control of Harmful Non-Native Animal Species (§ 5.2.5)

In accordance to Phase I efforts, the City of New Braunfels will continue to implement various methods of removal to reduce and control non-native animal species populations within the Comal River system on an annual basis. Methods of removal include gill nets, fyke nets, spearfishing and box traps.

The targeted non-native animal species include, but are not limited to, the suckermouth catfish, tilapia, nutria and Ramshorn snail.

CONB - Native Riparian Habitat Restoration – (pg. 6)

8. Native Riparian Habitat Restoration (Comal Springs riffle beetle) (§ 5.2.8)

The City of New Braunfels will continue to restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (*i.e.*, root structures and associated biofilms). Methods for riparian zone establishment includes the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and other riparian vegetation with extensive root systems are given preference to create maximum riffle beetle habitat. ~~Fine sediment covering springs will also be removed.~~ The riparian zones will be monitored (at least annually) for continued success and removal of reestablished non-native vegetation.

CONB – Reduction of Non-Native species introduction and Live Bait Prohibition– (pg. 6)

Additionally, the City of New Braunfels will continue to prohibit, by Ordinance, the introduction of domestic and non-native aquatic organisms, targeting specifically bait species and aquarium trade species into the Comal system. This action may include outreach, education and signage at key entrance points to parks on Landa Lake and the Comal River.

COSM/TxState: Management of Recreation in Key Areas (pg. 8)

~~In accordance to Phase I efforts,~~ Texas State University and the City of San Marcos will continue to control recreation in Spring Lake and the San Marcos River. ~~within Texas State University campus boundaries~~.

To minimize the impacts from recreation, Texas State University may establish and manage access points on the west bank of the San Marcos River between Spring Lake dam and the Aquarena Drive bridge, or other areas as needed. Riparian areas between access points will be maintained with dense vegetation to discourage streamside access.

To minimize the impacts from recreation, the City of San Marcos has established and will manage permanent river access points~~. Permanent access points are located~~ at City Park, one across from Lion's Club Tube Rental and one just below pedestrian bridge, Hopkins Street bridge, Bicentennial Park, ~~Hopkins Bridge,~~ Rio Vista Park, ~~the Wildlife Anne~~and two at Ramon Lucio Park (§ 5.3.~~7~~2.1). Riparian a~~A~~reas between access points ~~will be~~have been ~~densely~~ planted and will be maintained with native, dense vegetation ~~that~~ to discourage~~s~~ streamside access~~.~~.

To support the TPWD's creation of the State Scientific Area~~s~~ in the San Marcos River (§ 5.6.1), the City of San Marcos and Texas State University will establish exclusion zones in critical areas to protect Texas wild-rice and San Marcos salamander habitat from recreational impacts, as well as continue to maintain kiosks at key areas along the river that show access points, exclusion zones, and associated educational components at key locations.

The City of San Marcos will continue to employ a group called the Conservation Crew to help educate ~~and~~ , monitor recreational use, and other activities, as needed, in the San Marcos River. Activities include, but are not limited to, ~~Employees will pick up~~collecting trash, educating recreationists about the threatened and endangered species that live in the river, installing and maintaining exclusion barriers, as well as monitoring vulnerable stands of Texas wild-rice and San Marcos salamander habitat to reduce adverse impacts from recreation.

COSM/TxState: Native Riparian Habitat Restoration (pg. 8-9)

The City of San Marcos will continue to undertake a program to increase the area of the riparian zone on public lands along the banks of the river using native vegetation. Texas State University will continue to restore the riparian zone with native vegetation in ~~upper~~ Sewell ~~Park~~ North and Spring Lake. Phase I activities focused on non-native removal and planting of native riparian species. While some areas may require new riparian plants over time, Phase II riparian activities will be focused more on non-native removal and maintenance. If non-native plant treatment is needed on riparian private property, the City of San Marcos will work with private landowners to coordinate methods for removal and planting of native species. Areas that need more riparian planting will be planted with drought-tolerant, native ~~vegetation~~ species ~~such as big bluestem, switchgrass, Indian grass, live oak, Texas red oak, bur oak, pecan, bald cypress, American beautyberry, buttonbush, or other native plants,~~ as needed.

COSM/TxState: Control of Non-native Plant Species (pg. 9)

Texas State University and the City of San Marcos will continue to implement a non-native plant replacement program from Spring Lake to city limits. Non-native species of aquatic, littoral, and small caliper riparian plants (less than 4") will be replaced with native species to enhance Covered Species habitat. The quantity and location of areas restored in this program are provided in Table 34 of the *Submerged Aquatic Vegetation Analysis and Recommendations Report* (BIO-WEST, Watershed Systems Group, Inc, 2016). The non-native aquatic plants will be shaken, checked for aquatic fauna, and ~~bagged for removal from the system in the same manner described in Section 5.4.3.1~~transported to the Texas State composting facility. Aquatic fauna that are recovered will be documented and returned to the system. Areas will be "weeded" until the area is suitable to plant native aquatic vegetation.

COSM/TxState: Control of Harmful Non-native and Predator Species (pg. 9)

In accordance to Phase I efforts, The City of San Marcos and Texas State University will continue to implement non-native and predator species control for the San Marcos River and Spring Lake on a periodic basis with expanded effort of control, if needed, at low flows. The targeted species include, but are not limited to, suckermouth catfish, tilapia, nutria, and *Melanoides* and Marisa snails. Routine biological monitoring will be conducted by EAA and EAHCP contractors to monitor and assess the distribution of new or existing harmful non-native and invasive species. If a threat is identified, EAHCP staff will work with the contractor to identify areas of concern and potential methods for removal.

COSM: Management of Public Recreational Use of San Marcos Springs and River Ecosystem (pg. 9)

Public recreational use of the San Marcos Spring and River ecosystems include, but are not limited to swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving, snorkeling and fishing. In accordance to Phase I efforts, the City of San Marcos will continue to implement the Recreation Mitigation Measures adopted by the San Marcos City Council on February 1, 2011 (Resolution 2011-21) (Appendix P of the EAHCP). In addition, pursuant to Section 9.2 of the IA, the City of San Marcos will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses (businesses and nonprofit entities that rent tubes, canoes, kayaks, or similar equipment to facilitate recreational activities on the San Marcos River) (Outfitters) that comply with the requirements of the COI program established in section 5.3.2.1 of the HCP.

COSM: Designation of Permanent Access Points/Bank Stabilization(pg. 11)

To minimize the impacts of recreation, permanent access points were combined with bank stabilization at various locations during Phase I. They serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. The City of San Marcos has stabilized banks in eroded areas that include two in City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, and two in Ramon Lucio Park~~, and Cheatham Street underpass~~.

Natural rocks were used to create a stone terrace for access and bank stabilization with the bank on either side restored with riparian vegetation. Native riparian vegetation was planted in areas adjacent to the access/stabilization areas to discourage river users from entering the river in places other than the access point. Phase II activities will include upkeep of these access points. If additional repairs or maintenance ~~are~~ is needed, the City of San Marcos will cover the financial responsibilities of construction costs.

COSM: Impervious Cover/Water Quality Protection (pg. 12)

In 2017, the City of San Marcos approved the San Marcos WQPP, a comprehensive program to protect water quality and reduce the impacts of impervious cover (John Gleason LLC., 2017). Criteria and incentives for the program were based upon the WQPP and the EAHCP LID/Water Quality Work Group Final Report (Appendix Q of the EAHCP) recommendations for Implementation Strategies and BMPs. The WQPP has identified Sessom Creek tributary as a priority watershed (John Gleason LLC, 2017). LID~~S~~s and BMP~~S~~s will be implemented in this watershed during Phase II. Efficacy of the LID~~S~~s and BMPs may be assessed through water quality sampling, funded through grants and other sources.

TxState: Management of Public Recreational Use of San Marcos Springs and River Ecosystem (pg. 12)

Texas State University will continue to manage aquatic vegetation in Spring Lake through use of its harvester boat and through hand cutting of vegetation by divers authorized to dive in Spring Lake. The activities around the spring openings will be monitored by trained divers and will be documented through various methods.

TxState: Diving Classes in Spring Lake (pg. 14)

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat. The Diving Supervisor coordinates and supervises all volunteer diving. No more than 16 volunteer divers will be allowed in the lake per day, with no more than eight at one time.

Any individual diving outside of the Dive Training Area must have completed the Diving for Science Program.

TPWD - State Scientific Areas – pg.15

Except for the eastern spillway immediately below Spring Lake Dam, none of the protected areas will extend across the entire river channel; thus, allowing longitudinal connectivity for recreation and access to be maintained downstream throughout the river. In their 3rd report, the National Academy of Sciences recommended controlling the footprint of recreation in the 50m reach below Spring Lake Dam. San Marcos salamanders have been found in abundance in the eastern spillway, so the majority of the spillway ~~will~~may be excluded from recreation. Exclusion zones in the remainder of the 50m reach ~~will~~may be established primarily around the Texas wild-rice stands.

Interlocal agreements between the City of San Marcos, TPWD and Texas State University will be pursued, if necessary, for local in-water enforcement of the protected zones.

In order to protect existing and restored fountain darter habitat, TPWD may pursue the creation of a state scientific area in the Comal Springs ecosystem. An interlocal agreement between the City of New Braunfels and TPWD will be pursued, if necessary, for local in-water enforcement of the protected zones.

SAWS – ASR – pg. 16

The San Antonio Water System (SAWS) ASR facility will continue to be used to store and deliver Aquifer water leased by the EAA in exchange for actions outlined in an Interlocal Contract between the EAA and SAWS for the purposes of springflow protection. When triggers are reached, SAWS will ~~use water stored in the ASR to serve as a baseload supply~~ forbear usage initially in its North East service areas large primary groundwater pumping facilities. These facilities from a regional perspective are considered nearest to the springs and provide groundwater pumping relief during extreme drought. As described below, an amount equivalent to the water recovered from the ASR will be used to offset SAWS's Edwards aquifer demands.

SAWS will attempt, to the extent practicable, to mimic the pattern of delivery and or forbearance developed by HDR Engineering (HDR 2011). However, the actual pattern of delivery of water from the ASR and or forbearance may differ from that HDR used in its modeling simulations depending on the actual course of the drought. The two agencies entered an Interlocal Contract for the use of the Aquifer Storage and Recovery capabilities to support Springflow Protection covering Phase I of the HCP Program. From time to time the Interlocal Contract is brought up to date through adaptive management and or necessary contractual amendments but will continue to support protections throughout Phase II of the HCP Program.

