

An underwater photograph showing a school of small, silver fish swimming in clear water. On the left, there is a dense patch of bright green, feathery aquatic vegetation. Sunlight filters down from the surface, creating a shimmering effect on the water and the plants. The overall scene is serene and natural.

EDWARDS AQUIFER HABITAT CONSERVATION PLAN 2022 ANNUAL REPORT

Prepared by
The Edwards Aquifer Habitat Conservation Plan Permittees





Edwards Aquifer Authority / Edwards Aquifer Habitat Conservation Plan Permittees. 2023. *Edwards Aquifer Habitat Conservation Plan: 2022 Annual Report*. March. San Antonio, TX. Prepared with assistance from ICF, Austin TX.

If you would like an accessible version of this document, please email eahcp@edwardsaquifer.org.

ON THE COVERS

Front—San Marcos River by Erich Schlegel. *Back*—Texas wild-rice by David Zippin.



EDWARDS AQUIFER HABITAT CONSERVATION PLAN

2022 ANNUAL REPORT

Prepared by

The Edwards Aquifer Habitat Conservation Plan Permittees with assistance from **ICF**



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2022 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 activities and accomplishments in 2022, the tenth year of EAHCP implementation.

Overview of the Edwards Aquifer Habitat Conservation Plan (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.

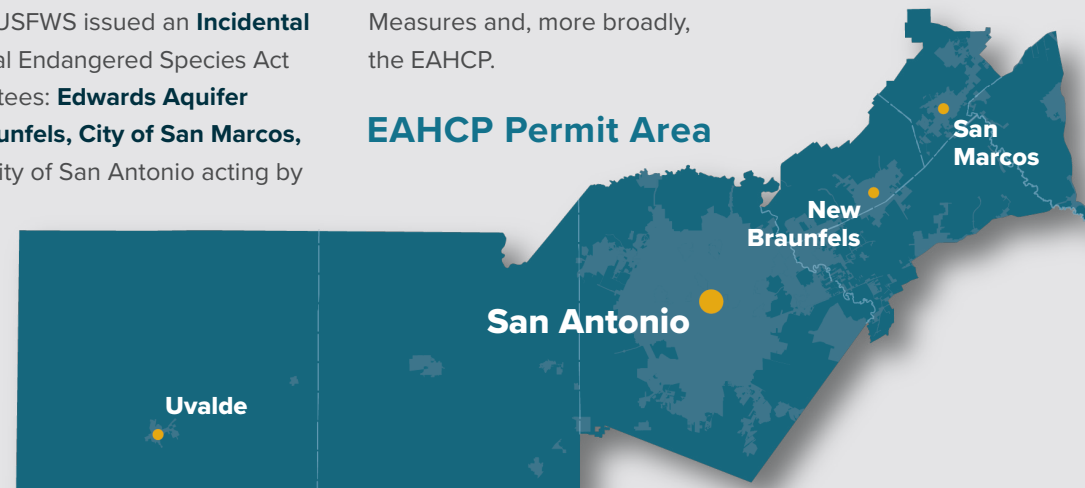
After approval of the EAHCP, the USFWS issued an **Incidental Take Permit (ITP)** under the federal Endangered Species Act of 1973 to five cooperating Permittees: **Edwards Aquifer Authority (EAA), City of New Braunfels, City of San Marcos, Texas State University**, and the City of San Antonio acting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

EAHCP Permit Area



Covered Species



Texas Wild-Rice
Zizania texana
ENDANGERED



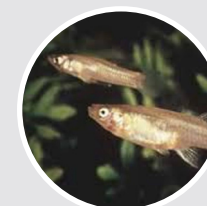
Texas Blind Salamander
Eurycea rathbuni
ENDANGERED



San Marcos Salamander
Eurycea nana
THREATENED



Fountain Darter
Etheostoma fonticola
ENDANGERED



San Marcos Gambusia¹
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 Troglabitic Water Slater
Lirceolus smithii
PETITIONED



Edwards Aquifer Diving Beetle
Haideoporus texanus
PETITIONED



Comal Springs Salamander²
Eurycea sp.
NOT LISTED

¹ 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.

² The petition to list the Comal Springs salamander was withdrawn in 2020.

Highlights of 2022



Program Administration

10-year highlight: Program staff updated the EAHCP logo in recognition of the plan's 10th anniversary.

- Program staff launched a multi-year ITP renewal process in coordination with the USFWS. Funding for this effort will come in part from a \$1 million federal Habitat Conservation Planning Assistance Grant.
- The National Habitat Conservation Plan Coalition showcased the EAHCP during its 2022 Annual Meeting in Austin.
- In coordination with the USFWS, EAHCP staff helped bring fountain darters and Texas blind salamanders to display aquariums at the new EAA Education Outreach Center.

Springflow Protection

10-year highlight: Despite multiple periods of extreme drought (2013, 2014, 2018, 2021, 2022), the springflows were below average but stayed above the minimum flow requirements.

- La Niña drought conditions persisted through 2022, bringing above-average temperatures and below-average rainfall. In June, Comal and San Marcos springflows fell below Condition M levels; habitat mitigation and restoration activities were limited in accordance with the ITP. Condition M restrictions remained in place through 2022.
- 2022 drought impacted both spring systems, causing Spring Runs 1 and 2 to stop flowing temporarily in New Braunfels and reduced flow in San Marcos to historic lows.
- Springflow conditions below 635 feet mean sea level at the J-17 Bexar Index Well on October 1 triggered the Voluntary Irrigation Suspension Program Option. Participants in the program will suspend Edwards Aquifer pumping in 2023.

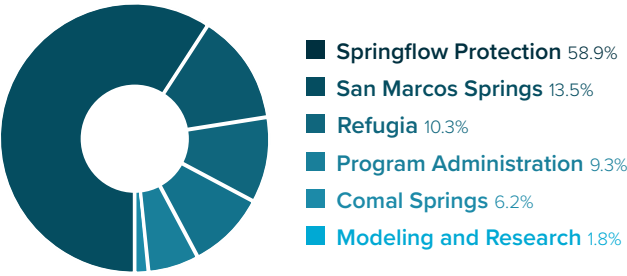
Habitat Restoration

10-year highlight: 10 years of restoration of aquatic and riparian habitat in the Comal and San Marcos springs systems.

- Since 2013, Texas wild-rice (TWR) has expanded from 5,020 m² in 2013 to 13,070 m² in 2022. Planting of TWR in the upper San Marcos River stopped in 2019, but TWR continues to expand naturally.
- Since 2013, *hygrophila*, an aggressive non-native aquatic present in both spring systems, has been drastically reduced in all of the Long-term Biological Goal Reaches.
- Since 2013, most non-native riparian plants have received initial treatment in the public parks along the Comal and San Marcos rivers, treatment of regrowth will continue until the end of the permit.

Fiscal Stability

Budget by Program Activity, 2022



The current financial projections and cost estimates for the EAHCP indicate an overall fiscally stable Program with an adequate budget for Program implementation in fiscal year 2023. The EAHCP Program has a reserve balance of \$22,702,150 and a cash balance of \$35,556,158. There are adequate funds for the EAHCP Program in fiscal year 2023.

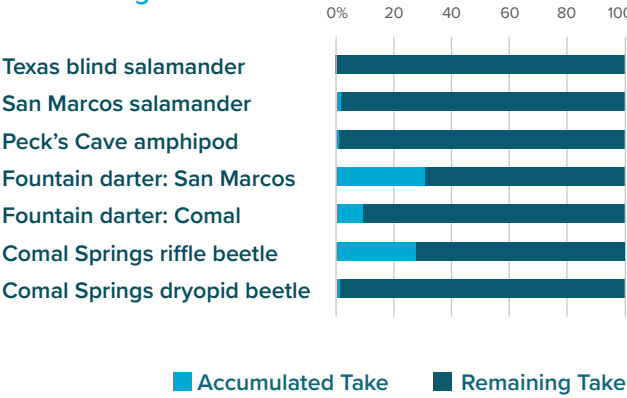
Incidental Take

Incidental take of listed species from Covered Activities is quantified annually and measured against the total take authorized by the ITP.

In the Comal Springs system, take totaled 5,064 fountain darters, 743 Comal Springs riffle beetles, 5 Comal Springs dryopid beetles, and 115 Peck’s cave amphipod. The Comal invertebrate take was mostly due to severe drought conditions that reduced portions of occupied habitat.

In the San Marcos Springs system, take totaled 37,442 fountain darters and 3,559 San Marcos salamanders, primarily due to recreational impacts on aquatic vegetation in Spring Lake Dam and City Park monitored sections of the San Marcos River.

Covered Species Accumulated Take through 2022



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 springflow protection, habitat conservation, and various supporting activities such as research and biological monitoring.

The tables at right summarize progress toward fulfilling the Conservation Measures. Implementation efforts are highlighted for 2022. As the EAHCP enters its 11th year of implementation, most Conservation Measures have either been fulfilled or are in an on-going or maintenance phase.

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



SPRINGFLOW PROTECTION



HABITAT CONSERVATION



SUPPORTING ACTIVITIES

Status Key and Abbreviations

- Implementation Status**
- W Working toward fulfillment
 - ✓ Fulfillment expected
 - ✓ Fulfillment achieved or implemented
 - M Maintenance
 - O On-going
 - I Implemented when triggered
 - T Triggered
 - N New opportunities sought contingent on funding
 - No activity

Permittees

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

Springflow Protection Measures

		2022 is the tenth year of EAHCP implementation																
		13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		
Aquifer Storage and Recovery Springflow Protection Program Enrollment	EAA, SAWS	W	W	W	W	W	W	W	✓	✓	✓	✓	W	W	W	W		
Aquifer Storage and Recovery Springflow Protection Program Storage	EAA, SAWS	W	W	W	W	W	W	W	✓	I	I	I	I	I	I	I		
Aquifer Storage and Recovery Springflow Protection Program Forbearance	EAA, SAWS	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		
Voluntary Irrigation Suspension Program Option Enrollment	EAA	W	W	✓	✓	✓	✓	W	W	✓	✓	✓	W	W	W	W		
Voluntary Irrigation Suspension Program Option Implementation	EAA	I	T	✓	I	I	I	I	I	I	T	✓	I	I	I	I		
Regional Water Conservation	EAA	W	W	W	W	W	W	W	✓	–	–	–	–	–	–	–		
Stage V Critical Period Management (San Antonio Pool)	EAA	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		
Stage V Critical Period Management (Uvalde Pool)	EAA	T	T	T	I	I	I	I	I	I	I	I	I	I	I	I		

