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Memorandum

To: Regional Director, Region 2, Albuquerque, New Mexico

Through: Assistant Regional Director, Ecological Services, Region 2, Albuquerque, New Mexico

From: Field Supervisor, Austin Ecological Services Field Office, Austin, Texas

Subject: Biological Opinion for the Southern Edwards Plateau Habitat Conservation Plan – Permit TE-48571B (Consultation No. 21450-2011-F-0210)

Enclosed is the biological opinion for Bexar County and the City of San Antonio (Applicants) for the Southern Edwards Plateau Habitat Conservation Plan (SEP-HCP) to avoid, minimize, and mitigate adverse effects to nine federally listed species from certain activities over a period of 30 years. These species include two birds: the golden-cheeked warbler (*Setophega* [=*Dendroica*] *chrysoparia*) and black-capped vireo (*Vireo atricapilla*), and seven karst invertebrates: *Rhadine exilis* (no common name), *R. infernalis* (no common name), Helotes mold beetle (*Batrisodes venyivi*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), Madla cave meshweaver (*Cicurinia madla*), Government Canyon Bat Cave meshweaver (*C. vespera*), and Braken Bat Cave meshweaver (*C. venii*) (Covered Species).

The biological opinion is based on the final SEP-HCP and the accompanying final Environmental Impact Statement pursuant to the National Environmental Policy Act of 1969, both dated July 2015; recommendations provided by the Biological Advisory Team and the Citizens Advisory Committee pursuant to Subchapter B, Chapter 83 of the Texas Parks and Wildlife Code; Service files; discussions with species experts; published and un-published literature available on the species of concern and related impacts; and other sources of information available to the Service. A complete administrative record of this consultation is available at the Austin Ecological Service Field Office.

We appreciate your staff's assistance throughout this consultation. If you have any questions regarding this biological opinion, please contact Christina Williams at 512-490-0057, extension 235.

Attachment

Biological Opinion

This transmits our biological opinion for the issuance of a U.S. Fish and Wildlife Service (Service) 10(a)(1)(B) incidental take permit (Permit or ITP) to Bexar County and the City of San Antonio (County and City, collectively Applicants) for the Southern Edwards Plateau (SEP) Habitat Conservation Plan (HCP, and SEP-HCP collectively), which will minimize and mitigate, to the maximum extent practicable, adverse effects from activities affecting nine federally endangered species pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq., Act). These species include two birds: the golden-cheeked warbler (*Setophaga [=Dendroica] chrysoparia*) and black-capped vireo (*Vireo atricapilla*), and seven karst invertebrates: *Rhadine exilis* (no common name), *R. infernalis* (no common name), Helotes mold beetle (*Batrisodes venyivi*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), Madla cave meshweaver (*Cicurinia madla*), Government Canyon Bat Cave meshweaver (*C. vespera*), and Braken Bat Cave meshweaver (*C. venii*) (Covered Species). The issuance of a Service permit to authorize incidental take associated with the HCP is the action for this intra-Service consultation pursuant to section 7 of the Act.

Other species listed as threatened or endangered pursuant to the Act or candidate species that may occur in the action area are: the endangered Texas wild-rice (*Zizania texana*), Peck's cave amphipod (*Stygobromus pecki*), fountain darter (*Etheostoma fonticola*), Comal Springs dryopid beetle (*Stygoparnus comalensis*), Comal Springs riffle beetle (*Heterelimis comalensis*), Texas blind salamander (*Eurycea rathbuni*), San Marcos gambusia (*Gambusia georgei*), Robber Baron Cave meshweaver (*C. baronia*), Cokendolpher cave harvestman (*Texella cokendolpheri*), black bear (*Ursus americanus*), jaguarundi (*Herpailurus yaguarondi*), gray wolf (*Canis lupus*), red wolf (*Canis rufus*), Whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), and Tobusch fishhook cactus (*Sclerocactus brevihamatus* subsp. *tobuschii*); the threatened San Marcos salamander (*Eurycea nana*); and the candidate bracted twistflower (*Streptanthus bracteatus*), golden orb (*Quadrula aurea*), false spike (*Q. mitchelli*), smooth pimpleback (*Q. houstonensis*), Texas pimpleback (*Q. petrina*), and Texas fatmucket (*Lampsilis bracteata*).

The Edwards Aquifer aquatic species (Texas wild-rice, Peck's cave amphipod, fountain darter, Comal Springs dryopid beetle, Comal Springs riffle beetle, Texas blind salamander, San Marcos gambusia, and San Marcos salamander) are dependent on the Edwards and Trinity (Hill Country segment) aquifers. These species are not provided incidental take coverage by the proposed Permit, but may be affected by the Covered Activities. Therefore, they are addressed in this biological opinion. If take of any of these species does occur, a major amendment to the Permit would be required. For all other listed or candidate species in the action area no effect from the Covered Activities is expected because of the Applicants' planned avoidance, minimization, and conservation measures. The Applicants will coordinate with the appropriate agencies, including Texas Parks and Wildlife Department (TPWD), on a project-by-project basis where State-listed species may be affected.

Consultation History

After several Biological Advisory Team (BAT) and Citizens Advisory Committee (CAC) meetings, the Applicants submitted their draft HCP, along with their application for an ITP, on December 21, 2012. After several reviews and some unforeseen delays, a notice of receipt of the application and availability of the draft HCP and draft Environmental Impact Statement (EIS) was published in the *Federal Register* on December 19, 2014 (79 FR 75830).

I. Proposed Action

The proposed federal action associated with the accompanying SEP-HCP and permit application is to issue an ITP to the Applicants for otherwise lawful activities conducted on Enrolled Properties that are located within Bexar County or within portions of the City of San Antonio (including the City's extra-territorial jurisdiction [ETJ]), excluding Comal County which is covered by ITP TE-223267. The SEP-HCP establishes a conservation program that minimizes and mitigates, to the maximum extent practicable, the adverse effects of authorized take of nine federally endangered species (collectively the Covered Species). These species include two birds: golden-cheeked warbler (*Setophaga* [=*Dendroica*] *chrysoparia*, GCWA) and black-capped vireo (*Vireo atricapilla*, BCVI), and seven karst invertebrates (collectively the Covered Karst Invertebrates): *Rhadine exilis* (no common name), *R. infernalis* (no common name), Helotes mold beetle (*Batrisodes venyivi*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), Madla cave meshweaver (*Cicurinia madla*), Government Canyon Bat Cave meshweaver (*C. vespera*), and Braken Bat Cave meshweaver (*C. venii*).

The implementing regulations for section 7(a)(2) of the Act defines an action area to be all areas affected directly or indirectly by the federal action and not merely the immediate area affected by the proposed project (50 CFR § 402.02). For the purposes of this biological opinion, the action area includes Bandera, Bexar, Blanco, Comal, Hays, Kendall, Kerr, and Medina counties (see Figure 1 of the SEP-HCP). Hays County is included only for analysis of the Edwards Aquifer aquatic species; no Covered Activities will occur there. Incidental take coverage will: 1) only be offered to Participants in the jurisdictions of Bexar County and the City of San Antonio, including current and future portions of the City's ETJ; 2) only be allowed within preserves established in Comal County, since Comal County has their own ITP to cover incidental take; and 3) be provided within any SEP-HCP preserves established within Bandera, Bexar, Blanco, Kendall, Kerr, and Medina counties. This last level of take will be in the form of preserve management activities, as described in Service approved management plans, which may cause take but are otherwise beneficial to the species.

The BAT for the SEP-HCP was responsible for advising the Applicants on technical matters relating to the biology and conservation of the species and habitats addressed in the SEP-HCP. The BAT recommended the 7-county area as the Plan Area (Bandera, Bexar, Blanco, Comal, Kendall, Kerr, and Medina counties) at its February 8, 2010, meeting. Many factors were contemplated to define the boundaries, including: species and habitat distribution (mostly based on GCWA and BCVI distribution and their recovery regions), land use patterns and trends, and the types of impacts anticipated in different areas. County boundaries were then used as a means to clearly define the boundary of the Plan Area.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR § 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to designated critical habitat.

Covered Activities

The ITP associated with the HCP will authorize a certain amount of incidental take of the Covered Species that is associated with any type of otherwise lawful activity that may cause the permanent or temporary loss or degradation of habitat for one or more of the Covered Species. Covered Activities may be associated with a variety of different types of non-federal projects or actions, such as:

- The construction, use, and maintenance of public or private land development projects, including but not limited to single- and multi-family homes, residential subdivisions, farm and ranch improvements, commercial or industrial projects, government offices, and park infrastructure;
- The construction, maintenance, and improvement of roads, bridges, and other transportation infrastructure;
- The installation and maintenance of utility infrastructure, including but not limited to transmission or distribution lines and facilities related to electric, telecommunication, water, wastewater, petroleum or natural gas, and other utility products or services;
- The construction, use, maintenance, and expansion of schools, hospitals, corrections or justice facilities, and community service development or improvement projects;
- The construction, use, or maintenance of other public infrastructure and improvement projects (e.g., projects by municipalities, counties, school districts);
- The construction, use, maintenance and expansion of quarries, gravel mining, or other similar extraction projects; and
- Any activities necessary to manage habitat for the Covered Species that could temporarily result in incidental take but that would have long-term benefits for the listed species.[1]

Requirements for GCWA and BCVI Participation

Participants seeking to enroll properties that occur within the range of the GCWA or BCVI must submit a habitat assessment for these species with their application for enrollment. The habitat assessment must evaluate all areas within the boundary of the property to be enrolled and the area up to 300 feet outside of the property, which is the area assessed for indirect effects. The GCWA and BCVI habitat assessments must meet the following criteria:

- Habitat assessments must be prepared by a biologist holding a valid 10(a)(1)(A) research and recovery permit for the GCWA and/or BCVI;
- The habitat assessment must delineate all portions of the property to be enrolled that meet the Service's definition of suitable habitat for GCWA or BCVI (currently reported in Campbell 2003, but subject to future revision) or provide a habitat determination that has otherwise been approved by the Service;
- The habitat assessment must delineate all areas of suitable GCWA and BCVI habitat that occur up to 300 feet outside of the property to be enrolled;
- The habitat assessment must be based on a review of the best available information, and must include a discussion of actual site conditions as determined from a site visit to the property by the preparing biologist;

[1] Such activities might include vegetation manipulation or prescribed fire within BCVI habitat needed to occasionally set back the successional stage of the woody vegetation or limited thinning within dense GCWA habitat to open up areas for enhancing oak regeneration. The occasional need to construct or maintain boundary fencing, access roads, fire breaks, and other similar infrastructure that facilitates effective and responsible preserve management may also result in limited or temporary incidental take of the GCWA, BCVI, or karst invertebrates.

- The habitat assessment must have been completed no more than two years prior to the date of the application; and
- The habitat assessment must include a description of the information and methods used to delineate areas of suitable GCWA and BCVI habitat.

Applicants may optionally submit additional species survey information that identifies occupied and unoccupied habitats within the property to be enrolled. Survey data that is collected in accordance with the Service's current GCWA and BCVI presence/absence survey protocols may be used to refine the Applicant's impact assessment.

Requirements for Karst Participation

Participants wishing to receive coverage under the SEP-HCP will be required to submit karst surveys for portions of the property that occur over karst zones 1 through 4 (see Historic and Current Distribution section below for a description of these zones). The karst surveys must be performed by a person holding or named on a 10(a)(1)(A) research and recovery permit for Bexar County Karst Invertebrates and be in accordance with the Service's current requirements for presence/absence surveys for endangered karst invertebrates in Central Texas. Participants must identify any areas of designated critical habitat that occur within the vicinity of the property to be enrolled. Participants must submit the following information pertaining to karst resources with their application:

- A copy of the completed karst feature survey report for the property to be enrolled that describe the results of all applicable survey steps. Reports must demonstrate compliance with the Service's current[2] protocols for presence/absence surveys (including the qualifications of the biologists conducting the surveys) and the surveys must have been conducted no more than three years prior to the date of application;
- A map of the karst zones within and adjacent to the property to be enrolled;
- A detailed map showing the locations of all known karst features occupied by one or more of the Covered Karst Invertebrates that are associated with the property to be enrolled (i.e., features that occur on or within 750 feet of the property);
- A map showing 345-foot and 750-foot buffers around the entrance(s) of each occupied karst feature associated with the property to be enrolled;
- A map showing the extent of any designated critical habitat that occurs within the property to be enrolled;
- A map showing the extent (or footprint) of the cave; and
- A feature-by-feature list of the Covered Karst Invertebrates that have ever been recorded from each of the occupied karst features associated with the property to be enrolled.

For the purpose of evaluating applications for participation in the SEP-HCP, Occupied Cave Zones will be established around the entrance(s) of each karst feature found within a property to be enrolled or within 750 feet outside of a property to be enrolled that contains one or more of the Covered Karst Invertebrates. Areas that have been designated as critical habitat for one or more of the Covered Karst Invertebrates should be indicated if they are in or within 750 feet outside of the property. However, areas of a property within the Service's designated critical habitat are ineligible to participate in the SEP-HCP.

[2] Features with previously confirmed species locations may submit those surveys, unless they have received authorization from the Service (per the 10(a)(1)(A) requirements) to re-enter that feature.

Occupied Cave Zone A – Includes the area generally within 345 feet of the entrance[3] to a karst feature that is occupied by one or more of the Covered Karst Invertebrates. The extent of this zone encompasses approximately 8.5 acres around a feature. Occupied Cave Zone A is intended to include the currently known maximum foraging range of cave crickets (*Ceuthophilus* spp.) associated with central Texas caves (Taylor et al. 2005).

Occupied Cave Zone B – Includes the area generally between 345 feet and 750 feet of the entrance(s) to a karst feature that is occupied by one or more of the Covered Karst Invertebrates. This zone (in combination with Zone A) is intended to encompass all or most of the surface and subsurface resources needed to maintain the long-term viability of an occupied karst feature. Zone B (in combination with Zone A) circumscribes an area that includes approximately 40 acres and should be sufficient to encompass the surface and subsurface drainage basins of most occupied karst features[4], as well as a representative sample of the surface vegetation community surrounding the feature.

The Applicants will not allow Participation in either Occupied Cave Zones until the conservation baseline for all Covered Karst Invertebrate species within the affected cave has been met. The SEP-HCP conservation baseline is the protection of a specified minimum number of karst preserves in a Karst Fauna Region[5] (KFR) based on the Bexar County Karst Invertebrate Recovery Plan (Service 2011, see also Range-wide Survival and Recovery Needs below for this criterion). The minimum number of preserves varies by species, based on number of known locations.

If the conservation baseline has not been achieved for one or more of the Covered Karst Invertebrates that are known to occur in a particular karst feature, then the SEP-HCP will not provide incidental take authorization for Covered Activities in the Occupied Cave Zones of the feature. In these cases, a Participant will be required to avoid all surface and subsurface disturbances within the designated Occupied Cave Zones until the appropriate conservation baseline has been achieved.

The SEP-HCP will not will not cover any incidental take within a designated critical habitat unit. Project proponents with activities within designated critical habitat for listed karst invertebrates that require incidental coverage must seek incidental take authorization from the Service.

The Applicants may accept karst preserves that would contribute to achieving the conservation baseline for the affected species in lieu of participation fees. In lieu of paying karst participation fees to the Applicants, a Participant may offer new karst preserves as mitigation for incidental take. All karst preserves accepted in lieu of participation fees must contribute to achieving the

[3] This configuration may not always be a circle, so may not always be 345' or 750' from the entrance. For example, adjusting the configuration of the Occupied Cave Zones to more adequately protect the cave footprint and/or drainage basins when they are not included within an exact circle, but still maintaining the 8.5 acre or 40 acre total setback.

[4] The Service reviewed the surface and subsurface drainage areas of 67 endangered species caves in Bexar County (delineated by Veni 2002) and found 72 percent (48 caves) of the drainage areas would be included within a 750 foot radius from the cave entrance(s). Of the remaining 19 caves 13 percent (9 caves) had only the surface within that distance and 15 percent (10 caves) had only the subsurface within that distance. Of those with the surface outside of 750 feet, 80 percent (8 caves) were in creek drainages resulting in larger than normal surface drainage areas.

[5] Karst Fauna Region (KFR) - geographic areas delineated by Veni (1994) based on discontinuity of karst habitat that may reduce or limit interaction between troglobite populations. Troglobites - a species of animal that is restricted to the subterranean environment and typically exhibits morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment (Veni 2002).

conservation baseline for one or more of the Covered Karst Invertebrates. Therefore, each accepted preserve should:

- Be occupied by one or more of the Covered Karst Invertebrates;
- Protect the surface and subsurface drainages and cave footprint;
- Meet the standards of a recovery-quality karst preserve, as determined by the Service; and
- Fulfill an unmet need towards achieving the range-wide downlisting criterion for at least one of the Covered Karst Invertebrates.

The Applicants will have the discretion to accept or reject all offers of preserve land in lieu of karst participation fees on a case-by-case basis. All karst preserves accepted in lieu of participation fees are subject to the same standards and approval process as other SEP-HCP karst preserves and must be approved by the Service. Additionally, by accepting an offer of in-lieu preserve land, the Applicants commit to protect and manage the offered preserve land in perpetuity, in the same way as other SEP-HCP preserves (Section 7.2 of the SEP-HCP).

Some karst features may not have surface expressions within an Enrolled Property and their presence might not be detected during the pre-application karst surveys required by the SEP-HCP. The pre-application karst surveys and avoidance measures required for Plan participation minimize the risk of encountering previously undetected, occupied features during construction. Nevertheless, the risk of such an encounter cannot be completely eliminated. A Participant who has completed the enrollment process and obtained a Participation Certificate might encounter such a feature while engaging in Covered Activities. By participating in the SEP-HCP, contributing to the karst conservation program by providing survey data, avoiding known features, and paying participation fees, Participants will be fully covered for any unknown or accidental incidental take of the Covered Karst Invertebrates within an Enrolled Property. Participation Agreements will include conditions for investigating and closing karst features accidentally discovered during Covered Activities to minimize impacts to Covered Karst Invertebrates.

Future land uses over the next 30 years, such as development or construction activities, are expected to cause the loss and degradation of habitat for the Covered Species. The SEP-HCP is designed to offset the impacts associated with up to 9,371 acres of GCWA habitat loss, 2,640 acres of BCVI habitat loss, and 21,086 acres of development activity over karst zones 1 through 4 (i.e., the level of requested incidental take authorization). This level of incidental take authorization represents approximately 50 percent of the projected habitat losses for the GCWA and BCVI and approximately 20 percent of the projected impacts over karst zones 1 through 4 within Bexar County or the City of San Antonio for the next 30 years (see Appendix E to the SEP-HCP for details on how these numbers were calculated).

<u>Proposed Conservation Measures</u>

The primary conservation measure for the GCWA and BCVI is the acquisition, permanent protection, and management of their habitats. The GCWA and BCVI preserve systems will be assembled over the duration of the ITP at a level or rate that is sufficient to stay ahead of the demand for participation in the SEP-HCP. With full utilization of the SEP-HCP's incidental take authorization, the HCP would protect approximately 23,500 acres of preserves for the GCWA and approximately 6,600 acres of preserves for the BCVI.

For the Covered Karst Invertebrates, the HCP's enrollment process requires that HCP Participants avoid surface and subsurface disturbances within 750 feet of a known occupied karst feature until the conservation baselines for each species are met. The conservation baselines are based on the downlisting criterion described in the Bexar County Karst Invertebrate Recovery Plan (Service 2011, see also Range-wide Survival and Recovery Needs section below). The goal is to minimize the direct and indirect impacts to the Covered Karst Invertebrates by requiring HCP Participants to avoid conducting Covered Activities close to known species localities until these conservation baselines are achieved. The 750-foot buffer circumscribes an area that includes approximately 40 acres around a feature entrance, which is generally consistent with the size of a medium sized recovery-quality karst preserve (Service 2011). This approach will avoid the most severe impacts to occupied features, such as filling or excavating karst features which can directly and permanently destroy the physical karst environment and could even directly kill or wound individuals of the Covered Karst Invertebrates.

Additionally, the SEP-HCP budgets for the acquisition of 1,000 acres of new recovery-quality karst preserves as mitigation for authorized incidental take of these species. The anticipated size of the SEP-HCP karst preserve system is roughly equivalent to the acquisition of one high quality karst preserve and two medium quality karst preserves in each of the five KFRs that represent the combined range of the Covered Karst Invertebrates.

II. Status of the species and critical habitat

Because this biological opinion covers both terrestrial and aquatic species, the analysis has been organized as follows:

A. Terrestrial species (including Status of the Species, Environmental Baseline, and Effects of the Action under each species)
    1. GCWA
        a. Status of the Species
        b. Environmental Baseline
        c. Effects of the Action
    2. BCVI
        a. Status of the Species
        b. Environmental Baseline
        c. Effects of the Action
    3. Bexar County karst invertebrates
        a. Status of the Species
        b. Environmental Baseline
        c. Effects of the Action

B. Aquatic species
    1. Overview of Aquifers
    2. Overview of Springs
        a. Comal Springs
        b. Hueco Springs
        c. San Marcos Springs
        d. Fern Bank Spring
    3. Status of the Species and Critical Habitat

A. TERRESTRIAL SPECIES

Since not all projects that will be covered by the ITP are known at this time, the incidental take that is anticipated to occur over the next 30 years from the Covered Activities are estimates by the Applicants and would be the maximum authorized take under the HCP. Estimates of the acreage of potential habitat impacted are as described in the Proposed Action section above and in the SEP-HCP. Note that the action area for the terrestrial species is the 7-county Plan Area.

1. Golden-cheeked warbler

a. Status of the Species

Species Description and Life History
The GCWA was emergency listed as endangered on May 4, 1990 (55 FR 18844). The final rule listing the species was published on December 27, 1990 (55 FR 53160). No critical habitat is designated for this species.

The GCWA is a small, insectivorous songbird, 4.5 to 5 inches long with a wingspan of approximately 8 inches (Pulich 1965 and 1976, Oberholser 1974). Golden-cheeked warblers breed exclusively in the mixed Ashe juniper/deciduous woodlands of the central Texas Hill Country west and north of the Balcones Fault (Pulich 1976). Golden-cheeked warblers require the shredding bark produced by mature Ashe junipers for nest material. Typical deciduous woody species include Texas oak (*Quercus buckleyi*), Lacey oak (*Q. glaucoides*), live oak (*Q. fusiformis*), Texas ash (*Frazinus texensis*), cedar elm (*Ulmus crassifolia*), hackberry (*Celtis* *occidentalis*), bigtooth maple (*Acer grandidentatum*), sycamore (*Platanus occidentalis*), Arizona walnut (*Juglans major*), and pecan (*Carya illinoinensis*) (Pulich 1976, Ladd 1985, Wahl et al. 1990). Breeding and nesting GCWAs feed primarily on insects, spiders, and other arthropods found in Ashe junipers and associated deciduous tree species (Pulich 1976).

Male GCWAs arrive in central Texas around March 1st and begin to establish breeding territories, which they defend against other males by singing from visible perches within their territories. Females arrive a few days later, but are more difficult to detect in the dense woodland habitat (Pulich 1976). Three to five eggs are generally incubated in April, and unless there is a second nesting attempt, nestlings fledge in May to early June (Pulich 1976). If there is a second nesting attempt, it is typically in mid-May with nestlings fledging in late June to early July (Pulich 1976). By late July, GCWAs begin their migration south (Chapman 1907, Simmons 1924). Golden-cheeked warblers winter in the highland pine-oak woodlands of southern Mexico and northern Central America (Kroll 1980).

Historic and Current Distribution
The GCWA's entire breeding range occurs on the Edwards Plateau and Lampasas Cut Plain of central Texas. Golden-cheeked warblers have been confirmed breeding in 27 counties: Bandera, Bell, Bexar, Blanco, Bosque, Burnet, Comal, Coryell, Edwards, Gillespie, Hays, Johnson, Kendall, Kerr, Kimble, Kinney, Lampasas, Llano, Medina, Palo Pinto, Real, San Saba, Somervell, Travis, Uvalde, Williamson, and Young (Pulich 1976, Oberholser 1974). Golden-cheeked warblers have been sighted in the following 10 counties: Dallas, Eastland, Erath, Hamilton, Hill, Hood, Jack, McLennan, Stephens, and Val Verde (Pulich 1976; Edwards and Lewis 2008, 2009; V. Collins, Pape Dawson Engineers, pers. comm. 2012). Diamond (2007) estimated that the amount of suitable GCWA habitat across the species' range was approximately 4.2 million acres, much of this habitat occurring on private lands. As a result, the population status for the GCWA on private lands remains undocumented throughout major portions of the breeding range.

