Final Recovery Plan for the Southern Edwards Aquifer Springs and Associated Aquatic Ecosystems, Second Revision

Fountain darter (*Etheostoma fonticola*), Peck's cave amphipod (*Stygobromus pecki*), Comal Springs riffle beetle (*Heterelmis comalensis*), Texas wild-rice (*Zizania texana*), San Marcos salamander (*Eurycea nana*), Texas blind salamander (*Eurycea rathbuni*), and Comal Springs dryopid beetle (*Stygoparnus comalensis*)

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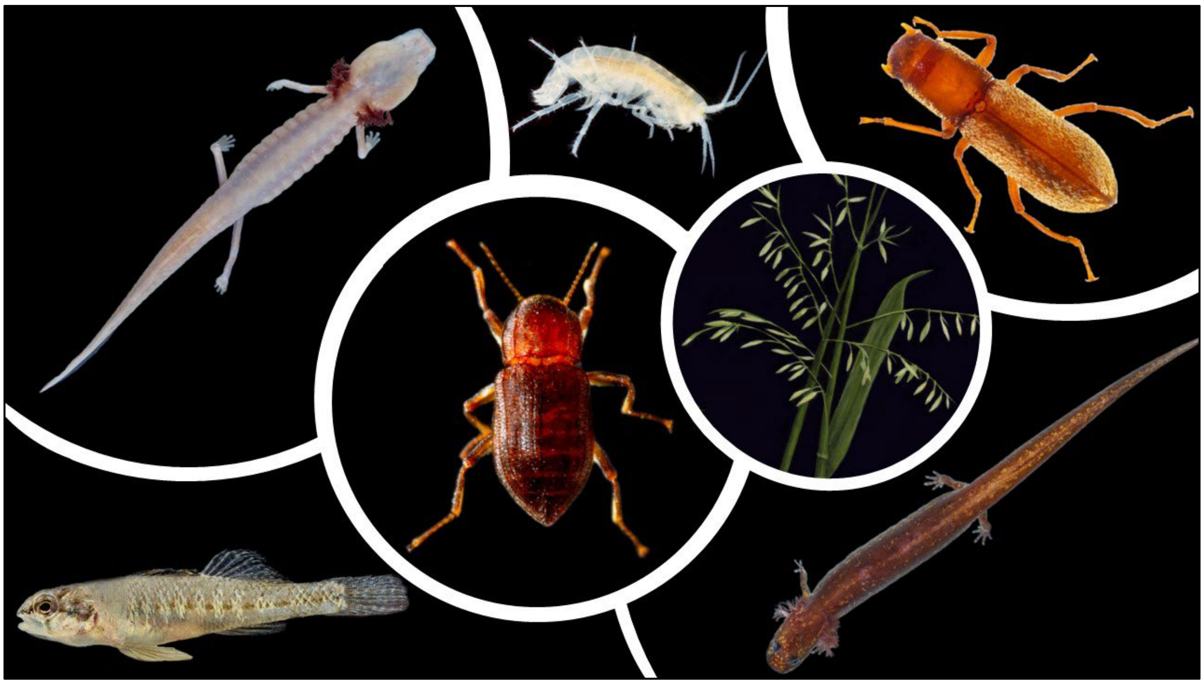

U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, NM

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Regional Director, Southwest Region
U.S. Fish and Wildlife Service

Purpose and Disclaimer

This document presents the U.S. Fish and Wildlife Service's (USFWS) plan for the conservation of southern Edwards Aquifer springs and associated aquatic ecosystem species. The recovery plan is the second part of the USFWS's 3-part recovery planning framework and includes the statutorily required elements pursuant to section 4(f) of the Endangered Species Act (ESA). This recovery plan is informed by the first part of the framework, a Species Biological Report (SBR) (USFWS 2025a, entire). The SBR report delivers foundational science for informing decisions related to the ESA and includes an analysis of the best available scientific and commercial information regarding a species' life history, biology, and current and future conditions that characterizes the species' viability (i.e., ability to sustain populations in the wild over time) and extinction risk. We have also prepared a Recovery Implementation Strategy (RIS), the third part of the framework (USFWS 2025b, entire). The RIS is an easily updateable operational plan that is separate and complementary to the recovery plan that details the on-the-ground recovery activities needed to complete the recovery actions contained in the recovery plan.

Recovery plans describe the envisioned recovered state for a listed species (when it should no longer meet the ESA definitions of a threatened species or endangered species) and include a recovery strategy, recovery criteria, recovery actions, and the estimates of time and cost needed to achieve recovery. Plans are published by the USFWS and are often prepared with the assistance of recovery teams, contractors, State agencies, and others. Recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in plan formulation, other than the USFWS. They represent the official position of the USFWS only after they have been signed by the Regional Director as approved. Recovery plans are guiding and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery actions.

Acknowledgements

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We are grateful to the people who have contributed their expertise, perspectives, and dedication to these species' recovery efforts over the last four decades. In particular, we would like to express our gratitude to the previous Recovery Team members, the Permittees and staff of the Edwards Aquifer Recovery Implementation Plan - Habitat Conservation Plan, the local communities within the recovery area, and the general public.

In addition to the people identified above, the following USFWS staff reviewed and provided comments on previous drafts of this plan: Katie Bockrath, Ph.D., Justin Crow, Randy Gibson, Chris Hathcock, and Desiree Moore, Ph.D. (San Marcos Aquatic Resources Center); Pete Diaz

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An electronic copy of the final recovery plan will be made available at the USFWS Environmental Conservation Online System (ECOS):

- ECOS species profile webpage for Comal Springs dryopid beetle;
- ECOS species profile webpage for Comal Springs riffle beetle;
- ECOS species profile webpage for fountain darter;
- ECOS species profile webpage for Peck's cave amphipod;
- ECOS species profile webpage for San Marcos salamander;
- ECOS species profile webpage for Texas blind salamander; and
- ECOS species profile webpage for Texas wild-rice

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1.0 Introduction

This recovery plan describes criteria for determining when the southern Edwards Aquifer springs and associated aquatic ecosystem species should be considered for delisting, lists site-specific actions that will be necessary to meet those criteria, and estimates the time and cost to achieve recovery. Additionally, a brief summary of information on the species' biology and status are included, along with a brief discussion of factors limiting their populations. A detailed discussion of these and other topics pertinent to the recovery of the southern Edwards Aquifer springs and associated aquatic ecosystem species can be found in the Species Biological Report (SBR) (USFWS 2025a, entire). Detailed on-the-ground activities implementing recovery actions can be found in the Recovery Implementation Strategy (RIS). The RIS and SBR are finalized separately from the recovery plan and will be updated on a routine basis. This document presents the USFWS plan for the conservation and recovery of the ESA-listed species of the southern Edwards Aquifer springs and associated aquatic ecosystems.

The southern Edwards Aquifer springs and associated aquatic ecosystem species are the Comal Springs dryopid beetle (*Stygoparnus comalensis*), Comal Springs riffle beetle (*Heterelmis comalensis*), fountain darter (*Etheostoma fonticola*), Peck's cave amphipod (*Stygobromus pecki*), San Marcos salamander (*Eurycea nana*), Texas blind salamander (*Eurycea rathbuni*), and Texas wild-rice (*Zizania texana*). All these species are endangered except for the San Marcos salamander, which is threatened. These species were listed under the ESA in 1975 (Texas blind salamander and fountain darter, 40 FR 44412), 1978 (Texas wild-rice, 43 FR 17910), 1980 (San Marcos salamander, 45 FR 47355), and 1997 (Comal Springs dryopid beetle, Comal Springs riffle beetle, and Peck's cave amphipod, 62 FR 66295). Changes to the species since the 1996 revision of the recovery plan include the removal of the San Marcos gambusia (*Gambusia georgei*) due to extinction (88 FR 71644) and the addition of the three invertebrate species (the beetles and amphipod) that were listed in 1997.

The species included in this recovery plan are all aquatic and depend on adequate groundwater and/or springflows in the southern segment of the Edwards Aquifer in Comal and Hays counties, Texas (see the SBR for hydrology information (USFWS 2025a, Section 1.1)). Receiving water from the Edwards Aquifer, Comal and San Marcos springs are the largest springs in Texas and host the only known populations of some species included in this plan. A few species have distributions that extend downstream in the Comal River and the upper San Marcos River. These are spring-dependent rivers, reliant on groundwater from the Edwards Aquifer, with relatively constant temperature and water chemistry. Genetically distinct populations of the Comal Springs dryopid beetle are found at Fern Bank Springs (Fries et al. 2004, pp. 9, 14-15; Gibson et al. 2008, pp. 76-77) and the Peck's Cave amphipod at Hueco Springs (Holsinger 1967, entire; Barr 1993, entire; Fries et al. 2004, p. 5; Gibson et al. 2008, pp.76-81; Ethridge et al. 2013, entire). Fern Bank Springs and Hueco Springs are two more springs that receive water from the Edwards Aquifer.

The location and habitat requirements of each species vary (Section 1.1.1 Management Units, below). The SBR (USFWS 2025a, Sections 1.2-1.8) provides additional background information on these species. The Texas blind salamander occurs in the subsurface of the Edwards Aquifer in the San Marcos area, including some caves and wells (Uhlenhuth 1921, p. 87; Russell 1976, pp. 1-4; Longley 1978, pp. 12-18; Chippindale 2009, pp. 8-11). This salamander is also expelled from springs in Spring Lake (receiving groundwater from the Edwards Aquifer). The San Marcos salamander is found at the headwaters of the San Marcos River and in Spring Lake (Tupa and Davis 1976, p. 191; Nelson 1993, pp. 19-20; Diaz et al. 2015, p. 317) and relies on interstitial spaces and vegetation for habitat (Diaz et al. 2015, pp. 307, 316).

The fountain darter and Texas wild-rice occur further downstream from the springs than the other species, with both species historically occurring throughout the upper San Marcos River (Jordan and Gilbert 1886, pp. 21-23 USFWS 2019, entire, BIO-WEST, Inc. 2023, p. 27). Texas wild-rice relies on cool, clear springwater for photosynthesis and establishes better in gravel and sand substrates overlying Crawford black silt and clay (Vaughan 1986, p. 17; Poole and Bowles 1999, entire; Saunders et al. 2001, p. 24). The fountain darter relies on submerged aquatic vegetation for habitat (Dowden 1968, pp.19-20; Phillips et al. 2011, entire; Edwards and Bonner 2022, entire). The fountain darter also occurs throughout the Comal River (Hubbs and Strawn 1957, p. 38; Schenck and Whiteside 1976, pp. 700-702).

The Comal Springs dryopid beetle occurs in springs, associated streams, and saturated subterranean pore spaces, including wells and springs at Landa Lake (an impoundment of the Comal River), in the New Braunfels, San Marcos, and Wimberley, Texas areas, all within the Edwards Aquifer (Barr and Spangler 1992, p. 41; Barr 1993, pp. 31, 53-55; BIO-WEST, Inc. 2004, p. 34; Fries et al. 2004, pp. 9, 14-15; Gibson et al. 2008, pp. 76-77; Kosnicki and Julius 2019a, p. 3). Peck's cave amphipod occurs in springs, associated streams, and saturated subterranean pore spaces in the New Braunfels area, including Panther Canyon Well (Holsinger 1967, p. 119; Barr 1993, pp. 56-57; Fries et al. 2004, pp. 5, 14; Gibson et al. 2008, pp.76-81). Comal Springs riffle beetle occurs immediately inside of or adjacent to springs, seeps, and upwellings where plant roots are inundated or otherwise influenced by aquifer water in the New Braunfels and San Marcos, Texas areas, including Spring Lake and Landa Lake spring openings (Bosse et al. 1988, entire; Barr 1993, pp. 31, 44; BIO-WEST, Inc. 2005, p. 51; 2006, p. 39; Gibson et al. 2008, p. 79; Nowlin and Worsham, 2015, p. 12).

