APPENDIX D

Background, Analysis, and Conservation Measures for Covered Species

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PREFACE

The following pages provide information about each Covered Species (or group of similar Covered Species) that is relevant to the assessment of incidental take and the implementation of the Conservation Program for Covered Activities, as specified in the LCRA TSC Transmission System HCP.[1] This information includes:

1. Ecology, range or distribution, phenology, potential habitat availability, and population size;
2. Potential effects of the Covered Activities;
3. Application of the tests for using habitat modification as a surrogate metric for incidental take; and
4. Application of the Conservation Program to Covered Activities, including:
    a. Methods for delineating Suitable Habitat;
    b. Methods for performing Presence/Absence Surveys and how to apply the results of Presence/Absence Surveys to the delineation of Occupied Habitat;
    c. Methods for identifying and delineating the extent of Existing Impacts and Special Cases
    d. Optional Avoidance Measures that can avoid entirely or minimize the amount of incidental take;
    e. Specific Minimization Measures that reduce the impact of incidental take;
    f. Methods for delineating the extent of Direct Habitat Modifications and Indirect Habitat Modifications that together are the surrogate metric for measuring incidental take;
    g. A matrix for assessing the amount of compensatory mitigation under certain Enrollment Scenarios and Mitigation Factors; and
    h. Anticipated forms and priorities for Mitigation actions.

The LCRA TSC Transmission System HCP includes additional context for the content provided herein. References cited in the treatment for each Covered Species appear at the end of this appendix.

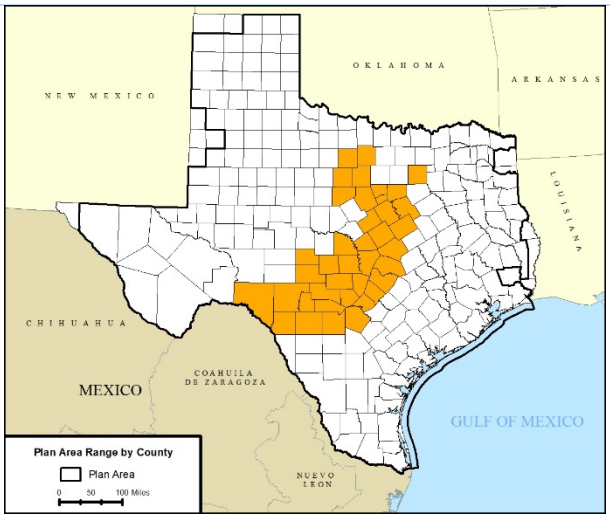
[1] Capitalized terms and abbreviations not defined herein are defined in the Glossary to the LCRA Transmission Services Corporation Transmission System Habitat Conservation Plan.

Golden-cheeked Warbler

Setophaga chrysoparia (GCWA)

Ecology

- Migratory songbird, with breeding range occurring entirely inside Plan Area
- GCWA arrive in Texas in early March and leaves for wintering grounds in Mexico to Nicaragua (or rarely to Costa Rica) by late July or mid-August (breeding season typically approximated as March 15 through July 31)
- Breeding GCWA are territorial and defend areas generally between 1 and 50 acres, depending on habitat quality, with the reported density of breeding territories varying between approximately four and 18 territories per 100 acres of habitat
- GCWA adults exhibit relatively high site fidelity between breeding seasons
- Annual survivorship estimated at 30% for juveniles and between 46% and 49% for adult males, with the oldest reported individual aged at 11 years



Texas Phenology

Potential Habitat

Breeding habitat is juniper-oak woodland typically with canopy cover between 35% and 100%. The likelihood of habitat occupancy reaches 50% in landscapes that are composed of at least 80% woodland cover. The following habitat estimates are from Morrison et al. (2010):

- Potential Breeding Habitat in Plan Area: 4,148,149 acres
- Potential Breeding Habitat in Range: 4,148,149 acres

Population

SWCA (2018) estimates the following populations, based on estimates of available habitat and likelihood of occupancy (Morrison et al. 2010) and assumed territory density in habitat of average quality (Pulich 1976) by patch size categories:

- Number in Plan Area: 56,469 pairs
- Number in Range: 56,469 pairs

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Covered Activities involving clearing of GCWA habitat can reduce the amount of habitat available for use by the species (USWS 2014).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Tied to habitat loss, fragmentation can reduce habitat patch sizes below the threshold used by the GCWA, indirectly causing habitat loss. Edge effects that may increase exposure to predators are possible (USFWS 2014).
3. COLLISION—Collision with transmission lines is not identified as a threat to migrating or breeding GCWA. GCWA are capable fliers and would be expected to move away from people and operating equipment during the conduct of Covered Activities; however, nests could be impacted by machinery operating in or adjacent to occupied habitat during the breeding season (Ladd and Gass 1999).
4. HERBICIDES—Application of herbicides is not anticipated in the dense forested areas preferred by breeding and foraging GCWA.
5. NOISE AND ACTIVITY DISTURBANCE—Noise and activity disturbances during the conduct of Covered Activities could affect GCWA breeding behaviors or breeding success (USFWS 2014). However, recent studies by Lackey et al. (2011) and Pruett et al. (2014) found road construction noise and activity have no effect on GCWA pairing success, territory placement, or productivity.
6. PREDATOR/PREY CHANGES—Covered Activities that modify vegetation within ROWs are unlikely to change insect communities in ways that substantially alter the GCWA prey base. Changes to potential predator populations may be possible if ROWs cross large patches of dense and previously unfragmented woodland potentially increasing the abundance and access of opportunistic species that prefer more open habitats (USFWS 2014).

Surrogate Test

1. CAUSAL LINK—Take that may occur via habitat loss and degradation, habitat fragmentation, edge effects, collision, and predator population changes is associated with the conduct of Covered Activities that modify habitat.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—The number and distribution of GCWAs in any particular area may naturally fluctuate within and between years, and the skill of the surveyor can affect survey results. It may not be possible to precisely identify or count those individuals taken via sub-lethal reductions in productivity, or determine the fate of individuals that do not return to the same breeding territory after migrating to and from wintering grounds.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Delineate Suitable Habitat as defined in Campbell (2003) when consistent with "Habitat Types Where Warblers Are Expected To Occur" or "Habitat Types That May Be Used by Warblers"

Optional Avoidance Measures

- Avoid Covered Activities within or within 300 feet of Suitable or Occupied Habitat.

Presence/Absence Surveys

- Presence/Absence Surveys will follow the recommendations in USFWS (2010), or may be revised in the future.
- The delineation of Suitable Habitat (with assumed occupancy) can be refined to Occupied or Unoccupied Habitat based on a P/A survey conducted during the GCWA breeding season and immediately prior to the start of Covered Activities, where all clearing will occur prior to the next GCWA breeding season. P/A Surveys will be conducted within and within 300 feet of the Project Area
- Occupied Habitat is all Suitable Habitat within a 500-foot radius of a GCWA detection documented within the prior GCWA breeding season (encompasses a 18-acre area around the detection, approximately the size of an average GCWA territory), including consideration of prior detections by other surveyors made within the prior 10 years, as provided to LCRA TSC by the USFWS.
- Unoccupied Habitat is all Suitable Habitat more than 500 feet from a GCWA detection recorded within the prior GCWA breeding season.

Specific Minimization Measures

- Avoid clearing of Suitable or Occupied Habitat during the breeding season (March 1 through July 31).
- May conduct construction activities (as opposed to clearing) within 300 feet of Suitable or Occupied Habitat during the breeding season (March 1 through July 31), as long as those activities promptly follow permitted clearing and/or were initiated before March 1, therefore being a continuous activity that began before initiation of the breeding season.
- Follow established LCRA TSC corporate oak wilt prevention policies, based on Texas Forest Service and Texas AgriLife Extension Service recommendations, in areas where oak wilt is known to occur.
- Avoid stringing of transmission lines (conductor and shield wires) during the breeding season (March 1 through July 31) across Suitable or Occupied Habitat within the ROW unless using a land-based tensioning system that will prevent transmission lines from sagging into treetops.

Existing Impacts

- Existing Impacts apply to Suitable or Occupied Habitat that occurs within 300 feet of previously developed land uses and structures, including, but not limited to, any public roads, utility rights-of-way, or developed lands (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the GCWA in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification occurs where Suitable or Occupied Habitat is physically removed or altered beyond suitable use from Covered Activities.

Special Cases

- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification occurs where Suitable or Occupied Habitat is within 300 feet of Covered Activities.

Sources: Campbell (2003); City of Austin et al. (2012); Diamond (2007); Duarte et al. (2013); Jetté et al. (1998); Ladd and Gass (1999); Lackey et al. (2011); Lockwood and Freeman (2014); Loomis-Austin, Inc. (2008); Mathewson et al. (2012); Morrison et al. (2010); Peak (2007); Peak and Thompson (2014); Pruett et al. (2014); Pulich (1976); Reidy et al. (2009); SWCA (2018); USFWS (2010, 2013, 2014, 2017)

Enrollment Scenario	Standard Mitigation Ratios	Mitigation Factors		
		Existing Impact	Relaxed Restrictions	Post-Enrollment Mitigation
Suitable Habitat with Assumed Occupancy	**Direct 2:1**	Direct: Standard Mitigation Ratio minus 50%	Standard Mitigation Ratios plus 100%	Standard Mitigation Ratios plus 25%
	Indirect 0.5:1	Indirect: No Mitigation		
Occupied Habitat with Demonstrated Occupancy	**Direct 3:1**	Direct: Standard Mitigation Ratio minus 50%	Standard Mitigation Ratios plus 100%	Standard Mitigation Ratios plus 25%
	Indirect 0.5:1	Indirect: No Mitigation		
Special Cases	**Direct 4:1**	Direct: Standard Mitigation Ratio minus 50%	Standard Mitigation Ratios plus 100%	Standard Mitigation Ratios plus 25%
	Indirect 1:1	Indirect: No Mitigation		

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC acknowledges that the USFWS has published mitigation guidance for the GCWA (USFWS 2013) and, to the extent practicable, will rely on such guidance to help plan conservation actions.

Whooping Crane

Grus americana (WHCR)

Ecology

- Large, long-lived, migratory bird that winters along the Texas Gulf Coast, usually in or near the Aransas National Wildlife Refuge; though some WHCR winter at other locations
- WHCR arrive in Texas between late October to mid-November and fly to summer habitat between late March to early May
- WHCR migrate along a relatively narrow, 200-mile-wide corridor and stop each night to rest after traveling between 200 to 400 miles per day
- WHCR migrate as single individuals, pairs, family groups, or in small flocks, sometimes accompanying sandhill cranes
- Omnivore that consumes Carolina wolfberry (*Lycium carolinianum*), blue crab (*Callinectes sapidus*), a variety of clams, and other items at wintering grounds
- Sources of mortality during migration and in winter include collision with power lines, shootings, disease/infection, and natural causes
- The WHCR has also been recently documented in Brazoria and Galveston Counties (USFWS 2019; striped counties in Texas distribution map)

Texas Phenology

Potential Habitat

Winter habitat generally characterized as coastal salt flats and adjacent upland areas.

- Habitat in Plan Area: 373,806 acres (winter habitat)
- Habitat in Range: 373,806 acres (winter habitat)

Population

Butler and Harrell (2017) estimates the following 2016–2017 WHCR population that winters at or near the Aransas National Wildlife Refuge:

- Number in Plan Area: 437 individuals
- Number in Range: 437 individuals

An additional 141 individuals occur in one of three non-essential, experimental populations.