Habitat Conservation Measures

		13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		
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		
Texas Wild-Rice Enhancement	COSM, TXST	W	W	W	W	W	W	W	W	W	W	W	W	✓	M	M		
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		
Decaying Vegetation Removal and Dissolved Oxygen Management	CONB	T	T	T	T	I	I	I	I	I	T	I	I	I	I	I		
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		
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		
Non-native Animal Species Control	CONB, COSM, 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		
Diversion of Surface Water	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		
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		
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 Routes	CONB	W	W	W	✓	–	–	–	–	–	–	–	–	–	–	–		
Prohibition of Hazardous Material Transport Routes	COSM	W	W	W	W	W	W	W	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		
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		
Sessom Creek Sand Bar Removal	TXST	W	W	W	✓	–	–	–	–	–	–	–	–	–	–	–		
Sediment Management	COSM, TXST	W	W	W	W	✓	–	–	–	–	–	–	–	–	–	–		
Septic System Registration and Permitting Program	COSM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		
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		
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		
Ecological Modeling	EAA	W	W	W	W	✓	–	–	–	–	–	–	–	–	–	–		
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	<i>Edwards Aquifer Habitat Conservation Plan</i>
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
lbs	pounds
LTBG	Long-Term Biological Goal
m	meter
m ²	square meter
N/A	not applicable
Permit Area	area covered by the Incidental Take Permit
SAMP	Strategic Adaptive Management Process
Program	EAHCP Program
SAWS	San Antonio Water System
SC	Adaptive Management Science Committee
SH	Adaptive Management Stakeholder Committee
SSA	state scientific area
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks & Wildlife Department
TWR	Texas wild-rice

Abbreviation	Term
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

1 | EAHCP Background and Edwards Aquifer Conditions

CHAPTER OVERVIEW

- 2022 marked the 10th 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.
- La Niña drought conditions persisted through 2022, bringing above-average temperatures and below-average rainfall.
- In March, the Edwards Aquifer entered Stage 1 water reductions for the San Antonio Pool. Water levels continued to decline during summer, and Stage 4 water reductions were triggered on August 12. Rainfall in late August and September offered some relief from drought conditions, and the San Antonio Pool ended the year in Stage 3.
- In June, the Edwards Aquifer entered Stage 2 water reductions for the Uvalde Pool. Water levels continued to decline during summer, and while rainfall in September offered some relief from drought conditions, the Uvalde Pool ended the year in Stage 2.
- In June, Comal and San Marcos springflows fell below Condition M levels (130 cubic feet per second and 120 cubic feet per second, respectively); habitat mitigation and restoration activities were limited in accordance with the Incidental Take Permit. Condition M restrictions remained in place through 2022.
- On the annual trigger date of October 1, 2022, the water level at the J-17 Bexar Index Well was below 635 feet mean sea level, which triggered the Voluntary Irrigation Suspension Program Option forbearance program. A total of 41,795 acre feet of water in Voluntary Irrigation Suspension Program Option agreements will not be pumped and will remain in the Edwards Aquifer during 2023.

The *Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan* (EAHCP¹; 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

TABLE 1-1
Covered Species

Common Name	Scientific Name	Federal Status	Spring System
Fountain darter	<i>Etheostoma fonticola</i>	Endangered	Comal and San Marcos
San Marcos gambusia	<i>Gambusia georgei</i>	Endangered (proposed delisted) ^a	San Marcos
Comal Springs dryopid beetle	<i>Stygoparnus comalensis</i>	Endangered	Comal and San Marcos
Comal Springs riffle beetle	<i>Heterelmis comalensis</i>	Endangered	Comal and San Marcos
Peck's cave amphipod	<i>Stygobromus pecki</i>	Endangered	Comal
Texas wild-rice	<i>Zizania texana</i>	Endangered	San Marcos
Texas blind salamander	<i>Eurycea rathbuni</i> ^b	Endangered	San Marcos
San Marcos salamander	<i>Eurycea nana</i>	Threatened	San Marcos
Edwards Aquifer diving beetle	<i>Haideoporus texanus</i>	Not listed (petitioned)	Comal and San Marcos
Comal Springs salamander	<i>Eurycea</i> sp.	Not listed ^b	Comal
Texas troglotic water slater	<i>Lirceolus smithii</i>	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. A final rule is anticipated in 2023 but has not been published as of March 15, 2023.

^b The U.S. Fish & Wildlife Service changed the scientific name for this species from *Typhlomolge rathbuni* to *Eurycea rathbuni* in 2021 (86 Federal Register 67352–67360). The petition to list the Comal Springs salamander was withdrawn in 2020.

The area covered by the ITP (Permit Area) is bound by the 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**).

¹ Abbreviations in this document are defined in the *List of Abbreviations* on page ix.

² Terms defined in the *Glossary* appear in blue, bolded typeface on their first use in text or tables.

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 ensures 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 Ecological Services Office in Austin and to the USFWS Southwest Regional Office in Albuquerque. 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 2022, the 10th year of EAHCP implementation.

FIGURE 1-1
EAHCP Permit Area

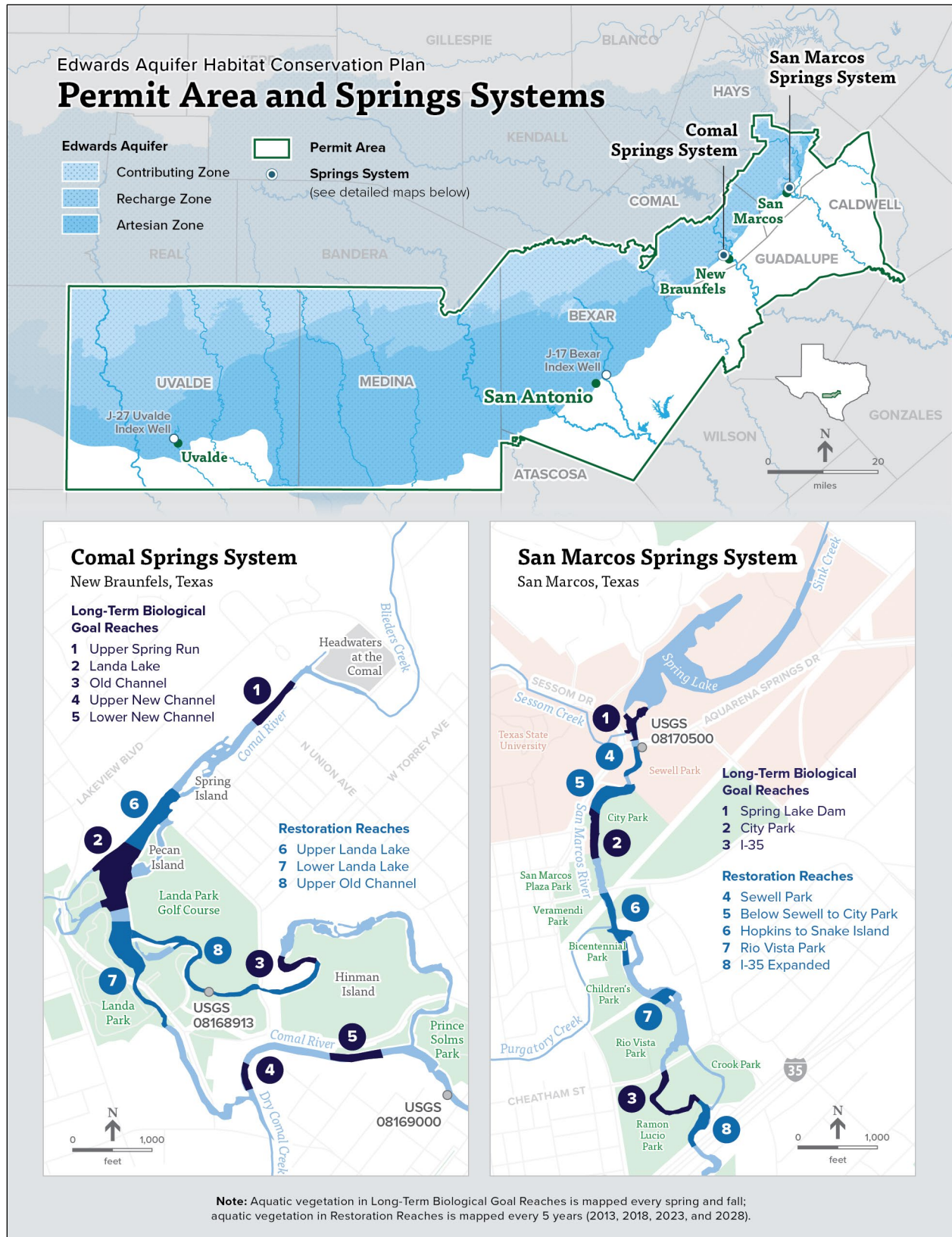


TABLE 1-2 identifies the ITP’s content requirements for the Annual Report and provides a reference to a chapter, section, or appendix where that content can be found in the 2022 Annual Report.

TABLE 1-2

EAHCP Annual Report Requirements and Associated 2022 Annual Report Reference

Requirement per Incidental Take Permit Condition U	Annual Report Reference
EAA permitted withdrawals	Appendix B
Reference well levels	Appendix C5
Springflows at Comal and San Marcos springs	Appendix C1, Appendix C3
Aquifer recharge	Appendix C3
Aquifer discharge from wells and springflow	Appendix C1, Appendix C3
Critical period management reductions	Section 1.2
Water quality data	Appendix C4, Appendix F1
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 2022
Any changes to the objectives for the monitoring program	N/A—no changes to report for 2022
Effects on the Covered Species or Permit Area	Appendix J
Evaluation of progress toward achieving the Biological Goals and Objectives	Chapter 3 and Appendices F1, F2, and F3
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—the J-17 Bexar Index Well in the San Antonio Pool, J-27 Uvalde Index Well in the Uvalde Pool, and flow measured at Comal and San Marcos springs. Withdrawal reductions are put into place for users withdrawing groundwater from whichever pool or springflow 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 and continued to fall as La Niña conditions persisted. Mandatory reductions were required for users in both the San Antonio Pool (J-17 Bexar Index Well) and Uvalde Pool (J-27 Uvalde Index Well).

- **TABLE 1-3** shows stages and withdrawal reductions for the San Antonio Pool in 2022. Water levels measured at the J-17 Bexar Index Well entered Stage 1 in March and fell to Stage 4 in August and October. Fall rainfall in the region offered relief to the San Antonio Pool, and the J-17 Bexar Index Well ended the year at 636.9 feet mean sea level (ft msl), or Stage 3.
- **TABLE 1-4** shows stages and withdrawal reductions for the Uvalde Pool in 2022. Water levels measured at the J-27 Uvalde Index Well entered Stage 2 in June and ended the year at 849.5 ft msl, or Stage 2.

TABLE 1-3

Stages in the San Antonio Pool, 2022

Stage	Withdrawal Reduction	Days in Stage	Duration Dates	Actual Required Reduction ^a
No Stage	0%	67	01/01 – 03/08	0%
Stage 1	20%	33	03/09 – 04/10	1.81%
Stage 2	30%	63	04/11 – 06/12	5.18%
Stage 3	35%	60	06/13 – 08/11	5.75%
Stage 4	40%	6	08/12 – 08/17	0.66%
Stage 3	35%	51	08/18 – 10/07	4.89%
Stage 4	40%	18	10/08 – 10/25	1.97%
Stage 3	35%	66	10/26 – 12/31	6.33%
Total	-	365	-	26.59%

^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.

