Interim Core Map Documentation for the Comal Springs Riffle Beetle

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Documentation and analysis supplemented by U.S. Environmental Protection Agency's (EPA) Office of Pesticide Programs[1]

Species Summary

The Comal Springs riffle beetle (*Heterelmis comalensis*; Entity ID #453) is an endangered aquatic invertebrate. This species inhabits gravel and cobble-dominated substrates with aquatic vegetation and submerged wood present within or around spring orifices at Comal Springs and San Marcos Springs in Texas. They have asynchronous generations, likely due to consistent water quality at occupied springs. The Comal Springs riffle beetle is a detritivore. There is a designated critical habitat for this species. Additional information is provided in **Appendix 1**.

Description of Core Map

The core map for the Warm Springs riffle beetle is based on critical habitat. All known occurrences of this species fall within the critical habitat. EPA did not find evidence that any key areas for this species exist outside of the designated critical habitat. **Figure 1** depicts the interim core map for the Comal Springs riffle beetle (green areas on map). The core map represents approximately 54 acres.

The Comal Springs riffle beetle occurs in gravel substrates and surface riffles of two springs: Comal Springs and San Marcos Spring. Beetles are most often found within or around spring orifices, even at shallow water depths. Typical water depth in occupied habitat is 2-10 cm (1-4 in), but the beetle has been found in slightly deeper areas within the spring runs and around the spring upwellings at the impoundments. Landcover categories within the core map area are included in **Table 1.** Landcover is predominantly open water, evergreen forest, and open space developed. Open water is generally consistent with the habitat of this species.

The core map developed for the Comal Springs riffle beetle is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the Comal Springs riffle beetle. This core map incorporates information developed by the U.S. Fish and Wildlife Service (FWS) and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate expert feedback from FWS. This interim core map has a "limited" best professional judgment classification because it consists of the species' critical habitat without additions or subtractions. However, EPA limited the core map only to designated critical habitat based on interpretation of FWS documentation. This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.

[1] CBD sent EPA a draft map for this species before EPA released its mapping process document and example documentation. EPA agrees with CBD's core map and used it as the basis for the core map for this species. EPA supplemented the documentation and supporting analysis for consistency with recent documentation for other maps.

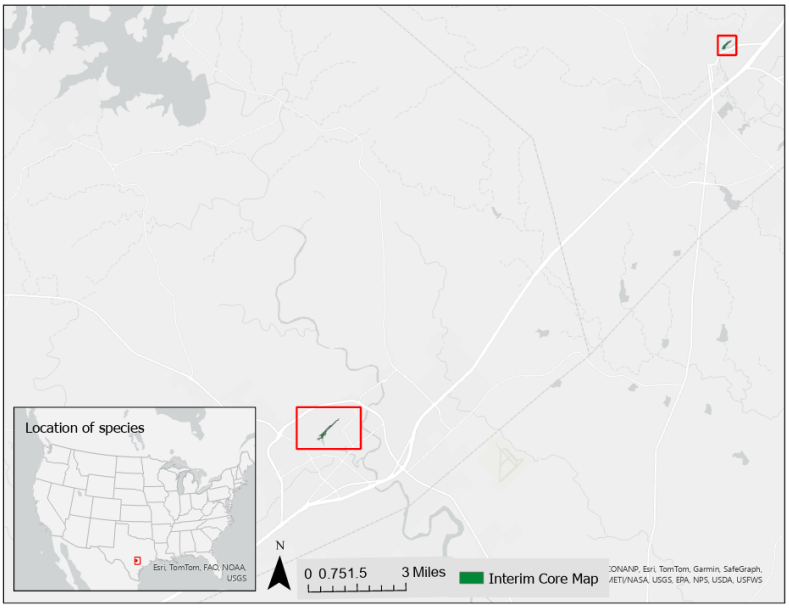

Figure 1. Interim core map for the Comal Springs riffle beetle. The total acreage of the interim core map is approximately 54 acres. Critical habitat is outlined in red on the map.

