EDWARDS AQUIFER HABITAT CONSERVATION PLAN

2021 ANNUAL REPORT

FINAL—MARCH 2022

Submitted to

U.S. Fish & Wildlife Service

On behalf of

The Edwards Aquifer Habitat Conservation Plan Permittees

HABITAT CONSERVATION PLAN EDWARDS AQUIFER

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Submitted to
The U.S. Fish & Wildlife Service

Prepared by
ICF
823 Congress Avenue
Unit 1010, Austin, TX 78701

Prepared for
The Edwards Aquifer Habitat Conservation Plan Permittees

ICF. 2022. *Edwards Aquifer Habitat Conservation Plan: 2021 Annual Report*. Final. March. Austin, TX. Prepared for the Edwards Aquifer Habitat Conservation Plan Permittees / Edwards Aquifer Authority. San Antonio, TX.

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2021 ANNUAL REPORT SUMMARY

Edwards Aquifer Habitat Conservation Plan

The Edwards Aquifer Habitat Conservation Plan (EAHCP) is a regional plan to protect 11 species associated with the Edwards Aquifer while helping to ensure its stability as a regional water supply.

INSIDE ▶

Overview of compliance activities and accomplishments in 2021, the ninth year of EAHCP implementation.

HABITAT CONSERVATION PLAN EDWARDS AQUIFER

Overview of the EAHCP

The ***Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan*** **(EAHCP)** was approved by the U.S. Fish & Wildlife Service (USFWS) as a regional plan to protect eight federally listed and three non-listed species—termed **Covered Species**—associated with the Edwards Aquifer while helping to ensure its stability as a regional water supply.

After approval of the EAHCP, the USFWS issued an **Incidental Take Permit (ITP)** under the federal Endangered Species Act of 1973 to five cooperating Permittees: **Edwards Aquifer Authority (EAA), City of New Braunfels, City of San Marcos, Texas State University**, and the City of San Antonio acting by and through its **San Antonio Water System** Board of Trustees.

The area covered by the ITP (Permit Area) is bounded by EAA's jurisdictional boundary, which encompasses Uvalde, Medina, and Bexar counties and portions of Atascosa, Caldwell, Comal, Guadalupe, and Hays counties.

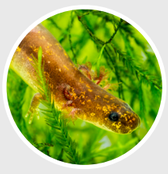
The EAHCP describes impacts that are likely to result from **Covered Activities**; identifies **Conservation Measures** to minimize and mitigate those impacts; and assures funding to implement those Conservation Measures and, more broadly, the EAHCP.

Permit Area

Covered Species

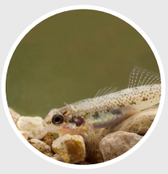
Texas Wild-Rice
Zizania texana
ENDANGERED

Texas Blind Salamander
Eurycea rathbuni
ENDANGERED



San Marcos Salamander
Eurycea nana
THREATENED

Comal Springs Salamander
Eurycea sp.
PETITIONED



Fountain Darter
Etheostoma fonticola
ENDANGERED

San Marcos Gambusia*
Gambusia georgei
ENDANGERED

Comal Springs Dryopid Beetle
Stygoparnus comalensis
ENDANGERED

Comal Springs Riffle Beetle
Heterelmis comalensis
ENDANGERED

Peck's Cave Amphipod
Stygobromus pecki
ENDANGERED

Texas Troglobitic Water Slater
Lirceolus smithii
PETITIONED

Edwards Aquifer Diving Beetle
Haideoporus texanus
PETITIONED

* *The USFWS published a proposed rule on September 30, 2021, to delist San Marcos gambusia due to extinction. Photo courtesy of Texas Parks & Wildlife Department.*

2021 Highlights

Springflow Protection

- Persistent drought in Texas continued to impact springflow. The San Marcos River began 2021 with flows below 120 cubic feet per second (the Condition M threshold). Low water levels at the J-17 Bexar Index Well triggered withdrawal restrictions in the San Antonio pool (88 days in Stage 1 and 11 days in Stage 2).
- Spring rainfall offered relief from drought conditions in the Permit Area. In mid-May, flows in the San Marcos River increased above 120 cubic feet per second, enabling the removal of Condition M restrictions.

Monitoring and Research

- Expanded water quality monitoring efforts included sampling for pharmaceuticals and personal care products, sucralose, and nutrients.
- EAA completed applied research on the cotton lure sampling technique used for monitoring the Comal Springs riffle beetle.

Habitat Restoration

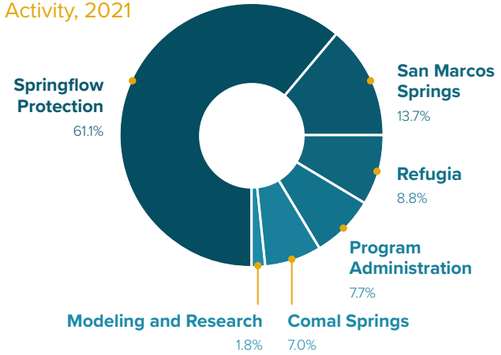
- 5,936 native aquatic plants were planted in the Restoration Reaches of the Old Channel, Comal River, and Landa Lake.
- 9,153 native aquatic plants were planted in the San Marcos River from Sewell Park to Bicentennial Park.

Administration

- Program staff began planning for a multi-year ITP renewal process in coordination with the USFWS.
- EAA awarded climate change modeling through the Climate Adaptation Science Center.
- Program coordinators and work–study students created story maps of Covered Species.
- The USFWS published a proposed rule on September 30, 2021, to delist the San Marcos gambusia species due to extinction. A final rule is anticipated in 2022.
- The Implementation Committee approved moving forward with the first priorities for studies and monitoring from the Springflow Habitat Protection Work Group.

Fiscal Stability

Budget by Program Activity, 2021

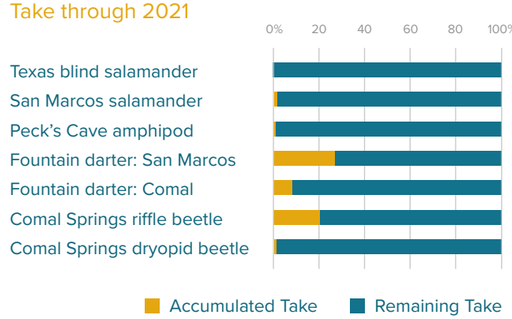


The current financial projections and cost estimates indicate an overall fiscally stable EAHCP with an adequate budget for Program implementation in fiscal year 2022. The EAHCP reserve is projected to remain above the established reserve floor of $26.4M, providing for adequate funding for springflow protection measures through the end of the permit term. The 2021 EAHCP expenses totaled $17,337,597.

Incidental Take

Incidental take of listed species from Covered Activities is quantified annually and measured against the total take authorized by the ITP. Covered Activities resulted in an estimated take of 773 fountain darters in the Comal Springs system and 48,686 fountain darters and 721 San Marcos salamanders in the San Marcos Springs system. Fountain darter habitat expanded in 2020 when public access was closed to the San Marcos River due to COVID-19 restrictions. However, in 2021 public access was restored, leading to habitat loss; this accounts for the large increase in take of fountain darters in 2021.

Covered Species Accumulated Take through 2021



Implementation of Conservation Measures

Conservation Measures are activities carried out by the Permittees in the Permit Area as part of EAHCP implementation. These measures encompass habitat protection, flow protection, and various supporting activities such as biological monitoring. The tables at right summarize progress toward fulfilling the Conservation Measures and highlight efforts in 2021, the ninth year of implementation.

All efforts to implement the Conservation Measures were conducted in accordance with the Permittees' annual Work Plans.

Status Key and Abbreviations

Implementation Status

- W — Working toward fulfillment
- ✓ — Fulfillment expected
- ✔ — Fulfillment achieved
- M — Maintenance
- O — On-going
- T — Implemented when triggered
- N — New opportunities sought contingent on funding

Permittees

- CONB — City of New Braunfels
- COSM — City of San Marcos
- EAA — Edwards Aquifer Authority
- SAWS — San Antonio Water System
- TXST — Texas State University

2021 is the ninth year of EAHCP implementation

Springflow Protection Measures

		13	14	15	16	17	18	19	20	**21**	22	23	24	25	26	27
Aquifer Storage and Recovery Springflow Protection Program	EAA, SAWS	W	W	W	W	W	W	✔	✔		T	T	T	T	T	T
Voluntary Irrigation Suspension Program Option	EAA	O	O	O	O	O	O	O	✔		O	O	O	O	O	O
Regional Water Conservation	EAA	W	W	W	W	W	W	W	✔							
Stage V Critical Period Management	EAA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T

Habitat Conservation Measures

		13	14	15	16	17	18	19	20	**21**	22	23	24	25	26	27
Texas Wild-Rice Enhancement	COSM, TXST	W	W	W	W	W	W	W	W	W	W	W	W	✓	M	M
Sediment Management	COSM, TXST	W	W	W	W	✔										
Sessom Creek Sand Bar Removal	TXST	W	W	W	✔											
Management of Floating Vegetation Mats and Litter	CONB, COSM, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Decaying Vegetation Removal and Dissolved Oxygen Management	CONB	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Aquatic Vegetation Restoration and Maintenance	COSM, TXST	W	W	W	W	W	W	W	W	W	W	W	W	✓	M	M
Aquatic Vegetation Restoration and Maintenance	CONB	W	W	W	W	W	W	W	W	W	W	✓	M	M	M	M
Non-Native Animal Species Control	CONB, COSM, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Reduction of Non-Native Species Introduction and Live Bait Prohibition	CONB	O	O	O	O	O	O	✔	O	O	O	O	O	O	O	O
Monitoring and Reduction of Gill Parasites	CONB	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Diving Classes (Spring Lake) and Boating (Spring Lake and Sewell Park)	TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Research Programs in Spring Lake	TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Diversion of Surface Water	TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Flow Split Management	CONB	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Management of Public Recreation	CONB, COSM, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Designation of Permanent Access Points/Bank Stabilization	COSM	W	✓	M	M	M										
Native Riparian Habitat Restoration	CONB, COSM, TXST	W	W	W	W	W	W	W	W	W	W	✓	M	M	M	M
Native Riparian Habitat Restoration (Riffle Beetle)	CONB	W	W	W	W	W	W	W	✔	M	M	M	M	M	M	M
Management of Golf Course and Grounds	CONB, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Prohibition of Hazardous Material Transport	COSM	W	W	W	W	W	W	W	W	W	✓					
Prohibition of Hazardous Material Transport Routes	CONB	W	W	W	✔											
Management of Household Hazardous Waste	CONB, COSM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Septic System Registration and Permitting Program	COSM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Minimizing Impacts of Contaminated Runoff	COSM	W	W	W	W	W	W	W	✔	N	N	N	N	N	N	N
Impervious Cover/Water Quality Protection	CONB, COSM	W	W	W	W	W	W	W	W	W	W	W	✓	N	N	N
Impervious Cover/Water Quality Protection: Coal Tar Sealant Ban	EAA	W	W	✔												

Supporting Measures

		13	14	15	16	17	18	19	20	**21**	22	23	24	25	26	27
Net Disturbance	EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Incidental Take	EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Refugia	EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Applied Research	EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Ecological Modeling	EAA	W	W	W	W	✔										
Biological Monitoring	EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Water Quality Monitoring	EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Groundwater Modeling	EAA	W	W	W	W	W	W	W	✔							

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List of Abbreviations

Abbreviation	Term
ac-ft	acre-foot
AMP	Adaptive Management Process
ASR	Aquifer Storage & Recovery
cfs	cubic feet per second
COI	Certificate of Inclusion
CONB	City of New Braunfels
COSM	City of San Marcos
CSRB	Comal Springs riffle beetle
EAA	Edwards Aquifer Authority
EAHCP	*Edwards Aquifer Habitat Conservation Plan*
EARIP	Edwards Aquifer Recovery Implementation Program
ESA	Endangered Species Act of 1973
FMA	Funding and Management Agreement
ft msl	feet mean sea level
ft^3	cubic foot
GIS	geographic information systems
HAZMAT	hazardous materials
HCP	Habitat Conservation Plan
IC	Implementing Committee
ITP	Incidental Take Permit
lb	pound
JFA	Joint Funding Agreement
LTBG	Long-Term Biological Goal
m	meter
m^2	square meter
N/A	not applicable
NBU	New Braunfels Utilities
Permit Area	area covered by the Incidental Take Permit
SAMP	Strategic Adaptive Management Process
SAWS	San Antonio Water System
SC	Adaptive Management Science Committee
SH	Adaptive Management Stakeholder Committee
SSA	state scientific area
TPWD	Texas Parks & Wildlife Department
TWR	Texas wild-rice
TXST	Texas State University
USFWS	U.S. Fish & Wildlife Service
USGS	United States Geological Survey
VISPO	Voluntary Irrigation Suspension Program Option
yd^3	cubic yard

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1 | EAHCP Background and Edwards Aquifer Conditions

CHAPTER OVERVIEW

- 2021 marked the ninth year of implementing the EAHCP, a regional plan to protect 11 species associated with the Edwards Aquifer while helping to ensure its stability as a regional water supply.
- This Annual Report fulfills reporting requirements of the Incidental Take Permit, a federally issued permit that authorizes incidental take resulting from Covered Activities carried out by the EAHCP's Permittees: the Edwards Aquifer Authority, City of New Braunfels, City of San Marcos, Texas State University, and City of San Antonio/San Antonio Water System.
- Spring rainfall offered relief from drought conditions in the Permit Area. Comal and San Marcos springflows also responded to increased rainfall. In mid-May, flows in the San Marcos River increased above 120 cubic feet per second, enabling the removal of Condition M restrictions that had been in place since December 2020.

The *Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan* (EAHCP[1]; RECON Environmental et al. 2012) was approved by the U.S. Fish & Wildlife Service (USFWS) as a regional plan to protect eight federally listed and three non-listed species (**Covered Species**[2]; **TABLE 1-1**) associated with the Edwards Aquifer while helping to ensure its stability as a regional water supply. After approval of the EAHCP, the USFWS issued an **Incidental Take Permit** (ITP) under the federal Endangered Species Act of 1973 (ESA). With an effective date of March 18, 2013, permit TE-63663A-1 (as amended January 21, 2015; Appendix A1) was issued to five cooperating Permittees:

- Edwards Aquifer Authority (EAA)
- City of New Braunfels (CONB)
- City of San Marcos (COSM)
- Texas State University (TXST)
- City of San Antonio acting by and through its San Antonio Water System (SAWS) Board of Trustees

[1] Abbreviations in this document are defined in the *List of Abbreviations* on page viii.
[2] Terms defined in the *Glossary* appear in blue, bolded typeface on their first use in text or tables.

TABLE 1-1
Covered Species

Common Name	Scientific Name	Federal Status	Spring System
Fountain darter	*Etheostoma fonticola*	Endangered	Comal and San Marcos
San Marcos gambusia	*Gambusia georgei*	Endangered (proposed delisted)[a]	San Marcos
Comal Springs dryopid beetle	*Stygoparnus comalensis*	Endangered	Comal and San Marcos
Comal Springs riffle beetle	*Heterelmis comalensis*	Endangered	Comal and San Marcos
Peck's cave amphipod	*Stygobromus pecki*	Endangered	Comal
Texas wild-rice	*Zizania texana*	Endangered	San Marcos
Texas blind salamander	*Eurycea (=Typhlomolge) rathbuni*	Endangered	San Marcos
San Marcos salamander	*Eurycea nana*	Threatened	San Marcos
Edwards Aquifer diving beetle	*Haideoporus texanus*	Not listed (petitioned)	Comal and San Marcos
Comal Springs salamander	*Eurycea* sp.	Not listed (petitioned)	Comal
Texas troglobitic water slater	*Lirceolus smithii*	Not listed (petitioned)	San Marcos

[a] The U.S. Fish & Wildlife Service published a proposed rule on September 30, 2021, to delist this species due to extinction. The species will not be officially delisted until the U.S. Fish & Wildlife publishes a final rule, which is anticipated in 2022 but has not occurred as of March 15, 2022.

The area covered by the ITP (Permit Area) is bounded by EAA's jurisdictional boundary—i.e., the area where pumping from the Edwards Aquifer is regulated by the EAA. This boundary encompasses Uvalde, Medina, and Bexar counties and portions of Atascosa, Caldwell, Comal, Guadalupe, and Hays counties (**FIGURE 1-1**).

Pumping, or groundwater **withdrawals**, is one of many **Covered Activities** that may lead to **incidental take** of a Covered Species. The EAHCP describes impacts that are likely to result from those Covered Activities; identifies **Conservation Measures** to minimize and mitigate those impacts; and assures funding to implement those Conservation Measures and, more broadly, the EAHCP. Amendments and clarifications made to the EAHCP and its supporting documents since ITP issuance are summarized in Appendix A2.

1.1 Annual Reporting and Monitoring Requirements

The ITP requires that by March 31 of each year, an Annual Report for the preceding year is submitted to the USFWS Austin Ecological Services Office and to the USFWS Albuquerque Region 2 Office. As specified by Condition U of the ITP, this report "will document the Permittees' activities and permit compliance for the previous year, thus documenting progress toward the goals and objectives of the Edwards Aquifer Recovery Implementation Program (EARIP) Habitat Conservation Plan (HCP) and demonstrating compliance with the terms and conditions of this incidental take permit."

This document serves as the Annual Report for 2021, the ninth year of EAHCP implementation.

FIGURE 1-1
Edwards Aquifer Authority Jurisdiction and EAHCP Permit Area

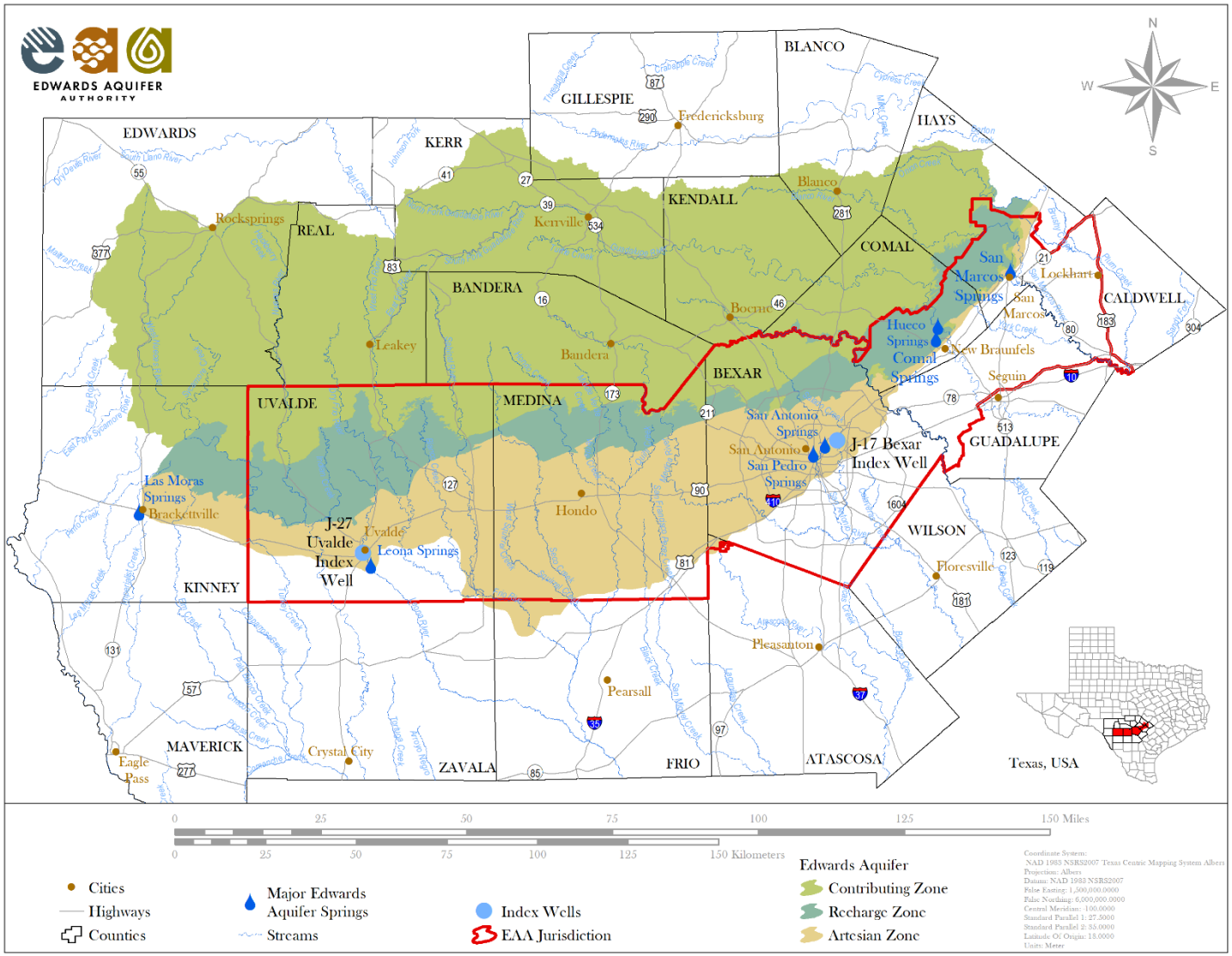


TABLE 1-2 identifies the ITP's content requirements for the Annual Report and provides a reference to a chapter, section, or appendix where that content can be found in the 2021 Annual Report.