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Covered Activities are not expected to significantly change the character of the open marsh and upland habitats used by WHCR during the winter or migration. There is no information to suggest that the presence of transmission lines is likely to displace an individual from a wintering territory.
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Habitat fragmentation and edge effects are not likely to be a significant concern for WHCR because its habitat is a naturally patchy mosaic of wetland and open grassland (Urbanek and Lewis 2015).
3. COLLISION—WHCR are known to collide with transmission lines, especially as juveniles, but this risk is reduced with the application of best practices to mark the locations of lines. Collision with equipment and machinery used during Covered Activities is unlikely because WHCR on their wintering grounds are fully mobile individuals (USFWS 2012).
4. HERBICIDES—Herbicide application within ROWs could degrade local foraging resources (e.g., *Lycium carolinianum*, a major winter food source) (USFWS 2012).
5. NOISE AND ACTIVITY DISTURBANCE—Noise and activity disturbances from the conduct of Covered Activities during the wintering season could annoy WHCR and temporarily displace them from preferred feeding or resting sites limiting their ability to obtain food resources (USFWS 2012).
6. PREDATOR/PREY CHANGES—The Covered Activities are not expected to significantly change land uses or land covers in the vicinity of ROWs. Therefore, populations of invertebrate prey or other predators are also not expected to significantly change.

Surrogate Test

1. CAUSAL LINK—Take of the WHCR may occur in response to the activity of people, equipment, and machinery during the conduct of Covered Activities in WHCR wintering habitat when birds are present. Similarly, legal application of herbicides in occupied wintering habitat could take individual WHCR.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—WHCR occupy large wintering territories and it may not be possible to precisely identify or count those individuals taken via sub-lethal effects or to determine the fate of individuals that do not return to the same area after migrating to and from wintering grounds.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Delineate Suitable Habitat to include areas of coastal prairie and coastal wetlands, excluding developed or wooded areas, that occur within the WHCR winter range.

Optional Avoidance Measures

- Avoid surface disturbance within or within 1,000 feet of Suitable or Occupied Habitat.
- Conduct Covered Activities involving existing Facilities during the WHCR breeding season (April 15 through October 14), when the species is not typically present in Texas.

Presence/Absence Surveys

- Conduct presence/absence surveys during the overwintering period (October 15 through April 14).
- Conduct presence/absence surveys using aerial visual transect surveys. Level of effort to detect WHCR to follow the recommendations in USFWS (2016). LCRA TSC anticipates:
  - survey corridor to include 1 mile on either side of route centerline with transects spaced at 0.5-miles intervals within the survey corridor
  - perform 3 runs of the transect line during January and February
- USFWS has not published a recommended protocol for performing Presence/Absence Surveys.
- Presence/absence survey results (and delineations of Occupied Habitat) remain valid until the following October 15.
- Occupied Habitat is the area of Suitable Habitat within 2,000 feet of a WHCR detection (encompasses a 289-acre area around the detection, approximately the size of an average WHCR winter territory) or previously reported WHCR observations (LCRA TSC will request such data at least annually from the USFWS).

Specific Minimization Measures

- Avoid Covered Activities within Suitable or Occupied Habitat during the overwintering period (October 15 through April 14) without the presence of an environmental monitor.
- During the overwintering period (October 15 through April 14), embed environmental monitors with construction crews, during active construction, to ensure minimization measures are implemented as intended.
- Temporarily cease Covered Activities when environmental monitoring detects a WHCR within 1,000 feet of the Covered Activity. Resume Covered Activities when WHCR move beyond 1,000 feet of the Covered Activity.
- Avoid application of pesticides and herbicides within Suitable Habitat.

Existing Impacts

- Existing Impacts occur within 1,000 feet of aboveground structures, roads, parking areas, public beaches, or other developed areas (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the WHCR in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification consists of Suitable or Occupied Habitat that is physically altered by subsurface disturbances from Covered Activities.

Special Cases

- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification consists of Suitable or Occupied Habitat that occurs within areas subject to surface disturbances or within 1,000 feet of surface disturbances from Covered Activities.

Sources: Butler and Harrell (2017); COSEWIC (2010); CWS and USFWS (2007); Howe (1987, 1989); Stehn and Wassenich (2008); Urbanek and Lewis (2015); USFWS (2009, 2012, 2015, 2016); USFWS (2019; personal communication from Christina Williams)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct 1:1** **Indirect 0.25:1**	Standard Mitigation Ratio minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**Direct 2:1** **Indirect 0.5:1**	Standard Mitigation Ratio minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct 4:1** **Indirect 1:1**	Standard Mitigation Ratio minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC will focus conservation actions on WHCR wintering habitats, including currently unoccupied but potential future wintering habitats.

Piping Plover

Charadrius melodus (PIPL)

Ecology

- Migratory shorebird, winters along the Texas coast. PIPL may also occur as a scarce migrant through the eastern part of Texas.
- PIPL arrive in Texas between late June and early September, reside on wintering grounds from September through early February, and leave for breeding grounds between February and early May
- PIPL mostly reside on the ground, but make short flights (generally less than 35 feet above ground) within a home range of approximately 3,100 acres when not migrating
- PIPL exhibit strong site fidelity to nonbreeding areas from fall through spring, but may use different habitats within the home range during this period
- PIPL may live for generally 5 to 10 years
- Density in some winter habitats shown to vary greatly from 0 to 61 birds/acre

Texas Phenology

Potential Habitat

Winter habitat occurs in association with coastal habitats such as tidal flats, beaches, mudflats, algal flats, washovers, and dredge spoil islands. The following estimates are from wintering habitat only.

- Potential Winter Habitat in Plan Area: 243,751 acres
- Potential Winter Habitat in Range (USA): 313,644 acres

Population

The following minimum population estimates are from the 2011 International Census of PIPL (Elliott-Smith et al. 2015):

- Number in Plan Area: 2,145 individuals
- Number in Range: 5,723 individuals

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Habitat loss and degradation is an identified threat to PIPL wintering habitats. Covered Activities would rarely occur in PIPL winter habitats, but if such habitat occurs within ROWs, then the operation of machinery and construction of Facilities could cause the loss or degradation of winter habitat potentially through avoidance behaviors (USFWS 2015).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Habitat fragmentation at the scale of a ROW is not known to be a threat to wintering PIPLs, as their habitat is naturally patchily distributed across the Texas coast. Similarly, the species uses relatively open and dynamic habitats that include a mosaic of land cover and vegetation types (Elliott-Smith and Haig 2004). Edge effects are not likely to adversely affect the species.
3. COLLISION—Collision with transmission lines is not identified as a threat to migrating or wintering PIPLs, although collision with power lines is identified as a threat for the Northern Great Plains population on their breeding grounds. PIPLs are capable fliers and would be expected to move away from people and operating equipment during the conduct of Covered Activities (USFWS 2015).
4. HERBICIDES—Application of herbicides is not anticipated in the tidal, riverine, or wetland areas used by PIPLs.
5. NOISE AND ACTIVITY DISTURBANCE—Noise and activity disturbances during the conduct of Covered Activities can cause PIPLs to avoid areas of habitat or decrease the time spent on normal foraging and roosting activities (USFWS 2015).
6. PREDATOR/PREY CHANGES—The Covered Activities are not expected to alter the landscape in a manner that would significantly change predator or prey populations.

Surrogate Test

1. CAUSAL LINK—Take that may occur via habitat loss and degradation and noise and activity disturbances are related to Covered Activities that modify habitat. Collision is linked to the presence of structures constructed or operated and maintained by LCRA TSC that modify the PIPL habitat by adding potential obstructions to the landscape.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—The migration period for PIPL is long and individuals use different habitats over the duration of the wintering season in ways that change the number of individuals present at any given location within and between years. Skill of the surveyor can affect survey results.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat is limited to the extent of wintering habitat along the Texas Gulf Coast, and does not include migratory stopovers.
- Suitable Habitat includes coastal intertidal beaches, related backbeach areas (i.e., high tide line to the edge of a dune or vegetation line), unvegetated or sparsely vegetated sand/mud/algal flats, spits, salterns, unvegetated washovers, seasonally emergent flats, or similar conditions mimicked by artificial habitat (e.g., dredge spoil piles).

Optional Avoidance Measures

- Avoid Covered Activities within, or within 1,000 feet of, Suitable or Occupied Habitat.

Presence/Absence Surveys

- Conduct presence/absence surveys during the overwintering period (September 1 through February 28/29) using the following methods:
  - Walk transects along the edge of the Suitable Habitat (e.g., along dune lines) during daylight hours (30 minutes after sunrise to 30 minutes before sunset)
  - 5 survey visits at least 10 days apart, with transects walked twice per visit and at least 5 hours apart
  - Survey pace of 30 minutes per 0.5 mile of transect
- USFWS has not published a recommended protocol for performing Presence/Absence Surveys.
- Occupied Habitat is the area of Suitable Habitat within 300 feet of a PIPL detection, including consideration of prior detections by other surveyors as provided to LCRA TSC by the USFWS on at least an annual basis.
- Presence/absence survey results (and delineations of Occupied Habitat) remain valid until the following September 1.

Specific Minimization Measures

- Conduct Covered Activities in Suitable Habitat during the PIPL breeding season (March 1 through August 31), when the species is not typically present in Texas.
- Establish 15-mile-per-hour (or less) speed limits within Suitable or Occupied Habitat during overwintering period (September 1 through February 28/29).
- Restore surface elevations after any ground disturbance, including smoothing out any deep ruts in Suitable or Occupied Habitat following construction.
- Avoid altering topography and naturally vegetated dunes adjacent to Suitable or Occupied Habitat to the maximum extent practicable.

Existing Impacts

- Existing Impacts occur within 1,000 feet of aboveground structures, roads, parking areas, public beaches, or other developed areas (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the PIPL in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification consists of Suitable or Occupied Habitat that is physically altered by subsurface disturbances from Covered Activities.

Special Cases

- Covered Activities performed within designated Critical Habitat.
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification consists of Suitable or Occupied Habitat that occurs within areas subject to surface disturbances or within 1,000 feet of surface disturbances from Covered Activities.

Sources: Drake et al. (2001); Elliott-Smith et al. (2015); Elliott-Smith and Haig (2004); Gratto-Trevor et al. (2012); Lockwood and Freeman (2014); Nicholls and Baldassarre (1990a, 1990b); Stantial and Cohen (2015); USFWS (2015); Zonick (2000)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct 1:1** **Indirect 0.1:1**	Standard Mitigation Ratio minus 90%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**Direct 1.5:1** **Indirect 0.2:1**	Standard Mitigation Ratio minus 90%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct 2:1** **Indirect 0.4:1**	Standard Mitigation Ratio minus 90%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC anticipates that Mitigation actions appropriate for Covered Activities involving Operations and Maintenance activities could include removal of dangling fishing line from electric transmission lines in coastal areas and suggests crediting at 0.5 credit per acre for the area within 300 feet of any removed fishing line.

Rufa Red Knot

Calidris canutus rufa (REKN)

Ecology

- Migratory shorebird that migrates through Texas and may winter within the Plan Area from September through May although, some REKN may remain year-round during their first year.
- Individual REKN generally return to same wintering grounds each year
- Migrating REKN may fly directly from Hudson Bay (Canada) to Texas and require adequate food supply to replenish energy
- Beach habitats are generally preferred due to the presence of food items
- Consume small, hard-shelled mollusks (mussels, clams, snails) and their larvae, shrimp, crabs, and marine worms while in winter habitat

Texas Phenology

Potential Habitat

REKN generally prefer sandy beaches and intertidal flats in Plan Area with abundant food availability, but also utilize extensive tidal flats on bay sides of barrier islands.