Primary threats to the seven species are the loss of groundwater and/or springflows and decreases in suitable habitat due to drawdown of the Edwards Aquifer (see SBR, USFWS 2025a, Section 2.1.1). These species are also sensitive to declines in water quality (see SBR, USFWS 2025a, Section 2.1.2). Metropolitan areas and smaller municipalities along the eastern extent of the southern segment of the Edwards Aquifer are experiencing rapid human population growth and urban development that is expected to affect groundwater quality and quantity (see SBR, USFWS 2025a, Sections 2.1.1 and 2.1.2). Climate change-driven aridity combined with withdrawal of groundwater could lead to decreased springflows (see SBR, USFWS 2025a, Section 2.5). Additional threats that could decrease water quantity and quality include hazardous spills, direct or indirect habitat destruction through alterations of natural flow regimes, habitat disturbance or habitat modification by humans (e.g., recreational activities, dam building, concrete filling, excavation, bank stabilization, and control of aquatic vegetation), and nonnative species (see SBR, USFWS 2025a, Section 2.1). The fountain darter, San Marcos salamander, and Texas blind salamander are also subject to diseases and parasites that may affect their population resiliency (see SBR, USFWS 2025a, Section 2.3). These threats have necessitated the use of captive propagation efforts to ensure the long-term survival of these seven species until threats are abated. The SBR (USFWS 2025a, Section 2.0) further describes the threats to these species.

1.1 Recovery Strategy

The recovery strategy provides a concise overview of the envisioned recovered state for the southern Edwards Aquifer springs and associated aquatic ecosystems species, describes the USFWS's chosen approach to achieve it, and includes the rationale for why the approach was chosen. Specifically, the recovery strategy articulates how the plan's statutory elements (recovery criteria, recovery actions, and estimates of time and cost) will work together to achieve the southern Edwards Aquifer springs and associated aquatic ecosystems species' recovery.

Each species in this plan has naturally low redundancy of one to three populations in its historical range, as described in the SBR (USFWS 2025a, Section 1.0). Redundancy is the ability of the species to withstand catastrophic events. The species also have naturally low representation from occurring exclusively in ecosystems in the Edwards Aquifer. Each of these species is dependent on water and environmental conditions specific to the Edwards Aquifer. Representation is the ability of the species to adapt to both near-term and long-term changes in its physical and biological environment. Therefore, the USFWS does not think that there are actions we can take to increase natural redundancy and representation of these species, although captive refugia populations can increase redundancy. The primary focus of the criteria is improving the resiliency (i.e., having self-sustaining viable populations) of existing populations and reducing anthropogenic, or human-caused, threats. Long-term viability would require that the threats to these species be ameliorated or actively managed to levels that ensure resilient populations. Habitat would be restored and conserved such that sufficient habitat quantity and quality is maintained to support the long-term survival of each species. The overall recovery strategy involves preserving, restoring, and managing species' aquatic habitats, along with the water resources necessary to support resilient populations and the ecosystems on which they depend. Based on the current status and description of threats provided in the SBR (USFWS 2025a, entire), the strategy will involve:

Protecting and restoring the springs and spring-fed ecosystems throughout each species' range from ongoing threats. These threats include losses in water quality and water quantity, nonnative species, disease and parasites, and habitat disturbance, both now and into the future. Efforts to ensure population resiliency and reduce exposure to stressors will include:

1) Monitoring population resiliency, ongoing effects of threats to resiliency, and effectiveness of conservation management actions;
2) Using captive refugia to increase redundancy and protect against catastrophic events; and
3) Collaborating with partners and engaging with the public to achieve conservation goals in balance with community needs.

1.1.1 Management Units

The range of these species has been classified into four management units (Table 1; Figures 1-5). These geographically distinct management units are not regulatory in nature; the boundaries of these management units do not identify individual properties that require protection but are described solely to facilitate recovery and management decisions. The management units represent both the potential extent of habitat within the species' ranges and the biologically distinct areas where recovery actions (Section 2.0) should take place that will eliminate or ameliorate threats. Management units are individually necessary to conserve genetic distinctiveness, demographic robustness, important life history stages, or other features necessary for the long-term sustainability of the species. All management units in this recovery plan where a species is present must be recovered to achieve recovery of that species.

Comal Ecosystem Management Unit

The Comal Ecosystem Management Unit includes multiple springs that together are called Comal Springs, as well as associated spring runs, Landa Lake, the Comal River, Panther Canyon Well, and saturated subterranean pore spaces in designated critical habitat (78 FR 63100) (Figure 2). See the SBR for more details on the hydrology of and threats to this ecosystem, and on the habitat distribution of individual species within the management unit (USFWS 2025a, entire).

San Marcos Ecosystem Management Unit

The San Marcos Ecosystem Management Unit includes multiple springs that together are called San Marcos Springs, Spring Lake, the upper San Marcos River from the headwaters until the confluence with the Blanco River, subsurface habitat including private caves and wells that intersect the Edwards Aquifer in the San Marcos area, and Sessom Springs (Figure 3). See the SBR for more details on the hydrology of and threats to this ecosystem, and on the habitat distribution of individual species within the management unit (USFWS 2025a, entire).

Hueco Ecosystem Management Unit

The Hueco Ecosystem Management Unit includes multiple springs that together are called Hueco Springs, including downstream upwellings and side seeps (also referred to as satellite springs), and saturated subterranean pore spaces in designated critical habitat (78 FR 63100) (Figure 4). See the SBR for more details on the hydrology of and threats to this ecosystem, and on the habitat distribution of individual species within the management unit (USFWS 2025a, entire).

Fern Bank Ecosystem Management Unit

The Fern Bank Ecosystem Management Unit includes multiple springs that together are called Fern Bank Springs and includes saturated subterranean pore spaces in designated critical habitat (78 FR 63100) (Figure 5). However, additional features on the site, such as the cave and cave stream, are not included because the species within this recovery plan are not known to inhabit these areas (78 FR 63100). See the SBR for more details on the hydrology of and threats to this ecosystem, and on the habitat distribution of individual species within the management unit (USFWS 2025a, entire).

Table 1. Management unit occupancy for each species from the southern Edwards Aquifer springs and associated aquatic ecosystems.

Species	Management Unit Occupancy
Comal Springs dryopid beetle	San Marcos, Comal, and Fern Bank Ecosystems
Comal Springs riffle beetle	San Marcos and Comal Ecosystems
Fountain darter	San Marcos and Comal Ecosystems
Peck's cave amphipod	Comal and Hueco Ecosystems
San Marcos salamander	San Marcos Ecosystem
Texas blind salamander	San Marcos Ecosystem
Texas wild-rice	San Marcos Ecosystem

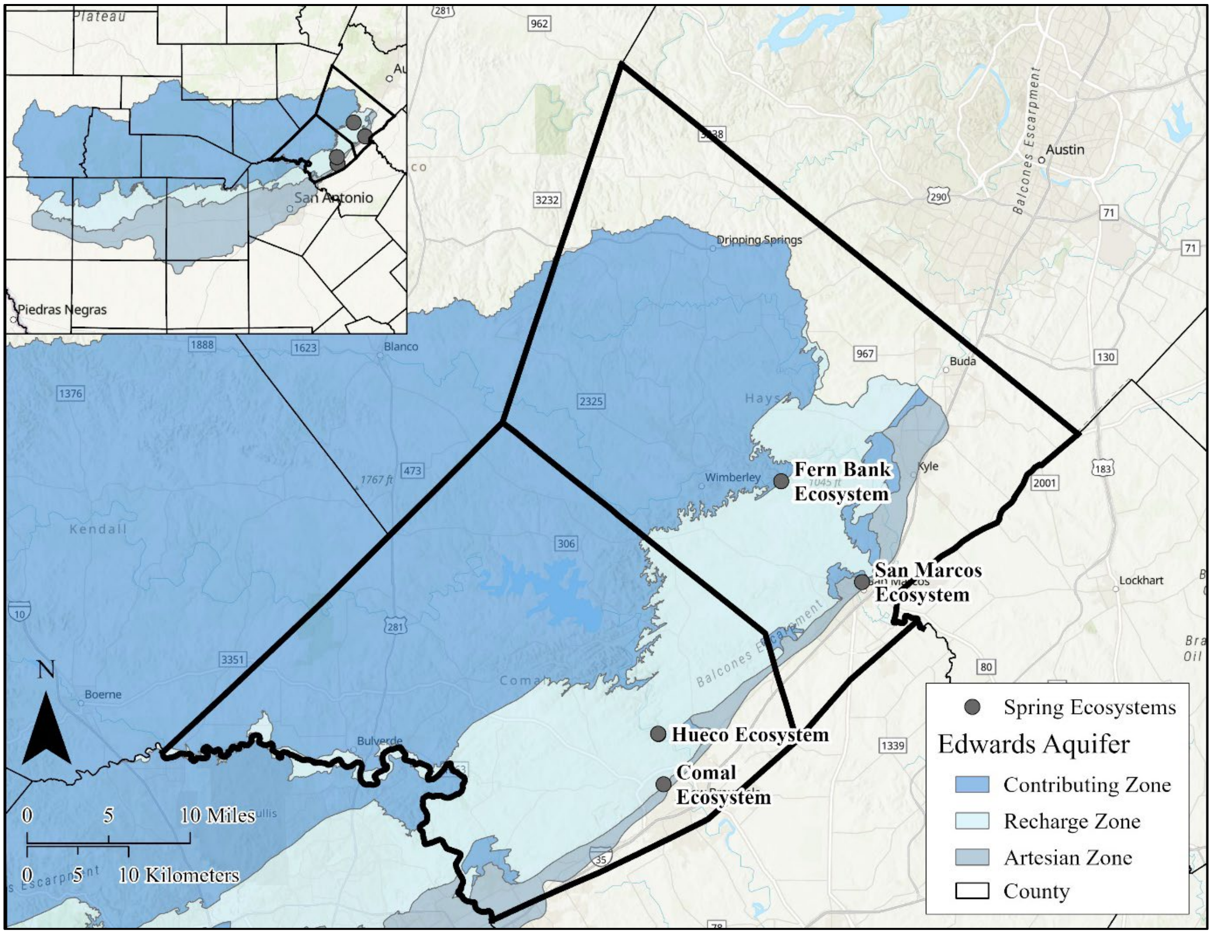

Figure 1. The four management units (Comal, San Marcos, Hueco, and Fern Bank ecosystems) for the southern Edwards Aquifer springs and associated aquatic ecosystems species in Comal and Hays counties, Texas.