APPENDIX D

EAHCP Strategic Adaptive Management Whitepaper

To: EAHCP Committees

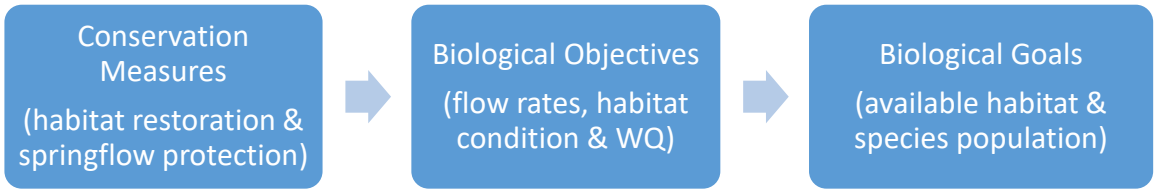
From: Nathan Pence, EAHCP Program Manager

Date: May 11, 2018

Subject: EAHCP Strategic Adaptive Management Process

The EAHCP is quickly approaching the Strategic Adaptive Management Process, which bridges Phase I (2013-2020) of the program to Phase II (2020-2028). **The information contained in this memo is intended to inform all Committee members of the baseline information involved in the process, frame the relevant questions for consideration, identify the decisions to be made by the Committees, and provide a timeline for planning, decision-making and implementation.**

Definitions:



<u>Executive Summary and Introduction</u>

The EAHCP Implementing, Stakeholder, and Science Committees are about to embark on the transition from Phase I to Phase II of the EAHCP, known as the Strategic Adaptive Management Process (SAMP). The primary deliverable from SAMP is the identification of the specific conservation measures (CM) to be implemented during Phase II of the ITP (FMA § 7.6.3). The potential outcomes include:

1. Continuation of Phase I CMs without change
2. Continuation of Phase I CMs with changes or expansion
3. Continuation of Phase I CMs, plus a new Phase II CM(s)
4. Continuation of Phase I CMs with changes, plus a new Phase II CM(s)

The SAMP is formally defined by the Funding and Management Agreement (FMA) and represents a structured review period built into the EAHCP (FMA § 7.14). Specifically, the review is focused on ensuring the EAHCP is meeting its biological objectives (both minimum springflows and habitat) and biological goals (habitat and population). If the EAHCP is meeting these biological objectives and goals, then the current Phase I implementation continues unchanged; if not, then all three Committees will make decisions on addition of our package of Phase II conservation measures to ensure we achieve the biological objectives. There are two primary sources of input that will assist the EAHCP Committees in determining if the biological objectives are met:

1. The EAA modeling team will perform a series of model runs to evaluate whether the springflow protection conservation measures[1] are meeting the minimum springflow objectives (Tables 1 and 2), and
2. The National Academies of Sciences Report #3 will evaluate whether the conservation measures achieve the habitat-oriented biological objectives and thus, the biological goals.

[1] These conservation measures are: (1) the Voluntary Irrigation Suspension Program option under EAHCP § 5.1.2; (2) the Regional Water Conservation Program under EAHCP § 5.1.3; (3) Critical Period Management – Stage V under EAHCP § 5.1.4; and (4) the SAWS ASR Springflow Protection Program under EAHCP § 5.5.

The detailed timeline for SAMP as set out in the FMA and expanded by staff, is outlined in Appendix A. Below is a summary of the milestones:

2018

- Conduct groundwater modeling.
- Receive Report 3 from the National Academy of Sciences.
- Committees make determination: are Biological Objectives meeting the Biological Goals, and are the current Phase I Conservation Measures meeting the Biological Objectives. (EAHCP § 7.13.7)

2019

- If the Biological Objectives are not being met, Program Manager initiates SAMP.
- Committees make decision on specific conservation measures to be expanded or added.
- Additional Groundwater modeling, if needed

2020:

- Finalize approach for implementation of expanded or additional conservation measures.
- Communicate all decisions to USFWS.
- Begin implementation of additional conservation measures, if required to meet Objectives.

2021

- By March, finalize implementation of additional conservation measures not yet completed in 2020.

Strategic Adaptive Management Process

SAMP is the transition from Phase I (2013-2020) to Phase II (2020-2028) of the EAHCP and associated Incidental Take Permit. Specifically, the decisions made through (SAMP) relate to the selection of Conservation Measures for Phase II of the EAHCP implementation. In other words, SAMP is defined as the formal use of non-routine AMP (FMA § 7), as the EAHCP transitions from Phase I to Phase II, to answer the following questions (FMA § 7.13.7):

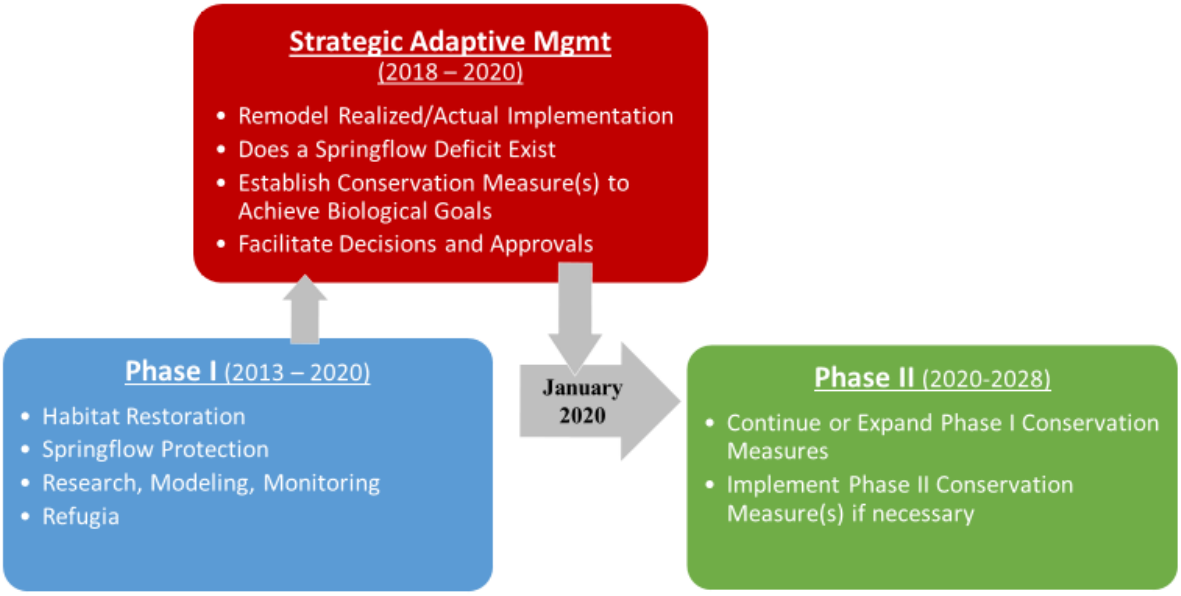
- **Are any of the current Biological Objectives not necessary to meet the Biological Goals?**
- **Are the current Biological objectives adequate to meet the Biological Goals?**
- **Are any of the current Phase I Conservation Measures not necessary to meeting the Biological Objectives?**
- **Are the current Phase I Conservation Measures meeting the Biological Objectives?**

As illustrated in Figure 1, during the transition between Phase I and Phase II, in addition to the questions presented immediately above, the SAMP specifically must be able to answer the following questions:

1. Does a springflow shortfall exist at Comal Springs or San Marcos Springs? If so, what would be an appropriate Phase II Conservation Measure(s) to make up the springflow deficit?
2. Do the Phase I Conservation Measures achieve the quantity and quality of habitat required?

To answer these questions, the EAHCP Committees will need to utilize the information and data produced by the Hydrologic Model, EAHCP monitoring programs and the National Academy of Sciences Report 3.

Figure 1: EAHCP Strategic Adaptive Management Conceptual Workflow



Hydrologic Model

During the EARIP process, the Science Subcommittee established minimum springflows that are required to maintain sufficient areal coverage of suitable aquatic vegetation and related habitat so that any incidental take of the Covered Species that may occur during a repeat of the Drought of Record (DOR) (Table 1 and Table 2) would not appreciably reduce the likelihood of the survival and recovery of the species in the wild once the DOR was over.[2] HDR was then engaged to conduct initial predictive hydrological modeling, that established the amount of springflow protection provided by the EAHCP Springflow Protection CMs. These springflow measures were designed and implemented with the goal of achieving the required minimum springflows. At the conclusion of the EARIP planning process, the Steering Committee decided to move forward with the submittal of an application for an incidental take permit to USFWS and implementation of the EAHCP, even though they were aware that the EAHCP, as modeled by HDR, did not quite achieve the required minimum springflows represented in Table 1 and Table 2 during a repeat of the DOR. Tables 3 and 4 below, identify the deficits in required minimum springflows as originally modeled by HDR during the EARIP process. The EARIP Steering Committee chose to move forward despite awareness of this modeled shortfall, as they knew at some point in Phase I, there would be a revised MODFLOW model from EAA that would provide a more refined modeled result. Moreover, the Steering Committee agreed to wait and see how the implementation of the Springflow Protection CMs actually came together (i.e. specific geographic locations of forbearance and

[2] The actual permitting criteria for the issuance of the EAHCP ITP was that any incidental take that may occur including during a repeat of the Drought of Record, resulting from the Covered Activities would "not appreciably reduce the likelihood of the survival and recovery of the [Covered S]pecies in the wild" once the Drought of Record was over. *See* 16 U.S.C. § 1539(a)(2)(B)(iv); and 50 C.F.R. §§ 17.22(b)(2)(D); 17.32(b)(2)(D). Additionally, any such incidental take could not "jeopardize the continued existence of any [of the Covered S]pecies or result in the destruction or adverse modification of [the designated critical] habitat of such species …" *See* 16 U.S.C. § 1536(a)(2); and 50 C.F.R. § 402.14(h)(3). As defined, the "jeopardize the continued existence of" is substantially similar to the "appreciably reduction" standard for ITP issuance. 50 C.F.R. § 402.02. *See also* EAHCP § 4.0.

actual acft enrolled). In short, the Steering Committee agreed to better quantify the springflow levels achieved by the EAHCP Springflow Protection CMs and ensure successful implementation of the CMs, before expending additional resources to make up modeled springflow deficits that may or may not actually exist.

The revised MODFLOW model (2017) will be used to model the amount of springflow protection (daily (1947-1958) and long-term (1947-2000)) provided by Springflow Protection CMs during a repeat of the DOR. Should the amount of modeled springflow be less than the required minimum springflows established by the EAHCP as set out in Tables 1 and 2, and the deficits in Table 3 are not made up, then the model will be used to establish the amount of additional springflow protection provided by expanded Phase I CMs and/or new Phase II CMs. Specifically, the following model runs will be made with the updated MODFLOW model (2017), as needed:

1. EARIP Daily Minimum: 1947-1960 copy of the HDR bottom up model runs using the Edwards updated MODFLOW model.
    a. The purpose of this is to examine minimum daily springflows at Comal and San Marcos through the DOR
    b. This is completed per Liu et al. 2017 (ASR AMP)

2. EARIP Long-term Average: 1947-2000 copy of the HDR bottom up model runs using the Edwards updated MODFLOW model.
    a. The purpose of this is to examine long term average springflows at Comal and San Marcos over a minimum 50-year modeling period including the DOR

3. EAHCP SAMP Daily Minimums: 1947-1958 with current implementation of springflow protection conservation measures.
    a. The purpose of this is to examine minimum daily springflows at Comal and San Marcos through DOR with our current Phase I measures as implemented. This model run will be used to determine if additional conservation measures may be needed to meet the Biological Objectives. Differences between model run 1 (described above) and this run include:
        i. VISPO – geographical distribution of forbearance and actual volume enrolled.
        ii. ASR – geographical distribution of EAA forbearance; new two tier system and trigger.
        iii. RWC – geographical distribution of forbearance.

4. EAHCP SAMP Long-term Average: 1947-2000 with current implementation of springflow protection conservation measures.
    a. This is the same run as for #3 above, with longer time period

5. Phase I CMs + Phase II CM(s) *(if needed to achieve minimum springflows)*[3]

[3] The Phase II CMs referenced here could be changes/expansion of Phase I CMs, or the addition of new CMs unrelated to the current Phase I CMs.

Table 1: Comal Springs Biological Objectives[4]

Long-term Daily Average (50 year; 1947-2000)	225cfs
Minimum Daily Average (1947-1960) - not to exceed 6 months in duration; followed by 3 months of 80cfs	30cfs

Table 2: San Marcos Springs Biological Objectives[5]

Long-term Daily Average (50 years; 1947-2000)	140cfs
Minimum Daily Average (1947-1960) - not to exceed 6 months in duration; followed by 3 months of 80cfs	45cfs

Table 3: Comal Springs Modeled Springflow compared to Biological Objective Springflows

	Required Minimum Springflows	Springflow Achieved	Deficit
Long-term	225	196[6]	29
Daily	30	27[6,7] / 29.7[8]	3 / .03

Table 4: San Marcos Springs Modeled Springflow compared to Biological Objective Springflows

	Required Minimum Springflows	Springflow Achieved	Deficit
Long-term	140	155[9]	-
Daily	45	51[9] / 48[8]	-

<u>National Academy of Sciences Report 3</u>
For the most part, the EAHCP habitat restoration efforts that have occurred since the inception of the ITP have been successful. Moreover, there have not been any observed impairments to surface water quality that have arisen. Therefore, it is anticipated that our habitat related and water quality related conservation measures are achieving our biological goals. Thus, the focus for SAMP has been springflow centric. However, the NAS Report 3 will look at both springflow protection and habitat restoration. To conduct their analysis, NAS will use the information learned during the 6 EAA NAS collaborative meetings held from 2013-2018 and the EAHCP scientific record that has been continually provided to NAS as it was developed.

