13. SOUTHERN SIERRA FOOTHILLS VERNAL POOL REGION

All three shrimp species occur within the Southern Sierra Foothills Vernal Pool Region.

13.1. Vernal Pool Habitat

Approximately 207,969 acres of vernal pool grassland existed within, or immediately adjacent to, this region when the Recovery Plan was published in 2005 (see **Figure 13.1**, **Table 13.1**; Witham et al. 2013). Approximately 190,042 acres remained as of 2012, with 17,927 (8.6% of 2005 total) lost between 2005 and 2012 (Witham et al. 2014). No new areas of vernal pool habitat were identified in 2012, either newly created habitat or habitat that had been missed in the 2005 aerial imagery. Of the habitat lost, 257 acres (1.4%) were to urbanization and 17,670 acres (98.6%) were to agricultural conversion (57.7% to orchards, 39.3% to bare plowed agricultural land, and 1.6% to other agricultural uses) (Witham et al. 2014).

By 2018, approximately 182,973 acres remained, with a total of 25,878 acres lost between 2005 and 2018 (see **Table 13.1**; Witham 2021). However, a total of 361 acres of new vernal pool grassland were identified in the 2018 aerial imagery: 61 acres on new mitigation banks created since 2012 and 260 acres that were either not present or not visible on both the 2005 and 2012 aerial imagery. Of the habitat lost since 2005, 299 acres (1.1%) were to urbanization and 25,878 acres (98.8%) were to agricultural conversions (75.6% to orchards, 21.7% to bare plowed agricultural land, and 1.5% to other agricultural uses) (see **Table 13.2**; Witham 2021). Note that many patches of vernal pool grassland that had been converted to bare plowed land in 2012 had been fully converted to agricultural use, mainly orchards, by 2018. There were also conversions of 12.6 acres of vernal pool grasslands to managed wetlands with hydrology that no longer supported vernal pool species.

This vernal pool region had the second highest amount of extant vernal pool habitat in 2005 of all the vernal pool regions, and this is still true today (Witham 2021). This region also exhibited the highest amount of vernal pool losses in the Central Valley, although proportional to total habitat it was second to the Northwestern Sacramento Valley Vernal Pool Region (Witham 2021). The vast majority of vernal pool losses within this region have been to agricultural conversions (98.8%), which is unsurprising given that the region is composed primarily of agricultural lands and very few cities or towns. The outskirts of Fresno and Merced extend into the vernal pool region, but there is not much vernal pool grassland directly adjacent to these urban areas with the exception of the area around the University of California Merced campus. Many of the losses in this region are likely due to land conversions to orchards that should be regulated by the Clean Water Act but that are proceeding illegally without the necessary 404 permit from the Corps (Witham et al. 2014; Witham 2021). This region had more than twice the losses to orchards compared to the next highest region, the neighboring San Joaquin Valley Vernal Pool Region. This region is also unique in the size of its Core Areas. There are 15 core areas designated by the Recovery Plan in this region totaling 820,569 acres in size, with the Madera and Merced being the two largest core areas. This is by far the largest acreage of core areas in a single vernal pool region, having three times the acreage of the next largest vernal pool region (Central Coast), and representing 33% of all land designated as core areas throughout all of California and southern Oregon.

As of 2018, roughly 32,737 acres of vernal pool grassland was estimated to be protected in this region, or immediately adjacent to it (see **Figure 13.1**, **Figure 13.2**, **Table 13.1**; Witham 2021; Vollmar et al. 2017). This represents 18% of the currently remaining vernal pool grassland in the region and 16% of the vernal pool grassland that existed in 2005, the Recovery Plan's baseline. This vernal pool region has the second lowest percentage of protected vernal pool habitat in the Central Valley, though the actual amount is still greater than the amount protected in the Northwestern Sacramento Valley and Solano-Colusa regions due to the Southern Sierra Foothills' large amount of extant habitat (Witham 2021).

13.2. Species Occurrences

13.2.1. Vernal Pool Fairy Shrimp

There are 307 occurrence records of the vernal pool fairy shrimp documented within, or immediately adjacent to, the Southern Sierra Foothills Vernal Pool Region in the Diversity Database (see **Figure 13.3**; Diversity Database 2022). There are a wide variety of private and public landowners listed in the Diversity Database for these occurrences, and occurrences on private land in particular are vulnerable to extirpation (Diversity Database 2022). One occurrence is listed as possibly extirpated by the Diversity Database; of the other 306 occurrences, 223 occur within extant vernal pool habitat based on Witham's (2021) mapping efforts, 9 occur within extirpated vernal pool habitat, and 74 are outside of mapped vernal pool habitat.

The protected areas contain, at least partially, 116 of the 307 Diversity Database records (38%) for the vernal pool fairy shrimp in this region. However, this does not mean that 38% of all occurrences of the vernal pool fairy shrimp in this region have been protected, as the Diversity Database is not an appropriate source for determining all known occurrences (individual Diversity Database records are not necessarily equivalent to occurrences, and some known occurrences may not be documented in the Diversity Database). There are 81 of the 307 Diversity Database polygons (26%) that are entirely within the protected areas; the difference between the number of records partially and entirely within the mapped protected areas is likely a reflection of the irregular size and shape of polygons in the Diversity Database, as well as slight discrepancies in the overlap between the two databases.

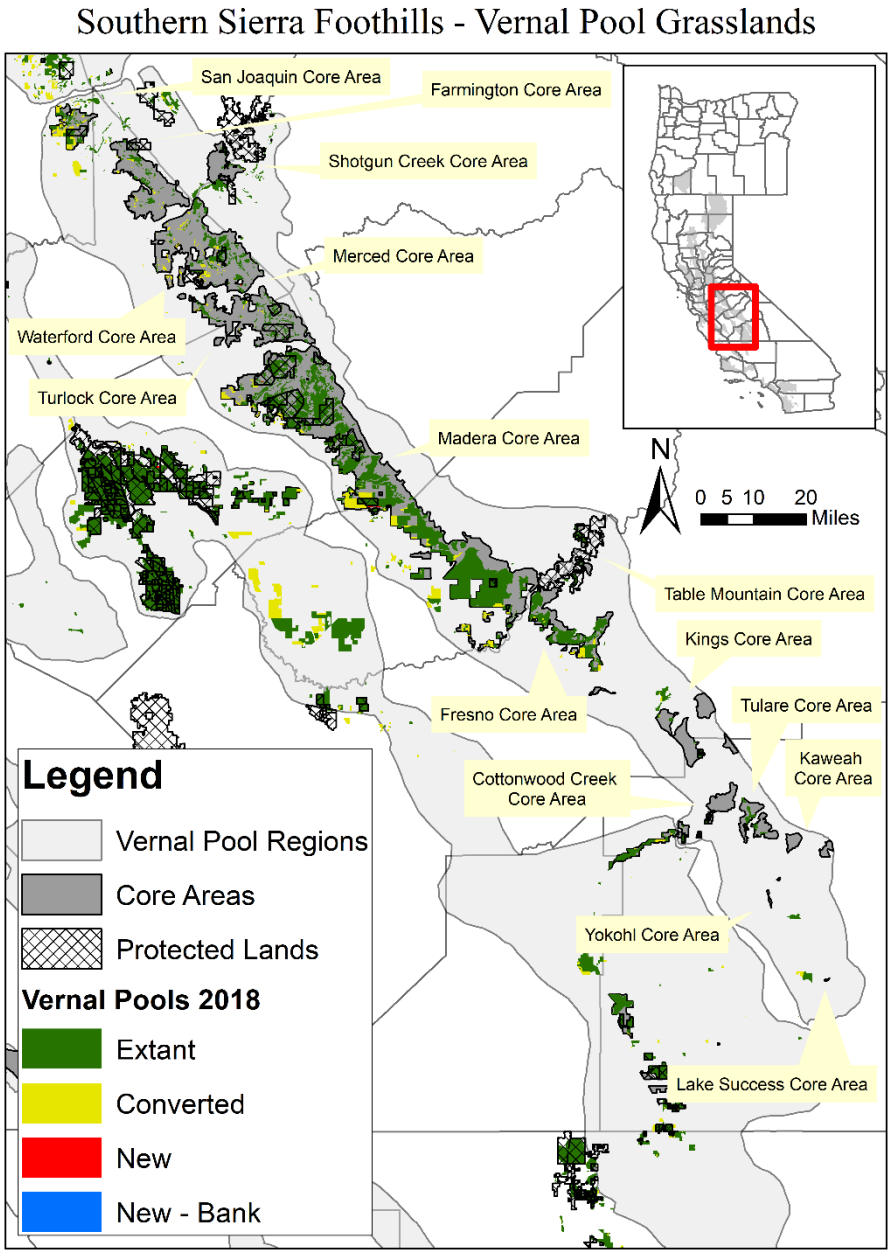

Figure 13.1. Map of vernal pool habitat within the Southern Sierra Foothills Vernal Pool Region mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