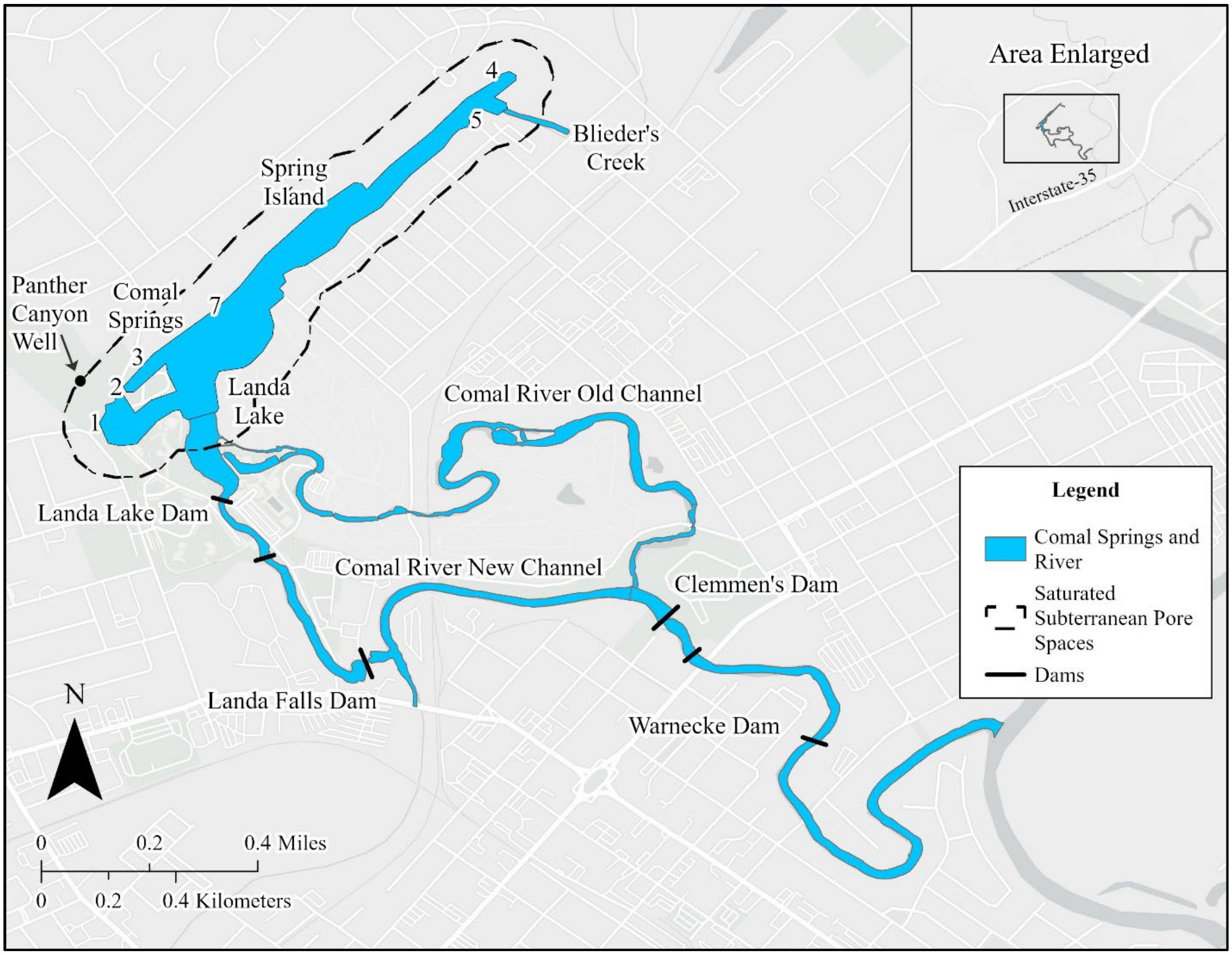

Figure 2. Map of the Comal Ecosystem Management Unit showing the Comal Springs ecosystem, the Comal River, and designated critical habitat surrounding Landa Lake in Comal County, Texas. Numbers on map indicate spring run locations referenced in this recovery plan.

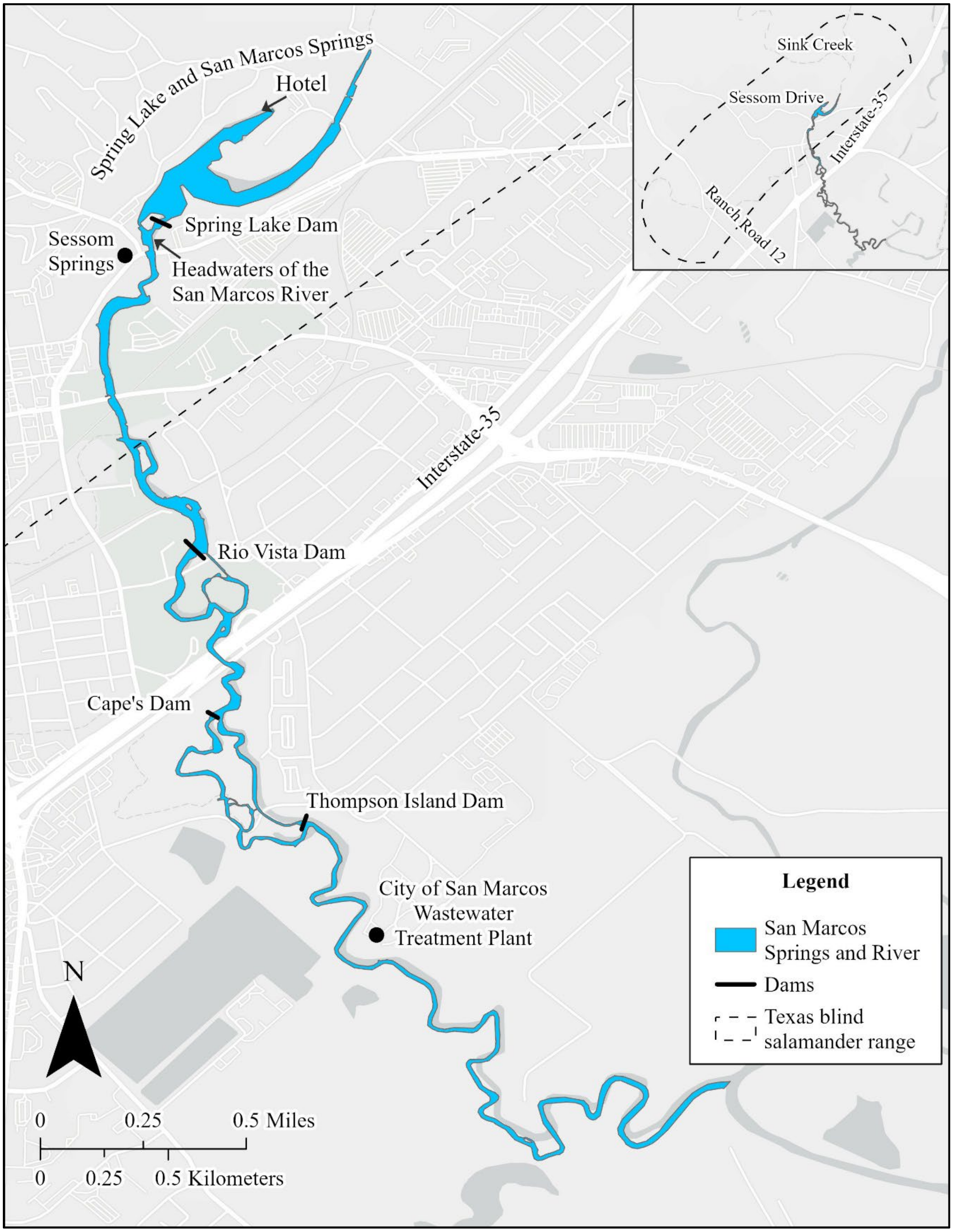

Figure 3. Map of the San Marcos Ecosystem Management Unit. The dotted outline encompasses subsurface habitat including private caves and wells that intersect the Edwards Aquifer in the San Marcos area.

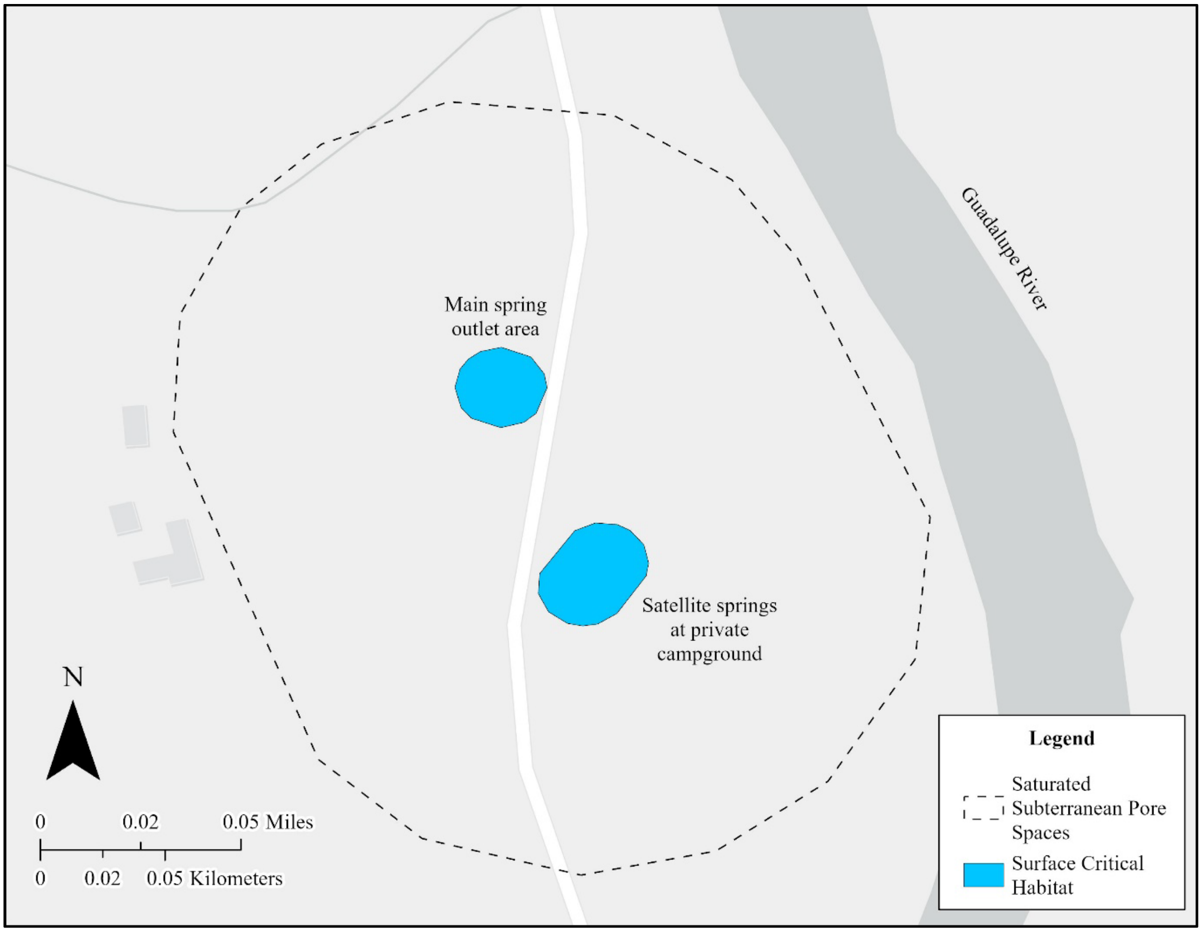

Figure 4. Map of the Hueco Ecosystem Management Unit showing the two major spring outlets at Hueco Springs and designated critical habitat adjacent to the Guadalupe River in Comal County, Texas.