Depending on comments received from NAS in Report 3, a habitat quality/quantity component to SAMP may be required. Specifically, I could potentially foresee NAS providing comments on our submerged aquatic vegetation restoration and riparian restoration conservation measures.

[4] EAHCP Table 4-2
[5] EAHCP Table 4-13
[6] EAHCP Table 4-30
[7] Minimum flow for only 2 months of DOR
[8] 2017 Updated MODFLOW Model Output
[9] EAHCP Table 4-52

As specified in their contract, NAS will determine the following: (NAS contract 2014 and FMA §7.13.7)

- Whether the biological objectives are likely to achieve the biological goals for all Covered Species, and if not, how might flow rates, amounts of habitat and water quality objectives be amended to achieve the biological goals.
- Whether the Phase I conservation measures are adequate to meet the biological objectives, if not, does the presumptive Phase II conservation measure (expanded ASR) achieve the biological objectives.
- If neither Phase I conservation measures nor the Presumptive Phase II conservation measure meet the biological objectives, NAS will determine the extent of the deficit.
- Whether any biological objectives for any Covered Species or Phase I conservation measures are not needed to achieve the Biological Goals.

Simply put, it is anticipated that the NAS Report 3 will evaluate our Springflow Protection Measures and Habitat Restoration, and ultimately determine if they achieve the EAHCP's required minimum springflows and habitat quantity/quality.

As the Report has yet to be received and it is unknown what if any issues will be identified, it is hard to plan for specific incorporation of the Report results into the SAMP process at this time. However, it is a given, that information in the Report will be utilized and incorporated in some manner. In past years, when NAS Reports have been submitted to the EAHCP process, workgroups have been used to evaluate and incorporate NAS recommendations into the overall EAHCP effort to the extent appropriate. As this Report is so important and the main reason NAS was engaged, at this point staff plans to utilize the Implementing, Stakeholder and Science Committees in the role of the previous workgroups to review and assess this report. Thus, presenting all relevant information in the Report to all appropriate Committees.

Ecological Model

The EcoModel for the Fountain Darter and Submerged Aquatic Vegetation, was built specifically as a predictive tool to "evaluate potential adverse ecological effects from Covered Activities and to the extent that such effects are determined to occur, to quantify their magnitude." (EAHCP § 6.3.3). In so doing, the model results would be used to "develop alternative approaches or possible mitigation strategies, if necessary." (EAHCP § 6.3.3). The EcoModel has been run to predict whether the incidental take of the Fountain Darter during a repeat of the DOR would appreciably reduce the likelihood of the survival and recovery of the Covered Species in the wild once the DOR was over, if the Conservation Measures, and specifically the Springflow Protection CMs, have been fully implemented. This model run was performed by BIOWEST as part of their EcoModel contract with EAA; and the results were that the incidental take of Fountain Darter during a repeat of the DOR with mitigation fully in place did not appreciably reduce their likelihood of survival and recovery in the wild when drought conditions ended. Therefore, no additional work with the EcoModel is required for SAMP.

Springflow Protection Phase II Conservation Measure(s), if Needed

The purpose of the Phase II CMs, either through an expanded Phase I CM(s) or a new Phase II CM(s), would be to ensure the modeled achievement of the springflow-related Biological Objectives. Specifically, an additional or expanded springflow protection CM may be needed to achieve the continuous minimum springflows set by the EAHCP in Tables 1 and 2 and makeup the deficits represented in Table 3. The EAHCP and FMA give the Stakeholder Committee and Implementing Committee the ability to choose and design that CM(s) based on the best available science. Should an additional CM be needed but the Committees cannot agree upon what the CM would be or how to best implement a new CM, the EAHCP defaults to the Presumptive Phase II CM, expanded use of the SAWS ASR (EAHCP § 5.5.2: Phase II Expanded Use of SAWS ASR and Water Resources Integration Program

Pipeline). Below is a brief description of the Expanded ASR and a listing of potential alternative Phase II CMs to achieve the continuous minimum springflows, *if needed*.

Presumptive Phase II CM – Expanded Use of SAWS ASR (EAHCP § 5.5.2)
The presumptive action for Phase II of the HCP, if needed, involves the use of the SAWS ASR with the expanded Water Resources Integrated Pipeline (WRIP) that is now operational. The WRIP consists of approximately 45 miles of water transmission pipeline and a pump station that conveys water from the SAWS ASR, Carrizo, and Brackish Desalination programs located at the Twin Oaks Facility property in south Bexar County to new and existing facilities in western and northwestern Bexar County. The WRIP links the existing facilities and new water supplies located at the ASR site in southern Bexar County with the southwestern and western portions of San Antonio.

SAWS' ability to expand the use of the ASR as a presumptive Phase II measure, if required, assumes that: (1) no additional water beyond that required for the Phase I use of the ASR will need to be stored; (2) the total amount of water to be returned from the ASR over the term of the permit will not exceed 126,000 ac-ft during the drought and 46,300 ac-ft in the worst year; and (3) no more than 40 percent of the capacity of the WRIP distribution system will be utilized at any time for HCP purposes.

The additional springflow benefit from expanded ASR would come from management and timing of recovery, rather than additional water storage or forbearance. Basically, rather than spreading forbearance across the year, it would be more focused on times of peak demand (summer).

Potential Alternatives to the Presumptive Phase II CM
At this point, based on preliminary modeling conducting during ASR AMP, it is likely that if additional springflow protection is needed to achieve the Minimum Daily Averages, it will not need to be as grand in scale as expanded use of the ASR. However, modeling will be needed to confirm this assumption. Seeking cheaper and smaller in scale Phase II CMs or a small increase in an already existing Phase I CM, seem to be a more reasonable approach.

Potentially Feasible Alternative Phase II CMs

1. Additional VISPO forbearance
2. Additional ASR forbearance by EAA
3. ASR Pooling by EAA for credited forbearance
4. Precipitation Enhancement by EAA

Funding

Strategic Adaptive Management planning process funding: In every budget year, the Program Manager has a budget related to professional contracting services and adaptive management. In years 2018, 2019 and 2020, the portion of that budget not already committed, would be earmarked to pay for any costs associated with SAMP. Anticipated expenditures include: 1) documentation of SAMP and production of a summary report, 2) facilitator services if needed, and 3) 3rd party review if needed.

Phase II Conservation Measure funding (EAHCP § 7.2): It is important to remember that a Phase II CM may or may not be needed. Because of this, the original EARIP Steering Committee did not set a budget or revenue source for a Phase II CM. If the presumptive Phase II CM is implemented, it is anticipated that no significant additional cost will be associated, as ASR is already included in Phase I. However, there could be additional cost if a CM other than the presumptive use of ASR is implemented, and funding will have to be identified at that time. *The most likely funding source would be the use of existing EAHCP funding, by utilizing savings or transferring costs between CMs. Currently, there is no identified funding for Phase II conservation measures*.

Summary and Recommendations

Over the next two years, with important decisions to make in 2018, the EAHCP will transition from Phase I to Phase II. Modeling will be used to determine if the daily and long-term minimum continuous springflows will be met by the current springflow protection measures. If a Springflow deficit does exist, it is likely to be in the range of only a couple of cfs. Therefore, the Committees should think simple and cost effective when selecting additional mitigation to achieve springflow targets. Point being, we probably do not need a brand new, large scale, springflow protection measure. But rather, probably only need to add acft to an existing forbearance program or something else small in scale, if at all. Again though, modeling results will drive these determinations and decisions.

The National Academy of Sciences will provide us input to our habitat restoration measures and we should remain open minded and flexible until the NAS report is received (Fall 2018). It is possible that the focus of these NAS recommendations will be focused on aquatic vegetation management, a subject that EAHCP staff and permittees are already working on.

Lastly, I believe that we should engage a consultant, as early in 2018 as possible, to document the SAMP process for communication to USFWS and the administrative record and also, have the contractor prepare a standalone exec summary to communicate SAMP decisions to all interested parties.

Appendix A –Timeline for the EAHCP Strategic Adaptive Management Process

Year	Action	Comment
2017		
	EAA finalized updated MODFLOW model	Reviewed by GWMAP and NAS
	Committees attended Ecological Model Workshop	Results of the EcoModel Fountain Darter survival were presented to Committees in July 2017
	Committees reviewed rerun of "Bottom Up Package" from updated MODFLOW model.	Joint meeting held in December 2017
	Science Committee reviewed Scientific Record	Done continuously from 2013-2018
	Program Manager provided Scientific Record to NAS	Done continuously from 2013-2018
2018		
	EAA conducts SAMP hydro modeling	
	Program Manager provides any remaining scientific information to NAS	Fulfilling NAS data, info and report requests
	NAS delivers Report #3 to Program Manager	September 30
	Committees review NAS Report #3 conclusions and SAMP hydro modeling	October – December
	Committees determine the following: • If Biological objectives are or are not adequate to meet the Biological Goals • If phase I Conservation Measures are or are not meeting the Biological Objectives	December 20 Joint meeting of Committees
2019		
	Implementing Committee directs Program Manager to initiate SAMP proposal to establish Phase II Conservation Measures	By January 2019, if Phase I Conservation Measures are determined to not be adequate to meet the Biological Objectives.
	Implementing Committee directs Program Manager to initiate SAMP proposal to change Biological Objectives	If Biological Objectives are determined not to be adequate to meet the Biological Goals. (No date specified in the FMA)
	Science Committee to meet and consider SAMP proposal(s) and draft recommendation to the Stakeholder Committee	
	Stakeholder Committee to review Science Committee report, consider SAMP proposal(s) and draft recommendation to IC	
	Implementing Committee to meet to consider the SH report on SAMP proposal(s)	
	PM completes Phase II Work Plan	March 1
	Committees make final decision to implement Phase II conservation measure	if no decision is made, default is the Presumptive Phase II ASR
2020 & 2021		
	Implement Phase II Conservation Measure(s) by March 18, 2021.	