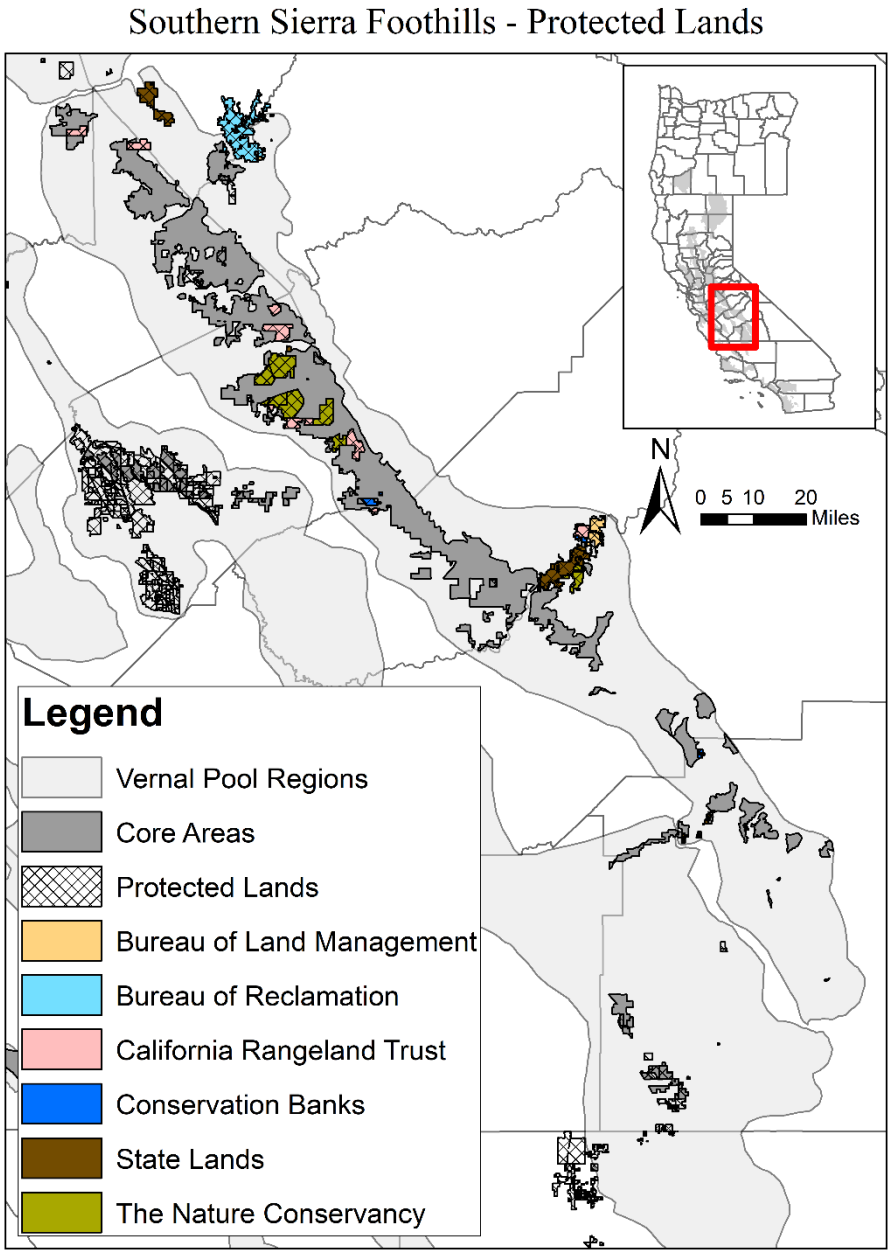

Figure 13.2. Map of protected areas that contain vernal pool grassland habitat and/or vernal pool fairy shrimp within the Southern Sierra Foothills Vernal Pool Region**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. Zoom in for finer resolution.

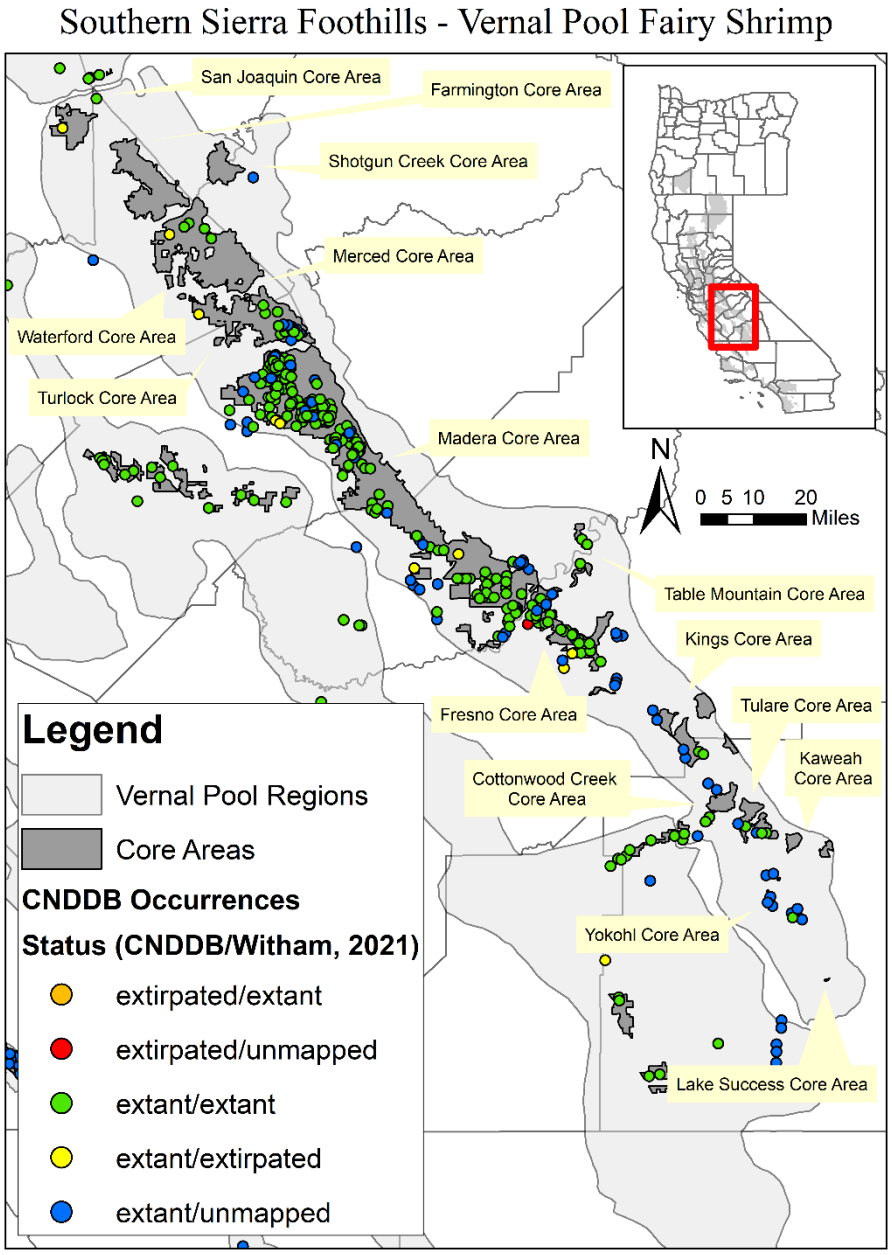

Figure 13.3. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) in the Southern Sierra Foothills Vernal Pool Region. Points may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both Diversity Database occurrence records and Witham's (2021) map of vernal pool habitat. All 15 core areas in the region are displayed, though not all core areas are designated for the vernal pool fairy shrimp.