Table 1. Percentage of Interim Core Map Represented by NLCD Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Class/Value	% Area	Total area for landcover type
Forestry	Deciduous Forest (41)	1%	35%
Forestry	Evergreen Forest (42)	34%	35%
Forestry	Mixed Forest (43)	0%	35%
Agriculture	Pasture/Hay (81)	0%	0%
Agriculture	Cultivated Crops (82)	0%	0%
Mosquito adulticide, residential	Open space, developed (21)	12%	14%
Mosquito adulticide, residential	Developed, Low intensity (22)	1%	14%
Mosquito adulticide, residential	Developed, Medium intensity (23)	1%	14%
Mosquito adulticide, residential	Developed, High intensity (24)	0%	14%
Invasive species control	Woody Wetlands (90)	7%	51%
Invasive species control	Emergent Herbaceous Wetlands (95)	0%	51%
Invasive species control	Open water (11)	42%	51%
Invasive species control	Grassland/herbaceous (71)	0%	51%
Invasive species control	Scrub/shrub (52)	2%	51%
Invasive species control	Barren land (rock/sand/clay; 31)	0%	51%
Total Acres	Interim Core Map Acres	54 acres	

Evaluation of Known Location Information

There are four datasets with known location information for this species:

- Descriptions of locations provided by FWS;
- Occurrence locations included in iNaturalist;
- Occurrence locations included in the Globa Biodiversity Information Facility (GBIF); and
- Occurrence locations included in NatureServe.

EPA evaluated these sets of data to inform or support the core map. FWS' 2024 Species Status Assessment (SSA), Recovery Plan (2024), and most recent 5-year review (2024) contain information about where the species resides. Occurrences in iNaturalist and GBIF were not inconsistent with the interim core map given the resolution of the data. NatureServe included no occurrence locations for this species. **Appendix 1** includes more information on the available known location information.

Approach Used to Create Core Map

The developer compiled available information for the Comal Springs riffle beetle from FWS, as well as observation information available from various publicly available sources (including iNaturalist, GBIF, and NatureServe). The information compiled for the Comal Springs riffle beetle is included in **Appendix 1**. Influential information that impacted the development of the core map included descriptions of known locations by FWS and description of designated critical habitat by FWS.

The developer used the compiled information to identify the core map type. EPA compared known location data to the critical habitat and found that these known locations are consistent with the species critical habitat given the precision of the occurrence data. Based on the narrow critical habitat that includes all occurrence data identified by FWS, the developer selected the critical habitat to use as the species core map.

Discussion of Approaches and Data that were Considered but not Included in Core Map

Approaches other than those described in this document were not explored for further refinement/development of this interim core map.

Appendix 1. Information Compiled for Species

1. **Recent FWS Documents**
   - 2007 Critical Habitat Designation
   - 2013 Revised Critical Habitat
   - 2024 Comal Springs riffle beetle 5-year review
   - 2024 Draft Recovery Plan for the Southern Edwards Aquifer Springs and Associated Aquatic Ecosystems, Second Revision
   - 2024 Species Biological Report for Southern Edwards Aquifer Springs and Associated Aquatic Ecosystems

2. **Background information on Species**
   - **Status:** Federally listed as endangered in 1997
   - **Taxonomy**: Aquatic Invertebrate
   - **Resiliency**
     - "To maintain population resiliency, these species rely upon (1) adequate water quantity, (2) adequate water quality, (3) intact undisturbed surface ecosystems, and (4) control of invasive competitors and predators. When each of these physical and biological needs is present and functioning, resilient populations are expected." (Species Status Assessment 2024, 84)
     - "A severe drought or water contamination event could eliminate many or all the existing populations (Bowles et al. 2003 p. 380). Having a high number of individuals at a site provides no protection against extinction due to stochastic events. Dispersal beyond their extant range is unlikely, given the isolated nature of the spring headwater system dynamics and aquifer hydraulic connectivity that limit movement of individuals." (5-year review 2024, 13)
     - "Even with the most effective management and recovery plans in place, the species remains vulnerable to devastating stochastic events such as floods or droughts that could eliminate the species." (5-year review 2024, 13)
   - **Redundancy**
     "Comal Springs riffle beetles have two genetically distinct populations…. It is susceptible to significant impacts from disturbances, including those potentially leading to a loss of redundancy, that would be influenced by changes in water quality and quantity in the aquifer." (Species Status Assessment 2024, 84)
   - **Representation**
     This species is a narrow endemic reliant on the spring systems of the southern Edwards Aquifer, reducing its ability to adapt to both near-term and long-term changes in their physical (e.g., climate and habitat structure, etc.) and biological (e.g., competitors, pathogens, and predators, etc.) environments. (Species Status Assessment 2024, 84)