TABLE 1-4

Stages in the Uvalde Pool, 2022

Stage	Withdrawal Reduction	Days in Stage	Duration Dates	Actual Required Reduction ^a
No Stage	0%	171	01/01 – 06/20	0%
Stage 2	5%	36	06/21 – 07/26	0.49%
Stage 3	20%	45	07/27 – 09/09	2.47%
Stage 2	5%	112	09/10 – 12/31	1.53%
Total	-	365	-	4.49%

^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.

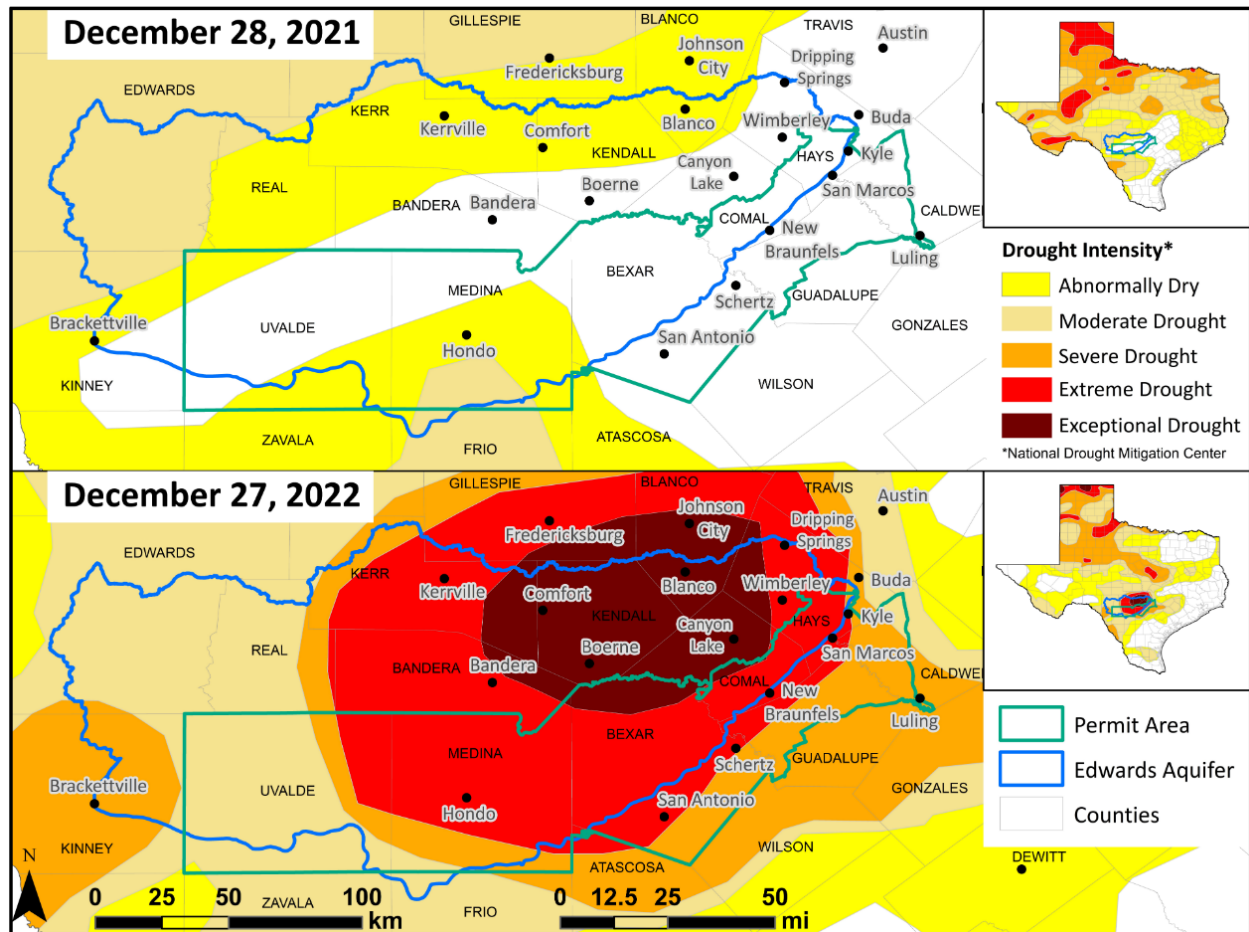
Rainfall was below historical averages through 2022, resulting in below-average recharge and springflow. Calculated recharge in the Edwards Aquifer for 2021 (the best available data) was estimated at 247,000 acre feet (ac-ft), which is below the mean annual recharge of 695,000 ac-ft for the period of record (1934–2021), excluding additional interformational flows. The 10-year rolling average recharge was calculated at 569,000 ac-ft. The estimated springflow was 341,000 ac-ft. Available rainfall and recharge data are included in the 2021 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 2022, springflows in the Comal and San Marcos rivers were well below average and continued to decrease during summer. On June 3, 2022, flows at the USGS station in the San Marcos River (USGS 08170500) dropped below 120 cubic feet per second (cfs), triggering Condition M of the ITP (Appendix D). Condition M limits restoration activities and prompts defined monitoring when flows are below 120 cfs in the San Marcos River and 130 cfs in the Comal River. On June 17, 2022, flows at the USGS station in the Comal River (USGS 08169000) dropped below 130 cfs, triggering Condition M. Condition M restrictions remained in place through December (Appendix D).

Drought conditions across the region continued into fall 2022. On the annual trigger date of October 1, 2022, the water level at the J-17 Bexar Index Well was below 635 ft msl, which triggered the Voluntary Irrigation Suspension Program Option (VISPO) forbearance program. A total of 41,795 ac-ft of water in VISPO agreements will not be pumped and will remain in the Edwards Aquifer during 2023. **FIGURE 1-2** compares Texas drought on December 29, 2021, with conditions on December 27, 2022. *The U.S. Seasonal Drought Outlook* expects drought conditions to persist into 2023 (National Oceanic and Atmospheric Administration National Weather Service Climate Prediction Center 2022).

FIGURE 1-2

Texas Drought Conditions in December 2021 and December 2022



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 2022 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 11th year of implementation, most of the Conservation Measures have either been fulfilled or are in an on-going or maintenance phase.
- In June, Comal and San Marcos springflows fell below Condition M levels (130 cubic feet per second and 120 cubic feet per second, respectively); habitat mitigation and restoration activities were limited in accordance with the Incidental Take Permit. Condition M restrictions remained in place through 2022. On the annual trigger date of October 1, 2022, the water level at the J-17 Bexar Index Well was below 635 ft msl, which triggered the VISPO forbearance program. A total of 41,795 ac-ft of water in VISPO agreements will not be pumped and will remain in the Edwards Aquifer during 2023.

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.

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
ASR Springflow Protection Program Enrollment–EAA, SAWS	W	W	W	W	W	W	W	✓	✓	✓	✓	W	W	W	W
ASR Springflow Protection Program Storage–EAA, SAWS	W	W	W	W	W	W	W	✓	I	I	I	I	I	I	I
ASR Springflow Protection Program Forbearance–EAA, SAWS	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
VISPO Enrollment–EAA	W	W	✓	✓	✓	✓	W	W	✓	✓	✓	W	W	W	W
VISPO Implementation–EAA	I	T	✓	I	I	I	I	I	I	T	✓	I	I	I	I
Regional Water Conservation–EAA	W	W	W	W	W	W	W	✓	-	-	-	-	-	-	-
Stage V Critical Period Management (San Antonio Pool)–EAA	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Stage V Critical Period Management (Uvalde Pool)–EAA	T	T	T	I	I	I	I	I	I	I	I	I	I	I	I

Abbreviations ASR = Aquifer Storage & Recovery; EAA = Edwards Aquifer Authority; SAWS = San Antonio Water System; VISPO = Voluntary Irrigation Suspension Program Option

Status Key

W	Working toward fulfillment
✓	Fulfillment expected
✓	Fulfillment achieved or implemented
I	Implemented when triggered
T	Triggered
-	No activity

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
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
Texas Wild-rice Enhancement–COSM, TXST	W	W	W	W	W	W	W	W	W	W	W	W	✓	M	M
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
Decaying Vegetation Removal and DO Management–CONB	T	T	T	T	I	I	I	I	I	T	I	I	I	I	I
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
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
Non-native Animal Species Control–CONB, COSM, 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
Diversion of Surface Water–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
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
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 Routes–CONB	W	W	W	✓	-	-	-	-	-	-	-	-	-	-	-
Prohibition of Hazardous Material Transport Routes –COSM	W	W	W	W	W	W	W	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
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
Sessom Creek Sand Bar Removal–TXST	W	W	W	✓	-	-	-	-	-	-	-	-	-	-	-
Sediment Management–COSM, TXST	W	W	W	W	✓	-	-	-	-	-	-	-	-	-	-
Septic System Registration and Permitting Program–COSM	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
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 or implemented
M	Maintenance
O	On-going
I	Implemented when triggered
T	Triggered
N	New opportunities sought contingent on funding
-	No activity

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
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
Ecological Modeling–EAA	W	W	W	W	✓	-	-	-	-	-	-	-	-	-	-
Groundwater Modeling–EAA	W	W	W	W	W	W	W	✓	-	-	-	-	-	-	-

Abbreviation

EAA = Edwards Aquifer Authority

Status Key

W	Working toward fulfillment
✓	Fulfillment achieved or implemented
O	On-going
-	No activity



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 2022 were carried out according to these reviewed and approved Work Plans (Appendix E). **TABLES 2-4 through 2-8** summarize, by Permittee, all 2022 compliance activities and activities proposed for 2023. 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.