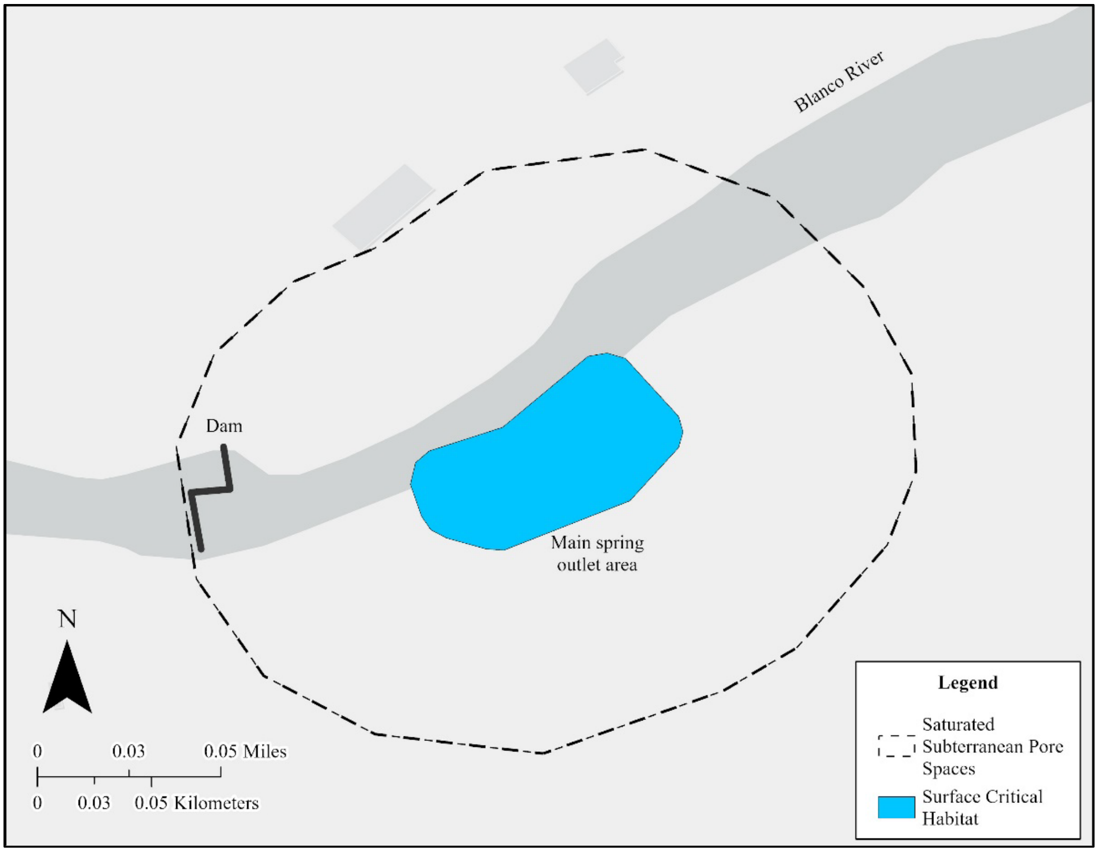

Figure 5. Map of the Fern Bank Ecosystem Management Unit showing the main spring outlet of Fern Bank Springs and subsurface designated critical habitat adjacent to the Blanco River in Hays County, Texas.

2.0 Criteria

Recovery criteria are statutorily required objective, measurable descriptions of a recovered state for threatened and endangered species, as described in 4(f)(1)(b)(ii) of the ESA. Recovery criteria describe the conditions of resiliency, redundancy, representation, and threat abatement that indicate when southern Edwards Aquifer springs and associated aquatic ecosystem species may no longer meet the ESA definitions of an endangered species or threatened species. Recovery criteria present our best estimate of a species' recovered condition at the time of recovery plan development. Changes in available information, technologies, and our understanding of the species over time might mean that the recovered state envisioned by the recovery criteria differs from our assessment in a later status determination.

All the species included in this plan, except for the San Marcos salamander, are currently endangered species; accordingly, this recovery plan includes both downlisting and delisting criteria. While the downlisting criteria do not apply to the San Marcos salamander, this species will also benefit from progress on the downlisting criteria. The species addressed in this recovery plan may be considered for downlisting and delisting when the following criteria have been met. Downlisting and delisting criteria are subject to revision as additional information becomes available about the species' biology and threats. Justifications for the criteria are below in Section 2.3.

2.1 Downlisting Criteria

The following downlisting criteria, when met collectively, would indicate that the Comal Springs dryopid beetle, Comal Springs riffle beetle, fountain darter, Peck's cave amphipod, Texas blind salamander, and Texas wild-rice may be reclassified as a threatened species. The San Marcos salamander is currently a threatened species; therefore, the downlisting criteria do not apply to this species. A detailed analysis of threats and summary of the threats to the seven southern Edwards Aquifer springs and associated ecosystem species is further described in the SBR (USFWS 2025a, entire).

1. All populations of each species, in all management units where the species is present, maintain sufficient resiliency for 18 consecutive years.

   For **surface species** (fountain darter, Comal Springs riffle beetle, and Texas wild-rice), sufficient resiliency will be achieved when:

   a. Populations do not trend toward a decline and do return to the cumulative mean after short-term fluctuations (cumulative mean is defined here as the mean of the dataset over time, also known as a running average);
   b. Populations do not fluctuate below the cumulative mean of non-drought years (non-drought years is defined as the mean of previous years that Comal or San Marcos springs did not decrease below 2.83 meters squared per second (m^3/s) (100 cubic feet per second [cfs]) by more than 10% in a given year;
   c. Populations do not decline from the cumulative mean of non-drought years more than 25% during drought years when Comal or San Marcos springs decreases below 2.83 m^3/s (100 cfs); and
   d. Populations do not decline from the cumulative mean of non-drought years more than 50% during a repeat of the Drought of Record or worse (Drought of Record is defined in this document as a three-year period when aquifer recharge is 397,800 acre-feet (ac-ft) total or less, which last occurred from 1954-1956).

   Methods used for animal species (fountain darter, Comal Springs riffle beetle) should estimate population size (based on, e.g., capture-recapture, depletion) rather than using counts of individuals as a surrogate to estimate population.

   For **subsurface species** (Comal Springs dryopid beetle, Peck's cave amphipod, and Texas blind salamander), sufficient resiliency is achieved when: surface species have also achieved sufficient resiliency, subsurface species are observed twice a year from known spring outflows during nondrought conditions, and subsurface species are observed in accessible subsurface habitat (e.g., caves, wells) during all springflows when wet.

2. All species: Habitat is protected, restored and maintained within each management unit in the areas described below (see the SBR for additional information on habitat within each management unit; USFWS 2025a, Section 1.0). The habitat restoration should achieve a level that supports resilient populations as described in downlisting criterion 1. This initiative should include restoration of terrestrial riparian areas aimed at minimizing runoff into adjacent aquatic habitat for the benefit of all species, while also providing suitable habitat and food resources for the Comal Springs dryopid beetle, Peck's cave amphipod, and Comal

Springs riffle beetle. The habitat restoration may occur with existing hydromorphological modifications if adequate habitat can be achieved. However, if there are any additional hydromorphological modifications, they should support a more natural ecosystem condition (e.g., impoundment removal, dechannelization, natural substrate) instead of leading to a more unnatural ecosystem. While it is expected that habitat may change during droughts and floods (e.g., siltation during low flows, loss of substrate or vegetation), the habitat management plan described in downlisting criterion 3 should restore habitat in the locations described here. After completion, the habitat restoration should be maintained for at least 18 years.

Comal Ecosystem:

- Comal Springs dryopid beetle: Spring runs 1 through 5 and 7, western shoreline, and spring island. These areas maintain the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100). Panther Canyon Well remains undisturbed.
- Comal Springs riffle beetle: Spring runs 1 through 3, western shoreline, and spring island. These areas maintain the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100).
- Fountain darter: At least 100,000 square meters (m^2) (10 hectares (ha) [24.7 acres (ac)]) of native submerged aquatic vegetation when flows are above 2.83 m^3/s (100 cfs), with a diversity of plant species that are demonstrated to provide fountain darter habitat (see SBR, USFWS 2025a, Section 1.5.3). Vegetation should be distributed through Landa Lake, spring runs, and the old and new channel.
- Peck's cave amphipod: Spring runs 1 through 4 and 7, western shoreline, and spring island. These areas maintain the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100). Panther Canyon Well remains undisturbed.

San Marcos Ecosystem:

- Comal Springs dryopid beetle: Sessom Springs area. This area maintains the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100).
- Comal Springs riffle beetle: Hotel area of Spring Lake (see Figure 3). This area maintains the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100).
- Fountain darter: At least 40,000 m^2 (4 ha [9.9 ac]) of native submerged aquatic vegetation in the Upper San Marcos River (not including Spring Lake) when flows are above 2.3 m^3/s (80 cfs), with a diversity of native species that are demonstrated to provide fountain darter habitat (see SBR, USFWS 2025a, Section 1.5.3). This amount of vegetation is in addition to any Texas wild-rice in the river. Abundant vegetation also continues to exist in Spring Lake for fountain darters. Vegetation should be distributed through Spring Lake and the Upper San Marcos River until the confluence with the Blanco River, with the expectation that vegetation density will be higher in the upstream reaches. This number does not include the Martindale area. Additional research will be needed to evaluate the possible fountain darter habitat in the Martindale area.

- Texas blind salamander: Cave habitat remains unmodified and undisturbed.
- Texas wild-rice: At least 20,000 m^2 (2 ha [4.9 ac]) of Texas wild-rice is maintained in the upper San Marcos River, including areas that are shallow enough to allow for natural seeding. Texas wild-rice should be distributed through the Upper San Marcos River to the City of San Marcos wastewater treatment plant outfall.

Hueco Ecosystem:

- Peck's cave amphipod: Designated surface critical habitat maintains the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100). If this site becomes accessible, habitat should be evaluated to assess the potential need for additional restoration and management.

Fern Bank Ecosystem:

- Comal Springs dryopid beetle: Designated surface critical habitat maintains the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100). If this site becomes accessible, habitat should be evaluated to assess the potential need for additional restoration and management.

3. All species: There is a habitat management plan that is fully implemented and focuses on habitat restoration and reducing habitat degradation for all waters and lands associated with management units to ensure that habitat continues to sustain resilient populations of each species. The habitat management plan should address how habitat will be managed when the needs of different listed species conflict, along with management of threats to habitat, including recreation, runoff, drought, floods, and harmful non-native species. The habitat management plan will be fully implemented in all management units for the species for at least 18 years.

4. All species: The daily average discharge during the 18-year period in the Comal River exceeds 6.4 m^3/s (225 cfs) including the Drought of Record or worse (i.e., a three-year period when aquifer recharge is 397,800 ac-ft total or less), and the minimum daily average flow is not less than 0.9 m^3/s (30 cfs). In the San Marcos River, the daily average discharge during the 18-year period exceeds 4 m^3/s (140 cfs) including the Drought of Record or worse (i.e., a three-year period when aquifer recharge is 397,800 ac-ft total or less), and the minimum daily average flow is not less than 1.3 m^3/s (45 cfs). The duration of minimum daily average flows in both rivers must not exceed six months and is followed by three months of 2.3 m^3/s (80 cfs) or greater to ensure adequate habitat and water quality. Achievement of this criterion will be measured using continuous monitoring data from streamflow gages at Comal and San Marcos springs (USGS 08168710 and 08170000) for a minimum of 18 years.

   Hueco Springs is located close to Comal Springs, and it shows a similar flow pattern to Comal Springs during droughts, based on U.S. Geological Survey gages (Hueco Springs gage 0816800 and Comal Springs gage 08168710). Therefore, Comal Springs will be used as a surrogate for the Hueco Springs flows needed. For Fern Bank Springs, more information will need to be gathered to evaluate the water quantity that is adequate for recovery. A groundwater management plan or equivalent conservation agreement should ensure adequate water quantity that is fully implemented for a minimum of 18 years. It is possible that future habitat restoration or management may be able to reduce the flows necessary to maintain adequate habitat, in which case these flow thresholds should be reevaluated.

5. All species: Water quality consistently meets or exceeds established Environmental Protection Agency (EPA) numeric criteria for protection of aquatic life throughout the areas where the species are present (EPA 2022, unpaginated). Water temperature in surface habitat does not exceed 25°C (77°F) near springs (areas within spring runs, Spring Lake, the main spring outlets at Sessom, Landa Lake, Spring Island, Panther Canyon Well, Hueco Springs, and Fern Bank Springs), other surface habitat does not exceed this temperature at least 50% of the days per year at the substrate, and downstream surface habitat at the substrate does not exceed 27°C (81°F). Conductivity is between 560-650 microsiemens per centimeter (µS/cm) in the San Marcos Ecosystem Management Unit and 560-610 µS/cm in the Comal Ecosystem Management Unit during conditions that do not contain surface runoff from rainfall. Turbidity is generally less than 1.0 Nephelometric Turbidity Units (NTU) in spring water and habitat. Water quality measurements should only be considered when taken during baseflow conditions that do not contain surface runoff. Areas of very shallow habitat during drought conditions should not be considered for this criterion. This criterion will be achieved when these standards are met throughout the species habitat within each management unit, as described in Criterion 2, above, during quarterly sampling for 18 years. For Fern Bank and Hueco springs, more information will need to be gathered to evaluate the expected conductivity, turbidity, pH, and temperature at these springs. Research may also be needed to evaluate species-specific groundwater quality needs if there is a concern that the EPA numeric criteria for aquatic life may not adequately address water quality needs or if EPA numeric criteria have not been established.