APPENDIX E

EAHCP

NAS REPORT 3 MATRIX

Reference (chapter:pg.#)	Program/Species Component	Ways to improve	Description	Recommendation	Staff response
2:39-40, 3:73	CSRB	BO->LTBG improvement	Biological goals for CSRB are to maintain silt-free gravel and cobble substrate in >90% of three area in the Comal system. No quantitative studies that associate variation in silt-free habitat with CSRB population estimates	Conduct a study to determine how sedimentation of habitat directly and indirectly affects CSRB population, and how sedimentation rates are related to riparian buffer conditions	The EAHCP Science Committee suggested not pursuing "Evaluation of the effects of sedimentation on Comal Springs riffle beetle" (see Sept 9, 2016 meeting minutes). The issue of how best (or if) to pursue sedimentation monitoring in CSRB habitats will be addressed under CSRB WR charge question 3.
2:42	CSRB	BO->LTBG improvement	Spring orifice selection is not described in detail in biomonitoring reports, and the number of lures used to generate the annual median values is highly variable among year. Are spring orifices mapped prior to lure deployment and are they randomly selected? Or are flowing spring openings selected in sequence that they are found?	These are important questions that influence how data generated from each sampling event should be analyzed and interpreted for compliance purposes.	CSRB WG charge questions 1 & 2.
2:42	CSRB	BO->LTBG improvement	The current method to calculate CSRB median densities per lure is to pool all samples from all sampling events. This could be problematic if sampling effort is not equal and consistent.	A well-designed and articulated approach to calculating the annual median values is needed.	CSRB WG charge questions 1 & 2.
2:51	CSRB	BO->LTBG improvement	The density goals were based on data derived from the VFS, which used unstandardized sampling methodology with no SOP.	The CSRB beetle density should be updated to reflect more quantitative and standardized monitoring methods.	CSRB WG charge questions 1 & 2.
3:72	CSRB	BO->LTBG improvement	Figure 3-6 shows that suitable habitat in Spring 3 is eliminated well above the 30 cfs minimum, suggesting that for at least one of the monitored locations, the minimum flow objective is unlikely to achieve the biological goals	Studies needed to validate the HS models from Hardy 2009 in areas where CSRB populations are monitored	No plans to pursue; the utility of conducting another Habitat Suitability Index model will be discussed with the CSRB WG.
3:72	CSRB	BO->LTBG improvement	There are three distinct scenarios that could cause water quality to deviate from the 10%. 1) toxic chemical spill, 2)catastrophic riparian bank collapse, 3)chronic erosion from riparian areas sufficient to bury spring openings	These scenarios should be considered in long-term HCP planning	The HCP already addresses each of these topics in some form or fashion. There are no plans to pursue additional measures.
3:73	CSRB	BO->LTBG improvement	Several actions to take the determination of somewhat likely toward likely for reaching CSRB biological goals	1) better understand the CSRB population in monitored reaches,2)develop a plan to quantitatively monitor CSRB habitat sedimentation associated with riparian restoration efforts, 3) repeat HS modeling in LTBG reaches	Issues 1 & 2 will be addressed by the CSRB WG. There are no plans to address issue 3.
2:30,51; 3:64	Fountain darter	BO->LTBG improvement	The use of cumulative median density is very insensitive to year to year changes. Its possible that as habitat quality decreases, only extreme decreases in FD densities would be detectable with multiyear densities.	calculate median FD densities using a running mean or median over the most recent years for each vegetation type, assess various ways to compute median densities that are response to year-specific variation	The EAHCP intends to review BOs and LTBGs in pursuit of permit rollover. The Adaptive Management process allows opportunity to change specific Bos and LTBGs is the need arises sooner.
3:63	Fountain darter	BO->LTBG improvement	Some caution is needed for false negatives in the fountain darter densities by SAV type	Further analyses of the ability to detect events and trends in FD monitoring data (power analysis) would determine what magnitude of trends is detectable and likelihood of false negatives.	No plans to pursue.
3:63-64	Fountain darter	BO->LTBG improvement	The recent addition of the restoration reaches raises concern on the capacity of the two systems. A sign that habitat is not limiting the FD population would be decreasing median densities in some reaches as individuals move to new habitat.	Data can be analyzed from the monitoring program to show that dispersal is not a limiting factor to FD inhabiting new habitats.	No plans to pursue formally, however, staff is regularly engaged with contracted field support, and periodically reviews monitoring data.
3:65	Fountain darter	BO->LTBG improvement	The 10 percent deviations water quality objectives	Should be confirmed using empirical data	The EAHCP intends to review BOs and LTBGs in pursuit of permit rollover.
3:65	Fountain darter	BO->LTBG improvement	Several actions to take the determination of likely toward very likely for reaching FD biological goals	1)show flow and habitat conditions during the VFS are comparable to today and into the future 2) update the HSI model with current state of the systems 3)expand FD monitoring into restoration reaches 4)analyze the FD data for temporal trends in population abundances that reflect each year	The EAA intends to examine the effect of climate change on springflow. There are no plans to address issues 2, however the EAHCP will conduct analysis on temperature regimes in both systems during the 2014 low flow period, and compare empirical results to HSI output. There are no plans to further expand FD monitoring. Currently, some dip netting occurs in FD restoration reaches. Issue 4 will be addressed during analysis of BOs and LTBGs.
2:47; 3:78	San Marcos salamander	BO->LTBG improvement	Salamander surveys are conducted in silt free/aquatic macrophyte free transects. It is possible that density estimates are inflated because of the current sampling protocol. The current sampling design does not allow density estimates to be extrapolated across Spring Lake area or the spillway area	To supplement current sampling, an additional protocol that uses occupancy estimation could be designed for SMS. Statistical methods by Denes et al. (2015) could shed light on the extent of error associated with current sampling method.	The EAHCP intends to review salamander management activities.
3:77	San Marcos salamander	BO->LTBG improvement	People physically disturb the area by Spring Lake dam by moving rocks to create structures, dams, etc.	Regulate recreational access to the 50-m reach of the SMR below Spring Lake Dam	CoSM/TSU Management of Recreation in Key Areas (§5.3.2, 5.4.2): restricting public access near the eastern spillway. HCP (§5.4.2) and Phase 1 Work Plan discusses creating an access point on the eastern side of the Spring Lake Dam LTBG reach. COSM and EAA will work with Texas State University to discuss not installing a public access point on the eastern side of the Spring Lake Dam LTBG reach.
3:77-78	San Marcos salamander	BO->LTBG improvement	No water quality objective for SMS. No knowledge on the effects of nutrients and environmental contaminants, and water quality effects on prey species	Such studies could be considered in the Applied Research Program.	Water quality objectives are already in place for the Fountain Darter in the SM system. There are no plans to add additional goals unless these objectives are deemed inappropriate. The EAHCP intends to review salamander management activities.
3:78	San Marcos salamander	BO->LTBG improvement	A biological objective is to complete aquatic gardening and maintenance of silt around spring openings in Spring Lake but its not monitored or quantified.	Quantify, monitor, and report the extent and outcomes of aquatic gardening and maintenance of silt-free gravel in salamander study reaches.	The EAHCP intends to review salamander management activities. Additionally, current practices in Spring Lake, and the ability to document them will be discussed with the Spring Lake manager.
5:140	SAV	BO->LTBG improvement		Committee suggest relaxation of species-specific targets. Two lines of argument: 1)small differences in FD densities among SAV species, 2) better understand the ecological/biological control on SAV distribution	The EAHCP intends to review SAV management activities.
2:36,51	TWR	BO->LTBG improvement	C4 species (Hydrilla/Hygrophila) outcompeting C3 species (TWR) when CO2 levels are low (and pH is high)	Mesocosm studies containing TWR in combination with C4 plants could determine the extent of competition	The current SAV management program pursues eradication of these non-native species from both systems, therefore, no mesocosm studies are planned. The EAHCP intends to review SAV management activities.
3:67	TWR	BO->LTBG improvement	Hardy (2009) used current velocity and depth to develop habitat suitability model	The habitat suitability modeling may be out of date since its was completed almost 10 years ago and the system has changed.	No plans to pursue. TWR has coverage has greatly expanded under HCP management activities.
3:67,69	TWR	BO->LTBG improvement	Existing habitat suitability contain no water quality parameters. C3 plants can be sensitive to higher temperatures. The HCP may lack an important driver that could limit TWR growth under stress conditions during drought conditions	Create a water quality objective for TWR, especially during low-flow conditions. A good starting point is 25C	Water quality objectives are already in place for the Fountain Darter in the SM system and effectively serve as water quality objectives for TWR.

3:68, 4:105	TWR	BO->LTBG improvement	The recent decision to remove nonnative SAV species should have a positive effect on TWR with reducing competition	Field plots should be used to confirm this but mean of a BACI experimental design and or a mesocosm approach. Also, there may be value in stating this as part of the biological objective for TWR	The current SAV management program pursues eradication of these non-native species from both systems, therefore, no mesocosm studies are planned. The EAHCP intends to review SAV management activities.
4:128,130	CSRB	CM->BO improvement	Removal and pruning of riparian has occurred by no quantitative measure of success for erosion control.	A quantitative evaluation of the role that native riparian planting activities are having on erosion and aquatic sedimentation is highly warranted.	CSRB WG question 3.
4:130	CSRB	CM->BO improvement	use of erosion control structures to mitigate soil erosion	A long term plan for dedicating resources to the development, maintenance, and replacement of erosion control and other structures would be useful.	CSRB WG question 3.
4:104	Fountain darter	CM->BO improvement	Reasons and suggestions to take water quality M&M from somewhat effective to a higher ranking	1) Formalize project tracking to help prioritize and assess progress, 2) Track project functioning, including visual inspections, 3) Mapping of stormwater capture areas, 4) performance monitoring of SCM (water level loggers could be used to detect SCMs overflows or bypassing	COSM Impervious Cover/Water Quality Protection (§5.7.6): water quality monitoring will continue at select locations in the watershed. Additional water quality monitoring may be implemented and managed through other funding sources to help assess the efficacy of new BMPs and LIDs.
4:113	Fountain darter	CM->BO improvement	bryophyte cover provides about 75% of fountain darter habitat in the Comal System	There is an overreliance on the capability of bryophytes to spread and provide habitat for the fountain darter without understanding what controls bryophyte success.	The EAHCP intends to review SAV management activities.
4:114	Fountain darter	CM->BO improvement	Sustainability of SAV program	it would be more desirable to have the systems become more self maintaining	The EAHCP intends to review SAV management activities.
4:123	TWR and San Marcos salamander	CM->BO improvement	shift recreation management from effective to highly effective	1)enrollment of COI program should be pursued, 2)Use of social media and university websites for education efforts, 3) Further restrict recreational access to the 50m downstream of Spring Lake Dam	COSM and CONB will pursue the voluntary Certificate of Inclusion (COI) for commercial aquatic recreational outfitters and increase outreach activities.
3:79	All species	general	There is little description of how the 10% deviation from historic conditions came to be applied and there are no actual lists of the water quality parameters being considered and their historical values.	A better approach would be to relate observed variations in water quality to adverse effects on organisms and use that information to define the objectives. For example, Harding (2014) and Sutula et al. (2017) used approaches as quantile regression or conditional probability analysis.	The EAHCP intends to review BOs and LTBGs in pursuit of permit rollover.
4:132	All species	general	Refugia program	Applied research under this program should investigate life history strategies of list organisms that can help inform future management	The primary focus of the Refugia research program is aimed at the San Marcos salamander and the Comal Springs riffle beetle. These are the main two species where this type of information is lacking.
5:147	Catastrophic events	general		The committee doesn't suggest EAA should undertake a formal contingency plan but to exam how the systems might respond to such events.	The EAHCP currently has measures in place to respond and monitor during critical situations.
5:138-139	FD	general		Further exploration of FD abundance, could help determine viable population abundance. One approach is population viability analysis	No plans to pursue. The Ecological Model was specifically designed to predict Fountain Darter populations under different management scenarios.
2:33	Fountain darter	general	The degree of analyses limited to mostly simple graphical presentation of the monitoring data, and process studies are done as specific issues arise rather than taking a broader strategic approach.	Further analyses of the monitoring data and process studies for the FD are warranted	The EAHCP intends to review reporting practices of their monitoring programs.
5:146	Invasive species control	general		These efforts are important and should expand to frequently and consistently reaching all members of the greater community, multiple layers of deterrence are warranted.	The monitoring program has recently expanded to include zebra mussels. These issues will be reviewed as they are identified, and handled through the Implementing Committee.
5:142	Macroinvertebrates	general	Macroinvertebrates are not formally a part of the HCP, Committee urges the EAA to consider incorporating them into ecosystem evaluations	1)Macroinvertebrate monitoring could serve as a proxy for overall ecosystem health,2)provide understanding of the complex natural history of the aquifer,3)general invertebrate community composition and dynamics could be paired statistically with CSRB population estimates to provide an evaluation of cotton-lure approach,4) Macroinvertebrate could serve as metric for evaluating the overall HCP,5)Invert sampling could be paired with water quality stations to assess the water quality assumptions (10% deviations), 6)Bring together the applied research projects under the refugia program to assess interrelationships between invert population estimates, water quality, and other biological variables.	The EAHCP biomonitoring program includes several macroinvertebrate monitoring components. In addition, the CSRB WG is anticipated to result in modifications to that program. Lastly, CSRB is the main focus of the refugia research program.