Reasons for Decline and Threats to Survival
Before 1990, the primary reason for GCWA habitat loss was juniper clearing to improve conditions for livestock grazing. Since then, habitat loss has occurred as suburban developments spread into GCWA habitat. Groce et al. (2010) summarized the rates of expected human population growth within the range of the GCWA and found by 2030 the growth rate ranges from 17 percent around the Dallas-Fort Worth area to over 164 percent around San Antonio. As the human population continues to increase, so do associated roads, single and multi-family residences, and infrastructure, resulting in continued habitat destruction, fragmentation, and increased edge effects (Groce et al. 2010).

Fragmentation is the reduction of large blocks of habitat into several smaller patches. While GCWAs have been found to be reproductively successful in small patches of habitat (<50 acres), there is an increased likelihood of occupancy and abundance as patch size increases (Coldren 1998, Butcher et al. 2010, DeBoer and Diamond 2006). Increases in pairing and territory success are also correlated with increasing patch size (Arnold et al. 1996, Coldren 1998, Butcher et al. 2010). In addition, while some studies have suggested that small patches that occur close to larger patches are likely to be occupied by GCWAs, the long-term survival and recovery of the GCWA is dependent on maintaining the larger patches (Coldren 1998, Peterson 2001, The Nature Conservancy [TNC] 2002).

As GCWA habitat fragmentation increases the amount of GCWA habitat edge, where two or more different vegetation types meet, also increases. For the GCWA edge is where woodland becomes shrubland, grassland, a subdivision, etc., and depending on the type of edge, it can act as a barrier for dispersal; act as a territory boundary; favor certain predators; increase nest predation; and/or reduce reproductive output (Johnston 2006, Arnold et al. 1996). Canopy breaks (the distance from the top of one tree to another) as little as 36 feet have been shown to be barriers to GCWA movement (Coldren 1998). Territory boundaries have not only been shown to stop at edges, but GCWAs are more often farther from habitat edges (Beardmore 1994, DeBoer and Diamond 2006, Sperry 2007).

Other threats to GCWAs include the clearing of deciduous oaks upon which the GCWA forage, oak wilt infection in trees, nest parasitism by brown headed cowbirds (Engels and Sexton 1994), drought, fire, stress associated with migration, competition with other avian species, and particularly, loss of habitat from urbanization (Ladd and Gass 1999). Throughout the GCWA's range, human activities have contributed to habitat loss, particularly areas associated with the I-35 corridor between the Austin and San Antonio metropolitan areas.

Range-wide Survival and Recovery Needs

The recovery strategy outlined in the Golden-cheeked Warbler Recovery Plan (Service 1992), which is currently being revised, divides the breeding range of the GCWA into eight regions, or units, and calls for the protection of sufficient habitat to support at least one self-sustaining population in each unit (Figure 1).

Based on the Golden-cheeked Warbler Recovery Plan (Service 1992), protection and management of occupied habitat and minimization of degradation, development, or environmental modification of unoccupied habitat necessary for buffering nesting habitat are necessary to provide for the survival of the species. Habitat protection must include elements of both breeding and non-breeding habitat (i.e., associated uplands and migration corridors). Current and future efforts to create new and protect existing habitat will enhance the GCWA's ability to expand in distribution and numbers. Efforts, such as land acquisition and conservation easements, to protect existing viable populations is critical to the survival and recovery of this species, particularly when rapidly expanding urbanization continues to result in the loss of prime breeding habitat.

According to the Golden-cheeked Warbler Population and Habitat Viability Assessment Report (Service 1996b) a viable population needs to consist of at least 3,000 breeding pairs. This and other population viability assessments on GCWAs have indicated the most sensitive factors affecting their continued existence are population size per patch, fecundity (productivity or number of young per adult), and fledgling survival (Service1996b, Alldredge et al. 2002). These assessments estimated one viable population will need a minimum of 32,500 acres of prime unfragmented habitat to reduce the possibility of extinction of that population to less than five percent over 100 years (Service 1996b). Further, this estimate of the minimum number of breeding pairs increases in poorer quality habitat (e.g., patchy habitat resulting from fragmentation).

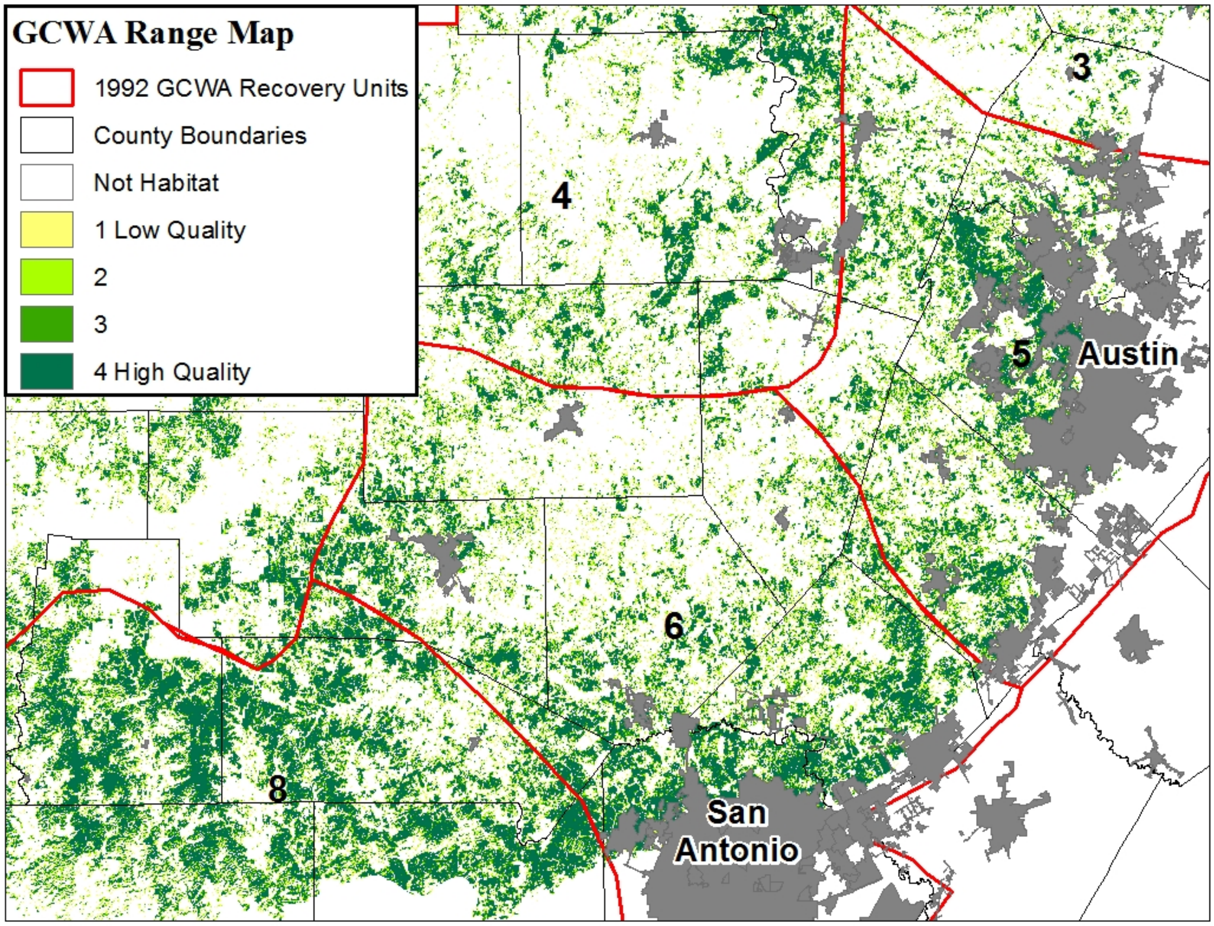


Figure 1: GCWA Recovery Regions (Service 1992) and potential GCWA habitat (Diamond 2007).

Several state and federally owned lands occur within the breeding range of the GCWA, but the majority of the species' breeding range occurs on private lands that have been either occasionally or never surveyed. Currently there are five large GCWA populations receiving some degree of protection: those at the Balcones Canyonlands Preserve in Travis County; the nearby Balcones Canyonlands National Wildlife Refuge (NWR) in Travis, Burnet, and Williamson counties; Camp Bullis Military Installation and TPWD's Government Canyon State Natural Area (GCSNA) in Bexar County; and the Fort Hood Military Reservation in Coryell and Bell counties. There are also several conservation banks (CB) whose goal is to protect GCWA habitat (acreages represent the total if the entire bank of credits are sold): Hickory Pass CB (3,003 acres) in Burnet County, Bandera Corridor CB (6,946 acres) in Bandera and Real counties, Clearwater CB (21,305 acres) in Burnet County, and Festina Lente CB (1,147 acres) in Bandera County.

b. <u>Environmental Baseline</u>

The GCWA Recovery Plan (Service 1992) places the Plan Area mostly in Recovery Region 6 with portions of Blanco County in Regions 4 and 5, half of Kerr County in Region 7, and portions of Bandera and all of Medina counties in Region 8.

There has never been a comprehensive survey of GCWAs. However, Groce et. al (2010) summarized surveys completed between 2005 and 2009 that documented at least 1,288 GCWAs within the Plan Area counties. Two habitat models estimate between 3.6 and 4.4 million acres of habitat in the breeding range and between 989,000 and 1.1 million acres of potential habitat in the Plan Area (Morrison et al. 2010, Diamond et al. 2010). However, both models include some areas of potential habitat that are not likely to be used by the species. In 2011, as part of the SEP-HCP analysis and to more accurately define GCWA habitat within the Plan Area, researchers overlaid Morrison et al. (2010) and Diamond et al. (2010) and calculated potential GCWA habitat where the two models intersected. This resulted in an estimated 674,000 to 893,000 acres of potential GCWA habitat within the Plan Area (see Appendix C of the SEP-HCP for more detail on this analysis and the results). The habitat that is likely to be potential GCWA habitat is approximately 16 to 22 percent of the total acreage of the Plan Area.

A range of GCWA abundance in the Plan Area may be derived using an average density of 2.0 to 4.1 singing males per 100 acres of habitat (Pulich 1976 and Cooksey and Edwards 2008, respectively). Using the more conservative estimate of potential habitat derived as part of the SEP-HCP, described above, and a GCWA density of 2.0 or 4.1 males per 100 acres of habitat, approximately 13,500 to 27,600 males could be present within the Plan Area.

The Greater Edwards Aquifer Alliance (GEAA) estimated that approximately 10,544 acres of prime GCWA habitat in Bexar County was lost between 2001 and 2009 (approximately 12.5 percent of the available habitat) (Hayes 2010). Prime habitat is defined using Diamond's (2007) model C, rank 4 habitat classification, which is based on 2001 imagery and includes potential moderate to high quality habitat. This habitat loss estimate represents a rate of approximately 1.6 percent loss per year, during that time. The GEAA estimate was developed by visually comparing the results of the Diamond (2007) Model C and 2008 aerial photography. Additionally, Diamond et al. (2010) estimated forest cover loss by comparing their results with a forest/non-forest classification of 2010 satellite data. This analysis estimated that approximately 23,070 acres of forest cover across the Plan Area was lost between 2005 and 2010, or 2.4 percent of the total forest cover over a 5-year period (about 0.5 percent per year). Note that not all forest cover is potential GCWA habitat.

Groce et al. (2010) reported there was no evidence to indicate that the amount of GCWA breeding habitat is increasing or stable, due to continued habitat loss and fragmentation from human development, shifts in land use, and construction of roads and utility transmission corridors. These threats are likely to be intensified by projected increases in human populations within the breeding range of the species. A variety of public and private lands currently receive some level of protection from future land development activities, and some of these are managed as natural areas or wildlife preserves with a focus on the protection and management of the GCWA. Approximately 163 conservation properties currently exist in the Plan Area, including properties under public and private ownership (not including military installations, such as Camp Bullis). These properties protect approximately 128,000 acres from a majority of future land development activities and contain between 50,000 and 60,000 acres of potential GCWA habitat (Loomis Partners 2010).

According to our consultations tracking database, there have been a total of 63 formal section 7 consultations on the GCWA. Almost 98,000 acres of GCWA habitat were authorized to be impacted by these consultations. Several large consultations make up the majority of this acreage: 1) over 37,900 acres were associated with Fort Hood activities; 2) over 52,000 acres were associated with brush control projects throughout the GCWAs 35 county range; and 3) 5,000 acres were for activities on Camp Bullis, less than 15 percent of which was considered occupied. The conservation resulting from these consultations is over 61,300 acres of GCWA habitat maintained on Department of Defense (DOD) land and over 22,000 acres of private land preserved and/or maintained for the benefit of the GCWA.

Additionally, we have issued a total of 134 individual 10(a)(1)(B) incidental take permits, which have their own formal intra-Service section 7 consultations. Over 48,000 acres of GCWA habitat were authorized to be impacted. Of this total over 21,000 were authorized as part of the Travis County and City of Austin HCP, 6,000 of which were authorized under Williamson County's Regional HCP, 3,000 of which were authorized as part of Oncor's programmatic HCP, 9,000 of which were authorized as part of Hays County's Regional HCP, 1,100 of which were part of LCRA's CREZ HCP, and 5,200 of which were authorized as part of Comal County's Regional HCP. The conservation result of all HCPs if fully implemented would be over 59,000 acres and almost $1.3 million for the preservation and/or maintenance of land for the benefit of the GCWAs.

Of the 63 formal section 7 consultations on the GCWA, 17 of these were in the Plan Area. These consultations authorized impacts to over 21,794 acres of GCWA habitat and resulted in the protection of at least 12,877 acres of GCWA habitat. Of the total authorized to be impacted, 17,390 acres were an estimate of impacts from one consultation over a five-year period; however, less than 1,000 acres were actually impacted, the majority of which were indirect impacts. Of the 134 10(a)(1)(B) incidental take permits 4 were within the Plan Area, 2 in Bexar County, 1 in Kerr County, and the other in Comal County. These permits authorized impacts to over 7,211 acres and at full implementation would result in 8,496 acres of GCWA habitat preservation.

c. Effects of the Action

The Service is authorizing the SEP-HCP to directly impact a total of 9,371 acres of GCWA habitat from Covered Activities. See Section 4.4.2 of the SEP-HCP for the methods used to determine acreage estimates.

Direct impacts from implementation of the SEP-HCP include habitat removal, degradation, and fragmentation. Indirect impacts from implementation of the SEP-HCP could occur from increased edge, which can increase the presence of nest predators and parasites, and reduction in patch quality and overall habitat suitability.

An estimated 3.6 to 4.4 million acres of potential GCWA habitat exists throughout the range (Diamond et al. 2010, Morrison et al. 2010). Within the Plan Area an estimated 674,000 to 893,000 acres of GCWA habitat exists (SEP-HCP Appendix E). The amount of habitat proposed to be impacted is 0.21-0.26 percent of all GCWA habitat range-wide and 1.04-1.4 percent within the Plan Area. The SEP-HCP will assess habitat suitability and occupancy on a project-by-project basis to more accurately quantify take. Furthermore, to reduce adverse impacts to GCWAs from the Covered Activities the SEP-HCP will: 1) require HCP Participants to abide by the seasonal clearing restrictions to avoid direct impacts to GCWAs during the breeding season; 2) require Participants to follow Texas Forest Service or a professional arborist's guidelines for the prevention of oak wilt when clearing or trimming trees within Enrolled Properties; and; 3) develop a public education and outreach program to educate landowners and residents about GCWAs and the HCP.

The incidental take being authorized could occur in five GCWA Recovery Regions (4, 5, 6, 7, and 8). However, the majority of the incidental take from Covered Activities will occur in Bexar, Kendall, Bandera, and Medina counties (Regions 6 and 8), since this is where the City's ETJ is expected to expand. Based on the distribution of habitat and approved conservation banks across all four Recovery Regions, it is likely that mitigation will also occur mainly, if not completely, in Recovery Regions 6 and 8 (see Figure 9 in the SEP-HCP). Regions 4, 5, and 7 that are within the Plan Area have very little GCWA habitat and have no Service-approved conservation banks.

With regard to a conservation strategy for the GCWA within Recovery Regions 6 and 8, there is still a significant amount of potential GCWA habitat (Loomis Partners 2008). Calculating just potential high quality GCWA habitat that is likely to be occupied in Recovery Regions 6 and 8 there is approximately 119,300 acres and 126,500 acres, respectively. There are an additional 87,600 acres in Region 6 and 117,200 acres in Region 8 when potential medium quality habitat that is likely to be occupied is included. Based on the distribution of modeled habitat, there are multiple large-acreage focal areas available to support at least one viable population in each Region (per the recovery plan, Service 1992). The mitigation as part of the SEP-HCP (23,430 acres) within the Plan Area will play a pivotal role in permanently protecting these focal areas, and will also assist in maintaining connectivity with Comal County, Hays County, and the larger preserves of the Travis County and City of Austin HCP and Balcones Canyonlands NWR to the northeast, thus maintaining the genetic diversity between multiple recovery regions.

While the exact number of acres of GCWA habitat that will be impacted by participants in the SEP-HCP, and will therefore need to be mitigated, is not currently known, a maximum of 9,371 acres will be impacted. The SEP-HCP proposes a mitigation ratio (acres of habitat preserved to acres impacted) of 2 acres preserved for every 1 acre of impact to GCWA habitat. Indirect impacts (impacts that occur in GCWA habitat adjacent to destroyed or modified habitat) will be assessed 0.5:1 ratio (that is half an acre for every acre indirectly impacted) for a distance of 300 feet from the edge of the direct impacts. This level of mitigation supports the conservation strategy for the GCWA and will contribute to overall recovery by permanently preserving more acreage than is removed or degraded, and by focusing that mitigation into larger parcels when acreage impacted will likely come from smaller parcels within the City's and County's jurisdictions.

Preserve acquisition and management will follow the Service's guidelines for GCWA mitigation lands (currently Service 2013), including blocks of high quality habitat at least 500 acres in size with a low edge to area ratio, confirmation of GCWA presence, a site that is sustainable into the future (such that it has low levels of adjacent urbanization and low oak wilt presence), managed and monitored in perpetuity, and approved by the Service. Additionally, the mitigation should support the recovery and conservation strategy of the species by protecting habitat in Recovery Regions 6 and 8 that helps secure viable populations of the species.

The SEP-HCP has a goal of establishing a preserve system of up to 23,430 acres of GCWA habitat over the term of the ITP. Lands within the preserve system could be County or City owned, but may also include preserves owned and/or managed by other cooperators such as local municipalities, conservation organizations, or private landowners that agree to manage in accordance with the HCP. Regardless of ownership, to count toward the preserve system, the preserve must be managed in perpetuity to benefit one or more of the Covered Species.

Critical habitat has not been designated for the GCWA; therefore, no adverse modification or destruction of critical habitat will occur.

2. Black-capped vireo

a. Status of the Species

Species Description and Life History
The BCVI was federally listed as endangered on October 6, 1987 (52 FR 37420-37423). No critical habitat has been designated for this species.

The BCVI is a 4.5 inch long, insectivorous songbird (Service 1991). Although BCVI habitat throughout Texas is quite variable with respect to plant species, soils, and rainfall, habitat types generally have a similar overall appearance. The BCVI typically inhabits shrublands and open woodlands with a distinctive patchy structure. The shrub vegetation generally extends from the ground to about six feet above ground and covers about 30 to 60 percent of the total area. In the Edwards Plateau, common plants in BCVI habitat include Texas oak (*Quercus texana*), shin oak (*Q. sinuata*), live oak (*Q. virginiana* & *Q. fusiformis*), mountain laurel (*Sophora secundiflora*), sumac (*Rhus. sp*), redbud (*Cercis canadensis*), Texas persimmon (*Diospyros texana*), mesquite (*Prosopis glandulosa*), and agarita (*Mahonia trifoliata*). In the Edwards Plateau, suitable habitat for the BCVI often includes early successional scrub/shrub created by fire or woodland clearing. Black-capped vireos are opportunistic foragers; however, they prefer insect larvae and seeds (Grzybowski 1995).

Male BCVI arrive in central Texas in late March and begin to establish breeding territories, which they defend against other males by singing within their territories. The females arrive a few days later, but are more difficult to detect in the dense brushy habitat. Three to four eggs are generally incubated in April, and unless there is a second nesting attempt, nestlings fledge in May to early June. In mid-July, BCVI's begin their migration south, beginning with females and young and followed by adult males (Campbell 2003, Graber 1957, Oberholser 1974). Typically, BCVI's are gone from Texas by mid-September.

Historic and Current Distribution
Black-capped vireos breed from Oklahoma south through central Texas to the Edwards Plateau, then south and west to central Coahuila, Nuevo Leon, and southwestern Tamaulipas, Mexico, and they winter on the Pacific slope of Mexico. Populations have been extirpated in Kansas and have been reduced in Oklahoma, suggesting habitat loss and parasitism may be particularly prevalent in that part of the species' range (Grzybowski 1995, Wilkins et al. 2006). The current section 7 consultation range of the BCVI includes 67 counties in Texas and 8 counties in Oklahoma. Records indicate that BCVIs are currently known from only 51 counties in Texas and 4 counties in Oklahoma.

Wilkins et al. (2006) estimated that in 2005, the known U.S. population of BCVIs was approximately 6,000 males, a marked increase since it was listed. It is unknown whether estimated population numbers have increased due to increased survey efforts, increased habitat due to habitat management efforts, or some combination of both. Approximately 75 percent of the known population is known from three locations: two in Texas - Kerr Wildlife Management Area (WMA) and Fort Hood (Ft. Hood), and one in Oklahoma shared between the Wichita Mountains NWR and adjacent DOD Ft. Sill (Wilkins et al. 2006). Utilizing records since 2006, there are 31 BCVI populations with more than 30 individuals, 10 of which contain more than 100 individuals. Within Texas many efforts are underway to assist landowners in determining the status of BCVIs on their property and to educate landowners on the implementation of management strategies beneficial to the BCVI. Fully understanding the current distribution of the BCVI in Texas largely depends on the data collected through these various efforts.

Reasons for Decline and Threats to Survival

Threats to the BCVI include habitat loss, fragmentation, and degradation due to development, vegetational succession, poor grazing practices, and brown-headed cowbird parasitism. A complete summary of the threats to the species can be found in in the Service's 5-year review (Service 2007a).

No new threats to the BCVI have been identified since listing, and based on the 5-year status review (Service 2007a), it appears the original threats to the species still exist, but the magnitude of the threats has changed, resulting in an overall decrease in threat level. Conservation programs and measures implemented to reduce the threats to the species include a 37-county Safe Harbor Agreement held by Environmental Defense, with 7 enrolled properties actively managing for BCVIs; private lands incentives; cowbird removal programs; and public outreach. Most of these measures have occurred within the species' range in Texas and target the major threats to the species – loss of habitat and brood parasitism.

Range-wide Survival and Recovery

The Black-capped Vireo Recovery Plan (Service 1991) divides the BCVI's Texas portion of the breeding range into six regions delineated primarily on physiographic boundaries (Figure 2). Recovery could occur when there is a viable vireo population, greater than 1,000 breeding females, is protected in four of the six Texas regions and one each in Oklahoma and Mexico (Service 1991 and 1995). In addition to the recovery plan recovery criteria, a Population and Habitat Viability Analysis resulted in a recommendation that each of the four populations necessary for recovery contain at least three subpopulations (Service 1995).

The protection of existing viable populations is critical to the survival and recovery of this species. Based on the Black-capped Vireo Recovery Plan (Service 1991), protection and management of occupied habitat, and the minimization of further degradation, development, or modification of unoccupied habitat are necessary to provide for the survival of the species. Habitat protection must include elements of both breeding and non-breeding habitat (i.e., associated uplands and migration corridors). Efforts to create new, and protect existing, habitat will enhance the BCVI's ability to expand in distribution and numbers. Conservation efforts that are necessary for the survival and recovery of this species include land acquisition, conservation easements, active habitat management and maintenance, and enrollment in Environmental Defense's Safe Harbor Agreement.