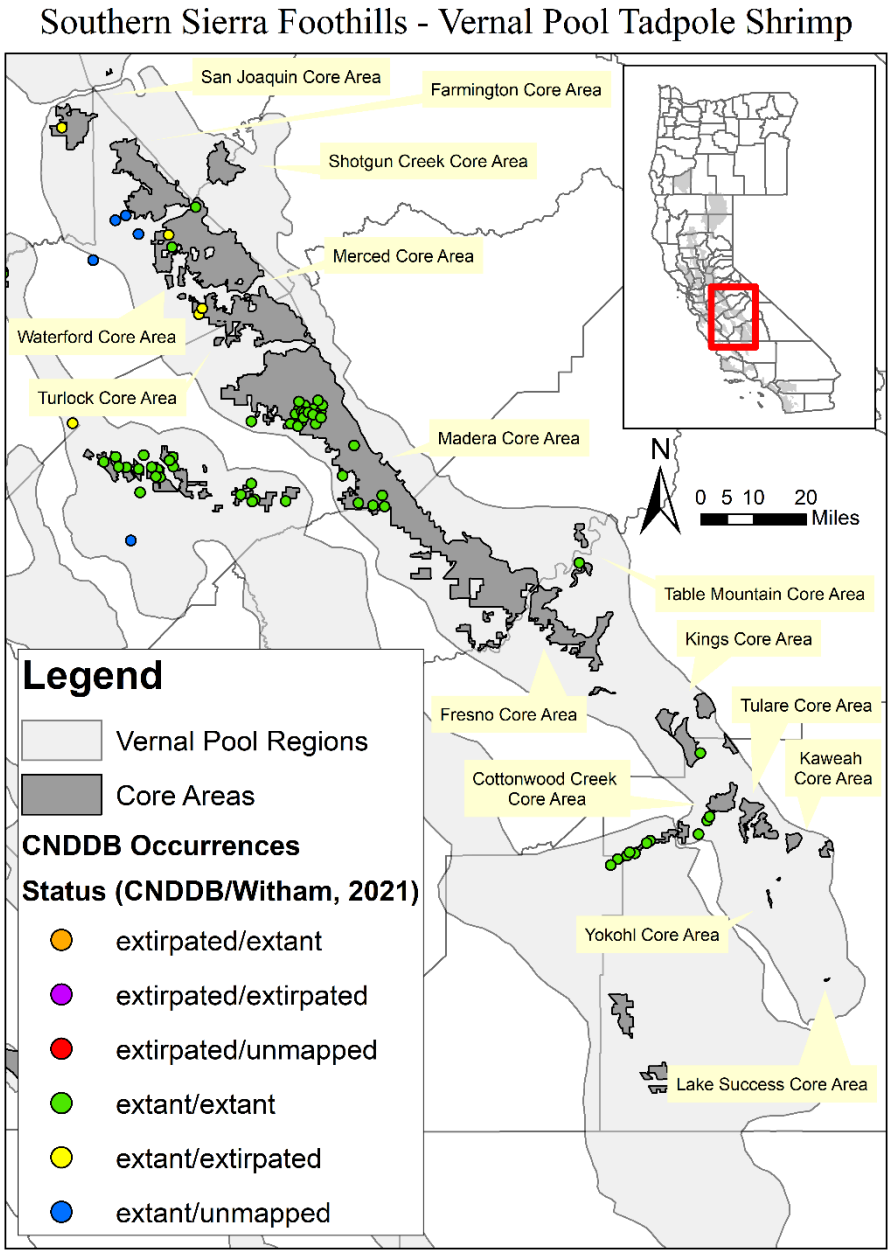

Figure 13.4. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) in the Southern Sierra Foothills Vernal Pool Region. Points may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both Diversity Database occurrence records and Witham's (2021) map of vernal pool habitat. All 15 core areas in the region are displayed, though not all core areas are designated for the vernal pool tadpole shrimp.

Table 13.1. Acreage of vernal pool habitat and habitat converted within the Southern Sierra Foothills Vernal Pool Region mapped by Witham (2021). All habitat labeled as not converted, altered, or new was considered extant. Protected acreage is based on Vollmar et al. (2017).

Core Area	2005 Acres	2018 Acres Total	2018 Acres Extant (% of Total)	2018 Acres Converted – Agriculture (% of Total)	2018 Acres Converted – Urban Development (% of Total)	2018 Acres Protected (% of Total)
Cottonwood Creek	1,049.0	1,049.0	1,045.4 (99.7%)	3.6 (0.3%)	0.0 (0.0%)	934.9 (89.1%)
Fresno	15,786.7	15,786.7	14,462.3 (91.6%)	1,324.4 (8.4%)	0.0 (0.0%)	18.0 (0.1%)
Kings	660.1	716.1	668.2 (93.3%)	47.9 (6.7%)	0.0 (0.0%)	341.5 (47.7%)
Madera	127,812.0	128,166.8	117,938.1 (92.0%)	9,988.2 (7.8%)	240.5 (0.2%)	24,564.0 (19.2%)
Merced	20,417.3	20,535.2	17,292.8 (84.2%)	3,229.8 (15.7%)	0.0 (0.0%)	3,161.1 (15.4%)
San Joaquin	7,259.0	7,259.0	4,229.1 (58.3%)	3,029.9 (41.7%)	0.0 (0.0%)	937.4 (12.9%)
Table Mountain	1,738.3	1,738.3	1,738.3 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	1,460.0 (84.0%)
Tulare	1,584.3	1,584.3	1,584.3 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)
Turlock	6.6	6.6	6.6 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)
Southern Sierra Foothills Vernal Pool Region Total	**207,969.3**	**208,862.4**	**182,972.7 (87.5%)**	**25,878.2 (12.4%)**	**298.8 (0.1%)**	**32,737.1 (15.7%)**

Table 13.2. Acreage of vernal pool habitat losses within the Southern Sierra Foothills Vernal Pool Region between 2005 and 2018 mapped by Witham (2021), broken down by what the land use was converted to. All categories besides urban development and managed wetlands are considered agricultural conversions.