APPENDIX F

COMPREHENSIVE PHASE I WORK PLAN

COMPREHENSIVE PHASE I WORK PLAN

Section 4.2 of the Funding and Management Agreement requires the Implementing Committee to develop and approve by March 1, 2012, a Comprehensive Phase I Work Plan (the "Comprehensive Plan"). The Comprehensive Plan must include descriptions, schedules, and cost estimates for the Phase I Conservation Measures and all Program activities conducted or managed by the Parties and Program Manager that are to be funded from the HCP program Account for the Phase I period through December 31, 2019. This document is intended to satisfy that requirement. The description, schedules, and cost estimates contained herein are taken largely from Chapters 5, 6, and 7 of the Habitat Conservation Plan ("HCP"). The description of the measures is not intended to reiterate all of the details in the HCP. To the extent this Comprehensive Plan conflicts with the HCP, the HCP controls.
The measures briefly described below are organized by the Party or Parties responsible for that measure.

I. Conservation Measures

A. Edwards Aquifer Authority

1. San Marcos National Fish Hatchery and Technology Center, Uvalde National Fish Hatchery, and Inks Dam National Fish Hatchery – Refugia (§ 5.1.1)

EAA will support and coordinate the work of the USFWS San Marcos NFHTC's operation and maintenance of a series of off-site refugia at USFWS's San Marcos, Uvalde, and Inks Dam facilities. A series of refugia, with back-up populations at other facilities, will preserve the capacity for these species to be re-established in the event of the loss of population due to a catastrophic event such as the unexpected loss of springflow or a chemical spill.
EAA's support of the refugia will augment the existing financial and physical resources of these facilities, and provide supplementary resources for appropriate research activities, as necessary, to house and protect adequate populations of Covered Species and expanded knowledge of their biology, life histories, and effective reintroduction techniques.
The use of this support will be limited to the Covered Species in this HCP.

2. Voluntary Irrigation Suspension Program Option (§ 5.1.2)

The Voluntary Irrigation Suspension Program Option (VISPO) program is intended to minimize and mitigate the impacts of incidental take from low springflows by suspending the withdrawal of Aquifer water for irrigation purposes during drought. This measure will require EAA irrigation permit-holders who voluntarily participate in the program to suspend the use of Aquifer water for irrigation purposes during drought to maintain springflow.
The volume goal for the VISPO program is to remove 40,000 ac-ft/yr from pumping during periods of drought. Irrigation permit-holders in Atascosa, Bexar, Comal, and Hays counties will be approached for enrollment in the program. It is hoped that at least 10,000 ac-ft can be

enrolled in these counties. Assuming that this goal can be obtained, the goal is to enroll 15,000 ac-ft/yr each in Medina and Uvalde counties.

If an irrigation permit-holder desires to enroll less than its full permitted volume, their withdrawals will be monitored by real time automated meters installed by the EAA.
The suspension of pumping by the participants in the program will be triggered if the J-17 index well in Bexar County is at or below 635 ft-MSL on the annual trigger date of October 1.
Irrigators will be offered the option of committing to the program for either five- or ten-year programs. The following payment structure will be offered for the voluntary commitments.

Five-year program:

- A standby fee of $50/acre-foot that increases 1.5 percent per year will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and

- A fee of $150/acre-foot that increases 1.5 percent per year will be paid for each year when temporary pumping suspensions are required.

Ten-year program:

- A standby fee of $57.50/acre-foot for years 1-5 and $70.20/acre-foot for years 6-10 will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and

- A fee of $172.50/acre-foot for years 1-5 and $210.60 for years 6-10 will be paid for each year when temporary pumping suspensions are required.

3. Regional Water Conservation Program (§ 5.1.3)

The Regional Water Conservation Program will minimize and mitigate the impacts of pumping from the Aquifer by building on the expertise of the successful programs to realize savings throughout the Edwards Aquifer region. The goal of the Regional Water Conservation Program is to conserve 20,000 ac-ft/yr of permitted or exempt Edwards Aquifer withdrawals. In exchange for technical assistance and incentives for implementing the various measures, one-half of the conserved water (10,000 ac-ft) will remain in the Aquifer unpumped, but still owned by participating permit-holders, for 15 years to benefit springflow levels and contribute to species protection. The other one-half of the conserved water will remain available to the participating entity.
To ensure that the benefit from this program is reasonably certain to be realized, SAWS and certain municipal purveyors will initially commit not to withdraw an amount equal to 10,000 ac-ft/yr from the Aquifer.
The EAA will administer the Regional Water Conservation Program targeting municipal water users and owners of exempt domestic wells. The Regional Water Conservation Program will focus on implementation of incentive programs encouraging: (1) reduction of “lost water” through leak detection; (2) installation of high-efficiency plumbing fixtures and high-efficiency

toilets; (3) large-scale commercial/industrial retrofit rebate; and (4) water reclamation for efficient water use.

The EAA will organize a Regional Conservation Monitoring Committee to be initially comprised of one representative knowledgeable in water conservation from SAWS, the City of San Marcos, the City of New Braunfels, and a small water purveyor which utilizes the Edwards Aquifer.

4. Critical Period Management – Stage V (§ 5.1.4)

By December 31, 2012, EAA will amend its Critical Period Management Program to add a new emergency Stage V reduction of 44 percent applicable in both the San Antonio and Uvalde pools. Stage V is designed to be triggered only when other measures have not proven sufficiently effective in maintaining springflow during drought conditions. For the San Antonio Pool, Stage V would be triggered by a combination of monthly average J-17 levels below 625 feet or springflows of either 45 cfs based on a ten-day rolling average at Comal Springs or 40 cfs based on a three-day rolling average. The Uvalde Pool would trigger Stage V using the Uvalde County Index Well (J-27) water level of 840 ft-MSL.

5. Expanded Water Quality Monitoring (§ 5.7.2)

The EAA and its predecessor agency have conducted a program of water quality data collection since 1968. The EAA will continue to maintain a network of groundwater and surface water monitoring sites, including sites in the Comal and San Marcos springs.

EAA will manage and oversee the expanded monitoring of water quality around Landa Lake and the Comal River, and Spring Lake and the San Marcos River to include stormwater sampling and additional groundwater and surface water sampling as necessary. Particular focus will be placed on point and non-point sources. Areas that are to be targeted include, but are not limited to, large areas of impervious cover, golf courses, swimming pools, and industrial runoff areas. In the event that certain constituents of concern are detected at levels indicating the potential for adverse effects, Best Management Practices (BMPs) will be evaluated to reduce and/or eliminate the constituent of concern if potential sources can be identified. Examples of constituents that could lead to BMP implementation and/or modifications include, but are not limited to, polycyclic aromatic hydrocarbons (PAHs), pesticides, ash, herbicides, turbidity, fertilizers, and bacteria from human and animal/pet waste.

EAA will consult with the cities of New Braunfels and San Marcos regarding sampling locations within their respective jurisdictions.

6. Recharge Monitoring (§ 6.2.3)

The EAA will accurately measure the amount of water (in ac-ft) recharging the Edwards Aquifer in the area described in Section 1.2 of this Plan. EAA will publish this measurement not later than June 1st of each year for the purposes of guiding the activities in Section 5.5.1of the HCP. EAA will then maintain this information on an ongoing basis in an appropriate publication.

7. Biological Monitoring (§ 6.3.1)

A comprehensive biological monitoring plan (Variable Flow Study) was established by the EAA in 2000 to gather baseline and critical period data to fill important gaps in the ecological condition of the Comal and San Marcos springs and river ecosystems. The EAA will continue this comprehensive sampling plan for the term of the ITP (with modifications as identified through the AMP process) and will provide a means of monitoring changes to habitat availability and the

population abundance of the Covered Species that may result from Covered Activities. The current Variable Flow Study has the following monitoring components:

- Aquatic vegetation mapping for select reaches;
- Fountain darter sampling (drop nets, dip nets, visual);
- San Marcos salamander sampling;
- Texas wild-rice physical observations and annual mapping;
- Comal Springs riffle beetle monitoring;
- Comal invertebrate sampling;
- Comal Springs salamander sampling;
- Parasite evaluations concerning the fountain darter; and
- Ramshorn and other exotic snail monitoring.

Additional components to be incorporated into the Variable Flow Study upon permit issuance will include sampling for two additional non-listed species, the Edwards Aquifer diving beetle, and Texas troglobitic water slater. The monitoring will also increase in magnitude, including increased frequency and number of parameters examined, as discharge falls to specific levels. In addition to long-term monitoring efforts that increase in intensity in response to the specified trigger events, a critical period monitoring component is incorporated into the Variable Flow Study that initiates full-scale sample efforts at specified trigger levels.

The scope of the Variable Flow Study currently can be modified on a yearly basis as provided in the FMA with agreement by the USFWS.

8. Groundwater Modeling (§ 6.3.2)

The MODFLOW model was used during the EARIP process to provide the model results for assessing the efficacy of the minimization and mitigation measures identified in Chapter 5 of the HCP. Like all groundwater models, the MODFLOW model has limitations and data gaps that manifest uncertainty in model results. By December 31, 2014, the EAA will take appropriate steps to reduce the level of uncertainty in the MODFLOW model by filling in the data gaps to the extent practicable and by reducing the number of structural limitations in the model.

As part of the adaptive management commitment, the EAA will create another model to reduce uncertainty in the model results for use during the AMP and to provide assurance/confirmation that modeling results for the Aquifer and springflows are more reliable and defensible. This additional groundwater model is expected to be a finite element model. This additional model will be developed and ready for use by December 31, 2014.

9. Ecological Modeling (§ 6.3.3)

The EAA will oversee and retain a contractor to develop a predictive ecological model to evaluate potential adverse ecological effects from Covered Activities and to the extent that such effects are determined to occur, to quantify their magnitude. The model will provide the ability to investigate potential impacts to these ecosystems from extreme short-term and sustained long-term impacts from natural and anthropogenic factors, including local and regional groundwater withdrawals.

10. Applied Research Facility Experimental Channel at the USFWS National Fish Hatchery and Technology Center (§ 6.3.4)

a. Description of the Applied Research Facility (§ 6.3.4.1)

The EAA will support and coordinate the NFHTC's construction and maintenance of the Applied Research Center. EAA will contract for the research activities in the Applied Research Center identified in this Section or developed as part of the AMP. The Program Manager will coordinate, supervise and oversee the implementation of all such research.

An applied research experimental facility will be constructed at the USFWS National Fish Hatchery and Technology Center (NFHTC) in San Marcos, Texas. The NFHTC has the existing infrastructure (Aquifer exempt wells, ponds, containment areas, recirculation and reuse capabilities, etc.) to allow for construction and operation of an applied research facility to inform Phase II decisions regarding the Covered Species and, to the extent possible, adjustments to Conservation Measures during Phase I.