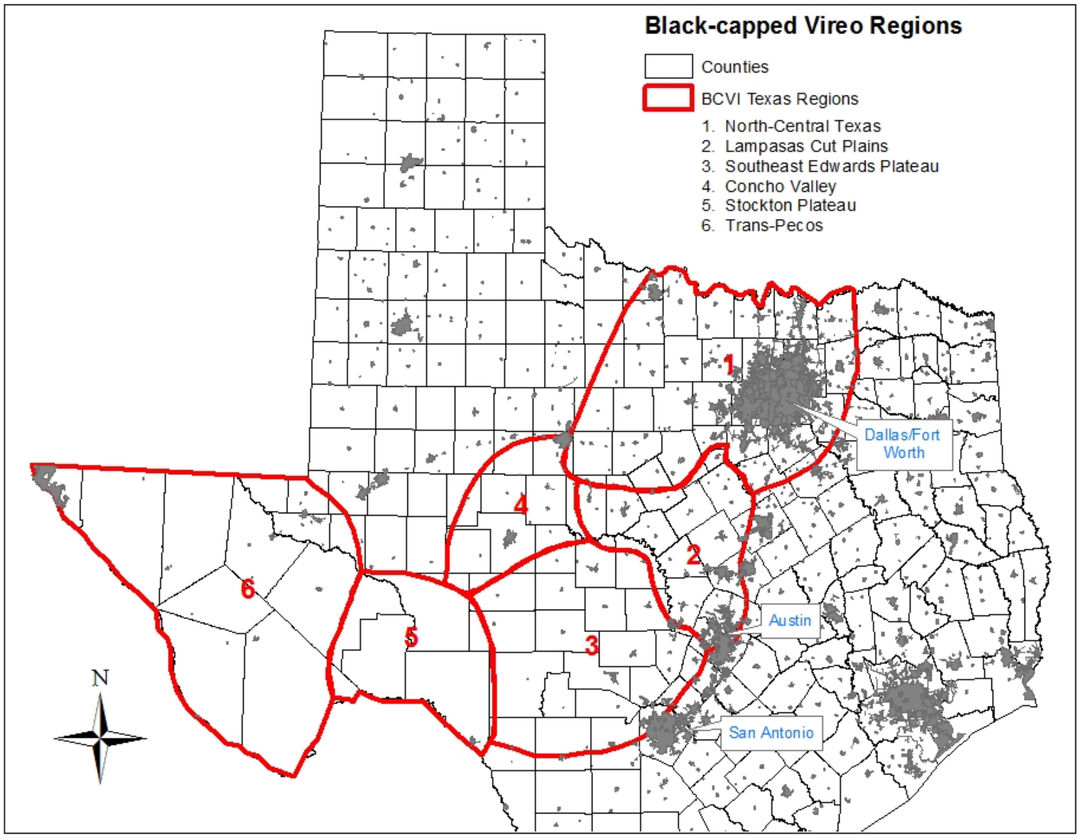


Figure 2: BCVI Recovery Regions of Texas (Service 1991).

There is no research-based data to indicate what the minimum patch size of BCVI habitat should be for the purpose of long-term persistence. However, important considerations for appropriately sized and managed conservation preserves are: a) patch size, connectivity, and density of birds present for management in perpetuity, b) habitat prescriptions (burn, mechanical) feasible for maintaining at least 75% occupation each breeding season, c) extent of threats such as brown-headed cowbird parasitism, white-tailed deer and exotic ungulate numbers, and how the size and location of the parcel may influence the manager's ability to effectively managing threats. A management goal of a minimum density of males should be set based on known densities on nearby, equivalent healthy populations. Generally, populations in the eastern portion of the range are denser in suitable habitat versus the western portion of the range.

b. <u>Environmental Baseline</u>

Reliable estimates of available habitat for BCVIs are unavailable due in large part to the wide variation in habitat characteristics not easily delineated with aerial imagery or remote sensing. Further, suitable BCVI habitat tends to be relatively short-lived, since much of the vegetation used by the species (particularly along the eastern edge of the Edwards Plateau ecoregion) is typically representative of an early successional stage following vegetation disturbance (such as a fire or mechanical brush management) (Campbell 2003). The short-lived nature of this early successional vegetation stage generally results in a shifting pattern of suitable habitat across the landscape over relatively short time periods (i.e., 5 to 15 years).

The BCVI Recovery Plan describes recovery criteria including protection of at least one viable BCVI population composed of at least 500 to 1000 breeding pairs in six described recovery regions in Texas plus Oklahoma and Mexico (Service 1991). The Plan Area is completely within Recovery Region 3 - Southeast Edwards Plateau. The current population of BCVI in the Plan Area is unknown, as no population survey has been completed and very few recent observations of the species have been confirmed. Wilkins et al. (2006) estimated populations across the BCVI breeding range as those with species observations recorded between 1996 and 2005. This review identified a total of 527 BCVI breeding units (i.e., direct counts of males, pairs, or territories) observed on private and public lands in the Plan Area. However, the Wilkins et al. (2006) review did not identify any recent records of BCVIs from Kendall or Comal counties, but the occurrence of potential habitat in these counties supports the likelihood that the species occurs there (Wilkins et al. 2006).

Continued threats to BCVIs in the action area include the clearing of breeding habitat, overgrazing, and nest parasitism by brown headed cowbirds. The overall loss and potential fragmentation of native rangeland caused by land use conversion and ownership changes throughout major portions of the species' breeding range, especially in the Edwards Plateau and North-central Texas regions, has likely resulted in an overall decrease in the potential habitat available for the species (Wilkens et al. 2006).

According to our consultations tracking database, there have been at least 31 formal section 7 consultations on BCVIs. Over 272,000 acres of BCVI habitat were authorized to be impacted by these consultations. Of this acreage 256,196 acres were associated with brush management and prescribed fire consultations. An additional 15,612 acres were associated with activities on Fort Hood. In total these consultations resulted in over 27,000 acres of habitat managed and maintained specifically for the BCVI with an expectation of an additional net benefit in BCVI habitat creation from the brush management and prescribed fire consultations.

Additionally, we have issued 9 individual 10(a)(1)(B) incidental take permits with their associated formal intra-Service section 7 consultations. These 9 permits authorized over 16,700 acres of effects to BCVI habitat and if all take occurs, would result in over 11,600 acres of habitat preserved and over $1,500,000 given to the Texas Parks and Wildlife Foundation to perpetually manage BCVI habitat on the 4,500 acre Pairrie Haynes Ranch.

Of the total number of formal section 7 consultations, 7 of these were for projects located within the Plan Area authorizing just over 31,800 acres of impacts to BCVI habitat. However, of the total authorized, 31,160 acres were an estimate of impacts over a 5 year period, which actually resulted in less than 500 acres of actual impacts. The result of these consultations is protection and management of over 3,900 acres and an overall net increase in BCVI habitat from the prescribed fire and brush management consultations, which were expected to return BCVI habitat to its optimal stage. Within the Plan Area 2 individual 10(a)(1)(B) permits have been issued authorizing 2,338 acres of BCVI habitat to be impacted. However, 1,088 acres of this authorization was indirect; therefore, the habitat is still intact on the landscape. At full implementation these permits would result in 2,406 acres of permanently protected BCVI habitat.

c. Effects of the Action

The Service is authorizing the Applicants to directly impact a total of 2,640 acres of BCVI habitat from Covered Activities. See Section 4.4 of the SEP-HCP for the methods used to determine acreage estimates.

Direct impacts from implementation of the HCP include habitat removal, degradation, and fragmentation. Indirect impacts could occur from increased potential for predation, including predation by the red imported fire ant (*Solenopsis invicta*), increased brood parasitism, and competition or changes in the structure or composition of adjacent habitat, which may affect foraging activity.

Of the estimated 1.45 million acres of potential BCVI habitat throughout the range, the Plan Area contains approximately 181,630 acres of potential habitat (Maresh and Rowell 2000). The amount of habitat proposed to be impacted is 0.18 percent of all BCVI habitat range-wide, 1.45 percent within the Plan Area, and 0.39 percent within recovery region 3 (Wilkens et al. 2006). Additionally, the SEP-HCP will assess habitat suitability and occupancy on a project-by-project basis to more accurately quantify incidental take. Furthermore, to reduce adverse impacts to BCVIs from the Covered Activities the SEP-HCP will: 1) require HCP participants to abide by the seasonal clearing restrictions to avoid direct impacts to BCVIs during the breeding season; 2) require participants to follow Texas Forest Service or a professional arborist's guidelines for the prevention of oak wilt when clearing or trimming trees within Enrolled Properties; and 3) develop a public education and outreach program to educate landowners and residents about BCVIs and the HCP.

While the BCVI 5-year status review (Service 2007a) stated the BCVI Recovery Plan (Service 1991) was out-of-date and needed revision, preservation of one population in at least four of the six regions is still part of our conservation strategy for the species. The Plan Area is located on the southeastern side of Region 3 and contains approximately 27 percent of the BCVI habitat in the Region. With the largest amount of potential habitat of any of the regions, Region 3 will likely be a focus for one of the protected populations. According to the Recovery Plan (Service 1991) a viable population would be between 500 and 1,000 breeding pairs. Focal areas for viable BCVI populations within Region 3, Southeast Edwards Plateau, would likely be near Kerr WMA and Kickapoo Caverns State Park, which documented 358 and 265 singing males, respectively, in 2005. Additionally, while Wilkens et al. (2006) estimated more than 47,000 acres of potential BCVI habitat within Bexar County, actual documented BCVIs (approximately 45 individuals) are currently only known from the City's Rancho Diana Preserve.

While the exact number of acres of BCVI habitat that will be impacted, and will therefore need to be mitigated for, is not currently known, a maximum of 2,640 acres of BCVI habitat could be impacted by SEP-HCP participants. The SEP-HCP proposes to mitigate for the effects of the incidental take of BCVIs from Covered Activities at a 2:1 ratio (2 acres of mitigation for every acre of impact) for direct impacts to BCVI habitat due to loss and a 0.5:1 ratio (0.5 acre of mitigation for every acre of impact) for indirect impacts to BCVI habitat. This level of mitigation supports the conservation strategy for the BCVI, contributes to overall recovery by permanently preserving more acreage than is removed, and focuses the mitigation into larger parcels, when acreage impacted will likely come from smaller parcels throughout the action area.

Preserve acquisition and management will follow the Service's guidelines for BCVI mitigation lands (currently Service 2013), including blocks of high quality habitat with a low edge to area ratio, confirmation of BCVI presence, a site that is sustainable into the future (such that it has low levels of adjacent urbanization and low oak wilt presence), and will be managed and monitored in perpetuity. Additionally, the mitigation should support the recovery and conservation strategy of the species by protecting habitat in a recovery unit that helps secure a viable population of the species. Mitigation will occur through purchase of mitigation credits from a Service-approved conservation bank or through the purchase of preserve lands in fee title or conservation easement. All preserve acquisitions and assignments of credits will be reviewed and approved by the Service.

The SEP-HCP has a goal of establishing a preserve system of up to 6,600 acres of BCVI habitat over the life of the ITP. Lands within the preserve system could be County or City owned, but may also include preserves owned and/or managed by other cooperators such as local municipalities, conservation organizations, or private landowners that agree to manage in accordance with the HCP. Regardless of ownership, to count toward the preserve system, the preserve must be managed in perpetuity to benefit one or more of the Covered Species.

Critical habitat has not been designated for the BCVI; therefore, no adverse modification or destruction of critical habitat will occur.

3. Bexar County Karst Invertebrates

Below we analyze seven of the nine listed karst invertebrates from Bexar County. While the Robber Baron Cave meshweaver and Cokendolpher cave harvestman are located in Bexar County, they are known only from the Alamo Heights KFR just north of downtown San Antonio in a fully developed portion of Bexar County (Service 2011). Therefore, the SEP-HCP will not cover activities within this KFR and thus will not authorize any take for these two species.

a. Status of the Species

Species Description and Life History
Rhadine exilis, *R. infernalis*, *Batrisodes venyivi*, *Neoleptoneta microps*, *Cicurinia madla*, *C. vespera*, and *C. venii* were listed as endangered on December 26, 2000 (65 FR 81419). Except *N. microps* and *C. vespera,* critical habitat was designated on April 8, 2003 (68 FR 17156). On February 14, 2012, the Service revised critical habitat designations, which included designating critical habitat for *N. microps* and *C. vespera* (77 FR 8450).

Three of these species are insects: two ground beetles and one mold beetle. The remaining species are arachnids, including one harvestman and three spiders. While harvestmen are in the same class (Arachnidea) as spiders, they are in a different order (Araneae) because they are anatomically and evolutionarily distinct from spiders. Taxonomic verification of these species is usually not possible in the field and usually requires examination of adult specimens under a microscope. Identification often requires dissection of the genitalia by a taxonomic expert. These species range in size from 0.039 inches to 0.39 inches.

All of these invertebrates are troglobites, spending their entire lives underground. They are characterized by small or absent eyes and pale coloration. Their habitat includes caves and mesocavernous voids in karst limestone (landforms and subsurface features, for example, sinkholes and caves, produced by dissolution of bedrock). Within this habitat these animals depend on high humidity, stable temperatures, suitable substrates (for example, spaces between and underneath rocks), and surface-derived nutrients. Examples of nutrient sources include leaf litter fallen or washed in, animal droppings, and animal carcasses. It is imperative to consider that while these species spend their entire lives underground; their ecosystem is dependent on the overlying surface habitat.

In some cases, the most important source of nutrients for a troglobite may be the fungus or microbes that grow on the leaves or troglophile (life cycle occurs both within and outside of the cave) feces rather than the original material itself (Elliott 1994, Gounot 1994). Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features (Howarth 1983, Holsinger 1988, Elliott and Reddell 1989). For predatory troglobites, accidental species of invertebrates (those that wander in or are trapped in a cave) may be an important nutrient source in addition to other troglobites and troglophiles found in the cave (Service 2000).

The cave cricket (*Ceuthophilus* spp.) is a particularly important nutrient component (Barr 1968, Reddell 1993) and is found in most caves in Texas (Reddell 1966). As a troglophile, cave crickets forage on the surface at night, and are generally known to return to the cave during the day, where they lays eggs and roost. A variety of troglobites are known to feed on cave cricket eggs (Mitchell 1971), feces (Barr 1968, Poulson et al. 1995) and on the adults and nymphs directly (Elliott 1994).

Historic and Current Distribution

Little information on these species is available prior to the 1960s, when the study of cave organisms began in earnest in Bexar County. According to the Bexar County Karst Invertebrate Recovery Plan (Service 2011), their historic ranges are unknown, but were likely similar to their present day ranges with the exception of caves that have been destroyed or severely impacted. Currently *Rhadine exilis* is known from 52 caves; *R. infernalis* is known from 47 caves; *Batrisodes venyivi* is known from 4 caves; *Cicurina madla* is known from 20 caves; *C. venii* is known from 2 caves; and *Neoleptoneta microps* and *C. vespera* are known from 1 cave each.

Each cave occurs in one of six Karst Fauna Regions (KFR) delineated for Bexar County: Stone Oak, University of Texas at San Antonio (UTSA), Helotes, Government Canyon, Culebra Anticline, and Alamo Heights (Veni 1994). Karst Fauna Regions are geographic areas delineated based on discontinuities of karst habitat that may reduce or limit interaction between troglobite populations. Additionally, the geologic context of the distribution of the listed karst invertebrates was examined by Veni (1994), who delineated five karst zones within the KFRs to facilitate assessment of the probability of the presence of rare or endangered species (see Figure 4 in the HCP).

These zones are:

- Zone 1. Areas known to contain listed karst invertebrate species.
- Zone 2. Areas having a high probability of containing habitat suitable for listed karst invertebrate species.
- Zone 3. Areas that probably do not contain listed karst invertebrate species.
- Zone 4. Areas that require further research but are generally equivalent to Zone 3, although they may include sections that could be classified as Zone 2 or Zone 5 as more information becomes available.
- Zone 5. Areas that do not contain listed karst invertebrate species.

Under contract with the Service, Veni (2002) re-evaluated and, where applicable, revised the boundaries of each karst zone originally delineated in Veni (1994). Revisions were based on current geologic mapping, further studies of cave and karst development, and current information available on the distribution of listed and non-listed karst species. Table 2 below gives the distribution of each species within each KFR.

Reasons for Decline and Threats to Survival

The primary threat to these species is habitat destruction. Caves and karst habitat are destroyed or impacted in several ways, including but not limited to (1) completely filling the cave with cement during development, (2) quarrying activities, and (3) capping or sealing cave entrances. Other causes of habitat degradation include altering drainage patterns, altering native surface plant and animal communities, reducing or increasing nutrient flow, contamination, excessive human visitation, and threats from red-imported fire ants. Red-imported fire ants impact karst invertebrates by competing with the beneficial cave crickets, feeding directly on karst invertebrates, and by competing with karst invertebrates for habitat resources (Service 2011).

Range-wide Survival and Recovery Needs

The recovery strategy is to reduce threats to the species by protecting an adequate number of karst areas to ensure a high probability of the species' long-term survival. This includes protecting caves or cave clusters and the associated mesocaverns necessary to support populations that represent the range of the species potential genetic diversity. Maintenance of these karst preserves involves keeping them free from contamination, excessive human visitation, and nonnative fire ants by maintaining an ecologically appropriate surface plant and animal community. Preserve managers are expected to monitor regularly and adaptively manage to control existing and new threats.

For the purposes of recovery, a karst fauna area (KFA) is an area known to support one or more locations of a listed species. A KFA is distinct in that it acts as a system that is separated from other KFAs by geologic and hydrologic features or processes that create barriers to the movement of water, contaminants, and troglobitic fauna. Karst fauna areas should be far enough apart so that if a catastrophic event (for example, contamination of the water supply, flooding, or disease) were to destroy or significantly impact one of the KFAs that event would not likely destroy any other area occupied by that species. There are three categories of KFAs high, medium, and low quality. All preserved KFAs should be either medium or high quality as defined in the karst preserve recommendations (http://www.fws.gov/southwest/es/AustinTexas/ESA_Sp_KarstInverts.html). Table 1 shows options for the minimum number and category of KFAs that need to be preserved in each KFR for a species to be considered for downlisting. The left column indicates the number of KFRs in which a species occurs (see Table 2 for the number of KFRs from which each species is currently known).

Table 1: Minimum quality and quantity of KFAs needed for recovery

# of KFRs that species occurs in	Combination of KFAs needed per KFR					Total No. of KFAs
1	KFR #1: 3 High (H) + 3 Medium (M)					6
2	KFR #1: HHM	KFR #2: HMM				6
3	KFR #1: HHM	KFR #2: HMM	KFR #3: HMM			9
4	KFR #1: HHM	KFR #2: HMM	KFR #3: HMM	KFR #4: HMM		12
5	KFR #1: HHM	KFR #2: HMM	KFR #3: HMM	KFR #4: HMM	KFR #5: HMM	15

Table 2: Distribution of covered karst species and preserve quality potential in KFRs

Species	Karst Fauna Region	Potential High Quality	Potential Medium Quality
Rhadine exilis	Government Canyon	3	
	UTSA	3	
	Helotes	1	1
	Stone Oak	1	
	Culebra Anticline	1	
Rhadine infernalis	Government Canyon	5	
	UTSA	2	
	Helotes	2	1
	Stone Oak		
	Culebra Anticline	2	
Batrisodes venyivi	Government Canyon	1	
	Helotes		1
Neoleptoneta microps	Government Canyon	1	
Cicurina madla	Government Canyon	4	
	UTSA	4	
	Helotes	2	1
	Stone Oak		
Cicurina venii	Culebra Anticline		
Cicurina vespera	Government Canyon	1	

To meet the downlisting criterion for these karst species, the location, quality, and configuration of at least the minimum number of KFAs in each KFR for each species are preserved. Also, legally binding commitments must be in place for perpetual protection and management of these KFAs. To delist these species, the downlisting requirements must be achieved, and the data from monitoring and research support the conclusion that the KFAs will provide a high probability of species survival (greater than 90 percent over 100 years).

Critical Habitat
In the Service's final rule that designated critical habitat for the nine Bexar County karst invertebrates we defined the primary constituent elements (PCEs) of critical habitat, which are the physical and biological features essential to the conservation of the Bexar County karst invertebrates, as:

- karst-forming rock containing subterranean spaces (caves and connected mesocaverns) with stable temperatures, high humidity (near saturation), and suitable substrates (for example, spaces between and underneath rocks for foraging and sheltering); and
- surface and subsurface sources (such as plants and their roots, fruits, and leaves, and animal (e.g., cave cricket) eggs, feces, and carcasses) that provide nutrient input into the karst ecosystem (77 FR 8450).

Twenty-eight units containing and surrounding 57 caves are designated as critical habitat for the 7 Covered Karst Invertebrates (77 FR 8450). Since designated critical habitat units cannot participate in the SEP-HCP, we are not providing a review of these units in this biological opinion.

b. <u>Environmental Baseline</u>

All known populations of *Rhadine exilis*, *R. infernalis*, *Batrisodes venyivi*, *Neoleptoneta microps*, *Cicurinia madla*, *C. vespera*, and *C. venii* occur within the action area. Therefore, the "Status of the Species" section above is the same as the status within the action area.

According to our consultations database there has been one formal section 7 consultation on an endangered Bexar County karst invertebrate, *C. venii*. This consultation was with the U.S. Federal Highway Administration on the discovery of *C. venii* during the construction of State Highway 151 in San Antonio. This project resulted in the filling in of one cave, 121 acres of direct surface impacts, and the funding of biota and genetics studies of *Cicurina* species.

We have issued one section 10(a)(1)(B) incidental take permit including the associated intra-Service section 7 consultation. This permit covered impacts to three caves containing three listed species (*R. infernalis*, *R. exilis*, and *C. madla*) and the additional potential incidental take of the species on 1,000 impacted acres in the event a feature with a listed species was discovered during construction. Two of the impacted caves are contained in one-acre setbacks and one cave was filled. Mitigation for the take authorized in this permit consisted of the purchase of se ven karst preserves totaling 181 acres. Any unknown features destroyed during construction were covered under the incidental take authorization and required no additional mitigation.

c. <u>Effects of the Action</u>

The impacts of Covered Activities on endangered karst invertebrates can be both direct and indirect. The direct impacts of Covered Activities include: filling cave entrances by depositing material or collapsing cave ceilings or both; altering natural drainage patterns (by altering topography, increasing impervious cover, installing berms or water collecting devices) resulting in drying or flooding; loss or degradation of the surface plant and animal communities resulting in changes to the moisture, temperature, or nutrient regimes of the karst ecosystem and increasing predation and/or competition; pollution; and increasing impacts related to human visitation, such as vandalism and dumping. Indirect impacts could occur from a loss of connectivity with other features which limits dispersal and genetic diversity, a reduction in the quality of the habitat over time (e.g. drying of a feature, less cave crickets, etc.), and less abundant vegetation for foraging cave crickets.

Only very limited information currently exists regarding the location or number of occupied karst features in Bexar County or the true distribution or abundance of the individual listed karst invertebrates. To estimate the impacts that will result from the taking, the Applicants first summed the total acreage in karst zones 1 through 4 present in the Plan Area (285,966 acres) and compared it to the estimated cumulative amount of future impact to the karst zones anticipated over the life of the proposed SEP-HCP (105,431 acres) (see Section 4.5 and Appendix E to the SEP-HCP for more detail). Note the cumulative amount exceeds the amount that is to be covered by the SEP-HCP. The Applicants anticipate that there may be a lower demand for participation in the HCP karst program possibly due to a preference to come to the Service for an individual ITP given the high standards for avoidance and mitigation required for enrollment in the SEP-HCP. Therefore, the Applicants are requesting incidental take coverage for the direct impacts to 20 percent of the total extent of projected impacts on karst zones 1 through 4 from future development (20,086 acres). This results in a projected reduction of up to 10,234 acres of karst zones 1 and 2 and 10,852 acres of karst zones 3 and 4.

To translate this to numbers of caves for illustrative purposes only, detailed karst feature and faunal surveys conducted on Camp Bullis and less rigorous data compiled by the Texas Speleological Society on the number and distribution of karst features and species-occupied caves were used to estimate the total number of species-occupied caves that might occur in the Plan Area. There are currently 103 known Covered Karst Invertebrate caves within the Plan Area. The Applicants estimate that there are at least 639 occupied karst features within the Plan Area and that 39 percent, or 247 caves, will be impacted by future development over the life of the ITP (see Appendix E to the SEP-HCP for a detailed description of how these numbers were derived). With an expected participation rate of 20 percent, the Applicants are expecting and the Service is authorizing impacts to 49 caves.