2.1 Edwards Aquifer Authority

TABLE 2-4

Edwards Aquifer Authority 2022 EAHCP Implementation and Proposed 2023 Activities by Conservation Measure

EAA 2022 Compliance Action	Proposed EAA 2023 Compliance Action	Annual Report Reference
Applied Research (EAHCP § 6.3.4) Conduct research to enhance understanding of the ecology of aquatic ecosystems and provide scientifically rigorous information needed to meet the Biological Goals and Objectives.		
Applied research for the <i>Comal Springs Riffle Beetle Population Assessment</i> , recommended by the Springflow Habitat Protection Work Group, was delayed by drought conditions.	Begin data collection for the <i>Comal Springs Riffle Beetle Population Assessment</i> .	N/A
Refugia (EAHCP §§ 5.1.1, 6.4.2, 6.4.3, and 6.4.4) Operate and maintain 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 (1) propagating Comal Springs riffle beetles, (2) conducting a genetic assessment of Comal Springs riffle beetles, (3) developing a handbook for the captive propagation of Comal Springs riffle beetles, (4) improving the efficacy of tagging small-bodied salamanders using p-Chip tags, (5) continuing a San Marcos salamander habitat modification study and developing a propagation manual, (6) compiling fountain darter tissue catalog and testing DNA viability, (7) testing chytrid fungus treatments for aquatic salamanders, and (8) continuing to investigate Comal Springs riffle beetle <i>Staphylococcus</i> exposure.	Continue day-to-day operations and maintenance of refugia. Continue species collections and 2023 research activities.	Appendix G

EAA 2022 Compliance Action	Proposed EAA 2023 Compliance Action	Annual Report Reference
VISPO (EAHCP § 5.1.2) Compensate 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 in 2021, and forbearance was not required in 2022. VISPO agreements totaling 41,795 ac-ft were held in 2022. Therefore, the VISPO goal of 41,795 ac-ft has been achieved.	Conditions were triggered in 2022, and forbearance will be required in 2023. The total volume goal of 41,795 ac-ft in VISPO agreements will go unpumped and will be managed by EAA staff. Throughout 2023, staff will continue to work on renewing 96 VISPO agreements (totaling 19,365 ac-ft) that will expire on December 31, 2023.	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
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 Uvalde Index Well level drops below 840 ft msl.		
This Conservation Measure was not triggered in 2022.	This Conservation Measure will be enforced if triggered in 2023.	N/A
Expanded Water Quality Monitoring (EAHCP § 5.7.2) Continue 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 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; groundwater sampling for pharmaceuticals, personal care products, and sucralose; surface water sampling for nutrients; sediment analysis; 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 fish tissue sampling.	Appendix F1

EAA 2022 Compliance Action	Proposed EAA 2023 Compliance Action	Annual Report Reference
Biological Monitoring (EAHCP §§ 6.3.1, 6.4.3, and 6.4.4) Monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities, collect data that can be used in the applied research studies, and provide data and information for ecological model development.		
Biological monitoring occurred as outlined in the EAHCP. Four low-flow monitoring surveys were triggered when flows in the San Marcos River dropped below 100 cfs and 80 cfs and when flows in the Comal River dropped below 150 cfs and 100 cfs.	Continue biological monitoring as completed in previous years. A full-system aquatic vegetation mapping survey will occur during spring and will include LTBG Reaches and Restoration 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 that evaluates, and quantifies the magnitude of, potential adverse ecological effects from Covered Activities in order 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) Assemble materials regarding the value of a ban on the use of coal tar sealants and work with local governments to explore and encourage the 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 ASR Springflow Protection (EAHCP § 5.5.1) Acquire 50,000 ac-ft of permitted Edwards Aquifer water through leases and forbearance agreements and maintain such leases on an annual basis for use in the SAWS ASR Program.		
For 2022, EAA acquired a total of 50,000 ac-ft of which 12,837.627 ac-ft were ASR leases and 37,162.373 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 2023 of which 12,754.164 ac-ft are ASR leases and 37,245.836 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; VISPO = Voluntary Irrigation Suspension Program Option

2.2 City of New Braunfels

TABLE 2-5

City of New Braunfels 2022 EAHCP Implementation and Proposed 2023 Activities by Conservation Measure

CONB 2022 Compliance Action	Proposed CONB 2023 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
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 of the Comal River to improve habitat conditions for the fountain darter by increasing the amount of usable habitat and by improving the quality of existing habitat.		
Planted 3,114 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 1,440 m ² , and the planted area within the Old Channel Restoration Reach totaled 181 m ² . Removed 6.5 m ² of non-native <i>Hygrophila</i> 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 was updated and installed along the waterways. Worked with EAHCP 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

CONB 2022 Compliance Action	Proposed CONB 2023 Compliance Action	Annual Report Reference
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 activities occurred between August 3rd and September 22nd due to below-average springflow conditions. In August, six dissolved oxygen loggers were installed in the Comal Springs system (four in Landa Lake, one in the Upper Spring Run, and one in the Old Channel). Dissolved oxygen sensors were removed in September.	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.	Appendix H2
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 195 armored sailfin catfish, 874 tilapia, and 11 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 H3
Monitoring and Reduction of Gill Parasites (EAHCP §§ 5.2.6 and 6.3.6) Monitor the gill parasite <i>Centrocestus formosanus</i> and its intermediate host snail, red-rimmed melania, and establish a reduction program.		
Performed water column cercaria (snail parasite larva) monitoring for <i>Centrocestus formosanus</i> as well as the parasitic <i>Haplorchis pumilio</i> in August at four established transects in the Comal River system.	Continue monitoring free-swimming cercaria in the water column at established transects.	Appendix H4
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.		
Removed non-native vegetation and planted native vegetation along Spring Run 2 to increase the riparian buffer zone. Increased the density of native riparian vegetation along Spring Run 1.	Monitor and maintain previously restored riparian areas along Spring Runs 1, 2, and 3 and the western shoreline of Landa Lake.	Appendix H5

CONB 2022 Compliance Action	Proposed CONB 2023 Compliance Action	Annual Report Reference
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 (1) dislodging vegetation mats that form on the water surface, particularly during low flows , to allow continued movement downstream and (2) removing 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 25 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
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 the 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. Diverted 270.96 ac-ft 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

CONB 2022 Compliance Action	Proposed CONB 2023 Compliance Action	Annual Report Reference
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 1,397 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 335 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 998 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 H6
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 896 cars/participants and collected 59,919 lbs of hazardous waste. New Braunfels Utilities implements a free, year-round medication disposal program that 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
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 design work for construction of a bioretention basin at the Landa Park Aquatics Center parking lot, which is planned to occur in early 2023.	Complete construction of a bioretention basin at the Landa Park Aquatics Center parking lot in early 2023.	Appendix H7

Abbreviations

ac-ft = acre-foot; COI = Certificate of Inclusion; CONB = City of New Braunfels; HAZMAT = hazardous materials; lbs = pounds; LTBG = Long-Term Biological Goal; m² = square meters; N/A = not applicable; TCEQ = Texas Commission on Environmental Quality



2.3 City of San Marcos

TABLE 2-6

City of San Marcos 2022 EAHCP Implementation and Proposed 2023 Activities by Conservation Measure

COSM 2022 Compliance Action	Proposed COSM 2023 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 TWR was planted in 2022.	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 included 2,403 conversations with river users regarding endangered species protection, removal of 3,162 ft ³ of litter from the river, and removal of 1,353 ft ³ of litter 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 vegetation 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 337 ft ³ of litter from the San Marcos River between Spring Lake Dam and Stokes Park. Dislodged more than 11,157 m ² of floating vegetation mats in and around stands of TWR from Spring Lake Dam to IH-35.	Continue to implement existing efforts to remove litter and manage floating aquatic vegetation mats.	Appendices I1 and I3
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. Certified letters and proposed HAZMAT route map were sent to 92 political subdivisions within a 25-mile radius of San Marcos.	The final HAZMAT routes are not yet approved by the Texas Department of Transportation. Continue to work with the Texas Department of Transportation for final approval of the HAZMAT routes.	N/A

COSM 2022 Compliance Action	Proposed COSM 2023 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 spoke with Discovery Center visitors to educate the public about proper disposal of unwanted aquatic pets. The aquarium pet donation drop-off at the Discovery Center received 70 unwanted fish.	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 2022.	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. Repairs to Dog Beach (across from City Park) and Rio Vista falls were funded and overseen by the City of San Marcos.	Continue to monitor access points annually through measuring undermining and gaps between rocks.	N/A
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 boundary to remove and replace aquatic, littoral, and riparian non-native plant species.		
Removed 7,676 m ² of non-native aquatic vegetation. Suspended aquatic vegetation planting and large-scale non-native aquatic vegetation removal from June to December due to Condition M low-flow restrictions. Maintained aquatic, littoral, and riparian areas planted in the past. Planted approximately 6,216 individual native aquatic plants from Sewell Park to Bicentennial Park. Performed initial and repeated treatments of non-native plants within the littoral and riparian 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

COSM 2022 Compliance Action	Proposed COSM 2023 Compliance Action	Annual Report Reference
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 1,924 non-native fish from the San Marcos River system, totaling 1,734 lbs of removed biomass. Volunteers assisted with removal efforts by participating in two non-native species polespear tournaments.	Continue routine removal of tilapia, suckermouth armored catfish, and snails, and host at least two non-native species polespear tournaments.	Appendix I5
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, non-native vegetation in Sewell Park and Bicentennial Park. Performed monitoring and re-treatment of re-emergent non-native vegetation along the riparian zone between Spring Lake Dam and Capes Dam as well as along portions of San Marcos River tributaries. Planted native vegetation within the riparian zone primarily through volunteer efforts.	Continue maintenance of riparian areas from Spring Lake to Stokes Park. Perform initial removal of non-native trees on Snake Island, adjacent to Bicentennial Park, and across from the upstream portion of Rio Vista 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, 2022, 533 septic systems were registered within the COSM's jurisdiction according to the San Marcos Environmental Health Department. One new septic system was registered in 2022.	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, 207 participants per month at the household hazardous waste drop-off center and 3 customers per month at the reuse center. The program helped prevent improper disposal of 198,627 lbs of household hazardous waste.	Continue to operate the household hazardous waste collection facility to accept household hazardous waste from area residents. 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

COSM 2022 Compliance Action	Proposed COSM 2023 Compliance Action	Annual Report Reference
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 <i>San Marcos Water Quality Protection Plan</i> (John Gleason LLC 2017).		
Began construction on Phase I of the Sessom Creek restoration project in August. Construction activities are being performed in accordance with the "Sessom Creek Stream Restoration Project" plans developed by John Gleason LLC & Complete Watershed Solutions.	Continue construction on Phase I of the Sessom Creek restoration project which is anticipated to be substantially complete in April 2023.	N/A

Abbreviations

COI = Certificate of Inclusion; COSM = City of San Marcos; ft³ = cubic foot; HAZMAT = hazardous materials; ITP = Incidental Take Permit; lbs = pounds; LTBG = Long-Term Biological Goal; m = meter; m² = square meter; N/A = not applicable; TWR = Texas wild-rice; TXST = Texas State University

2.4 Texas State University

TABLE 2-7

Texas State University 2022 EAHCP Implementation and Proposed 2023 Activities by Conservation Measure

TXST 2022 Compliance Action	Proposed TXST 2023 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 1,403 dives in Spring Lake. Harvested a total of 1,216 yd ³ of aquatic vegetation by boat in Spring Lake.	Continue programs outlined in the EAHCP and in the annual Work Plan.	N/A
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 2022.	No activities are proposed.	N/A

TXST 2022 Compliance Action	Proposed TXST 2023 Compliance Action	Annual Report Reference
Diversion of Surface Water (EAHCP § 5.4.5) Reduce surface water diversions when flow is less than 80 cfs.		
Permitted surface water diversions were not reduced because total San Marcos River flows remained greater than 80 cfs. TXST diverted 10.9 ac-ft from Spring Lake (TCEQ permit 18-3865) and 45.9 ac-ft from the San Marco River (TCEQ permit 18-3866). Due to low flow conditions and expansion of TWR, the surface water intake pump was blocked by TWR. Upon approval from USFWS on August 1, the TWR in front of the pump was removed and accounted for within the take report.	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 2023.	Appendix I6
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 the Covered Species. TXST will submit the study for review through 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 5,235 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.	N/A
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 the 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 at The Meadows Center.	Continue to evaluate research programs for consistency with the protocols identified in the EAHCP and Spring Lake Management Plan.	N/A

TXST 2022 Compliance Action	Proposed TXST 2023 Compliance Action	Annual Report Reference
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 standards for proper cleaning.		
Spring Lake Programs included 5,544 glass-bottom boat tours and 395 canoe/kayak tours. All boating activities adhered to EAHCP protocol.	Continue implementing existing programs in accordance with this Conservation Measure.	N/A
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
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; yd³ = cubic yard

2.5 San Antonio Water System

TABLE 2-8

San Antonio Water System 2022 EAHCP Implementation and Proposed 2023 Activities by Conservation Measure

SAWS 2022 Compliance Action	Proposed SAWS 2023 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 2022. In 2022, 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 2022 EAHCP Implementation and Proposed 2023 Activities by Conservation Measure

TPWD 2022 Compliance Action	Proposed TPWD 2023 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 a state scientific area (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. New signs and an exclusion barrier was installed in the eastern spillway to protect the San Marcos salamander.	Fencing will be added if flow conditions are triggered.	N/A
Comal River State Scientific Area (EAHCP § 5.6.1).		
On November 23, 2022, a letter of clarification for EAHCP Sections 2.7, 5.2.2.2, 5.6.1, 5.8.3.1, and 9.1.1, relative to an SSA in the Comal Spring System, was sent to the USFWS.	N/A	Appendix D

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

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 2022 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 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 2022.