   - **Habitat Description**
     - "Comal Springs riffle beetles inhabit gravel and cobble-dominated substrates with aquatic vegetation and submerged wood present at Comal Springs and San Marcos Springs. They are best captured within or around spring orifices, even at shallow water depths. Comal Springs riffle beetles, being ectothermic, exhibit a stenothermal adaption,

preferring temperatures between 22.5-25.5°C (72.5-78°F). They avoid low concentrations of carbon dioxide and prefer dark spaces." (5-year review 2024, 9)
    - "Not confined to spring openings, the Comal Springs riffle beetle is equally found in deeper habitats where diffuse springflows are present." (5-year review 2024, 8)

- **Relevant Life History Information:**
    - "Female adult Comal Springs riffle beetles reproduce multiple times annually with up to 121 larvae produced in their lifetime." (5-year review 2024, 5)
    - "Egg development and incubation occur for 21-25 days until hatching, which is longer than other riffle beetle species (e.g., 5-15 days). There is no evidence of diapause (i.e., period when development is delayed during unfavorable environmental conditions) during the incubation period either in captivity or in the wild….Larvae undergo six molts for a total of seven instars, reaching the final instar at 12 weeks." (5-year review 2024, 5)
    - "Pupation occurs 38 weeks (8.8 months) post-hatching, with more than half of that duration spent in the 7th instar. Pupae for this species are capable of eclosing both underwater and right below the waterline possibly due to trapped air in their pupal case." (5-year review 2024, 6)
    - "Adults in captivity have been reported to live up to a year with an average generation time of two years, although further research is needed." (5-year review 2024, 6)

- **Ecology**
    - "Comal Springs riffle beetles are detritivores, feeding on organic matter sourced from terrestrial coarse and particulate materials scraped off substrates of microbial origin, including fungi and bacteria, as well as periphyton. This feeding behavior remains consistent irrespective of the canopy cover" (5-year review 2024, 4).
    - "Similar to the adults, Comal Springs riffle beetle larvae feed on allochthonous material and acquire nutrients from associated microbial communities, particularly bacteria" (5-year review 2024, 5).

- **Taxonomy**
    - FWS Category: aquatic invertebrate
    - **"**Although the Comal Springs riffle beetle is a genetically distinct species, the species is most closely related to but divergent from H. glabra; a species capable of flight associated with rivers and streams." (5-year review 2024, 7)

- **Essential Physical Biological Features (PBFs) for Designated Critical Habitat**
    - **"**Critical habitat includes a total of 22 ha (54 ac) of surface habitat between two units were designated without additional subsurface designation because this species is restricted to surface waters (78 FR 63107)"
        - High-quality water with no or minimal pollutant levels of soaps, detergents, heavy metals, pesticides, fertilizer nutrients, petroleum hydrocarbons, and semi volatile compounds such as industrial cleaning agents; and
        - Hydrologic regimes similar to the historical pattern of the specific sites, with continuous surface flow from the spring sites and in the subterranean aquifer.
            - Spring system water temperatures that range from approximately 20-24°C (68-75°F); and
            - Food supply that includes, but is not limited to, detritus (decomposed materials), leaf litter, living plant material, algae, fungi, bacteria, other

microorganisms, and decaying roots. (Species Biological Report 2024, 38)

- **Relevant Pesticide Use Sites**
  - "Although water quality in the Edwards Aquifer is generally good, several studies have detected contaminants in groundwater from the southern segment including nitrates, herbicides, pesticides, and polycyclic aromatic hydrocarbons, among many others" (5-year review 2024, 19)
  - A primary biological factor for the continued existence and recovery of the riffle beetle is: "High-quality water with no or minimal pollutant levels of soaps, detergents, heavy metals, pesticides, fertilizer nutrients, petroleum hydrocarbons, and semi volatile compounds such as industrial cleaning agents." (Species Biological Report 2024, 38)