Impacts are not expected to affect the individual Covered Karst Invertebrate species equally, since some of these species are more widespread than others. For example, three of the Covered Karst Invertebrates occur in four or more KFRs: *C. madla* is currently known four KFRs and *R. infernalis* and *R. exilis* are currently known from five KFRs, thus existing in many more caves. Therefore, impacts to one or more caves with one of these three species would be expected to have less of an impact to the overall population across the range. However, the other four Covered Karst Invertebrate species (*N. microps*, *C. venii*, *C. vespera*, and *B. venyivi*) are known from two or less KFRs. Given the more restricted distribution and abundance, the impacts of authorized incidental take could have a proportionately stronger effect on these four relatively rare species. However, given their rarity, the likelihood of a Participant encountering these species is also small. For example, since the species listing in 2000, *N. microps* and *C. vespera* are still only known from caves on TPWD’s GCSNA and *C. venii* has only been found in one additional cave despite concerted efforts throughout the Culebra Anticline KFR to find additional caves with the species (V. Collins, pers. comm. 2014).

There exists the potential for listed species to be present in subsurface spaces lacking obvious surface expressions to be destroyed or significantly disturbed by construction activities. These voids are generally unanticipated because they have no significant openings to the surface, and for this reason they generally lack the input of moisture and nutrients essential for the support of karst invertebrates. Previously undetected voids discovered during construction activities rarely contain listed species. For example, the Buttercup Creek Subdivision in Williamson County, Texas found no additional listed invertebrates in any features found during development of the 438 acre parcel (as noted in the annual reports submitted for the Buttercup HCP PRT836384). Another example is construction of State Highway 45 where nine additional caves were discovered during construction; however, only two of them contained listed karst invertebrates (consultation number 1998-F-0205). While it is reasonably probable that take may occur when undetected yet occupied karst habitat is impacted by Covered Activities on enrolled properties, the SEP-HCP requires Plan Participants to conduct extensive karst surveys to minimize the likelihood that occupied karst habitat goes undetected.

Irrespective of the extent to which undiscovered features are impacted in the future, these features do not contribute to the environmental baseline for the species since their presence and extent are undeterminable. At the time of their discovery, these features are simultaneously increasing the known distribution of a species and significantly degrading or destroying them. Furthermore, a feature discovered during construction could, at most, be defined as a low quality KFA, thereby not contributing to recovery, because the impacts from typical construction methods will have one or more of the following consequences: total loss of the feature, alteration of the surface or sub-surface drainage basin, loss or reduction of the cave cricket foraging area, or loss of the supporting vegetation (Service 2011).

The SEP-HCP will not offer Karst Participation Certificates until a required minimum amount of mitigation for all of the Covered Karst Invertebrate species has occurred. The level and type of mitigation obtained for each species will vary, but will be an appropriate amount of mitigation to offset impacts from a certain amount of future take of Covered Karst Invertebrates. For example, for those species known from more locations and KFRs, such as *C. madla, R. exilis,* and *R. infernalis*, more opportunities will be available to preserve new sites that meet KFA status and enhance the conservation value of known localities, possibly bringing them up to KFA status. Therefore, initial mitigation actions are expected to be recovery quality KFAs for these three species. However, for those species with only one or two known locations, options remain limited. For example, *N. microps* and *C. vespera* only occur on TPWD's GCSNA. While they are owned by TPWD, the Service does not consider them permanently preserved, since they are not protected by a permanent easement. Therefore, an option for the Applicants could be to pursue a permanent easement around the caves and fund perpetual management and monitoring. Likewise, *C. venii* is known only from two heavily impacted localities. Therefore, other mitigation measures, such as extensively surveying for new caves or providing for some increased level of conservation for the heavily impacted known sites, may be the only options available to provide mitigation. The Applicants will work with the Service in determining when the appropriate mitigation has occurred. The Service must approve all mitigation measures for consistency with the SEP-HCP and to ensure that mitigation activities will contribute to the recovery of the species before the Applicants allow participants to impact Covered Karst Invertebrates.

The pace of preserve acquisition will be monitored to ensure that incidental take is not exceeding preserve acquisition. This will be tracked as a percentage of authorized acreage in karst zones 1 and 2 versus the percentage of 1,000 acres of new karst preserves. For example, if 300 acres of Service-approved karst preserves have been established (30 percent of the 1,000 acre preserve goal) then no more than 3,070 acres (30 percent of 10,234 acres of requested incidental take) of karst zone 1 and 2 may be impacted through the SEP-HCP. The karst conservation program does not consider enrollment over karst zones 3 and 4 since these areas are less likely to contain the Covered Karst Invertebrates.

The SEP-HCP will minimize the direct and indirect impacts to the Covered Karst Invertebrates by prohibiting Participants from conducting activities close to known species localities until the downlisting criterion for the number and type of karst preserves in a KFR is achieved. The 750-foot buffer circumscribes an area that includes approximately 40 acres around a feature's entrance, which is consistent with the minimum size of a medium quality karst preserve. This approach will avoid direct impacts to occupied features, such as filling or excavating karst features which can directly and permanently destroy the physical karst environment and could even directly kill or wound individuals of the Covered Karst Invertebrates. This buffer also retains a substantial amount of surface vegetation around the feature that is necessary for maintaining the internal environment of the karst feature. The 750-foot avoidance zone is also based on guidance from the Service and Texas Commission on Environmental Quality (TCEQ 2007) that recognizes such a buffer is generally sufficient to avoid any indirect water quality impacts to karst habitat from adjacent development.

Once the required number of KFAs is in place for a particular species in a KFR, then Participants may be authorized to conduct Covered Activities within 750 feet of a feature occupied by that species, since the regional recovery potential for that species will have been secured. However, even if the regional recovery potential for a Covered Karst Invertebrate has been secured and the SEP-HCP is able to authorize incidental take from Covered Activities conducted within 750 feet of a species-occupied feature, the participation fees to obtain such coverage are set at a level that continues to encourage minimizing activities close to such features.

In consideration of the uncertainties regarding the current status and future recovery potential of the Covered Karst Invertebrates, the SEP-HCP karst conservation program and enrollment process contains built-in safeguards, such as meeting the downlisting criterion within a KFR prior to allowing impacts to occur within Occupied Cave Zones and high fees thereafter, to assist with achieving recovery and avoiding occupied habitat. The enrollment process and fees will likely compel Participants to avoid the direct destruction of most occupied features, will minimize other impacts to known and unknown features containing the Covered Karst Invertebrates, and will actively implement preserve acquisitions and other conservation actions for karst. Further, the SEP-HCP funding plan anticipates a public funding stream for karst conservation that would be independent of actual levels of participation in the Plan.

The SEP-HCP at full implementation will preserve at least 1,000 acres of high quality karst habitat. Karst preserves acquired as mitigation will follow the Service's Karst Preserve Design Recommendations (currently Service 2011) including, but not limited to: perpetual protection, management and monitoring; meeting the standards of a high or medium quality cave preserve; will be occupied by one or more of the Covered Karst Invertebrates; and will contribute to recovery. The Service will review and approve all proposed mitigation preserves. In addition to protection of occupied caves, the Applicants will: 1) sponsor studies to help address important information gaps in the true distribution, abundance, and conservation status of the Covered Karst Invertebrates; 2) search existing public and private protected lands for occupied caves; 3) assist landowners of occupied caves in non-protected status with management, including perimeter fencing or cave gating, fire ant control, restoration of native vegetation within the drainage basin of a cave, and reducing threats; and 4) provide access, on a limited basis, for research projects that will contribute to the understanding of the biology, ecology, and conservation of the Covered Karst Invertebrates. Furthermore, legally enforceable avoidance zones around Occupied Cave Zones will be recorded and proof must be provided to the Applicants within 60 days of execution of a Participation Certificate. Participants must restrict all direct surface and subsurface disturbance within the zone, and install fencing and sedimentation controls around these zones and designated critical habitat units. If karst features are discovered during construction, there are several actions that must take place: 1) all activity must immediately stop within 50 feet of the feature for up to 7 days, 2) the feature must be protected from drying out, 3) the Applicants must be notified within 24 hours, 4) access to the feature for surveys by the Applicants must be provided, and 5) the feature must be closed in accordance with TCEQ guidelines.

Critical habitat has been designated for the Covered Karst Invertebrates; however, the SEP-HCP will not cover incidental take within these designated critical habitat areas. Therefore, adverse impacts to designated critical habitat are not expected from implementation of the SEP-HCP.

B. AQUATIC SPECIES

1. Overview of Aquifers

Segments of the Edwards and Trinity aquifers (Figure 3) are located beneath GCWA and BCVI habitat throughout the action area and provide the habitat for, or are the source of the springflows required by the species considered in this analysis. These aquifers will likely provide the groundwater resources for domestic, commercial, agricultural, industrial, and other uses by those seeking to participate in the SEP-HCP (e.g., landowners, developers, utility districts).

The Southern Segment of the Edwards Aquifer underlies portions of southwest Texas and is approximately 180 miles long and varies from approximately 5 to 40 miles in width. Water within the Southern Segment generally flows from areas of higher elevation in the southwest to areas of lower elevation to the northeast. The Southern Segment of the Edwards Aquifer is the primary water source for municipal, industrial, agricultural, and domestic uses for over two million people, primarily in the greater San Antonio area.

The Southern Segment of the Edwards Aquifer has three distinct zones (contributing, recharge, and artesian), each with unique hydrogeological characteristics. The contributing zone is approximately 5,400 square miles and is composed of the watersheds that cross the recharge zone, thereby providing the source of most of the water that will enter the aquifer as recharge. The recharge zone is approximately 1,250 square miles of exposed, porous Edwards Limestone. Recharge occurs when water enters the aquifer by infiltration through the soils and rock strata overlying the aquifer and through recharge features (caves, sinkholes, faults, fractures, and other open cavities). Creeks and streams with these features can lose much or all of their baseflow to

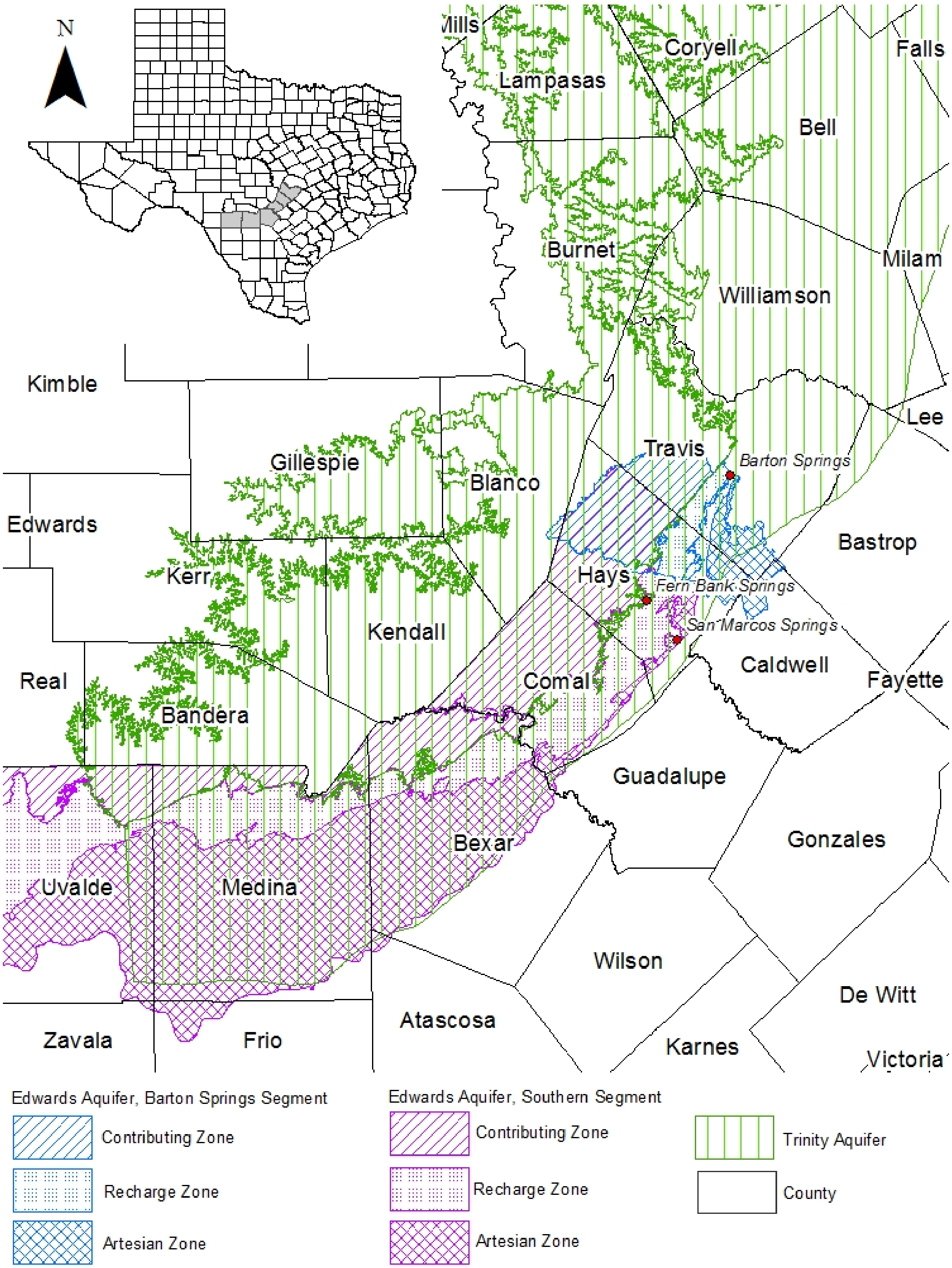


Figure 3. Central Texas aquifers.

the aquifer as they cross the recharge zone. The artesian zone of the Southern Segment is a less permeable geology that confines water and is characterized by high surface springflows resulting from the hydraulic pressure of the confined waters in this zone. Faults and fissures allow these pressurized waters to be released at the surface in numerous springs and seeps.

The Southern Segment of the Edwards Aquifer is the source of water for several major and minor springs, including Pinto and Ft. Clark springs in Kinney County, Leona Springs in Uvalde County, San Antonio and San Pedro springs in Bexar County, Comal and Hueco springs in Comal County, and San Marcos and Fern Bank Springs in Hays County. While none of the Edwards Aquifer listed aquatic species occur within the Plan Area (where incidental take of the terrestrial species will occur), negative impacts to water quality and quantity from Covered Activities could impact all of these species.

The Southern Segment of the Edwards Aquifer has a high capacity for rapid recharge, and rainfall over the contributing and recharge zones can quickly increase water levels within the aquifer. It is also subject to rapid drops in water levels due to pumping, especially during drought periods.

The Trinity Aquifer stretches across central Texas in a narrow band from the Red River on the Oklahoma border south to Bandera and Medina counties. In some areas, the Trinity Aquifer is overlaid by the Edwards Aquifer and contributes recharge to the Edwards through faults and fissures (Mace et al. 2000). The extent of the mixing and relationship between these aquifers at this interface is poorly understood; though a recent Texas Water Development Board study assessing current groundwater trends for the Trinity modeled current discharge at approximately 60 percent to springs, rivers and reservoirs; 25 percent to wells; and the remaining 15 percent to recharge of the Edwards Aquifer (Anaya and Jones 2009).

Unlike the segments of the Edwards Aquifer, the Trinity Aquifer recharges slowly, with only about four to five percent of rainfall in the area recharging the aquifer.

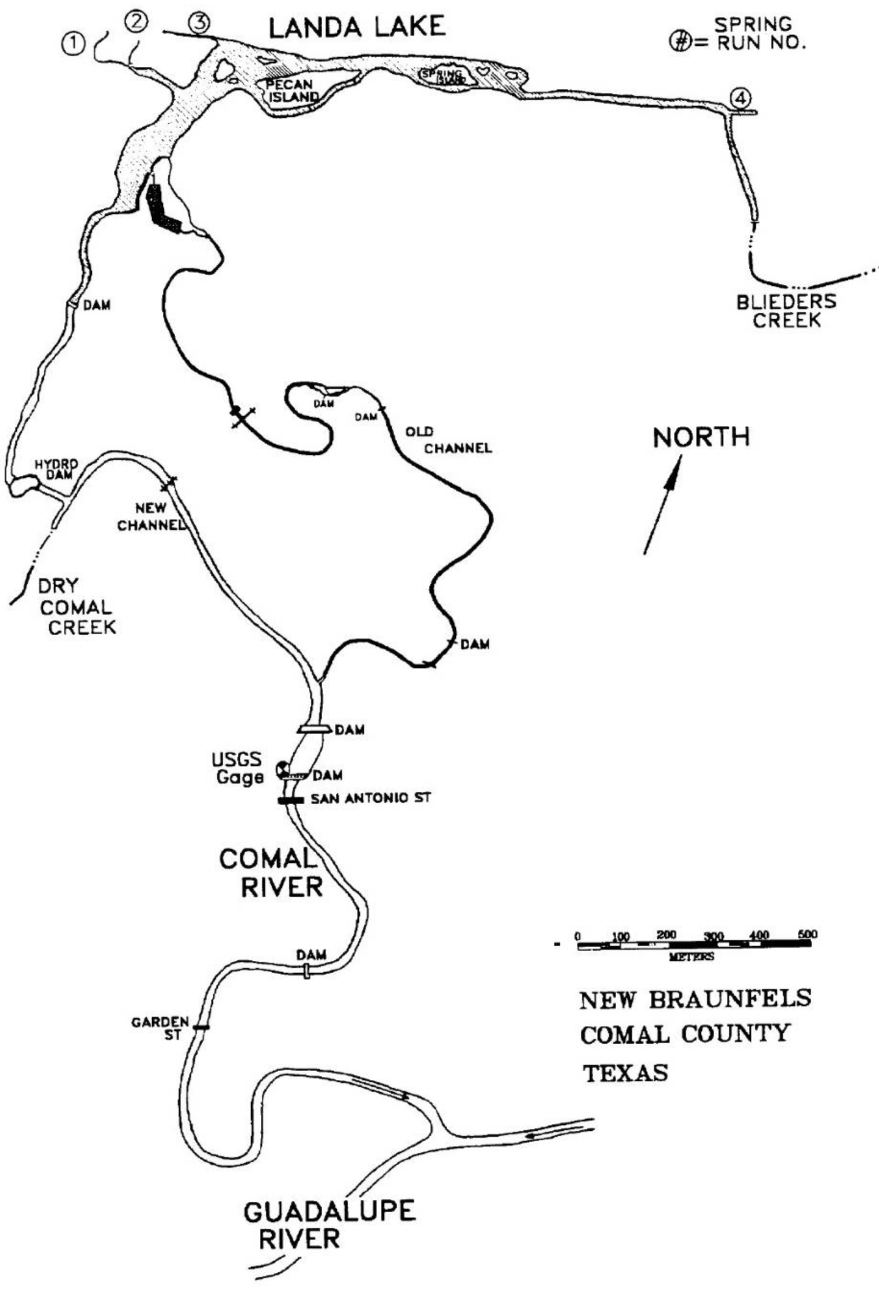
2. Overview of Springs

a. Comal Springs

The Comal Springs system is the largest spring system in Texas, and consists of numerous spring openings, collectively called Comal Springs, that originate from the Edwards Aquifer. These spring openings include Brune’s Springs j, k, and l (referred to herein as spring runs 1, 2, and 3, respectively; Figure 4). These springs provide flow to three short spring runs that empty into the western end of Landa Lake in Landa Park, a municipal recreational area owned by the City of New Braunfels, Comal County, Texas. Another smaller group of springs, referred to collectively as spring run 4, occur at the eastern end of Landa Lake near the confluence with Blieders Creek. Blieders Creek is about 6.8 miles long and dry except immediately after rains. Numerous small springs and seeps occur in the spring runs, along the banks of Landa Lake, and beneath the Lake (Brune 1981).

Landa Lake was created when the original river channel was dammed in 1847 to create a new channel providing water for Merriwether’s Mill. Landa Park was established as a privately owned park open to the public in l898. The city of New Braunfels acquired the park in 1936.

Figure 4: Comal Springs System



Water emerging from the multiple springs passes through Landa Lake before flowing into either the old or new channel of the Comal River. The old and new channels merge about 1.6 milesdownstream from Landa Lake and the Comal River flows generally south another 1.6 miles before joining the Guadalupe River. A short distance downstream from the headsprings, Dry Comal Creek enters the new channel of the Comal River from the southwest. Dry Comal Creek is an intermittent stream, but it does provide some recharge.

Faulting has, for the most part, hydrologically isolated Comal Springs, although local storms contribute a small recharge component to spring run 3 (Rothermel and Ogden 1987). Brune (1981) and Guyton and Associates (1979) determined the primary recharge area for Comal Springs lays as much as 62 miles to the west of Comal County and includes a large area of the western Edwards Aquifer. In addition to deep confined regional flow coming from Bexar County and westward, there is also a substantial amount of flow from the unconfined Hueco Springs Fault Block that originates in eastern Bexar County and western Comal County (Otero 2007). Evidence also suggests that a portion of the recharge entering the Edwards Recharge Zone in western Comal County included a component of flow sourced from the Trinity Group, juxtaposed against the Edwards along another fault zone.

Flow at Comal Springs has been monitored since the early 1880s and has the greatest mean discharge of any springs in the southwestern United States (George 1952). The average annual discharge from 1928-1989 was 284 cubic feet per second (cfs) with maximum daily springflows of 666 cfs on December 22, 1991, and the highest monthly flow was 467 cfs in 1973 (Edwards Underground Water District, pers. comm.; Guyton and Associates 1979). Much lower flows have been recorded during drought years, and in dry years, flows from Comal Springs can drop very rapidly. Comal Springs ceased flowing from June 13 to November 4, 1956, during the most severe drought on record (Service 1996a, Longley 1995). At that time, all major springs in the Balcones Fault Zone had ceased to flow, with the exception of San Marcos Springs, which had substantially decreased flow (Guyton and Associates 1979).
The mean annual water temperature of Comal Springs is 74°F and is not believed to fluctuate more than about 1°F (George 1952). This nearly constant temperature is significant in maintaining the endangered aquatic species in the Comal Springs ecosystem.

b. Hueco Springs

Hueco Springs are a smaller group of springs on private property near the Guadalupe River about three miles north of New Braunfels, Comal County, Texas (Guyton and Associates 1979). The west spring (Hueco I) flows down a small ravine into a diversion canal to a small lake, from which it spills into the Guadalupe River. The east spring (Hueco II) rises from a deposit of stream gravels between a county road and the Guadalupe River and flows directly to the river.

Springflows at Comal and San Marcos springs are inseparably tied to water usage from the entire Southern Segment of the Edwards Aquifer. The source of Hueco Springs is considered Edwards Aquifer, although the subset of the aquifer supplying Hueco Springs is thought to be smaller than that supplying Comal and San Marcos springs (Guyton and Associates 1979). Lindgren et al. (2004) expressed uncertainty about the source of Hueco Springs. Regardless, EAA uses Hueco Springs discharge as part its annual water budget for the Edwards aquifer.

The larger of the two springs, Hueco I, typically exhibits constant flow but has been documented to stop flowing during severe droughts (Ogden et al. 1986), such as in 1984. However, Hueco I did not stop flowing during the drought from 1989–1991. Hueco II is an intermittent spring that typically stops flowing during the driest months of the year (Barr 1993). The spring discharge data for Hueco Springs are less complete than for Comal and San Marcos springs. The USGS reported the annual discharge of Hueco Springs was 1.38 cfs for 1954 and 1955, and zero for 1956. The USGS established a discharge gaging station at Hueco Springs in 2002 and recorded a monthly mean discharge that ranged from 21.8 cfs to 116.6 cfs from 2002-2005 and fell to 3.1 cfs in December 2006. During 2011, the state's worst single drought year based on inflows to rivers and lakes, Hueco Springs ceased flowing in September (LCRA 2012, USGS 2011). However, after a record month of rain in May 2015, Hueco Springs discharge flows were still over 300 cfs in June (USGS provisional data for Comal River gage in New Braunfels, Texas).