TABLE 1-2
EAHCP Annual Report Requirements and Associated 2021 Annual Report Reference

Requirement per ITP Condition U	Annual Report Reference
EAA permitted withdrawals	Appendix B
Reference well levels	Appendix C
Springflows at Comal and San Marcos springs	Appendix C
Aquifer recharge	Appendix C
Aquifer discharge from wells and springflow	Appendix C
Critical period management reductions	Section 1.2
Water quality data	Appendix F
Location of sampling sites	Appendix F
Methods for data collection and variables measured	Appendix F
Frequency, timing, and duration of sampling for the variables	Appendix F
Description of the data analysis and who conducted the analysis	Appendix F
Adaptive management activities undertaken during the year	Section 6.2
Expenditures by the EAA on implementation activities	Section 5.2
Proposed activities for the next year	Chapter 2
Report on the status of implementation of minimization and mitigation measures and their effectiveness	Chapter 2
Interim updates and final copies of any research, thesis or dissertation, or published studies accomplished in association with the EARIP or EAHCP	Chapter 7 and Appendix N
Description of species-specific research and management actions undertaken with specific reference to the Biological Goals and Objectives identified for each species	Appendix F, Appendix G
Any changes to the Biological Goals and Key Management and Flow-Related Objectives of the EAHCP and the reasons for such changes	N/A—no changes to report for 2021
Any changes to the objectives for the monitoring program	N/A—no changes to report for 2021
Effects on the Covered Species or Permit Area	Appendix J
Evaluation of progress toward achieving the Biological Goals and Objectives	Chapter 3 and Appendix F
Any recommendations regarding actions to be taken	Chapter 2

Abbreviations

EAA = Edwards Aquifer Authority; EARIP = Edwards Aquifer Recovery Implementation Program; N/A = not applicable

1.2 Edwards Aquifer Management, Conditions, and Springflows

The EAA declares a **critical period** based on declining groundwater levels and diminished springflow at four locations—J-27 Uvalde Index Well in the Uvalde Pool, J-17 Bexar Index Well in the San Antonio Pool, San Marcos Springs, and Comal Springs. Withdrawal reductions are put into place for users withdrawing groundwater from whichever pool triggers the reduction. The purpose of these mandatory reductions is to stabilize water levels and springflow until rainfall replenishes the aquifer. Although reductions are announced whenever thresholds are triggered, reductions are applied only at year-end based on the number of days in a stage or stages. Appendix B lists all EAA **groundwater withdrawal permits**.

Edwards Aquifer levels began the year near critical period/drought management triggers, but spring rains recharged the aquifer. Mandatory reductions were required for users of the San Antonio Pool (J-17 Bexar Index Well) in 2021 but not for users of the Uvalde Pool (J-27 Uvalde Index Well). Water levels measured at the J-27 Uvalde Index Well remained above critical period/drought management triggers, ending the year at 861.4 feet mean sea level (ft msl). Water levels measured at the J-17 Bexar Index Well began the year near 660 ft msl and fell 13 feet during the February winter storm when infrastructure was impacted by prolonged freezing. Stages in the San Antonio Pool were triggered as shown in **TABLE 1-3**. Water levels measured at the J-17 Bexar Index Well ended the year at 663.6 ft msl.

TABLE 1-3
Stages in the San Antonio Pool, 2021

Stage	Withdrawal Reduction	Days in Stage	Duration Dates	Actual Required Reduction [a]
No Stage	0.0%	51	01/01–02/20	0%
Stage 1	20.0%	11	02/21–03/03	0.60%
No Stage	0.0%	20	03/04–03/23	0%
Stage 1	20.0%	26	03/24–04/18	1.42%
Stage 2	30.0%	11	04/19–04/29	0.90%
Stage 1	20.0%	7	04/30–05/06	0.38%
No Stage	0.0%	117	05/07–08/31	0%
Stage 1	20.0%	44	09/01–10/14	2.41%
No Stage	0.0%	78	10/15–12/31	0%
Total	–	365	–	5.71%

[a] Although reductions are announced whenever thresholds are triggered, reductions are applied only at year-end based on the number of days in a stage or stages: this column shows those calculated reductions.

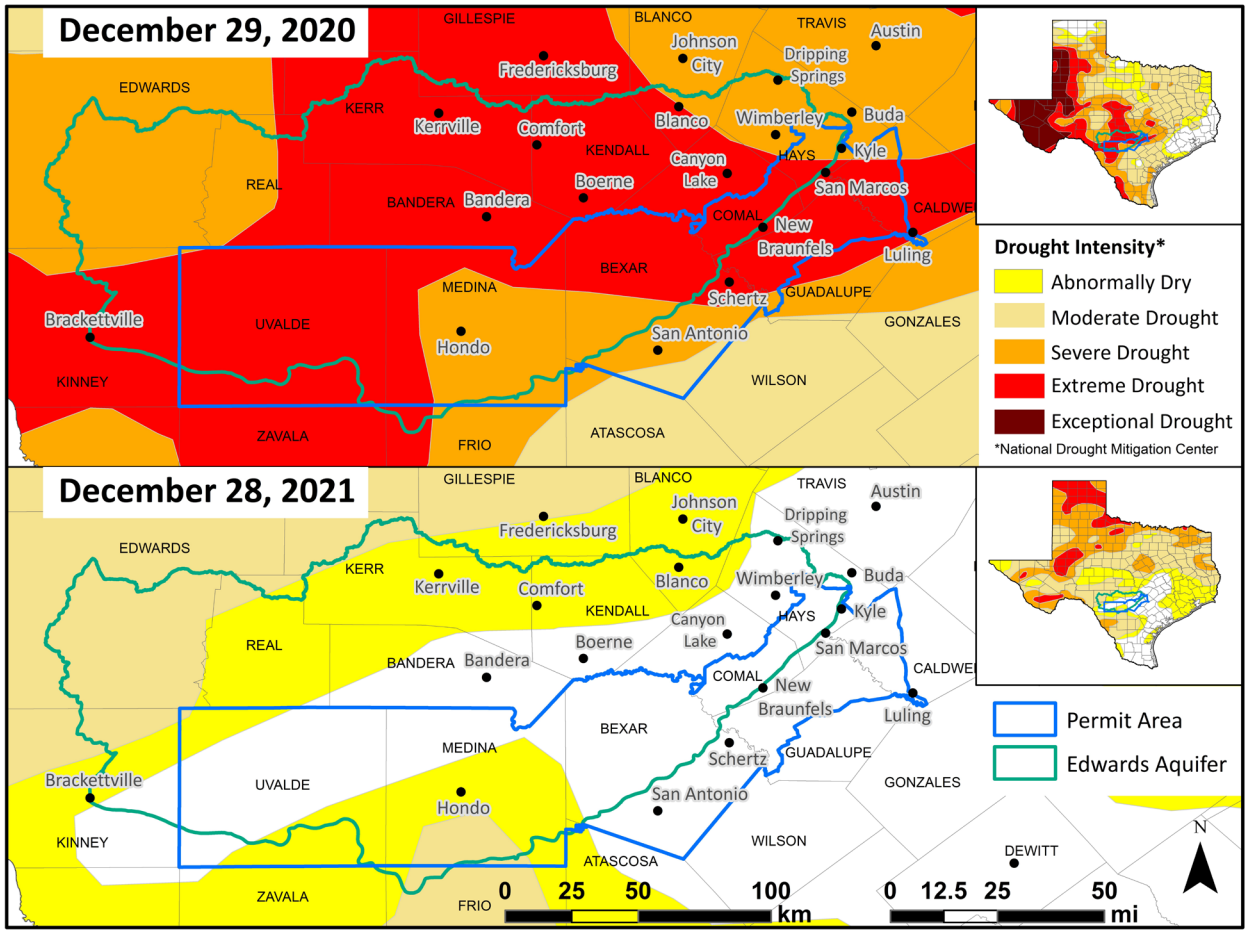
The Stage 1 critical period/drought management trigger in the San Antonio pool requires Edwards Aquifer groundwater withdrawal permit holders withdrawing from the San Antonio Pool to reduce their annual authorized amount by 20 percent. The Stage 2 critical period/drought management trigger at the J-17 Bexar Index Well requires 30 percent reductions for users of the San Antonio Pool. As noted above, reductions are applied only at year-end based on the number of days in a stage or stages. These restrictions apply only to permit holders in Atascosa, Bexar, Caldwell, Comal, Guadalupe, Hays, and Medina counties who are authorized to pump more than 3 acre-feet (ac-ft) annually.

Rainfall was below historical averages through 2020 and into the beginning of 2021, resulting in below-average recharge and springflow. Calculated recharge for 2020 was estimated at 184,340 ac-ft, which is below the mean annual recharge of 700,000 ac-ft for the period of record (1934–2020) excluding additional interformational flows. The 10-year rolling average recharge was calculated at 555,780 ac-ft. The estimated springflow was 353,000 ac-ft. Available rainfall and recharge data are included in the 2020 Hydrological Reports (Appendix C).

The U.S. Geological Survey (USGS) measures springflow at the Comal and San Marcos springs via two gages located downstream in the **Comal River** at New Braunfels and the **San Marcos River** at San Marcos, respectively. At the beginning of 2021, springflows in the Comal and San Marcos rivers were well below average but responded to spring rainfall and increased to average flows in May. Flows at the USGS station in the Comal River (USGS 08169000) remained above critical period/drought management triggers for the entire year. The San Marcos River (USGS 08170500) began the year with much lower flows. Flows were below the ITP Condition M, which limits restoration activities and prompts defined monitoring when flows are below 120 cubic feet per second (cfs). Condition M restrictions were lifted in mid-May (Appendix D). The San Marcos River remained above 120 cfs for the remainder of the year.

Drought conditions across the region lifted in spring 2021. **FIGURE 1-2** compares Texas drought on December 29, 2020, with conditions on December 28, 2021. *The U.S. Seasonal Drought Outlook* expects drought conditions to remain into 2022 (National Oceanic and Atmospheric Administration National Weather Service Climate Prediction Center 2021).

FIGURE 1-2
Texas Drought Conditions in December 2020 and December 2021



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2 | Conservation Measures

CHAPTER OVERVIEW

- Conservation Measures are activities carried out by the Permittees in the Permit Area as part of EAHCP implementation. These measures encompass habitat protection, flow protection, and various supporting activities (e.g., biological monitoring).
- Tables presented in this chapter show 2021 compliance actions undertaken by Permittees to fulfill Conservation Measures. These efforts were carried out according to approved annual Work Plans.
- As the EAHCP enters its tenth year of implementation, the majority of Conservation Measures have either been fulfilled or are in an on-going or maintenance phase.

Conservation Measures are activities carried out by the Permittees in the Permit Area as part of EAHCP implementation. These measures encompass habitat protection, flow protection, and various supporting activities such as biological monitoring. **TABLES 2-1 through 2-3** list Conservation Measures by topic and show the overall implementation status of each measure within the context of the permit term.

Each year, Permittees undertake compliance activities to fulfill Conservation Measures; these activities are defined annually in Work Plans developed by the implementing Permittee and approved by the Implementing Committee (IC). Permittees' efforts to implement the Conservation Measures in 2021 were carried out according to these reviewed and approved Work Plans (Appendix E). **TABLES 2-4 through 2-8** summarize, by Permittee, all 2021 compliance activities and activities proposed for 2022. Additionally, **TABLE 2-9** summarizes activities by a non-Permittee, the Texas Parks & Wildlife Department (TPWD), who implements two Conservation Measures as a signatory to the Implementing Agreement.

TABLE 2-1
Springflow Protection Measures–Implementation Status

Conservation Measure and Permittee	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Aquifer Storage & Recovery Springflow Protection Program–EAA, SAWS	W	W	W	W	W	W	✔	✔		T	T	T	T	T	T
Voluntary Irrigation Suspension Program Option–EAA	O	O	O	O	O	O	O	✔		O	O	O	O	O	O
Regional Water Conservation–EAA	W	W	W	W	W	W	W	✔							
Stage V Critical Period Management–EAA	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T

Abbreviations EAA = Edwards Aquifer Authority; SAWS = San Antonio Water System

Status Key

W	Working toward fulfillment
✔	Fulfillment achieved
O	On-going
T	Implemented when triggered

TABLE 2-2

Habitat Conservation Measures–Implementation Status

Conservation Measure and Permittee	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Texas Wild-Rice Enhancement–COSM, TXST	W	W	W	W	W	W	W	W	W	W	W	W	✓	M	M
Sediment Management–COSM, TXST	W	W	W	W	✔										
Sessom Creek Sand Bar Removal–TXST	W	W	W	✔											
Management of Floating Vegetation Mats and Litter–CONB, COSM, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Decaying Vegetation Removal and DO Management–CONB	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Aquatic Vegetation R&M–COSM, TXST	W	W	W	W	W	W	W	W	W	W	W	W	✓	M	M
Aquatic Vegetation R&M–CONB	W	W	W	W	W	W	W	W	W	W	✓	M	M	M	M
Non-Native Animal Species Control–CONB, COSM, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Reduction of Non-Native Species/Live Bait Prohibition–CONB, COSM	O	O	O	O	O	O	✔	O	O	O	O	O	O	O	O
Monitoring and Reduction of Gill Parasites–CONB	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Diving Classes (Spring Lake) and Boating (Spring Lake/ Sewell Park)–TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Research Programs in Spring Lake–TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Diversion of Surface Water–TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Flow Split Management–CONB	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Management of Public Recreation–CONB, COSM, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Designation of Permanent Access Points/Bank Stabilization–COSM	W	✔	M	M	M										
Native Riparian Habitat Restoration–CONB, COSM, TXST	W	W	W	W	W	W	W	W	W	W	✓	M	M	M	M
Native Riparian Habitat Restoration (Riffle Beetle)–CONB	W	W	W	W	W	W	W	✔	M	M	M	M	M	M	M
Management of Golf Course and Grounds–CONB, TXST	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Prohibition of Hazardous Material Transport–COSM	W	W	W	W	W	W	W	W	W	✓					
Prohibition of Hazardous Material Transport Routes–CONB	W	W	W	✔											
Management of Household Hazardous Waste–CONB, COSM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Septic System Registration and Permitting Program–COSM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Minimizing Impacts of Contaminated Runoff–COSM	W	W	W	W	W	W	W	✔	N	N	N	N	N	N	N
Impervious Cover/WQ Protection–CONB, COSM	W	W	W	W	W	W	W	W	W	W	W	✓	N	N	N
Impervious Cover/WQ Protection: Coal Tar Sealant Ban–EAA	W	W	✔												

Abbreviations EAA = Edwards Aquifer Authority; CONB = City of New Braunfels; COSM = City of San Marcos; DO = dissolved oxygen; R&M = restoration and maintenance; TXST = Texas State University; WQ = water quality

Status Key

W	Working toward fulfillment
✓	Fulfillment expected
✔	Fulfillment achieved
M	Maintenance
O	On-going
T	Implemented when triggered
N	New opportunities sought contingent on funding

TABLE 2-3
Supporting Measures–Implementation Status

Conservation Measure and Permittee	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Net Disturbance–EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Incidental Take–EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Refugia–EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Applied Research–EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Ecological Modeling–EAA	W	W	W	W	✔										
Biological Monitoring–EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Groundwater Modeling–EAA	W	W	W	W	W	W	W	✔							
Water Quality Monitoring–EAA	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

Abbreviation EAA = Edwards Aquifer Authority

Status Key

W	Working toward fulfillment
✔	Fulfillment achieved
O	On-going

Annual Biological Monitoring in the Comal Springs. In spring of 2021, BIO-WEST conducted drop-net surveys to measure fountain darter density in the Comal Springs system The biological monitoring report is included in Appendix F2.

2.1 Edwards Aquifer Authority

TABLE 2-4
Edwards Aquifer Authority 2021 EAHCP Implementation and Proposed 2022 Activities by Conservation Measure

EAA 2021 Compliance Action	Proposed EAA 2022 Compliance Action	Annual Report Reference
Applied Research (EAHCP § 6.3.4) Intended to enhance understanding of the ecology of aquatic ecosystems and provide scientifically rigorous information needed to meet the Biological Goals and Objectives.		
Completed applied research on the cotton lure sampling technique used for monitoring the CSRB.	Conduct the applied research recommended by the Implementing Committee in the Springflow Habitat Protection Work Group Prioritization and begin a multi-year CSRB population study in Landa Lake and contributing Spring Runs.	Appendix F4
Refugia (EAHCP §§ 5.1.1, 6.4.2, 6.4.3, and 6.4.4) Operation and maintenance of two off-site refugia to house and protect adequate populations of Covered Species and expand knowledge of their biology, life histories, and effective reintroduction techniques.		
Species collections occurred and standing stocks of species were maintained. Research activities focused on evaluating genetics of captive and wild Texas wild-rice stock; increasing CSRB survival, propagation, and pupation rates in captivity; altering the microbial environment to increase CSRB survival rates; increasing Comal Springs dryopid beetle culture and propagation rates; and continuing San Marcos salamander reproduction strategies.	Continue day-to-day operations and maintenance of refugia. Continue species collections and 2021 research activities.	Appendix G
VISPO (EAHCP § 5.1.2) Compensates irrigation permit holders for not pumping (a total combined volume goal of 41,795 ac-ft) from the Edwards Aquifer during certain drought conditions when the water level at the J-17 Bexar Index Well is at or below 635 ft msl on October 1.		
Conditions were not triggered, and **forbearance** was not required. VISPO agreements totaling 41,795 ac-ft were held in 2021. Therefore, the VISPO goal of 41,795 ac-ft has been achieved.	Conditions were not triggered in 2021, and forbearance will not be required in 2022. VISPO agreements totaling 41,795 ac-ft will be held in 2022, and no agreements will expire in 2022. Continue to promote re-enrollment to those enrollees with expiring agreements in 2024 and beyond.	N/A
Regional Water Conservation (EAHCP § 5.1.3) Conserve 20,000 ac-ft of permitted or exempt Edwards Aquifer water: 10,000 ac-ft will be held by the EAA in trust to remain un-pumped for the permit term, and the other 10,000 ac-ft will remain available for withdrawal by the participating entities.		
Final payment was made to SAWS for its leak repairs made in 2019. The City of Universal City, City of Uvalde, and SAWS contracts to conserve water have been fulfilled.	Although this Conservation Measure is fulfilled, EAA is working to identify alternatives to increase recharge, protect springflows, and control erosion using regenerative land management strategies, conservation easements, and other approaches.	N/A