- **Threats**
  - "The Comal Springs riffle beetle occurs in a limited range at a small number of localities with little or no ability to disperse between or beyond these localities. These characteristics make them susceptible to local extirpation and extinction." (5-year review 2024, 10)
  - "The areas inhabited by individuals of the species can be protected through localized conservation measures (e.g., intact riparian zones, springflow protection measures); however, the groundwater that provides water quality and quantity for the species can originate a significant distance from these habitats, and efforts that protect or conserve groundwater may be variable in their success and implementation. Even with the most effective management and recovery plans in place, the species remains vulnerable to devastating stochastic events such as floods or droughts that could eliminate the species." (5-year review 2024, 10)

- **Relevant Recovery Criteria and Actions (Source: 2024 Draft Recovery Plan)**
  - Downlisting criteria include:
    1. All populations of each species, in all management units where the species is present, maintain sufficient resiliency for 18 consecutive years.
       Sufficient resiliency will be achieved when:
       a. Populations do not trend toward a decline and do return to the cumulative mean after short-term fluctuations;
       b. Populations do not fluctuate below the cumulative mean of non-drought years (defined as the mean of previous years that Comal or San Marcos springs did not decrease below 100 cubic feet per second) by more than 10% in a given year;
       c. Populations do not decline from the cumulative mean of non-drought years more than 25% during drought years when Comal or San Marcos springs decreases below 100 cubic feet per second; and
       d. Populations do not decline from the cumulative mean of non-drought years more than 50% during a repeat of the drought of record (defined here as a three-year period when aquifer recharge was at its lowest recorded level of 397,800 acre-feet total for 1954-1956).
    2. Habitat is restored and maintained within each management unit in the areas described below (see the SBR for additional information on habitat within each

management unit; FWS 2024a, Section 1.0). The habitat restoration should achieve a level that supports resilient populations as described in Downlisting Criterion 1. This initiative should include restoration of terrestrial riparian areas aimed at minimizing runoff into adjacent aquatic habitat for the benefit of all species, while also providing suitable habitat and food resources for the Comal Springs dryopid beetle, Peck's cave amphipod, and Comal Springs riffle beetle. The habitat restoration may occur with existing hydromorphological modifications. However, if there are any additional hydromorphological modifications, they should support a more natural ecosystem condition (e.g., impoundment removal, dechannelization, natural substrate) instead of leading to a more unnatural ecosystem. While it is expected that habitat may change during droughts and floods (e.g., siltation during low flows, loss of substrate or vegetation), the habitat management plan described in Downlisting Criterion 3 should restore habitat in the locations described here. After completion, the habitat restoration should be maintained for at least 18 years.

3. There is a habitat management plan that is fully implemented and focuses on habitat restoration and reducing habitat degradation for all waters and lands associated with management units to ensure that habitat continues to sustain resilient populations of each species. The habitat management plan should address how habitat will be managed when the needs of different listed species conflict, along with management of threats to habitat, including recreation, runoff, drought, floods, and harmful non-native species. The habitat management plan will be fully implemented in all management units for the species for at least 18 years.
4. The daily average discharge during the 18-year period in the Comal River exceeds 6.4 m3/s (225 cfs) including the drought of record, and the minimum daily average flow is not less than 0.9 m3/s (30 cfs). In the San Marcos River, the daily average discharge during the 18-year period exceeds 140 cfs (4 m3/s) including the drought of record, and the minimum daily average flow is not less than 1.3 m3/s (45 cfs). The duration of minimum daily average flows in both rivers must not exceed six months and is followed by three months of 2.3 m3/s (80 cfs) or greater to ensure adequate habitat and water quality. Achievement of this criterion will be measured using continuous monitoring data from streamflow gages at Comal and San Marcos springs (USGS 08168710 and 08170000) for a minimum of 18 years.
5. Water quality consistently meets or exceeds established EPA numeric criteria for protection of aquatic life throughout the areas where the species are present (EPA 2022, unpaginated). Water temperature in surface habitat does not exceed 25°C (77°F) near springs (areas within spring runs, Spring Lake, the main spring outlets at Sessom, Landa Lake, Spring Island, Panther Canyon well, Hueco Springs, and Fern Bank Springs), other surface habitat does not exceed this temperature at least 50% of the days per year at the substrate, and downstream surface habitat at the substrate does not exceed 27°C (81°F). Conductivity is 560-650 microsiemens per centimeter in the San Marcos Management Unit and 560-610 microsiemens per centimeter in the Comal Management Unit during conditions that do not contain surface runoff from rainfall. Turbidity is generally less than 1.0 in spring water and habitat. Measurements should only be considered during baseflow conditions that do not contain surface runoff. Areas of very shallow habitat during drought conditions should not be considered for this criterion. This criterion will be achieved when these standards are met throughout the species habitat within each management unit, as described in Criterion 2, above, during quarterly sampling for