Reported dissolved solids for Hueco Springs are within similar ranges as Comal and San Marcos springs at 253 to 302 milligrams per liter. The average temperature of Hueco Springs is about 70.4° F, with a range from about 68 to 73°F.

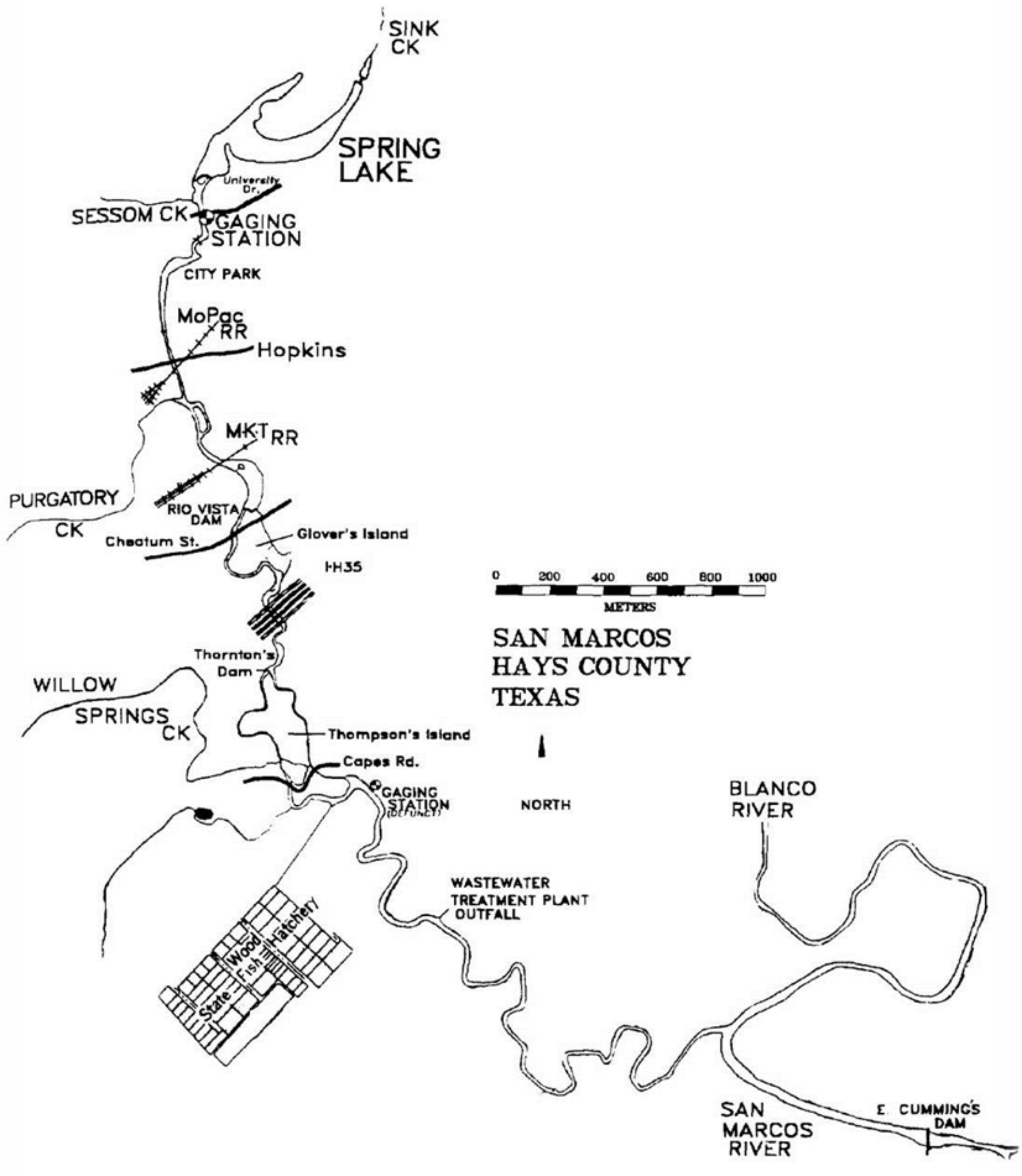
c. <u>San Marcos Springs</u>

The San Marcos spring system primarily occurs as a series of spring outlets that lie at the bottom of Spring Lake and along its shoreline in the City of San Marcos, Hays County, Texas (Figure 5). The landownership of San Marcos Springs consists entirely of State holdings: the surface water and bottom of Spring Lake are State-owned, and the State-affiliated Texas State University owns the adjacent land surface. The spring outlets associated with San Marcos Springs occur within the main part of the lake, excluding the slough portion that exists as an arm of the lake. San Marcos Springs is the second largest spring system in Texas and historically has exhibited the greatest flow dependability and environmental stability of any spring system in the southwestern United States. Records indicate that the San Marcos Springs have never ceased flowing, although the flow has varied and is tied to fluctuations in the Southern Segment of the Edwards Aquifer.

Guyton & Associates (1979) determined the majority of recharge for San Marcos Springs was from an area of the aquifer southwest of Comal Springs that flows under Comal Springs and is discharged at San Marcos Springs. These flows are derived primarily from the same sources as the Comal Springs, which likely include the recharge area from rivers and creeks north and west of the City of San Antonio. Additionally, local stream recharge from the Blanco and Guadalupe rivers and Sink, Purgatory, York, Dry Comal, and Alligator creeks also contributes to San Marcos Springs (Brune 1981, Musgrove and Crow 2012).

Guyton and Associates (1979) reported an average temperature in the headwaters (within Spring Lake) at 71.6°F between 1968 and 1974 and Guadalupe Blanco River Authority (GBRA) (2013) recorded the temperature in the upper San Marcos River (within Spring Lake and down to the confluence with the Blanco River at a median temperature of 73°F, ranging from 66.6°F to 77.4°F (GBRA 2013). The average discharge at San Marcos Springs from 2001 to 2007 was 164 cfs (GBRA 2013). During drought years much lower flows occurred, especially in the mid-1950s during the drought of record with a monthly flow of 54 cfs during 1956 and the lowest measured daily flow of 45.5 cfs, which occurred on 15 and 16 August 1956 (Guyton and Associates 1979).

Figure 5: San Marcos Springs System



d. Fern Bank Springs

Fern Bank Springs is located about 8 miles northwest of San Marcos Springs and is 0.2 miles east of the junction of the Blanco River and Sycamore Creek on privately-owned land in a predominately rural landscape. The spring system consists of a main outlet and a number of small springs that issue forth from a steep cliff overlooking the Blanco River. The exact water source for Fern Bank Springs is unknown, but may derive its flows from the Glen Rose formation of the Trinity Aquifer, from drainage associated with the Edwards Aquifer recharge zone, or from the Blanco River (Veni in litt. 2006). Fern Bank Springs discharges to the Blanco River just upstream of the Edwards aquifer recharge zone thus, this spring may provide some small contribution to Edwards aquifer recharge.

Fern Bank Springs discharge is not gaged and has only been intermittently measured. Brune (1981) reported Fern Bank spring flow discharge of 4.9 cfs on May 31, 1975, and 0.3 cfs on May 1, 1978. Mace et al. (2000) modeled simulated ground water levels over a four decade period. The model estimated a 42-foot drop in water level by 2050 at Fern Bank Springs based on average recharge levels through 2043 and drought of record conditions from 2044 to 2050 (Mace et al. 2000). However, a single-family owned the spring site from the late 1800s until 2009, and in 2008, the landowner claimed that the spring never ceased flowing during that time, including the drought of the 1950s.

3. Status of the Species/Critical Habitat

a. Comal Springs dryopid beetle

Species Description and Life History

The Comal Springs dryopid beetle (*Stygoparnus comalensis*) was listed as endangered on December 18, 1997 (62 FR 66295). Critical habitat was designated on October 23, 2013, and consists of Comal Springs in Comal County, Texas, and Fern Bank Springs in Hays County, Texas (78 FR 63100).

The Comal Springs dryopid beetle is the only known hypogean- (subterranean) adapted member of the family Dryopidae. Barr and Spangler (1992) described this species based on its unique morphological distinctions including vestigial (rudimentary) eyes and wings. Adult beetles are elongate, parallel-sided and slender, head retractile, with cuticle (skin) coloration reddish-brown and translucent (Barr and Spangler 1992). Larvae are elongate, cylindrical, and yellowish-brown in color (Barr and Spangler 1992). Mature larvae are approximately 0.24 to 0.31 inches long.

Larvae in the family Dryopidae do not have gills and are considered terrestrial, inhabiting moist soil along stream banks, presumably feeding on roots and decaying vegetation (Brown 1987, Ulrich 1986). Vestigial eyes indicate adaptation to subterranean habitats. Barr and Spangler (1992) presumed the microhabitat for the Comal Springs dryopid beetle to be soil, roots, and debris exposed above the waterline on the ceilings of spring orifices. Larval development is unknown for this species.

Adult Comal Springs dryopid beetles are limited to aquatic habitats but are not capable of swimming, instead they move slowly. Adults respire through a plastron (gas film produced by an area of dense water-repelling hairs), which requires them to live habitats with high dissolved oxygen (Brown 1987, Resh et al. 2008). Some wild caught adult specimens have survived in captivity 11-21 months (Barr and Spangler 1992, Fries et al. 2004), but lifespan in the wild is unknown.

Dryopid beetle adults typically feed on biofilm (microorganisms and debris) scraped from surfaces such as rocks, wood, and vegetation (Brown 1987). Potential food sources may include detritus (decomposed materials), leaf litter, and decaying roots. However, it is possible that this species may feed on bacteria and fungi associated with decaying plant material (R. Gibson, Service, pers. comm. 2006).

The Comal Springs dryopid beetle relies on high-quality water with no occurrence or minimal levels of pollutants; low salinity with total dissolved solids that generally range from 307 to 368 mg/L and turbidity of less than 5 nephelometric turbidity units (NTUs; measurement of turbidity in a water sample by passing light through the sample and measuring the amount of the light that is deflected); aquifer water temperatures that range from about 68° to 75.2°F; a hydrologic regime that allows spring flows to maintain dissolved oxygen levels to range from 4.0 to 10.0 milligrams/liter; and a food supply that includes, but is not limited to, detritus, leaf litter, and decaying roots (Service 2007b).

Historic and Current Distribution

Comal Springs dryopid beetles were first collected at Comal Springs in New Braunfels, Texas, in 1987 (Service 1996a). Barr (1993) collected specimens at additional spring runs around Comal Springs, and in 1992 also found them at Fern Bank Springs in San Marcos, Texas. Collections during 2003 to 2009 extended the known range of the beetle within the Comal Springs system to all major spring runs; seeps along the western shoreline of Landa Lake; upwellings within Landa Lake, primarily in the Spring Island area; and Panther Canyon Well (EAA 2003, 2004, 2005, 2006, Fries et al. 2004, Gibson et al. 2008). The extent of the subterranean range of the species is unknown, though it has been suggested that they may be confined to small areas surrounding spring openings (Barr 1993, 62 FR 66295).

Reasons for Decline and Threats to Survival

The primary threat to the Comal Springs dryopid beetle is the reduction of water quantity and quality (62 FR 66295). The primary threats to water quantity are drought and ground water pumping. Water quality is threatened by land use changes throughout the region that may increase risks of aquifer, springflow, and streamflow contamination. Pollution threats include: 1) groundwater pollution from land-based hazardous material spills and leaking underground storage tanks; 2) cumulative impacts of urbanization (road runoff, leaking sewer lines, residential pesticide and fertilizer use, etc.); 3) increased impact of contaminants due to decreased dilution from smaller volumes of water in the aquifer and springflows; and, 4) surface, stormwater, and point and nonpoint source discharges into the streamflows.

Range-wide Survival and Recovery Needs

There is no recovery plan for the Comal Springs dryopid beetle and because beetles are rarely collected there is little population information. Development of culture techniques for Comal Springs dryopid beetles continues to progress slowly, and until the Service's San Marcos Aquatic Resources Center (formerly San Marcos National Fish Hatchery and Technology Center, SMARC) is reasonably successful at rearing the Comal Springs dryopid beetle, they do not plan to collect more specimens (SMARC 2014). Two full comprehensive sampling efforts (spring and fall) and several critical period sampling efforts take place via drift nets at three locations in the Comal Springs system (Edwards Aquifer Recovery Implementation Program [EARIP] 2012, BIO-WEST 2015). Fern Bank Springs is privately owned, so there is no monitoring or collecting occurring at this site. Additionally, a refugia plan has been drafted as part of the EARIP HCP (EARIP 2012); however, it has yet to be implemented.

Critical Habitat

Primary constituent elements, as defined by the critical habitat designation (78 FR 63100) for Comal Springs dryopid beetle are:

- Springs, associated streams, and underground spaces immediately inside of or adjacent to springs, seeps, and upwellings that include:
  - High-quality water with no or minimal pollutant levels of soaps, detergents, heavy metals, pesticides, fertilizer nutrients, petroleum hydrocarbons, and semivolatile compounds such as industrial cleaning agents; and
  - Hydrologic regimes similar to the historical pattern of the specific sites, with continuous surface flow from the spring sites and in the subterranean aquifer;
- Spring system water temperatures that range from approximately 68 to 75 °F (20 to 24 °C); and
- Food supply that includes, but is not limited to, detritus (decomposed materials), leaf litter, living plant material, algae, fungi, bacteria, other microorganisms, and decaying roots.

b. <u>Comal Springs riffle beetle</u>

Species Description and Life History

The Comal Springs riffle beetle (*Heterelmis comalensis*) was listed as endangered on December 18, 1997 (62 FR 66295). Critical habitat was designated on October 23, 2013, and is primarily restricted to surface water in the impounded portion of Comal Springs (Landa Lake, Comal County) and San Marcos Springs (upstream portion of Spring Lake, Hays County) (78 FR 63100).

The Comal Springs riffle beetle is a small, aquatic beetle found in the Comal Springs system, including Landa Lake, in Comal County and Spring Lake in Hays County, Texas. Examples of this species were first collected by Bosse in 1976 and described in 1988 (Bosse et al. 1988). Adult Comal Springs riffle beetles are reddish-brown in color, range in length from 0.067 to 0.83 inches. The sides of the body are approximately parallel and the entire dorsal surface is coated with fine golden-colored setae (hairs) (Bosse et al. 1988). The hind wings of Comal Springs riffle beetles are short and non-functional (Bosse et al. 1988) and the species is incapable of flying. Larval Comal Springs riffle beetles are elongate, tubular in cross-section and light tan in color. The Comal Springs riffle beetle pupa is pale in color and legs and wing pads project loosely from the body.

The Comal Springs riffle beetle is an epigean (surface-dwelling) species that inhabits fast flowing waters with gravel and cobble substrates (Bowles et al. 2003). Food sources include, but are not limited to, detritus, leaf litter, and decaying roots. Little is known of their life history and habitat (Bowles et al. 2003). BIO-WEST (2006) reported that riffle beetles may take six months to three years to complete their life cycle from egg, to larvae, to adult. Bowles et al. (2003) found all life stages of Comal Springs riffle beetles were represented throughout the year. Some wild caught adult specimens have survived in captivity 17-19 months (Fries 2003), but true lifespan is unknown.

Historic and Current Distribution

Comal Springs riffle beetle was first described from Comal Springs, New Braunfels, Texas (Bosse et al. 1988), where it still occurs throughout the spring system, including in Landa Lake (BIO-WEST 2007). Barr (1993) found a single riffle beetle in Spring Lake, San Marcos, Texas, which was long thought to be in error. However, Gibson et al. (2008) collected Comal Springs riffle beetles again from Spring Lake and found adults and larvae, indicating the presence of a reproducing population. The Comal Springs riffle beetle is not known from any other locations.

Reasons for Decline and Threats to Survival

Since Comal Springs riffle beetles require flowing water for respiration, the primary threats to Comal Springs riffle are a decrease in water quantity and quality as a result of water withdrawal and drought throughout the Southern Segment of the Edwards Aquifer. Although, the absolute low water limits for survival are not known. They survived the drought of the middle 1950's, which resulted in cessation of flow at Comal Springs from June 13 through November 3, 1956. Bowles et al. (2003) speculated that the riffle beetle may be able to retreat back into spring openings or burrow down to wet areas below the surface of the streambed. Brown (1987) reported finding adult *Heterelmis* in a dry stream in central Texas by digging to where the gravel substrate was still damp. Given that these beetles are fully aquatic and that no water was present in the springs for a period of several months, they were probably negatively impacted at some unknown level. However, it is not known how adapted the Comal Springs riffle beetle is to surviving long periods of drying. Although San Marcos Springs have not stopped flowing in recorded history, dewatering of this system would be expected to have a similar negative effect on survival of Comal Springs riffle beetle populations at that location.

Stagnation of water also may be a limiting condition. Stagnation of water and/or drying within the spring runs and the photic (lighted) zone of the spring orifices would probably be limiting for the Comal Springs riffle beetle because natural water flow is considered important to the respiration and therefore survival of this invertebrate species.

Range-wide Survival and Recovery Needs

There is no recovery plan for the Comal Springs riffle beetle. There is also no population estimate for this species; however, sampling efforts between 2004 and 2010 provide general density estimates at each of the three Comal Springs locations sampled and suggests a general upward trend in density (BIO-WEST 2011). Two full comprehensive sampling efforts (spring and fall) and several critical period sampling efforts take place via drift nets at three locations in the Comal Springs system and at San Marcos Springs (EARIP 2012, BIO-WEST 2015). From these sampling efforts specimens are collected and transferred to SMARC for captive rearing and research. Researchers will continue to research and develop captive culture techniques (SMARC 2014).

As part of the EARIP HCP, the City of New Braunfels will restore native riparian zones and increase the amount of usable habitat and food sources in Comal Springs for Comal Springs riffle beetles. Additionally, as part of the EARIP HCP research plans include determining habitat requirements and responses; low-flow impacts; and the implications of the timing, frequency, and duration of multiple events in varying sequences to assess ecological model predictions (EARIP 2012).

Critical Habitat

Primary constituent elements, as defined by the critical habitat designation (72 FR 39248), for Comal Springs riffle beetle are:

- Springs, associated streams, and underground spaces immediately inside of or adjacent to springs, seeps, and upwellings that include:
  - High-quality water with no or minimal pollutant levels of soaps, detergents, heavy metals, pesticides, fertilizer nutrients, petroleum hydrocarbons, and semivolatile compounds such as industrial cleaning agents; and
  - Hydrologic regimes similar to the historical pattern of the specific sites, with continuous surface flow from the spring sites and in the subterranean aquifer;
- Spring system water temperatures that range from approximately 68 to 75 °F (20 to 24 °C); and
- Food supply that includes, but is not limited to, detritus (decomposed materials), leaf litter, living plant material, algae, fungi, bacteria, other microorganisms, and decaying roots.

c. Peck's Cave Amphipod

Species Description and Life History

Peck's cave amphipod (*Stygobromus pecki*) was listed as endangered on December 18, 1997 (62 FR 66295). Critical habitat was designated in October 23, 2013 at Comal and Hueco Springs in Comal County, Texas (78 FR 63100).

Holsinger (1967) described Peck's cave amphipod from two female specimens collected at Comal Springs. Verification of this species is usually not possible in the field and usually requires microscopic examination of adult specimens by those with expertise in the taxonomy of subterranean amphipods. Holsinger (1967) characterized the flagellatus species group to which Peck's cave amphipod belongs as largely cavernicolous (living in subterranean caves or passages) in habitat preference, having restricted ranges, and occupying deep groundwater niches. Mature and immature life stages have been collected only near spring outlets, from seeps along the spring runs, and from a single shallow well (R. Gibson, SMARC, pers. comm.).

The specific microhabitat of Peck's cave amphipod is unknown, but it may be similar to that of the Comal Springs dryopid beetle (Barr and Spangler 1992), which is soil, roots, and debris exposed above the waterline on the ceilings of spring orifices. Gibson et al. (2008) found Peck's cave amphipod in gravel, rocks, and organic debris (leaves, roots, wood) immediately inside of or adjacent to springs, seeps, and upwellings of Comal Springs and their impoundment, Landa Lake. They were not observed in nearby surface habitats. Gibson et al. (2008) collected Peck's Cave amphipod in drift nets at Hueco and Comal springs, implying they were ejected from the spring mouth into the water column. At Panther Canyon Well specimens were collected in a baited bottle trap, implying that free-swimming individuals entered the trap through the opening following the smell of the bait.

Evidence suggests Peck's cave amphipod is likely omnivorous, enabling the amphipod to exist as a scavenger or predator inside the aquifer in addition to using detritus in areas near spring outlets where plant roots interface with spring water (Service 2007b). Potential food sources include detritus, leaf litter, decaying roots, and bacteria and fungi associated with decaying plant material.

Historic and Current Distribution

The type locality of Peck's cave amphipod is Comal Springs in Comal County (Holsinger 1967). Barr (1993) reported Peck's cave amphipod from Hueco Springs in Comal County, and found this amphipod at all four of the primary spring runs at Comal Springs. In a similar study, Arsuffi (1993) found Peck's cave amphipod only at the orifice openings of Comal Spring runs 1 and 3. Recently, researchers confirmed the occurrence of this amphipod at Hueco Springs in addition to discovering the species at Panther Canyon Well in the vicinity of Comal Springs (Gibson et al. 2008).

Various researchers have examined amphipod assemblages from springs, caves, and wells in Comal, Hays, and Bexar counties without finding this species (e.g., Holsinger 1967, 1978; Holsinger and Longley 1980; Barr 1993; Gibson et al. 2008). These negative findings suggest that the species is not abundant in these areas, though these efforts do not provide conclusive evidence that the species does not occur elsewhere. Cave and groundwater fauna are known to be rare and infrequently collected. Because the drainage basins of Comal and Hueco Springs are extensive, the range of Peck's Cave amphipod could be much larger than previously thought if this species is able to inhabit groundwater conduits far from the spring orifices from where they are currently known. Alternately, the species may be restricted to the downstream portions because of competition with other taxa or unsuitable habitat (e.g., fewer nutrients, different water chemistry parameters).

Reasons for Decline and Threats to Survival

The general threats to this species are a decrease in water quantity and quality as a result of water withdrawal and other human activities throughout the San Antonio segment of the Edwards Aquifer. As described by the critical habitat designation and species listing, the specific primary threats to the survival of this species are associated with water quality (dissolved oxygen, temperature, pollution), water quantity (habitat reduction and drying), and riparian habitat associated with springs and subsurface flowing waters (reduction in nutrient input via roots and allochthonous [sediment or rock that originates at a distance from its present position] materials).

The potential failure of spring flows due to drought or excessive groundwater pumping could result in loss of aquatic habitat for this species.

Range-wide Survival and Recovery Needs

Since 2004, monitoring of Peck's Cave amphipod takes place twice yearly by netting the major spring orifices and collecting with cotton cloth lures at Comal Springs (BIO-WEST 2015). Genetic analysis using mitochondrial DNA found known populations of Peck's Cave amphipod contained sequences from two distinct haplotype groups in roughly equal proportions (Nice and Ethridge 2011). This observation raises several possible explanations, including the presence of two cryptic species within the nominal species, but requires additional genetic analysis to interpret the findings. The SMARC (2014) continues to collect specimens, develop captive propagation techniques, and conduct research on Peck's Cave amphipod. Additionally, as part of the EARIP HCP, the long-term biological goal for the Peck's Cave amphipod will focus on maintaining water quality at the spring flow outlets and continuing to collect demographic data to better manage the species and its habitat (EARIP 2012).

Critical Habitat

Primary constituent elements, as defined by the critical habitat designation (78 FR 63100), for Peck's Cave amphipod are:

- Springs, associated streams, and underground spaces immediately inside of or adjacent to springs, seeps, and upwellings that include:
    - High-quality water with no or minimal pollutant levels of soaps, detergents, heavy metals, pesticides, fertilizer nutrients, petroleum hydrocarbons, and semivolatile compounds such as industrial cleaning agents; and
    - Hydrologic regimes similar to the historical pattern of the specific sites, with continuous surface flow from the spring sites and in the subterranean aquifer;
- Spring system water temperatures that range from approximately 68 to 75 °F (20 to 24 °C); and
- Food supply that includes, but is not limited to, detritus (decomposed materials), leaf litter, living plant material, algae, fungi, bacteria, other microorganisms, and decaying roots.

d. <u>Texas wild-rice</u>

Species Description and Life History

Texas wild-rice (*Zizania texanus*) was listed as endangered on April 26, 1978 (43 FR 17910). Critical habitat was designated for this species on July 14, 1980, and consists of Spring Lake and its outflow and the San Marcos River downstream to the confluence with the Blanco River (45 FR 47355).