Core Area	Urban, Commercial, & Industrial	Orchards, Vineyards, Eucalyptus	Alfalfa and Irrigated Pasture	Bare Plowed Agricultural Lands	Other Ag (Rice, Row Crops, Dairy, Nurseries)	Agricultural Residential	Managed Wetlands	Total Losses	% Losses Urban Development	% Losses Agricultural Conversions
Cottonwood Creek	0.0	0.0	0.0	3.6	0.0	0.0	0.0	3.6	0.0%	100%
Fresno	0.0	312.2	0.0	876.2	9.9	126.1	0.0	1,324.4	0.0%	100%
Kings	0.0	0.0	0.0	47.9	0.0	0.0	0.0	47.9	0.0%	100%
Madera	240.5	8,030.0	0.0	1,912.0	45.3	0.9	0.0	9,988.2	2.4%	97.6%
Merced	0.0	2,829.4	11.4	331.9	56.7	0.4	12.6	3,229.8	0.0%	99.6%
San Joaquin	0.0	2,257.4	14.4	747.8	10.3	0.0	0.0	3,029.9	0.0%	100%
Table Mountain	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Tulare	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Turlock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Southern Sierra Foothills Vernal Pool Region Total	**298.8**	**19,804.8**	**41.9**	**5,684.4**	**154.9**	**192.2**	**12.6**	**25,878.2**	**1.1%**	**98.8%**

13.2.2. Vernal Pool Tadpole Shrimp

There are 42 occurrence records of the vernal pool tadpole shrimp documented within, or immediately adjacent to, the Southern Sierra Foothills Vernal Pool Region in the Diversity Database (see **Figure 13.4**; Diversity Database 2022). There are a wide variety of private and public landowners listed in the Diversity Database for these occurrences, and occurrences on private land in particular are vulnerable to extirpation (Diversity Database 2022). All are presumed extant by the Diversity Database; 34 occur within extant vernal pool habitat based on Witham's (2021) mapping efforts, 4 occur within extirpated vernal pool habitat, and 4 are outside of mapped vernal pool habitat.

The protected areas contain, at least partially, 21 of the 42 Diversity Database records (50%) for the vernal pool tadpole shrimp in this region. There are 5 of the 42 Diversity Database polygons (12%) that are entirely within the protected areas; the difference between the number of records partially and entirely within the mapped protected areas is likely a reflection of the irregular size and shape of polygons in the Diversity Database, as well as slight discrepancies in the overlap between the two databases.

13.2.3. Conservancy Fairy Shrimp

There are nine occurrence records of the Conservancy fairy shrimp documented within the Southern Sierra Foothills Vernal Pool Region in the Diversity Database (Diversity Database 2022). These occurrences are all considered part of the UC Merced population and are within the Madera Core Area. However, four of these occurrences were first documented in 2016 (after the last 5-year review in 2012) on Roen Ranch and are approximately 10 miles southeast of the previously known occurrences in the UC Merced population (Diversity Database 2022). Due to the proximity to the UC Merced population and the somewhat continuous stretch of vernal pool grasslands between the two locations, the Service will consider the Roen Ranch occurrences to be a southern extension of the UC Merced population unless future evidence suggests that these two locations should be considered separately. All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). See the Madera Core Area section for more details.

13.3. Federal Lands

13.3.1. National Wildlife Refuges

There are no National Wildlife Refuges with known occurrences of the three shrimp species in the Southern Sierra Foothills Vernal Pool Region.

13.3.2. Military Lands

There are no military lands with known occurrences of the three shrimp species in the Southern Sierra Foothills Vernal Pool Region.

13.3.3. Bureau of Land Management

The Bureau of Land Management (BLM) has lands with mapped vernal pool grasslands (Witham 2021) in Madera and Fresno Counties around the San Joaquin River Gorge, Table Mountain, and Kennedy Mountain and in Calaveras and Tuolumne Counties mainly around Table Mountain and New Melones Lake (**Figure 13.2**). Madera and Fresno Counties are within the jurisdiction of the BLM's Bakersfield Field Office; all of these lands are managed under that office's Resource Management Plan from 2014 (BLM 2014). Objectives specific to vernal pool habitat include maintaining the hydrologic regime of vernal pools, delineating the Table Mountain and Kennedy Table areas as areas of ecological importance for protection of vernal pools and vernal pool species (both areas are within the Table Mountain Core Area), avoiding vernal pools by 300 feet during certain project activities, and compensating for any impacts to vernal pool habitat by preserving habitat at a 5:1 ratio and replacing habitat at a 1:1 ratio (BLM 2014). Vernal pools are only known to occur within the 1,059-acre Table Mountain and 60-acre Kennedy Table areas of ecological importance, both of which provide known habitat for the vernal pool fairy shrimp and potential habitat for the vernal pool tadpole shrimp (BLM 2012). The nearest known occurrence of the vernal pool tadpole shrimp is on CDFW's Big Table Mountain Ecological Reserve (Diversity Database 2022).

Calaveras and Tuolumne Counties are within the jurisdiction of the BLM's Mother Lode Field Office; all of these lands are managed under the Sierra Resource Management Plan from 2008 (BLM 2008). The valley grassland and vernal pool conservation strategy within that plan has the objective to sustain and manage the valley grassland and vernal pool ecosystems within the Mother Lode Field Office area to support viable populations of several vernal pool animal species through management of ecosystem processes and associated species and through management of habitat on BLM land (BLM 2008). The plan then contains an extensive list of prioritized goals and avoidance measures, including identifying vernal pool habitat and inventorying vernal pool species occurrences within the Mother Lode Field Office's jurisdiction, protecting the Tuolumne County Table Mountain vernal pools through monitoring and range management, using compatible grazing strategies, and avoiding filling or grading vernal pools during projects (BLM 2008). BLM has seven separate parcels totaling 659 acres around New Melones Lake that overlap with mapped vernal pool grasslands. Four parcels are on or near the Tuolumne County Table Mountain and three are within the Shotgun Creek Core Area, which is not designated for the three shrimp species. Monitoring for vernal pool species has not occurred on any of these parcels (B. Brenneman, BLM, *in litt*. 2022). The nearest known occurrence of the vernal pool fairy shrimp is more than 3 miles to the southeast within the Grand Yosemite Golf and Wetland Preserve (Diversity Database 2022). The nearest known occurrence of the vernal pool tadpole shrimp is 6 miles southwest of the Shotgun Creek Core Area along Highway 108 at the Tuolumne-Stanislaus County border (Diversity Database 2022).

13.3.4. Other Federal Lands

The U.S. Bureau of Reclamation (BOR) manages the New Melones Lake Area in Calaveras and Tuolumne Counties. The New Melones dam was completed in 1979 and is the most recent major project incorporated into the Central Valley Project (BOR 2010). The New Melones Lake Area is approximately 30,000 acres in size (12,500 acres of New Melones Lake and 17,500 acres of surrounding areas). BOR has documented 1,179 acres of annual grassland across this area, as

well as 53 acres of vernal pools on Table Mountain in the southeastern portion of the New Melones Lake Area within the Peoria Wildlife Management Area (BOR 2010). Witham's (2021) mapping effort also identified vernal pool grassland within the Bowie Flat Management Area, a disjunct area to the southwest within the Shotgun Creek Core Area. The New Melones Lake Resource Management Plan includes goals related to protecting vernal pools (BOR 2010), but the three shrimp species have never been documented within this area (Diversity Database 2022). BOR also owns most of the lands surrounding Millerton Lake in Madera and Fresno Counties; this area is managed by the California Department of Parks and Recreation (CDPR).

13.4. Conservation Banks

There are three conservation banks within the Southern Sierra Foothills Vernal Pool Region that provide credits for preserved vernal pools that support the vernal pool fairy shrimp and vernal pool tadpole shrimp: Drayer Ranch Conservation Bank, Great Valley Conservation Bank at Flynn Ranch, and Sand Creek Conservation Bank (see **Figure 13.2**; RIBITS 2021). These banks protect a total of 1,820 acres of land, including 184.29 acres of preserved vernal pools for the two shrimp species (Table 6). The three banks have sold a total of 60.51 acres of preservation credits (33%) for the vernal pool fairy shrimp and vernal pool tadpole shrimp (RIBITS 2021).

A fourth conservation bank, Kennedy Table, also provides credits for protected vernal pools that support only the vernal pool fairy shrimp. This bank protects 600 acres of land, including 57.69 acres of preserved vernal pools for the vernal pool fairy shrimp (Table 6). This bank has sold 11.15 acres of preservation credits (19%) for the vernal pool fairy shrimp (RIBITS 2021).

There are no conservation banks within the Southern Sierra Foothills Vernal Pool Region that provide credits for the Conservancy fairy shrimp.