- Potential Habitat in Plan Area: 243,751 acres
- Potential Wintering Habitat in Range (USA): 601,018 acres

Population

The following include the Newstead et al. (2013) estimated wintering population in Texas and the Andres et al. (2012) estimated range-wide population:

- Number in Plan Area: 2,000 individuals
- Number in Range: 42,000 individuals

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Habitat loss and degradation due to coastline development is considered a threat to the species. REKN is also vulnerable to noise-related disturbances adjacent to machinery (USFWS 2013, 2014).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Fragmentation is not listed as a threat to REKN (USFWS 2014). Edge effects are not likely to adversely affect the species.
3. COLLISION—REKN are not known to collide with transmission lines or towers. They are capable fliers and would be expected to move away from people and operating equipment during the conduct of Covered Activities (USFWS 2013,2014).
4. HERBICIDES—Application of herbicides is not anticipated in the areas used by REKN.
5. NOISE AND ACTIVITY DISTURBANCE—The noise and activity of people, equipment, and machinery during the conduct of Covered Activities adjacent to feeding REKN could cause the species to abandon food sources, avoid areas of habitat, or decrease the time spent on normal foraging and roosting activities (USFWS 2013,2014).
6. PREDATOR/PREY CHANGES—The addition of new transmission lines near REKN feeding habitat could increase the number of perches for predatory raptors that could increase predation risk (USFWS 2013). The Covered Activities are not expected to affect the invertebrate prey used by the REKN.

Surrogate Test

1. CAUSAL LINK—Take is most likely via noise and activity disturbances or by enhancing the foraging behavior of predatory raptors near active REKN feeding sites. The opportunity for take is directly related to the presence of occupied feeding habitat within or adjacent to ROWs.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—The migration period for REKN is long and individuals use different habitats over the duration of the wintering season in ways that change the number of individuals present at any given location within and between years. Skill of the surveyor can affect survey results.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat is limited to the extent of wintering habitat along the Texas Gulf Coast, and does not include migratory stopovers.
- Suitable Habitat includes coastal intertidal beaches, related backbeach areas (i.e., high tide line to the edge of a dune or vegetation line), unvegetated or sparsely vegetated sand/mud/algal flats, spits, salterns, unvegetated washovers, or similar conditions mimicked by artificial habitat (e.g., dredge spoil piles).

Optional Avoidance Measures

- Avoid subsurface disturbance within, or within 1,000 feet of, Suitable or Occupied Habitat.

Presence/Absence Surveys

- Conduct presence/absence surveys during the prime overwintering period (December 1 through March 31) using the following methods:
  - Walk transects along the edge of the Suitable Habitat (e.g., along dune lines or above the wrack line when tides are low) during daylight hours (30 minutes after sunrise to 30 minutes before sunset)
  - 5 survey visits at least 10 days apart, with transects walked twice per visit and at least 5 hours apart
  - Survey pace of 30 minutes per 0.5 mile of transect
- USFWS has not published a recommended protocol for performing Presence/Absence Surveys.
- Occupied Habitat is the area of Suitable Habitat within 300 feet of a REKN detection, including consideration of prior detections by other surveyors as provided to LCRA TSC by the USFWS on at least an annual basis.
- Presence/absence survey results (and delineations of Occupied Habitat) remain valid until the following November 1.

Specific Minimization Measures

- Conduct Covered Activities in Suitable or Occupied Habitat during the REKN breeding season (April 1 through November 31), when the species is not typically present in Texas.
- Establish 15-mile-per-hour (or less) speed limits within Suitable or Occupied Habitat during overwintering period (December 1 through March 31).
- Restore surface elevations after any ground disturbance, including smoothing out any deep ruts (i.e., 2 inches or deeper) in Suitable or Occupied Habitat following construction.
- Avoid altering topography and naturally vegetated dunes adjacent to Suitable or Occupied Habitat to the maximum extent practicable.

Existing Impacts

- Existing Impacts occur within 1,000 feet of aboveground structures, roads, parking areas, public beaches, or other developed areas (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the REKN in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification consists of Suitable or Occupied habitat that is physically altered by subsurface disturbances from Covered Activities.

Special Cases

- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification consists of Suitable or Occupied Habitat that occurs within areas subject to surface disturbances or within 1,000 feet of surface disturbances from Covered Activities.

Sources: Andres et al. (2012); Harrington (2001); Lockwood and Freeman (2014); Newstead et al. (2013); Niles et al. (2008); USFWS (2013, 2014); Wells (2007)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct 1:1** **Indirect 0.1:1**	Standard Mitigation Ratio minus 90%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**Direct 1.5:1** **Indirect 0.2:1**	Standard Mitigation Ratio minus 90%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct 2:1** **Indirect 0.4:1**	Standard Mitigation Ratio minus 90%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

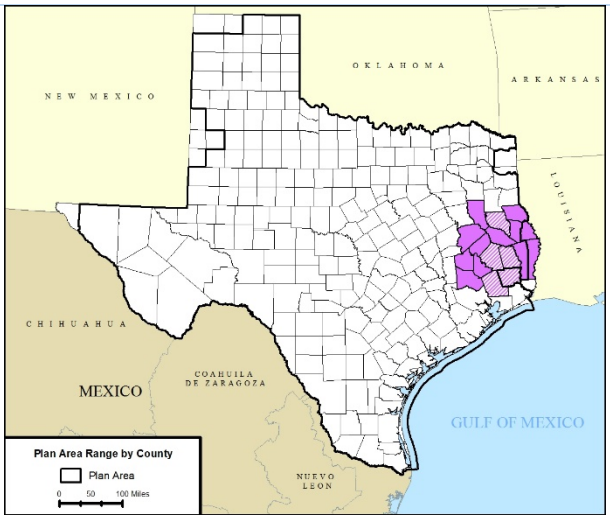
LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC anticipates that Mitigation actions appropriate for Covered Activities involving Operations and Maintenance activities could include removal of dangling fishing line from electric transmission lines in coastal areas and suggests crediting at 0.5 credit per acre for the area within 300 feet of any removed fishing line.

Red-cockaded Woodpecker

Picoides borealis (RCWO)

Ecology

- Non-migratory bird living in cooperative breeding groups referred to as clusters of 2 to 6 individuals
- RCWO eat mostly arthropods, but will consume seeds and small fruit
- Reproduction occurs from April through July
- RCWO group home range ranges between 60 to 360 acres, with most home ranges exceeding 100 acres
- Most family groups in Texas inhabit National Forest land
- RCWO construct nest and roost cavities that are typically 20 to 50 feet above the ground, in live pine trees at least 60 years old or more; cavity excavation can require between 2 and 13 years
- Long-lived species with the oldest recorded individual reaching 16 years of age
- RCWO may be extirpated from Hardin, Liberty, Nacogdoches, Polk, and Tyler Counties (USFWS 2019; striped counties in Texas distribution map)



Texas Phenology

Potential Habitat

RCWO occur in mature open pine forests. The following habitat extent is approximated by 2011 National Land Cover Database evergreen forest cover within counties deemed occupied by USFWS Environmental Conservation Online System.

- Potential Habitat in Plan Area: 2,131,202 acres
- Potential Habitat in Range: 24,407,002 acres

Population

USFWS (2006, 2017) reports the following number of RCWO family groups in Texas:

- Number in Plan Area: <342 family groups or approximately 855 individuals
- Number in Range: 6,105 family groups or approximately 15,263 individuals

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Habitat removal or degradation may occur during Covered Activities involving vegetation clearing related to construction. Vegetation clearing could remove cavity trees or degrade foraging habitat (USFWS 2006).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS— Habitat fragmentation is one of the primary threats to the RCWO (USFWS 2003). However, habitat loss at the scale of a linear ROW less than 200 feet in width is not likely to fragment RCWO foraging habitat because individuals will regularly fly across such distances (Jackson 1994).
3. COLLISION—RCWO are not known to collide with transmission lines or other structures. Collision is possible if an active nest tree is destroyed by equipment or machinery used during Covered Activities.
4. HERBICIDES—Localized applications of herbicides to control vegetation within ROWs is possible, but are not likely to affect RCWO that forage high in the forest canopy (Jackson 1994).
5. NOISE AND ACTIVITY DISTURBANCE—Noise and activity disturbances could harass RCWO if Covered Activities are performed in or adjacent to nesting or roosting cavity trees resulting in avoidance behaviors or abandonment of a nesting cavity (Jackson 1994).
6. PREDATOR/PREY CHANGES—The Covered Activities are not expected to significantly alter prey populations. Linear clearings through RCWO habitat could promote predator populations that are better adapted to more open or edge habitats (Jackson 1994, USFWS 2006).

Surrogate Test

1. CAUSAL LINK—The USFWS identifies the loss of old growth pine forest habitat as a threat to the species. Potential edge effects and changes in predator populations are directly related to habitat modifications. Collision, noise, and activity disturbances occur when equipment and machinery modify RCWO habitat during the conduct of Covered Activities.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—Distinguishing take caused by the Covered Activities from death or injury of RCWO caused by other factors unrelated to the Covered Activities is not practicable.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Delineate Suitable Habitat following USFWS-recommended protocols (USFWS 2003).

Optional Avoidance Measures

- Avoid Covered Activities within, or within 300 feet of, Suitable or Occupied Habitat.

Presence/Absence Surveys

- Presence/Absence Surveys will follow the recommendations in USFWS (2003), or may be revised in the future.
- The delineation of Suitable Habitat (with assumed occupancy) can be refined to Occupied or Unoccupied Habitat based on a single year of survey results completed no more than three survey seasons prior to the start of Covered Activities.
- Occupied Habitat is all Suitable Habitat within, or within 0.5-mile radius of, an Active Cluster. Occupied Habitat will also include the area within 0.5 mile of any previously documented Active Cluster.
- Unoccupied Habitat is all Suitable Habitat more than a 0.5-mile radius from an Active Cluster.

Specific Minimization Measures

- Avoid Covered Activities requiring mechanical equipment within 50 feet of a cavity tree or 200 feet of a cavity tree during the breeding season (April 1 through July 31).
- Avoid Clearing of Suitable or Occupied Habitat during the breeding season (April 1 through July 31).
- Avoid performing Covered Activities within one hour after sunrise and one hour before sunset inside an Active Cluster.
- Within Active Clusters, restrict vehicle use to existing access roads and avoid construction of new access roads outside of ROWs.

Existing Impacts

- Existing Impacts apply to Suitable or Occupied Habitat that occurs within 300 feet of previously developed land uses and structures, including, but not limited to, any public roads, utility rights-of-way, or developed lands (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the RCWO in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification consists of surface disturbances within Suitable or Occupied Habitat.

Special Cases

- Covered Activities within the boundary of an Active Cluster.
  - Direct Habitat Modification from Covered Activities within an Active Cluster requires the translocation of the Active Cluster following standard translocation techniques described in DeFazio et al. (1987), if the Covered Activities remove active cavity trees.
  - Coordinate salvage collection and relocation with USFWS and TPWD staff, if deemed necessary by the USFWS to prevent the loss of the Active Cluster.
- Covered Activities that cause the amount of foraging habitat within 0.5-mile of the center of an Active Cluster to fall below a threshold of 75 acres.
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification consists of Suitable or Occupied Habitat that occurs within 300 feet of surface disturbances.

Sources: Campbell (2003); DeFazio et al. (1987); Homer et al. (2015); Jackson (1994); USFWS (2003, 2006, 2017); USFWS (2019; personal communication from Christina Williams)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct 1:1** **Indirect 0.5:1**	Standard Mitigation Ratio minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**Direct 2:1** **Indirect 1:1**	Standard Mitigation Ratio minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct 3:1** **Indirect 1:1 (translocate Active Cluster)**	Standard Mitigation Ratio minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

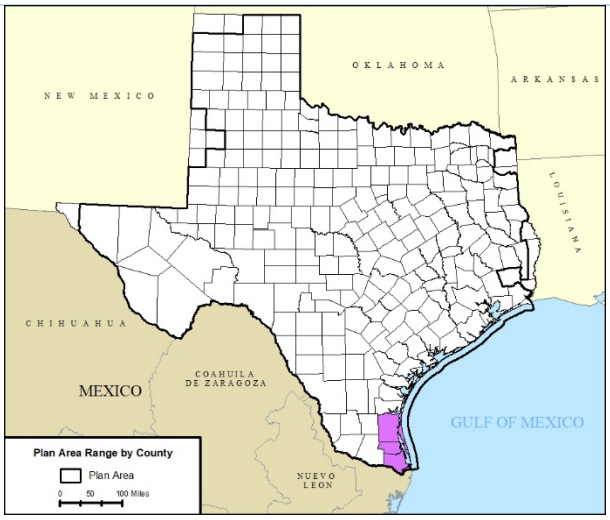
LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC will also prioritize conservation actions that are of a similar type as the form of take (i.e., in-kind mitigation, where removal of cavity trees is balanced by actions that create new nesting cavities or where modifications of foraging habitat is balanced by actions that control understory brush in foraging habitat).