6. All species: A self-sustaining refugia population in captivity is capable of maintaining at least 90% of the genetic diversity from the wild for 10 years without collections, as determined by population genetic modeling and a population with lambda of 0.95 or greater. This captive population may be used for population reintroduction and augmentations, or emergency refugia in case of catastrophic loss in the wild. This minimum target captive population size should be 500 individuals unless new science indicates that another number is more appropriate for these goals. If research compromises individuals for these goals, those individuals should not be included as part of the refugia population. There should be refugia populations for every species population in the San Marcos Ecosystem, and for every management unit for the three invertebrate species (Table 1).

7. Fountain darter and Texas blind salamander: Disease and parasites do not negatively affect the resiliency (defined as no more than 20% of individuals sampled) of any wild population for 10 years.

2.2 Delisting Criteria

A delisting decision will involve evaluating the five statutory factors (i.e., threats), which were also evaluated when the species were listed, as specified in section 4(a)(1) of the ESA. The following delisting criteria address the threats in the listing rule and reflect our best assessment of what needs to be achieved based on our current understanding of the species and its environment. Circumstances can change in unpredictable ways, so it is not a requirement for delisting that all criteria be met. For example, a species may be able to tolerate one ongoing threat if another is eliminated or reduced. Conversely, all criteria could be met but delisting may not be warranted should, for example, a catastrophic event or new threat arise. Recovery of the southern Edwards Aquifer springs and associated aquatic ecosystem species will require entirely self-sustaining populations made possible by a reduction of threats within the known range. The interim goal is long-term stability of the species. Justifications for the criteria are found in Section 2.3.

The following delisting criteria, when met collectively, may indicate that the Comal Springs dryopid beetle, Comal Springs riffle beetle, fountain darter, Peck's cave amphipod, San Marcos salamander, Texas blind salamander, and Texas wild-rice no longer meets the ESA definitions of either a threatened species or endangered species, and may be able to be the removed from the Federal Lists of Endangered and Threatened Wildlife and Plants:

1. All species: All populations maintain resiliency for 45 consecutive years and are expected to maintain resiliency in the future. Populations will be considered resilient when they meet the definition described in downlisting criterion 1 above. For the San Marcos salamander, the criterion for surface species should be followed.

2. All species: Habitat can sustain resilient populations and is protected/restored/maintained as described above in downlisting criterion 2, maintained for at least 45 years, and anticipated to remain protected/restored/maintained due to the actions of the habitat management plan described in downlisting criterion 3. Habitat for the San Marcos salamander is not included in downlisting criterion 2 and should meet the criteria provided for all species, as well the following for the San Marcos ecosystem: Approximately 6000 m^2 (0.6 ha [1.5 ac]) of unembedded cobble and gravel substrate with low macrophyte cover is maintained through Spring Lake and the upper 50 m (164 ft) of the river when flows are above 2.3 m^3/s (80 cfs) and maintain at least 3000 m^2 (0.3 ha [0.7 ac]) of unembedded substrate when flows are below 2.3 m^3/s (80 cfs). Surface habitat should connect to a groundwater source, such as a spring.

3. All species: Future habitat degradation is prevented through a habitat management plan as described above in downlisting criterion 3. The habitat management plan will be fully implemented for at least 45 years and anticipated to continue for at least 75 years into the future.

4. All species: The flows in downlisting criterion 4 are achieved for 45 years. Flows are expected to continue for at least 75 years into the future through actions of a fully implemented water management plan.

5. All species: Groundwater quality in downlisting criterion 5 is achieved for 45 years and there is no indication that water quality is degrading over time, as determined by increasing trends in nutrients, conductivity, or contaminants.

6. All species: Captive populations continue to be maintained as described in downlisting criterion 6. This will continue until the five years of post-delisting monitoring is completed.

7. Fountain darter, San Marcos salamander, Texas blind salamander: Disease and parasites do not affect the resiliency of any wild population for 45 years as defined in downlisting criterion 7 and are not anticipated to affect the resiliency for at least 75 years into the future.

2.3 Justification for Criteria

Justification for timeframe to downlisting and delisting: Drought can affect the success of most of the criteria. Therefore, multiple droughts should occur prior to downlisting and delisting the species to ensure that the criteria continue to be met in these conditions. These timeframes were established by evaluating the amount of time between droughts at Comal Springs. Comal Springs was used because it has more data available than Hueco Springs and Fern Bank Springs. While data exists for San Marcos Springs, this spring system has decreased below 2.83 m^3/s (100 cfs) more frequently than has Comal Springs. Therefore, using the amount of time between droughts at Comal Springs is a more protective estimate that focuses on more severe droughts.

Severe droughts will provide better information for how the species habitat and water quality respond to low flows than less severe droughts, as severe droughts have more negative effects to the species. Since 1950, the median amount of time between droughts that caused flows to decrease below 2.83 m^3/s (100 cfs) at Comal Springs was nine years, with a range of 5-18 years. Thus, for most of the criteria (downlisting criteria 1-5 and delisting criteria 1-5), 18 years was established as the minimum amount of time to downlist the species once all the downlisting criteria have been met; this timeframe will usually include two droughts, with at least one drought, that bring(s) Comal Springs below 2.83 m^3/s (100 cfs) based on historical drought data in Table 2. To delist species, a timeframe of 45 years was used because this is the median amount of time for five droughts to occur that previously decreased Comal Springs flows below 2.83 m^3/s (100 cfs). This timeframe will ensure that species resiliency and the recovery criteria are assessed through multiple severe droughts prior to delisting. Table 2 has a list of droughts for the Comal Springs ecosystem. If droughts of the magnitude considered here occur sooner than the time estimates for downlisting and delisting, and if the species remains resilient during these droughts and recovery criteria are met, then it may be possible to delist the species sooner than the times estimated.

Because these species are conservation-reliant, it was important to include timeframes beyond delisting for conservation in support of the species' needs, specifically for management plans for springflows and habitat management. When determining the post-delisting implementation timeframe, a 75-year timeframe was selected for the relevant delisting criteria. This is because future projections of threats typically can project to the year 2100, which is 75 years from 2025. We expect that future projections of threats will continue at least 75 years into the future when the species meet the recovery criteria. However, it is expected that the species will continue to be conservation-reliant beyond the timeframe of these future projections.

Justification for resilient populations: The existence of resilient populations allows a species to better withstand and recover from environmental variability and stochastic perturbations relative to populations that are not resilient. Because there is natural low redundancy (i.e., one to three populations) for each of these species, it is important that all populations are resilient to reduce the extinction risk and improve the species' long-term viability. Species viability is further discussed in the SBR (USFWS 2025a, Section 3.0). For animal species, it is important to use methods that estimate population size rather than counts, because habitat conditions may affect the ability to detect individual animals and affect count data. However, the Comal Springs riffle beetle currently lacks an established methodology for accurate population size estimation. Further investigation is required to address these complexities and enhance the accuracy of population assessments for this species. For subsurface populations that cannot be easily quantified by monitoring, it is unlikely that accurate population estimates can be obtained. However, surface populations of other species may be used as surrogates because all the species within this plan share the primary threats of water quantity and water quality. It is expected that Fern Bank and Hueco springs will not flow during extreme droughts, preventing counts at these times. Subsurface species at Fern Bank and Hueco springs are expected to persist in the subsurface, and counts may continue once springflows return. Drought of Record conditions are expected to negatively affect the species, but these events are rare. If the frequency of droughts comparable to the Drought of Record increases, then additional measures may be needed for species recovery.

Justification for habitat and habitat management: Resilient populations are dependent on the quality and quantity of habitat present in the management units. The habitat used by each species is described further in the SBR (USFWS 2025a, Section 1.0). The amount and areas of habitat included are areas where the species are already known to occur and in amounts that are already demonstrated to be possible from previous studies. The habitat at Comal and San Marcos management units requires ongoing management due to recreational activities, non-native species, runoff, and habitat modifications that have altered the ecosystem. The invertebrate species use the riparian zone as a foraging area and shelter (see SBR, USFWS 2025a, Sections 1.2.3, 1.3.3, and 1.4.3). Maintenance of riparian vegetation is important to these species' persistence. These habitat management plans will also need to balance the conflicting habitat needs of different species when habitat overlaps (e.g., fountain darter and Texas wild-rice habitat) to ensure adequate habitat for each species. Although subsurface habitat may not require the same type of management as surface habitat, caves and wells hosting these species still need protection from human activities and impacts (e.g., vandalism and contamination due to surface run-off). Habitat disturbance and non-native species are further discussed as threats to these species in the SBR (2025a, Sections 2.1.3 and 2.1.4). Habitat at Hueco and Fern Bank management units are under private ownership, and knowledge is limited on which restoration activities may be needed, but some examples that may be needed include channel restoration, recreation control, vegetation restoration, and sediment removal. Habitat management plans put in place at the Hueco and Fern Bank management units would increase the ability to maintain species redundancy and genetic diversity and would potentially improve habitat conditions if promoted through partnerships.

For fountain darters, the amount of total vegetation for the Comal River and Upper San Marcos River (excluding Spring Lake) aligns with estimates from the 1990s (Linam 1993, p. 12; Linam et al. 1993, p. 345). For the Upper San Marcos River, this was extrapolated from the proportion of transects without vegetation (561/1812) for a river of 102,000 m^2 (10.2 ha [25.2 ac]) to estimate approximately 70,420 m^2 (70.4 ha [174 ac]) of vegetation in the 1990s. However, the amount of Texas wild-rice was lower in this study and will need to be balanced with needs for the fountain darter, which is why the goal for fountain darter habitat is 40,000 m^2 (4 ha [9.9 ac]). It is also expected that vegetation will naturally fluctuate and will not always occur at the maximum possible amount. While the amount of vegetation in Spring Lake is not quantified, it is plentiful and should not require management unless there are major ecosystem changes. In 2022, fountain darters were found in the Martindale, Texas area (see SBR, USFWS 2025a, Section 1.5.2). Research is needed to understand the extent of habitat in the area and its possible importance for fountain darter recovery.

For San Marcos salamanders, 6,000 m^2 (0.6 ha [1.5 ac]) of habitat aligns with what was found by previous studies (Diaz et al. 2015, p. 317). Although this is a small portion of the designated critical habitat, Spring Lake is larger than the area would be naturally because of the impoundment, and it is unlikely that the impoundment increases salamander habitat. It is important for surface habitat to connect to the subsurface habitat to allow salamanders to move between the surface and subsurface. Surface connectivity between springs should also be included when feasible.

Justification for water quantity and water management plan: Natural springflows and subsurface groundwater flows capable of supporting resilient populations are critical to the survival of these species. The species included in this plan are dependent on groundwater from the aquifer. The Drought of Record is discussed here because it is the worst drought conditions that have occurred in recent history and is often used as a water planning benchmark. However, droughts worse than the Drought of Record would negatively affect the species and also must be considered. Groundwater pumping, in concert with climate change-driven aridity (i.e., increased drought conditions), will continue to be a threat to these species into the future. Groundwater pumping along with decreased aquifer recharge could lead to declines in aquifer levels and declines or cessation of spring flows necessary for each species. Water quantity is further discussed as a threat to these species in the SBR (USFWS 2025a, Section 2.1.1). By working with groundwater conservation districts and other partners to establish a groundwater management plan, a mechanism can be established that will protect adequate flows for these species. During drought, measures are established to ensure that flows and/or subsurface habitat do not drop below critical levels, ensuring that populations continue to persist. However, surface habitat is still affected by low flows. Low flows increase sedimentation, algae, the effects of recreation, and dewatered habitat, so it is important that flows do not remain low for extended periods of time. It is possible that future work may determine that habitat management may be able to mitigate for some of these effects. Hueco Springs is expected to experience extended dry periods, and subsurface water levels must be adequate for the invertebrate populations to persist. To ensure flows in the future, these measures need to account for future rainfall scenarios, including a repeat Drought of Record or worse. Tracer tests and a contamination event suggest a potential regional groundwater connection between Hueco Springs and Comal Springs, though further testing is needed (Ogden et al. 1986, pp. 122-126; Gibson et al. 2008, p. 75). Hueco Springs shows a pattern similar to Comal Springs during droughts based on U.S. Geological Survey gages (Hueco Springs gage 0816800 and Comal Springs gage 08168710). Therefore, we are using Comal Springs as a surrogate for Hueco Springs. Fern Bank Springs does not have a gage to measure flows. Research will need to further evaluate what water quantity is adequate to achieve recovery at Fern Bank and Hueco springs. Currently there is little information to evaluate what water quantity is necessary at Fern Bank and Hueco springs and where water from Fern Bank Springs originates.