EAA 2021 Compliance Action	Proposed EAA 2022 Compliance Action	Annual Report Reference
Critical Period Management Program–Stage V (EAHCP § 5.1.4) Mandates a 44 percent reduction in the authorized groundwater withdrawal amount of EAA-issued groundwater withdrawal permits triggered when the 10-day average level at the J-17 Bexar Index Well drops below 625 ft msl, or if the springflows at **Comal Springs** decline below 45 cfs based on a 10-day rolling average, or below 40 cfs based on a 3-day rolling average, or when the J-27 Index Well Aquifer level drops below 840 ft msl.		
This Conservation Measure was not triggered in 2021.	This Conservation Measure will be enforced if triggered in 2022.	N/A
Expanded Water Quality Monitoring (EAHCP § 5.7.2) Continued historical groundwater and surface water quality monitoring along with expanded water quality monitoring efforts to include groundwater and surface water sampling as necessary around Landa Lake, the Comal River, Spring Lake, and the San Marcos River.		
Implemented a new water quality monitoring plan that was developed in 2020 and based on results of historical monitoring efforts. Expanded water quality monitoring included real-time network water quality monitoring; surface water and groundwater sampling for pharmaceuticals and personal care products, sucralose, and nutrients; and fish tissue analysis.	Continue to implement the water quality monitoring plan as revised in 2020. Perform real-time network monitoring of water quality parameters as well as surface water, groundwater, and sediment sampling.	Appendix F1
Biological Monitoring (EAHCP §§ 6.3.1, 6.4.3, and 6.4.4) To monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities, to collect data that can be used in the applied research studies, and to provide data and information for ecological model development.		
Biological monitoring occurred as outlined in the EAHCP.	Continue biological monitoring as completed in previous years, with the vegetation mapping occurring only within the **LTBG Reaches**.	Appendices F2 and F3
Groundwater Modeling (EAHCP § 6.3.2) Improve MODFLOW model to reduce uncertainty in the results for use during the Adaptive Management Process and to provide assurance/confirmation that modeling results for the Edwards Aquifer and springflows are more reliable and defensible.		
Groundwater modeling was completed in 2020.	No activities are proposed.	N/A
Ecological Modeling (EAHCP § 6.3.3) Develop a predictive ecological model to evaluate, and quantify the magnitude of, potential adverse ecological effects from Covered Activities to develop alternative approaches or mitigation strategies.		
Ecological modeling was completed in 2017.	No activities are proposed.	N/A
Impervious Cover and Water Quality Protection (EAHCP § 5.7.6) 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.		
Work was completed in 2015. The EAA continues to enforce its coal tar rules and serve as a resource for other local governments.	Continue to enforce the coal tar rules and serve as a resource for any local government that concludes future regulatory action is necessary.	N/A

EAA 2021 Compliance Action	Proposed EAA 2022 Compliance Action	Annual Report Reference
EAA ASR Springflow Protection (EAHCP § 5.5.1) The EAHCP requires the EAA to acquire 50,000 ac-ft of permitted Edwards Aquifer water through **leases** and **forbearance agreements** and to maintain such leases on an annual basis for use in the SAWS ASR Program.		
For 2021, EAA acquired a total of 50,000 ac-ft of which 14,561.797 ac-ft were ASR leases and 35,438.203 ac-ft were ASR forbearance agreements.	Upon expiration of existing EAA ASR leases, future enrollments will become ASR springflow protection forbearance agreements consistent with the Interlocal Contract for the remainder of the permit term unless ASR is used. EAA has acquired a total of 50,000 ac-ft for year 2022 of which 12,837.627 ac-ft are ASR leases and 37,162.373 ac-ft are ASR forbearance agreements. This water will serve as forbearance water and will go un-pumped if the 10-year rolling average of the estimated annual recharge to the aquifer is equal to or less than 500,000 ac-ft.	N/A

Abbreviations

ac-ft = acre-foot; ASR = Aquifer Storage & Recovery; cfs = cubic feet per second; CSRB = Comal Springs riffle beetle; EAA = Edwards Aquifer Authority; ft msl = feet mean sea level; LTBG = Long-Term Biological Goal; N/A = not applicable; USGS = United States Geological Survey; VISPO = Voluntary Irrigation Suspension Program Option

2.2 City of New Braunfels

TABLE 2-5

City of New Braunfels 2021 EAHCP Implementation and Proposed 2022 Activities by Conservation Measure

CONB 2021 Compliance Action	Proposed CONB 2022 Compliance Action	Annual Report Reference
Flow-Split Management in the Old and New Channels (EAHCP § 5.2.1) Control flow entering the Old and New channels of the Comal River from Landa Lake to maintain optimal habitat conditions for the Covered Species under varying total flow conditions.		
Continued to monitor flow rates in the Old and New channels of the Comal River. Operated the flow-control gates between Landa Lake and the Old Channel to meet the flow objectives.	Continue to monitor flow rates in the Old and New channels of the Comal River and operate the flow-control gates to meet the flow objectives defined in the annual Work Plan.	N/A

CONB 2021 Compliance Action	Proposed CONB 2022 Compliance Action	Annual Report Reference
Native Aquatic Vegetation Restoration and Maintenance (EAHCP § 5.2.2) Implement an Aquatic Vegetation Restoration Program (removal of non-native aquatic plant species, planting of target native aquatic plant species, and maintenance of restored areas) within key, sustainable reaches of the Comal River system including Landa Lake, the Upper Spring Run area, and portions of the Old and New channels to improve habitat conditions for the fountain darter by increasing the amount of usable habitat and by improving the quality of existing habitat.		
Planted 5,936 native aquatic plants, in the **Restoration Reaches** of the Old Channel, Comal River, and Landa Lake. The planted area within the Landa Lake LTBG Reach totaled 471 m^2, and the planted area within the Old Channel Restoration Reach totaled 181 m^2. Removed 10 m^2 of non-native *Hygrophila* from the Comal River system. Monitored and maintained previously restored native aquatic vegetation stands.	Continue efforts to increase the coverage and density of target aquatic vegetation preferred by fountain darters for habitat as defined by EAHCP Tables 4-1 and 4-1-1. Continue aquatic vegetation maintenance activities in Landa Lake, Old Channel, and Upper Spring Run LTBG and Restoration Reaches.	Appendix H1
Management of Public Recreational Use of Comal Springs and River Ecosystems (EAHCP § 5.2.3) Enforce recreation restrictions on the Comal River to limit recreation on Landa Lake, the Spring Runs in Landa Park, and the Old Channel of the Comal River along with extending take protection to commercial outfitting businesses that voluntarily participate in the COI Program.		
Continued enforcement of CONB Code § 142-5, which restricts access to Landa Lake, the Spring Runs (except for the wading pool on Spring Run #2), and portions of the Comal River. CONB park rangers routinely patrolled Landa Park to enforce the ordinance. Informative signage remained in place along the waterways. Worked with Program staff and stakeholders to develop a plan to inform river recreation outfitters about the COI Program. Delivered presentation on the COI Program to the CONB River Advisory Committee. Distributed a survey to river recreation outfitters to gauge interest in the COI Program.	Continue to enforce CONB Code § 142-5 and educate Comal River recreation outfitters about participation in the COI Program.	N/A
Decaying Vegetation Removal and Dissolved Oxygen Management (EAHCP § 5.2.4) Monitor dissolved oxygen concentrations and related water quality parameters in Landa Lake and mitigate depressed dissolved oxygen levels (less than 4 milligrams per liter), regardless of the initiating circumstances.		
Dissolved oxygen monitoring and mitigation activities did not occur in 2021 due to above-average springflow conditions and adequate dissolved oxygen concentrations.	Monitor dissolved oxygen concentrations in prime habitat areas of Landa Lake and the Upper Spring Run if low flow conditions are realized. Manage floating vegetation mats and remove decaying vegetation if it is negatively affecting dissolved oxygen concentrations.	N/A
Control of Harmful Non-Native Animal Species (EAHCP § 5.2.5) Implement a non-native species control program that targets armored sailfin catfish, tilapia, nutria, and giant ramshorn snail.		
Removed 62 armored sailfin catfish, 835 tilapia, and 13 nutria from the Comal River system. Giant ramshorn snail removal efforts have been discontinued due to the limited impact that removal has on its population.	Continue routine removal of target non-native species including tilapia, nutria, and armored sailfin catfish using proven and effective methods.	Appendix H2

CONB 2021 Compliance Action	Proposed CONB 2022 Compliance Action	Annual Report Reference
Monitoring and Reduction of Gill Parasites (EAHCP §§ 5.2.6 and 6.3.6) Monitor the gill parasite *Centrocestus formosanus* and its intermediate host snail, red-rimmed melania, and establish a reduction program.		
Performed water column cercaria (snail parasite larva) monitoring for *Centrocestus formosanus* as well as the parasitic *Haplorchis pumilio* in August at four established transects in the Comal River system.	Continue monitoring of free-swimming cercaria in the water column at established transects.	Appendix H3
Prohibition of Hazardous Materials Transport across the Comal River and its Tributaries (EAHCP § 5.2.7) Prohibit the transport of HAZMAT on routes crossing the Comal River and its tributaries.		
HAZMAT transport prohibitions (CONB Code § 126-185) remained in effect and notification signs remained in place and in good condition.	Maintain HAZMAT signage installed in 2016 and monitor for the presence of trucks carrying hazardous cargo on routes crossing the Comal River and its tributaries.	N/A
Native Riparian Habitat Restoration (Riffle Beetle) (EAHCP § 5.2.8) Implement a restoration program by removing non-native vegetation and planting native vegetation to improve the riparian zone along Spring Run #3 and the western shoreline of Landa Lake and to minimize sedimentation impacts.		
Monitored and maintained the riparian zone and sediment capture structures along Spring Run #3 and the Western Shoreline. Planted 28 native plants and trees within the riparian zone to increase density of native vegetation.	Remove non-native vegetation and plant native vegetation along Spring Run #2 to increase the riparian buffer zone. Increase the density of native riparian vegetation along Spring Run #1.	Appendix H4
Reduction of Non-Native Species Introduction and Live Bait Prohibition (EAHCP § 5.2.9) Prohibit the introduction of domestic and non-native aquatic organisms, targeting bait species and aquarium trade species, and spread knowledge on the adverse impacts of aquarium dumping and use of non-native bait species.		
Educated residents and visitors about the **negative impacts** of aquarium dumping and use of specific live bait species. Continued to enforce CONB Code § 142-6.	Continue to educate residents and visitors about the negative impacts of aquarium dumping and use of specific live bait species. Continue to enforce CONB Code § 142-6.	N/A
Litter Collection and Floating Vegetation Management (EAHCP § 5.2.10) Remove litter and manage floating vegetation to enhance habitat for the Covered Species. This includes dislodging vegetation mats that form on the water surface, particularly during **low flows**, to allow continued movement downstream, and removal of litter from the littoral zone and stream bottom.		
Continued to dislodge floating vegetation mats in Landa Lake to minimize (1) oxygen consumption associated with decaying vegetation, (2) shading of restored aquatic vegetation, and (3) entrainment of floating vegetative material around the Landa Lake/ Old Channel flow-control gates. Removed litter along the banks of the Old Channel of the Comal River twice each month from May to September. Collected 68 7-gallon mesh bags of litter.	Continue efforts to remove litter and dislodge floating vegetation mats to prevent negative impacts on flow control structures, aquatic Restoration Reaches, and Covered Species habitat.	N/A

CONB 2021 Compliance Action	Proposed CONB 2022 Compliance Action	Annual Report Reference
Management of Golf Course Diversions and Operations (EAHCP § 5.2.11) Develop and implement a Golf Course Management Plan that will include an Integrated Pest Management Plan designed to target techniques to protect water quality and minimize potential negative effects on the Covered Species. EAHCP § 2.3.4 also defines Covered Activities for spring-fed pool diversions and operation.		
Continued to implement existing Integrated Pest Management Plan and maintained vegetative buffers between the golf course and Landa Lake and the Old Channel of the Comal River to protect water quality. Continued withdrawals from the Old Channel for golf course irrigation and filling of the spring-fed pool per TCEQ permit #18-3826. Continued to maintain the spring-fed pool according to the 2003 Comal Ecosystem Management Plan.	Continue to update the Integrated Pest Management Plan as needed and maintain a vegetative buffer between the golf course and Landa Lake and the Old Channel of the Comal River. Continue withdrawals from the Old Channel for golf course irrigation and filling of the spring-fed pool per TCEQ permit #18-3826, and continue to maintain the spring-fed pool according to the 2003 Comal Ecosystem Management Plan.	N/A
Native Riparian Habitat Restoration (Old Channel Improvements) (EAHCP § 5.7.1) Initiate a riparian restoration program to enhance the riparian zone along the Old Channel, the golf course, and near Clemens Dam.		
Addressed approximately 1,015 linear feet of shoreline including removal of non-native vegetation and the introduction of native vegetation along the banks of Landa Lake. Removed and/or treated 359 non-native trees within the riparian zone along Landa Lake. Also treated all observed non-native tree seedlings, re-emergent elephant ears, and other non-native littoral species throughout the riparian zone along Blieders Creek, Upper Spring Run, Landa Lake, and the Old Channel. Transplanted 723 native plants and distributed approximately 5 lbs of native seed into the riparian restoration areas along Landa Lake.	Continue to remove non-native vegetation along the banks of Landa Lake and the Comal River. Install erosion control berms, plant native vegetation, and disperse seed in areas where non-native vegetation is removed.	Appendix H5
Management of Household Hazardous Wastes (EAHCP § 5.7.5) Continue to implement a household hazardous waste program and enhance the program to generate additional participation by the public.		
Held three household hazardous waste collection events. Overall, recorded 971 cars/participants and collected 73,637 lbs of hazardous waste. Partnered with New Braunfels Utilities to hold one unused medication collection and disposal event. Also implemented a free, year-round medication disposal program that began in July and allows for on-going drop-off opportunities at eight locations within New Braunfels.	Hold three household hazardous waste collection events and partner with New Braunfels Utilities on the Operation MedSafe drug recovery and collection program.	N/A

CONB 2021 Compliance Action	Proposed CONB 2022 Compliance Action	Annual Report Reference
Impervious Cover and Water Quality Protection (EAHCP § 5.7.6) Expand criteria related to desired impervious cover, provide incentives to reduce existing impervious cover on public and private property in New Braunfels, and implement stormwater runoff best management practices around Landa Lake and the Spring Runs.		
Completed construction of bioretention basins at the Headwaters at the Comal and at the intersection of Elizabeth Avenue/ Landa Park Drive, adjacent to the **Comal Springs system.** The basins are intended to capture and treat stormwater runoff.	Prepare for construction of a bioretention basin at the Landa Park Aquatics Center parking lot, which is planned to occur in early 2023.	Appendix H6

Abbreviations

COI = Certificate of Inclusion; CONB = City of New Braunfels; HAZMAT = hazardous materials; lbs = pounds; LTBG = Long-Term Biological Goal; m^2 = square meters; N/A = not applicable; TCEQ = Texas Commission on Environmental Quality

Bioretention Basin at the intersection of Elizabeth Avenue and Landa Park Drive in Landa Park. In 2021, CONB completed construction of this bioretention basin adjacent to the Mill Race of the Comal River in Landa Park that will capture and treat stormwater runoff.

2.3 City of San Marcos

TABLE 2-6
City of San Marcos 2021 EAHCP Implementation and Proposed 2022 Activities by Conservation Measure

COSM 2021 Compliance Action	Proposed COSM 2022 Compliance Action	Annual Report Reference
TWR Enhancement and Restoration (EAHCP §§ 5.3.1 and 6.3.5) Identify areas of optimal habitat for TWR and target those areas for removal of non-native submerged aquatic vegetation species, conduct propagation and planting guided by the TWR LTBGs defined in EAHCP Table 4-10, and perform continual monitoring of new and existing stands.		
Maintained existing stands of TWR by removing non-native vegetation in and around those stands. No planting occurred from January to May because of low flows. Planted a total of 579 TWR individuals only in Spring Lake.	Continue planting in Spring Lake; focus monitoring and maintenance efforts in reaches where planting goals have been achieved.	Appendix I1
Management of Recreation in Key Areas (EAHCP § 5.3.2) Continue to implement recreation mitigation measures approved by COSM Resolution 2011-21, which include, but are not limited to, implementing buffer zones around designated recreation areas, developing and implementing a robust river education program, addressing the accumulation of silt in the river through watershed controls, reducing recreational impacts that harm the river (such as litter), and issuing COIs to river outfitters to extend protections of the ITP to those entities.		
Conservation Crew activities resumed in 2021; held 778 conversations with river users, removed 3,894 ft^3 of litter from the river, and removed 2,548 ft^3 from river parks during the recreation season. Public education activities included public service announcements, monitoring EAHCP projects, and conversations with river users. The Conservation Crew also helped dislodge floating plant mats off stands of TWR.	Continue implementation of recreational management goals and continue to educate water recreationists on sustainable river use that protects the Covered Species and their habitats. Seasonal workers will also continuously perform litter removal and EAHCP project maintenance while walking/kayaking between COSM public parks.	Appendix I2
Management of Aquatic Vegetation and Litter below Sewell Park (EAHCP § 5.3.3) Dislodge and remove floating vegetation mats and remove inorganic litter regularly.		
Removed approximately 297 ft^3 of litter and large debris and dislodged 28,047.48 m^2 of floating vegetation mats in and around stands of TWR from Spring Lake Dam to Bicentennial Park and 7,113 m^2 from Bicentennial Park to IH-35.	Continue to implement existing removal efforts.	Appendices I1, I3, and I9
Prohibition of Hazardous Materials Transport across the San Marcos River and Its Tributaries (EAHCP § 5.3.4) Designate routes for the transportation of HAZMAT that will minimize the potential for impacts on the San Marcos River and its tributaries.		
HAZMAT routes have been mapped. Began process of designating the Wonder World Drive route as a HAZMAT route, including identifying subdivisions within a 25-mile radius to be notified.	Mapped HAZMAT routes are not yet approved by the Texas Department of Transportation. Submit the Wonder World Drive route for approval to the Texas Department of Transportation as a HAZMAT route.	N/A

COSM 2021 Compliance Action	Proposed COSM 2022 Compliance Action	Annual Report Reference
Reduction of Non-Native Species Introduction (EAHCP § 5.3.5) Establish an education campaign targeted at reducing the introduction of non-native species and provide people with disposal sites for unwanted aquatic animals and plants to deter aquarium dumps into waterbodies.		
Used social media (including Facebook posts) and held conversations with visitors to Discovery Center to educate public about proper disposal of unwanted aquatic pets. The donation drop-off at the Discovery Center received 41 unwanted fish—50 percent were adopted.	Continue to implement existing efforts.	N/A
Sediment Management below Sewell Park (EAHCP § 5.3.6) Remove sediment from the San Marcos River between City Park and IH-35—efforts specifically targeted for TWR habitat. Funding for this measure has been transferred to the Impervious Cover and Water Quality Protection Conservation Measure (EAHCP § 5.7.6) per the Nonroutine Adaptive Management Process Proposal approved in fall 2017.		
No sediment removal activities occurred in 2021.	No activities are proposed.	N/A
Designation of Permanent Access Points and Bank Stabilization (EAHCP § 5.3.7) Stabilize banks and maintain a healthy riparian buffer in City Park, at the Hopkins Street underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and at the Cheatham Street underpass using stone terraces and native vegetation along the riparian zone to include permanent access points to the river where possible.		
Monitored eight access points. Dog Beach (across from City Park) access point repairs were funded and begun.	Complete Dog Beach access point repairs. Monitor access points annually through measuring undermining and gaps between rocks.	Appendix I2
Control of Non-Native Plant Species (EAHCP § 5.3.8) Develop and implement a non-native plant replacement program from Spring Lake downstream to the city limit boundary to remove and replace aquatic, littoral, and riparian non-native plant species.		
Removed approximately 5,110.31 m^2 of non-native aquatic vegetation. Suspended aquatic planting and large-scale non-native removal from January to May because of low flows. Maintained aquatic, littoral, and riparian areas planted in the past. Planted approximately 9,153 individuals of native aquatic plant species from Sewell Park to Bicentennial Park. Performed initial and repeated treatments of littoral zone from Bert Brown Road to IH-35.	Continue to remove non-native vegetation and plant native aquatic and littoral vegetation. Aquatic plant restoration efforts will seek to achieve the long-term goals of native aquatic plant species as defined by the fountain darter LTBGs in EAHCP Tables 4-21 and 4-21-1.	Appendices I1 and I4
Control of Harmful Non-Native and Predator Species (EAHCP § 5.3.9) Implement a non-native species control program that targets the suckermouth armored catfish, tilapia, red-rimmed melania, and the giant ramshorn snail and conduct annual monitoring and maintenance to ensure continued control of invasive species.		
Removed 1,414 lbs of non-native fish and animal species. Volunteers assisted with removal efforts by participating in two polespear tournaments.	Continue routine removal of tilapia, suckermouth armored catfish, and snails with monthly monitoring and bi-annual tournaments.	Appendix I5