18 years. Research may also be needed to evaluate species-specific groundwater quality needs if there is a concern that the EPA numeric criteria for aquatic life may not adequately address water quality needs.

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

- De-listing criteria include:
  1. All populations maintain resiliency for 45 consecutive years and are expected to maintain resiliency in the future. Populations will be considered resilient when they meet the definition described in Downlisting Criterion 1 above.
  2. Habitat can sustain resilient populations and is restored as described above in Downlisting Criterion 2, maintained for at least 45 years, and anticipated to remain restored in perpetuity due to the actions of the habitat management plan described in Downlisting Criterion 3.
  3. Future habitat degradation is prevented through a habitat management plan as described above in Downlisting Criterion 3. The habitat management plan will be fully implemented for at least 45 years and anticipated to continue in perpetuity.
  4. The flows in Downlisting Criterion 4 are achieved for 45 years. Flows are expected to continue in perpetuity through actions of a fully implemented water management plan.
  5. Groundwater quality in Downlisting Criterion 5 is achieved for 45 years and there is no indication that water quality is degrading over time, as determined by increasing trends in nutrients, conductivity, or contaminants.
  6. Captive populations continue to be maintained as described in Downlisting Criterion 6. This will continue until the five years of post-delisting monitoring is completed.

3. Description of Species Range

- The current geographic range is 7,456,520 acres and encompasses part of San Antonio, New Braunfels, and San Marcos, Texas, and extends west almost to Del Rio, Texas.
- **Figure A1-1** depicts the current FWS species range map (last updated 05/06/2021).