13.5. Habitat Conservation Plans

There are two regional Habitat Conservation Plans (HCPs) within the Southern Sierra Foothills Vernal Pool Region that include all three shrimp species as covered species. There is one additional regional HCP and one project-level HCP that include just the vernal pool fairy shrimp and vernal pool tadpole shrimp as Covered Species (**Figure 13.5**).

13.5.1. PG&E Multiple Region Operations and Maintenance HCP

See section 2.5.1 for a description of this HCP.

13.5.2. PG&E San Joaquin Valley Operations and Maintenance HCP

See section 9.5.2 for a description of this HCP.

13.5.3. San Joaquin County HCP

See section 6.5.3 for a description of this HCP.

13.5.4. Southern California Edison Cross Valley Transmission Line HCP

The Southern California Edison Cross Valley Transmission Line (a.k.a., Cross Valley Loop) HCP covers the construction and ongoing operations and maintenance activities associated with a 23-mile electrical transmission line in Tulare County (AECOM 2013). The HCP Planning Area encompasses approximately 3,385 acres surrounding the proposed project, which extends north from the Rector Substation outside of the City of Visalia to Avenue 368 and then east to an existing transmission line northeast of the City of Woodlake. This HCP was permitted in 2013 and has a 30-year permit term, and the permittee is Southern California Edison. The HCP's conservation strategy includes avoiding and minimizing impacts to Covered Species to the maximum extent practicable through project design and conservation measures, as well as mitigating for unavoidable impacts. Mitigation may be in the form of purchasing credits at a conservation or mitigation bank, preserving habitat at a Service-approved permittee-responsible mitigation site, restoring and protecting habitat onsite, or any other means acceptable to the Service.

The HCP Planning Area contains a total of 19.46 wetted acres of suitable habitat for the vernal pool fairy shrimp, and the species was detected in 1.90 acres of vernal pools during surveys in 2010-2012 (AECOM 2013). The HCP Planning Area contains a total of 18.60 wetted acres of suitable habitat for the vernal pool tadpole shrimp, although the species was not detected during surveys in 2010-2012 (AECOM 2013). Construction of the new transmission line was anticipated to have direct effects to 0.15 acres suitable of habitat, indirect effects to 4.71 acres of suitable habitat, and temporary effects to 0.16 acres of suitable habitat for the vernal pool fairy shrimp and direct effects to 0.14 acres of suitable habitat, indirect effects to 4.58 acres of suitable habitat, and temporary effects to 0.14 acres of suitable habitat for the vernal pool tadpole shrimp. Ongoing operations and maintenance activities were anticipated to have temporary effects to 0.09 acres and 0.08 acres of suitable habitat for each species, respectively. The HCP had three biological goals specific to the two shrimp species. The first goal was to avoid and minimize impacts to the species during construction of the new transmission line to the maximum extent practicable; construction is complete, and this goal was successfully achieved by implementing all applicable conservation measures from the HCP (Southern California Edison 2021). The second goal was to avoid and minimize impacts to the species during operations and maintenance activities to the maximum extent practicable; this work is ongoing, and to date the goal has been successfully achieved by implementing all applicable conservation measures from the HCP (Southern California Edison 2021). The third goal was to contribute to conservation of the species as mitigation by preserving a minimum of 14.86 acres and 14.40 acres of high quality vernal pools known to be occupied by the vernal pool fairy shrimp and vernal pool tadpole shrimp, respectively. This goal was achieved in fall of 2014 through the purchase of 14.86 acres of vernal pool preservation credits at the Sand Creek and Great Valley Conservation Banks (Southern California Edison 2021).

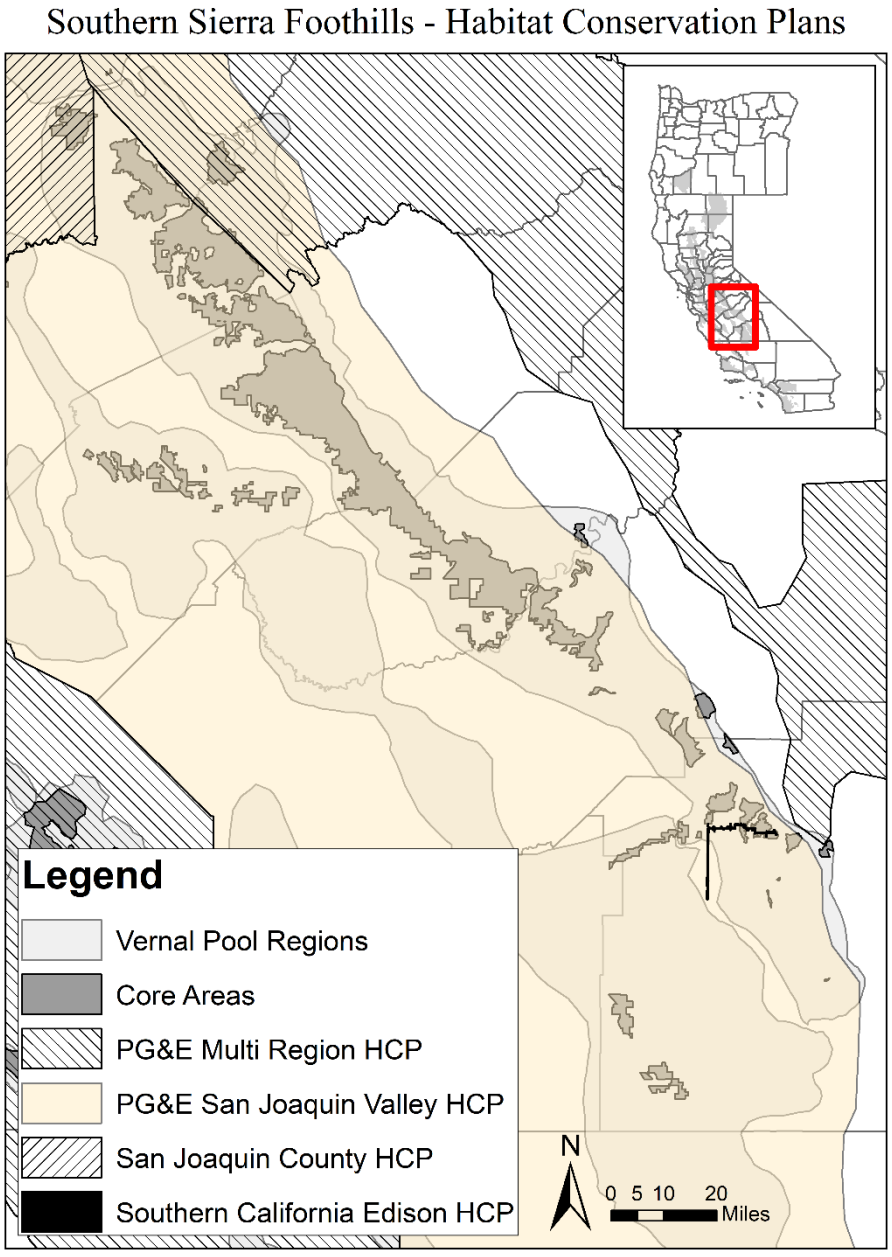

Figure 13.5. Map of the habitat conservation plans (HCPs) within the Southern Sierra Foothills Vernal Pool Region that include the three shrimp species as a Covered Species.

13.6. Other Preserves

The California Department of Fish and Wildlife (CDFW) owns two Ecological Reserves within the Southern Sierra Foothills Vernal Pool Region that contain vernal pool habitat: Big Table Mountain and Stone Corral (**Figure 13.2**). Neither of these preserves have final management plans (Battistoni, *in litt*. 2022).