Texas wild-rice is an aquatic, monoecious (pistillate and staminate flowers are on the same plant), perennial grass, which is generally 3.3 to 6.5 feet long and usually immersed and prostrate in the swift-flowing water of the San Marcos River. Texas wild-rice forms large stands at depths from 0.76 to 3.3 feet and requires clear, relatively cool, thermally constant (approximately 72°F) flowing water. Texas wild-rice prefers gravel and sand substrates overlaying Crawford black silt and clay (Poole and Bowles 1999, Saunders et al. 2001; Vaughan 1986).

Spring flow and San Marcos River discharge are critically important for growth and survival of Texas wild-rice (Saunders et al. 2001). Texas wild-rice relies on carbon dioxide as its inorganic carbon source for photosynthesis rather than the more commonly available bicarbonate used by most other aquatic plants (TPWD 1994; Seal and Ellis 1997). Edwards Aquifer water contains relatively high levels of carbon dioxide and is readily available near spring openings and in relatively fast-moving waters that transport the dissolved gas downstream. Low flow situations can be carbon limiting for carbon dioxide-using obligates including Texas wild-rice.

Reproduction of Texas wild-rice occurs either asexually (clonally) through stolons or sexually via seeds. Asexual reproduction occurs where shoots arise as clones at the ends of rooting stolons (Emery and Guy 1979). Clonal reproduction appears to be the primary mechanism for expansion of established stands, but does not appear to be an efficient mechanism for dispersal and colonization of new areas. Texas wild-rice segments have, however, been observed floating downstream and some of these may become established plants; but only if lodged in suitable substrate and physical habitat.

During sexual reproduction, Texas wild-rice flowers above the water surface and wind pollinated florets produce seed. This typically takes place in late spring through fall, though flowering and seed set may occur at other times in warm years (Service 1996a). Triggers for flowering are not well understood. Texas wild-rice seed is not long-lived, and viability begins to drop markedly within one year of production. No appreciable seed bank is therefore expected. In slow moving waters, Texas wild-rice function as annuals, exhibiting less robust vegetative growth, then flowering, setting seed, and dying within a single season.

Historic and Current Distribution

The San Marcos River originates from San Marcos Springs, which are located within Spring Lake in San Marcos, Hays County, Texas. The San Marcos River runs approximately 4 miles until it meets with the Blanco River (this reach is also called the Upper San Marcos) and then extends another 75 miles until it meets with the Guadalupe River (this reach is also called the Lower San Marcos) (Handbook of Texas Online 2012). Based on Terrell et al. (1978), Texas wild-rice was first collected in the San Marcos River in 1892. When the species was originally described in 1933, it was reported to be abundant in the San Marcos River, including Spring Lake. By 1967 Emery found only one plant in Spring Lake, only scattered plants in the last 1.5 miles of the Upper San Marcos, and none in the Lower San Marcos (Emery 1967). Emery (1967) stated several reasons for the decline: bottom plowing to keep the lake and river clean for tourists, floating debris from the mowing damages the emergent part of wild-rice preventing it from reproducing, plant collection, and pollution.

By the mid-1970's Beaty (1975) found about 2,580 square feet (0.06 acre) of coverage. In 1976 Emery again checked abundance of Texas wild-rice and found no plants in Spring Lake and calculated 12,161 square feet (0.3 acre) in the Upper San Marcos River (Emery 1977). Subsequent data were gathered by Vaughan (1986) for several years (1984-1986) and overall areal coverage in 1986 was 4,881 square feet (0.1 acre). Texas Parks and Wildlife Department has monitored area coverage since June 1989, which has ranged from 10,810 to 46,050 square feet (0.25 to 1.1 acre)(Poole and Bowles 1999). The current distribution of Texas wild-rice extends from the upper reaches of the San Marcos River, including several plants that were reintroduced into Spring Lake just upstream of the dam, and numerous stands just below the dam, throughout the river habitat to an area just below the wastewater treatment plant (EARIP 2012). Until recently, it had not occurred between the Rio Vista railroad bridge and the Cheatham Street dam (Service 1996a), however a single plant is now present in this reach (E. Oborny, BIO-WEST, personal communication).

Reasons for Decline and Threats to Survival

Reduced flow of water from the springs is the greatest threat to the survival of Texas wild-rice (Service 1996a). Drought conditions in 1996 killed Texas wild-rice stands in portions of the river that were dewatered. Low flows during this period also allowed floating mats of vegetation, which normally move downriver, to become lodged in wild-rice stands. These mats shaded Texas wild-rice and are thought to have interfered with culm emergence, thereby interfering with sexual reproduction (Power 1996, 2002; Poole 2006). Decreased flows, which expose more of the plant, can also leave Texas wild-rice more susceptible to increased herbivory by waterfowl and non-native nutria, and ramshorn snails, which prefer slow moving water (Rose and Power 1992). Altered flow conditions may also result in competitive advantages for non-native plants when conditions are sub-optimal for Texas wild-rice. Given the historically stable nature of flow from San Marcos Springs, vulnerability of Texas wild-rice to negative impact from reduced flows is greater than in other aquatic ecosystems accustomed to seasonal changes in water quantity and quality. Conservation of the quantity and quality of Edwards Aquifer water emanating from the springs is fundamental to the preservation of this spring ecosystem (Saunders et al. 2001).

There are numerous non-native plant species that occur in the San Marcos River system, which can displace Texas wild-rice through direct competition for space, light and nutrients, and also alter the ecosystem. These species include alligatorweed (*Alternanthera philoxeroides*), giant reed (*Arundo donax*), floating fern *(Ceratopteris thalichtroides*), elephant ear (*Colocasia esculenta*), water trumpet (*Cryptocoryne beckettii*), water-hyacinth *(Eichornia crassipes*), and hydrilla (*Hydrilla verticillati*) (Bowles and Bowles 2001).

An additional threat to Texas wild-rice is recreational use of the San Marcos River. Bradsby (1994) found recreation was related to season, with the highest use during the summer months, especially holidays and weekends. Breslin (1997) sampled impacts from tubing, swimming, boating, fishing, and dogs on wild-rice and found visible damage to plants occurred with 1.92 percent of observed contact. Tubing was found to cause the greatest individual damage and dogs had the highest level of damage proportional to visits (Breslin 1997). While these studies did not quantify effects to the species at various discharge levels, as discharge decreases, which typically occurs during the summer months, a greater percentage of the plants are presumably exposed to recreational users, increasing the potential for adverse effects. In September 2006, a significant loss of Texas wild-rice was recorded due to vandalism (Poole 2006).

Range-wide Survival and Recovery Needs

According to the San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan (Service 1996a), which includes Texas wild-rice, there are several specific recovery criteria for protecting and recovering Texas wild-rice, including: ensuring adequate flows and water quality in Spring Lake and the San Marcos River; maintenance of genetically diverse reproductive populations in captivity; creation of reintroduction techniques for use in the event of a catastrophic event; removal or reduction of local threats from non-native species, recreational users, and habitat alteration; and maintenance of healthy, self-sustaining, reproductive populations in the wild.

In 1996, a refugium population of Texas wild-rice was created at the Service's San Marcos Aquatic Resources Center. A reintroduction plan was drafted and restoration work began in 2007. The SMARC continues to collect specimens, maintain refugium, and conduct research on populations of Texas wild-rice. The Uvalde NFH also maintains a refugium for Texas wild-rice (SMARC 2014).

A population of water trumpet, (*Cryptocoryne beckettii*), native to Southeast Asia, has occurred in the San Marcos River near the outfall of the San Marcos Wastewater Treatment Facility since about 1996 (Rosen 2000). This species occupies similar habitats as Texas wild-rice and during the initial decade after its introduction, the areal coverage of this highly invasive species increased several hundred times from 1,840 square feet in 1998 to 6,953 square feet in 2000 (Doyle 2001). Since August of 2002, through a cooperative effort led by the SMARC, this plant appears now to have been effectively removed from the San Marcos River. (Alexander 2008).

The San Marcos River Foundation (SMRF) was founded in 1985 to preserve public access to the San Marcos River and protect the flow, natural beauty, and purity of the river, its watershed, and estuaries for future generations. Volunteers of SMRF conduct regular water quality testing to determine if there is damage or deterioration of the water quality. Once a month, SMRF volunteers remove water hyacinth from the slough and Spring Lake, and daily volunteers read river gauges to determine if there is any collapse or leaking from Rio Vista Dam, an aging dam on the river.

There are several river cleanups each year on the San Marcos River coordinated by the Texas River Protection Association. There are other river cleanups during the year that are coordinated by the City of San Marcos, and many groups adopt a stretch of river that they clean up regularly, like the Lions Club.

To minimize the impacts of recreational activities on Texas wild-rice TPWD in support of the EARIP HCP created a State Scientific Area in the San Marcos Springs ecosystem effective May 1, 2012 (TPW Code § 81.501). This Scientific Area is designed to protect Texas wild-rice by limiting recreation in these areas during low flow conditions. The rule makes it unlawful for any person (1) to move , deface alter, or destroy any sign, bouy, boom, or other such marking delineating the boundaries of the area; (2) uproot Texas wild-rice within the area; and (3) enter an area that is marked. The regulations are intended to preserve at least 1,000 m2 of Texas wild-rice. As part of the EARIP HCP long-term biological goals include minimum areas of Texas wild-rice coverage in Spring Lake and downstream in the San Marcos River, recreation awareness with designated control during low flows, and active restoration and long-term monitoring (EARIP 2012).

Critical Habitat
The critical habitat designation for Texas wild-rice predates the requirement for identification of primary constituent elements that are essential for the conservation of this species. However, the rule designating critical habitat (45 FR 47362) does describe those actions that would adversely modify designated critical habitat, including any actions that would cause the following: significantly alter the flow or decrease water quality in the San Marcos River; physically alter Spring Lake or the San Marcos River, such as by dredging, bulldozing, or bottom plowing; or physically disturb the plants, such as by harrowing, cutting, or intensive collecting. Based on the best available scientific and commercial data available, the primary constituent elements could generally be defined as:

- Clear water,
- Uniform annual flow rates,
- Constant year-round temperature, and
- Maintenance of the natural substrate.

e. Fountain darter

Species Description and Life History
The fountain darter (*Etheostoma fonticola*) was listed as endangered on October 13, 1970 (35 FR 16047), and received Federal protection with the passage of the Endangered Species Act in 1973. While the fountain darter is located in both San Marcos and Comal river systems, on July 14, 1980, critical habitat was only designated in Spring Lake and its outflow and the San Marcos River downstream to 0.5 mile past Interstate 35 (45 FR 47355).

The fountain darter is usually less than 1 inch standard length (from tip of snout to last vertebrae), and is mostly reddish brown (Page and Burr 1979). Three small dark spots are present on the base of the tail and there is a dark spot on the opercle (a boney flap covering the gills) (Jordan and Gilbert 1886; Gilbert 1887; Jordan and Evermann 1896). Although fountain darters spawn year-round (Schenck and Whiteside 1977b), they appear to have two peak spawning periods, one in August and another late winter to early spring (Schenck and Whiteside 1977b). Dowden (1968) found fountain darter eggs attached to bryophytes and algae in Spring Lake. Phillips et al. (2011) observed fountain darter eggs deposited on filamentous algae *Rhizoclonium* sp., *Ludwigia repens*, *Sagittaria* sp., and the endangered Texas wild-rice. After hatching, fry are not free swimming, in part due to the reduced size of their swim bladders.

Data collected during an ongoing variable flow study suggests that fountain darter reproduction may be tied to habitat quality (BIO-WEST 2007). Length frequency data from several sample reaches suggest year-round reproduction in areas of high-quality habitat in both the Comal and San Marcos systems (e.g., Spring Lake, Landa Lake), and a strong spring peak in reproduction (with limited reproduction in summer and fall of most years) in areas of lower quality habitat farther downstream.

Fountain darters prefer undisturbed stream floor habitats; a mix of submergent plants (algae, mosses, and vascular plants), in part for cover; clear and clean water; a live invertebrate food supply (copepods, dipteran [fly] larvae, and emphemeropteran [mayfly] larvae); constant water temperatures within the natural and normal river gradients; and adequate springflows (Bergin 1996, Schenck and Whiteside 1977a). Fountain darters are rarely found in areas lacking vegetation (BIO-WEST 2007), and in habitat studies within the San Marcos River, Schenck and Whiteside (1976) never found fountain darters in areas without vegetation.

While fountain darters can move between patches of vegetation, they appear to be highly resident fish (Dammayer et al., Service, unpublished data). It is not known if fountain darters are capable of swimming long distances to evade degrading habitat or if the darters can move from patch to patch, if patches are isolated by non-suitable habitat.

Historic and Current Distribution

The range of the fountain darter is the San Marcos and Comal river systems in central Texas (Jordan and Gilbert 1886, Gilbert 1887, Evermann and Kendall 1894). In 1884, Jordan and Gilbert (1886) collected the type specimens of *E. fonticola* in the San Marcos River from immediately below the confluence of the Blanco River. Fountain darters were collected in the Comal River in 1891 (Evermann and Kendall 1894). The present distribution of the fountain darter in the San Marcos River includes Spring Lake downstream to just before the confluence with the Blanco River, (Service 1994 permit report, C. T. Phillips, Service, unpublished data). Hubbs and Strawn (1957) made the last collection record for the Comal River in 1954, before its apparent extirpation there and subsequent reintroduction (from February of 1975 to March of 1976) into the Comal system.

During March 1973 through February 1975, Schenck and Whiteside (1976) spent 300 person-hours sampling the Comal River but collected no fountain darters. They proposed that the most likely cause was the cessation of flow from Comal Springs from June to November, 1956, drought of record. This cessation probably caused drastic temperature fluctuations in the remaining pools of water, decreased habitat/water quality, and increased predation of fountain darters. From February 1975 through March 1976 fountain darters were collected from the San Marcos River and about 450 fish were released into the headsprings area of the Comal River, Landa Park and into the old Comal River channel. By June of 1976 five offspring were found a short distance below the headsprings (Schenck and Whiteside 1976), and now fountain darters occupy the entire Comal spring and river system from Landa Lake approximately three miles to the Comal/Guadalupe River confluence.

The population of fountain darters in the San Marcos River, excluding Spring Lake, was estimated to be approximately 103,000 by Schenck and Whiteside (1976) and 45,900 by Linam (1993). In 1991, Janet Nelson conducted scuba-aided underwater surveys in Spring Lake and estimated at least 16,000 fountain darters at the spring openings and another 15,000 in the green algae habitat (J. Nelson, TPWD, personal communication). Linam et al. (1993) sampled 7 transects in Landa Lake and the Comal River in 1990 and reported a population estimate of about 168,078 darters above Torrey Mill Dam.

Reasons for Decline and Threats to Survival

The primary threats to fountain darter are related to the quality and quantity of aquifer and spring water. Drought conditions or increased groundwater utilization resulting in reductions to or loss of spring flows could threaten the species. Activities that may pollute the Edwards Aquifer and its springs and stream flows may also threaten the species (45 FR 47355, Service 1996a).

Additional threats include effects from increased urbanization near the rivers, recreational activities, alteration of the rivers, habitat modification (e. g. dams, bank stabilization, flood control), predation, competition, habitat alteration by non-native species, and introduced parasites (Service 1996a). One parasite threatening the fountain darter is a trematode that attacks and damages the darter's gills (Salmon 2000, McDonald et al. 2007). The risks posed by these parasites are anticipated to increase during stressful periods of low spring discharge (Cantu 2003) and the parasite's adverse effects may be greater to younger fountain darter life-stages (McDonald et al. 2007).

Range-wide Survival and Recovery Needs

According to the San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan (Service 1996a), which includes fountain darter, specific recovery actions include: ensuring adequate flows and water quality in the San Marcos River; maintenance of genetically diverse reproductive populations in captivity and creation of reintroduction techniques for use in the event of a catastrophic event; removal or reduction of threats due to non-native species, recreational use of the river, and habitat alteration; and maintenance of healthy, self-sustaining, reproductive populations in the wild.

A refugium has been established at the SMARC to serve as a back-up population for the fountain darter from both the San Marcos and Comal springs systems (SMARC 2014). In the event of a low flow situation, additional refugium stock can and will be collected. Additionally, the Service's Uvalde National Fish Hatchery (NFH) has a refugium of fountain darters from the Comal River given the potential for San Marcos fish to carry an unknown reovirus (SMARC 2014).

As part of the EARIP HCP, long-term biological goals for the fountain darter in the San Marcos and Comal springs systems are quantified as areal coverage of aquatic vegetation (habitat) within four representative reaches of the Comal system and maintaining a specific level of fountain darter density per aquatic vegetation type (EARIP 2012). Additional measures of the EARIP HCP include aquatic vegetation restoration, maintaining surface water quality and sufficient flow, monitoring key components (i.e., aquatic vegetation, the species themselves, water quality, non-native species, gill parasites, etc.), and conducting applied research and ecological modeling (EARIP 2012).

On March 29, 2012, the TPWD adopted a rule creating the San Marcos River State Scientific Area (31 TAC § 57.901), which will help protect fountain darter habitat. Additionally, as part of the EARIP HCP, they will pursue an additional state scientific area in the Comal Springs ecosystem to protect fountain darter habitat. TPWD also intends to participate in the implementation of other minimization and mitigation measures in both ecosystems (EARIP 2012).

Critical Habitat
The critical habitat designation for fountain darter predates the requirement for identification of primary constituent elements that are essential for the conservation of this species. However, the rule designating critical habitat (45 FR 47362) does describe those actions that would adversely modify designated critical habitat, including any actions that would: significantly reduce aquatic vegetation in Spring Lake and the San Marcos River, impound water, excessively withdraw water, reduce flow, and pollute the water. Based on the best available scientific and commercial data available, the primary constituent elements could generally be defined as:

- Undisturbed stream floor habitats (including runs, riffles, and pools),
- A mix of submergent vegetation (algae, mosses, and vascular plants);
- Clear and clean water;
- A food supply of small, living invertebrates;
- Constant water temperatures; and
- Adequate spring flows to maintain the conditions above.

f. San Marcos salamander

Species Description and Life History
San Marcos salamander (*Eurycea nana*) was listed as threatened with designated critical habitat on July 14, 1980 (45 FR 47355). Critical habitat was designated on July 14, 1980, and consists of Spring Lake and its outflow and the San Marcos River downstream 164 feet from Springs Lake Dam (45 FR 47355).

The San Marcos salamander is a member of the family Plethodontidae (lung-less salamanders) and is a neotenic salamander in that it retains its external gills (the larval condition) throughout life. The salamander does not leave the water to metamorphose into a terrestrial form, but instead becomes sexually mature and breeds in the water. This dark reddish-brown salamander has well developed and highly pigmented gills, relatively short, slender limbs, and a slender tail with a well-developed dorsal fin.

San Marcos salamanders are found at San Marcos Springs in the western half of Spring Lake, on a limestone shelf in the northernmost portion of Spring Lake, and in the spillway areas below Spring Lake Dam. Habitat consists of algal mats (Tupa and Davis 1967), where rocks are associated with spring openings (Nelson 1993). Sandy substrates devoid of vegetation and muddy silt or detritus-laden substrates with or without vegetation are unsuitable habitats for this species. Specimens occasionally are collected from beneath stones in predominantly sand and gravel areas. In view of the abundance of predators (primarily larger fish, but also crayfish, turtles, and aquatic birds) in the immediate vicinity of spring orifices, protective cover such as that afforded by algal mats and rocks is essential to the survival of the salamander. The flowing spring waters in the principal habitat are slightly alkaline (pH 6.7-7.2), range from 69.8-73.4°F, clear, and dissolved oxygen levels are low (less than 50% saturated, 3-4 mg/L (Tupa and Davis 1967, Najvar 2001, Guyton and Associates 1979, Groeger et al. 1997).

Prey items for the San Marcos salamander include amphipods (scuds or sideswimmers), tendipedid (midge fly) larvae and pupae, other small insect pupae and naiads (an aquatic life stage of mayflies, dragonflies, damselflies, and stone flies), and small aquatic snails (Service 1996a).

Most evidence suggests reproduction occurs throughout the year with a possible peak in May and June (Bogart 1967).

Historic and Current Distribution

C.E. Mohr collected 20 specimens from San Marcos Springs on June 22, 1938 (Bishop 1941). Tupa and Davis (1976) and Nelson (1993) found them distributed throughout Spring Lake among rocks near spring openings, in algal mats. Additionally, San Marcos salamanders have been found in mosses and other plants and in rocky areas just downstream from the dams (Nelson 1993, BIO-WEST 2011). In total, San Marcos salamanders are found near all of the major spring openings scattered throughout Spring Lake and downstream of the dam to about 500 feet.

Tupa and Davis (1976) estimated the number of San Marcos salamanders in the floating algal mats at the uppermost portion of Spring Lake to be between about 17,000 to 21,000 individuals. Nelson (1993) followed the same procedure used by Tupa and Davis (1976) and estimated the mats were inhabited by about 23,000 salamanders. Additionally, Nelson (1993) found 53,200 salamanders in and just below Spring Lake, including 23,000 associated with algal mats, 25,000 among rocky substrates around spring openings, and 5,200 in rocky substrates within 492 feet below Spring Lake. Seven years of quarterly monitoring of San Marcos salamander populations using visual surveys by divers showed stable visual counts (BIO-WEST 2011).

Reasons for Decline and Threats to Survival

The primary threats to the San Marcos salamander are related to the quality and quantity of aquifer and spring water. The restricted distribution of the species, loss of protective cover, contaminants, siltation, and introduced predators may also threaten the species (45 FR 47355, Service 1996a).

Range-wide Survival and Recovery Needs

According to the San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan (Service 1996a), which includes San Marcos salamander, recovery tasks include: ensuring adequate flows and water quality in San Marcos Springs and the San Marcos River; maintenance of genetically diverse reproductive populations in captivity and creation of reintroduction techniques for use in the event of a catastrophic event; removal or reduction of threats due to non-native species, recreational use of the river, and habitat alteration; and maintenance of healthy, self-sustaining, reproductive populations in the wild.

The SMARC has worked on rearing and captive breeding techniques for San Marcos salamander in the event that the natural population at San Marcos Springs is lost. Techniques for maintaining this species' genetic diversity have been developed. However, the ability to maintain this species in captivity (without supplemental wild caught individuals) over the long-term is uncertain (Fries 2002). The SMARC actively collects wild specimens and continues to research and develop captive propagation techniques for the San Marcos salamander (SMARC 2014).

As part of the EARIP HCP, long-term biological goals for the San Marcos salamander include a qualitative habitat component and a quantitative population measurement. From a habitat perspective, the goal is to maintain silt-free habitat conditions via continued springflow, riparian zone protection, and recreation control throughout each of the three representative reaches (EARIP 2012). Additional measures of the HCP (EARIP 2012) include continuing the twice annual monitoring and aquatic gardening at current levels, maintaining silt-free substrates in reaches known to support the salamander, and implementing recreational control below Spring Lake Dam.

Critical Habitat
The critical habitat designation for San Marcos salamander predates the requirement for identification of primary constituent elements that are essential for the conservation of this species. However, the rule designating critical habitat (45 FR 47362) does describe those actions that would adversely modify designated critical habitat, including any actions that would: lower the water table; expose algal mats, leading to the desiccation of the species sole habitat; and disturb algal mats or the bottom of the lake, such as from SCUBA divers. Based on the best available scientific and commercial data, the primary constituent elements could generally be defined as:

- Thermally constant waters;
- Flowing water;
- Clean and clear water;
- Sand, gravel, and rock substrates with little mud or detritus; and
- Vegetation or rocks for cover.

g. <u>San Marcos gambusia</u>

Species Description and Life History
The San Marcos gambusia (*Gambusia georgei*) was listed as endangered with designated critical habitat on July 14, 1980 (45 FR 47355).