Ocelot

Leopardus pardalis

Ecology

- Medium-bodied, spotted, cryptic, and solitary cat that may live for at least 15 years in the wild
- Texas represents a very small part of the species' range, which also includes much of Mexico, Central America, and South America; documented breeding populations occurring in three Texas counties
- Ocelots are most active from sunset to sunrise prowling for vertebrate prey within a home range that may measure 1 to 4 square miles
- Females use two to six dens, usually hidden in dense cover, to raise litters of one or two kittens
- Subadults often engage in long-distance dispersal, with recorded distances of up to 22 miles
- Collision with vehicles on roads is the largest source of documented mortality for the species in Texas



Texas Phenology

Potential Habitat

In Texas, breeding habitat is vertically dense thornscrub with at least 75% canopy cover. Potential breeding habitat can include, but is not limited to, linear or non-linear patches, stands, mattes, blocks, or lines of Tamaulipan thornscrub; riparian; live oak habitat; vegetated drainage ditches, irrigation canals, or fence lines; or other thickly vegetated corridors or habitats.

- Potential Breeding Habitat in Plan Area: 78,289 acres in 3 counties
- Potential Habitat in Range: 6,443,668 square miles south of the United States

Population

Population estimates are difficult to produce because of the wide, multi-national range and cryptic habits of the ocelot. The following include the Plan Area estimate from USFWS (2016) and range-wide estimate from Defenders of Wildlife (2017).

- Population in Plan Area: 80 individuals
- Population in Range: >800,000 individuals

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Removal of dense thornscrub within ROWs would reduce available habitat for ocelots, which is already a limiting resource for the species in Texas (USFWS 2006).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Ocelot habitat is already significantly fragmented, and most habitat patches are small and isolated. Fragmentation of remaining patches may render remaining patches unusable or less suitable for ocelots by reducing a patch to an unusable size and impeding dispersal of individuals (USFWS 2006). Adverse edge effects, aside from fragmentation, are not likely.
3. COLLISION—Collision is not expected from conduct of the Covered Activities because vehicular travel within ROWs occurs via unimproved access roads where slow travel speeds are required. Ocelots are sensitive to human activity and mobile individuals would be expected to move away from active construction (USFWS 2006). Likewise, females would likely move kittens to alternate den sites before collisions occur.
4. HERBICIDES—Ocelots use a large home range and the limited application of herbicides would not likely affect a large portion of an individual's home range (USFWS 2006).
5. NOISE AND ACTIVITY DISTURBANCE—Relatively short periods of noise or human activity are not likely to harass ocelots because mobile individuals may simply move to another part of their large home range. Ocelots rarely use the same daytime resting site on consecutive days, unless denning (Murray and Gardner 1997). Likewise, females would likely move kittens to alternate den sites away from noise and activity.
6. PREDATOR/PREY CHANGES—Covered Activities are unlikely to significantly alter ocelot prey populations, because of the relatively narrow linear corridors associated with most Facilities and land uses that remain relatively similar to the surrounding landscape.

Surrogate Test

1. CAUSAL LINK—Take in the form of harm that may arise from habitat loss and fragmentation are related to aspects of the Covered Activities that directly or indirectly modify ocelot habitats.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—Ocelots are cryptic, travel great distances, are active mostly at night, and occupy large home ranges. It is not practical to track the location and behavior of individual ocelots across their home ranges to determine if individuals have indeed been killed or injured by significant disruptions of essential breeding feeding and sheltering activities because LCRA TSC does not have access to lands outside of its ROWs.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation
- Suitable Habitat is dense thornscrub vegetation within counties having a documented breeding population.

Optional Avoidance Measures
- Avoid Covered Activities within 500 feet of Suitable Habitat.

Presence/Absence Surveys
- Presence/Absence Surveys to refine Suitable Habitat into areas of Occupied or Unoccupied Habitat are not proposed.

Specific Minimization Measures
- Conduct Covered Activities during daylight hours to avoid light and noise disturbances during the night.
- Direct artificial lighting on Facilities towards the Facility and shield to minimize night-time disturbance.
- Contain and remove daily all garbage and foodstuff from work sites to prevent attracting prey species.
- Establish 25-mile-per-hour (or less) speed limits within, or within 500 feet of, Suitable Habitat.
- Embed environmental monitors with construction crews, during active construction, to ensure minimization measures are implemented as intended.

Existing Impacts
- Existing Impacts apply to Suitable Habitat that occurs within 500 feet of previously developed land and structures, including, but not limited to, any public roads, utility rights-of-way, or developed lands (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the ocelot in the context of an incidental take assessment).

Direct Habitat Modification
- Direct Habitat Modification consists of surface disturbances to Suitable Habitat.

Special Cases
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification
- Indirect Habitat Modification consists of Suitable Habitat that occurs within 500 feet of surface disturbances from Covered Activities.

Sources: Campbell (2003); Defenders of Wildlife (2017); Haines et al. (2006); Harveson et al. (2004); Horne (1998); Laack et al. (2005); Murray and Gardner (1997), Tewes et al. (1995); USFWS (2016); USFWS (2018; personal communication from Hilary Swarts); USFWS (2018; personal communication from Christina Williams)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct 3:1** **Indirect 0.5:1**	Direct: Standard Mitigation Ratio minus 50% Indirect: No Mitigation	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**N/A**	N/A	N/A	N/A
Special Cases	**Direct 6:1** **Indirect 1:1**	Direct: Standard Mitigation Ratio minus 50% Indirect: No Mitigation	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

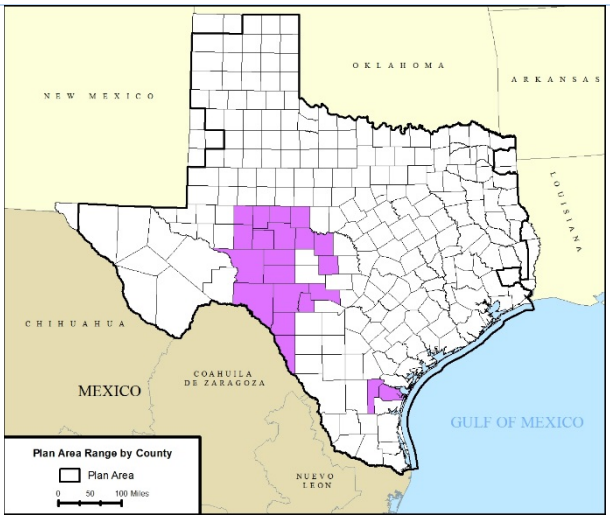
LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC recognizes that The Conservation Fund has an active program to collect funds for the purchase of ocelot dispersal corridors and may represent a potential in-lieu fee program sponsor or Conservation Provider for LCRA TSC. To the extent practicable, LCRA TSC will prioritize conservation actions that contribute to this effort.

Spot-tailed Earless Lizard

Holbrookia lacerata (STEL)

Ecology

- Extremely wary, diurnally active lizard that seeks cover under objects or underground when disturbed
- Active when ground temperature exceeds approximately 82°F; more active (and observable) early in the summer, with activity decreasing in July and August
- Generalist predator on ground- or low vegetation-dwelling insects and arthropods
- Relatively small home range of 1.2 to 1.5 acres
- Lays eggs underground, with reproductive peaks in May or June and again in July or August
- Historic Texas range spans 75 counties. Current Texas range includes 21 counties with detections recorded between 2000 and 2016



Texas Phenology

Potential Habitat

STEL occur in sparse grassland and disturbed areas along drainages and usually associated with early successional vegetation communities. Suitable habitat may occur in mesquite savannas, live oak savannas, coastal prairies, stony plateaus, and other areas.

- Potential Habitat in Plan Area: 9.5 million acres
- Potential Habitat in Range: 9.5 million acres (USA only)

Population

No published population abundance or density estimates are available for this species. STEL populations are thought to be large, based on low rates of recapture of marked individuals during surveys and numerous captures of unmarked individuals during repeat surveys of the same area. Recent detections of juvenile STEL have been recorded from across the current range.

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Covered Activities could replace some areas of suitable habitat with structure foundations, but unpaved access roads are likely to remain used by STEL (Duran et al. 2011). Vegetation and soil disturbance likely to improve habitat conditions (i.e., promote sparse, short herbaceous vegetation and small areas of disturbed soils) after implementation of a Covered Activity (LaDuc et al. 2016).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Covered Activities and Facilities are unlikely to fragment the open habitat used by STEL (Duran et al. 2011; LaDuc et al. 2016), create barriers to dispersal, or introduce novel edge effects to adjacent habitats.
3. COLLISION—Collisions of STEL individuals with equipment and vehicles is possible when relatively small STEL home ranges overlap with ROWs. The species' habit of seeking cover when disturbed suggests that individuals may not flee from areas subject to Covered Activities increasing the likelihood of a potential encounter with an individual STEL (Axtel 1956).
4. HERBICIDES—Reductions of prey items or direct toxicity to applied herbicides are possible within home ranges that overlap with ROWs (USFWS 2011). Adverse effects are likely to be temporary as prey populations return to the disturbed area.
5. NOISE AND ACTIVITY DISTURBANCE—Long-duration, daytime disturbances may cause individual STEL to remain under cover for extended periods (Axtel 1956), forgoing foraging and other normal behaviors.
6. PREDATOR/PREY CHANGES—The Covered Activities are unlikely to significantly alter STEL prey populations, because of the relatively narrow linear corridors associated with most Facilities and land uses that remain relatively similar to the surrounding landscape.

Surrogate Test

1. CAUSAL LINK—Take that may arise from habitat loss and degradation, collisions with vehicles and equipment, direct toxicity from legally applied herbicides, and altered behavior from noise and activity disturbances are all related to aspects of the Covered Activities that modify STEL habitats. Because of the small home ranges for STEL individuals, effects of the Covered Activities that may cause take are tightly associated with the area of actual habitat modification.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—Full censuses of STEL populations within ROWs are not practicable. Recent survey efforts demonstrate low rates of recapture of marked individuals and numerous captures of unmarked individuals during repeat surveys of the same area.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat includes areas of sparse grassland and disturbed areas along drainages that are usually associated with early successional vegetation communities of the Great Plains ecoregion (e.g., mesquite savannas, coastal prairies, flay stony plateaus, and live oak savannas).

Optional Avoidance Measures

- Avoid Covered Activities within, or within 50 feet of, Suitable or Occupied Habitat.

Presence/Absence Surveys

- Conduct surveys following recommendations in Fitzgerald et al. (1997).
- USFWS has not published a recommended protocol for performing Presence/Absence Surveys.
- The delineation of Suitable Habitat (with assumed occupancy) can be refined to Occupied or Unoccupied Habitat based on a single year of survey results completed no more than three survey seasons prior to the start of Covered Activities.
- Occupied Habitat is all Suitable Habitat within a 150-foot radius of a documented STEL detection (encompasses a 1.5-acre area around the detection, approximately the size of an average STEL territory), including consideration of prior detections by other surveyors.
- Unoccupied Habitat is all Suitable Habitat more than 150 feet from a STEL detection.

Specific Minimization Measures

- No pesticide or herbicide applied within, or within 50 feet of, Suitable or Occupied Habitat.
- Establish 25-mile-per-hour (or less) speed limits within, or within 50 feet of, Suitable or Occupied Habitat.