COSM 2021 Compliance Action	Proposed COSM 2022 Compliance Action	Annual Report Reference
Native Riparian Habitat Restoration (EAHCP § 5.7.1) Restore riparian habitats with native species on COSM and TXST property and establish a program for private landowners to implement riparian restoration with the opportunity for reimbursement.		
Removed and treated invasive re-growth from Spring Lake Dam to Capes Dam and portions of San Marcos River tributaries.	Continue maintenance of riparian areas from Clear Springs to Stokes Park. Continue to focus on restoration of public areas with volunteer groups.	Appendix I6
Septic System Registration and Permitting Program (EAHCP § 5.7.3) Establish a registration, evaluation, and permitting program for aerobic and anaerobic septic systems.		
A septic system registration and permitting program has been established. As of October 31, 2021, 623 septic systems were registered within the COSM's jurisdiction according to the San Marcos Environmental Health Department. Three new regulated septic systems were added.	Continue to implement the septic system registration and permitting program (COSM Code § 86.152).	N/A
Minimizing Impacts of Contaminated Runoff (EAHCP § 5.7.4) Excavate and stabilize two areas for the construction of two water quality bioretention ponds in the vicinity of the San Marcos River and regularly monitor them.		
This Conservation Measure was fulfilled in 2020.	This Conservation Measure is fulfilled.	N/A
Management of Household Hazardous Waste (EAHCP § 5.7.5) Continue to expand the existing household hazardous waste program and offer collection locations available to the public.		
Accommodated, on average, 24 participants per month at the drop-off center and 236 customers per month at the reuse center. The program helped prevent improper disposal of 171,500 lbs of household hazardous waste.	Increase participation rates and continue to enhance awareness of the impact of hazardous household waste on the environment, particularly on Covered Species habitat.	Appendix I7
Impervious Cover and Water Quality Protection (EAHCP § 5.7.6) Establish a program to protect water quality and reduce the impact of impervious cover based on recommendations from the *San Marcos Water Quality Protection Plan* (John Gleason LLC 2017).		
Began construction on Phase I of the Sessom Creek restoration project.	Continue construction on Phase I of the Sessom Creek restoration project.	N/A

Abbreviations

COI = Certificate of Inclusion; COSM = City of San Marcos; ft^3 = cubic foot; HAZMAT = hazardous materials; ITP = Incidental Take Permit; lbs = pounds; LTBG = Long-Term Biological Goal; m = meter; m^2 = square meters; N/A = not applicable; TWR = Texas wild-rice; TXST = Texas State University

2.4 Texas State University

TABLE 2-7

Texas State University 2021 EAHCP Implementation and Proposed 2022 Activities by Conservation Measure

TXST 2021 Compliance Action	Proposed TXST 2022 Compliance Action	Annual Report Reference
TWR Enhancement and Restoration (EAHCP §§ 5.4.1 and 6.3.5) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.		
See related discussion in **TABLE 2-6** and Appendix I1 of this Annual Report.	See related discussion in **TABLE 2-6** and Appendix I1 of this Annual Report.	Appendix I1
Management of Recreation in Key Areas (EAHCP § 5.4.2) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.		
See related discussion in **TABLE 2-6** and Appendix I2 of this Annual Report.	See related discussion in **TABLE 2-6** and Appendix I2 of this Annual Report.	Appendix I2
Management of Vegetation (EAHCP § 5.4.3) Hand-cutting and a harvester boat will be used to manage aquatic vegetation in Spring Lake.		
Aquatic vegetation maintenance activities by volunteers accounted for 1,262 dives in Spring Lake. Harvested a total of 1,104 yd^3 of aquatic vegetation by boat in Spring Lake.	Continue programs outlined in the EAHCP and in the 2022 TXST Work Plan.	Appendix I8
Sediment Management in Spring Lake and Sewell Park (EAHCP § 5.4.4) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM. Funding for this Conservation Measure has been transferred to the Impervious Cover and Water Quality Protection Conservation Measure (EAHCP § 5.7.6) per the Nonroutine Adaptive Management Process Proposal approved in fall 2017.		
No sediment removal occurred in 2021.	No activities are proposed.	N/A
Diversion of Surface Water (EAHCP § 5.4.5) Surface water diversions will be reduced when flow is less than 80 cfs.		
Permitted pumping was not reduced because total San Marcos River flows were greater than 80 cfs; 26 ac-ft/year (Certificate 18-3865) were diverted.	Continue to reduce or cease the diversion of surface water as required by flow conditions.	N/A
Native Riparian Habitat Restoration (EAHCP § 5.7.1) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.		
See related discussion in **TABLE 2-6** and Appendix I6 of this Annual Report.	See related discussion in **TABLE 2-6** and Appendix I6 of this Annual Report. Volunteers will be used if additional planting is needed in 2022.	Appendix I6

TXST 2021 Compliance Action	Proposed TXST 2022 Compliance Action	Annual Report Reference
Sessom Creek Sand Bar Removal (EAHCP § 5.4.6) TXST and the COSM will conduct a study of sand and gravel bar removal options to determine which best minimizes impacts on Covered Species. TXST will submit the study for review though the Adaptive Management Process and implement the actions coming out of that process.		
This Conservation Measure was fulfilled in 2016.	This Conservation Measure is fulfilled.	N/A
Diving Classes in Spring Lake (EAHCP § 5.4.7) Divers must show an understanding of the Covered Species and critical habitats in Spring Lake and the laws and regulations relevant to them. Divers must exhibit good buoyancy control, avoid contact with Covered Species and critical habitat, and maintain distance from the lake bottom. Training will be conducted for check-out dives and Self-Contained Underwater Breathing Apparatus (SCUBA) classes.		
A total of 3,686 dives occurred in Spring Lake. All divers completed the Dive Authorization Course and were monitored for safe diving behavior.	Continue the Dive Authorization Course consistent with the protocols identified in the EAHCP and Spring Lake Management Plan.	Appendix I8
Research Programs in Spring Lake (EAHCP § 5.4.8) Research in Spring Lake needs prior review and approval by the Meadows Center for Water and the Environment to assess impacts on Covered Species, and researchers must be educated to limit take in situations where take cannot be avoided; individual permits from the USFWS may be necessary.		
Research projects occurred in Spring Lake, including a diversity of biota studies, consistent with the protocols identified in the EAHCP and Spring Lake Management Plan and as approved by the Spring Lake Environmental Review Committee.	Continue to evaluate research programs for consistency with the protocols identified in the EAHCP and Spring Lake Management Plan.	Appendix I8
Management of Golf Course and Grounds (EAHCP § 5.4.9) Develop and implement a Grounds Management Plan, including an Integrated Pest Management Plan, that considers the appropriate application of environmentally sensitive chemicals to reduce negative impacts on neighboring ecosystems.		
Managed recreation fields consistent with the Grounds Management Plan and Integrated Pest Management Plan.	Undertake management activities consistent with the Grounds Management Plan and Integrated Pest Management Plan.	N/A
Boating in Spring Lake and Sewell Park (EAHCP § 5.4.10) Restrict boating at Spring Lake to areas treated with the harvester; operators will enter and exit boats at designated access points and all boats will follow USFWS standards for proper cleaning.		
Spring Lake Programs included 3,705 glass-bottom boat tours and 286 canoe/kayak tours. All boating activities adhered to EAHCP protocol.	Continue implementing existing programs.	Appendix I8
Reduction of Non-Native Species Introduction (EAHCP § 5.4.11) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.		
See related discussion in **TABLE 2-6** of this Annual Report.	See related discussion in **TABLE 2-6** of this Annual Report.	N/A

TXST 2021 Compliance Action	Proposed TXST 2022 Compliance Action	Annual Report Reference
Control of Non-Native Plant Species (EAHCP § 5.4.12) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.		
See related discussion in **TABLE 2-6** of this Annual Report.	See related discussion in **TABLE 2-6** of this Annual Report.	Appendices I1 and I4
Control of Harmful Non-Native and Predator Species (EAHCP § 5.4.13) TXST extended its EAHCP obligations for this Conservation Measure in partnership with the COSM.		
See related discussion in **TABLE 2-6** of this Annual Report.	See related discussion in **TABLE 2-6** of this Annual Report.	Appendix I5

Abbreviations

ac-ft = acre-foot; cfs = cubic feet per second; N/A = not applicable; TWR = Texas wild-rice; TXST = Texas State University; USFWS = U.S. Fish & Wildlife Service; yd^3 = cubic yard

2.5 San Antonio Water System

TABLE 2-8

San Antonio Water System 2021 EAHCP Implementation and Proposed 2022 Activities by Conservation Measure

SAWS 2021 Compliance Action	Proposed SAWS 2022 Compliance Action	Annual Report Reference
SAWS ASR Springflow Protection (EAHCP § 5.5.1) SAWS will inject and store EAHCP groundwater in its ASR and, under certain drought conditions, forbear withdrawals from the Edwards Aquifer under its EAA-issued permits. This measure allows SAWS the ability to use this stored water to offset the volume of water forborne during a drought of record as defined for the SAWS ASR Program. The amount of forbearance during a 10-year repeat of the drought of record is no more than 126,000 ac-ft or 46,000 ac-ft annually as defined in the Interlocal Contract between EAA and SAWS.		
Use of ASR was not triggered, and, accordingly, there was no forbearance under the (1) EAA leases, (2) EAA forbearance agreements, or (3) SAWS forbearance of Edwards Aquifer pumping in 2021. In 2021, SAWS also did not make any "offset" recovery from the ASR to "offset" any forborne Edwards Aquifer pumping.	Enforce if triggered; withdrawals under SAWS Edwards Aquifer permits will remain un-pumped when the J-17 Bexar Index Well is less than 630 ft msl and the 10-year rolling recharge average of the Edwards Aquifer is at or below 500,000 ac-ft.	N/A
Phase II Expanded Use of the SAWS ASR and Water Resources Integration Program Pipeline (EAHCP § 5.5.2) The presumptive action for **Phase II of the EAHCP** involves the use of SAWS ASR with a planned construction of the Water Resources Integration Program Pipeline.		
The Implementing Committee voted to approve the EAHCP Comprehensive Phase II Work Plan and a Nonroutine Adaptive Management Process Proposal in May 2019 that did not include the use of SAWS Water Resources Integration Program as the presumptive Phase II Conservation Measure because it was not needed.	N/A	N/A

Abbreviations

ac-ft = acre-foot; ASR = Aquifer Storage & Recovery; ft msl = feet mean sea level; N/A = not applicable; SAWS = San Antonio Water System

2.6 Texas Parks & Wildlife Department

TABLE 2-9

Texas Parks & Wildlife Department 2021 EAHCP Implementation and Proposed 2022 Activities by Conservation Measure

TXST 2021 Compliance Action	Proposed TXST 2022 Compliance Action	Annual Report Reference
TPWD serves as the state agency with primary responsibility for conserving, protecting, and enhancing the state's fish and wildlife resources. In this role, TPWD has the authority to establish an SSA for "the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value" (Texas Parks & Wildlife Code § 81.501). Although TPWD is not a Permittee, it implements the following Conservation Measures as a signatory to the Implementing Agreement.		
San Marcos River State Scientific Area (EAHCP § 5.6.1)		
To minimize the impacts of recreation, TPWD has designated a 2-mile segment of the public waters of the San Marcos River as an SSA in the **San Marcos Springs** ecosystem (31 Texas Administrative Code § 57.910) to provide expanded protections to TWR. The COSM fenced off stands of TWR when flows decreased below 120 cfs.	Fencing will be added if flow conditions are triggered.	N/A
Comal River State Scientific Area (EAHCP § 5.6.1).		
To protect existing and restored fountain darter habitat, obligations under EAHCP §§ 2.1, 2.7, 5.2.2.2, and 5.6.1 indicate that TPWD will also pursue an SSA within the Comal River system. No new activities were performed in 2021 in this regard. An SSA may be established after 2023, following completion of habitat restoration for the fountain darter, as described in the Comprehensive Phase II Work Plan and EAHCP §§ 5.2.2.2 and 5.6.1.	No new activities are expected.	N/A

Abbreviations

cfs = cubic feet per second; COSM = City of San Marcos; N/A = not applicable; SSA = state scientific area; TPWD = Texas Parks & Wildlife Department; TWR = Texas wild-rice

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3 | Biological Goals and Key Management Objectives

CHAPTER OVERVIEW

- Biological Goals and Objectives, key management objectives, and flow objectives (1) guide the Conservation Measures implemented under the EAHCP; (2) apply to Covered Species and their habitat in the Comal Springs system and San Marcos Springs system; and (3) are established in the EAHCP and subject to changes through adaptive management.
- Monitoring conducted in 2021 indicates achievement or progress toward achieving Biological Goals and Objectives, key management objectives, and flow objectives.

EAHCP § 4.1 details Covered Species Long-Term Biological Goals (LTBGs), key management objectives, and flow objectives, which are defined for individual springs systems (the Comal River and Springs and the San Marcos River and Springs) because of unique circumstances that define their occupied habitat. LTBGs are the rationale behind the Conservation Measures—conversely, Conservation Measures are the means for achieving the LTBGs, key management objectives, and flow objectives. Flow objectives were designed to ensure adequate water is available for the Covered Species over time and during a repeat of the drought of record–like conditions.

The Covered Species LTBGs, key management objectives, and flow objectives are subject to change under limited circumstances through adaptive management set out in the Funding and Management Agreement (FMA). The LTBGs, key management objectives, and flow objectives described below reflect the clarifications of, and/or amendments made to, the EAHCP through 2021.

3.1 Fountain Darter

LTBGs for fountain darter in defined reaches of the Comal Springs and River (**TABLE 3-1**) and San Marcos River (**TABLE 3-2)** depend upon areal coverage of aquatic vegetation types and darter densities by vegetation type, which are used to estimate fountain darter numbers. The LTBGs seek to maintain fountain darter densities greater than or equal to an established baseline—i.e., the median density of fountain darters observed per aquatic vegetation type per spring system from 2002 to 2012 during the EAA Variable Flow Study monitoring and prior to issuance of the ITP.

Fountain darter
Etheostoma fonticola
ENDANGERED

Two key management objectives are used to achieve the fountain darter LTBGs: one associated with restoration of native aquatic vegetation and another

associated with surface water quality. Work is being performed in each system to achieve the LTBGs through active non-native aquatic vegetation removal and subsequent native aquatic vegetation restoration and maintenance. Restoration activities have also been extended beyond the reaches defined for LTBGs to account for proportional expansion of submerged aquatic vegetation. These areas were established as Restoration Reaches through the Adaptive Management Process (AMP) in 2016 (**TABLE 3-1** for the Comal Springs and River and **TABLE 3-2** for the San Marcos River).

FIGURES 3-1 and **3-2** illustrate the area of aquatic vegetation mapped twice per year for LTBG Reaches in the Comal and San Marcos rivers, respectively. Restoration reaches are mapped every five years. The variation in aquatic vegetation year to year illustrates the dynamic nature of these aquatic systems. As shown in these figures, substantial progress is being made to achieve areal extent requirements for both native and non-native aquatic vegetation.

FIGURE 3-1 shows the following in the Comal Springs system:

- Submerged aquatic vegetation supporting fountain darter populations in the Old Channel and Landa Lake have continued to progress toward the LTBG, including removing *Hygrophila* from these reaches.
- As the result of planting restoration efforts, coverage of *Ludwigia* and *Cabomba* increased from spring to fall 2021 and reached their highest coverage levels to date.

FIGURE 3-2 shows the following in the San Marcos Springs system:

- At Spring Lake Dam, non-native species (*Hydrilla* and *Hygrophila*) were removed in 2020 and have not returned. *Hydrilla* was removed at the City Park and I-35 LTBG Reaches. *Hygrophila* was removed at City Park but remains in abundance at I-35.
- All native species combined at the Spring Lake Dam and I-35 LTBG Reaches exceed combined native species LTBG coverage targets. Coverage at City Park declined in 2021 below the LTBG target, but non-native species remain absent.

The second key management objective addresses surface water quality as measured at the EAA Variable Flow Study water quality monitoring stations as well as temperature and dissolved oxygen as measured in representative study reaches. Surface water quality in the Comal Springs and River and San Marcos River is not to exceed a 10 percent daily average deviation from historical long-term average water quality conditions measured at the EAA Variable Flow Study monitoring stations. Instantaneous water temperatures in representative study reaches should be maintained below 25 °C throughout each river. Similarly, instantaneous dissolved oxygen concentrations in representative study reaches should be maintained above 4.0 milligrams per liter.

TABLE 3-1

Goals for Areal Coverage of Habitat within Long-Term Biological Goal and Restoration Reaches of the Comal Springs and River and the Associated Fountain Darter Densities for Each Aquatic Vegetation Type

Study Reach	Reach Type	Bryophytes	*Potamogeton*	*Ludwigia*	*Cabomba*	*Sagittaria*	*Vallisneria*
Fountain Darter Habitat (Aquatic Vegetation) Goal in Meters Squared (m^2)							
Upper Spring Run	LTBG	1,750	0	25	25	850	0
Landa Lake Upper	Restoration	5,500	0	25	250	250	0
Landa Lake	LTBG	3,950	25	900	500	2,250	12,500
Landa Lake Lower[b]	Restoration	500	0	50	125	100	22,50
Old Channel Upper[c]	Restoration	1,250	100	850	200	750	750
Old Channel	LTBG	550	0	425	180	450	0
New Channel	LTBG	150	0	100	2,500	0	0
Fountain Darter Median Density Goal (number/m^2)							
–	–	20	3.3	7	7	1	1
2021 median densities (number/m^2)		20	N/A	6	9	<1	2

[a] Landa Lake Long-Term Biological Goal reach to downstream boundary of Spring Island.

[b] Landa Lake Long-Term Biological Goal reach to weir across from City of New Braunfels Park Office.

[c] Old Channel from Long-Term Biological Goal reach upstream to Landa Lake Dam.

Abbreviations

LTBG = Long-Term Biological Goal reach; m^2 = square meter; N/A = not applicable

TABLE 3-2

Goals for Areal Coverage of Fountain Darter Habitat within Long-Term Biological Goal and Restoration Reaches of the San Marcos River and the Associated Fountain Darter Median Densities for Each Aquatic Vegetation Type

Study Reach	Reach Type	*Ludwigia*	*Cabomba*	*Potamogeton*	*Sagittaria*	*Hydrocotyle*	*Zizania*
Fountain Darter Habitat (Aquatic Vegetation) in Meters Squared (m^2)							
Spring Lake Dam	LTBG	100	50	200	200	50	700
Sewell Park	Restoration	25	25	152	25	10	1,100
Below Sewell to City Park[a]	Restoration	50	50	500	700	20	2,300
City Park	LTBG	150	90	1,450	300	10	1,750
Hopkins Street to Snake Island	Restoration	50	50	475	750	10	950
Cypress Island in Rio Vista Park	Restoration	50	50	150	50	0	350
IH-35	LTBG	50	50	250	150	50	600
IH-35 Expanded[b]	Restoration	50	100	250	450	50	450
Fountain Darter Median Density Goal (number/m^2)							
–		7	7	5	1	4	5
2021 median densities (number/m^2)		2	2	3	1	3	<1

[a] Sewell Park to upstream boundary of City Park Long-Term Biological Goal reach.