The conceptual design is a series of man-made channels with earthen substrate intertwined with the existing ponds available at the NFHTC. This will allow water use and reuse through the plumbing already in place while allowing the flexibility to pump water through several research channels for experimentation. To recreate the natural environment to the extent possible, considerable effort will be needed to simulate channel configuration, substrate, instream debris, riparian zone structure (trees, shrubs, grass), aquatic vegetation, and other natural and anthropogenic conditions present in the Comal River. These components will be carefully designed and constructed to provide the most authentic simulation practicable. A riffle beetle upwelling and spring run area will be created at the headwaters of two of the research channels.

b. Research in the Experimental Channels (§ 6.3.4.2)

The main focus of the research channels will be to evaluate the effects of low-flow on Covered Species and their habitat. This evaluation will include springflow conditions that bracket the range of 5 cfs to 100 cfs. The applied research at the NFHTC facility for Phase I will focus on the fountain darter relative to Comal and the Comal Spring riffle beetle, as these are the two species with the greatest potential for impact relative to the Phase I package. This applied research will be further divided into three tiers. Tier A will focus on habitat requirements and responses; Tier B will focus on low-flow impacts directly on the fountain darter and Comal Springs riffle beetle; and Tier C will investigate the implications of the timing, frequency, and duration of multiple events in varying sequences and include specific research efforts designed to assess ecological model predictions (*e.g.,* model validation). The research projects are enumerated below

Tier A – Fountain Darter Habitat and Food Supply

- Low-flow effects on native aquatic vegetation
- Low-flow effects on macroinvertebrates (fountain darter food source)

Tier A – Comal Springs Riffle Beetle Habitat Associations and Movement

- Effects of flow levels on Comal Springs riffle beetle movement

- Extended Low-flow period effects on Comal Springs riffle beetles

- Test spring run connectivity

Tier B – Direct Impacts to Covered Species
- Low-flow effects on fountain darter movement, survival, and reproduction
- Low-flow effects on Comal Springs riffle beetle survival and reproduction

Tier C – Testing repeat occurrences of low-flow or combination of effects.
- System Memory
- Ecological Model Validation

11. Coal Tar Sealants (§ 5.7.6)

The EAA will put together materials regarding the value of a ban on the use of coal tar sealants and work with local governments to explore and encourage their consideration of such a ban.

12. Science Review Panel (FMA § 7.10)

Not later than December 31, 2013, the EAA will enter into a contract with the National Academy of the National Academies of Science to establish an independent Science Review Panel, select its members, and undertake the ongoing role of overseeing the Panel's activities.

13. Program Management

B. City of New Braunfels

1. Flow-Split Management in the Old and New Channel (§ 5.2.1)

To minimize and mitigate the impacts of low flows, the City of New Braunfels staff will manipulate at least once monthly the valves and culverts to the Old Channel and New Channel of the Comal River for the protection of existing and restored native aquatic vegetation in the river, based on EAA's real-time flow gauges in these channels and as often as appropriate for the maintenance of a beneficial hydrologic condition of the Old Channel habitat. Prior to this, the City of New Braunfels will replace and repair existing gates and control mechanisms to restore the operability of all four water paths to the Old Channel from Landa Lake: the two small culverts, the one large culvert, and the Springfed Pool inlet.

2. Native Aquatic Vegetation Restoration and Maintenance (§§ 5.2.2; 6.3.4.3)

To minimize and mitigate the impacts of incidental take from low-flow events by providing better habitat conditions for the ecological community, the City of New Braunfels will undertake a program of native aquatic vegetation restoration within key, sustainable reaches of the Comal River by planting native vegetation in unoccupied areas and in areas previously occupied by non-native aquatic vegetation, with the latter preceded by non-native vegetation removal.

The amounts and types of vegetation removed and restored in this program will be established by Table 4-5 and 4-6 of the HCP respectively. Prior to initiating restoration activities, models and other studies will be used to evaluate the potential for success of the native vegetation restoration.

The focus of native vegetation restoration will be on Landa Lake downstream of Spring Run 3 but above the New Channel USGS weir and on the portions of the Old Channel bordered on both sides by City of New Braunfels' property, including the Old Channel ERPA. Restoration efforts will also include establishing additional *Cabomba* along the eastern shoreline of Landa Lake and along the New Braunfels' golf course property to create valuable fountain darter habitat.

a. Old Channel Environmental Restoration and Protection Area (Old Channel ERPA) (§§ 5.2.2.1, 6.3.4.3)

To minimize and mitigate the impacts of recreation and pumping during periods of low flow, the City of New Braunfels will remove problematic non-native vegetation, restore native habitat (per Table 4-6), undertake limited channel modification to enhance fountain darter habitat, and remove a small sediment island. The Old Channel Environmental Restoration and Protection Area (ERPA) includes the EAA Variable Flow Study reach below Elizabeth Avenue upstream to the culverts feeding the Old Channel from Landa Lake where the preferred native aquatic vegetation of the fountain darter, native has been scoured and replaced over time with less-preferred non-native aquatic vegetation.

One specific area of targeted sediment removal is a small island that has formed just behind the Springfed Pool and immediately downstream of Landa Lake. This sediment island continues to grow, has established destructive non-native cane, and has displaced/destroyed fountain darter habitat.

b. Comal River Restoration (§ 5.2.2.2)

Upon final determination of locations suitable for fountain darter habitat for restoration in the Comal River proper (below the USGS gauging weir, aka Stinky Falls), the City of New Braunfels will conduct native vegetation restoration and yearly maintenance to establish additional fountain darter habitat. Areas for targeted restoration preferred by the City of New Braunfels include the portion of the Comal River between Last Tubers Exit and the confluence of the Guadalupe River and portions of the Comal River that allow for protection on one side of the river and safe passage of recreators on the other side of the river. Once the habitat has been established, City of New Braunfels will work with the TPWD will to pursue the creation of State Scientific Areas to protect fountain darter habitat.

c. Native Aquatic Vegetation Maintenance (§ 5.2.2.3)

To sustain the restored native vegetation within the Comal system, the City of New Braunfels will conduct yearly maintenance of native aquatic vegetation restoration sites in Landa Lake and the Old Channel, and the flow-split management discussed above in Section 5.2.1 of the HCP.

Native aquatic vegetation maintenance consists of actively monitoring and maintaining planted stands of native vegetation. Temporal monitoring will incorporate some form of quantitative measurement system to assess whether plantings are increasing, decreasing, or remaining stable. Additionally, intensive non-native vegetation control in the adjacent areas will be implemented until the native vegetation is well-established. It will include additional activities following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism. Anytime a disturbance is

observed, the monitoring/maintenance schedule will be modified temporarily in order to provide the stability for the native vegetation re-establishment.

3. Management of Public Recreational Use of Comal Springs and River Ecosystems (§ 5.2.3)

To minimize and mitigate the impacts of recreation, the City of New Braunfels will manage recreational use of the Comal Springs and Comal River Ecosystem through two methods:

1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce these regulations, including:

   a. Limiting recreation on Landa Lake to Paddle Boats

   b. Prohibiting recreational access to the Spring Runs in Landa Park to the Wading Pool in Spring Run 2.

   c. Prohibiting on water recreation on the Old Channel; with the exception of Schlitterbahn operations within its present location.

2) Pursuant to Section 9.2 of the IA, the City of New Braunfels will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in this section.

4. Decaying Vegetation Removal and Dissolved Oxygen Management (§ 5.2.4)

To minimize and mitigate the impact of incidental take from low-flow events, upon receipt of DO data indicating a water quality concern created by decaying vegetation and the total Comal springflow drops below 80 cfs, the City of New Braunfels will implement a dissolved oxygen management program. The program will be focused on ensuring adequate DO levels for the ecosystem. Techniques to accomplish this objective may include artificial aeration of areas of Landa Lake or other solutions. If appropriate, the program may include removal of decaying vegetation. Removal techniques for decaying vegetation, if necessary, may include using rakes/pitch forks and a jon boat to transfer material to the banks for subsequent disposal.

5. Control of Harmful Non-Native Animal Species (§ 5.2.5)

To minimize and mitigate the impacts of low flows, the City of New Braunfels will conduct non-native animal species control on an annual basis. Initial control efforts will be intense and take place during the winter's first freeze, with continued control every winter. Control of non-natives will include annual maintenance and monitoring and non-natives will be disposed of out of the floodplain. The non-native species animal species that will be addressed include the suckermouth catfish, tilapia, nutria, and ramshorn snail.

6. Monitoring and Reduction of Gill Parasites (§ 5.2.6)

To minimize and mitigate for the impact of low flows, the City of New Braunfels will retain and oversee the work of a contractor to establish a gill parasite monitoring and reduction. The

program may consist of non-native snail removal based on the pilot study conducted by USFWS and BIO-WEST (*Id.*).

The initial activity will be the evaluation of alternative methods for snail removal so that removal can be accomplished in the most effective, yet least destructive manner. The second activity deals with understanding the magnitude of snail removal necessary to affect downstream cercaria concentrations in the water column. Once the magnitude of snail removal for effective control of water column cercaria is identified, a study is necessary to evaluate the long-term benefits of that removal.

Additionally, although cercarial densities may be abating in the Comal system (Johnson *et al*. 2011), *C. formosanus* still poses a threat to fountain darters in the Comal River, especially during low-flows. As such, continued monitoring is essential and the following activities are included within this HCP conservation measure:

- A system-wide survey of snail population density and cercarial concentrations will be conducted to provide a baseline condition;
- Based on that system-wide survey, a decision will be made following the process set out in the AMP Agreement as to whether an initial system-wide removal effort is necessary, and if so, how to facilitate the performance of that effort;
- Based on the system-wide survey, a gill parasite monitoring program will be designed and implemented. Cercarial concentrations will be monitored in multiple areas along the Comal River on at least a semi-annual basis, and more frequently when spring flow drops initially below 150 cfs or other springflow triggers that are developed. Corresponding fountain darter sampling to examine correlations between cercariae densities and fountain darter impacts in the wild will also be part of that monitoring effort.

7. Prohibition of Hazardous Materials Transport Across the Comal River and Its Tributaries (§ 5.2.7)

The City of New Braunfels will coordinate with the Texas Department of Transportation (TDOT) to prohibit transportation of hazardous materials on routes that cross the Comal River and its tributaries. This effort may include legislation, City of New Braunfels ordinances, additional signage, and TDOT approval.

8. Native Riparian Habitat Restoration (Comal Springs riffle beetle) (§ 5.2.8)

To minimize and mitigate the impacts of low flow, the City of New Braunfels will restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (*i.e.*, root structures and associated biofilms). The method of riparian zone establishment will include the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and plants with extensive root systems will be given preference to create the maximum beetle habitat. Fine sediment covering exposed roots and springs will also be removed. The riparian zone will be monitored (at least annually) for continued success and removal of reestablished non-natives. Riparian zones will be protected until the preferred riparian zone is established. Riparian habitat zones will be created along both sides of Spring Run 3 and along the portion of the western shoreline that is owned by City of New Braunfels.

In addition, riparian restoration also benefits the system through bank stabilization and nutrient and sediment processes. The City of New Braunfels will develop a program to incentivize private landowners on the Comal River and its tributaries to establish riparian zones along the western shoreline.

9. Reduction of Non-Native Species Introduction and Live Bait Prohibition (§ 5.2.9)

To mitigate the impacts of recreation and pumping from the Aquifer during drought, the City of New Braunfels will undertake measures to stop or substantially reduce the introduction of non-native species from aquarium dumps and prohibit the use of live bait species.

The City of New Braunfels will prohibit by Ordinance introductions of domestic and non-native aquatic organisms, targeting specifically bait species and aquarium trade species into the Comal system. This action will include signage at key entrance points to parks on Landa Lake and the Comal River.

10. Litter Collection and Floating Vegetation Management (§ 5.2.10)

To minimize and mitigate the impacts of recreation and pumping during low flow periods, the City of New Braunfels will clean litter and debris from and manage floating vegetation in the Comal Springs, Landa Lake, and Old and New Channels of the Comal River. Litter and debris collection both flood-related and routine, will utilize self-contained underwater breathing apparatus (SCUBA). Debris removal also includes the removal of litter from floating vegetation mats before dislodging the vegetation mat and allowing it to continue downstream.

11. Management of Golf Course Diversions and Operations (§ 5.2.11)

The City of New Braunfels will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the Covered Species. Expanded water quality sampling targeted at Golf Course operations will be conducted per Section of 5.7.2. of the HCP.