Existing Impacts

- Existing Impacts apply to Suitable or Occupied Habitat that occurs within 50 feet of previously developed land and structures, including, but not limited to, any public roads, utility rights-of-way, or developed lands (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the STEL in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification consists of subsurface disturbances to Suitable or Occupied Habitat.

Special Cases

- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification consists of surface disturbances to Suitable or Occupied Habitat.

Sources: Axtell (1956); Duran et al. (2011); Fitzgerald et al. (1997); LaDuc et al. (2016, 2017); Pierre et al. (2017); Texas Parks and Wildlife Department (2017); USFWS (2011); WildEarth Guardians (2010)

Enrollment Scenario	Standard Mitigation Ratios	Mitigation Factors		
		Existing Impact	Relaxed Restrictions	Post-Enrollment Mitigation
Suitable Habitat with Assumed Occupancy	**Direct 1:1** **Indirect 0.25:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**Direct 2:1** **Indirect 0.5:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct 3:1** **Indirect 0.75:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 10%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

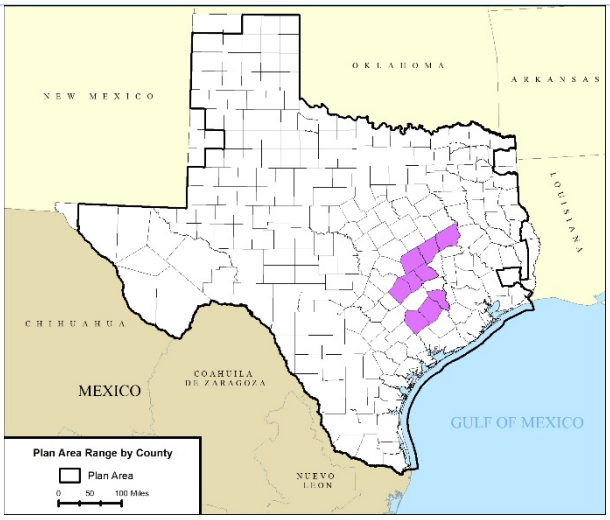
LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP.

Houston Toad

Bufo (=*Anaxyrus*) *houstonensis* (HOTO)

Ecology

- Terrestrial amphibian most active at night during breeding season from late January to June
- Generally inactive during hot, dry seasons and during the coldest months of the year
- Species congregates at ponds when breeding and disperses into adjacent uplands during other times of the year; juveniles occasionally engage in long-distance dispersal
- Species seeks refuge in burrows excavated in sandy soils or may use other forms of cover



Texas Phenology

Potential Habitat

Generally, breeding and resident habitat requires forested areas over deep, sandy soils in proximity to potential breeding ponds. Dispersal habitat may include areas without canopy cover or deep, sandy soils. Habitat estimate from Buzo (2008) using the simple model and including areas of high or medium likelihood of use.

- Potential Habitat in Plan Area: 1.2 million acres
- Potential Habitat in Range: 1.2 million acres

Population

No reliable published population estimates are available for this species. Forstner et al. (2016) estimated approximately 2,500 individuals.

- Population in Plan Area: 2,500 individuals
- Population in Range: 2,500 individuals

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Removal of tree canopy from ROWs can degrade habitat quality or cause the loss of potential resting or wintering sites as HOTO show a strong affinity for forested or woodland vegetation (USFWS 2006, 2011). The addition of roads and structures can also remove potential resting or wintering sites (USFWS 2006).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—HOTO are able to disperse across open areas, soils unsuitable for burrowing, and roads (USFWS 2006). ROWs are not expected to fragment HOTO habitat.
3. COLLISION—Collision of HOTOs with vehicles, machinery, or equipment is possible when HOTOs are present under cover or in shallow burrows within ROWs during the conduct of Covered Activities, particularly during initial vegetation clearing in wooded areas (USFWS 2006).
4. HERBICIDES—HOTOs are not expected to regularly occur within ROWs following initial clearing as they show a strong affinity for forested and woodland vegetation (USFWS 2011), and are unlikely to be exposed to applied herbicides.
5. NOISE AND ACTIVITY DISTURBANCE—HOTOs are not known to be affected by noise or activity disturbances.
6. PREDATOR/PREY CHANGES—The Covered Activities are unlikely to significantly alter HOTO prey populations, because of the relatively narrow linear corridors associated with most Facilities and land uses that remain relatively similar to the surrounding landscape.

Surrogate Test

1. CAUSAL LINK—Take in the form of harm that may arise from habitat loss and degradation are related to aspects of the Covered Activities that directly or indirectly modify HOTO habitats.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—HOTOs are cryptic, mostly active at night, shelter underground or under cover, and rarely call outside of the breeding season. Small toadlets are difficult, if not impossible, to identify in the field by morphology. Counting the number of toads that may be present in ROWs, particularly during the winter, or that may otherwise disperse across ROWs is impractical.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat includes areas of deep sandy soils over Sparta Sand, Weches, Queen City Sand, Reklaw, Carrizo Sand, Goliad, Calvert Bluff, and Willis geologic formations that occur under tree canopy that with at least 50% canopy closure or within 100 feet of such tree cover.

Optional Avoidance Measures

- Avoid surface or subsurface disturbances within Suitable Habitat.

Presence/Absence Surveys

- Presence/Absence Surveys to refine Suitable Habitat into areas of Occupied or Unoccupied Habitat is not proposed.

Specific Minimization Measures

- Install toad exclusion fencing at the ROW perimeter when crossing Suitable Habitat (also closing the ends with flap gates or similar barriers), use USFWS-permitted biologists to search for and remove any individual HOTO from the exclusion zone, and monitor the integrity of the exclusion fencing for the duration of the Covered Activity.
- Avoid application of pesticides/herbicides within Suitable Habitat.
- Establish 25-mile-per-hour (or less) speed limits within Suitable Habitat during the breeding season (i.e., January 1 through June 30).
- For aspects of the Covered Activities that involve more than minimal vegetation or ground disturbance:
  - Install toad exclusion fencing at the ROW perimeter when crossing Suitable Habitat (also closing the ends with flap gates or similar barriers), use USFWS-permitted biologists to search for and remove any individual HOTO from the exclusion zone, and monitor the integrity of the exclusion fencing for the duration of the Covered Activity.
  - Perform such Covered Activities outside of the HOTO breeding season.

Existing Impacts

- Existing Impacts apply to Suitable Habitat that is coincident with impervious cover, developed cover, manicured landscape cover (e.g., lawns), cropland, or infrastructure rights-of-way (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the HOTO in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification consists of surface disturbances to Suitable Habitat.

Special Cases

- Covered Activities that occur within 300 feet of a known (i.e., previously documented) breeding pond located in Suitable Habitat. LCRA TSC will rely on data from the USFWS or other published sources to identify known breeding ponds.
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification consists of areas of Suitable Habitat within 50 feet of surface disturbances

Sources: Buzo (2008); Campbell (2003); Forstner and Dixon (2010); Forstner et al. (2007, 2016); USFWS (2007, 2011, 2017a, 2017b); Vandewege et al. (2013)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct 1:1**	Direct: Standard Mitigation Ratio minus 90% Indirect: No Mitigation	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
	Indirect 0.5:1			
Occupied Habitat with Demonstrated Occupancy	**N/A**	N/A	N/A	N/A
Special Cases	**Direct 5:1**	Direct: Standard Mitigation Ratio minus 90% Indirect: No Mitigation	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
	Indirect 2:1			

LCRA TSC-responsible Conservation Priorities and Crediting

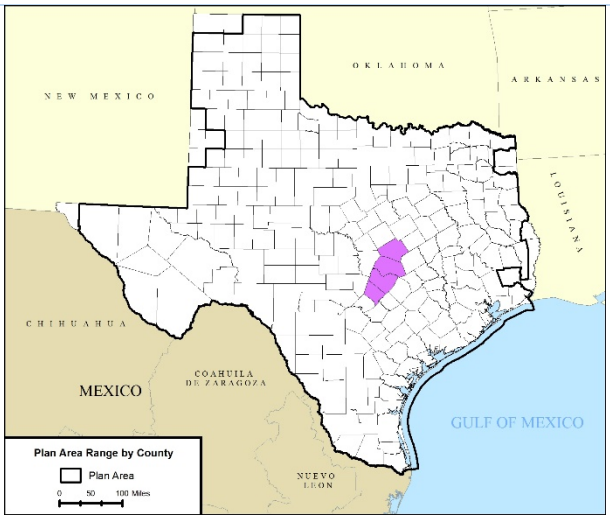
LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC will prioritize conservation actions for Direct or Indirect Habitat Modification related to New Construction in HOTO Critical Habitat by prioritizing the placement of Mitigation in other areas of HOTO Critical Habitat. LCRA TSC acknowledges that the USFWS has published guidance for the management of HOTO habitat (USFWS 2017b) and, to the extent practicable, will rely on such guidance to help plan conservation actions.

Spring-adapted *Eurycea* Salamanders

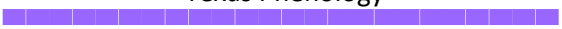
Salado Salamander *(Eurycea chisholmensis);* San Marcos Salamander *(Eurycea nana);* Georgetown Salamander *(Eurycea naufragia);* Barton Springs Salamander *(Eurycea sosorum);* Jollyville Plateau Salamander *(Eurycea tonkawae)*

Ecology

- Fully aquatic, neotenic salamanders that live in groundwater within and discharging from the Edwards and Trinity aquifers; use surface and subsurface aquatic habitats
- Reliant on a relatively narrow set of environmental conditions related to water chemistry (clean with low nitrogenous content), quantity (adequate spring flows at the surface), and generally cool water temperature (between 65°F and 86°F)
- Abundance on the surface varies widely, with an unknown portion of the population present within inaccessible parts of the aquifer
- Taxonomic uncertainty regarding species boundaries and assignments at known *Eurycea* localities; herein, species assignments follow USFWS critical habitat designations and Bendik et al. (2013)



Texas Phenology



Potential Habitat

Surface habitats are associated with spring outlets and spring runs, generally within 262 feet of the outlet. Subsurface habitats are relatively unstudied, but are likely to include the area within 984 feet of the spring outlet. The following habitat estimates, for the group, are based on the likely extent of subsurface habitat associated with known *Eurycea* localities.

- Potential Habitat in Plan Area: 9,936 acres
- Potential Habitat in Range: 9,936 acres

Population

No reliable published population estimates are available for any of the *Eurycea* species.

- Population in Plan Area: unknown
- Population in Range: unknown

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Clearing trees from riparian areas could alter the temperature of surface water habitat and degrade habitat quality. Soil disturbance along occupied spring runs could introduce sediment to the aquatic habitat and degrade habitat quality. Subsurface excavations, particularly for transmission tower footings, could intercept or alter groundwater flow paths and cause the loss of subsurface habitat (USFWS 2012).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Limited subsurface excavations are unlikely to fragment the highly interconnected passages of the karst aquifer. Surface habitats are naturally fragmented at disjunct spring outlets (USFWS 2012). Edge effects are unknown.
3. COLLISION—Excavations through occupied groundwater conduits could intercept *Eurycea* individuals although the likelihood of such an event is unknown because little is known about how *Eurycea* use subsurface habitats (USFWS 2012).
4. HERBICIDES—*Eurycea* are unlikely to be exposed to applied herbicides. Direct toxicity of applied herbicides to prey eaten by *Eurycea* is possible (USFWS 2012).
5. NOISE AND ACTIVITY DISTURBANCE—No published information suggests that *Eurycea* are disturbed by noise or human activity.
6. PREDATOR/PREY CHANGES—The Covered Activities are unlikely to significantly alter *Eurycea* prey or predator populations because LCRA TSC is expected to avoid altering surface aquatic environments by spanning such areas.