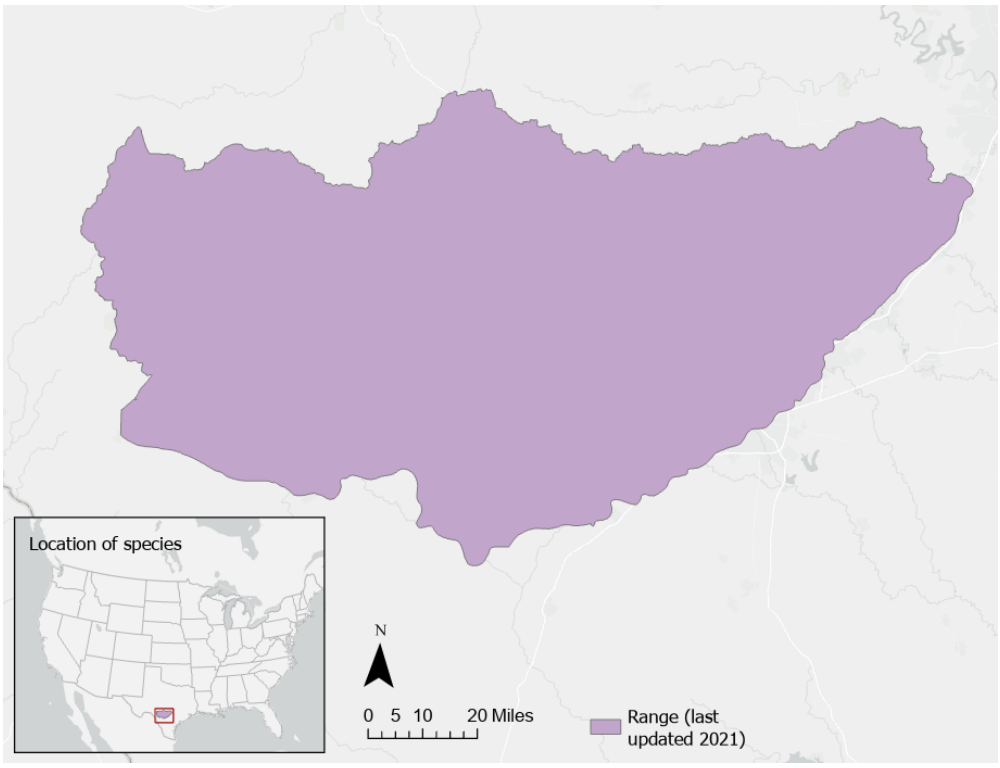

Figure A1-1. Map of the Comal Springs riffle beetle range.

4. Critical Habitat

- The Comal Springs riffle beetle critical habitat designation was revised in 2013, reducing it to 54 acres (22 hectares) (Service 2013, 78 FR 63100-63127).
- The revised designated critical habitat units include Comal Springs (38 ac; 15 ha) and San Marcos Springs (16 ac; 6 ha) (Service 2013, 78 FR 63100-63127, 10).
- **Figure A1-2** depicts the current critical habitat.

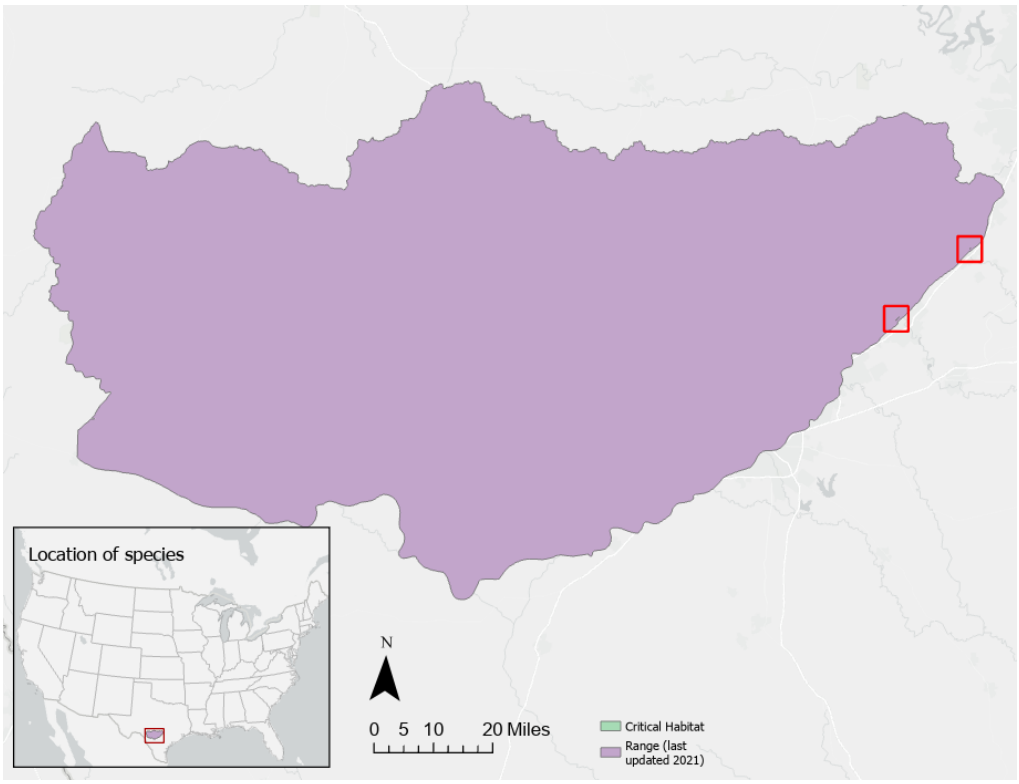

Figure A1-2. FWS critical habitat of Comal Springs riffle beetle outlined in red. Range also included for reference.