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.

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 5 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.

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.



Fountain darter
Etheostoma fonticola

ENDANGERED

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 (m²)							
Upper Spring Run	LTBG	1,750	0	25	25	850	0
Landa Lake Upper ^a	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/m²)							
–	–	20	3.3	7	7	1	1
2022 median densities (number/m²)		17	N/A	4	12	<1	1

^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; m² = 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	<i>Ludwigia</i>	<i>Cabomba</i>	<i>Potamogeton</i>	<i>Sagittaria</i>	<i>Hydrocotyle</i>	<i>Zizania</i>
Fountain Darter Habitat (Aquatic Vegetation) (m²)							
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/m²)							
–		7	7	5	1	4	5
2022 median densities (number/m²)		10	11	3	2	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; m² = 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, 2013-2022

Species coverage data are from routine spring/fall biological monitoring mapping events. Long-Term Biological Goals are represented in the stacked bar at the far right of each chart.

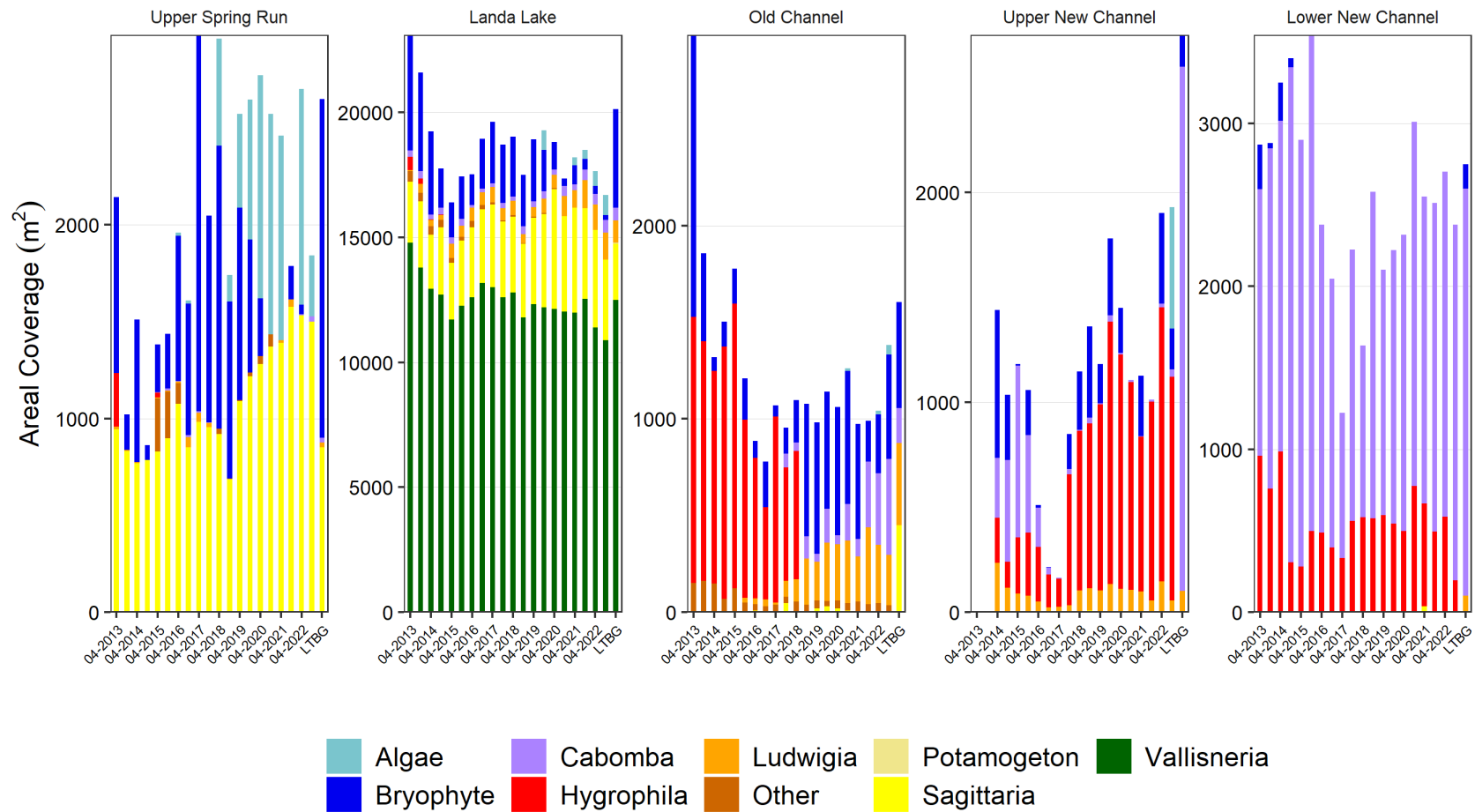
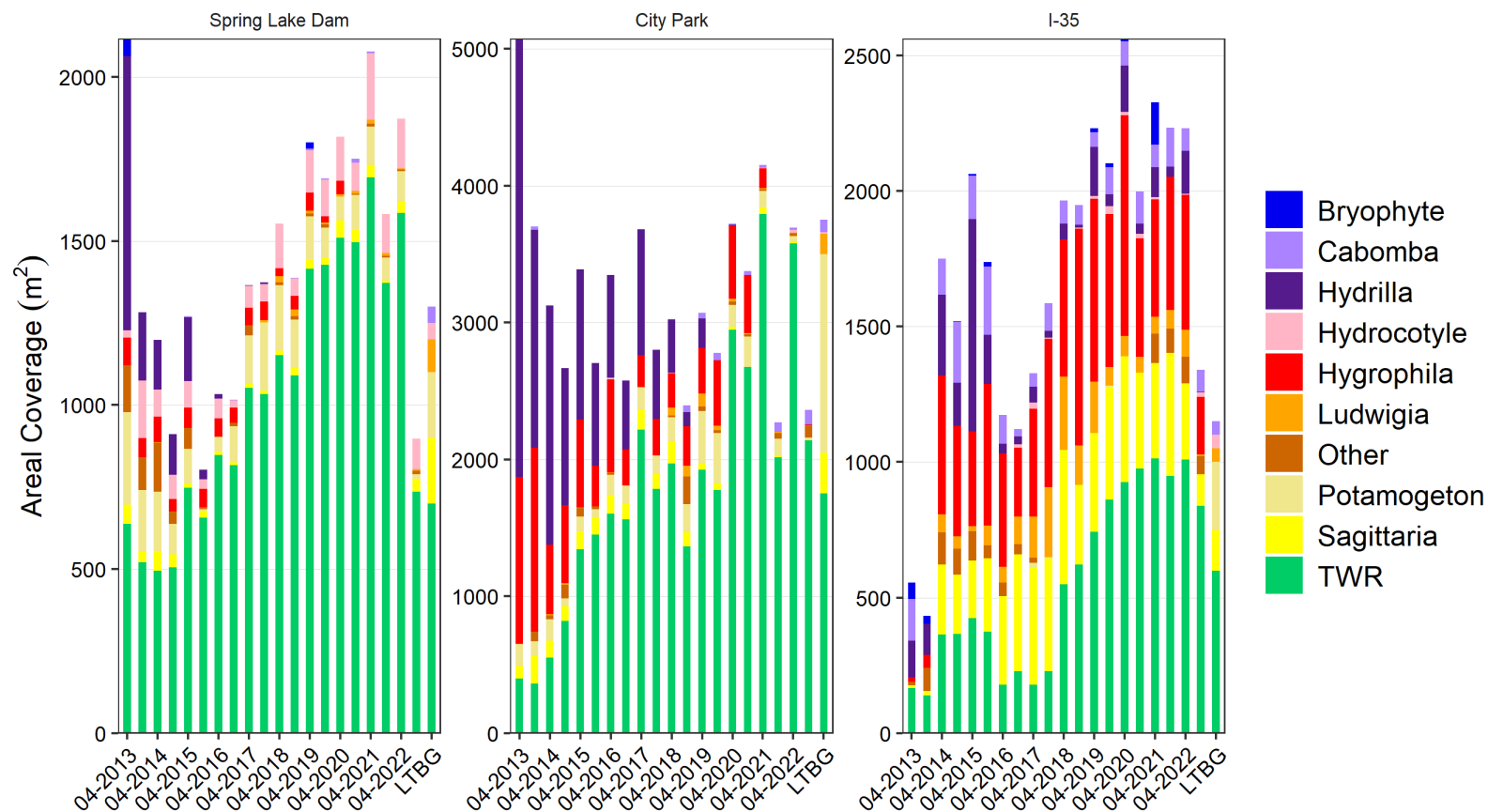


FIGURE 3-2

Submerged Aquatic Vegetation Coverage of Selected Plant Species in the Long-Term Biological Goal Reaches of the San Marcos Springs System, 2013-2022

Species coverage data are from routine spring/fall biological monitoring mapping events. Long-Term Biological Goals are represented in the stacked bar at the far right of each chart.



3.2 Comal Springs Riffle Beetle

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 2022 CSRB sampling results to the population-based LTBGs at each sample reach.