The San Marcos gambusia is a member of the family Poeciliidae and belongs to a genus of Central American origin having more than 30 species of livebearing freshwater fishes. Scales tend to be strongly crosshatched and their dorsal fins tend to have a prominent dark pigment stripe across the distal edges. The dorsal, caudal, and anal fins tend to be lemon yellow under certain behavioral patterns (when they are not under stress), but this color can approach a bright yellowish-orange.

The San Marcos gambusia prefers quiet waters adjacent to sections of moving water, but seemingly of greatest importance, thermally constant waters. San Marcos gambusia were found mostly over muddy substrates but generally not silted habitats, and shade from over-hanging vegetation or bridge structures was a factor common to all sites along the upper San Marcos River where apparently suitable habitats for this species occurred (Hubbs and Peden 1969, Edwards et al. 1980).

Historic and Current Distribution
The San Marcos gambusia was described from the upper San Marcos River system in 1969. Of the three species of *Gambusia* native to the San Marcos River, San Marcos gambusia apparently always has been much less abundant than the others (Hubbs and Peden 1969).

The San Marcos gambusia is represented in collections taken in 1884 (Jordan and Gilbert 1884) and as a hybrid in 1925 (Hubbs and Peden 1969). Unfortunately, records of exact sampling localities are not available for these earliest collections, which were merely listed as “San Marcos Springs.” During 1953, a single individual was taken below the low dam at Rio Vista Park, approximately one mile downstream from the headwaters. However, since that time, nearly every specimen of the San Marcos gambusia has been taken more than 1,000 feet downstream in the vicinity of the Interstate Highway 35 bridge. The single exception to this was a male taken incidentally with an Ekman dredge (sediment sampler) about 2 miles downstream of Interstate 35 (Longley 1975).

Historically, San Marcos gambusia populations have been extremely sparse; intensive collections during 1978 and 1979 yielded only 18 individuals (Edwards et al. 1980). Collections made in 1981 and 1982 within the range indicated a slight decrease in relative abundance of this species and subsequent samplings have yielded none.

Reasons for Decline and Threats to Survival
The pattern of San Marcos gambusia abundance strongly suggests a decrease beginning prior to the mid-1970s. The increase in hybrid abundance between the San Marcos gambusia and the western mosquitofish (*G. affinis*) and the decrease in the proportion of genetically pure San Marcos gambusia is considered evidence of its rarity. The subsequent decrease in San Marcos gambusia abundance along with their hybrids suggests the extinction of this species.
Many fish species have been introduced into the San Marcos ecosystem (e.g., tilapia, common carp, rock bass, redbreast sunfish, smallmouth bass, sailfin mollies, armored catfish), and some may have competed with the San Marcos gambusia for needed resources (food, breeding habitat) or preyed upon them. Taylor et al. (1984) note that introduced fish may also have indirect impacts, inducing changes in habitat characteristics (for example, by removal of vegetation or substrate disturbance) or introducing diseases and parasites.

Introduced elephant ears have been noted in previously recorded localities for the species. Although the exact nature of the relationship between the occurrence and abundance of elephant ears and the disappearance of San Marcos gambusia is unknown, some investigators believe these nonnative plants may have modified essential aspects of the gambusia’s habitat.

Range-wide Survival and Recovery Needs
According to the San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan (Service 1996a), which includes San Marcos gambusia, recovery tasks include: ensuring adequate flows and water quality in San Marcos Springs and the San Marcos River; maintenance of genetically diverse reproductive populations in captivity and creation of reintroduction techniques; removal or reduction of threats due to non-native species, recreational use of the river, and habitat alteration; and maintenance of healthy, self-sustaining, reproductive populations in the wild.

Unless and until specimens can be collected for captive rearing and propagation, maintenance of the San Marcos gambusia's habitat is the only achievable recovery goal.

Critical Habitat

The critical habitat designation for San Marcos gambusia predates the requirement for identification of primary constituent elements that are essential for the conservation of this species. However, the rule designating critical habitat (45 FR 47362) does describe those actions that would adversely modify designated critical habitat, including any actions that would: increase vegetation, disrupt the mud bottom, or alter the temperature regime. Based on the best available scientific and commercial data, the primary constituent elements could generally be defined as:

- Open areas with minimal aquatic vegetation,
- Mud substrate,
- Reduced water velocities, and
- Fairly constant water temperature.

h. <u>Texas blind salamander</u>

Species Description and Life History

The Texas blind salamander (*Eurycea rathbuni*) was listed as endangered on March 11, 1967 (32 FR 4001), and received federal protection with the passage of the Endangered Species Act in 1973. Critical habitat has not been designated.

The Texas blind salamander is a smooth, unpigmented, stygobitic (cave-adapted obligate aquatic). Adults attain an average length of about 4.7 inches and have a large, broad head, and reduced eyes. The limbs are slender and long with four toes on the forefeet and five toes on the hind feet (Longley 1978). The Texas blind salamander is a neotenic species believed to be adapted to the relatively constant temperatures (69.8°F) of the water-filled subterranean caverns of the Edwards Aquifer in the San Marcos area (Longley 1978). Juveniles have been collected throughout the year, making it likely that this species is sexually active year-round, as expected because of little seasonal change in the aquifer (Longley 1978).

Observations indicate that this salamander moves through the aquifer by traveling along submerged ledges and may swim short distances before spreading its legs and settling to the bottom of the pool (Longley 1978). Observations on captive individuals indicate that Texas blind salamanders feed indiscriminately on small aquatic organisms and do not appear to exhibit and appreciable degree of food selectivity. Prey items for the Texas blind salamander include amphipods, blind shrimp (*Palaemonetes antrorum*), daphnia, small snails, and other invertebrates. Cannibalism has been documented (Service 1996a).

Historic and Current Distribution

The Texas blind salamander was first described by Stejneger (1896) who collected the type specimen in 1895, which was expelled from an artesian well drilled at the federal Fish Hatchery in San Marcos, Texas, where it was expelled from an artesian well (Longley 1978). The species has been collected at several other locations, all within Hays County, including Ezell's Cave, San Marcos Springs, Rattlesnake Cave, Primer's Fissure, Texas State University's artesian well, and Frank Johnson's well (Russell 1976, Longley 1978). The species had been recorded from Wonder Cave (also known as Beaver Cave; Longley 1978) but searches in 1977 did not locate any specimens (Longley 1978).

Little is known about the population size or trends in population for this species, since it inhabits the aquifer. However, the distribution of this species has been hypothesized to be as small as 25.9 square miles beneath and near the city of San Marcos (Service 1996a).

Reasons for Decline and Threats to Survival
Threats to the Texas blind salamander include: loss of suitable habitat and encroachment of the saline interface into historical and currently occupied parts of the Edwards Aquifer, due to a decrease in aquifer level; a decrease in water quality; and a lack of constant temperatures.

Range-wide Survival and Recovery Needs
According to the San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan (Service 1996a), which includes Texas blind salamanders, recovery tasks include: adequate water levels and quality are assured in the aquifer, captive breeding populations are established to ensure genetic integrity, reintroduction techniques are established, local threats to water quality and quantity are addressed, and self-sustaining populations of this species exist throughout its range.
The Nature Conservancy purchased Ezell's Cave in 1967, and in 1972, Ezell's Cave was designated as a National Natural Landmark by the National Park Service. In 2004, the Texas Cave Management Association (TCMA) acquired Ezell's Cave, which is within a two acre protected area within a residential neighborhood. TCMA restricts visitation to the cave to protect it.

The SMARC continues to collect specimens from the wild, develop captive culture techniques, and study the Texas blind salamander (SMARC 2014). No techniques have yet been developed to reintroduce this species back into habitat within the aquifer. Additionally, as part of the EARIP HCP, long term biological goals include: 1) maintaining water quality and quantity to support the Texas blind salamander during low flow periods; 2) determining spatial and temporal distribution in the aquifer and life history characteristics (life span, tolerance to water quality changes, reproduction, food sources); and 3) determining how food sources, particularly those that originate from far away vary naturally and minimizing impacts as appropriate (EARIP 2012).

Critical habitat has not been designated for the Texas blind salamander; therefore, no adverse modification of critical habitat will occur.

4. Environmental Baseline

a. Regional Water Planning Groups

In 1997, the Texas State Legislature approved Senate Bill 1 to meet the State's water needs through 2050. This bill created 16 water planning regions and mandated the creation of regional water plans. Upon completion, each of the regional plans was sent to the Texas Water Development Board (TWDB) for review and approval and eventual combination into the State Water Plan (TWDB 2012).

The action area for the SEP-HCP is included within three regional water planning areas:

- Region J (Plateau) – Bandera and Kerr counties
- Region K (Lower Colorado) – Blanco and the northern half of Hays counties, and
- Region L (South Central Texas) – Bexar, Comal, Kendall, and the southern half of Hays counties.

Each of these regions relies on varying water sources, different measures for determining drought status, and varying measures for meeting future water demands (TWDB 2012). Within the action area Region J relies mainly on the Edwards and Trinity aquifers, but also on several rivers. Region J projects a 52 percent population increase by 2060, the majority of which will occur in Bandera County. Total water demands are projected to increase by 13 percent by 2060 and all needs are projected to be met by several different water management strategies, including conservation, brush control, and aquifer storage and recovery. Within the action area Region K relies mainly on surface water with the Trinity and Edwards aquifers providing the remainder. Region K's population is projected to increase by 100 percent by 2060; however, water demands are only expected to increase by 27 percent. Water needs are projected to be completely met through several water management strategies, including reservoirs, conservation, and new or amended surface water rights. Within the action area Region L relies mainly on the Edwards and Carrizo aquifers. Region L's population is projected to increase by 75 percent by 2060 with a projected water need to increase by 32 percent. The majority of water needs are expected to be met through construction of desalinization plants, increased surface water rights, reservoirs, and recycled water. While each of these regions has drafted preliminary updated plans, they will not be finalized until 2016.

b. Groundwater Conservation Districts

Under the authority provided by Texas Water Code (Chapter 36, Subsection 36.101), groundwater conservation districts may limit aquifer withdrawals under rules governed by Chapter 36 and by their enabling legislation to conserve, preserve, and protect groundwater or groundwater recharge, and to prevent waste of the groundwater resource or groundwater reservoirs in their jurisdiction as part of a comprehensive, approved groundwater management plan. There are two groundwater conservation districts in the action area:

i. The Edwards Aquifer Authority (EAA)

The EAA was created by the Texas Legislature in 1993 (Chapter 626, Laws of the 73rd Texas Legislature, 1993, as amended by Chapter 621, Laws of the 74th Texas Legislature, 1995). The purpose of the EAA is to manage and issue permits for the withdrawal of groundwater from portions of the Edwards Aquifer for the purposes of water conservation and drought management and to make and enforce rules. The EAA was designated a special regional management district and charged with protecting terrestrial and aquatic life (including the endangered species at Comal and San Marcos springs), domestic and municipal water supplies, the operation of existing industries, and the economic development of the state. The EAA is mandated to pursue all reasonable measures to conserve water; protect water quality in the aquifer; protect water quality of surface streams provided with spring flows from the aquifer; maximize the beneficial use of water available to be drawn from the aquifer; protect aquatic and wildlife habitat; protect threatened and endangered species under Federal or State law; and provide for instream uses, bays, and estuaries.

Estimates for annual recharge into the Edwards Aquifer range from 635,000 acre-feet (ac-ft) (USGS 1995) to 717,500 ac-ft with an even higher annual average of 965,400 ac-ft from 2000-2009 (EAA 2010). The lowest annual recharge (44,000 ac-ft) occurred during 1956 at the peak of the drought of record, an extended period of drought that lasted 18 months (September 1955 through February 1957), and the highest annual recharge (2,486,000 ac-ft) occurred in 1992. Wells are the principal source of water usage, and are typically used for agricultural, municipal, and industrial uses in the region. Average annual discharge from wells from 1934-2009 was 311,400 ac-ft (44.7 percent of all discharge), in comparison to 384,400 ac-ft (55.3 percent) from spring flow. During droughts, the proportion of well discharge to spring discharge can change considerably. During 1956 at the height of the drought of record, wells contributed 82 percent of the discharge compared to 18 percent for springs, and during the drought of 2008, wells contributed 51 percent of the total discharge, while spring discharge comprised 49 percent (EAA 2010).

In 2007 the Texas Legislature set a cap on how much pumping the EAA could allow from the Edwards Aquifer at 572,000 ac-ft annually (80th Texas Legislature, 2007, Senate Bill HB 3). Additionally, the Texas Legislature amended the EAA Act by passing Senate Bill 3.1, which directs the EAA to adopt and enforce a Critical Period Management plan with withdrawal reduction. For pumpers within Bexar and Medina counties, and portions of Atascosa, Caldwell, Comal, Guadalupe and Hays counties, the following reductions apply during reduced flow events:

Critical Period Stage*	J-17 Index Well (feet above msl)	Comal Springs Flow (cfs)	San Marcos Springs Flow (cfs)	Withdrawal Reduction
I	< 660' msl	< 225 cfs	< 96 cfs	20%
II	< 650' msl	< 200 cfs	< 80 cfs	30%
III	< 640' msl	< 150 cfs	n/a	35%
IV	< 630' msl	< 100 cfs	n/a	40%

* A change to a critical period stage is based on 10-day daily average of spring flows at Comal or San Marcos springs and/or aquifer levels at the J-17 Index Well.

ii. Hays Trinity Groundwater Conservation District

The Hays Trinity Groundwater Conservation District (HTGCD) was created by the Texas Legislature in 1999 (76th Legislature, S.B. 1911, Chapter 1331, 1999 Texas General Laws 4536 and Acts of May 27, 2001, 77th Legislature, S.B. 2), Regular Session, Chapter 966 (Part 3), 2001 Texas General Laws 1880). The HTGCD, whose water influences flows at Fern Bank and San Marcos springs, may exercise any and all statutory authority or power conferred by its enabling legislation, including the adoption and enforcement of rules under Texas Water Code. The HTGCD works to conserve, preserve, recharge, and prevent waste of groundwater within western Hays County (District). To help accomplish these goals the HTGCD is charged to gather information needed for sound decisions, to provide information to citizens and local agencies, and to insure that groundwater is used efficiently and at sustainable rates.

The estimated annual amount of recharge from precipitation to the District's portion of the Trinity Aquifer is 26,101 ac-ft annually. The estimated volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers is 21,555 ac-ft. The following is a summary of the water budget for the District through 2060 (HTGCD 2010).

Year	2020	2030	2040	2050	2060
Projected Trinity Aquifer Total Availability for the District (ac-ft/year)					
	3,713	3,713	3,713	3,494	3,494
Projected Total Water Supply for the District (ac-ft/year)					
Groundwater	1,497	1,497	1,496	1,270	1,269
Surface water	4,232	4,510	4,779	3,096	3,358
Total	5,729	6,007	6,274	4,366	4,627
Projected Total Water Demand by the District (ac-ft/year)					
	13,924	17,212	20,607	24,799	28,422

Source: SRC Availability table (TWDB 2007)

The HTGCD has several water management strategies to meet projected needs in Hays County. These include renewing contracts and increasing supply from existing water providers, constructing new water lines, purchasing water from new suppliers, increasing pumping from the Trinity, and recycling water. While increasing withdrawals from the Trinity Aquifer is a strategy, it would only account for a small percentage of the total new supply: 0.6 percent in 2020, 0.56 percent in 2030, 1.1 percent in 2040, 1.27 percent in 2050, and 1.4 percent in 2060.

There is a "No-Drought" stage and two drought severity stages: Alarm and Critical. A Water Conservation Period will be in place between May 1 and September 30 of each year, during which 10 percent voluntary reductions in water use are requested of all groundwater users. The implementation of required demand reduction of 20 percent begins in the Alarm stage, and 30 percent reductions are required in the Critical stage.

c. Previous consultations

According to our consultations database there have been at least 20 formal section 7 consultations completed for one or more of the Edwards Aquifer, Southern Segment, aquatic species. Six of these consultations were about pumping from the Edwards Aquifer: two for the San Marcos and Uvalde National Fish Hatcheries and four for military bases in Bexar County. These pumping withdrawals could not be directly attributed to numbers of species impacted, but rather percentages of total pumping allowed throughout the aquifer and how that would impact both the water quality and quantity of the spring systems. The remaining 14 consultations were for construction projects or work directly within the water (bank stabilization, exotic removal, etc.). Of those 14 consultations that expected actual death or injury to a species (11 authorized take of over 60,000 darters, 2 authorized take of up to 184 riffle beetles, 1 authorized take of 52 dryopid beetles, 2 authorized take of 747 San Marcos salamanders, and 1 authorized take of 414 amphipods), minimization measures were put in place to reduce the impacts and species recolonization was typically expected after project completion. Turbidity was also a primary impact expected from most construction projects. Conservation measures, as a result of these consultations, included $200,000 to a conservation entity for funding of studies, creation and maintenance of captive populations, remediation of hazardous areas in ways that would not impact the aquifer, and a commitment to reducing water needs from the aquifer by finding alternate water sources. Two consultations covered the Edwards Aquifer aquatic species associated with the Hays County and Comal County Regional HCPs; however, neither received incidental take coverage for these species. These consultations concluded that issuance of the ITPs, supported by the Hays County and Comal County Regional HCPs, were not likely to jeopardize the continued existence of these species or destroy or adversely modify designated critical habitat.

The EARIP HCP is the only section 10(a)(1)(B) incidental take permit that covers incidental take of the Edwards Aquifer, Southern Segment, aquatic species. This permit is for a period of 15 years and was issued in 2011. As described in detail above, the EARIP HCP includes several measures to assure water continues to flow at the springs, despite drought conditions, and will provide specific measures to benefit each of the listed species in both the San Marcos and Comal springs systems (EARIP 2012).

5. Effects of the Action

There are no direct effects from the issuance of the permit on Comal Springs dryopid beetle, Comal Springs riffle beetle, Peck’s cave amphipod, Texas wild-rice, fountain darter, Texas blind salamander, San Marcos gambusia, and San Marcos salamander. Indirect effects of permit issuance on these species from implementation of the HCP could occur from impacts to the quantity and quality of aquifer water and the resulting spring flows upon which they depend. Threats to water quantity could include, but may not be limited to, pumping, creation of impervious surfaces that alter infiltration rates, and other activities that result in removing water from the aquifer systems. Threats to water quality could include, but may not be limited to, development that affects recharge capability, contaminants/dissolved materials, and changes to water temperature. These could result in loss of natural substrates - mainly due to siltation, alteration of aquatic habitats, shelter sites, and reduction in food supplies for these species.

a. Water Quantity

i. Supply

Continued population growth in the San Antonio region and associated increases in water demand may exacerbate declining spring flows if future water needs are met by increased pumping from the Edwards Aquifer. Current water supplies for the San Antonio area rely on the Edwards, Trinity, Carrizo aquifers; Canyon and Dunlap lakes; Medina River and Lake; and recycled water. According to regional water planning efforts, all of the projected water needs through 2060 within the three regions in the action area are accounted for, except agricultural irrigation within Region L during times of drought (TWDB 2012). The majority of the Plan Area is within Region L; however, the majority of agricultural irrigation occurs outside of the Plan Area.

ii. Drought

Droughts vary significantly in duration and intensity. While numerous droughts of short intensity have been recorded, at least five droughts of extended duration and extreme intensity have occurred since 1931 on the Edwards Plateau (Riggio et al. 1987). Between 1931 and 1985, droughts occurred with following frequencies: three-month droughts varied from 62 to 70 occurrences, six-month droughts varied between 32 and 40 occurrences, and a 12-month drought occurred less than 24 times (Riggio et al. 1987). The six-year drought that occurred from 1951 through 1956 is considered the drought of record for the Edwards Aquifer as it resulted in the only known cessation of flow at Comal Springs in 1956 (Longley 1995). However, in general, droughts in the Edwards Aquifer region are generally short in duration and not intense.

A study utilizing dendrochronology (tree-ring analysis) was conducted to evaluate historic drought patterns in the Edwards Aquifer region (Mauldin 2003). An extensive data base of tree-ring data (from 1700–1979) for the southwest was used in the analysis (Cook 2000) and correlated with the Palmer Drought Severity Index (PDSI; a standard measure of soil moisture conditions used to classify drought frequency, intensity, and duration). Over the 280-year period, 25.7 percent of the years were drought years. (Mauldin 2003). During the 280-year period, the Edwards Aquifer region experienced 40 droughts of various lengths (Mauldin 2003). Droughts that lasted only 1 year were more common; however, the average drought was 1.8 years. Long-term droughts, those exceeding 3 years in duration, occurred only four times: three of those were in the 1700s, and the fourth was the drought of record, which lasted 5 years (Mauldin 2003). The drought of record represents only 2.1 percent of the 280-year period analyzed and only 2.5 percent of the 40 droughts.

In response to concerns about the likelihood of another significant drought that could adversely affect the spring systems, the potential for a repeat of the drought of record was analyzed from three perspectives: the long-term regional rainfall pattern based on tree-ring data, the regional pattern of rainfall from the instrumental rainfall records, and a probabilistic analysis based on the characteristics of the historic instrumental data (Cleaveland et al. 2011). Based on this analysis, it was inferred that if the overall climatic regime during the past eleven years were to continue into the near-term future (approximately 15 years), the probabilities of a recurrence of a year as dry as 1956 is approximately 1.6 percent in any given year. The probabilities of three- or five-year periods as dry as the drought of record are approximately 0.2 percent, and the probabilities of seven- or ten-year periods as dry as the drought of record are 0.1 percent or less (Cleaveland et al. 2011).

iii. Edwards Aquifer Water Usage

Since the HCP will only provide incidental take authorization for the terrestrial species, participation in the HCP will only occur in areas with habitat for these species. To analyze the amount of Edwards Aquifer water that may be used by Participants of the SEP-HCP, we started with the potential habitat estimated to be impacted under the HCP: 9,371 acres of GCWA habitat, 2,640 acres of BCVI habitat, and 21,086 acres of karst habitat. Because the actual location of future participation and the source water for participants is unknowable, for the purposes of this analysis water demand is assumed to be met solely from the Edwards Aquifer. Additionally, we assumed no overlap of habitat between the three species.

The effect of Regional HCP participation on the Edwards Aquifer is summarized in the following table. Given the total number of acres covered under the incidental take permit (33,097 acres), we estimate the number of people that will use the Regional HCP in habitat, over the Edwards Aquifer, with a density of 3.84 persons per acre, to be 127,093. Given the Region L water consumption rate of 132 gallons per day per person, we estimate the total will result in a water demand of 16,776,207 gallons per day (or 18,797.5 acre-feet per year). Comparing the annual rate of water demand attributable to the Regional HCP to the total permitted annual withdrawals by EAA (572,000 acre-feet per year), the water demand strictly attributable to the Regional HCP is about 3.3 percent of total permitted Edwards withdrawals.

SEP-HCP	Water Demand Calculation
Acres of GCWA habitat covered under SEP-HCP	9,371 ac
Acres of BCVI habitat covered under SEP-HCP	2,640 ac
Acres of karst covered under SEP-HCP	21,086 ac
Total Acres	33,097 ac
Density of people per acre	3.84
Total people estimated under SEP-HCP over 30 years	127,093
Average gallons per person per day	132
Average total gallons per day under SEP-HCP	16,776,207
Converted to acre feet X 365 for annual usage	18,797.5
Total annual pumping allowed from Edwards Aquifer	572,000 ac ft
Percent demand attributable annually to SEP-HCP of total permitted Edwards Aquifer withdrawals	3.3

This assumption has the effect of overstating the likely actual water demand because: 1) some participants may be served by municipal utilities that receive some portion of their water from sources other than the Edwards Aquifer, and 2) because we know karst and bird habitat overlaps, so some acreage is getting double counted. Additionally, the Service anticipates that during drought conditions, the state-mandated EAA Critical Period Management regulations and those requirements described under the EARIP HCP are likely to maintain flows at Comal, Hueco, and San Marcos springs.

b. Water Quality

The general sources of water quality concerns are common to all of the aquifer systems in the action area and are considered together here. Land use changes throughout the region may increase risks to the aquifer and springs. Pollution threats include:

- increases in sedimentation from runoff;
- cumulative impacts of urbanization (road runoff, leaking sewer lines, residential pesticide and fertilizer use, etc.);
- groundwater pollution from land-based hazardous material spills and leaking underground storage tanks; and,
- surface, stormwater, and point and nonpoint source discharges into streams.