Surrogate Test

1. CAUSAL LINK—Take in the form of harm that may arise from habitat loss and degradation are related to aspects of the Covered Activities that directly or indirectly modify *Eurycea* habitats.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—*Eurycea* salamanders are cryptic and shelter in the aquifer or under cover. An unknown portion of the population occurs within inaccessible subterranean habitats for unknown periods of time. Counting the number of salamanders that may be present in ROWs, particularly in the subsurface, is impractical, if not impossible.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat for each Covered Species in this group is the area within 984 feet of a spring outlet and associated spring run, pool, or lake edge within the known range of the Covered Species that discharges from the Edwards Aquifer.

Presence/Absence Surveys

- Known Occupied Features (REQUIRED) – Query USFWS to obtain the current locations of previously documented localities for these Covered Species during the Annual Coordination Meeting (see Chapter 8.2 of the HCP).
- Presence/Absence Surveys (OPTIONAL) -- Conduct surveys following USFWS 10(a)(1)(A) permit requirements at springs where presence is undetermined following recommendations in USFWS (2014), or may be revised in the future. If presence of a Covered Species is documented, then the spring becomes an "Occupied Spring Feature" for that Covered Species. If the Presence/Absence Surveys fail to detect the presence of a Covered Species in this group, then the spring becomes Unoccupied Habitat.
- Assumed Occupied Spring Features (REQUIRED) -- For Suitable Habitat where a Presence/Absence Survey is not conducted, the spring becomes an "Assumed Occupied Spring Feature" for the Covered Species with a range that overlaps the location of the spring.
- The limit of an Occupied Spring Feature or Assumed Occupied Spring Feature is the area within 984 feet of a spring outlet and associated spring run, pool, or lake edge within the known range of the Covered Species that discharges from the Edwards Aquifer. As a General Minimization Measure for the HCP, LCRA TSC agreed to avoid disturbances within 50 feet of the spring outlet and associated spring run to the maximum extent possible.
- For the purposes of applying the mitigation matrix below, Occupied Habitat is the area associated with an Occupied Spring Feature or Assumed Occupied Spring Feature.

Existing Impacts

- Existing Impacts apply to Occupied Habitat that is coincident with impervious cover, developed cover, manicured landscape cover (e.g., lawns), cropland, or infrastructure rights-of-way (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on these species in the context of an incidental take assessment).

Special Cases

- Covered Activities that occur within designated Critical Habitat.
- Covered Activities performed within 50 feet of an Occupied or Assumed Occupied Spring Feature
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Optional Avoidance Measures

- Avoid surface or subsurface disturbances within Occupied Habitat.

Specific Minimization Measures

- Erect erosion and sediment controls, such as silt fencing, at the boundary of the 50-foot avoidance zone around the Occupied Spring Feature or Assumed Occupied Spring Feature that will remain for the duration of the construction and any post-construction restoration.
- Schedule grading and earthmoving operations to expose the smallest practical area for the shortest possible time.
- Implement a materials management plan to address the safe handling, storage, treatment, and/or disposal of materials brought into Suitable Habitat.
- Avoid application of pesticides and herbicides within Occupied Habitat.
- Embed environmental monitors with construction crews, during active construction, to ensure minimization measures are implemented as intended.
- Within Critical Habitat for these species, LCRA TSC will reclaim and restore the footprint of any existing Structure that is removed and not occupied by a replacement Structure. The reclamation/restoration will be to a condition substantially consistent with any immediately adjacent land cover, with a priority for matching natural cover types and native plants.

Direct Habitat Modification

- Direct Habitat Modification is subsurface disturbance within Occupied Habitat.

Indirect Habitat Modification

- Indirect Habitat Modification is surface disturbances that are limited to the addition of impervious cover (e.g., gravel placement for access roads or where surface grading is not necessary) within areas of Occupied Habitat not subject to Direct Habitat Modification.

Sources: Adcock et al. (2016); Barrett et al. (2010); Bendik (2006, 2017); Bendik et al. (2013, 2014, 2016); Bendik and Glusenkamp (2012); Bowles et al. (2006); Cambrian (2017); Chippindale (2012); Chippindale and Fries (2005); Chippindale and Price (2005); Chippindale et al. (2000); Crow (2015); Diaz et al. (2015b); Hillis et al. (2015); Krejca et al. (2017); Lucas et al. (2009); Nelson (1993); O'Donnell et al. (2008); Oborny (2016); Pierce and Wall (2011); Pierce et al. (2010, 2014); Smith (2011); Travis County (2017); USFWS (1980, 2012, 2013a, 2013b, 2013c, 2014)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**N/A**	N/A	N/A	N/A
Occupied Habitat with Demonstrated Occupancy	**Direct: 5:1** **Indirect: 0.5:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct: 20:1** **Indirect: 1:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion

in Chapter 6.5.1 of the HCP. LCRA TSC anticipates that Mitigation for impacts to Occupied Habitat can be satisfied with the protection and management of undeveloped acres within the range of the associated Covered Species. LCRA TSC will prioritize available opportunities in the following manner: 1) lands within 984 feet of an Occupied Spring Feature; 2) lands within the spring shed of the Occupied Spring Feature or Assumed Occupied Spring Feature; 3) lands within the spring shed of another known Occupied Spring Feature for that Covered Species; 4) lands within the range of the associated Covered Species; and 5) lands within the recharge zone of the segment of the Edwards Aquifer that contains the Occupied Spring Feature or Assumed Occupied Spring Feature. LCRA TSC will prioritize mitigation within 984 feet of an occupied spring feature for habitat modification that occurs within 984 feet of an occupied spring feature. Anticipated crediting, subject to modifications as described in Chapter 6.5.2: 1) 1 acre of protection and management within the spring shed of the impacted Occupied Spring Feature or Assumed Occupied Spring Feature or within the spring shed of another such feature for that Covered Species = 1 credit; 2) 1 acre of protection and management within the general range of that Covered Species = 0.5 credit; 3) 1 acre of protection and management within the general recharge zone for that Covered Species = 0.1 credit. Management actions should improve the condition of the spring run (i.e., promote shading) or be designed to improve recharge.

Comal Springs Riffle Beetle

Heterelmis comalensis (CSRB)

Ecology

- An aquatic beetle that is known only to occur at two major spring complexes at San Marcos Springs and Comal Springs associated with the Edwards Aquifer, but is not known to occur in subterranean parts of the aquifer
- Closely associated with silt-free, gravel substrates within a few feet of a spring outlet, where they are found between gravel or under rocks in shallow riffle habitat
- Riffle beetles crawl across substrates in the water, and do not swim or fly
- Presumed diet is of spring-adapted biofilms of algae and fungi
- Species remains extant at Comal Springs despite a period of 5 months of no spring flow due to severe drought conditions; species possibly survived by retreating into the aquifer

Texas Phenology

Potential Habitat

Only known to be associated with surface aquatic habitats within a few feet of spring outlets at San Marcos Springs and Comal Springs. The following potential habitat is approximated by the extent of Critical Habitat designated for the species.

- Potential Habitat in Plan Area: 54 acres
- Potential Habitat in Range: 54 acres

Population

No reliable population estimates are available for this species.

- Population in Plan Area: unknown
- Population in Range: unknown

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Clearing trees from riparian areas could alter the temperature of surface water habitat and degrade habitat quality. Soil disturbance along occupied spring runs could introduce sediment to the aquatic habitat and degrade habitat quality. Subsurface excavations, particularly for transmission tower footings, could intercept or alter groundwater flow paths and cause the loss of habitat (USFWS 1997).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Covered Activities will largely avoid surface aquatic habitats and are unlikely to fragment or introduce edge effects to CSRB habitat.
3. COLLISION—Collision of LCRA TSC machinery or equipment with CSRBs are not expected.
4. HERBICIDES—Direct toxicity of applied herbicides to individual riffle beetles or the biofilms eaten by the species is possible (USFWS 1997).
5. NOISE AND ACTIVITY DISTURBANCE—No published information suggests that riffle beetles are disturbed by noise or human activity.
6. PREDATOR/PREY CHANGES—The Covered Activities are unlikely to significantly alter prey or predator populations because LCRA TSC is expected to avoid altering surface aquatic environments by spanning such areas.

Surrogate Test

1. CAUSAL LINK—Take in the form of harm that may arise from habitat loss and degradation are related to aspects of the Covered Activities that directly or indirectly modify riffle beetle habitats.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—CSRBs are cryptic and shelter among gravel or under rocks, and it is possible that individuals occur within the aquifer itself. Population estimates are not available. Counting the number of riffle beetles that may be present in ROWs, is impractical, if not impossible.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat is the area within 984 feet of a a spring outlet or associated spring run or lake or wellwith known occupancy by CSRB (i.e., an "Occupied Spring Feature" as defined in the Glossary to the HCP).

Optional Avoidance Measures

- Avoid surface or subsurface disturbances within Suitable Habitat.

Presence/Absence Surveys

- Presence/Absence Surveys are not applicable because all Suitable Habitat is either known to be, or assumed to be, occupied.

Specific Minimization Measures

- Erect erosion and sediment controls, such as silt fencing, at the boundary of the 50-foot avoidance zone around the Occupied Spring Feature that will remain in place for the duration of the construction and any post-construction restoration.
- Schedule grading and earthmoving operations to expose the smallest practical area for the shortest possible time.
- Implement a materials management plan to address the safe handling, storage, treatment, and/or disposal of materials brought into Suitable Habitat.
- Avoid application of pesticides and herbicides within Suitable Habitat.
- Embed environmental monitors with construction crews, during active construction, to ensure minimization measures are implemented as intended.
- As a General Minimization Measure for the HCP, LCRA TSC agreed to avoid disturbances within 50 feet of the spring outlet and associated spring run to the maximum extent possible.
- LCRA TSC has also agreed, as a General Minimization Measure, to avoid causing subsurface Disturbances to wetlands, riparian areas, and to aquatic habitats to the maximum extent practicable.
- Within Critical Habitat for this species, LCRA TSC will reclaim and restore the footprint of any existing Structure that is removed and not occupied by a replacement Structure. The reclamation/restoration will be to a condition substantially consistent with any immediately adjacent land cover, with a priority for matching natural cover types and native plants.

Existing Impacts

- Existing Impacts apply to Suitable Habitat that is coincident with impervious cover, developed cover, or manicured landscape cover (e.g., buildings, roads, sidewalks, lawns) (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the CSRB in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification is subsurface disturbance within Suitable Habitat.

Special Cases

- Covered Activities performed within Critical Habitat.
- Covered Activities performed within 50 feet of an Occupied or Assumed Occupied Spring Feature
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification is surface disturbance, limited to the addition of impervious cover (e.g., gravel placement for access roads or where surface grading is not necessary), within areas of Suitable Habitat not subject to Direct Habitat Modification.

Sources: BIO-WEST (2016); Bosse et al. (1988); Bowles et al. (2003); Brown (1987); Cooke (2012); Cooke et al. (2015); Gibson et al. (2008); Huston and Gibson (2015); USFWS (1997, 2007, 2012a, 2013); Zara Environmental (2015)

Enrollment Scenario	**Standard Mitigation Ratios**	**Mitigation Factors**		
		Existing Impact	**Relaxed Restrictions**	**Post-Enrollment Mitigation**
Suitable Habitat with Assumed Occupancy	**Direct: 5:1** **Indirect: 0.5:1**	Standard Mitigation Ratios minus 90%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**N/A**	N/A	N/A	N/A
Special Cases	**Direct: 20:1** **Indirect: 1:1**	Standard Mitigation Ratios minus 90%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC anticipates that Mitigation for impacts to Suitable Habitat can be satisfied with the protection and management of undeveloped acres within the range of the associated Covered Species. LCRA TSC will prioritize available opportunities in the following manner: 1) lands within 984 feet of an Occupied Spring Feature; 2) lands within the spring shed of the Occupied Spring Feature or Assumed Occupied Spring Feature; 3) lands within the spring shed of another known Occupied Spring Feature for that Covered Species; 4) lands within the range of the associated Covered Species; and 5) lands within the recharge zone of the segment of the Edwards Aquifer that contains the Occupied Spring Feature or Assumed Occupied Spring Feature. LCRA TSC will prioritize mitigation within 984 feet of an occupied spring feature for habitat modification that occurs within 984 feet of an occupied spring feature. Anticipated crediting, subject to modifications as described in Chapter 6.5.2: 1) 1 acre of protection and management within the spring shed of the impacted Occupied Spring Feature or within the spring shed of another such feature for that Covered Species = 1 credit; 2) 1 acre of protection and management within the general range of that Covered Species = 0.5 credit; 3) 1 acre of protection and management within the general recharge zone for that Covered Species = 0.1 credit. Management actions should improve the condition of the spring run (i.e., promote shading) or be designed to improve recharge.