[b] Immediately downstream of established IH-35 Long-Term Biological Goal reach to IH-35.

Abbreviations

LTBG = Long-Term Biological Goal reach; m^2 = square meter

FIGURE 3-1

Submerged Aquatic Vegetation Coverage of Selected Plant Species in the Long-Term Biological Goal Reaches of the Comal Springs System, 2013–2021

Species coverage is from Routine Spring/Fall Biological Monitoring mapping events. Long-Term Biological Goals are represented in the stacked bar at the far right of each figure.

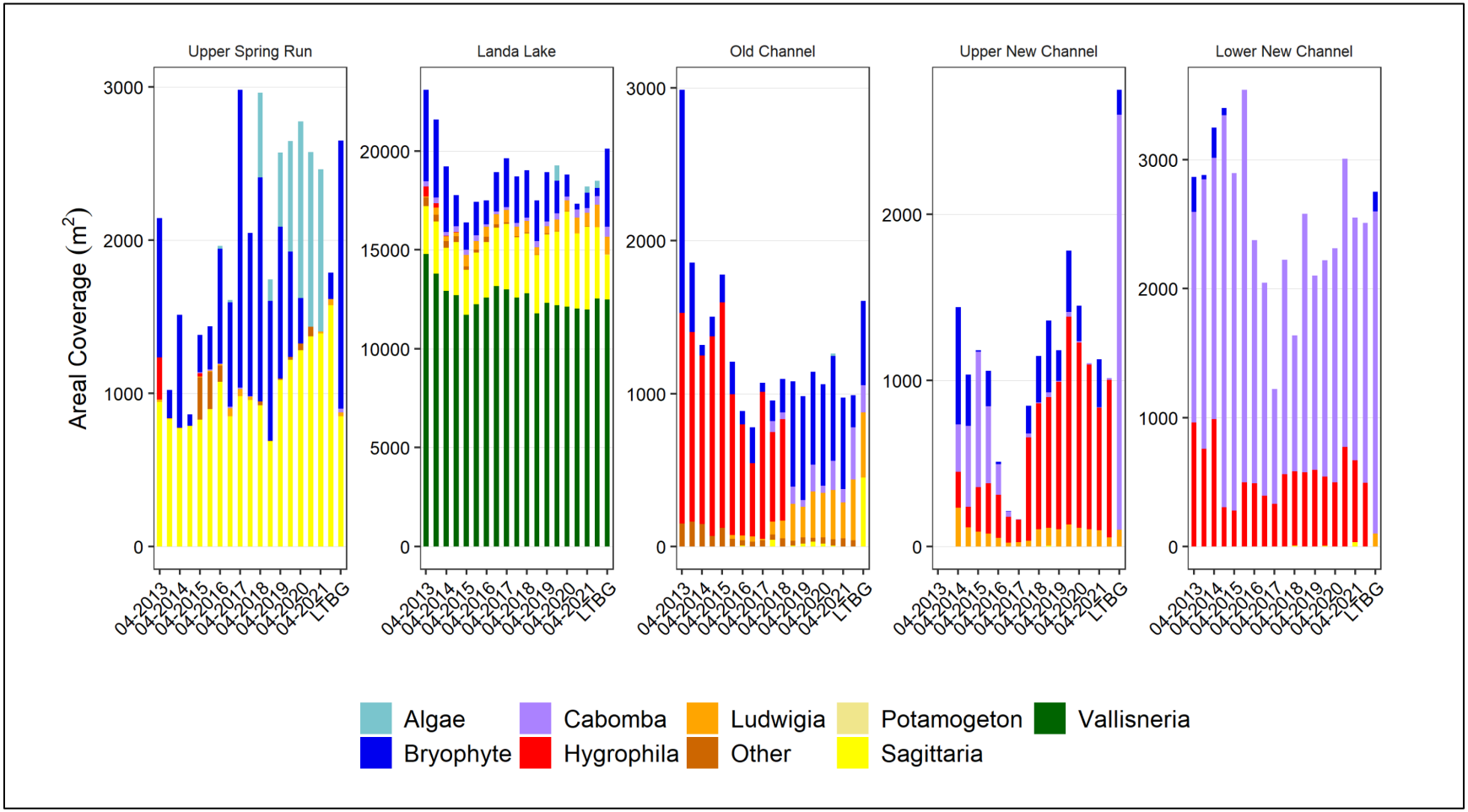
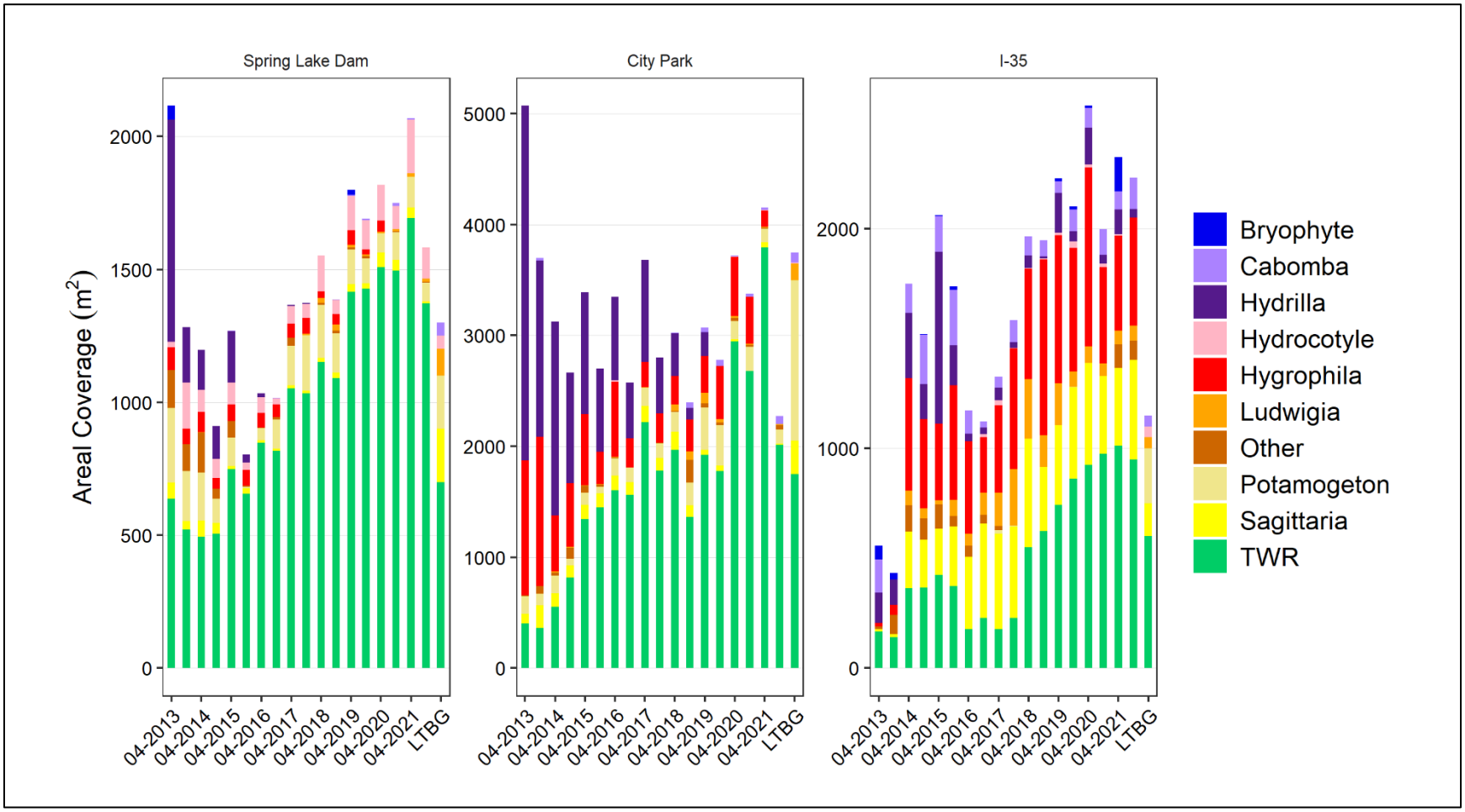


FIGURE 3-2

Submerged Aquatic Vegetation Coverage of Selected Plant Species in the Long-Term Biological Goal Reaches of the San Marcos Springs System, 2013–2021

Species coverage is from Routine Spring/Fall Biological Monitoring mapping events. Long-Term Biological Goals are represented in the stacked bar at the far right of each figure.



A real-time water quality network was established where water quality monitoring could support this second key management objective. Appendix F1 details the 2021 real-time monitoring results. Measured daily average conditions in both systems were within 10 percent of historical average conditions. Water temperatures in the San Marcos River were generally lower than 25 °C at each location, with the most downstream station measuring a maximum daily water temperature at or above 25 °C for 13 days in 2021. The highest maximum daily water temperature measured in 2021 was 25.69 °C on July 29. Measured maximum daily water temperatures reported in the Comal System exceeded 25 °C consistently in the Old Channel between the months of April and October. However, water temperatures in the Old Channel did not reach or exceed 26 °C as observed in 2020. Measured maximum daily water temperatures in the Spring Runs were reported at less than 25 °C throughout the year. Minimum dissolved oxygen concentrations reported in both systems were greater than 4.0 milligrams per liter.

3.2 Comal Springs Riffle Beetle

Comal Springs riffle beetle
Heterelmis comalensis
ENDANGERED

LTBGs for the Comal Springs riffle beetle (CSRB) include habitat- and population-based goals (**TABLE 3-3**) that depend on key management objectives to maintain silt-free habitat in three sample reaches in Landa Lake: Spring Run 3, the Western Shoreline, and Spring Island. The habitat-based LTBG seeks to maintain silt-free habitat conditions via continued springflow, riparian zone protection, and recreation control. The population-based LTBG is maintaining CSRB median densities greater than or equal to those observed from 2006 to 2012 in the EAA Variable Flow Study. **FIGURE 3-3** compares the 2021 CSRB sampling results to the population-based LTBGs at each sample reach.

Key management objectives guide Conservation Measures listed in **TABLE 2-5** to restore riparian habitat and maintain water quality conditions for the CSRB. Active riparian habitat restoration occurs adjacent to spring openings in Spring Run 3 and along the western shoreline of Landa Lake to limit sedimentation following rainfall events. Historically, these locations have been identified as CSRB habitat. Spring openings continue to be monitored for water quality constituents measured in the EAA Variable Flow Study to ensure Edwards Aquifer water quality does not exceed a 10 percent daily average deviation from historical long-term average water quality conditions. Water quality monitoring results are described in **SECTION 3.1** and Appendix F1.

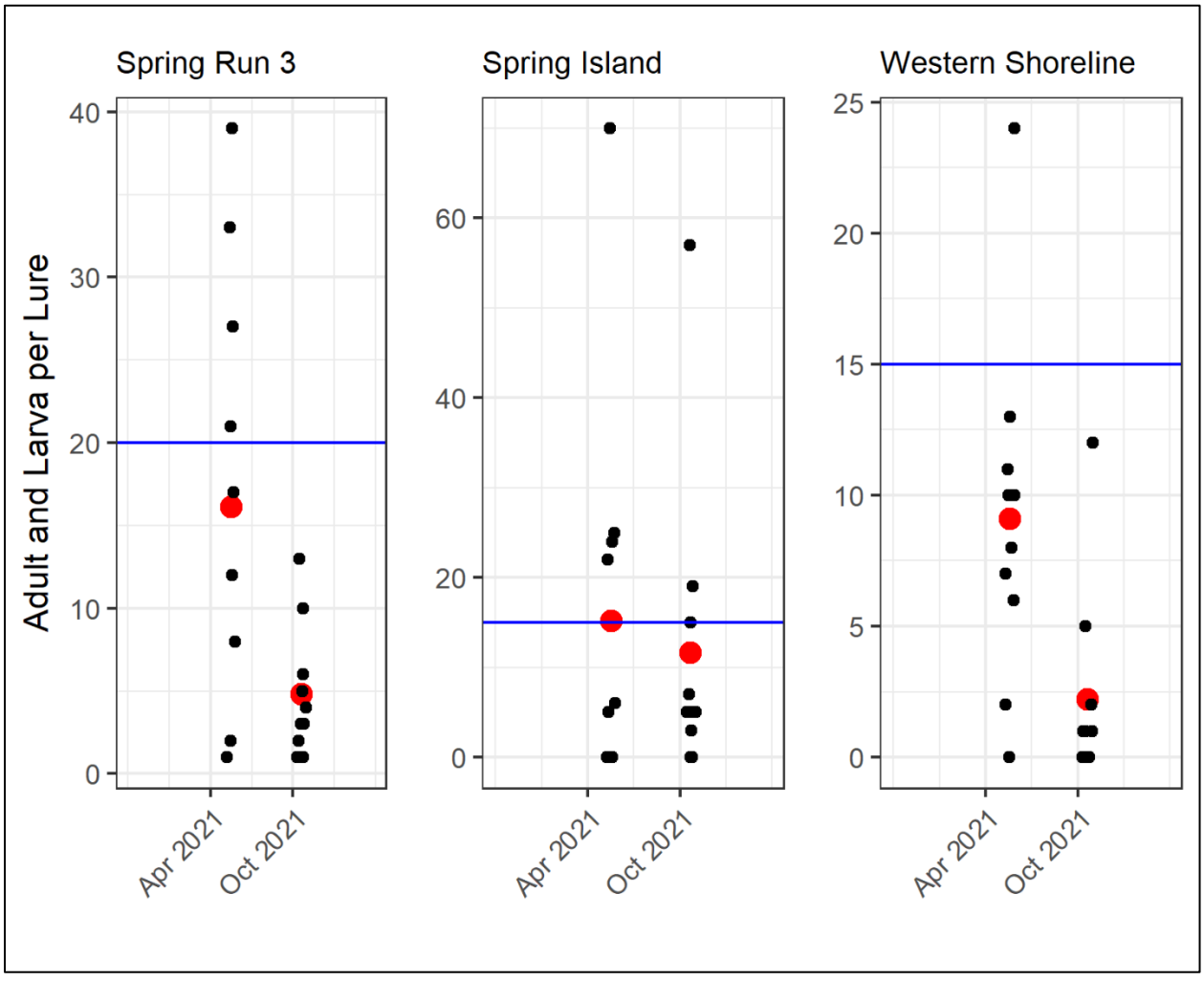
As noted by the National Academies of Science (2018), no quantitative assessments have been performed to establish the effectiveness of conservation measures in reducing sedimentation in the gravel and cobble substrates that are CSRB habitat.

TABLE 3-3
Comal Springs Riffle Beetle Long-Term Biological Goals

	Spring Run 3	Western Shoreline	Spring Island Area
Habitat	Silt-free gravel and cobble substrate ≥ 90% of each study area		
Density (# of individuals/lure)	≥ 20	≥ 15	≥ 15

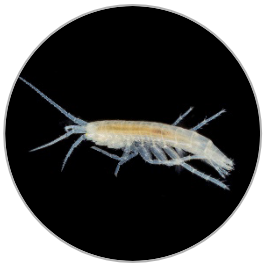
FIGURE 3-3
Comal Springs Riffle Beetle Results from Cotton Lure Biological Monitoring in Landa Lake

Long-Term Biological Goals are displayed as a horizontal line. The seasonal averages of adults and larva per lure sampled in 2021 are displayed as red dots.



3.3 Comal Springs Dryopid Beetle and Peck's Cave Amphipod

Comal Springs dryopid beetle
Stygoparnus comalensis
ENDANGERED



Peck's cave amphipod
Stygobromus pecki
ENDANGERED

LTBGs for Comal Springs dryopid beetle and Peck's cave amphipod depend on maintaining water quality conditions consistent with historical water quality conditions. They are not dependent on key management objectives explicitly identified in the EAHCP. Similar to other LTBGs related to water quality, water quality constituents measured in the EAA Variable Flow Study are not to exceed a 10 percent daily average deviation from historically recorded long-term average conditions. Water quality monitoring results are presented in **SECTION 3.1** and Appendix F1.

3.4 Texas Wild-Rice

Texas wild-rice
Zizania texana
ENDANGERED

TABLE 3-4 identifies the LTBGs for Texas wild-rice (TWR) in segments of the San Marcos River where EAHCP mitigation and management activities occur. The TWR LTBG is accompanied by three key management objectives and Conservation Measures to protect and restore TWR. The first focuses EAHCP TWR restoration and expansion efforts on high-quality habitat areas that are monitored annually, the second defines a minimum coverage of TWR during **low flow conditions**, and the third includes activities to promote awareness of TWR during all flows and designated controls to limit the impacts of recreation during low flows.

High recreational use of TWR-occupied habitat occurs throughout the San Marcos River. Signs are placed throughout the San Marcos River to educate users and promote the protection of TWR. Rope exclosures around TWR stands were created in early 2021 to reduce the impacts of recreation during low flow conditions in accordance with EAHCP § 5.6.1 and in support of TWR LTBGs and key management objectives.

TABLE 3-4
Texas Wild-Rice Long-Term Biological Goals and 2021 Coverage

River Segment	Areal Coverage (m^2)	2021 Areal Coverage (m^2)	Reach Percentage of Total Areal Coverage	2021 Percent of Total Areal Coverage
Spring Lake	1,000–1,500	115	N/A	<1
Spring Lake Dam to Rio Vista Dam	5,810–9,245	12,579	83–66	90
Rio Vista Dam to IH-35	910–1,650	954	13–12	6.8
Downstream of IH-35	280–3,055	317	4–22	2.2
TOTALS	**8,000–15,450**	**13,965**	**100**	**100**

Abbreviations

m^2 = square meter; N/A = not applicable

3.5 San Marcos Salamander

LTBGs for the San Marcos salamander include habitat and population based goals (**TABLE 3-5**) that depend on key management objectives to maintain silt-free habitat conditions through aquatic gardening of Spring Lake. A second key management objective unique to the San Marcos salamander is intended to maintain recreation control through the use of state scientific area exclusions at flows less than 100 cfs in the eastern spillway below Spring Lake Dam. The habitat-based LTBG seeks to maintain silt-free habitat conditions in three sample reaches where the San Marcos salamander is known to live (the hotel area of Spring Lake, in the riverbed area of Spring Lake, and in the eastern spillway below Spring Lake Dam). This LTBG is achieved via maintaining springflow, riparian zone protection, and recreation control. The population-based LTBG is maintaining a median density of San Marcos salamanders greater than or equal to that observed in these three sample reaches during monitoring from 2002 to 2012. **FIGURE 3-4** illustrates 2021 biological monitoring results compared with the LTBGs at each location.

San Marcos salamander
Eurycea nana
THREATENED

FIGURE 3-4 also illustrates sampling and seasonal variability. Random square meter areas are selected within known habitat to spot San Marcos salamanders. Variability is inherent in this approach and as seen in the hotel area the number of individuals collected during one event may be very different from the next sampling event. Over the course of implementation, salamander densities have fluctuated but are generally within range of the LTBGs at all three sampling locations.