Sediment may affect aquatic organisms in a number of ways. Excessive deposition of sediment can physically reduce the amount of available habitat and protective cover for aquatic organisms. Once deposited in large volumes, sediment can become anoxic (devoid of oxygen) and cease to provide suitable habitat. Silt and sediment can clog the interstitial spaces of the substrates surrounding the spring outlets that offer protective cover and an abundant supply of well-oxygenated water for respiration, and can flow downstream reducing natural rocky substrates that plants and animals, like Texas wild-rice and fountain darter, rely on (45 FR 47355).

To prevent pollution and sedimentation of the aquifer, there are several regulations currently in place; the first of which is the Federal Safe Drinking Water Act (1974), which protects sources of public drinking water. This Act was amended in 1996, and mandates enforceable drinking water standards established by the Environmental Protection Agency (EPA). The TCEQ has responsibility for enforcement of these standards in Texas and has drafted its own rules, which are sometime stricter than the EPA's. Under these rules, for certain activities over the recharge, transition, or contributing zones, developers must submit an application including an Aquifer protection plan to TCEQ. Additionally, certain facilities are prohibited from being built in the recharge or transition zones such as municipal solid waste landfills and waste disposal wells.

For any regulated construction activity over the recharge zone, TCEQ also requires a water pollution abatement plan (WPAP). The WPAP must include a geological assessment report identifying pathways for movement of contaminants and sediment to the Aquifer, and a report on best management practices and measures to prevent pollution of the Aquifer. All activities that disturb the ground or alter a site's topographic, geologic, or existing recharge characteristics are subject to regulation, which would require either sediment and erosion controls or a contributing zone plan (CZP) to protect water quality during and after construction. Exemptions include construction of single-family residences on lots larger than five acres, where no more than one single-family residence is located on each lot; agricultural activities; oil and gas exploration, development, and production; clearing of vegetation without soil disturbance; and maintenance of existing structures not involving additional site disturbance.

Additionally, the EAA has implemented a water quality protection program that includes well construction rules that regulate the construction, operation, maintenance, abandonment, and closure of wells (EAA Rules Chapter 713, Subchapters B, C, and D). The EAA also regulates the reporting of spills (Subchapter E), storage of certain regulated substances on the recharge zone and the contributing zone (Subchapter F), and installation of tanks on the recharge zone (Subchapter G).

Each year the EAA monitors the quality of water in the Southern Segment of the Edwards Aquifer by sampling approximately 80 wells, 8 surface water sites, and major springs across the region. Tests include measurements of temperature, pH, conductivity, alkalinity, major ions, minor elements (including heavy metals), total dissolved solids, nutrients, pesticides, herbicides, volatile organic compounds, and other analytes. Results of the EAA's water quality testing have not indicated widespread contamination in the Aquifer. However, in 2009 elevated nitrate detections (greater than 2 mg/L) were present in 16 of the 79 wells sampled (EAA 2009). It is not clearly understood what the source of nitrate is, but agriculture, bats, and natural processes are possibilities (Eckhardt 2012). Chemical fertilizers, which contain nitrates, have been used in agriculture for decades. Nitrate levels are generally higher the farther west over the aquifer you go, which has more agricultural areas. However, nitrates can also come from urban areas. Some scientists have suggested that high nitrate levels could originate from bat guano. There are several bat colonies in recharge caves and their excrement accumulates on cave floors, so much so that some caves were mined for guano as a source of nitrate for making gunpowder. During major recharge events, the guano could be washed down into the Edwards Aquifer.

In August 2004, the Service and the TCEQ began a collaborative effort to develop voluntary guidelines that, if followed by project planners within the entire Edwards Aquifer region, would result in "no take" of several federally-listed, aquifer-dependent species, including the San Marcos salamander and fountain darter. As a result of this collaboration, the "Optional Enhanced Measures for the Protection of Water Quality in the Edwards Aquifer" were finalized in February 2005, as an addendum to TCEQ's technical guidance document for implementing the Edwards Aquifer Rules. In addition, the Service and TCEQ are committed to a monitoring and adaptive management program. These two agencies have met with many of the groups that are monitoring Edwards Aquifer water quality, and in some cases, biological resources. These groups have committed to sharing the results of their monitoring information, which will be stored in a centralized database and used for trend analyses. If the analysis of the monitoring information indicates water quality degradation that could affect aquifer-dependent species such as the San Marcos salamander, then the TCEQ and the Service would convene an expert group to evaluate the causes. If necessary, the agencies plan to modify the optional water quality measures to ensure the continued protection of these species.

In addition, significant preservation of land over the Recharge and Contributing Zones has occurred. For example, the City of San Antonio passed four propositions (the fourth was in May 2015) for Edwards Aquifer protection, which have resulted in the preservation of more than 125,000 acres of land throughout Bexar, Medina, and Uvalde counties. Further protecting the water quality of the Edwards Aquifer are water quality ordinances passed by the City of San Antonio that require, among other things, an Aquifer Protection Plan be prepared and approved by the Resource Protection Division of the San Antonio Water System. The ordinances also include impervious cover limitations and require floodplain setbacks, recharge feature protection and buffer zones, and use of best management practices.

Additionally, the action area has over 128,000 acres of existing conservation lands (see Appendix B of the HCP for a list of these tracts and their conservation status) made up of a number of parks, preserves, and privately owned tracts under easements that protect them as open space. While these tracts may not have the primary purpose of protecting the aquifer, it is likely that the aquatic species are receiving some conservation value from the non-developed nature of these parcels. In addition to these existing open spaces new protected lands for the GCWA and BCVI will be created through the HCP that will also protect water quality and quantity to the aquifers. Increasing the amount of land preserved in its natural state may result in a reduction in the number of acres of managed landscape and turf (areas that are intensely managed through the use of irrigation, fertilization, or pest control practices) that can serve as a source of pollutants during stormwater runoff or irrigation events.

c. Critical Habitat

Water quantity is a PCE for Comal Springs dryopid beetle, Comal Springs riffle beetle, Peck’s cave amphipod, Texas wild-rice, fountain darter, San Marcos gambusia, and San Marcos salamander, and a threat for Texas blind salamander. During normal conditions, spring discharge is expected to be near the reported average at each of the springs. During low-flow events, the water levels may decrease, and while this has been shown to be a natural phenomenon, we expect critical period management conditions to go into effect. With these protections of water quantity PCEs, spring flows will fluctuate seasonally and cyclically, but flows are expected to be sufficient to protect designated critical habitat.

Water quality is a PCE for Comal Springs dryopid beetle, Comal Springs riffle beetle, Peck’s cave amphipod, Texas wild-rice, fountain darter, San Marcos gambusia, and San Marcos salamander, and a threat for Texas blind salamander. Based on existing water quality laws and regulations, which include both mandatory and voluntary measures, and the number of monitoring efforts that are occurring, we do not expect the water quality to decrease over the life of the permit.

Constant temperature is a PCE for Comal Springs dryopid beetle, Comal Springs riffle beetle, Peck’s cave amphipod, Texas wild-rice, fountain darter, San Marcos gambusia, and San Marcos salamander, and a threat for Texas blind salamander.

Maintenance of a natural substrate is a PCE for Texas wild-rice, Comal Springs riffle beetle, fountain darter, San Marcos gambusia, and San Marcos salamander. The main threat to maintaining a natural substrate is sedimentation. Based on existing water quality laws and regulations and the number of monitoring efforts that are occurring, we do not expect an in increase sedimentation at the springs or downstream.

Maintenance of a food supply is a PCE for Comal Springs dryopid beetle, Comal Springs riffle beetle, and Peck's cave amphipod, and fountain darter. We expect that if water quality and quantity are maintained, then the food supply should also be maintained.

Maintenance of submergent vegetation is a PCE for fountain darter. We expect that if water quality and quantity are maintained, then submergent vegetation should also be maintained.

C. Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area is made up of eight counties: Hays County, which supports listed Edwards Aquifer aquatic species, and the seven Plan Area counties, where SEP-HCP Covered Activities may occur. According to the 2014 Census Bureau reports, the City of San Marcos, which is within Hays County, was the fastest growing city in the nation for the third consecutive year. Within the Plan Area counties, the SEP-HCP predicts the population will increase an additional 1.25 million people by 2040 with projected new development impacting over 241,000 acres. Within the Enrollment Area, where incidental take will be authorized, the City of San Antonio is the largest city. In 2014 Forbes Magazine ranked San Antonio in the top 20 fastest growing American cities. As of 2014, the Census Bureau lists San Antonio as the 7th largest city in the nation. Within the Enrollment Area, the SEP-HCP estimates 21,002 acres of GCWA habitat, 5,556 acres of BCVI habitat, 285,965 acres of karst zones 1 through 4 will be impacted over the over the next 30 years.

Specific project types that are expected in the Plan Area as a result of the increase in population include, but are not limited to: new urban development, including associated infrastructure like roads, water lines, and electric distribution lines; increase in the size of existing roads; and conversion of woodland to agriculture or impervious cover. One specific project is the San Antonio Water System's pipeline from Burleson County, which is expected to cross from eastern Bexar County to northern Bexar County. It is expected that this pipeline will cross through karst zones and will likely require consultation with the Service, since avoidance will be unlikely.

The reasonably expected impacts to the Covered Species from this continued increase in population include: (1) unpredictable fluctuations in habitat due to urbanization; (2) increase in impervious cover due to urbanization (e.g., roads, houses, and businesses); (3) use of pesticides; (4) contaminated runoff from agriculture and urbanization; (5) nest parasitism; and, (6) predation by feral animals and pets. For the aquatic species, expected effects include: (1) increased pumping demands, (2) increased impervious cover, and (3) contaminated runoff from agriculture conversion and urbanization.

The term climate refers to a “complex, interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things” (Le Treut et al. 2007). Different factors can act to change the climate; there are natural factors, such as volcanic eruptions and solar variations, as well as human factors, such as changes in atmospheric composition (Le Treut et al.2007). Climate change refers to a major shift in weather patterns over a number of years due to these factors. One of these major shifts is a spike in global temperatures caused by an excess of carbon dioxide in the atmosphere (Le Treut et al.2007). The reason the Earth’s surface is warm is the presence of greenhouse gases, which act as a partial blanket keeping heat in. One of the most important greenhouse gases is carbon dioxide. Studies have shown that human activities have intensified the blanketing effect through the release of greenhouse gases, primarily through the combustion of fossil fuels and removal of forests (Le Treut et al.2007). It can be expected that the increase in population and the associated infrastructure in the action area will continue to increase the production of greenhouse gases.

Expected beneficial cumulative effects that are reasonably expected to occur include continued State, local government, and private lands preservation. While these lands may not all specifically be conserved for the Covered Species, to some degree they are likely to benefit them and the Edwards Aquifer aquatic species. Additional expected benefits include the preservation of 1,000 acres of new, permanently protected, karst preserves through the SEP-HCP. It can also be reasonably expected that other karst preserves will be established by means other than the SEP-HCP, such as grants, donations of land or easements, or preserves established as part of separate consultations with the Service. Thus, it is likely that the long-term cumulative impacts to karst invertebrates will be achieving downlisting for many of the Covered Karst Invertebrates. Additionally, at full implementation, the SEP-HCP preserve system would include a minimum of 23,430 acres of GCWA habitat and a minimum of 6,600 acres of BCVI habitat. All of these preserves are expected to benefit the Edwards Aquifer aquatic species through water quality and quantity protection and could buffer against localized climate change impacts.

D. Conclusion

After reviewing the current status of the GCWA, BCVI, *R. exilis, R. infernalis*, Helotes mold beetle, Government Canyon Bat Cave spider, Madla cave meshweaver, Government Canyon Bat Cave meshweaver, and Braken Bat Cave meshweaver; the environmental baseline for the action area; the effects of the proposed project; and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of these species. No critical habitat has been designated for the GCWA and BCVI; therefore, none will be affected. While critical habitat has been designated for the Covered Karst Invertebrates, the SEP-HCP will not cover activities within these units. Therefore, no adverse effects to designated critical habitat are expected as part of the SEP-HCP.

As stipulated throughout the HCP, pursuant to section 10(a)(1)(B) of the Act, and the intent to provide some recovery benefit to the Covered Species, the proposed action is an effort on the part of Bexar County and the City of San Antonio to add to the recovery of the GCWA, BCVI, and Covered Karst Invertebrates. For the GCWA, by mitigating and permanently preserving large blocks of habitat, the Applicants will play a pivotal role in creating large focal areas and increasing the size of currently protected blocks of habitat. For the BCVI, implementation of the SEP-HCP will contribute to recovery through discovery and permanent protection of BCVI populations within and adjacent to Bexar County. For the Covered Karst Invertebrates, the preservation of at least 1,000 acres of high quality karst habitat will contribute significantly to the long-term protection and recovery of the species.

After reviewing the current status of the Texas wild-rice, fountain darter, Comal Springs dryopid beetle, Comal Springs riffle beetle, Peck's cave amphipod, San Marcos salamander, and Texas blind salamander; the environmental baseline for the action area; the effects of the proposed action; designated critical habitat; and the cumulative effects, it is the Service's biological opinion that issuance of the ITP, supported by the SEP-HCP, is not likely to jeopardize the continued existence of these species or destroy or adversely modify designated critical habitat for any of these species. Maintenance of adequate flows and water quality are the primary needs for these species. Water quantity is expected to be maintained at the springs through authority of the local water conservation districts and water quality is expected to remain at or above current standards through state and federal regulations already in place.

Permit issuance is not expected to appreciably alter the distribution or population size of any of the aquatic species addressed in this analysis during normal conditions. Indeed, it is likely that permit issuance could benefit to these species if the proposed preserve system of over 31,000 acres containing GCWA, BCVI, and/or karst habitat in and around Bexar County is achieved, assuming all incidental take coverage is utilized. Protection of these terrestrial habitats over aquifer resources may provide benefits otherwise unavailable to the species considered here. However, it is not possible, to measure potential benefits, largely because the preserve locations are unknown at this time.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined by the Service as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is further defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding and sheltering (50 CFR §17.3). Harm is also further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns, including breeding, feeding, and sheltering. Incidental take is defined by the Service as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary and must be implemented by the Service so that they become binding conditions of any authorization issued to implement a project covered by this biological opinion, as appropriate, in order for the exemption in section 7(o)(2) to apply.

The Service has a continuing duty to regulate the activity covered by this incidental take statement. If the Service (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the authorizations, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Service must report the progress of the action and its effect on the species [50 CFR 402.14(i)(3)].

The Fish and Wildlife Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

Amount or Extent of Take

The Service anticipates incidental take of GCWAs, BCVIs, and Covered Karst Invertebrates will occur as a result of the proposed action and is expected to occur mostly in the form of harm and harassment through direct loss of habitat and indirect adverse effects resulting from the issuance of an incidental take permit pursuant to 10(a)(1)(B) of the Act. Individuals of these species are difficult to detect unless they are observed undisturbed in their environment. Most close-range observations of any of these species represent chance encounters that are difficult to predict. Because quantifying take of individual species is difficult, this biological opinion instead evaluates acres of habitat removed as a surrogate for the level of incidental take, which is consistent with the Act's section 7 implementing regulations at 50 CFR 402.14(i)(1)(i). We are using habitat as a surrogate for the following reasons:

- Surveys for the GCWA, BCVI, and Covered Karst Invertebrates provide valuable information for determining the extent of occupation of a given area; however, they do not provide a precise mechanism for predicting the number of individuals that may actually be "taken" by the proposed action.
- The area of habitat affected by a particular action is a relatively stable metric of take, compared to the number, size, and location of individual birds, bird territories, or karst invertebrates in the area.
- The effects of a given activity may not be fully realized in a single season or year but rather spread over several seasons or even many years, during which the species' utilization of a given area may vary quite significantly for reasons unrelated to the action itself.
- Variability is influenced by species preferences or environmental factors that may include natural year-to-year variations in the precise habitat utilized by individuals, variations in individual behavior that influence detectability, variations in the ability of surveyors to detect and accurately map individuals, survey methodology, and other factors.
- For the Covered Karst Invertebrates they would be difficult to detect and quantify due to their extremely small size and subterranean, often inaccessible, karst habitat. And, as previously discussed, occupied karst features in the action area are often undetectable until they are exposed from surface disturbing activities.

For these reasons, it is not possible to predict the precise number of GCWA, BCVI, or Covered Karst Invertebrates that may be "taken" over time as a result of the Covered Activities. Therefore, incidental take is provided as loss of habitat in acres under this opinion. The following amount of incidental take will be authorized by the proposed Permit:

1. No more than 9,371 acres of GCWA habitat that occurs within Bexar County and the City of San Antonio's ETJ (excluding Comal County) may be adversely affected;
2. No more than 2,640 acres of BCVI habitat that occurs within Bexar County and the City of San Antonio's ETJ (excluding Comal County) may be adversely affected and,
3. No more than 21,086 acres of Bexar County karst zones 1 through 4 may be adversely affected.

An estimate can be made of the number of GCWAs and BCVIs expected to be taken through authorization of this Permit; however, since we do not know the quality of habitat that is going to be impacted over the life of the Permit, it is impossible to implicitly state a number for each species. However, if you take the average territory size of a GCWA (20-80 acres) and BCVI (1-10 acres) and divide the number of acres authorized to be effected, the result is 117-468 GCWA pairs and 264-2,640 BCVI pairs (Pulich 1976, Graber 1957). It is important to note that the amount of habitat represents only about one percent of GCWA and two percent of BCVI habitat in the entire Plan Area. Additionally, some habitat will remain intact and is only expected to be indirectly affected by the Covered Activities.

An estimate cannot be made of the number of Covered Karst Invertebrates expected to be taken through authorization of this Permit, since the true distribution or abundance of these species is unknown. Of the acreage amount (21,086 acres) being authorized for take, the chances of voids containing listed species with no surface expression being damaged during construction are expected to be rare, as discussed under the effects of the action on karst invertebrates. While there are instances where occupied features are hit during construction, significantly more acreage covered under previous consultations has not found unforeseen voids. Therefore, the Service does not expect a significant loss of caves with no surface expression as part of this ITP.

The Service expects increased groundwater withdrawals from actions associated with the SEP-HCP. However, these effects are neither expected to jeopardize Peck's cave amphipod, fountain darter, Comal Springs dryopid beetle, Comal Springs riffle beetle, San Marcos salamander, San Marcos gambusia, and Texas blind salamander, nor adversely modify designated critical habitat.

The Service recognizes that: (1) the Permit applicants do not control pumping from the aquifers within the County, and (2) for the period covered under this opinion; water withdrawal associated with Permit issuance from the aquifers in the Applicant's jurisdictions will generally be less than one percent (1percent) of total withdrawals. Efforts to reduce withdrawals, and provide springflows for the listed species to reduce the risk of jeopardizing the species or adversely modifying their designated critical habitats to low levels is the responsibility of all Edwards Aquifer users. However, it is the Applicants' responsibility to avoid unauthorized take of any listed species and avoid adverse effects to designated critical habitat for any listed species within the action area.

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to the incidental take of listed plant species like Texas wild-rice. However, protection of listed plants is provided to the extent that Act prohibits the removal, reduction to, and possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

Effect of the Take

In the accompanying biological opinion, the Service has determined that this level of anticipated take is not likely to result in jeopardy of the GCWA, BCVI, or Covered Karst Invertebrates due to the long-term beneficial effects associated with the proposed action. No critical habitat has been designated for the GCWA or the BCVI; therefore, none will be affected. Projects or portions of projects planned in areas of designated critical habitat for the Covered Karst Invertebrates are prohibited from participating in the SEP-HCP; therefore, no destruction or adverse modification of critical habitat is expected.

The Service expects that groundwater withdrawals that may result from actions associated with the SEP-HCP may effect, but are not likely to adversely affect Texas wild-rice, fountain darter, Comal Springs dryopid beetle, Comal Springs riffle beetle, San Marcos salamander, fountain darter, and Texas blind salamander. Further, due to the implementation of mitigation strategies that will result in preserve lands, some of which may occur over the aquifers, the Service anticipates some benefits to aquifer-dependent species may occur over the life of the Permit. Since the aquatic species are not covered in the Southern Edwards Plateau Habitat Conservation Plan, and were not requested to be included on the Permit, the Habitat Conservation Plan Assurances, "No Surprises Rule", (63 FR 8859) are not applicable for these species.

Critical habitat has been designated for: Texas wild-rice, Comal Springs dryopid beetle, Comal Springs riffle beetle, Peck's cave amphipod, fountain darter, and San Marcos salamander; however, the Service does not anticipate that the proposed action will adversely modify designated critical habitat for these species.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of golden-cheeked warblers and black-capped vireos and avoid take of listed aquatic species in the action area. The Service shall:

1. require that the applicants fully implement the SEP-HCP and comply with all terms and conditions of the issued section 10(a)(1)(B) incidental take permit; and
2. suspend or revoke the Applicant's Permit if new information becomes available or under new conditions (e.g. critically-low springflow levels, severe drought conditions) that is shown to cause direct or indirect take of listed aquatic species. The Service will notify Bexar County and the City of San Antonio as soon as we become aware of such take.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Service must comply with the following terms and conditions that implements all of the reasonable and prudent measures described above and outlined reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Ensure that Bexar County and the City of San Antonio fully comply with avoiding and minimizing incidental take, in the form of harassment and harm, of golden-cheeked warblers, black-capped vireos, and the Covered Karst Invertebrates through full implementation of the Southern Edwards Plateau Habitat Conservation Plan dated July 2015.
2. Ensure that Bexar County and the City of San Antonio fully mitigate the effects of the incidental take of golden-cheeked warblers, black-capped vireos, and the Covered Karst Invertebrates from all covered activities, as described in the Southern Edwards Plateau Habitat Conservation Plan dated July 2015.
3. Ensure that Bexar County and the City of San Antonio produce and implement a public education/outreach program to inform local citizens and HCP participants of the HCP permit conditions and mitigation strategy proposed by the HCP.
4. Work with the permit holder to monitor conditions and collect data necessary to monitor effects of implementation of the Permit on aquatic species to determine future conservation measures and if take is likely to occur; and
5. Reinitiate consultation on the aquatic species if new information indicates that the implementation of the section 10(a)(1)(B) incidental take permit and the Southern Edwards Plateau Habitat Conservation Plan dated July 2015 may affect threatened or endangered aquatic species.

The reasonable and prudent measures, with their implementing term and condition, are designed to minimize the effects of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring re-initiation of consultation and review of the reasonable and prudent measures.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered or threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or designated critical habitat, to help implement recovery plans, or to develop information.

1. The Service with the Applicant should work to institute water conservation designs in residential and business development and landscape projects.
2. The Service recognizes that Fern Bank Springs is located on private property, and urges the applicant to seek cooperation with the landowner or party responsible for Fern Bank Springs and the U.S. Geological Survey to request access and institute a regular

monitoring program of springflow and the status of the Comal Springs dryopid beetle and its designated critical habitat at this location.

3. The Service should encourage the applicant to ensure compliance with the TCEQ "*Optional Enhanced Measures for the Protection of Water Quality in the Edwards Aquifer" and "Optional Enhanced Measures for the Protection of Water Quality in the Edwards Aquifer and Related Karst Features that May Be Habitat for Karst Dwelling Invertebrates*", described above, to best protect the listed aquatic species in Comal and Hays counties.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Review Requirements

The reasonable and prudent measures, with their implementing terms and conditions, are designed to avoid, minimize, and mitigate effects of incidental take that might otherwise result from the proposed action. If, during the course of the authorized activities, this level of incidental take is exceeded prior to the annual review, such incidental take represents new information requiring review of the reasonable and prudent measure provided. The Service must immediately provide an explanation of the causes of the taking and review the need for possible modification of the reasonable and prudent measures. This biological opinion will expire at the expiration of the incidental take permit issued to implement the SEP-HCP.

Reinitiation Notice

This concludes formal consultation on the issuance of a Service 10(a)(1)(B) permit for the Southern Edwards Plateau Habitat Conservation Plan to minimize and mitigate, to the maximum extent practicable, adverse effects to the endangered golden-cheeked warbler, black-capped vireo, or Covered Karst Invertebrates from covered activities described in the SEP-HCP over a period of 30 years. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of authorized incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species not considered in this biological opinion; or, (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Approved:

Adam Zerrenner, Field Supervisor
Austin Ecological Services Field Office

December 11, 2015
Date

Concur:

[signature] 12/11/15

Assistant Regional Director, Ecological Services
Region 2

Date

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