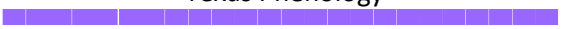
Peck's Cave Amphipod

Stygobromus pecki (PCAM)

Ecology

- An aquatic amphipod (Crustacean) that is known only to occur at Comal Springs complex and Hueco Springs; both associated with the Edwards Aquifer
- Species likely inhabits deep aquifer habitat
- Closely associated with spring outlets and seeps, where they are found underneath gravel, rocks, or other debris
- Presumed diet is of organic material growing on karst substrates (i.e., microbial colonies) and other organic debris (e.g., leaves, roots, invertebrate corpses, etc.) washed into their habitat
- Species remains extant at Comal Springs despite a period of 5 months of no spring flow due to severe drought conditions; species possibly survived by retreating into the aquifer

Texas Phenology



Potential Habitat

Only known to be associated within or adjacent to the Comal Springs complex and Hueco Springs. The following potential habitat is approximated by the subsurface extent of Critical Habitat designated for the species.

- Potential Habitat in Plan Area: 138 acres
- Potential Habitat in Range: 138 acres

Population

No population estimates are available for this species; however, the species is considered stable.

- Population in Plan Area: unknown
- Population in Range: unknown

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Clearing trees from riparian areas could alter the temperature of surface water habitat and degrade habitat quality at spring runs. Soil disturbance along occupied spring runs could introduce sediment to the aquatic habitat and degrade habitat quality. Subsurface excavations, particularly for transmission tower footings, could intercept or alter groundwater flow paths and cause the loss of habitat (USFWS 1997).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Covered Activities will largely avoid surface aquatic habitats and are unlikely to fragment or introduce edge effects to PCAM habitat.
3. COLLISION—Collisions of LCRA TSC machinery or equipment with PCAM are not expected.
4. HERBICIDES—Direct toxicity of applied herbicides to individual PCAM or the biofilms eaten by the species is possible (USFWS 1997).
5. NOISE AND ACTIVITY DISTURBANCE—No published information suggests that PCAM are disturbed by noise or human activity.
6. PREDATOR/PREY CHANGES—The Covered Activities are unlikely to significantly alter prey or predator populations because LCRA TSC is expected to avoid altering surface aquatic environments by spanning such areas.

Surrogate Test

1. CAUSAL LINK—Take in the form of harm that may arise from habitat loss and degradation are related to aspects of the Covered Activities that directly or indirectly modify habitat.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—PCAMs are cryptic and shelter among gravel or under rocks, and it is likely that individuals occur within the aquifer itself. Population estimates are not available. Counting the number of PCAM that may be present in ROWs, is impractical, if not impossible.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat is the area within 984 feet of a a spring outlet or associated spring run or lake or wellwith known occupancy by PCAM (i.e., an "Occupied Spring Feature" as defined in the Glossary to the HCP).

Optional Avoidance Measures

- Avoid surface or subsurface disturbances within Suitable Habitat.

Presence/Absence Surveys

- Presence/Absence Surveys are not applicable because all Suitable Habitat is either known to be, or assumed to be, occupied.

Specific Minimization Measures

- Erect erosion and sediment controls, such as silt fencing, at the boundary of the 50-foot avoidance zone around the Occupied Spring Feature that will remain in place for the duration of the construction and any post-construction restoration.
- Schedule grading and earthmoving operations to expose the smallest practical area for the shortest possible time.
- Implement a materials management plan to address the safe handling, storage, treatment, and/or disposal of materials brought into Suitable Habitat.
- Avoid application of pesticides and herbicides within Suitable Habitat.
- Embed environmental monitors with construction crews, during active construction, to ensure minimization measures are implemented as intended.
- As a General Minimization Measure for the HCP, LCRA TSC agreed to avoid disturbances within 50 feet of the spring outlet and associated spring run to the maximum extent possible.
- LCRA TSC has also agreed, as a General Minimization Measure, to avoid causing subsurface Disturbances to wetlands, riparian areas, and to aquatic habitats to the maximum extent practicable.
- Within Critical Habitat for this species, LCRA TSC will reclaim and restore the footprint of any existing Structure that is removed and not occupied by a replacement Structure. The reclamation/restoration will be to a condition substantially consistent with any immediately adjacent land cover, with a priority for matching natural cover types and native plants.

Existing Impacts

- Existing Impacts apply to Suitable Habitat that is coincident with impervious cover, developed cover, or manicured landscape cover (e.g., buildings, roads, sidewalks, lawns) (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on the PCAM in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification is subsurface disturbance within Suitable Habitat.

Special Cases

- Covered Activities performed within Critical Habitat.
- Covered Activities performed within 50 feet of an Occupied or Assumed Occupied Spring Feature.
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification is surface disturbance, limited to the addition of impervious cover (e.g., gravel placement for access roads or where surface grading is not necessary), within areas of Suitable Habitat not subject to Direct Habitat Modification.

Enrollment Scenario	Standard Mitigation Ratios	Mitigation Factors		
		Existing Impact	Relaxed Restrictions	Post-Enrollment Mitigation
Suitable Habitat with Assumed Occupancy	**Direct: 5:1** **Indirect: 0.5:1**	Standard Mitigation Ratios minus 90%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Demonstrated Occupancy	**N/A**	N/A	N/A	N/A
Special Cases	**Direct: 20:1** **Indirect: 1:1**	Standard Mitigation Ratios minus 90%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC anticipates that Mitigation for impacts to Suitable Habitat can be satisfied with the protection and management of undeveloped acres within the range of the associated Covered Species. LCRA TSC will prioritize available opportunities in the following manner: 1) lands within 984 feet of an Occupied Spring Feature; 2) lands within the spring shed of the Occupied Spring Feature or Assumed Occupied Spring Feature; 3) lands within the spring shed of another known Occupied Spring Feature for that Covered Species; 4) lands within the range of the associated Covered Species; and 5) lands within the recharge zone of

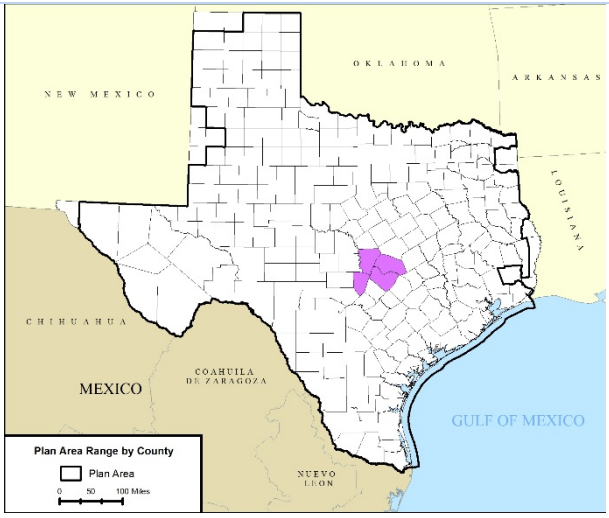
the segment of the Edwards Aquifer that contains the Occupied Spring Feature or Assumed Occupied Spring Feature. LCRA TSC will prioritize mitigation within 984 feet of an occupied spring feature for habitat modification that occurs within 984 feet of an occupied spring feature. Anticipated crediting, subject to modifications as described in Chapter 6.5.2: 1) 1 acre of protection and management within the spring shed of the impacted Occupied Spring Feature or within the spring shed of another such feature for that Covered Species = 1 credit; 2) 1 acre of protection and management within the general range of that Covered Species = 0.5 credit; 3) 1 acre of protection and management within the general recharge zone for that Covered Species = 0.1 credit. Management actions should improve the condition of the spring run (i.e., promote shading) or be designed to improve recharge.

Northern Karst Invertebrates (NKIN)

Bee Creek Cave Harvestman (*Texella reddelli*), Tooth Cave Spider (*Tayshaneta* [syn. *Neoleptoneta*] *myopica*), Tooth Cave Ground Beetle (*Rhadine persephone*)

Ecology

- Very small, mostly blind, cryptic group that live underground in karst voids
- Few details regarding the life history and ecology of these species are known, due largely to the inaccessibility of their habitat
- Thought to be predatory on microarthropods, but some may scavenge cave cricket eggs
- Rhadine beetles are known to cruise across the floor and walls of void passages, whereas most of the other species are typically found under rocks or other cover objects
- Surface communities provide important nutrient inputs and moderate the physical environment karst habitat



Texas Phenology

Potential Habitat

NKIN occur in caves, other karst voids, and mesocavernous spaces in limestone karst formations with stable temperatures and high humidity. The following acres of potential habitat for the NKIN group are approximated by the area of Karst Zones 1 and 2 mapped in Travis and Williamson Counties. See SWCA (2018) for species-specific habitat estimates based on known range.

- Potential Habitat in Plan Area: 182,735 acres
- Potential Habitat in Range: 182,735 acres

Population

No population estimates are available for any of these species.

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Covered Activities involving excavation can result in the permanent loss of habitable karst voids. Clearing trees from ROW can degrade karst habitat by altering the amount or composition of nutrient inputs to the subsurface environment or altering the subsurface climate through additional sun exposure at the ground surface (USFWS 2011, 2018).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Covered Activities involving excavation can fragment previously connected subsurface voids, disrupting the movement of individual NKINs or the flow of air, moisture, and nutrients used by these species. Temporary edge effects are possible when karst voids adjacent to excavated areas are open to the surface climate, thereby changing the temperature and moisture regime of the adjacent voids for an unknown distance (USFWS 2011, 2018). Edge effects would likely be temporary and cease once excavated areas were backfilled and no longer directly exposed to the surface.
3. COLLISION—Equipment or rubble may collide with and kill or wound an individual NKIN, if an individual is present in a void during excavation of the surrounding karst matrix (USFWS 2011, 2018).
4. HERBICIDES—Direct toxicity of applied herbicides to individual NKIN or their prey is possible (USFWS 2011, 2018).
5. NOISE AND ACTIVITY DISTURBANCE—No published information suggests that NKIN are disturbed by noise or human activity.
6. PREDATOR/PREY CHANGES—Vegetation and soil disturbances associated with the Covered Activities can facilitate the invasion or proliferation of red imported fire ants, which the USFWS (2011, 2018) identifies as a threat to endangered karst fauna via predation or competition.

Surrogate Test

1. CAUSAL LINK—Take that may arise from habitat loss and degradation, habitat fragmentation and edge effects, collisions with equipment, direct toxicity from legally applied herbicides, and altered prey communities are all related to aspects of the Covered Activities that modify NKIN habitats directly in the subsurface or indirectly at the surface.
2. COUNT OF INDIVIDUALS NOT PRACTICAL—It is impractical, and perhaps impossible, to establish the number and/or specific identity of the individuals of any particular listed species likely to be taken by the Covered Activities. The difficulties in making these determinations are related to the inaccessible nature of the habitat, the cryptic nature of the individuals themselves, and uncertainties about the basic taxonomic identity of several species of karst fauna.
3. CLEAR STANDARD FOR EXCEEDANCE—Acres of Direct and Indirect Habitat Modification can be precisely measured during and after conduct of the Covered Activity and compared to authorized limits.