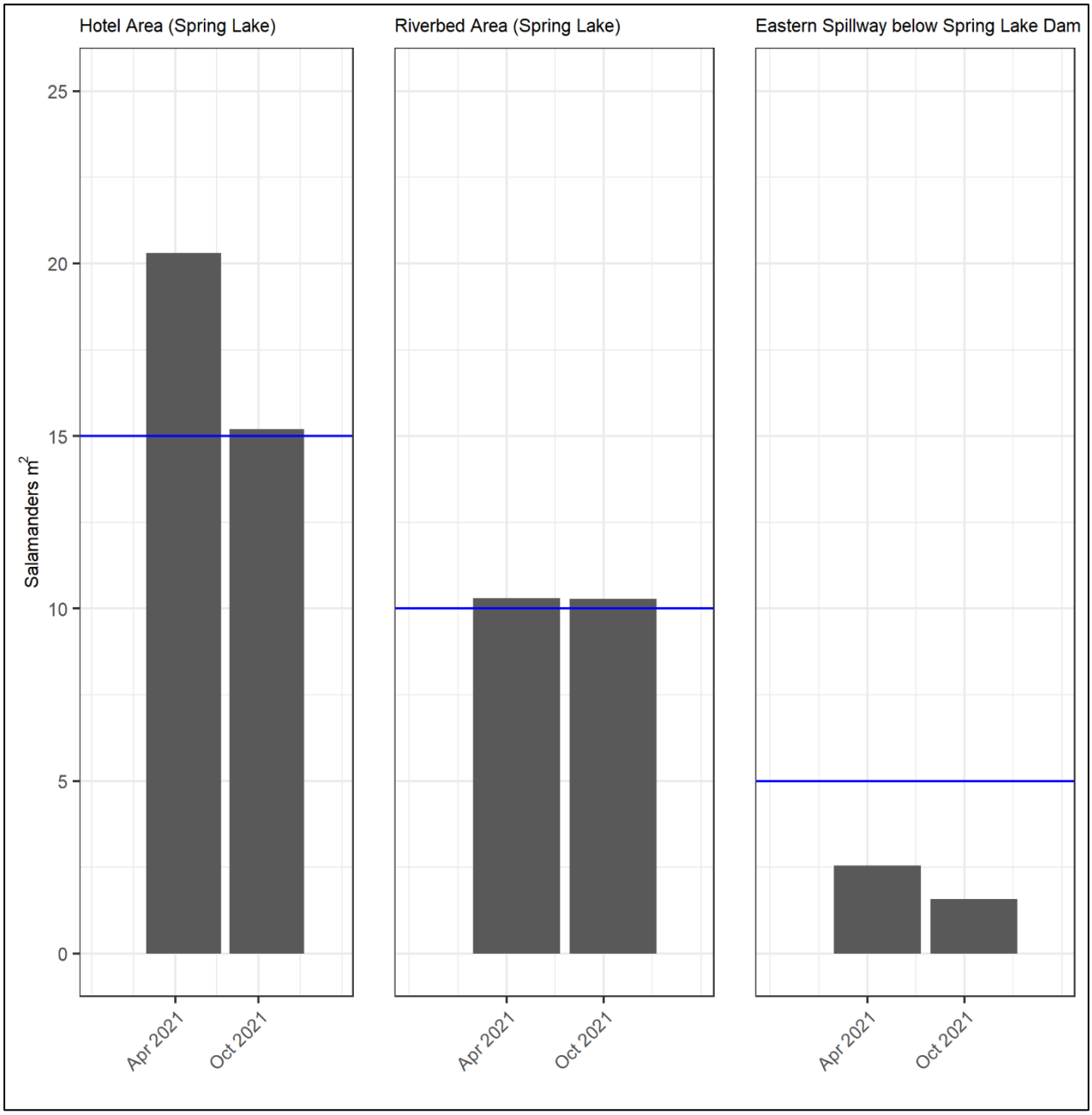
TABLE 3-5
San Marcos Salamander Long-Term Biological Goals

	Hotel Area (Spring Lake)	Riverbed Area (Spring Lake)	Eastern Spillway below Spring Lake Dam
Habitat	Silt-free gravel and cobble substrate ≥ 90% of each study area		
Density (# of individuals/m^2)	≥ 15	≥ 10	≥ 5

Abbreviation
m^2 = square meter

FIGURE 3-4
San Marcos Salamander Results from Biological Monitoring in the San Marcos River

Long-Term Biological Goals are displayed as horizontal lines.



3.6 Texas Blind Salamander

Achieving LTBGs for Texas blind salamanders depends on water quality constituents measured in the EAA Variable Flow Study. Water quality is not to exceed a 10 percent daily average deviation from the historical long-term average water quality conditions within the Edwards Aquifer as measured from the spring openings in Spring Lake. No specific key management objectives are listed in the EAHCP for the Texas blind salamander. Water quality monitoring results are presented in **SECTION 3.1**.

Texas blind salamander
Eurycea (=Typhlomolge) rathbuni
ENDANGERED

3.7 Flow Objectives

Flow protection Conservation Measures—Aquifer Storage & Recovery (ASR), Voluntary Irrigation Suspension Program Option (VISPO), the Regional Water Conservation Program, and critical period management—were developed to achieve flow objectives. **TABLE 3-6** identifies the flow objectives included in the EAHCP. The long-term average and minimum flow objectives have been achieved, as predicted through groundwater modeling that assumed drought of record conditions. The final component of these objectives was achieved in 2019 when the overall VISPO goal was increased to 41,795 ac-ft to ensure minimum springflow objectives were met at Comal Springs. In connection with that adaptive management decision, the Springflow Habitat Protection Work Group was created to pursue a better understanding of the "average daily flows of 80 cfs for 3 months" component of the minimum flow objective (**SECTION 5.3.1.1**).

TABLE 3-6
Flow Objectives for All Covered Species–Comal and San Marcos Springs

Flow Objectives	Comal Springs	San Marcos Springs
Long-term average flow	Daily average of 225 cfs total **Comal discharge**	Daily average of 140 cfs total **San Marcos discharge**
Minimum flow	Daily average of 30 cfs total Comal discharge not to exceed a period of 6 months followed by average daily flows of 80 cfs for 3 months	Daily average of 45 cfs total San Marcos discharge not to exceed a period of 6 months followed by average daily flows of 80 cfs for 3 months

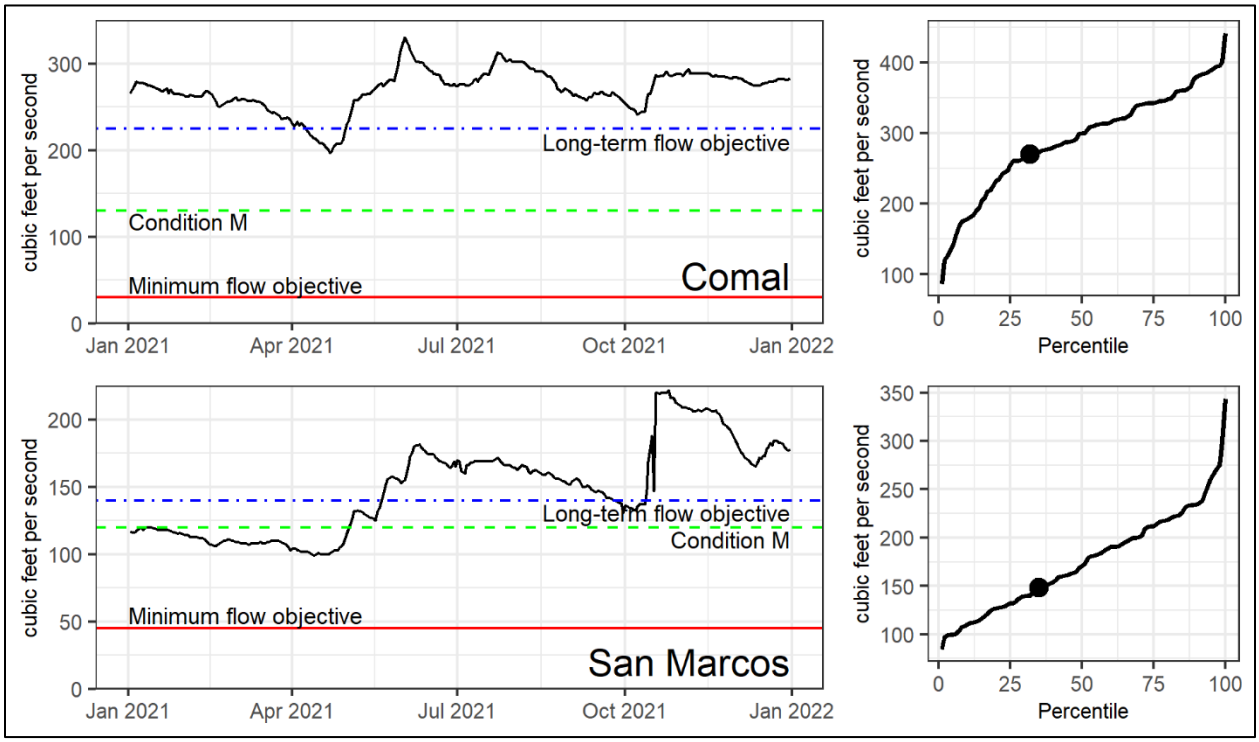
Abbreviation
cfs = cubic feet per second

FIGURE 3-5 illustrates daily average flows (left-plots) and long-term daily average flows (left) for the Comal and San Marcos rivers in 2021. The year began with restricted restoration activities in the San Marcos River because of flows less than the ITP Condition M (120 cfs) while the Comal River remained well above its threshold for ITP Condition M (130 cfs). Above average rainfall in the spring increased springflows which remained less than long-term average but greater than the ITP Condition M or critical period/drought management triggers.

FIGURE 3-5

Springflow Hydrographs for Comal and San Marcos Springs for Calendar Year 2021 (USGS 08168710 and USGS 08170000)

Plots on the left display daily average flow. EAHCP benchmarks are shown in colored straight lines. Plots on the right display percentile curves of average calendar year springflow for the period of record at the gauge. 2021 average springflow is marked with a dot.



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4 | 2021 Annual Take and Net Disturbance Estimates

CHAPTER OVERVIEW

- Covered Activities resulted in take of 773 fountain darters in the Comal Springs system.
- Covered Activities resulted in take of 48,686 fountain darters and 721 San Marcos salamanders in the San Marcos Springs system.
- Fountain darter habitat expanded in 2020 when public access was closed to the San Marcos River due to COVID-19 restrictions. However, in 2021 public access was restored, leading to habitat loss; this accounts for the substantial increase in take of fountain darters in 2021.
- Minimization and mitigation activities resulted in a net disturbance of <0.5 percent of fountain darter occupied habitat in the Comal Springs system. Minimization and mitigation activities resulted in a net disturbance of 2.6 percent and <0.5 percent of fountain darter habitat and San Marcos salamander habitat, respectively, in the San Marcos Springs system. Minimization and mitigation activities conducted in 2021 were in compliance with Condition M of the Incidental Take Permit.

Condition H of the ITP authorizes incidental take and explicitly defines the amount of incidental take authorized over the permit term. Condition M of the ITP limits occupied habitat disturbance, specifying that over any given year, no more than 10 percent of the occupied habitat of a Covered Species can be affected by minimization and mitigation activities intended to contribute to species recovery.

Both incidental take and net disturbance are evaluated on an annual basis and reported to the USFWS (**TABLE 4-1**). To calculate the total amount of take for 2021, incidental take associated with implementation of non-mitigation/restoration Covered Activities was characterized and quantified to the degree practical and added to the incidental take calculated from disturbed areas. The detailed description of methodologies and species-specific results of the 2021 incidental take and net disturbance assessments are included in Appendix J.

Annual incidental take has been fairly consistent over the life of the ITP. Take rarely occurs for species other than fountain darter in both systems. The EAHCP measures take from changes in occupied habitat in the San Marcos Springs or Comal Springs systems. Occupied habitat for fountain darters is an extensive area where Conservation Measures related to submerged aquatic vegetation are being implemented for fountain darter's benefit. The fountain darter's occupied habitat is also the location of seasonal recreation in both the San Marcos Springs and Comal Springs systems. COVID-19 restrictions in 2020 closed public access and recreation to occupied fountain darter habitat in both of these systems. The lack of recreational access in the San Marcos Springs system, which experiences heavy recreational

use from wading in the San Marcos River, resulted in a pronounced increase in fountain darter habitat. Recreation access was restored in 2021, and the return of wading in the river resulted in a pronounced decrease in occupied fountain darter habitat (roughly back to pre-2020 levels).

This decrease in occupied habitat is reflected in the increase in fountain darter take compared to previous years. From 2014 through 2020, San Marcos fountain darter take each year was approximately 11,000 individuals. As noted in **TABLE 4-1**, San Marcos fountain darter take in 2021—as measured by the reduction in habitat—was 48,686 individuals. **TABLE 4-1** also shows total take available for implementation of the EAHCP over the remaining permit term.

TABLE 4-1

Summary of Impacted Habitat, Net Disturbance, and Incidental Take for EAHCP Covered Species Compared against Maximum Permit Amounts

Covered Species per System	EAHCP Mitigation/ Restoration		EAHCP Measures/ Drought	Combined Impacted Habitat 2021 Total (m^2)	Incidental Take		2021 Incidental Take Total	Permitted Maximum Take	Accumulated Take to Date	Remaining Permitted Take
	Impacted Habitat (m^2)	Net Disturbance % of Total Occupied Habitat	Impacted Habitat (m^2)		EAHCP Mitigation/ Restoration	EAHCP Measures/ Drought				
Comal Springs System										
Fountain darter	473	0.46%	42	515	710	63	773	797,000	66,587	730,413
Comal Springs riffle beetle	0	0%	0	0	0	0	0	11,179	2,292	8,887
Comal Springs dryopid beetle	0	0%	0	0	0	0	0	1,543	16	1,527
Peck's Cave amphipod	0	0%	0	0	0	0	0	18,224	167	18,057
San Marcos Springs System										
Fountain darter	2,490	2.6%	12,843.3	15,333.3	3,735.0	44,951.5	48,686	549,129	147,735	401,394
San Marcos salamander	4.3	0.17%	236	240.3	12.9	708	721	263,857	3,395	260,462
Texas blind salamander	0	0%	0	0	0	0	0	10	0	10
Comal Springs riffle beetle	0	0%	0	0	0	0	0	N/A	N/A	N/A
Comal Springs dryopid beetle	0	0%	0	0	0	0	0	N/A	N/A	N/A

Abbreviations

m^2 = square meter; N/A = not applicable

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5 | Program Management, Financial Report, and Committee Activities

CHAPTER OVERVIEW

- Program staff participated in a custom two-day training program on habitat conservation plan preparation and implementation.
- EAHCP staff began planning for a multi-year planning process that would lead up to renewal of the incidental take permit.
- The Program is fiscally stable with a reserve balance of $29,099,665 and $35,243,901 cash balance. There are adequate funds for fiscal year 2022.
- EAHCP Committees and Work Groups continued to meet virtually.

5.1 Program Management

General management and oversight of the EAHCP is administered through the EAA pursuant to Section 2.2 of the FMA. EAA's responsibilities include facilitating the employment of the Program Manager[3] who is responsible for managing the EAHCP Program (Program) and ensuring compliance with all relevant Program documents. Section 5.6.5 of the FMA allows for use of EAHCP monies to fund EAA administrative costs and employee salaries, so long as all incurred costs, including salaries, are not used (with certain exceptions) for the costs of non-EAA Permittees' employees or administrative costs relative to the EAHCP.

In 2021, full-time Program staff consisted of the Program Manager, Chief Science Officer (an EAA-funded position), Habitat Conservation Manager, Contract Administrator, Environmental Scientist (an EAA-funded position), and two Program Coordinators. Seasonal staff consisted of three Trinity University work–study students (spring). One Program staff position—Senior Program Coordinator—remained unfilled in 2021.

5.1.1 Management Activities and Special Projects

Program management activities performed in 2021 included coordination with Permittees in accordance with the ITP, Implementing Agreement, EAHCP, FMA, and other Program documents.

[3] Although referred to in the FMA as the *Program Manager*, the title for this position under the EAA organizational structure is *Executive Director—Threatened and Endangered Species*.

Program staff coordinated IC, Adaptive Management Stakeholder Committee (SH), Adaptive Management Science Committee (SC), and Work Group activities (see **SECTION 5.3**) and emailed monthly reports on EAHCP activities to all committee members. To promote engagement and provide transparency, Program staff communicated activities to the public and stakeholders through the EAHCP website, *EAHCP Steward* newsletter, EAA's *News Drop Magazine*, and *EAHCP Conserve* newsletter (see **SECTION 5.1.3)**.

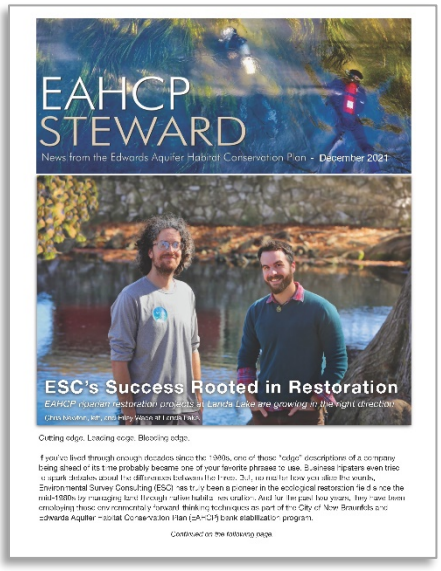
Several special projects were initiated, advanced, and/or completed in 2021. The Program Coordinators worked with work–study students to create story maps of Covered Species and digitize previous implementation efforts to update geographic information systems (GIS). The EAHCP Program Manager, Program staff, and Permittees participated in a two-day workshop on the USFWS HCP Handbook. They also coordinated refugia activities with USFWS Fisheries and Program activities and planning for the ITP renewal with the USFWS Ecological Services.

Staff also began planning for an ITP renewal in coordination with the USFWS. In mid-August the Program Manager, Scott Storment, presented a timeline of activities to the IC to submit an ITP application to the USFWS in late 2024. Staff coordinated closely with TPWD to draft an ESA Section 6 HCP Planning Assistance Grant to fund the ITP renewal process. A request for proposals to select a contractor to support this effort was released in late 2021.

5.1.2 Program Funding Applications and Work Plans

Program staff worked with Permittees throughout the year to reimburse and implement activities defined in annual Work Plans. **CHAPTER 2** summarizes these activities as amended and approved by the IC and EAA Board of Directors; 2021 Work Plans are included in Appendix E1.

5.1.3 Outreach


EAHCP STEWARD

News from the Edwards Aquifer Habitat Conservation Plan - December 2021

ESC's Success Rooted in Restoration

EAHCP riparian restoration projects at Landa Lake are growing in the right direction

Cutting edge. Leading edge. Bleeding edge.

If you've lived through enough decades since the 1990s, one of those "edge" descriptions of a company being ahead of its time probably became one of your favorite phrases to use. Business hipsters even tried to spark debates about the differences between the three. But, no matter how you slice the words, Environmental Survey Consulting (ESC) has truly been a pioneer in the ecological restoration field since the mid-1980s by managing land through native habitat restoration. And for the past few years, they have been employing those environmentally forward thinking techniques as part of the City of New Braunfels and Edwards Aquifer Habitat Conservation Plan (EAHCP) bank stabilization program.

Continued on the following page

The Program has several platforms to inform stakeholders about the Covered Species and the work performed to protect them. Program staff produce and distribute the monthly *EAHCP Steward* newsletter and accompanying podcast. The *EAHCP Steward* highlights collaborative efforts to protect the threatened and endangered species that inhabit the Edwards Aquifer and the Comal and San Marcos springs systems. Each newsletter features a story about a conservation activity, contractor, volunteer organization, or dedicated individual working to support and/or implement Conservation Measures or to protect the Edwards Aquifer. In 2021, 12 *EAHCP Steward* newsletters and podcasts were published covering a range of stakeholder- and public-interest topics such as volunteer efforts that support conservation activities in the San Marcos Springs and Comal Springs systems and stakeholder education about EAA's new Education Outreach Center. The EAA also publishes a quarterly magazine entitled *News Drop Magazine* and a bi-monthly newsletter

entitled *EAHCP Conserve*. In 2021 each *News Drop Magazine* included two to four EAHCP feature articles. *EAHCP Conserve*, which is distributed to Edwards Aquifer permit holders, focused in part on increasing participation of groundwater withdrawal permit holders in the ASR and VISPO Conservation Measures.

5.1.4 Permit Oversight

Each year Program staff work with two consultants to monitor and track the status of local, state, and federal permits necessary to implement Conservation Measures. A permit tracking matrix was maintained to monitor and track the status of permits. To ensure compliance with other state and federal permit requirements, contractors also reviewed restoration plans, monitored construction projects, coordinated with a TPWD game warden, and coordinated with the Texas Historical Commission. The Texas Historical Commission coordination letters are provided in Appendix K.