Comal Springs
riffle beetle
Heterelmis comalensis
ENDANGERED

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

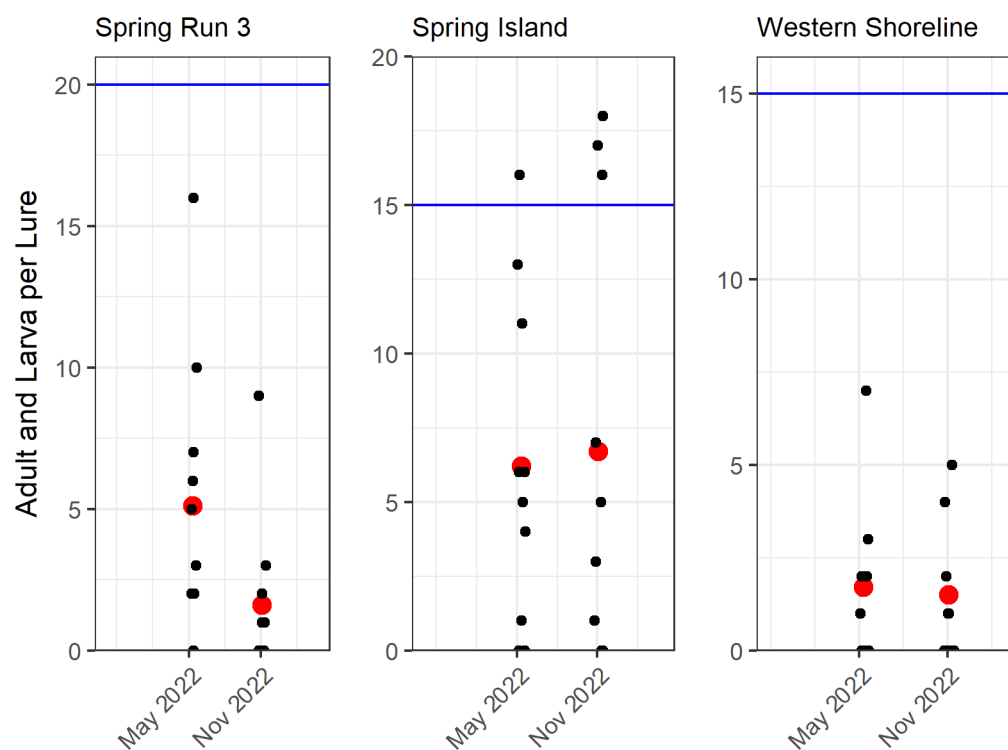
Comal Springs Riffle Beetle Long-Term Biological Goals

	Spring Run 3	Western Shoreline	Spring Island Area
Habitat	Silt-free gravel and cobble substrate \geq 90% of each study area		
Density (# of individuals/lure)	\geq 20	\geq 15	\geq 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 2022 are displayed as red dots.



3.3 Comal Springs Dryopid Beetle and Peck's Cave Amphipod

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.



Comal Springs
dryopid beetle
Stygoparnus comalensis
ENDANGERED



Peck's cave
amphipod
Stygobromus pecki
ENDANGERED

3.4 Texas Wild-Rice

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.



Texas wild-rice
Zizania texana
ENDANGERED

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. In an effort to reduce the impacts of recreation during low flow conditions, rope exclosures were installed around TWR stands in early 2022 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 2022 Coverage

River Segment	Goal Areal Coverage (m ²)	2022 Areal Coverage (m ²)	Goal Percentage of Total Areal Coverage	2022 Percent of Total Areal Coverage
Spring Lake	1,000-1,500	99	N/A	0.8
Spring Lake Dam to Rio Vista Dam	5,810-9,245	11,692	83-66	89.5
Rio Vista Dam to IH-35	910-1,650	860	13-12	6.5
Downstream of IH-35	280-3,055	419	4-22	3.2
TOTALS	8,000-15,450	13,070	100	100

Abbreviations

m² = 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 and limiting the impacts of recreation by using state scientific area (SSA) exclusions at flows less than 120 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 seeks to maintain 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 2022 biological monitoring results compared with the LTBGs at each location.

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.



San Marcos salamander

Eurycea nana

THREATENED

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 \geq 90% of each study area		
Density (# of individuals/m ²)	\geq 15	\geq 10	\geq 5

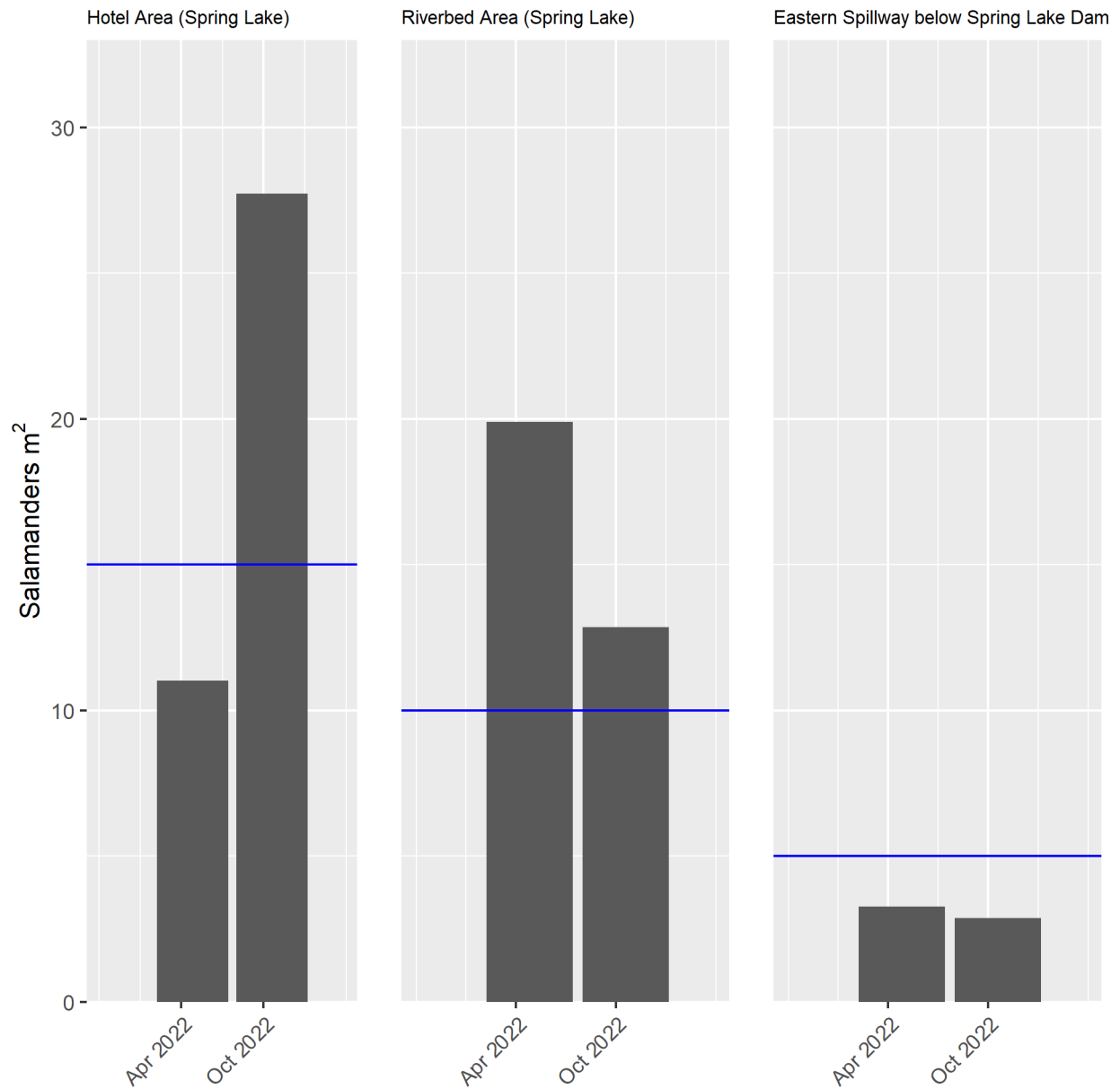
Abbreviation

m² = 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 rathbuni

ENDANGERED

3.7 Flow Objectives

Flow protection Conservation Measures—Aquifer Storage & Recovery (ASR), 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

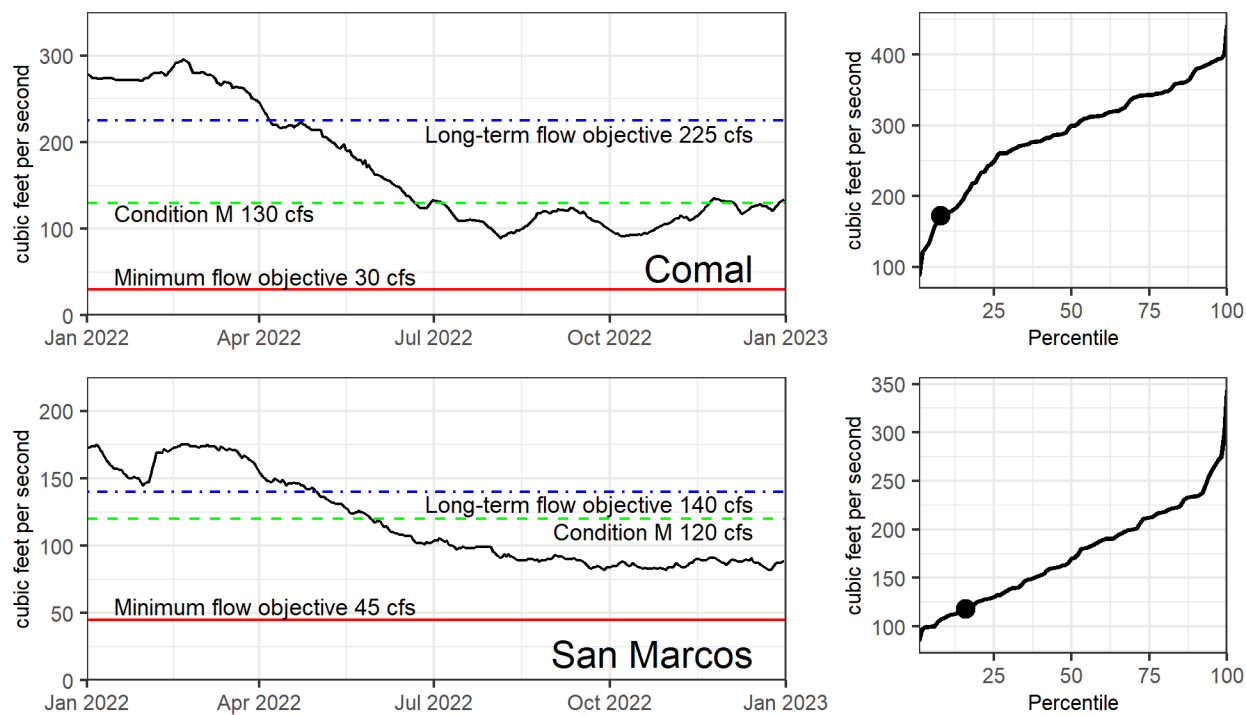
cfs = cubic feet per second

FIGURE 3-5 illustrates daily average flows (plots on the left) and the average calendar year springflow as a percentile for the period of record (plots on the right) for the Comal and San Marcos rivers in 2022. In June, Comal and San Marcos springflows fell below Condition M levels (130 cubic feet per second and 120 cubic feet per second, respectively); habitat mitigation and restoration activities were limited in accordance with the ITP. Condition M restrictions remained in place through 2022.