Justification for water quality: Adequate water quality is critical to the survival of these species. No alternative sites exist for these species to occupy (i.e., the species naturally have low redundancy). It is critical that groundwater, spring water, and surface water quality are protected and maintained at levels adequate to enable persistence of these species. Water quality is further discussed as a threat to these species in the SBR (2025a, Section 2.1.2). EPA numeric criteria are used when available because specific thresholds at which most pollutants become toxic are not known for these species. Conductivity, temperature, and turbidity are known to affect the listed species. Increased conductivity is associated with decreased abundance of some Texas *Eurycea* species and is associated with increased contaminants and impervious cover (Bowles et al. 2006, pp. 115-118). Texas wild-rice requires clean and clear water with low turbidity (Poole and Bowles 1999, entire). Elevated turbidity is associated with a decrease in prey items consumed by fountain darters in lab experiments (Swanbrow Becker et al. 2016, entire) and impairs the ability of fountain darters to detect and respond to predators in lab experiments (Swanbrow Becker and Gabor 2012, p. 117). Temperature and conductivity in the groundwater have been relatively stable over time (EAA 2022, pp. 27-28). Low springflows during droughts can decrease the dilution of potentially harmful pollutants and increase fluctuations in surface water temperature. Changes in temperature may not be tolerated by these species. Temperature likely affects the ability of Peck's cave amphipod to reach maturity (Kosnicki and Julius 2019b, p. 19). The rate of growth was lower in other central Texas *Eurycea* salamanders when they were exposed to higher temperatures (Crow et al. 2016, p. 331). Fountain darter reproduction is negatively impacted above 24°C (75.2°F), with almost no reproduction above 26°C (78.8°F) (McDonald et al. 2007, pp. 311, 314-316). While fountain darters should be able to persist for short periods with warmer temperatures, periods of lower temperatures throughout fountain darter habitat are important for recruitment. Dissolved oxygen is important for these species, as discussed in multiple sections in the SBR (2025a, Sections 1.4.3, 1.6.3, 1.7.3, and 2.5). However, we do not have current evidence to believe that decreasing dissolved oxygen is a threat when springflows are adequate.

Justification for captive populations: Until threats to these species are ameliorated, extirpations or extinctions from the wild are possible due to stochastic or catastrophic events. Maintaining captive refugia of sufficient size to reestablish wild populations helps ensure that reintroduction after extirpation is possible. Maintaining genetic diversity for an extended period of time without collections from the wild is important in case reintroduction could not occur quickly after extirpation. Because the number of individuals needed to maintain genetic diversity long-term without collections from the wild has not been evaluated, 500 individuals was used based on population management studies (Franklin 1980, entire; Lande and Barrowclough 1987, entire) for the captive refugia until more specific information is available for how many individuals are needed. There are many reasons immediate reintroduction may not be possible, including ongoing threats in the wild or insufficient understanding and evaluation of the species or habitat needs to inform a successful reintroduction. Once threats to the species are ameliorated and post-delisting monitoring is completed, captive populations would no longer be required.

For the three invertebrate species, each population exhibits a high degree of genetic structure, with no evidence of contemporary gene flow, and significant differentiation between management units (see SBR, USFWS 2025a, Section 1.2.1, 1.3.2, and 1.4.2). Representatives from each management unit should be maintained in captivity separately to safeguard genetic diversity (i.e., evolutionarily significant units). The fountain darter population in the Comal River is derived from the San Marcos River and would not need separate representation in the refugia (see SBR, USFWS 2025a, Section 1.5.2).

While captive populations do not fulfill the criterion of self-sustainability in the wild and count towards natural redundancy, they play a vital role in the overall recovery strategy. These populations can serve as a genetic reservoir and provide critical insights into the species' life history, behavior, and ecological needs through invaluable research and observation. This knowledge can be instrumental in developing effective management practices and reintroduction efforts, ultimately contributing to the long-term recovery of these species in their natural habitats.

Justification for disease and parasites: Population resiliency is further degraded by the presence of diseases within a habitat. Habitat management plans will need to be updated to respond accordingly to changes in severity and diversity of disease threats. Currently, salamanders may contract microsporidia and chytrid (*Batrachochytrium dendrobatidis*). There is a potential future threat of another chytrid, *B. salamandrivorans*, that could impact salamanders. Fountain darters may be infected by nonnative gill parasites and largemouth bass virus. Disease and parasites are further discussed as a threat to these species in the SBR (USFWS 2025a, Section 2.3). Research targeting unknown or novel pathogens will improve treatment procedures and prevent future population declines.

Table 2. Droughts resulting in monthly mean flows below 2.83 m^3/s (100 cfs) at Comal Springs.

Dates	**Duration of Low Flows (months)**	**Minimum Monthly Flow (m^3/s [cfs])**
08/1954-03/1957	23	0 (0)
07/1967-08/1967	2	2.23 (78.7)
05/1984-09/1984	5	0.93 (32.8)
07/1989-10/1989	4	2.14 (75.4)
07/1996-08/1996	2	2.59 (91.5)
08/2014-10/2014	3	2.09 (73.9)
10/2022-12/2024	10	1.56(63.8)

Table 3. Downlisting and delisting criteria by species. The San Marcos salamander is threatened and does not have downlisting criteria.

Criteria	**Comal Springs riffle beetle**	**Comal Springs dryopid beetle**	**Fountain darter**	**Peck's cave amphipod**	**San Marcos salamander**	**Texas blind salamander**	**Texas wild-rice**
Downlisting 1-6	X	X	X	X		X	X
Downlisting 7			X			X	
Delisting 1-6	X	X	X	X	X	X	X
Delisting 7			X		X	X	

3.0 Recovery Actions

Recovery actions are the statutorily required, site-specific management actions needed to achieve recovery criteria, as described in section 4(f)(1)(B)(i) of the ESA. The USFWS assigns recovery action priority numbers (1-3) to rank recovery actions. The assignment of priorities does not imply that some recovery actions are of low importance, but instead implies that lower priority items may be deferred while higher priority items are being implemented. Recovery action priority numbers are based on the following:

> Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.
>
> Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
>
> Priority 3: All other actions necessary to provide for full recovery of the species.

Implementation of the recovery actions will involve participation from State and Federal agencies, non-Federal landowners, non-governmental organizations, academia, and the public. The on-the-ground activities or specific tasks associated with each action will be included in a separate RIS (USFWS 2025b, entire). The RIS is intended to be an adaptable operational plan stepped down from the recovery actions. We intend to update specific activities in the RIS with our conservation partners to design tasks that are feasible and effective and take our partners' interests and abilities into consideration.

As stated in the disclaimer, recovery plans are advisory documents, not regulatory documents. A recovery plan does not commit any entity to implementing the recommended strategies or actions contained within it for a particular species, but rather provides guidance for ameliorating threats (Table 4) and implementing proactive conservation measures, as well as providing context for implementation of other sections of the ESA, such as section 7(a)(2) consultations on Federal agency actions, development of Habitat Conservation Plans, or the establishment of experimental populations under section 10(j).

Recovery Action 1. Ensure Adequate Water Quantity and Quality within the Southern Edwards Aquifer and Management Units. Priority 1.

This action will include the protection of groundwater quantity and quality that would improve or protect habitat quality for each of the management units. Conservation water management agreements, groundwater management plans, or equivalent, will be developed, implemented, and fulfilled to ensure adequate surface and groundwater to maintain springflow and water quality at each of the management units. This action should also evaluate if additional land in the recharge and contributing zone should be protected to maintain groundwater quality. Watershed protection plans that include stormwater treatment, appropriate management of wastewater discharges, and hazardous spill prevention and response should also be implemented to protect water quality. Monitoring should evaluate the effectiveness of different water quality and quantity protections, and whether new water quality thresholds are needed to ensure resilient populations.

Recovery Action 2. Protect and Restore Habitat in Waters and on Lands Within and Adjacent to the Management Units. Priority 1.

Habitat within the management units, including springs, caves, subsurface habitat, streams, and riparian zones, should be restored and protected for each species. Adequate buffers of natural vegetation should be maintained around the aquatic habitats to support and maintain ecological integrity. Protections may include, but are not limited to, land management activities, ordinances, land acquisition from willing sellers, long-term conservation agreements, and habitat management plans. The plans should address and plan to resolve threats to habitat including local development, runoff, recreation, habitat modification and destruction, and non-native species.

Recovery Action 3: Establish and Implement Captive Refugia Populations with a Captive Population Management Plan and Reintroduction Plan. Priority 1 for San Marcos salamander, Texas blind salamander, Texas wild-rice; Priority 2 for Comal Springs riffle beetle, Comal Springs dryopid beetle, Peck's cave amphipod, fountain darter.

Until the threats to these species are ameliorated, extinction from the wild is possible due to stochastic or catastrophic events. Populations of these species should be maintained in captive refugia as a means of preventing extinction in case of such events. The captive management plan and reintroduction plan should account for situations in which species cannot be reintroduced immediately, and where several reintroduction attempts may be necessary. This will likely require genetic management and captive propagation of each species. Development of these plans will require determining the needs of the species in captivity, financial resources to support the efforts, plans for emergency collections during catastrophic events, and the steps needed for reintroduction in case of extirpation from the wild. Research may also be needed to test techniques for captive population management and reintroduction.

Recovery Action 4: Promote Edwards Aquifer Species Conservation and Recovery through Outreach, Education, and Cooperation. Priority 3.

Proactive outreach and education will be achieved by management agencies and partners to the local communities through events, workshops, and social media. Outreach efforts should use strategies to seek out broad participation, including by those who may not pursue conservation-focused events. Messaging should include topics important to the recovery of the species, including threats, conservation needs, and the importance of conserving rare species. Incentives and education should be offered to private landowners, land managers, and businesses to encourage active cooperation needed to aid the recovery of these species. Working with landowners adjacent to habitat and near contributing streams should be prioritized.

Recovery Action 5: Establish and Implement Effective Disease and Parasite Protocols. Priority 2.

This recovery action is specific to the fountain darter, San Marcos salamander, and Texas blind salamander. Effective protocols to control and eliminate diseases and parasites that affect population resiliency should be created and implemented. An array of protocols may be necessary for captive refugia compared to wild populations. Monitoring of diseases and parasites will be necessary to assess whether protocols are effective. This recovery action is rated Priority 2 because diseases and parasites are currently not primary threats to population resiliency. This action should be considered as Priority 1 if the effects of diseases or parasites increase and degrade population resiliency.

Recovery Action 6. Monitor Progress Toward Criteria within the Management Units: *Priority 3.*

This action would implement formal monitoring plans that provide information needed to evaluate species status and trends. Monitoring will further facilitate the assessment of climate change impacts on species and their habitats as well as efficacy of habitat restoration efforts. Specific associated activities will be described in the RIS. Monitoring should continue for five years after delisting, as required by the 1988 amendments to the ESA.