5.2 Financial Report

The current financial projections and cost estimates indicate an overall fiscally stable EAHCP with an adequate budget for the Program in fiscal year 2022. The Program is fiscally stable with a reserve balance of $29,099,665 and $35,243,901 cash balance. If triggered by drought, ASR and VISPO forbearance payments are the largest expense. There is a 0 percent chance that ASR forbearance will trigger in 2022 or 2023 and a near zero probability of triggering in 2024, as indicated by modeling performed for the 2021 Budget Work Group. However, there is a 43.2 percent chance of VISPO triggering between 2022 and the end of the permit term, 2028. (This is detailed further in the EAHCP Budget Work Group findings; see **SECTION 5.3.1.2**).

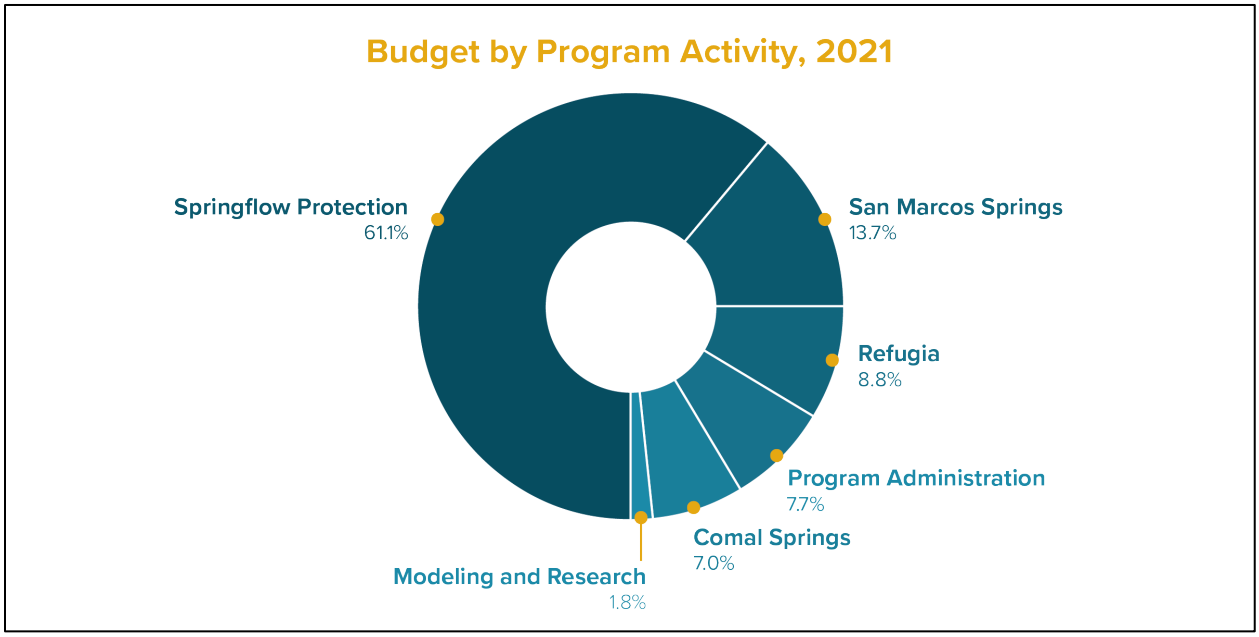
Section 4.6 of the FMA specifies that the EAA Board of Directors approves each Permittee's Program Funding Application budget in October of each year. A Program Funding Application is the mechanism by which a Permittee requests funding to implement the Conservation Measures or other Program-related activities. The EAA Board of Directors approved the 2021 Program Funding Applications for Permittees at its meeting on November 10, 2020.

Four amendments to the EAHCP Program Funding Applications were approved by the EAA Board of Directors in 2021. Collectively, this amounted to a cumulative net increase of roughly $271,000 for the Program in 2021. Other transfers between various accounts for reclassification of expenditure needs were made but did not require approval from the EAA Board of Directors. The amendments and transfers are identified in the EAHCP Expense Report (Appendix L).

The EAHCP Expense Report shows Table 7.1 of the EAHCP funding amounts for 2021 totaling $17,337,597. These amounts can be compared to the EAA Board of Directors–approved/amended 2021 Program Funding Applications totaling $13,953,154.

FIGURE 5-1 reflects the unaudited 2021 EAA Board of Directors–approved/amended 2021 Program Funding Applications, by budget and EAHCP activity. No new funding needs were identified in 2021.

FIGURE 5-1
2021 EAA Board of Directors–Approved/Amended Program Funding Applications by Budget and EAHCP Activity



5.3 Committee Activities

Virtual meetings throughout 2021 maintained accountability and transparency to the public in accordance with the following:

- The FMA
- *Operational Procedures of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan Program* (March 2012)
- *Parliamentary Rules of Conduct of the Implementing Committee of the Edwards Aquifer Habitat Conservation Plan Program* (March 2012)
- *Program Operational Rules for EAHCP Program Adaptive Management Stakeholder Committee Members and Participants* (October 2012)
- *Operational Procedures of the Science Committee of the Edwards Aquifer Habitat Conservation Plan Program* (April 2014)

Agendas and notices for all meetings were emailed to a stakeholder listserv at least one week in advance of the meetings, and opportunities for public comment were provided. Meeting minutes and video recordings were posted on the EAHCP website and/or EAA Granicus System.

In total, five IC meetings, three SC meetings, and four SH meetings were successfully facilitated; of these, four were joint meetings of the SH and IC, and one was a joint committee meeting of the IC, SH, and SC (**TABLE 5-1**). Additionally, Program staff organized the meetings of four Work Groups—Springflow

Habitat Protection Work Group, Budget Work Group, Research Work Group, and Comal Springs Riffle Beetle Work Group.

Videos of all IC and SH meetings were made viewable online through the EAA Granicus System. Beginning in April, all virtual SC meetings were also made viewable online through the EAA Granicus System. Virtual Work Group meetings were recorded and provided to stakeholders as requested.

TABLE 5-1
2021 EAHCP Virtual Committee Meetings

Date	Committee(s)	Actions, Reports, or other Notable Items
March 18	IC and SH	• Approved submission of the 2020 EAHCP Annual Report to the USFWS and amended the 2021 EAA Program Funding Application and Work Plan • Appointed Colette Barron Bradsby to the Springflow Habitat Protection Work Group to replace Cindy Loeffler, who retired December 2020 • Report on the 2020 EAHCP Annual Report story map and the Springflow Habitat Protection Work Group Part 1 Report and Proposed Part 2 Charge
April 29	SC	• Reports on the 2022 CONB, COSM, and EAA Work Plans and a fountain darter habitat study
May 20	IC and SH	• Approved 2022 EAA, COSM, and CONB Work Plans and amendments to the 2021 COSM Program Funding Application and Work Plan • Update on the Springflow Habitat Protection Work Group Part 1 Report and Proposed Part 2 Charge • Report from the USFWS on the conclusion of the five-year reviews of the Texas blind salamander and fountain darter
August 19	IC	• Update on the Springflow Habitat Protection Work Group's progress toward prioritization of questions in the Part 1 Report and Proposed Part 2 Charge • Report on EAHCP updates and notification to the USFWS regarding EAHCP § 7.1.2 changes about the Joint Funding Agreement • Report of the process and timeline for the next EAHCP ITP
September 15	SC	• Report on climate change modeling by the EAA and South-Central Climate Adaptation Science Center
October 14	IC and SH	• Report from the 2021 EAHCP Budget Work Group • Approval of the Springflow Habitat Protection Work Group's prioritization in response to the IC's request • Approved the 2022 CONB, COSM, and EAA Program Funding Applications and the EAA's 2022 Work Plan amendments • Report on the ITP renewal schedule and from USFWS on its ITP renewal process and its proposal to remove 23 species from the Federal List of Endangered and Threatened Wildlife and Plants due to extinction
December 16	IC, SH, and SC	• Approved 2022 IC officers, EAA 2022 Work Plan amendments, and updates to the Budget Work Group charge • Report on climate change modeling by the EAA and USFWS Texas wild-rice genetics research

Abbreviations

CONB = City of New Braunfels; COSM = City of San Marcos; CSRB = Comal Springs riffle beetle; IC = Implementing Committee; ITP = Incidental Take Permit; SC = Adaptive Management Science Committee; SH = Adaptive Management Stakeholder Committee; USFWS = U.S. Fish & Wildlife Service

5.3.1 Implementing Committee

Implementation of the EAHCP is supervised by the IC to ensure compliance with the ITP, EAHCP, FMA, and other Program documents. Five voting members represent the five Permittees, and in 2021 one non-voting member from the Guadalupe-Blanco River Authority served on the IC. **TABLE 5-2** lists 2021 IC members.

In 2021 the IC met four times virtually. Meeting dates and action items are listed in **TABLE 5-1;** agendas and meeting minutes are provided in Appendix M1.

TABLE 5-2
2021 Implementing Committee Members

Committee Member	Entity	Alternate
Mark Enders [Chair]	City of New Braunfels	Phillip Quast
Robert Mace, Ph.D. [Vice-Chair]	Texas State University	Kimberly Meitzen, Ph.D.
Roland Ruiz	Edwards Aquifer Authority	Brock Curry
Tom Taggart	City of San Marcos	Melani Howard
Darren Thompson [Secretary]	San Antonio Water System	Donovan Burton
Chad Norris	Guadalupe-Blanco River Authority	Nathan Pence

5.3.1.1 Springflow Habitat Protection Work Group

The Springflow Habitat Protection Work Group is charged with identifying technical evaluations to address the discussion document circulated to the SH members by Myron Hess on May 22, 2019. Nine virtual meetings were held in 2021 to address Part 1 of the Springflow Habitat Protection Work Group charge, which included clarifying and refining discussion document topics to identify the technical expertise and analysis needed to inform the deliberations of the Work Group during Part 2. The Work Group's results, primarily in the form of 15 questions, were presented to the IC as a Part 1 Report and Proposed Part 2 Charge (Report and Charge).

The IC considered the Report and Charge at its meeting on May 20, 2021, in addition to written comments on the Report and Charge from SAWS, but it did not act to approve or reject that document. Instead, the IC asked the Work Group to move ahead with prioritization of the 15 identified questions and bring that proposed prioritization back to the IC for consideration along with the Report and Charge.

The Work Group held additional meetings and identified a subset of the previously identified questions. These were presented to the IC at its October meeting as first priority for studies and a subset of questions as first priority to be addressed through monitoring triggered during low-flow periods. In addition, the Work Group identified a subset of questions as second priority for evaluation. Finally, the Work Group recommended that the remaining questions not included in those three priority groupings be retained for future consideration. The IC agreed with recommendations to allow staff to begin work to address questions identified as the first priority for study and low-flow monitoring plans.

Members of the Work Group included Myron Hess—Chair (Texas Living Waters Project), Patrick Shriver (SAWS), Adam Yablonski (Irrigator), Doris Cooksey (City Public Service Energy), Colette Barron Bradsby (TPWD, replacing Cindy Loeffler who retired in 2020), Ryan Kelso (New Braunfels Utilities), Melani Howard (COSM), Kimberly Meitzen (TXST), Charles Ahrens (EAA), Jacquelyn Duke (SC representative), Charles Kreitler (SC representative), and Tom Arsuffi (SC representative). Appendix M2 includes the charge and meeting materials.

5.3.1.2 EAHCP Budget Work Group

The Budget Work Group's two-part charge for the duration of the ITP from the IC is to (1) collaborate with and inform the EAA budget process as it relates to the EAHCP, EAHCP reserve, and EAHCP Aquifer Management Fee and (2) address fiscal issues as they arise and are referred by the IC.

Members of the Budget Work Group for 2021 were Tom Taggart (IC), Brock Curry (EAA designee), Myron Hess (SH), Cecilia Velasquez (SAWS designee), and Adam Yablonski (Irrigator). The Work Group met on September 29, 2021, to review and discuss the EAA 2022 budget process and to monitor the management of EAHCP revenue and expenses.

The Work Group's report (Appendix M3) describes the current financial projections and cost estimates for the EAHCP program for fiscal year 2022; acknowledges the ASR and VISPO trends; notes that Aquifer Management Fee would not increase in 2022 but that there would be a $3 reduction in the amount of funding devoted to the EAHCP compared to EAA operations; and recommends that the IC, EAA Board of Directors, and Program staff continue to monitor the potential drought of record and the impact it would have on the EAHCP reserve funds. The report also recommends that the IC take actions to appoint individuals to fill open positions on the Work Group. The IC updated the Budget Work Group charge at its December meeting. New individuals will be appointed in 2022 to fill open positions.

5.3.2 Adaptive Management Stakeholder Committee

The SH's role is to consult with, advise, and make recommendations on adaptive management decisions (see **SECTION 6.2**); the design of studies related to the LTBGs and key management objectives; and any other matter at the request of the Program Manager or IC. The SH also coordinates with the IC to appoint members to the SC. The **Edwards Aquifer Authority Act** identifies the organizational makeup of the SH; membership is also addressed in Section 7.8.1 of the FMA. **TABLE 5-3** lists the 27 SH representatives, their affiliations, and their alternates as of the end of 2021.

In 2021 the SH met four times virtually. Meeting dates and action items are listed in **TABLE 5-1**; agendas and meeting minutes are provided in Appendix M4.

TABLE 5-3
2021 Stakeholder Committee Members

Committee Member	Entity	Affiliation	Alternate
Doris Cooksey [Chair]	City Public Service Energy	City Public Service Energy	Matthew Schwartz
Myron Hess [Vice Chair]	Texas Living Waters Project	Environmental interest from the Texas Living Waters Project	Jennifer Walker
Patrick Shriver [Secretary]	San Antonio Water System	San Antonio Water System	Brandon Payne
Carl Adkins	Texas BASS Federation Nation	Recreational interest in the Guadalupe River Basin	Tim Cook
Chuck Ahrens	Edwards Aquifer Authority	Edwards Aquifer Authority	Javier Hernandez
Bruce Alexander	East Medina County Special Utility District	Holder of an **Initial Regular Permit** issued by the Edwards Aquifer Authority for a retail public utility located west of Bexar County	No alternate named
Colette Barron Bradsby	Texas Parks & Wildlife Department	Texas Parks & Wildlife Department	Kimberly Horndeski
Buck Benson	Barton Benson Jones PLLC	Holder of an Initial Regular Permit issued by the Edwards Aquifer Authority for industrial purposes	Shanna Castro/Paul Hunt
Ryan Kelso	New Braunfels Utilities	Retail public utility in whose service area the Comal Springs or San Marcos Springs is located	No alternate named
John Byrum	Nueces River Authority	Nueces River Authority	Sky Lewey
James Dodson	City of Victoria	Holder of a municipal surface water right in the Guadalupe River Basin	No alternate named
Mark Enders	City of New Braunfels	City of New Braunfels	Phillip Quast
Rader Gilleland	Gilleland Farms	Holder of an Initial Regular Permit issued by the Edwards Aquifer Authority for irrigation	Adam Yablonski
Renee Green	Bexar County	Bexar County	Kerim Jacaman
David Heier	Board of the Comal Trinity Water District	Holder of an EAA Initial Regular Permit issued to a small municipality (population under 50,000)	No alternate named
Cindy Hooper	Texas Commission on Environmental Quality	Texas Commission on Environmental Quality	Mike Chadwick
Melani Howard	City of San Marcos	City of San Marcos	Laurie Moyer
Dan Hunter	Texas Department of Agriculture	Texas Department of Agriculture	David Villarreal
Glenn Lord	DOW Chemical	Holder of an industrial surface water right in the Guadalupe River Basin	Dwaine Schoppe
Brian Mast	San Antonio River Authority	San Antonio River Authority	Allison Elder
Kimberly Meitzen	Texas State University	Texas State University	Robert Mace
Gary Middleton	South Central Texas Water Advisory Committee	South Central Texas Water Advisory Committee	No alternate named

Committee Member	Entity	Affiliation	Alternate
Carol Patterson	Regional Clean Air and Water	Edwards Aquifer region municipal ratepayers/general public	Kirk Patterson
Nathan Pence	Guadalupe-Blanco River Authority	Guadalupe-Blanco River Authority	Mike Urrutia/Chad Norris
Ray Joy Pfannstiel	Guadalupe County Farm Bureau	Agricultural producer from the Edwards Aquifer region	Gary Schlather
Humberto Ramos	Guadalupe Basin Coalition	Guadalupe River Basin municipal ratepayers/general public	Mike Dussere
Rachel Sanborn	San Marcos River Foundation	Conservation organization	Virginia Parker

5.3.3 Adaptive Management Science Committee

The SC comprises nine experts with technical expertise in one or more of the following areas: the Edwards Aquifer or its management, the Comal Springs and Comal River, the San Marcos Springs and San Marcos River, the Covered Species, or experimental design and data. The SC serves as an independent scientific panel to advise, consult, and provide recommendations to the SH and IC. The SC members for 2021 are listed in **TABLE 5-4**.

In 2021 the SC met twice virtually and participated in the December Joint Committee meeting. Meeting dates and action items are listed in **TABLE 5-1**; agendas and meeting minutes are provided in Appendix M5.

TABLE 5-4
2021 Science Committee Members

Committee Member	Entity	Expertise	Nominating Entity
Jacquelyn Duke, Ph.D. [Chair]	Baylor University	Stream Ecology–Riparian Ecohydrology	IC
Chad Norris, M.S. [Vice Chair]	Guadalupe-Blanco River Authority	Aquatic Biology–Aquatic Invertebrate Specialist	SH
Floyd Weckerly, Ph.D.	Texas State University	Population Ecology–Experimental Design	SH
Tom Arsuffi, Ph.D.	Texas Tech University	Aquatic Biology–Stream Ecology	IC
Janis Bush, Ph.D.	University of Texas at San Antonio	Plant Ecology–Experimental Design	SH
Charlie Kreitler, Ph.D.	LBG-Guyton Associates (Retired)	Hydrogeology–Groundwater Science	IC
Conrad Lamon, Ph.D.	Statistical Ecology Associates LLC	Ecological Modeling	IC
Glenn Longley, Ph.D.	Edwards Aquifer Research and Data Center (Retired)	Biologist–Edwards Aquifer Specialist	SH
Jack Sharp, Ph.D.	University of Texas at Austin	Hydrology–Hydrogeology	Joint IC and SH

Abbreviations
IC = Implementing Committee; SH = Adaptive Management Stakeholder Committee

5.3.3.1 Comal Springs Riffle Beetle Work Group

The CSRB Work Group's charge is to review and provide input on monitoring the CSRB as part of EAHCP implementation. The Work Group members—Conrad Lamon (SC), Chad Norris (SC and TPWD), Floyd Weckerly (SC), David Britton (USFWS), and Tom Arsuffi (SC)—met December 9, 2021, to review refugia CSRB collection numbers, husbandry procedures, and survivability curves followed by the 2021 CSRB collections associated with the EAHCP biological monitoring. The CSRB Work Group also discussed the CSRB population survey scheduled to occur in 2022–2023 in Landa Lake and its Spring Runs. The CSRB Work Group's meeting agenda and supporting materials are provided in Appendix M6.

5.3.3.2 Research Work Group

The Research Work Group is charged with suggesting, while operating on a consensus-basis, specific applied research projects to be conducted as part of the Applied Research Program and suggesting refinements to the methodology proposed for refugia research projects. Refugia research projects are considered in light of the research prioritization need of each Covered Species and what is known about each for the five research topics necessary to establish fully functional refugia and illustrated in **Table 5-5**. Progress on refugia research projects is documented annually in a report from the USFWS to the EAA (Appendix G).