FIGURE 3-5

Springflow Hydrographs for Comal and San Marcos Springs for Calendar Year 2022 (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 gage. 2022 average springflow is marked with a dot.



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4 | 2022 Annual Take and Net Disturbance Estimates

CHAPTER OVERVIEW

- Covered Activities resulted in take of 5,064 fountain darters, 743 Comal Springs riffle beetles, 5 Comal Springs dryopid beetles, and 115 Peck's cave amphipods in the Comal Springs system.
- Covered Activities resulted in take of 37,442 fountain darters and 3,559 San Marcos salamanders in the San Marcos Springs system.
- Aquatic recreation in 2022 increased compared to prior years, leading to habitat loss; this accounts for the increase in take of fountain darters in 2022.
- Minimization and mitigation activities resulted in a net disturbance of 0.46 percent of fountain darter occupied habitat in the Comal Springs system. Minimization and mitigation activities resulted in a net disturbance of 4.4 percent and 0.17 percent of fountain darter habitat and San Marcos salamander habitat, respectively, in the San Marcos Springs system. Minimization and mitigation activities conducted in 2022 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 2022, 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 2022 incidental take and net disturbance assessments are included in Appendix J.

The EAHCP measures take from changes in occupied habitat in the San Marcos Springs and Comal Springs systems. Annual incidental take has been fairly consistent over the life of the ITP. In either system, take rarely occurs for species other than fountain darter. 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. Recreation increased in

2022, 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 2021, San Marcos fountain darter take each year was approximately 12,000 individuals. As noted in **TABLE 4-1**, San Marcos fountain darter take in 2022—as measured by the reduction in habitat—was 37,442 individuals. **TABLE 4-1** also shows total take available for implementation of the EAHCP over the remaining permit term.

The incidental take of Comal Springs system invertebrates resulted from low total system discharge, increasing the amount of exposed surface habitat characterized as Comal invertebrate occupied habitat.

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 2022 Total (m²)	Incidental Take		2022 Incidental Take Total	Permitted Maximum Take	Accumulated Take to Date	Remaining Permitted Take
	Impacted Habitat (m²)	Net Disturbance % of Total Occupied Habitat	Impacted Habitat (m²)		EAHCP Mitigation/ Restoration	EAHCP Measures/ Drought				
Comal Springs System										
Fountain darter	227	0.46%	3,149	3,376	341	4,724	5,064	797,000	71,655	725,345
Comal Springs riffle beetle	0	0%	112.6	112.6	0	743	743	11,179	3,034	8,145
Comal Springs dryopid beetle	0	0%	48.8	48.8	0	5	5	1,543	21	1,522
Peck's cave amphipod	0	0%	110.7	110.7	0	115	115	18,224	281	17,943
San Marcos Springs System										
Fountain darter	4,172.9	4.4%	8,909.2	13,082.1	6,259.4	31,182.2	37,442	549,129	185,178	363,951
San Marcos salamander	4.3	0.17%	591	595.3	12.9	3,546	3,559	263,857	6,955	256,902
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

Abbreviationsm² = square meter; N/A = not applicable

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5 | Program Management, Financial Report, and Committee Activities

CHAPTER OVERVIEW

- EAHCP staff initiated the Permit Renewal for the EAHCP, a multi-year planning process to complete a major amendment of the Incidental Take Permit to extend the permit duration beyond its expiration in 2028.
- Program staff participated in a series of four public “listen and learn” workshops for the Permit Renewal.
- The EAHCP Program is fiscally stable with a reserve balance of \$22,702,150 and a \$35,556,158 cash balance. There are adequate funds for fiscal year 2023.
- EAHCP Committees and Work Groups continued to meet virtually and in-person.

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 Manager³ 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 2022, 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 one work-study student (summer). One Program staff position—Senior Program Coordinator—remained unfilled in 2022.

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*.

5.1.1 Management Activities and Special Projects

Program management activities performed in 2022 included coordination with Permittees in accordance with the ITP, Implementing Agreement, EAHCP, FMA, and other Program documents. 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 2022. The Program Coordinators worked with the work-study student to create story maps of Covered Species and digitize previous implementation efforts to update geographic information systems (GIS). EAHCP staff initiated the **Permit Renewal** for the EAHCP, a multi-year planning process to complete a major amendment of the ITP to extend the permit duration beyond its expiration in 2028. The EAHCP Program Manager, Program staff, and Permittees participated in four “listen and learn” workshops facilitated by a consultant, ICF, to gather public feedback about key topics to be addressed by the Permit Renewal (Appendix F4). They also coordinated refugia activities with USFWS Fisheries and Program activities and planning for the Permit Renewal with the USFWS Ecological Services.

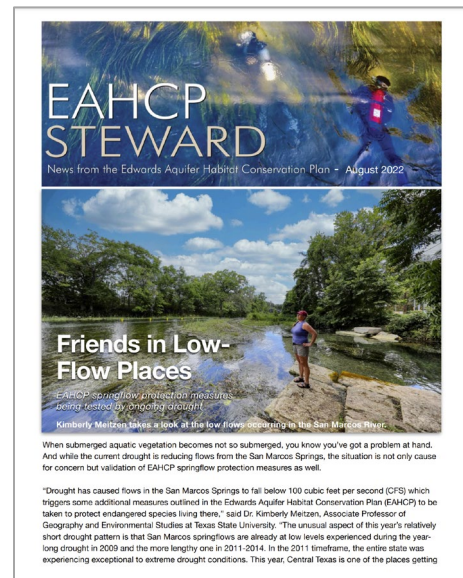
In 2021, Program staff coordinated closely with TPWD to submit a Cooperative Endangered Species Fund (ESA Section 6) HCP Planning Assistance Grant to fund the Permit Renewal process. The grant was awarded in 2022 and funds will be applied in 2023. To support the Permit Renewal effort, a contractor (ICF) was selected in early 2022 following a competitive bid process.

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; 2022 Work Plans are included in Appendix E.

5.1.3 Outreach

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 2022, 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 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 2022 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 local, 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 2023. The Program is fiscally stable with a reserve balance of \$22,702,150 and a \$35,556,158 cash balance. If triggered by drought, ASR and VISPO forbearance payments are the largest expense. ASR forbearance did not trigger in 2022. VISPO triggered in October 2022 and will require the EAA to issue VISPO forbearance payments in 2023.

Section 6.1 of the FMA specifies that the EAA Board of Directors approves each Permittee's Program Funding Application budget in the fall of the year prior to implementation. A Program Funding

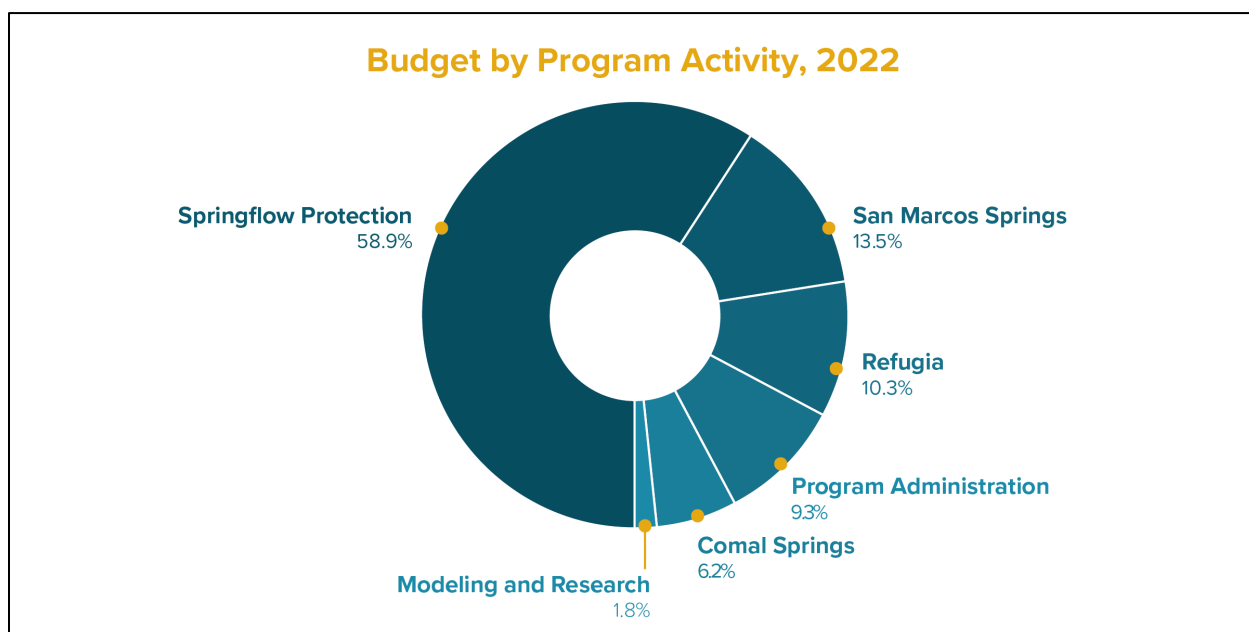
Application is the mechanism by which a Permittee requests funding to implement the Conservation Measures or other Program-related activities. The EAA Board of Directors approved the 2022 Program Funding Applications for Permittees at its meeting on November 9, 2021.

Amendments to the EAA and CONB Program Funding Applications were approved by the EAA Board of Directors in 2022. 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 Financial Report (Appendix L). The EAHCP Financial Report shows Table 7.1 of the EAHCP funding amounts for 2022 totaling \$16,924,347.

FIGURE 5-1 reflects the 2022 EAHCP Program budget by EAHCP activity. No new funding needs were identified in 2022.

FIGURE 5-1

2022 EAHCP Program Budget by Program Activity



5.3 Committee Activities

Virtual meetings throughout 2022 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* (Revised May 2022)
- *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 1 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, five SC meetings, and four SH meetings were facilitated; of these, three 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 three Work Groups—the Budget Work Group, Research Work Group, and Science Committee Vacancy Work Group.