Table 4. Needs and threats to address for Edwards Aquifer species, recovery actions that will address threats, and the criteria to which the actions contribute. The ESA listing factor abbreviations described below are habitat loss and degradation (A), disease or predation (C), inadequacy of existing regulatory mechanisms (D), and other natural or manmade factors affecting the species continued existence (E). The listing factor for the over-utilization of the species for commercial, recreational, scientific, or educational purposes (B) is not currently a threat to these species and is not included in the table.

Threat or Need	**ESA Listing Factor**	**Downlisting Criteria**	**Delisting Criteria**	**Recovery Action**
Water Quantity	A, D, E	4	4	1, 4, 6
Water Quality	A, D, E	5	5	1, 4, 6
Habitat Quality	A, D, E	2, 3	2, 3	1, 2, 4, 6
Captive Refugia/ Redundancy	n/a	6	6	3
Disease and Parasites	C	7	7	5, 6
Resiliency	n/a	1	1	1, 2, 4, 5, 6

4.0 Time and Cost Estimates

Estimates of time and cost, as defined in section 4(f)(1)(B)(iii) of the ESA, must reflect, to the maximum extent practicable, the total amount of time and costs it will take to achieve the recovery (delisting) of the southern Edwards Aquifer springs and associated aquatic ecosystems species. The time and cost estimates provided do not account for possible future inflation or delays to initiating recovery actions.

Estimated costs include only project-specific contract, staff, or operations costs in excess of base budgets. They do not include budgeted amounts that support ongoing agency staff responsibilities. This recovery plan does not commit the USFWS or any partners to carry out a particular recovery action or expend the estimated funds.

We expect the status of these species to improve in such a way that we may downlist to threatened status in approximately 33-38 years (Table 5), following the adoption of this recovery plan, and cost approximately $314,108,000. This estimate excludes specific costs for the San Marcos salamander, a threatened species. Where possible, species-specific costs have been deducted. However, in cases where only aggregate costs for captive refugia management and monitoring were provided, these costs have been distributed equally among the species.

We estimate that the full implementation of the recovery actions would improve the status of the Edwards Aquifer springs and associated aquatic ecosystems such that species could be delisted within 60-65 years (Table 5), following the adoption of this recovery plan, for a total of approximately $534,690,000 (including $314,108,000 to downlisting plus an additional $220,582,000; Table 6). This time estimate includes up to 20 years to complete the recovery actions that are not ongoing until recovery, and 45 years for the recovery criteria to be met after the recovery actions are completed. These timeframes are based on assumptions of full funding without delay, implementation of the recovery actions and RIS, high degree of success in executed actions, and full cooperation of partners. The timeframe will be longer if these assumptions are not met.

While most recovery actions are anticipated to take the same amount of time for each species, recovery actions 2 and 3 will vary by species. While recovery action 2 could be complete within 10 years if initiated immediately, Fern Bank and Hueco springs are privately owned and are not immediately accessible to implement recovery action 2. Therefore, we assume these sites could be accessed within 10 years if outreach and cooperation with private landowners is successful. This delay extends the time of recovery for two of the three invertebrate species (i.e., Comal Springs dryopid beetle and Peck's cave amphipod) to 65 years, while the other species could be recovered after 60 years.

Recovery action 3 also varies by species based on the current status of captive breeding for the species. There is more work that is needed for successfully creating self-sustaining populations of the Comal Springs riffle beetle, Comal Springs dryopid beetle, and Peck's cave amphipod than there is for the other species. Thus, the time estimate for completing this action is 15 years for the invertebrates and 10 years for other species. However, this does not change the overall timeline to recovery because the captive refugia will continue to function until 5 years post delisting.

The cost estimates are further broken down through comparisons of ongoing and new costs (Table 7) and by management unit (Table 8). Ongoing costs encompass existing financial commitments allocated through established partnerships or funding arrangements, contributing to ongoing species recovery efforts through ongoing projects or initiatives. In contrast, new costs include expenses required for implementing recovery actions or initiating new projects not covered by existing funding. These expenditures would expand or enhance species recovery efforts beyond current initiatives, representing financial resources needed for future endeavors.

Table 5. Estimated time necessary to complete recovery actions and achieve delisting. Actions are expected to occur concurrently.

Recovery Action	**Time to Complete Action**	**Implementation Time for Downlisting**	**Total Time for Downlisting**	**Implementation Time for Delisting**	**Total Time for Delisting**
1. Ensure Adequate Water Quantity and Quality within the Southern Edwards Aquifer and Management Units	15 years	18 years	33 years	45 years	60 years
2. Protect and Restore Habitat in Waters and on Lands Within and Adjacent to the Management Units	10-20 years, varies by species	18 years	28-38 years	45 years	55-65 years
3. Establish and Implement Captive Refugia Populations with a Captive Population Management Plan and Reintroduction Plan	10-15 years, varies by species	10 years	20-25 years	Continue until 5 years post-delisting	Does not affect timeline
4. Promote Edwards Aquifer Species Conservation and Recovery through Outreach, Education, and Cooperation	Ongoing	n/a	n/a	n/a	n/a
5. Establish and Implement Effective Disease and Parasite Protocols for (Fountain Darter and Salamanders)	15 years	10 years	25 years	Continue until delisting	60 years
6. Monitor Progress Toward Criteria within the Management Units	Ongoing	Continue until 5 years post-delisting	Does not affect timeline	Continue until 5 years post-delisting	Does not affect timeline
Total Time to Recovery			**33-38 years**		**60-65 years**

Table 6. Estimated cost for recovery actions necessary to move towards recovery of the southern Edwards Aquifer springs and associated aquatic ecosystems species. Each action likely includes costs that could not be reasonably estimated at this time. Costs are based on 60-65 years to achieve recovery.

Recovery Actions	**Estimated Cost**
1. Ensure Adequate Water Quantity and Quality within the Southern Edwards Aquifer and Management Units	$306,632,000
2. Protect and Restore Habitat in Waters and on Lands Within and Adjacent to the Management Units	$60,421,000
3. Establish and Implement Captive Refugia Populations with a Captive Population Management Plan and Reintroduction Plan	$57,861,000
4. Promote Edwards Aquifer Species Conservation and Recovery through Outreach, Education, and Cooperation	$37,050,000
5. Establish and Implement Effective Disease and Parasite Protocols	$2,873,000
6. Monitor Progress Toward Criteria within the Management Units	$69,853,000
Total estimated cost of recovery actions	**$534,690,000**

Table 7. Estimated costs for recovery actions, differentiating between ongoing costs and new costs. Costs are based on 60-65 years to achieve recovery.

Recovery Actions	Ongoing Cost	New Cost
1. Ensure Adequate Water Quantity and Quality within the Southern Edwards Aquifer and Management Units	$302,707,000	$3,925,000
2. Protect and Restore Habitat in Waters and on Lands Within and Adjacent to the Management Units	$57,098,000	$3,323,000
3. Establish and Implement Captive Refugia Populations with a Captive Population Management Plan and Reintroduction Plan	$55,980,000	$1,881,000
4. Promote Edwards Aquifer Species Conservation and Recovery through Outreach, Education, and Cooperation	$37,050,000	$0
5. Establish and Implement Effective Disease and Parasite Protocols	$2,873,000	$0
6. Monitor Progress Toward Criteria within the Management Units	$55,417,000	$14,437,000
Total estimated costs	**$511,124,000**	**$23,566,000**

Table 8. Estimated costs for recovery actions, separated by management unit, where applicable. Costs are based on 60-65 years to achieve recovery.

Recovery Actions	**All Management Units**	**Comal Ecosystem Management Unit**	**San Marcos Ecosystem Management Unit**	**Fern Bank Ecosystem Management Unit**	**Hueco Ecosystem Management Unit**
1. Ensure Adequate Water Quantity and Quality within the Southern Edwards Aquifer and Management Units	$306,414,000	$0	$193,000	$25,000	$0
2. Protect and Restore Habitat in Waters and on Lands Within and Adjacent to the Management Units	$0	$15,579,000	$41,619,000	$1,764,000	$1,460,000
3. Establish and Implement a Captive Population Management Plan and Reintroduction Plan	$57,861,000	$0	$0	$0	$0
4. Promote Edwards Aquifer Species Conservation and Recovery through Outreach, Education, and Cooperation	$37,050,000	$0	$0	$0	$0
5. Establish and Implement Effective Disease and Parasite Protocols	$0	$1,686,000	$1,186,000	$0	$0
6. Monitor Progress Toward Criteria within the Management Units	$0	$27,708,000	$27,708,000	$7,218,000	$7,218,000
Total estimated cost of recovery actions by management unit	**$401,325,000**	**$44,974,000**	**$70,706,000**	**$9,007,000**	**$8,678,000**

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Appendix 1 – Substantive Peer Review and Public Comments Addressed

We received two of six requested peer and technical reviews of the draft recovery plan for the Southern Edwards Aquifer Springs and Associated Aquatic Ecosystems, Second Revision. There were no Tribal interests. We received two public comments on the draft recovery plan during the 90-day comment period, which ended December 12, 2024. Substantive comments and how they were addressed are described in the table below.

We received comments on and made multiple minor, non-substantive changes, and corrections throughout this document (e.g., typos, spelling errors, grammatical revisions) to improve its readability and clarity. A full summary of these minor edits is not provided. We did not include, below, responses to comments for which information was requested that we had already included in the recovery plan, Species Biological Report (SBR), or Recovery Implementation Strategy (RIS).

Comment	Response
Comments suggested including more details about the implementation of recovery actions, what activities are currently in progress, existing partners, and funding sources.	The USFWS has revised its approach to recovery planning and implementation relative to the last recovery plan that was completed in 1996, resulting in a shorter and more concise document. Now, the recovery plan is one component of a three-part framework; it is informed by the SBR and is implemented via the RIS. The RIS provides information on implementation of actions and potential partners; it is a more flexible document that can be updated as needed. Progress on implementation actions will be tracked digitally through annual recovery reporting. Recovery actions and costs are included in the recovery plan, even if they are currently being implemented, to meet the statutory requirements of the ESA. Funding sources are not required to be included in recovery plans. More information on how these documents complement each other may be found at the following website: https://www.fws.gov/project/recovery-planning-and-implementation.
A comment asked if local and state agencies' existing monitoring data would be used for informing water quality needs in the recovery criteria and recovery actions, and whether additional monitoring will be required under the revised recovery plan.	Existing monitoring data and ongoing data collection will be used where appropriate to meet the information needs of this recovery plan. Additional monitoring is needed to fill data gaps; however, the recovery plan does not require specific entities to fulfill these monitoring needs. Existing data were used in the SBR when evaluating threats to water quality (see SBR, USFWS 2025a, Section 2.1.2).

Comment	Response
Comments suggested that it is unlikely that some of the recovery criteria can be met due to the nature of the threats remaining and could worsen long-term. Comments stated that some protection (local, state, or Federal) must be maintained past delisting due to the narrow-range endemic nature of these species. Comments also referred to the potential for species to go extinct in the wild after delisting and the need for ongoing refugia, and whether past lawsuits required this.	The recovery criteria represent the conditions the species need to no longer be considered endangered or threatened; if they were not met due to ongoing threats that were not ameliorated, then the species would remain listed under the ESA. We agree that these species will continue to rely on conservation into the future. While there currently are not other protections that would continue past delisting, delisting criteria 2 and 3 address this need through a habitat management plan and water management plan that would continue after delisting. At the time of delisting, threats should be ameliorated to the extent that captive refugia aren't needed. Previous lawsuits referencing a contingency plan for refugia was in relation to a previous version of the Edwards Aquifer Recovery Plan, which did not require ongoing refugia after delisting.
Comments highlighted concerns about the inaccuracy of using surface species as surrogates for subsurface species in the recovery criteria, alongside the lack of quantitative values for subsurface species in the downlisting criteria, which raises questions about how subsurface species can be downlisted or delisted given the limited knowledge of their populations.	Surrogates are used for endangered species in Species Status Assessments and recovery plans when adequate information is not available for a species (Che-Castaldo and Neel 2012, pp. 1-2, 6). As described in this comment, the lack of quantitative information for subsurface species necessitates another metric to evaluate their status. As described in the recovery plan, surface and subsurface species are in the same geographic area sharing the same threats; thus, surface species responses to threats is used to gage subsurface responses. If additional methods become available to evaluate the status of subsurface species, then these would be used instead of surrogates.
Concerns were expressed regarding the reliance on the figure of 500 individuals for refugia populations in the recovery criterion, derived from older studies, without considering more genetic studies conducted more recently.	More recent population genetic studies have not evaluated what minimum population sizes are needed for the refugia populations to maintain genetic diversity without ongoing collections from the wild. New information that adequately informs the criterion can be incorporated as it becomes available.