The approximately 1,000-acre Big Table Mountain Ecological Reserve is a flat-topped volcanic mesa located in Fresno County adjacent to the Millerton Lake State Recreation Area. Approximately 197 acres of vernal pool grassland has been mapped in the southern part of this Ecological Reserve, which is within the Table Mountain Core Area. The vernal pool fairy shrimp and vernal pool tadpole shrimp were first recorded throughout the vernal pool grassland on the Ecological Reserve in 2001 and 1995, respectively (Diversity Database 2022), partly leading to its designation in 2007. The two shrimp species were most recently observed in 2012 (Battistoni, *in litt*. 2022).

The 981-acre Stone Corral Ecological Reserve is located in Tulare County north of Visalia and is entirely composed of vernal pool grasslands (Witham 2021). Vernal pool fairy shrimp were identified in multiple units of the Ecological Reserve in 1993 (which prompted the acquisition of the properties by CDFW) and throughout all units of the Ecological Reserve in 2008 (Diversity Database 2022). Vernal pool tadpole shrimp were identified in the northeastern unit of the Ecological Reserve in 1995 and the central unit in 2001 (Diversity Database 2022). The two shrimp species were most recently documented in 2012 (Battistoni, *in litt*. 2022).

CDFW also holds the 7,548-acre Salt Spring Valley Conservation Easement around the Salt Spring Valley Reservoir in Calaveras County. This site contains approximately 329 acres and 71 acres of vernal pool grassland mapped on the north and south sides of the reservoir, respectively (Witham 2021). The two shrimp species are not known to occur at this site; the nearest occurrence of the vernal pool fairy shrimp is 10 miles west, and the nearest occurrences of the vernal pool tadpole shrimp are 16 miles west and 16 miles south (Diversity Database 2022). CDFW's Merced River Hatchery also slightly overlaps mapped vernal pool grassland habitat (Witham 2021), with the nearest occurrence of the vernal pool fairy shrimp being on the Chance family ranch and the nearest occurrence of the vernal pool tadpole shrimp 10 miles to the south (Diversity Database 2022).

The California Department of Parks and Recreation (CDPR) manages the approximately 11,000-acre Millerton Lake State Recreation Area located on the Madera and Fresno County border around Millerton Lake and the San Joaquin River. Millerton Lake was created in 1944 by the construction of the Friant Dam on the San Joaquin River, and the lake and surrounding lands are owned by the Bureau of Reclamation (BOR). The Recreation Area is adjacent to CDFW's Big Table Mountain Ecological Area, BLM's Table Mountain area of ecological importance, and several preserves owned by the Sierra Foothill Conservancy. Almost all vernal pool habitat in the area is within these adjacent preserved lands, but there are small bits of vernal pool grassland that extend into the Millerton Lake State Recreation Area (Witham 2021). The two shrimp species have not been documented within the Recreation area, but both are known to occur on the Big Table Mountain Ecological Reserve and the vernal pool fairy shrimp occurs just south of Millerton Lake as well (Diversity Database 2022).

In eastern Merced County, there are many preserves associated with or surrounding the UC Merced campus expansion. The Nature Conservancy (TNC) owns one property and holds conservation easements on seven properties in eastern Merced County, totaling 27,889 acres, and California Rangeland Trust (CRT) holds conservation easements on four properties in the area, totaling 7,204 acres. Immediately adjacent to the UC Merced campus are the Cyril Smith Trust property owned by TNC and two preserves with TNC-held conservation easements: the Merced Vernal Pools and Grassland Reserve (formerly the Virginia Smith Trust and the Campus Natural Reserve) owned by the University of California and the Myers Easterly property jointly owned by the University of California and the Virginia Smith Trust. Management of these preserves is guided by the 2008 Management Plan for the UC Merced conservation lands (Airola Environmental Consulting 2008). Farther north of the campus are the Chance and Robinson family ranches, and southeast of the campus are the Carlson, Cunningham, and Nelson family ranches, all of which have conservation easements held by TNC or CRT. Unlike the TNC- or University of California-owned preserves, management of these lands is undertaken by the private landowners in accordance with requirements of the conservation easements, and thus the main management action discussed in the UC Merced Management Plan is easement compliance monitoring (Airola Environmental Consulting 2008). CRT also holds conservation easements on a mitigation site, on the Ichord family ranch adjacent to the UC Merced campus, and on a small portion of the Roen family ranch adjacent to the Nelson family ranch. TNC also holds a conservation easement on part of the Flying M Ranch east of the UC Merced campus. An estimated 20,671 acres of extant vernal pool grassland has been mapped on all of these properties (Witham 2021).

The vernal pool fairy shrimp is known to occur throughout all of the above preserves (Diversity Database 2022). The vernal pool tadpole shrimp is known to occur throughout most of the UC Merced-area preserves and the Nelson family Ranch (Diversity Database 2022). The Conservancy fairy shrimp is known to occur at the southern end of the Merced Vernal Pools and Grassland Reserve and on the adjacent Ichord family ranch (Diversity Database 2022). The species also occurs on adjacent unprotected areas, including unprotected portions of Ichord Ranch, the Flying M Ranch east of the UC Merced campus, and the Roen Ranch to the southeast between the Cunningham and Nelson family ranches (Diversity Database 2022).

TNC also holds a conservation easement over the 3,333-acre Ruth McKenzie Table Mountain Preserve owned by Sierra Foothill Conservancy in Fresno County adjacent to the Big Table Mountain Ecological Reserve and Millerton Lake State Recreation Area. An estimated 408 acres of vernal pool grassland have been mapped on the volcanic mesas within this preserve (Witham 2021). The vernal pool fairy shrimp and vernal pool tadpole shrimp have been documented immediately adjacent on the Big Table Mountain Ecological Reserve, but no occurrence records have been documented within the Table Mountain Preserve in the Diversity Database (Diversity Database 2022).

CRT also holds conservation easements on six properties in the Southern Sierra Foothills Vernal Pool Region outside of the UC Merced area. The 2,235-acre Cook Ranch is owned by the Cook Cattle Company and is located in eastern San Joaquin County. It contains 937 acres of extant vernal pool habitat (Witham 2021); the nearest known occurrence of the vernal pool fairy shrimp is 0.5 miles northeast and the nearest known occurrence of the vernal pool tadpole shrimp in 0.5 miles northwest (Diversity Database 2022). The Orvis family ranch is located on the border of

Calaveras and Stanislaus Counties. It contains 137 acres of extant vernal pool grassland (Witham 2021); the nearest known occurrence of the vernal pool fairy shrimp is 9 miles northwest and the nearest known occurrence of the vernal pool tadpole shrimp is 13 miles south (Diversity Database 2022). The 1,395-acre JCR Ranch and 4,447-acre Richards family ranch are both located in northeastern Merced County, north of the Merced River; they contain 541 acres and 1,151 acres of extant vernal pool grassland, respectively (Witham 2021). JCR Ranch has one occurrence record of the vernal pool fairy shrimp from 2008, representing a cluster of 5 vernal pools, and the Richards family ranch has 11 occurrence records of the vernal pool fairy shrimp from 2001, representing numerous vernal pools on the eastern portion of the property (Diversity Database 2022). The nearest known occurrences of the vernal pool tadpole shrimp are 13 miles west and 13 miles south (Diversity Database 2022). The 542-acre Lazy K Ranch mitigation site is composed of two parcels on the border of Merced and Madera Counties. These parcels contain 445 acres of extant vernal pool habitat and an additional 60 acres of newly created vernal pool grassland for mitigation (Witham 2021). The vernal pool fairy shrimp is known to occur throughout both parcels of Lazy K Ranch and the vernal pool tadpole shrimp is known to occur throughout the larger western parcel of Lazy K Ranch (Diversity Database 2022). The 2,294-acre Van Alen family ranch is located in the Kennedy Table area of Madera County adjacent to BLM land and the Kennedy Table Conservation Bank; it contains 392 acres of extant vernal pool grassland (Witham 2021), and the vernal pool fairy shrimp occurrence on the Kennedy Table Conservation Bank extends slightly onto the Van Alen family ranch as well (Diversity Database 2022). The nearest occurrence of the vernal pool tadpole shrimp is 5 miles south on the Big Table Mountain Ecological Reserve (Diversity Database 2022).