Habitat Delineation

- Suitable Habitat for each Covered Species in this group is the area of Karst Zone 1 or 2 that occurs within the range of that species, as defined by the boundaries of the Karst Fauna Regions in which it is known to occur (if applicable) or other delineation of its known range (see SWCA 2018).
- Suitable Habitat excludes areas of karst matrix previously subject to excavation and backfill.

Optional Avoidance Measures

- Avoid Covered Activities in Suitable Habitat.

Presence/Absence Surveys

- Phase 1 Karst Feature Surveys (REQUIRED) – Will follow protocol recommendations in USFWS (2015), or may be revised in the future, for the identification of karst features that may contain karst invertebrate habitat (i.e., generally, steps 1 through 3) to areas of Suitable Habitat (i.e., Karst Zones 1 or 2).
  - Karst features that may contain karst invertebrate habitat can be addressed in the HCP with an assumption of occupancy without further investigation (Assumed Occupied Karst Feature – use the "Occupied Habitat with Demonstrated Occupancy" Enrollment Scenario) OR proceed to Phase 2.
- Phase 2 Feature Investigations (OPTIONAL) – Will follow protocol recommendations in USFWS (2015), or may be revised in the future, for additional investigations of karst features to either remove the feature from consideration (i.e., upon excavation, the feature does not contain karst invertebrate habitat; step 4) or conduct karst invertebrate surveys to determine actual presence or likely absence of individual Covered Species (step 5).
  - For each Covered Species detected within the karst feature, the feature becomes an "Occupied Karst Feature" – use the "Occupied Habitat with Demonstrated Occupancy" Enrollment Scenario.
  - For any Covered Species not detected within the karst feature, the feature is treated as if it were Suitable Habitat (i.e., general areas of Karst Zone 1 or 2).
- The limit of an Occupied Karst Feature or Assumed Occupied Karst Feature is the area within 345 feet of the feature entrance or (if known) the feature footprint. As a General Minimization Measure, LCRA TSC agreed to avoid disturbances within 50 feet of a feature entrance or footprint.
- For the purposes of applying the mitigation matrix below, Occupied Habitat is the area associated with an Occupied Karst Feature or Assumed Occupied Karst Feature.
- Given the potential for encountering voids largely undetectable from the surface, "Unoccupied Habitat" does not apply to this group of Covered Species.

Specific Minimization Measures

- Apply and monitor erosion and sediment control best management practices before, during, and after construction to prevent sediment from flowing into Occupied Habitat (i.e., Occupied Karst Features or Assumed Occupied Karst Features).
- Schedule grading and earthmoving operations to expose the smallest practical area for the shortest possible time.
- Implement a materials management plan to address the safe handling, storage, treatment, and/or disposal of materials brought into Suitable or Occupied Habitat.
- Avoid application of pesticides and herbicides within Suitable or Occupied Habitat.

Existing Impacts

- Existing Impacts are areas with prior subsurface disturbance (i.e., surface grading; previously excavated areas are not Suitable Habitat) or the addition of impervious cover (i.e., any land use or prior disturbance for which the USFWS would typically consider as creating an indirect habitat modification on these species in the context of an incidental take assessment).

Direct Habitat Modification

- Direct Habitat Modification is subsurface disturbance within Suitable Habitat or Occupied Habitat.

Special Cases

- Covered Activities performed within 50 feet of an Occupied Feature or Assumed Occupied Feature, applicable only to features allowed to be "completely taken" by participation in another existing programmatic HCP.
- Covered Activities involving New Construction and affecting certain conservation lands under certain conditions, as described in Chapter 6.6.7.

Indirect Habitat Modification

- Indirect Habitat Modification is surface disturbance, limited to the removal of woody canopy (i.e., tree or shrub cover) within areas of Suitable Habitat or Occupied Habitat not subject to Direct Habitat Modification.

Sources: G. Veni & Associates (1992); SWCA 2018; USFWS (1994, 2009a, 2009b, 2011, 2015, 2018); Veni and Martinez (2007)

Enrollment Scenario	Standard Mitigation Ratios	Mitigation Factors		
		Existing Impact	Relaxed Restrictions	Post-Enrollment Mitigation
Suitable Habitat or Unoccupied Habitat	**Direct: 0.25:1** **Indirect: 0.1:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Occupied Habitat with Known or Assumed Occupancy	**Direct: 10:1** **Indirect: 1:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%
Special Cases	**Direct: 20:1** **Indirect: 2:1**	Standard Mitigation Ratios minus 50%	Standard Mitigation Ratio plus 100%	Standard Mitigation Ratio plus 25%

LCRA TSC-responsible Conservation Priorities and Crediting

LCRA TSC will prioritize conservation actions in the order listed in Chapter 6.5.2 of the HCP, with expectations for crediting of such actions consistent with the discussion in Chapter 6.5.1 of the HCP. LCRA TSC will first prioritize mitigation opportunities that contribute to the creation of a karst fauna area, subject to the availability of practicable mitigation opportunities, and if not practicable, then other opportunities may be evaluated. Mitigation for impacts to Suitable Habitat (i.e., general Karst Zone 1 or 2) can be satisfied with the protection and management of undeveloped acres over Karst Zone 1 or 2. No demonstration of occupancy is needed. One acre of protection and management = 1 credit. Mitigation for impacts within Occupied Habitat that is not otherwise stacked with mitigation fees paid to a regional HCP will to extent practicable be the protection and management of land that is within 1,200 feet of a known Occupied Karst Feature (1,200 feet is approximately the diameter of a 100-acre circle, the recommended size of a high-quality karst fauna area) or that otherwise contributes to the creation or expansion of a karst fauna area.

Note on Standard Mitigation Ratios

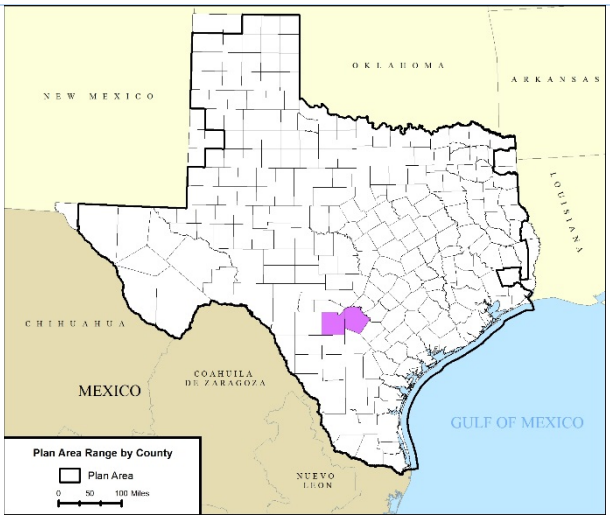
Standard Mitigation Ratios are roughly consistent with the participation fees charged by the Williamson County Regional HCP and the Southern Edwards Plateau HCP, both approved by the USFWS and address similar types of habitat modifications (i.e., modifications to general Karst Zone habitat and modifications to areas adjacent to features known to be occupied by listed karst invertebrates). For instance, the Williamson County Regional HCP charges $100/acre of disturbance to Karst Zone habitat and the Southern Edwards Plateau HCP charges $1,000/acre of disturbance to Karst Zone habitat. Similarly, the Williamson County Regional HCP charges $10,000/acre of disturbance within the zone between 50 and 345 feet of an occupied karst feature and the Southern Edwards Plateau HCP charges $40,000/acre of disturbance within the zone between 345 and 750 feet of an occupied karst feature. Based on these two examples, the mean fee for disturbances to general Karst Zones is $550/acre and the mean fee for disturbances at the outer zone of an occupied karst feature is $25,000. The average per-acre rural land value for Burnet, Williamson, and Medina Counties (i.e., those where take authorized under this HCP is most likely to occur) is $5,000 (see Appendix H of the HCP). Therefore, a mitigation ratio that would generate an obligation similar to the mean fees of the existing programmatic HCPs is approximately 0.1 : 1 for Suitable Habitat with Assumed Occupancy (i.e., the $500/acre mean fee is approximately 10% of the average per-acre rural land value) and approximately 5 : 1 for the outer zone of Occupied Habitat (i.e., the $25,000/acre mean fee is approximately 5× the average per-acre rural land value). Using a similar comparison, the proposed 20 : 1 Standard Mitigation Ratio for Special Cases is generally equivalent to $100,000/acre of disturbance.

Southern Karst Invertebrates (SKIN)

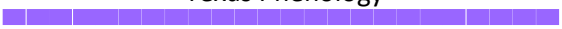
Government Canyon Bat Cave spider (*Tayshaneta microps*), Helotes mold beetle (*Batrisodes venyivi*), Madla's Cave meshweaver (*Cicurina madla*), *Rhadine exilis* (no common name), *Rhadine infernalis* (no common name)

Ecology

- Very small, blind, cryptic group that live underground in karst voids
- Thought to be predatory on microarthropods, but some may scavenge cave cricket eggs
- Rhadine beetles are known to cruise across the floor and walls of void passages, whereas most of the other species are typically found under rocks or other cover objects
- Surface communities provide important nutrient inputs and moderate the physical environment karst habitat



Texas Phenology



Potential Habitat

SKIN occur in caves, other karst voids, and mesocavernous spaces in limestone karst formations with stable temperatures and high humidity. The following acres of potential habitat for the SKIN group are approximated by the area of Karst Zones 1 and 2 located within Medina County, Texas. See SWCA (2018) for species-specific habitat estimates based on known range.

- Potential Habitat in Plan Area: 20,162 acres in Medina County
- Potential Habitat in Range: 138,640 acres

Population

No population estimates are available for any of these species.

Potential Effects of the Covered Activities

1. HABITAT LOSS AND DEGRADATION—Covered Activities involving excavation can result in the permanent loss of habitable karst voids. Clearing trees from ROW can degrade karst habitat by altering the amount or composition of nutrient inputs to the subsurface environment or altering the subsurface climate through additional sun exposure at the ground surface (USFWS 2011).
2. HABITAT FRAGMENTATION AND EDGE EFFECTS—Covered Activities involving excavation can fragment previously connected subsurface voids, disrupting the movement of individual SKINs or the flow of air, moisture, and nutrients used by these species. Temporary edge effects are possible when karst voids adjacent to excavated areas are open to the surface climate, thereby changing the temperature and moisture regime of the adjacent voids for an unknown distance (USFWS 2011). Edge effects would likely be temporary and cease once excavated areas were backfilled and no longer directly exposed to the surface.
3. COLLISION—Equipment or rubble may collide with and kill or wound an individual SKIN, if an individual is present in a void during excavation of the surrounding karst matrix (USFWS 2011)
4. HERBICIDES—Direct toxicity of applied herbicides to individual SKIN or their prey is possible (USFWS 2011).
5. NOISE AND ACTIVITY DISTURBANCE—No published information suggests that SKIN are disturbed by noise or human activity.
6. PREDATOR/PREY CHANGES—Vegetation and soil disturbances associated with the Covered Activities can facilitate the invasion or proliferation of red imported fire ants, which USFWS (2011) identifies as a threat to endangered karst fauna via predation or competition.

Surrogate Test

1. CAUSAL LINK—Take that may arise from habitat loss and degradation, habitat fragmentation and edge effects, collisions with equipment, direct toxicity from legally applied herbicides, and altered prey communities are all related to aspects of the Covered Activities that modify NKIN habitats directly in the subsurface or indirectly at the surface.
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- Suitable Habitat excludes areas of karst matrix previously subject to excavation and backfill.
- Suitable Habitat for the purpose of this HCP is limited to Medina County.

Optional Avoidance Measures

- Avoid Covered Activities in Suitable Habitat.

Presence/Absence Surveys

- Phase 1 Karst Feature Surveys (REQUIRED) – Will follow protocol recommendations in USFWS (2015), or may be revised in the future, for the identification of karst features that may contain karst invertebrate habitat (i.e., generally, steps 1 through 3) to areas of Suitable Habitat (i.e., Karst Zones 1 or 2).
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