TABLE 5-5
Refugia Research Prioritization and Information Status

	Research Topic				
Covered Species	Collection Methods and Techniques	Husbandry	Propagation	Genetics	Species Reintroduction Methods
Fountain darter	5	5	5	4	5
Texas wild-rice	5	5	5	5	5
Texas blind salamander	4	5	4	4	1
San Marcos salamander	5	4	3	3	0
Comal Springs salamander	5	4	3	3	0
Comal Springs riffle beetle	5	4	3	2	0
Comal Springs dryopid beetle	3	2	1	1	0
Texas troblibitic water slater	1	1	0	1	0
Peck's cave amphipod	4	4	4	2	0
Edwards Aquifer diving beetle	1	0	0	0	0

Darker = More Information Exists
(5 indicates documented procedures exist; 0 indicates that no information currently exists in a form usable for refugia management)

The Research Work Group meets on an as-needed basis and is expected to be in existence for the duration of the ITP. The Work Group members—Chad Norris (Guadalupe-Blanco River Authority), Tom Arsuffi (Texas Tech University, retired), Floyd Weckerly (TXST), and Conrad Lamon (Statistical Ecology Associates, LLC)—are all SC members.

The Research Work Group met virtually on December 8, 2021, and discussed the following research projects as part of the EAHCP refugia program:

- Results of the TWR genetic analysis for captive and wildstock populations (USFWS)
- Continuation of a study examining factors affecting population of CSRB (TXST)
- Results of the first year of a study to assess CSRB nutrition using nutritional pellets (USFWS)
- Continuation of CSRB captive propagation and longevity in Refugia (USFWS/BIO-WEST)

The meeting agenda and minutes are provided in Appendix M7.

5.4 Other Work Groups

5.4.1 San Antonio Water System Aquifer Storage & Recovery Regional Advisory Group and Staff Work Group

The EAHCP and Interlocal Contract provide for continued discussion and interaction through two groups. The SAWS ASR Regional Advisory Group is a 12-person Regional Advisory Group that provides advice to SAWS regarding the implementation of the program. **TABLE 5-6** lists the members of the SAWS ASR Regional Advisory Group, which met once in 2021.

The second group, the Staff Work Group, consists of four SAWS staff members and four EAA staff members who provide advice to each agency regarding drought conditions, aquifer levels and springflows at Comal Springs, meteorology, and aquifer and springflow modeling.

TABLE 5-6

San Antonio Water System Aquifer Storage & Recovery Regional Advisory Group 2021 Members

Appointee	Affiliation	Alternate
Darren Thompson	San Antonio Water System	Patrick Shriver/Roger Placencia
Robert Escobar	San Antonio Water System	Patrick Shriver/Roger Placencia
Karen Guz	San Antonio Water System	Patrick Shriver/Roger Placencia
Roger Placencia	San Antonio Water System	Patrick Shriver
Roland Ruiz	Edwards Aquifer Authority	Marc Friberg
Rader Gilleland	Irrigator	Adam Yablonski
Bruce Alexander	Small municipal utility	No alternate named
Ryan Kelso	Springs Communities	Mike Short
Colette Barron Bradsby	Environmental interest	No alternate named
Buck Benson	Industry	Doris Cooksey
Chad Norris	Downstream interest	Charlie Hickman
Scott Storment	EAHCP Program Manager	Jamie Childers

6 | Plan Changes and Correspondence

CHAPTER OVERVIEW

- An informational memo was sent to the U.S. Fish & Wildlife Service in 2021 regarding language changes in EAHCP § 7.1.2 about the *Joint Funding Agreement*. It was a Routine Adaptive Management Process decision per the EAHCP Funding and Management Agreement.

6.1 Administrative Changes

The EAHCP uses four categories of changes that are administrative in nature: annual report, informational memoranda, Clarifications, and Minor Administrative Amendments. Clarifications and Minor Administrative Amendments are defined in the EAHCP; the annual report and informational memoranda categories of changes were established in 2013 via a Program Manager memorandum to the IC.

The *annual report* can be used to report a change that is temporary or caused by current conditions, with the intent in the future to adhere to the HCP.

Informational memoranda can be used to report a change that was very minor and has not substantively affected the species or objectives and did not rise to the level of needing scientific consideration.

Clarifications are defined as changes that "do not change the substantive portions of any of the documents in any way but merely clarify and make more precise the provisions as they exist." The 2013 Program Manager memorandum noted above further defines Clarifications, noting that they are used when "the HCP is not clear on a specific issue and the issue could be interpreted differently depending on perspective [and] confirmation from USFWS [is needed] that the interpretation chosen … is accepted/agreed to by USFWS." Clarifications are implemented by submitting a proposed change to the USFWS for its approval within a requested 30-day period. According to the EAHCP, Clarifications must be provided in writing through a letter agreement or substituted plan documents between the Permittees and the USFWS.

Minor Administrative Amendments are defined as changes that do not make substantive changes to any of the provisions of the documents but which may be necessary to represent more fully the overall intent of the Permittees and the USFWS. The 2013 Program Manager memorandum noted above further defines Minor Administrative Amendments, noting that they are used when "the change is very minor and has no substantive [effect on] the species or objectives [and] could require some minimal level of justification, possibly scientific in nature." The process for executing Minor Administrative Amendments is more extensive than that used for Clarifications. Minor Administrative Amendments require

submitting in writing to the USFWS a description of the proposed amendment, explanation of why the amendment is necessary or desirable, and an explanation of why the proposed amendment will not change the effects described in the EAHCP. These changes require public noticing and posting the proposed amendment on the EAHCP website for public comment. The proposed Minor Administrative Amendment must then be approved by the USFWS Field Supervisor, documented by written authorization within 30 days.

Language was updated in EAHCP § 7.1.2 to be consistent with the latest Joint Funding Agreement (JFA) (Appendix A2) following approval by the USFWS on October 28, 2021. Several entities who are not Edwards Aquifer users and do not pay Aquifer Management Fees contribute to the EAHCP through a JFA. The JFA was updated by these third-party contributors in 2020. The updated JFA reduces contributions to the EAHCP from the Guadalupe-Blanco River Authority, decreasing the total third-party contribution from $735,000 to $485,000. The EAA agreed to cover differences in EAHCP funding and signed the JFA in May 2021. EAA's approval of the JFA prompted updates to the EAHCP.

6.2 Adaptive Management Process

Article 7 of the FMA outlines the procedural steps and responsibilities of the Permittees for adaptive management. It also identifies three AMP decisions the Permittees may make—Routine AMP, Nonroutine AMP, and **Strategic AMP** (SAMP) decisions. *Routine AMP decisions* are those involving on-going, day-to-day matters related to the management and administration of existing Conservation Measures and Phase II Conservation Measures implemented through the SAMP that do not require an amendment to the ITP. *Nonroutine AMP* decisions are those related to existing Conservation Measures, but which are not Routine AMP decisions. *SAMP decisions* are decisions that relate to the selection of Phase II Conservation Measures that are to be implemented by the Permittees from 2020 through the end of the ITP (2028). One Routine AMP decision and no nonroutine AMP or SAMP decisions were made in 2021. Updates to the EAHCP regarding the JFA described in **SECTION 6.1** were a Routine AMP decision.

6.3 Changed Circumstances

The EAHCP describes 12 changed circumstances that, if they occur during the permit term, would require responsive measures to address. On April 21, 2021, New Braunfels Utilities (NBU) had a water main break that discharged chlorinated, potable water into Blieders Creek which flows into the upper portion of Landa Lake. This event was an acute pollution event and therefore a Changed Circumstance. TPWD worked with NBU to document the impacts on the aquatic environment; no Covered Species were found to be impacted. No responsive measures were taken under the EAHCP since no Covered Species were impacted. NBU has made a substantial investment in replacing aging infrastructure over the past 15 years to reduce the likelihood of these types of events from occurring. $120 million has been invested in fiscal year 2021 to replace aging infrastructure across their lines of business which includes sanitary sewers.

6.4 Other USFWS Correspondence

Other memoranda, clarifications, or amendments not related to Conservation Measures or Biological Goals and Objectives as defined by AMP decisions may be necessary to address changes to the EAHCP, Implementing Agreement, FMA, or ITP. Such correspondence was issued in August 2021 as an informational memorandum regarding the JFA described in **SECTION 6.1** (Appendix D).

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7 | Literature Review

Appendix N lists recent literature (e.g., journal articles, study reports, theses, and dissertations) related to the Covered Species, habitat, and other pertinent topics associated with the EAHCP. To coincide with the development schedule of the Annual Report, this review includes literature published or approved from December 1, 2020, to November 30, 2021, as well as any earlier literature not documented in an Annual Report. The literature search was accomplished by conducting online searches of academic databases (such as EBSCO and JSTOR), Google Scholar, TXST dissertations and theses, and the EAA document library.

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8 | References

John Gleason LLC. 2017. *Water Quality Protection Plan for the City of San Marcos and Texas State University*. Available: https://www.edwardsaquifer.org/wp-content/uploads/2019/02/WQPP_2017_0228.pdf. Accessed: December 16, 2021.

National Academies of Science. 2018. *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3*. Washington, D.C. The National Academies Press.

National Oceanic and Atmospheric Administration National Weather Service Climate Prediction Center. 2021. *U.S. Seasonal Drought Outlook*. Available: https://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php. Accessed: January 5, 2021.

RECON Environmental, Inc.; Hicks & Company; Zara Environmental, LLC; and BIO-WEST. 2012. *Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan.* November. Available: https://www.edwardsaquifer.org/wp-content/uploads/2019/02/Final-HCP-November-2012.pdf. Accessed: December 8, 2020.

San Marcos Aquatic Resources Center. 2018. *Refugia Research Plan*. May 23. San Marcos Aquatic Resources Center. San Marcos, Texas.

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Species of Interest

The species listed in the table below are managed by the EAHCP program or of interest through their relevance to EAHCP implementation activities.

EAHCP Species of Interest

Common Name	Scientific Name
Covered Species	
Comal Springs dryopid beetle	*Stygoparnus comalensis*
Comal Springs riffle beetle	*Heterelmis comalensis*
Comal Springs salamander	*Eurycea* sp.
Edwards Aquifer diving beetle (or Texas cave diving beetle)	*Haideoporus texanus*
Fountain darter	*Etheostoma fonticola*
Peck's cave amphipod	*Stygobromus pecki*
San Marcos gambusia	*Gambusia georgei*
San Marcos salamander	*Eurycea nana*
Texas blind salamander	*Eurycea (=Typhlomolge) rathbuni*
Texas troglobitic water slater	*Lirceolus smithii*
Texas wild-rice	*Zizania texana*
Submerged Aquatic Vegetation Species for Fountain Darter Habitat	
Delta arrowhead	*Sagittaria platyphylla*
Creeping primrose-willow	*Ludwigia repens*
Carolina fanwort (or Cabomba)	*Cabomba caroliniana*
Illinois pondweed	*Potamogeton illinoensis*
Mosses, liverworts, and allies	Bryophytes[a]
Whorled pennywort	*Hydrocotyle verticillata*[b]
Texas wild-rice	*Zizania texana*[b]
Water celery	*Vallisneria americana*[a]
Native Species	
Grassleaf mudplantain	*Heteranthera dubia*
Non-Native Animal Species Removed or Monitored	
Giant ramshorn snail	*Marisa cornuarietis*
Gill parasite (no common name)	*Centrocestus formosanus*
Intestinal fluke	*Haplorchis pumilio*
Nutria	*Myocastor coypus*
Red-rimmed melania	*Melanoides tuberculata*
Suckermouth armored catfishes (suckermouth and sailfin)	Loricariidae: *Hypostomus Plecostomus* and *Pterygoplichthys* spp.

Common Name	Scientific Name
Tilapia (or blue tilapia)	*Oreochromis* spp.
Zebra mussels	*Dreissena polymorpha*
Non-Native Plant Species Removed or Monitored	
Chinaberry	*Melia azedarach*
Chinese privet	*Ligustrum sinense*
Chinese tallow	*Triadica sebifera*
Elephant ear (or coco yam, or taro)	*Colocasia esculenta*
Giant reed	*Arundo donax*
Hydrilla (or water thyme)	*Hydrilla verticillata*
Indian swampweed	*Hygrophila polysperma*
Japanese honeysuckle	*Lonicera japonica*
Japanese privet (or Japanese ligustrum)	*Ligustrum japonicum*
Tapegrass (or eelgrass)	*Vallisneria spiralis*
Watercress	*Nasturtium officinale*
Water hyacinth	*Eichhornia crassipes*
Water lettuce	*Pistia stratiotes*
Water sprite	*Ceratopteris thalictroides*
White mulberry	*Morus alba*

[a] This species comprises habitat for the fountain darter in the Comal Springs system only.

[b] This species comprises habitat for the fountain darter in the San Marcos Springs system only.

Glossary

Comal discharge: The volume of water passing a defined location in the Comal River; in the EAHCP, this location is often referenced at the USGS station number 08169000, which is below the confluence of the Old and New Channels of Comal River.

Comal River: A 2-mile natural watercourse originating from the Comal Springs in New Braunfels, Texas, at Landa Lake to its confluence with the Guadalupe River in New Braunfels, Texas.

Comal Springs: A collection of artesian springs in New Braunfels, Texas, emanating from the Edwards Aquifer and creating the headwaters of the Comal River including areas of Landa Lake and Spring Runs that feed Landa Lake.

Comal Springs system: The aquatic area containing the Comal Springs, Landa Lake, and Comal River.

Conservation Measures: Projects specified in Chapter 5 of the EAHCP to be implemented by the assigned Permittees in order to minimize and mitigate to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of the Covered Species due to the performance of the Covered Activities by the Permittees during the term of the ITP.

Covered Activities: Those activities identified in Condition L of the ITP and Chapter 2 of the EAHCP and performed by the Permittees within the Permit Area, including recreation, restoration, and management of groundwater pumping from the Edwards Aquifer, for which incidental take coverage has been provided over the permit term.

Covered Species: The 11 federally listed or petitioned species "covered" by the ITP and HCP and conserved and managed through the implementation of the EAHCP.

critical period: Generally, a period characterized by defined lower aquifer levels and which is primarily managed by the triggering of specific withdrawal restrictions from the Edwards Aquifer. Specifically, a *critical period* is defined in Section 702.1(52) of the EAA's rules to mean "[a]ny day of a calendar year when a critical period stage is in effect." A critical period is in effect when so declared by the EAA General Manager pursuant to Section 715.212 of the EAA's rules based on the aquifer level triggers found in Appendix Table 1 to Subchapter E, Chapter 715 of the EAA's rules.

curtail or curtailment: The act of reducing or restricting something. In the case of a forbearance agreement, the right to withdrawal under an EAA groundwater withdrawal permit would be reduced or restricted.

defined period of extreme drought, drought, drought conditions: In the EAHCP, the "springflow protection" Conservation Measures are based on the specific drought triggers that are tailored for each measure, except for the Regional Water Conservation Program, which has no drought triggers. These

measures are designed to prevent springflows at Comal Springs and San Marcos Springs from being reduced below certain levels stated in the EAHCP during a repeat of the *drought of record–like conditions*. Reference to drought or extreme drought is in perspective of similar experiences.

drought of record: The drought of record occurred from 1951 through 1956 and is characterized by an average recharge for any 7-year period of less than 168,700 ac-ft as derived for the period 1950-1956. For the purposes of the SAWS ASR Program, Section 1.9 of the SAWS–EAA ASR contract defines the *drought of record* as "the period of time declared by the [EAA] General Manager pursuant to Section 3 [of the SAWS–EAA ASR contract] characterized as a period of lower than normal precipitation and recharge to the Aquifer resulting in a drought of record–like event as provided therein." Section 3(a) of the SAWS–EAA ASR contract provides that the EAA General Manager is to issue a "notice of commencement of a drought of record" when the 10-year rolling average of the estimated annual recharge to the aquifer is equal to or less than 500,000 ac-ft per annum.

Edwards Aquifer Authority Act: The Act of May 30, 1993, 73rd Leg., R.S., ch. 626, 1993 Tex. Gen. Laws 2350, as amended.

EAA groundwater withdrawal permit: An Initial Regular Permit or Regular Permit issued by the EAA.

forbearance: The complete curtailment of all or part of a right to make withdrawals under a specific EAA groundwater withdrawal permit.

forbearance agreement: As used in the SAWS ASR and VISPO, a contractual agreement whereby a permit holder agrees to the complete curtailment of all or part of the permit holder's right to make withdrawals in the future under a specific EAA groundwater withdrawal permit when certain conditions—commonly referred to as *triggers*—are met in exchange for compensation.

incidental take: Unintentional taking of a species that results from, but is not the purpose of, carrying out an otherwise lawful activity. *Taking* is defined in the ESA as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting any threatened or endangered species.

Incidental Take Permit: A permit issued by the U.S. Fish & Wildlife Service under Section 10a(1)(B) of the Endangered Species Act that allows permit holders to proceed with an otherwise legal activity but which may result in "incidental take" of a listed species.

Initial Regular Permit: An EAA groundwater withdrawal permit originally issued by the EAA under Subsection 1.16(d) of the Edwards Aquifer Authority Act.

lease: As used in the SAWS ASR Program, a lease is a contractual arrangement to presently grant the exclusive possession of the right to make withdrawals from the Edwards Aquifer under an EAA groundwater withdrawal permit.

Long-Term Biological Goal Reach: River segments in both the Comal and San Marcos Springs systems that are specified in the EAHCP and hold quantitative goals associated with covered species habitat.

low flow(s), low flow conditions: A period of springflow below the long-term average and the minimum averages identified in Tables 4-2 and 4-13 of the EAHCP. Low flow may also be specified as

130 cfs or lower at the Comal discharge and 120 cfs or lower at the San Marcos discharge based on Condition M in the ITP.

negative impacts: Generic term associated with impacts on the Covered Species and their habitat through reduced springflow, flood, contaminated runoff, excess recreation in protected areas, and other potentially threatening activities to the Comal Springs and San Marcos Springs ecosystems.

Old Channel of the Comal River: From Landa Lake, water flows into two channels, the original "old" channel and a "new" channel created in 1847.

Phase I—EAHCP Implementation: Phase I of the EAHCP occurred between 2013 and 2020, during which the Permittees implemented the habitat restoration, springflow protection, research, modeling, monitoring, and refugia Conservation Measures required by the EAHCP and the ITP to determine their effectiveness in achieving the EAHCP Biological Goals and Objectives.

Phase II—EAHCP Implementation: Phase II of the EAHCP spans 2020–2028 and consists of continued implementation of existing, or modifications to existing, Conservation Measures, or implementation of new Conservation Measures that may be necessary to achieve the Biological Goals and Objectives in the EAHCP as a result of the SAMP.

Regular Permit: An EAA groundwater withdrawal permit issued by the EAA after August 12, 2008, resulting from the sale or amendment of an Initial Regular Permit or the consolidation of two or more such permits.

Restoration Reach: River segments in both the Comal and San Marcos rivers created out of the 2016 AMP to satisfy the EAHCP key management objective of proportionally expanding submerged aquatic vegetation restoration beyond the LTBG Reaches.

riparian: Land adjacent to a river or stream.

San Marcos discharge: The volume of water passing a defined location in the San Marcos River; in the HCP this location is referenced at the USGS station number 08170500, which is located in Sewell Park.

San Marcos River: A 75-mile natural watercourse originating from the San Marcos Springs in San Marcos, Texas, at Spring Lake to its confluence with the Guadalupe River near Gonzales, Texas.

San Marcos Springs: A collection of artesian springs in San Marcos, Texas, emanating from the Edwards Aquifer and creating the headwaters of the San Marcos River including areas of Spring Lake, Sink Creek, and Sessom Creek; generally, refers to artesian springs in Spring Lake.

San Marcos Springs system: The aquatic area containing the San Marcos Springs, Spring Lake, and San Marcos River.

Strategic Adaptive Management Process: The SAMP formalized adaptive management during the transition from Phase I (2013–2020) to Phase II (2020–2028) of the EAHCP and the ITP as defined in Sections 7.13 and potentially 7.14 of the FMA. No SAMP decisions were needed during the transition from Phase I to Phase II.

trigger: To cause an event or situation to happen or exist. In the case of the VISPO, Critical Period Management Program, and SAWS ASR springflow protection programs, including the associated forbearance agreements, a trigger would be a condition that causes or requires the curtailment of all or part of the right to make withdrawals under a specific EAA groundwater withdrawal permit.

withdrawal: Taking groundwater from the Edwards Aquifer by or through human-made facilities, including pumping.