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

TABLE 5-1
2022 EAHCP Committee Meetings

Date	Committee(s)	Actions, Reports, or other Notable Items
February 15	SC	<ul style="list-style-type: none"> ▪ Report from Hakan Basagaoglu on the artificial intelligence modeling for groundwater management ▪ Report on the Springflow Habitat Work Group proceedings related to low-flow monitoring programs and performance of the EAHCP water quality modeling during 2014 low flow conditions
March 24	IC and SH	<ul style="list-style-type: none"> ▪ Approved submission of the 2021 EAHCP Annual Report to the USFWS and amended the 2022 EAA Work Plan and Funding Application ▪ Approved Nathan Bendik, salamander expert, as a new member of the SC ▪ Report on the 2021 net disturbance and incidental take in the Comal and San Marcos Springs systems ▪ Elected 2022 SH officers
April 27	SC	<ul style="list-style-type: none"> ▪ Welcomed new SC member, Nathan Bendik ▪ Reports on the 2023 EAA, COSM, and CONB Work Plans ▪ Presentation on the proposed routine adaptive management to add two native aquatic plants to the list of approved submerged aquatic vegetation restoration plants
May 19	IC and SH	<ul style="list-style-type: none"> ▪ Approved the 2023 EAA, COSM, and CONB Work Plans and amendments to the 2022 CONB and EAA Work Plans and Funding Applications ▪ Approved the 2022 Budget Work Group members ▪ Report on the SC Vacancy Work Group ▪ Approved SH Operational Rule revisions
September 9	IC	<ul style="list-style-type: none"> ▪ Report on the U.S. Army Corps of Engineers' Section 206 Aquatic Ecosystem Restoration Project in San Marcos ▪ Reports on the Permit Renewal process, the 2021 critical period management, permitted groundwater authorization, and reported use ▪ Approved submittal of the 2022 Budget Work Group Report for the EAA Board of Directors

Date	Committee(s)	Actions, Reports, or other Notable Items
September 14	SC	<ul style="list-style-type: none"> Report on the proposed schedule and activities related to springflow projections for the Permit Renewal process Report on the proposed 2023 submerged aquatic vegetation applied research activities Approved two native aquatic plant species to be added to the list of submerged aquatic vegetation restoration plants
October 13	IC and SH	<ul style="list-style-type: none"> Report on several Permit Renewal items: schedule, Biological Goals Subcommittee, and activities related to springflow projections Approved Megan Bean, native fish expert, and Jason Martina, aquatic vegetation expert, as new members of the SC Approved the final 2023 EAA, COSM, and COSM Work Plans and Funding Applications
November 9	SC	<ul style="list-style-type: none"> Welcomed new SC members Megan Bean and Jason Martina Presentation on the South Central Climate Adaptation Center's progress on downscaling future climate scenarios for the Permit Renewal
December 16	IC, SH, and SC	<ul style="list-style-type: none"> Approved the Biological Objectives Subcommittee Charge as part of the Permit Renewal process Approved 2023 IC and SH officers and 2023 EAA Work Plan amendments Presentation on the Permit Renewal listen and learn workshops report

Abbreviations

CONB = City of New Braunfels; COSM = City of San Marcos; CSRB = Comal Springs riffle beetle; EAA = Edwards Aquifer Authority; 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 2022 one non-voting member from the Guadalupe-Blanco River Authority served on the IC. **TABLE 5-2** lists 2022 IC members.

In 2022 the IC met once virtually; and the remaining four meetings were in-person at either EAA or CONB City Hall. Meeting dates and action items are listed in **TABLE 5-1**; agendas and meeting minutes are provided in Appendix M1.

TABLE 5-2

2022 Implementing Committee Members

Committee Member	Entity	Alternate
Robert Mace, Ph.D. [Chair]	Texas State University	Kimberly Meitzen, Ph.D.
Donovan Burton [Vice-Chair]	San Antonio Water System	Patrick Shriver
Roland Ruiz	Edwards Aquifer Authority	Brock Curry
Phillip Quast	City of New Braunfels	No alternate named
Tom Taggart [Secretary]	City of San Marcos	Mark Enders
Jana Gray	Guadalupe-Blanco River Authority	Nathan Pence

5.3.1.1 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 2022 were Tom Taggart (IC), Brock Curry (EAA designee), Myron Hess (SH), Cecilia Velasquez (SAWS designee), and Adam Yablonski (Irrigator). The Work Group met on June 30, 2022, to review and discuss the EAA 2023 budget process and to monitor the management of EAHCP revenue and expenses.

The Budget Work Group’s report (Appendix M2) describes the current financial projections and cost estimates for the 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 in the Work Group. The IC updated the Budget Work Group charge at its December meeting. New individuals will be appointed in 2023 to fill open positions.

5.3.1.2 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. No meetings were held in 2022; however, the work group continues in existence and is charged with reviewing results of ongoing studies and monitoring to develop possible additional recommendations (Appendix M3).

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, retired in 2022), Kimberly Meitzen (TXST), Charles Ahrens (EAA), Jacquelyn Duke (SC representative), Charles Kreidler (SC representative), and Tom Arsuffi (SC representative).

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 26 SH representatives, their affiliations, and their alternates as of the end of 2022.

In 2022 the SH met four times in-person with a virtual option. The SH amended their Operational Rules at its meeting in May. Meeting dates and action items are listed in **TABLE 5-1**; agendas and meeting minutes are provided in Appendix M4.

TABLE 5-3

2022 Stakeholder Committee Members

Committee Member	Entity	Affiliation	Alternate
Myron Hess [Chair]	Texas Living Waters Project	Environmental interest from the Texas Living Waters Project	Jennifer Walker
Kimberly Meitzen, Ph.D. [Vice Chair]	Texas State University	Texas State University	Robert Mace, Ph.D.
Patrick Shriver [Secretary]	San Antonio Water System	San Antonio Water System	Brandon Payne
Doris Cooksey	City Public Service Energy	City Public Service Energy	Matthew Schwartz
Vacant	To be determined	Recreational interest in the Guadalupe River Basin	No alternate named
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
Kevin Mayes	Texas Parks & Wildlife Department	Texas Parks & Wildlife Department	Shannon Love
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	Michael Short
Julie Lewey	Nueces River Authority	Nueces River Authority	John Byrum
James Dodson	City of Victoria	Holder of a municipal surface water right in the Guadalupe River Basin	No alternate named
Phillip Quast	City of New Braunfels	City of New Braunfels	No alternate named
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	City of Garden Ridge	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
Mark Enders	City of San Marcos	City of San Marcos	Greg Schwartz
David Villarreal	Texas Department of Agriculture	Texas Department of Agriculture	Addie Stone
Glenn Lord	DOW Chemical	Holder of an industrial surface water right in the Guadalupe River Basin	Dwaine Schoppe

Committee Member	Entity	Affiliation	Alternate
Brian Mast	San Antonio River Authority	San Antonio River Authority	Allison Elder
Gary Middleton	South Central Texas Water Advisory Committee	South Central Texas Water Advisory Committee	No alternate named
Carol Patterson	Regional Clean Air and Water	Edwards Aquifer region municipal ratepayers/general public	Kirk Patterson
Jana Gray	Guadalupe-Blanco River Authority	Guadalupe-Blanco River Authority	Nathan Pence
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

5.3.2.1 Science Committee Vacancy Work Group

The Science Committee Vacancy Work Group comprises members from the SH and is charged with nominating two new SC members to replace two SC members who retired in 2021. The Work Group nominated Megan Bean, Native Fish Conservation Coordinator at TPWD, and Jason Martina, Assistant Professor in the Department of Biology at TXST. The Work Group nominations were approved by the IC at its October meeting, and the two new members were welcomed to the SC at its November meeting.

Members of the Work Group included Colette Barron Bradsby —Chair (TPWD), Kimberly Meitzen (TXST), Nathan Pence (Guadalupe-Blanco River Authority), Patrick Shriver (SAWS), and James Dodson (City of Victoria). Appendix M5 includes the Work Group’s final report, which includes the charge, agenda, and meeting documents.

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 2022 are listed in **TABLE 5-4**.

In 2022 the SC met twice in-person with a virtual option 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 M6.

TABLE 5-4

2022 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
Butch Weckerly, Ph.D.	Texas State University	Population Ecology–Experimental Design	SH
Tom Arsuffi, Ph.D.	Texas Tech University (Retired)	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
Jack Sharp, Ph.D.	University of Texas at Austin	Hydrology–Hydrogeology	Joint IC and SH
Nathan Bendik, M.S.	City of Austin	Salamander Conservation	IC
Megan Bean, M.S.	Texas Parks & Wildlife Department	Native Fish Conservation	SH
Jason Martina, Ph.D.	Texas State University	Aquatic Macrophytes	SH

Abbreviations

IC = Implementing Committee; SH = Adaptive Management Stakeholder Committee

5.3.3.1 Comal Springs Riffle Beetle Work Group

The CSRБ Work Group is charged with reviewing and providing input on monitoring the CSRБ as part of EAHCP implementation. The Work Group members are Conrad Lamon (SC), Chad Norris (SC), Butch Weckerly (SC), David Britton (USFWS), and Tom Arsuffi (SC). The CSRБ Work Group met on May 27, 2022. Members discussed the proposed system-wide survey and genetic assessment on the CSRБ in Landa Lake; however, implementation of the proposed studies was suspended in 2022 due to low-flow conditions. The CSRБ Work Group’s meeting materials are provided in Appendix M7.

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 (**Table 5-5**). Progress on refugia research projects is documented annually in a report from the USFWS to the EAA (Appendix G). The Research Work Group’s meeting materials are provided in Appendix M8.

TABLE 5-5

Refugia Research Prioritization and Information Status

Covered Species	Research Topic				
	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	1
Comal Springs salamander	5	4	3	3	1
Comal Springs riffle beetle	5	4	3	2	1
Comal Springs dryopid beetle	3	2	1	1	1
Texas troglobitic water slater	1	1	0	1	0
Peck's cave amphipod	4	4	4	2	1
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), Butch Weckerly (TXST), and Conrad Lamon (Statistical Ecology Associates, LLC)—are all SC members. No meeting of the Research Work Group occurred in 2022.

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 2022.

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 2022 Members

Appointee	Affiliation	Alternate
Donovan Burton	San Antonio Water System	Patrick Shriver
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
Shannon Love	Environmental interest	No alternate named
Buck Benson	Industry	Summer Johnson
Chad Norris	Downstream interest	Charlie Hickman
Scott Storment	EAHCP Program Manager	No alternate named

6 | Plan Changes and Correspondence

CHAPTER OVERVIEW

- No administrative changes occurred in 2022.
- The EAHCP Program Manager corresponded with the U.S. Fish & Wildlife Service in 2022 regarding its 5-year status review of Texas wild-rice, creation of a state scientific area within the Comal Springs system, and triggering of the Voluntary Irrigation Suspension Program Option on October 1.

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.

6.2 Adaptive Management Process

Article 7 of the FMA outlines the procedural steps and responsibilities of the Permittees for the AMP. 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 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). No AMP changes were made in 2022.

6.3 Changed Circumstances

The EAHCP describes 12 changed circumstances that, if they occur during the permit term, would require responsive measures to address. No changed circumstances occurred in 2022.

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 on (1) responding to the USFWS’ 5-year status review of Texas wild-rice (Appendix D1), (2) notifying the USFWS of implementation of ITP Condition M on the San Marcos (Appendix D2) and Comal (Appendix D3) rivers, (3) notifying the USFWS of the VISPO trigger (Appendix D4), and clarifying sections of the EAHCP in relation to an SSA on the Comal River (Appendix D5).



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, 2021, to November 30, 2022, 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

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

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

^a These species occur as habitat for the fountain darter in the Comal Springs system only.

^b These species occur as 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 USFWS 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.

Permit Renewal: Initiated in 2022 by the Permittees, this multi-year planning process is intended to complete a major amendment of the ITP to extend the permit duration beyond its expiration in 2028.

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.

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EAHCP



**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.**

www.edwardsaquifer.org/habitat-conservation-plan