12. Management of Household Hazardous Wastes (§ 5.7.5)

To reduce the potential for future water quality problems, the City of New Braunfels will initiate a hazardous household waste (HHW) program that will include accepting prescription drugs and Freon, through the TCEQ and/or the waste disposal division of the City of New Braunfels. The City of New Braunfels will establish a four-times-a-year program that could be recognized in the City's anticipated MS4 compliance and storm water permit as a contributing activity.

13. Impervious Cover/Water Quality Protection (§ 5.7.6)

The City of New Braunfels will establish criteria related to desired impervious cover and provide incentives to reduce existing impervious cover on public and private property in New Braunfels. The City of New Braunfels will establish criteria and incentives for the program based upon the

low impact development (LID)/Water Quality Work Group Final Report (Appendix Q) recommendations for Implementation Strategies and best management practices (BMPs).

14. Native Riparian Habitat Restoration (§ 5.7.1)

The City of New Braunfels will undertake a program to increase the area of the riparian zone along the Old Channel, the golf course and in the vicinity of Clemens Dam. As plans take shape for the reestablishment of the riparian zone, private landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant.

C. City of San Marcos and Texas State University

1. Texas Wild-Rice Enhancement and Restoration (§§ 5.3.1, 5.4.1, 6.3.5)

Based on BIO-WEST and TPWD monitoring data collected over the past decade and Hardy (2011) model results, the City of San Marcos, in partnership with Texas State University, will implement a Texas wild-rice enhancement and restoration program.

Initially, these activities will involve an applied research component. Methods for Texas wild-rice enhancement will need to be investigated to understand the potential for increased areal coverage of Texas wild-rice through implementation of this measure. Non-native vegetation mixed in with Texas wild-rice or surrounding existing Texas wild-rice plants but still located within optimal habitat areas will be removed to see if areal coverage of Texas wild-rice will expand in those areas. The specific areas chosen for evaluation will include only areas that would be suitable over the full range of discharges between the long term average and Phase I minimum flows.

2. Management of Recreation in Key Areas (§§ 5.3.2, 5.4.2)

Texas State University and the City of San Marcos will control recreation in Spring Lake and the San Marcos River within Texas State University campus boundaries.

To minimize the impacts from recreation, Texas State University will establish permanent access points on the east and west banks of the San Marcos River between Spring Lake dam and the Aquarena Drive bridge, and other areas as determined during the AMP. These areas will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc. Areas between access points will be planted with vegetation that discourages streamside access (*e.g.*, prickly pear and acacia).

To minimize the impacts from recreation, the City of San Marcos will establish permanent river access points. Permanent access will be located at Dog Beach, Lion's Club Tube Rental, Bicentennial Park, Rio Vista Park, the Wildlife Annex, and potentially other areas (as determined through the AMP). Areas between access points will be densely planted with vegetation that discourages streamside access.

To support the TPWD's creation of State Scientific Areas in the San Marcos Springs ecosystem and River, the City of San Marcos and Texas State University will install kiosks showing access points, exclusion zones, and associated educational components at key locations.

3. Native Riparian Habitat Restoration (§ 5.7.1)

The City of San Marcos will undertake a program to increase the area of the riparian zone on public lands from City Park to IH-35 using native vegetation. Texas State University will undertake a similar program to restore the riparian zone with native vegetation in upper Sewell Park. As plans take shape for the reestablishment of the riparian zone, private landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant.

4. Control of Non-Native Plant Species (§§ 5.3.8, 5.4.12)

Texas State University and the City of San Marcos will implement a non-native plant replacement program from Spring Lake to city limits. Non-native species of aquatic, littoral, and riparian plants will be replaced with native species to enhance Covered Species habitat. The divers that will be conducting sediment control will first remove non-native aquatic plant species from the area to be worked that day. Removal will initially focus on hydrilla (*Hydrilla verticillata*) as this species causes sediment deposition and adds turbidity to the water column when disturbed. The non-native aquatic plants will be shaken and bagged for removal from the system in the same manner described in Section 5.4.3.1. Areas will be "weeded" until the natives become established at the site.

The riparian zone will be restored to at least 15 meters in width where possible. Areas will be planted at a ratio of three hard mast trees to one soft mast tree, with 20 percent of the vegetation consisting of fruit-bearing shrubs. Vegetation such as big bluestem, switchgrass, Indian grass, live oak, Texas red oak, bur oak, pecan, bald cypress, American beautyberry, and buttonbush will be used. Fencing may be required for the first two years to allow for the establishment of the species.

5. Control of Harmful Non-Native and Predator Species (§§ 5.3.9, 5.4.13)

To mitigate the impacts of incidental take by pumping and recreational activities, the City of San Marcos and Texas State University, will implement non-native and predator species control for the San Marcos River on a periodic basis with expanded effort of control, if needed, at low flows. The species include suckermouth catfish, tilapia, and *Melanoides* and *Marisa* snails.

6. Reduction of Non-Native Species Introduction (§§ 5.3.5, 5.4.11)

To mitigate the impacts of recreation and pumping from the aquifer during drought, Texas State University and the City of San Marcos to undertake a program of non-native and predator species control for Spring Lake and the San Marcos River within the University's campus boundaries as described in Section 5.3.9 of the HCP. Dumping aquariums into the San Marcos River and its tributaries will be minimized through education, including signage and brochures, and offering alternative disposal to citizens wanting to get rid of unwanted aquatic pets. The

City of San Marcos and Texas State University will partner with the River Systems Institute, and local citizen groups to help distribute educational materials. Partnerships with the school districts will also be considered. Educational materials will also be provided to local pet shops.

7. Sediment Removal below Sewell Park (§§ 5.3.6, 5.4.4)

The City of San Marcos will remove sediment from the river bottom at various locations from City Park to IH-35. These areas include but are not limited to reaches of the river in City Park, Veramendi Park, Bicentennial Park, Rio Vista Park and Ramon Lucio Park. To minimize and mitigate the impacts of incidental take from recreation and pumping during low flow periods, the City of San Marcos will remove sediment from key areas of Texas wild-rice habitat below Sewell Park. Texas State University will mitigate the impacts of incidental take from diving activities, research activities, recreation and pumping during low flow periods by removing sediment from key areas of Texas wild-rice habitat in Spring Lake and from Spring Lake Dam to City Park.

Sediment samples will be sent to TCEQ for contaminant testing per TCEQ requirements.

D. City of San Marcos

1. Minimizing Impacts of Contaminated Runoff (§ 5.7.4)

The City of San Marcos will construct two sedimentation ponds along the river to help reduce the amount of contaminated materials that enters the river as a result of rain events. The ponds will also reduce runoff velocity which will help to reduce bank erosion, and subsequently the amount of sediment that enters the river. The sedimentation ponds will be constructed by excavating and stabilizing a specified area, and building a controlled-release structure. Water source for the ponds is solely runoff from rain events. Specific details for all ponds will be submitted through the AMP as each pond is contracted for design. Each construction area will be surrounded by silt fence/rock berm to minimize runoff. Sediment controls will be monitored daily during construction and the construction area will be covered with a tarp in the event of rain.

The first pond will be located in Veramendi Park beside Hopkins Street bridge. The first pond will be designed to remove sediment and street pollutants from runoff prior to entering the river. The size, shape, and depth will be determined based on an analysis of the volume of water discharging from the storm drains. The City of San Marcos will detain as much as possible for treatment purposes. The City of San Marcos will undertake required maintenance of the sedimentation ponds on a regular basis.

The second pond will be created by widening of drainage ditches that run alongside Hopkins Street and cut directly to the San Marcos River. Widened areas will be designed to store water for a short period of time, but long enough to collect sediments and associated pollutants from roadway runoff.

2. Management of Public Recreational Use of San Marcos Springs and River Ecosystem (§ 5.3.2.1)

Public recreational use of the San Marcos Spring and River ecosystems include, but are not limited to swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving,

snorkeling and fishing. To minimize the impacts of incidental take resulting from recreation, the City of San Marcos will implement the Recreation Mitigation Measures adopted by the San Marcos City Council on February 1, 2011 (Resolution 2011-21) (Appendix N of the HCP). In addition, pursuant to Section 9.2 of the IA, the City of San Marcos will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses (businesses and nonprofit entities that rent tubes, canoes, kayaks, or similar equipment to facilitate recreational activities on the San Marcos River) (Outfitters) that comply with the requirements of the COI program established in section 5.3.2.1 of the HCP.

3. Management of Aquatic Vegetation and Litter below Sewell Park (§ 5.3.3)

To minimize the impacts of recreation on Texas wild-rice and other Covered Species from Sewell Park to IH-35, the City of San Marcos will perform activities to manage floating vegetation and litter to enhance habitats for Covered Species. Management activities will include removal of vegetation mats that form on top of the water surface as well as on top of Texas wild-rice plants, particularly during low flows, and removal of litter.

The City of San Marcos will push floating vegetation downstream of any Texas wild-rice stands. The City will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation.

Inorganic litter will be removed from the San Marcos River from City Park to IH-35 during the recreational season (May through September) and less often during offseason. Litter in or around Texas wild-rice stands will not be removed.

4. Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries (§ 5.3.4)

Hazardous materials transported by truck across the watershed of the San Marcos River and its tributaries presents the possibility of accidental spills or releases into the environment. The limited geographic distribution of the endangered species at San Marcos Springs could cause the species to be highly impacted by such a spill.

The City of San Marcos will coordinate with the Texas Department of Transportation to designate hazardous materials routes which minimize the potential for spills entering the San Marcos River. This effort will include legislation, if necessary, and additional signage.

5. Designation of Permanent Access Points/Bank Stabilization (§ 5.3.7)

To minimize the impacts of recreation, permanent access points will be combined with bank stabilization at various locations. They will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. The City of San Marcos will stabilize banks in eroded areas, to include City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and Cheatham Street underpass.

Natural rock will be used to create a stone terrace for access and bank stabilization with the bank on either side restored with riparian vegetation. Native riparian vegetation will be planted

in areas adjacent to the access/stabilization areas in order to discourage river users from entering the river in places other than the access point. Prior to each construction period, the area will be swept clean of darters and enclosures will be put into place to keep darters out of the construction area.

6. Septic System Registration and Permitting Program (§ 5.7.3)

The City of San Marcos will undertake an aerobic and anaerobic septic system registration, evaluation, and permitting program to prevent subsurface pollutant loadings from potentially being introduced to the San Marcos Springs ecosystem within its city limits.

7. Management of Household Hazardous Wastes (§ 5.7.5)

The City of San Marcos will maintain a HHW program that involves the periodic collection of HHW and its disposal.

8. Impervious Cover/Water Quality Protection (§ 5.7.6)

The City of San Marcos will establish a program to protect water quality and reduce the impacts of impervious cover (such as through LID). The City of San Marcos will develop criteria and incentives for the program based upon the LID/Water Quality Work Group Final Report (Appendix Q) recommendations for Implementation Strategies and BMPs.

E. Texas State University

1. Management of Submerged and Floating Aquatic Vegetation in Spring Lake (§ 5.4.3.1)

To mitigate the impacts of incidental take on Covered Species from recreation, Texas State University will manage aquatic vegetation in Spring Lake through use of its harvester boat and through hand cutting of vegetation by divers authorized to dive in Spring Lake.

Each week about five springs will be cut, thus returning to cut the same springs every two to three weeks. During summer algal blooms, the springs will be managed more frequently (up to four springs per day), but mostly to remove algae. Texas State employees and supervised volunteers will fin the area around the springs to remove accumulated sediment, and then clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe. Over the next 1.5-meter radius around the spring opening, they will shear vegetation to a height of 30 cm, and then to one meter over the following three meter radius. Plant material will not be collected, but carried away by the current. Cumulatively, about six meters of vegetation around each spring opening will be modified. Mosses will not be cut. The volume of plant material to be removed will vary by the amount of time between cuttings, and season.