5. **Known Locations**
   - **Occurrences Described in FWS Documents**
     - The riffle beetle is known from Comal and San Marcos Springs.
     - Figure A1-3 depicts the areas in the Comal ecosystem that maintain the primary constituent elements that were identified in the rule designating critical habitat (78 FR 63100). The relevant areas in the Comal ecosystem mentioned in the Critical Habitat designation (78 FR 63100) are spring runs 1 through 3, western shoreline, and spring island (circled in red on Figure A1-3). (Recovery Plan 2024, 18)
     - Figure A1-4 depicts the areas in the San Marcos ecosystem that maintain the primary constituent elements identified in the rule designating critical habitat (78 FR 63100). The relevant area is the Hotel area (circled in red on Figure A1-4). (Recovery Plan 2024, 18)

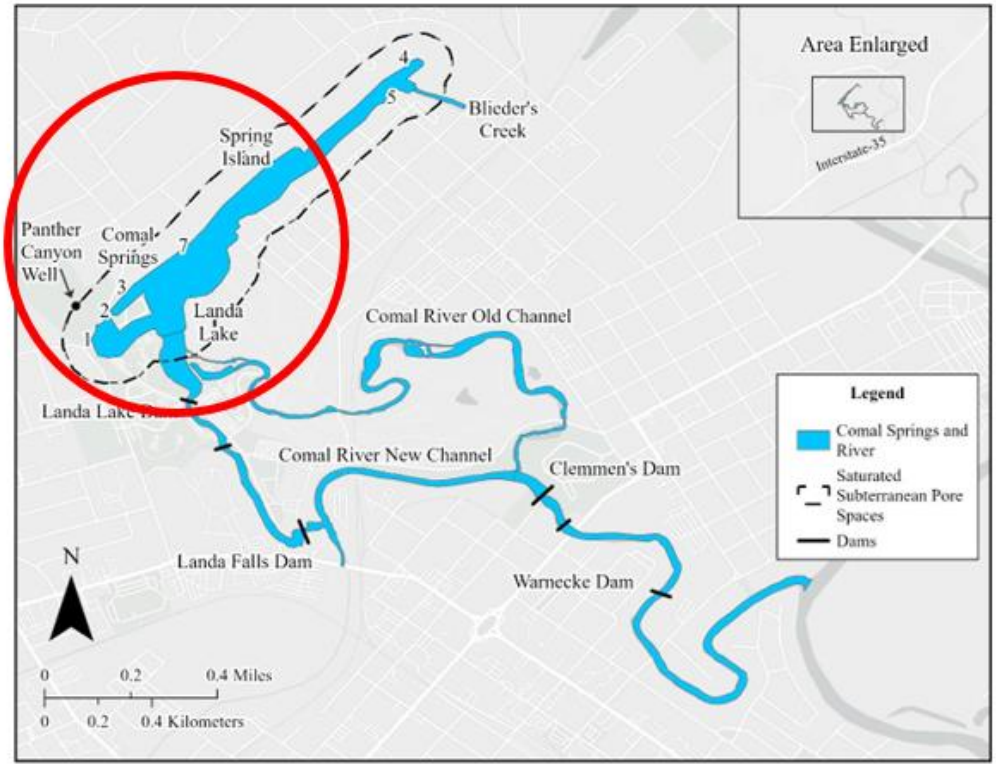

Figure 2. Map of the Comal Ecosystem Management Unit showing the Comal Springs ecosystem, the Comal River, and designated critical habitat surrounding Landa Lake in Comal County, Texas. Numbers on map indicate spring run locations referenced in this Recovery Plan.

Figure A1-3. Known locations of the Comal Springs riffle beetle. Reproduced from FWS Recovery Plan (2024).