In addition to the many protected areas described here, Vollmar et al. (2017) identified 14 other protected properties within the Southern Sierra Foothills Vernal Pool Region. Five of these sites are private preserves that were protected as mitigation by landowners, likely as part of proposed conservation measures during Section 7 interagency consultations; ownership of these sites includes Caltrans, Merced County Regional Waste Management Authority, a private rancher, and two properties where the owner is unknown. Of the remaining nine sites, three are public land, four have a conservation easement held by the Natural Resources Conservation Service (NRCS), one has a conservation easement held by The Access Fund, and one has a conservation easement held by Central Valley Farmland Trust.

13.7. Vernal Pool Core Areas

There are seven Core Areas within the Southern Sierra Foothills Vernal Pool Region that are designated in the Recovery Plan for the vernal pool fairy shrimp: Cottonwood Creek, Fresno, Madera, Merced, San Joaquin, Table Mountain, and Turlock. There are two additional Core Areas that were not designated for the vernal pool fairy shrimp in the Recovery Plan, but that have known occurrences of the species in the Diversity Database: Kings and Tulare (Diversity Database 2022). For the Tulare Core Area, the vernal pool fairy shrimp was not identified until 2010, which is why this core area was not designated for the vernal pool fairy shrimp in the Recovery Plan. For the Kings Core Area, the Diversity Database occurrences include information about surveys that occurred before 2005, so the core area likely should have been designated for the vernal pool fairy shrimp in the Recovery Plan; however, it is possible that these occurrence records were not uploaded to the Diversity Database until after 2005. One of these nine core areas has met the target of 85% of vernal pool habitat protected based on mapped

habitat (see **Table 13.1**; Vollmar et al. 2017; Witham 2021). As of 2018, two of the nine core areas (Merced and San Joaquin) had lost more than 15% of the baseline level of habitat present in 2005, making the 85% target unattainable without habitat creation or restoration.

There are four Core Areas within the Southern Sierra Foothills Vernal Pool Region that are designated in the Recovery Plan for the vernal pool tadpole shrimp: Cottonwood Creek, Madera, Merced, Table Mountain. There are three additional Core Areas that were not designated for the vernal pool tadpole shrimp in the Recovery Plan, but that have known or nearby occurrences of the species in the Diversity Database: Kings, San Joaquin, and Turlock (Diversity Database 2022). For the Kings and San Joaquin Core Areas, the vernal pool tadpole shrimp was not identified until 2006 and 2011, respectively, which is why these core areas were not designated for the vernal pool tadpole shrimp in the Recovery Plan. The Turlock Core Area was designated for the vernal pool fairy shrimp and not the vernal pool tadpole shrimp. However, neither species is known to occur within the core area; the nearest occurrence of the vernal pool fairy shrimp is more than 3 miles away, while the nearest occurrence of the vernal pool tadpole shrimp is only 1 mile away, so we have decided to discuss this core area further here. None have met the target of vernal pool habitat protected (95% for zone 1 and 85% for zone 2) (see **Table 13.1**; Vollmar et al. 2017; Witham 2021). As of 2018, two of the zone 1 core areas (Madera and Merced) and one of the zone 2 core areas (San Joaquin) had lost more than 5% or 15%, respectively, of the baseline level of habitat present in 2005, making the target unattainable without habitat creation or restoration.

There is one Core Area within the Southern Sierra Foothills Vernal Pool Region that is designated in the Recovery Plan for the Conservancy fairy shrimp: Madera. This core area has not yet met the target of 95% of vernal pool habitat protected, and as of 2018 it had lost 8.0% of the baseline level of habitat that was present in 2005, making the 95% target unattainable without habitat creation or restoration (see **Table 13.1**; Vollmar et al. 2017; Witham 2021).

13.7.1. Cottonwood Creek

This is a zone 2 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp. The core area is located in northwestern Tulare County, is composed of several polygons, and is adjacent to the Tulare Core Area to the east and the Cross Creek Core Area in the San Joaquin Valley Vernal Pool Region to the west.

There were approximately 1,049 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 1,045 acres of vernal pool grassland remaining (see **Figure 13.6**, **Table 13.1**; Witham 2021). The 3.6 acres that has been lost since the Recovery Plan's 2005 baseline were converted to bare plowed agricultural land (**Table 13.2**). Roughly 935 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 89.1% of the 2005 baseline. Stone Corral Ecological Reserve is the only protected area within this core area (**Figure 13.7**).

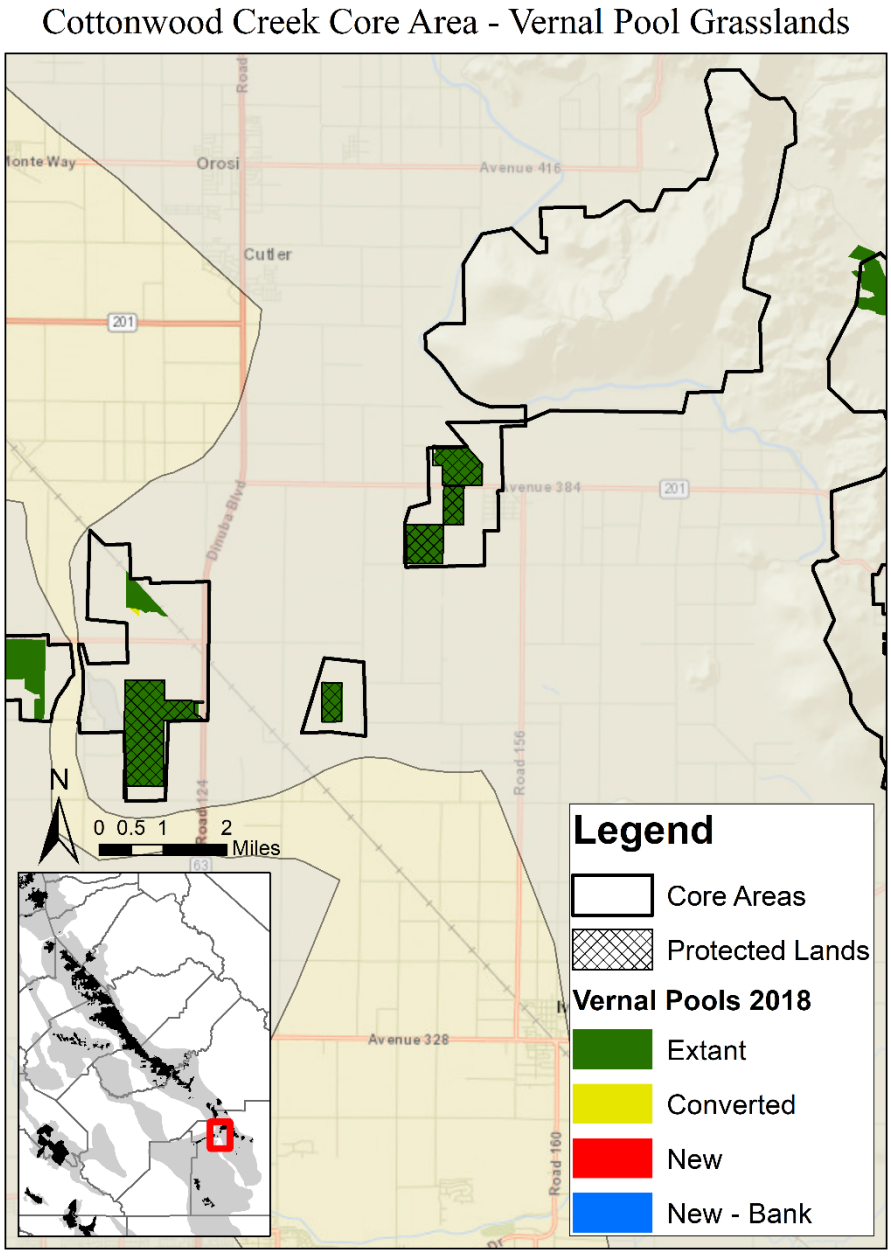

Figure 13.6. Map of vernal pool grassland habitat within the Cottonwood Creek Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