Comment	Response
A comment stated that using "in perpetuity" for evaluating the potential for future species declines and potential extinction risk would be more meaningful than using "foreseeable future".	Foreseeable future is part of the definition of a threatened species; that is, any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. It is used in listing and classification decisions because it is the time period for which future threats can be assessed. However, we have changed this language to reflect the planning timeframe that is often used when considering future scenarios. Since future projections of threats often project to 2100, which is 75 years into the future from 2025, we replaced "foreseeable future" with "at least 75 years into the future."
Comments pointed out that the draft recovery plan does not commit the USFWS or any partner organizations to carry out specific actions or allocate the estimated funds. This raised questions about how the recovery plan can be effectively implemented over an extended period of 18 to 65 years without clear commitments from the responsible agencies. Comments emphasized the need for defined roles and responsibilities to ensure accountability and successful execution of the recovery plan.	As stated in the disclaimer of the recovery plan and RIS, identification of an activity that can be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in the recovery plan or RIS should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. This in accordance with USFWS policy and the three-part recovery planning framework. Success of this recovery plan will require successful partnerships and agreements. Timeframes would need to be updated if recovery actions did not take place in the estimated timeframes.
A comment stated that it is doubtful that ≥ 90% genetic diversity over 10 years will be maintained in refugia without additional collections from the wild due to mortality, stress, and reduced reproduction in refugia tanks. At a minimum, it should be addressed in the recovery plan how this be will obtained.	Breeding programs often call for maintaining at least 90% genetic diversity in a captive population for time periods longer than 10 years (Ralls and Ballou 2013, p. 664; Díaz et al. 2020, pp. 412-413); therefore, it is reasonable to conclude, as supported by research, that this timeframe and genetic diversity are achievable with a captive population management plan. The RIS calls for a captive population management plan that would include the details of the genetic management.

Comment	Response
A comment suggested that the total cost of the recovery plan seems too high.	Time and cost estimates were calculated based on the best available information and may not be completely accurate. This specific estimate was gathered from budgets provided by partners with existing monitoring and management programs for these species. More information regarding cost estimates of specific recovery activities is included in the RIS.
Some comments indicated confusion between the USFWS recovery plan for the southern Edwards Aquifer species (this document), and other documents, especially the Habitat Conservation Plan, that is also in place for these species and actions that are currently in progress.	One of the recovery criteria in this plan is for a habitat management plan, which should not be confused with a Habitat Conservation Plan (HCP). HCPs are voluntary agreements under section 10(a)(1)(B) of the ESA. HCPs are planning documents that are part of an application for an incidental take permit. Some of the required elements of HCPs may overlap with elements of the recovery plan, including the biological goals and objectives, monitoring for compliance effectiveness, and minimization and mitigation of incidental take. However, these elements of HCPs are written by the applicant and are not required to be identical to the recovery criteria and recovery actions in the recovery plan, though these elements may, and often will, contribute to species recovery.

Comment	Response
Submerged aquatic vegetation from the 1990s was used as the basis for recovery criteria for the fountain darter habitat. Because there are more recent data available that consider current levels of recreation, it was recommended that we use this information instead of the 1990s estimates.	The earliest data available on full aerial coverage of submerged aquatic vegetation for the San Marcos and Comal rivers is from the 1990s. While there are more recent data on aerial coverage, the data from the 1990s had greater aerial coverage of submerged aquatic vegetation, which serves as a historical baseline for assessing population resiliency and recovery. Submerged aquatic vegetation decreases with recreation (see SBR, USFWS 2025a, Section 2.1.3). Recreational pressure has likely increased since the 1990s as the human population has increased. Threats from recreational pressure and other sources would not change recovery criteria, because the recovery criteria are based on what conditions the species need to no longer be considered endangered or threatened. Habitat restoration to remove nonnative species and to plant native submerged aquatic vegetation is also in progress (see SBR, USFWS 2025a, Section 1.9). While habitat restoration is an overall benefit to the species and is also a component of this recovery plan, the efforts are not yet complete and can result in reductions in submerged aquatic vegetation while nonnatives are removed and before the native submerged aquatic vegetation fully establishes and reaches a climax plant community. For these reasons, the 1990s estimates are more representative of what is feasible for these rivers if threats to habitat are ameliorated.

Comment	**Response**
There was concern that the criteria for submerged aquatic vegetation do not consider that native submerged aquatic vegetation may not fully replace the amount of nonnative submerged aquatic vegetation in the rivers. The comment stated that native vegetation coverage has not replaced nonnative vegetation coverage in equal proportions for habitat restoration completed. There was also concern that the estimates are unachievable with current recreational levels, natural and anthropogenic pressures, and current levels of submerged aquatic vegetation. Existing monitoring data on coverage of submerged aquatic vegetation from 2013, 2018, and 2023 was included in the comment to show vegetation coverage with current recreation levels and current amounts of native and nonnative vegetation.	There are no data available for the rivers on the amount of aerial coverage of native vegetation before nonnative species were introduced, nor are there models assessing what proportion of the rivers could not sustain native vegetation once threats are ameliorated. Thus, all estimates of vegetation are necessarily based on time periods with nonnative vegetation present. As mentioned above, restoration efforts are not yet completed and can result in an initial reduction in submerged aquatic vegetation until the rivers reach a climax plant community due to the initial removal of nonnative vegetation, as well as potential difficulty establishing new vegetation. Native vegetation may also be more sensitive to disturbance from threats such as recreation and low springflows, which are difficult to tease apart from the overall native vegetation coverage, given that these threats have not been ameliorated. We acknowledge the potential that some areas that contain nonnative species may not be able to sustain native species after full habitat restoration is completed, if nonnative species are capable of filling a wider variety of habitat types in the river. If this is the case, the recovery criteria would need to account for this new information. Decreased stressors from recreation and other sources are representative of recovery actions that need to take place to ameliorate threats to the species for their recovery. The recovery criteria are based on what conditions the species need to no longer be considered endangered or threatened and do not change based on the difficulty in meeting these recovery criteria due to the presence of threats. As discussed above, HCPs are not written by USFWS. The elements included in HCPs are not required to be identical to the recovery criteria and recovery actions in the recovery plan. Thus, it is possible that the submerged aquatic vegetation goals for an HCP may differ from those in this recovery plan.

Comment	Response
There was a comment that suggested that 20,000 m^2 coverage for Texas wild-rice may not be achievable as a minimum standard. The comment recommended 8,000 to 12,000 m^2 of Texas wild-rice coverage, and existing data were included from 1989-2024 showing that until recently, the amount of Texas wild-rice in the river was much lower. Existing information was also included that demonstrated that higher coverages of Texas wild-rice occurred during recreational restrictions from COVID-19 but argued that this minimum would not be sustainable over time.	While documented aerial coverage of Texas wild-rice in the San Marcos River was low until recently, historical information on Texas wild-rice coverage is not available from before the current threats and habitat modifications. Plantings substantially increased the amount of Texas wild-rice. The relief of threats from recreation during park closures from COVID-19 also resulted in substantial increases in Texas wild-rice coverage (see SBR, USFWS 2025a, Section 1.8.5), indicating that the proposed criterion amounts are achievable. Thus, the best available information indicates that this amount of coverage is reasonable when threats have been ameliorated. As discussed in the recovery criteria, it is expected that floods and droughts may temporarily decrease the amount of habitat, but the habitat management plan would ensure that habitat is restored following such events. Threats from recreation and other sources are why certain recovery actions need to take place to ameliorate threats to the species for their recovery. The recovery criteria are based on what conditions the species need to no longer be considered endangered or threatened and do not change based on the difficulty in meeting these recovery criteria due to the presence of threats. Because of the small range and single population of this species, it is important to maximize the resiliency of this species by having the largest population possible in the river. As discussed above, HCPs are not written by USFWS. The elements included in HCPs are not required to be identical to the recovery criteria and recovery actions in the recovery plan. Thus, it is possible that the Texas wild-rice goals for an HCP may differ from those in this recovery plan.

Comment	Response
A comment stated that the downlisting criterion for Texas wild-rice should consider the trade-off with fountain darter habitat quality, and the target Texas wild-rice coverage should consider habitat conditions for the San Marcos salamander. The comment recommended prioritizing the needs of fountain darters and San Marcos salamanders above those of Texas wild-rice where they overlap. Photos of San Marcos salamander habitat were included with Texas wild-rice present as evidence of decreased habitat quality.	The downlisting criterion 2 already considers the tradeoffs recommended in this comment. The calculations for the total amount of submerged aquatic vegetation for fountain darters is discussed in the Justification for Habitat and Habitat Management section and includes considerations of Texas wild-rice coverage to balance the needs of both species. The amount of overlap between San Marcos salamanders and Texas wild-rice is minimal relative to the total amount of Texas wild-rice habitat in the river and should not significantly affect the potential Texas wild-rice coverage throughout the river if some areas are prioritized for San Marcos salamanders. Balancing the needs of these three species in the San Marcos River also would be included in the habitat management plan as described in downlisting criterion 3. Which species needs should be prioritized could vary over time, contingent upon the current status of each species. Therefore, the habitat management plan should focus on balancing the species' needs, rather than consistently favoring one species. Acknowledging the current threats to these species, it is evident that balancing the needs of all species in a way that achieves the recovery criteria presents challenges.

Comment	Response
A comment expressed concern that with current water management practices, minimum springflows would not be able to return to 80 cfs during a Drought of Record in the required 6-month timeframe and there are no feasible options to meet it. It was suggested to instead use a 3-year rolling average for the species and stated that that would better support the species' needs and would be more practical for springflow protection measures. The comment referenced a planning document for an HCP renewal.	Recovery criteria describe how to address species' demographic, habitat, and threat conditions that, when met, collectively demonstrate the species may be recovered and no longer meet the definition of an endangered species or threatened species (i.e., the recovered state). To effectively establish these recovery criteria, we must consider what conditions the species need to no longer be considered endangered or threatened. Many of the species in this recovery plan are short-lived, making them vulnerable to droughts that will affect them in a shorter timeframe than three years, which makes consideration of a 3-year rolling average too long as the shortest time-period considered. While a rolling 3-year average could potentially be used for other reasons, it does not replace the shorter timeframe necessary to consider survival and reproduction timeframes of short-lived species. Extended periods of low flows can have a significant impact on their life history and reduce population resiliency. Therefore, minimizing periods of low flows is critical to the recovery of these species, and the flow criteria in this recovery plan are intended to address this need. The long-term average flows included in the recovery criteria also limit the extent of repeat droughts over the long-term. Combined, these flows should recover the species even with ongoing droughts. We acknowledge that it is unlikely feasible to increase springflows when extreme drought conditions are already in progress if there is no additional rainfall to relieve drought conditions. Thus, this is achievable by focusing on water reduction prior to reaching Drought of Record conditions, which will reduce the timeframe of minimum springflows. As discussed above, the recovery criteria are based on what conditions the species need to no longer be considered endangered or threatened and do not change based on the difficulty in meeting these recovery criteria due to the presence of threats. As discussed above, HCPs are not written by USFWS. The elements included in HCPs are not required to be identical to the recovery criteria and recovery actions in the recovery plan. Thus, it is possible that the springflow goals for an HCP may differ from those in this recovery plan.