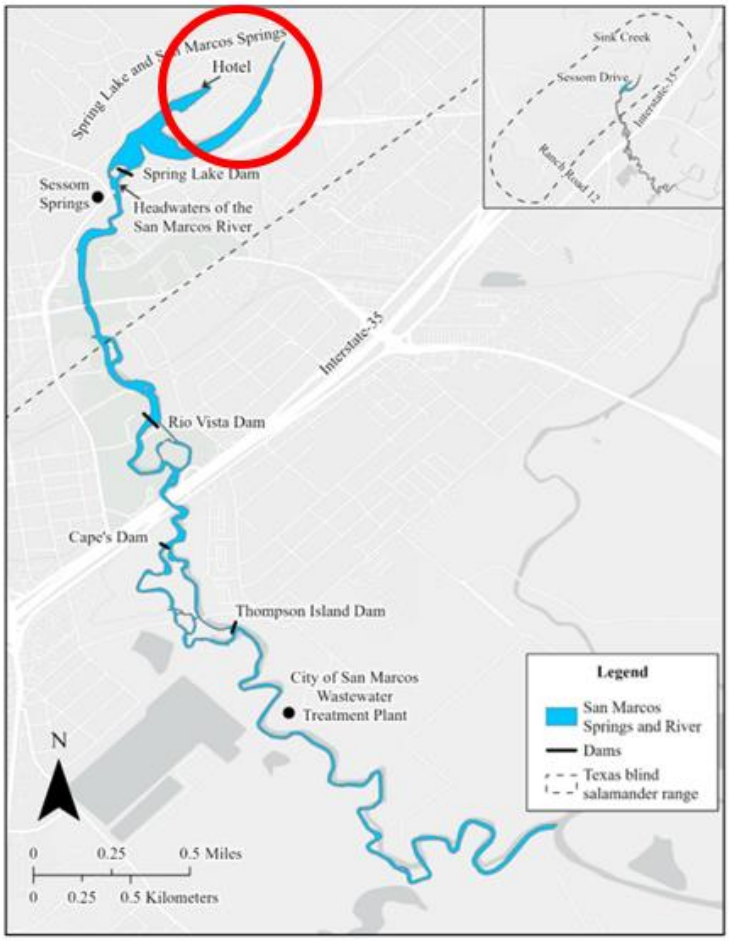

Figure 3. Map of the San Marcos Ecosystem Management Unit. The dotted outline encompasses subsurface habitat including private caves and wells that intersect the Edwards Aquifer in the San Marcos area.

Figure A1-4. Known locations of the Comal Springs riffle beetle. Reproduced from FWS Recovery Plan (2024).

- **Occurrences in iNaturalist**
  - Searched on March 28, 2025.
  - https://www.inaturalist.org/observations?subview=map&taxon_id=221273
  - iNaturalist includes six research grade observations available from 2009-2024.
  - Figure A1-5 depicts the locations of these observations.
  - Due to the coarse resolution of these data, many observations are mapped outside of the designated critical habitat. Therefore, it is unclear if these observations are in the core map area or not.

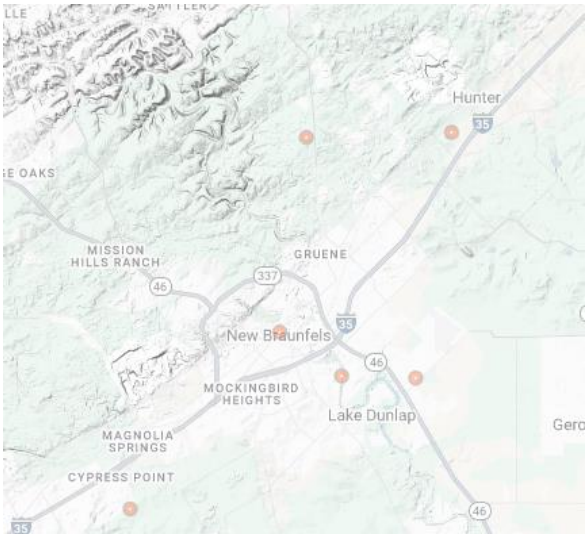

Figure A1-5. Occurrences available in iNaturalist.

- **Occurrences in GBIF**
  - Searched on March 28, 2025.
  - There were 6 "human observations" available for this species, all of which were included in iNaturalist.
  - There were 24 "preserved specimens" available for this species with coordinates, 14 of which are from 2016 to present. The remaining 10 records are from 1988 or earlier.
  - https://www.gbif.org/occurrence/search?has_coordinate=true&has_geospatial_issue=false&taxon_key=1033532
  - Figure A1-6 depicts the locations of "preserved specimen" observations post 1988.

Figure A1-6. Occurrences available in GBIF.

- **Occurrences in NatureServe**
    - Searched on March 28, 2025
    - https://explorer.natureserve.org/pro/Welcome
    - There were no observations recorded.

Collectively, the occurrence data from iNaturalist, GBIF, and NatureServe do not support expanding the core map beyond the designated critical habitat.