The harvester boat will remove a range of 15-to-20 boatloads of plant material a month from Spring Lake. The harvester will clear the top meter of the water column, cutting vegetation from sections one, two, and three once a week. The harvested vegetation will be visually checked by driver for fauna caught in the vegetation. If the driver observes fauna, he/she will stop work and put the animal(s) back into Spring Lake if appropriate. Texas State employees and supervised volunteers are trained to recognize the Covered Species through the Diving for Science program, and avoid contact with them.

Vegetation mats will be removed from zones four and five on an as-needed basis. The total area cut will equal about nine surface acres.

The Spring Lake Area Supervisor will also schedule cleanup of nuisance floating species such as water hyacinth and water lettuce from Spring Lake. The floating plants will be collected by hand and shaken prior to removal from the river to dislodge any aquatic species caught in the plant. The plants will be deposited into dump trucks and taken to the River System Institute compost area.

2. Management of Aquatic Vegetation from Sewell Park to City Park (§ 5.4.3.2)

To mitigate the impacts of incidental take from recreational activities, Texas State University will push floating vegetation downstream of any Texas wild-rice stands. Inorganic litter will be picked up weekly from the San Marcos River from Sewell Park to City Park during the recreational season (Memorial Day to Labor Day) and monthly during offseason.

Texas State University will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation. Divers will not pick up litter in or around Texas wild-rice stands.

University employees or others will be trained by the TPWD to recognize Texas wild-rice and to protect the plant stand while removing the accumulated floating plant material. On Texas wild-rice stands, Texas State University employees will lift (not push) the floating material from the top of the Texas wild-rice stands and allow it to float downstream. Downstream accumulations of plant material will be removed by the City of San Marcos to avoid impacts to Texas wild-rice further downstream.

3. Diversion of Surface Water (§ 5.4.5)

Under TCEQ Certificates 18-3865 and 18-3866, Texas State University's total diversion rate from the headwaters of the San Marcos River for consumptive use is limited to 8.1 cfs. The total diversion rate from Spring Lake is limited to 4.88 cfs; the total diversion rate from the San Marcos River at Sewell Park is limited to 3.22 cfs. To minimize the impacts of these diversions, when flow at the USGS gauge at the University Bridge reaches 80 cfs, Texas State University will reduce the total rate of surface water diversion by 2 cfs, *i.e.*, to a total of approximately 6.1 cfs. This reduction in pumping will occur at the pump just below Spring Lake Dam in order to maximize the benefits to salamanders, Texas wild-rice, and other aquatic resources in the San Marcos River below Spring Lake Dam. The University will reduce the total rate of surface water diversion by an additional 2 cfs when the USGS gauge reaches 60 cfs. The additional 2 cfs reduction will be made from the pumps located in the slough arm of Spring Lake, and, therefore, maximize the benefits to the aquatic resources within the main stem San Marcos River below Spring Lake Dam. When the USGS gauge reaches 49 cfs, Texas State University will reduce the total diversion rate to 1 cfs. This further reduction will be made by restricting the pumps located in the Sewell Park reach. The diversion of water will be suspended when the springflow reaches 45 cfs.

The reductions in Texas State University's total diversion rate for consumptive use is summarized in the Table below:

Streamflow (cfs)	Spring Lake Diversions (cfs) Cert. No. 18-3865	San Marcos River Diversions (cfs) Cert. No. 18-3866	Total Diversion Rate (cfs)
>80	4.9	3.2	8.1
80 – 60	2.9	3.2	6.1
60 – 49	0.9	3.2	4.1
49-45	1.0	0	1.0
<45	0	0	0

To avoid or minimize the impacts of the surface water diversions, the University will routinely monitor the screens to determine if any entrainment occurs and will make any necessary modifications to the screens to minimize any incident take from the operation of the diversions.

4. Sessom Creek Sand Bar Removal (§ 5.4.6)

For decades, a sand and gravel bar has been building with each major rain event at the confluence of Sessom Creek and the San Marcos River. The bar is about two-thirds meter deep, 7 meters wide, and 21 meters long (98.5 m^3). Over time it has widened, deepened, and constricted the river channel; furthermore, the continued expansion has covered a stand of Texas wild-rice. The bar has become vegetated with both littoral and terrestrial plants, and is used heavily by recreationists as it provides a shallow swimming area.

To minimize and mitigate the impacts of incidental take from recreation, Texas State University and the City of San Marcos will conduct a study of sediment removal options to determine the best procedure to remove this sand and gravel bar that minimizes impacts to listed species. Texas State University will submit the study for review though the AMP and implement the actions coming out of that process.

A separate sediment retention pond has been constructed to minimize additional deposition to this area and will be maintained to maintain an effective level of performance.

5. Diving Classes in Spring Lake (§ 5.4.7)

a. The Diving for Science Program

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae, and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat.

The Diving Supervisor coordinates and supervises all volunteer diving. No more than sixteen volunteer divers will be allowed in the lake per day, with no more than eight at one time.

Any individual diving outside of the Dive Training Area has to have completed the Diving for Science Program.

b. Texas State University Continuing Education

Texas State University Continuing Education classes for check-out dives will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

c. Texas State SCUBA Classes

Texas State SCUBA classes will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

6. Research Programs in Spring Lake (§ 5.4.8)

To minimize the impacts of its research programs, all proposals to conduct research in Spring Lake will be reviewed by the River Systems Institute to ensure there is no impact on Covered Species or their habitat. If incidental take cannot be avoided, it will be minimized by educating the researchers as to the area where the listed species are located and by requiring measures to minimize any potential impacts. All diving in support of a research study will be provided by individuals who have completed the Diving for Science program.

7. Management of Golf Course and Grounds (§ 5.4.9)

To minimize any impacts of the use of fertilizers and pesticides to maintain the golf course and grounds, Texas State University will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the ecosystem. Expanded water quality sampling targeted at Golf Course operations will be conducted as described in Section of 5.7.2. of the HCP.

8. Boating in Spring Lake and Sewell Park (§ 5.4.10)

To minimize the impacts of boating on the Covered Species' habitat in Spring Lake, boats in Spring Lake will be confined to areas that are mowed by the harvester, thereby not impacting vegetation and specifically avoiding Texas wild-rice stands. Individuals will enter and exit boats at specified access points to avoid impacting the flora and fauna along the bank. All boats launched into Spring Lake will undergo a USFWS-approved process for cleaning.

Further, canoeing/kayaking classes in the lake will be limited to no more than 2 classes per day and each class will be in the water no more than 1 hour. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

To minimize the impacts of boating on the Covered Species' habitat in Sewell Park, canoeing/kayaking classes in Sewell Park will be confined to the region between Sewell Park

and Rio Vista dam. Students will enter/exit canoes/kayaks at specified access points to avoid impacting the flora and fauna along the bank. Classes will be no longer than two hours and up to three classes will be held per day. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

F. San Antonio Water System

1. Use of the SAWS ASR for Springflow Protection (§ 5.5.1)

To minimize the impacts of incidental take from extended drought, the SAWS ASR facility will be used to store and deliver Aquifer water leased by the EAA. When triggers are reached, SAWS will use water stored in the ASR to serve as a baseload supply in its service area near to the springs. As described below, an amount equivalent to the water recovered from the ASR will be used to offset SAWS's Edwards demand.

EAA will acquire through lease and option 50,000 ac-ft/yr of EAA-issued Final Initial Regular Permits. The leases and options will used to fill, idle, and maintain a portion of the capacity of the SAWS ASR Project for subsequent use to protect springflows.

The lease program is comprised of three components. The first one-third, approximating 16,667 acre-feet of permits, will be leased for immediate storage in the ASR. The remaining pumping rights will be placed under a lease option. One-third (16,667 ac/ft) of the total will be options exercised in the year after the 10-year moving annual average of Edwards recharge falls below 572,000 ac-ft/yr, as determined by the EAA, and is likely to continue to decrease. The last one-third will be options exercised when the 10-year moving recharge average is less than 472,000 ac-ft/yr, as determined by the EAA. When the leases are in place, this water will either be pumped to fill the SAWS ASR or not pumped for any reason. When the ASR is in recovery mode (*i.e.*, when water is being returned from the ASR), the leased water will not be pumped. Trigger levels for implementation of ASR management in accordance with the HCP will be 630 ft-MSL at the J-17 index well during an identified repeat of drought conditions similar to the drought of record as indicated by the ten-year rolling average of Edwards recharge of 500,000 ac-ft, as determined by the EAA. When triggered, the ASR or other supplies capable of utilizing shared infrastructure will be activated to deliver up to 60 million gallons per day to SAWS distribution system during a repeat of drought of record-like conditions. When the monthly average groundwater levels at J-17 are below 630 ft-MSL and the ten-year rolling average of Aquifer recharge is 500,000 ac-ft or less, pumping of selected wells on the northeast side of SAWS water distribution system will be reduced in an amount that on a monthly basis equals the amount of water returned from the ASR only to the extent of the Aquifer water provided by the EAA for storage in the ASR. SAWS will use up to 100 percent of the conveyance capacity of existing SAWS ASR facilities to off-set SAWS' Edwards Aquifer demand.

SAWS will attempt, to the extent practicable, to mimic the pattern of delivery developed by HDR Engineering (HDR 2011). However, the actual pattern of delivery of water from the ASR may differ from that HDR used in its modeling simulations depending on the actual course of the drought.

The use of the SAWS ASR is predicated on an assumption informed by HDR Engineers' groundwater modeling that the SAWS ASR will be utilized to deliver approximately 126,000 ac-

ft of water to SAWS distribution system during a decadal drought similar to the drought of record. It is further predicated on the assumption from HDR 2011 that the maximum amount of HCP water that will be delivered in a given year is 46,300 ac-ft.

SAWS will make the day-to-day decisions necessary to fulfill the ASR commitment. A 12-person Regional Advisory Group consisting of four representatives of SAWS, the Program Manager, and one representative each from EAA, EAA permit holder for irrigation purposes, small municipal pumpers, the Spring cities, environmental (including Texas Parks and Wildlife), industrial pumpers, and downstream interests will provide advice to SAWS regarding the implementation of the program. The Advisory Group will meet as needed but no less than quarterly. SAWS will organize and facilitate the Advisory Group.

G. Texas Parks and Wildlife Department

1. State Scientific Areas (§ 5.6)

Texas Parks and Wildlife Department (TPWD) has the authority to establish state "scientific areas" for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value. (TPW Code § 81.501). To minimize the impacts of recreation, TPWD will pursue creation of state scientific areas in the San Marcos Springs ecosystem. The scientific areas will be designed to protect Texas wild-rice by limiting recreation in these areas during low flow conditions. The regulations are intended to preserve at least 1,000 m^2 of Texas wild-rice.

With the exception of the eastern spillway immediately below Spring Lake Dam, none of the protected areas will extend across the entire river channel; thus, allowing longitudinal connectivity for recreation and access to be maintained downstream throughout the river.

Interlocal agreements between the City of San Marcos and TPWD and Texas State University and TPWD will be used to allow for local in-water enforcement of the protected zones.

In order to protect existing and restored fountain darter habitat, TPWD will pursue creation of state scientific areas in the Comal Springs ecosystem. The goal of the regulations will be to minimize impacts to habitat from recreation activities. An interlocal agreement between the City of New Braunfels and TPWD will be used to allow for local in-water enforcement of the protected zones.

II. Costs

The estimated cost of the HCP and the schedule by which those costs are expected to be realized are set out in Table 7.1 of the HCP and are hereby incorporated by reference in this Comprehensive Plan. The cost estimates are arrayed in the Table below according to the entity assigned by the HCP.