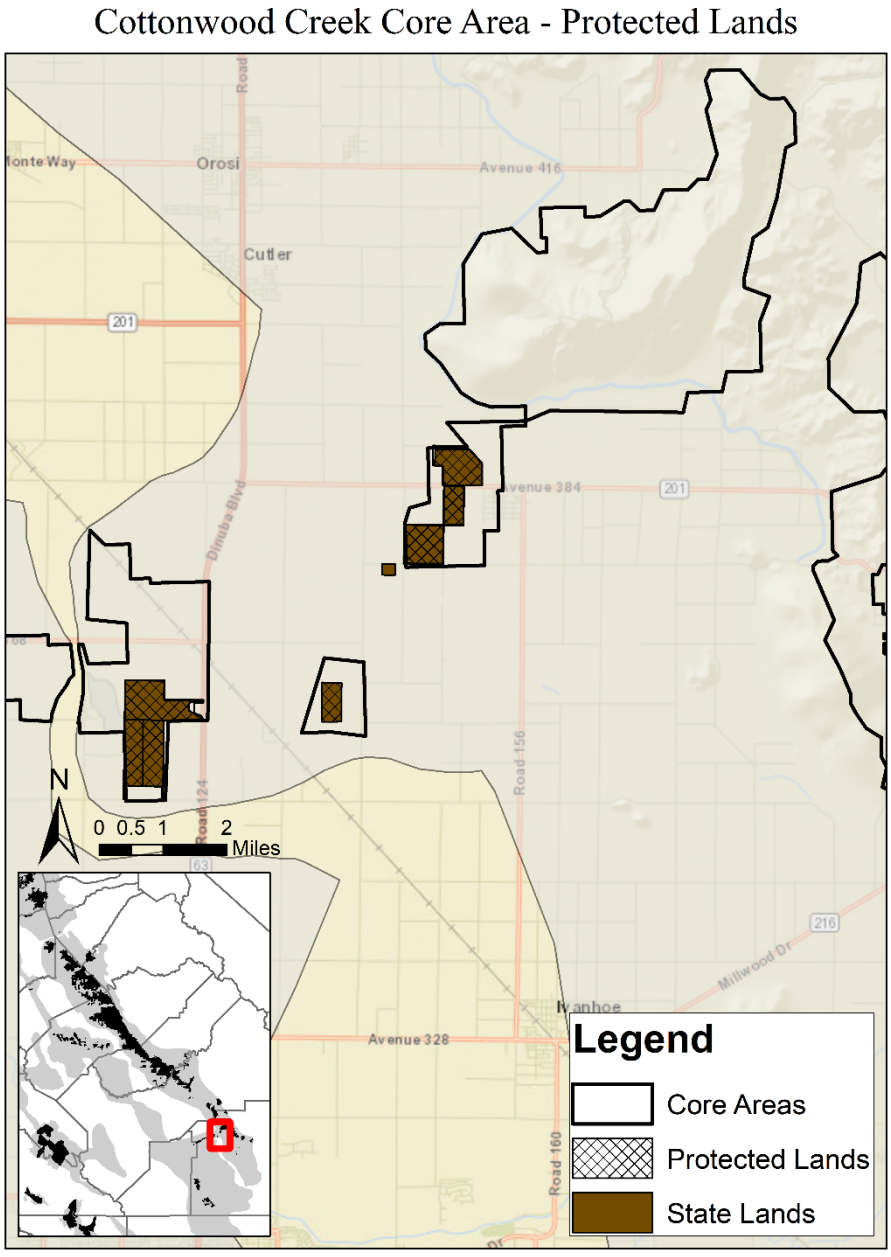

Figure 13.7. Map of protected areas within the Cottonwood Creek Core Area**.** Protected lands are based on Vollmar et al. (2017).

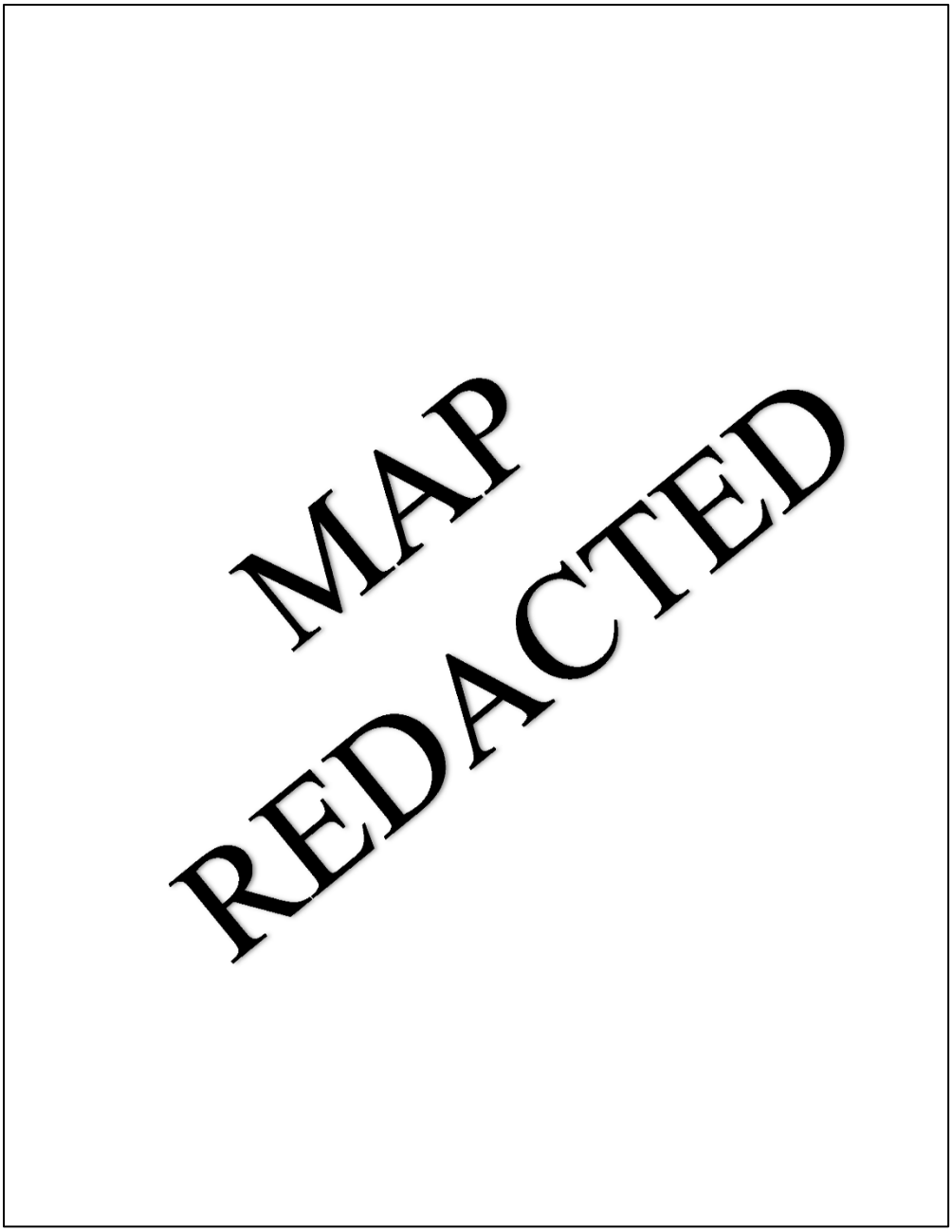

Figure 13.8. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Cottonwood Creek Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

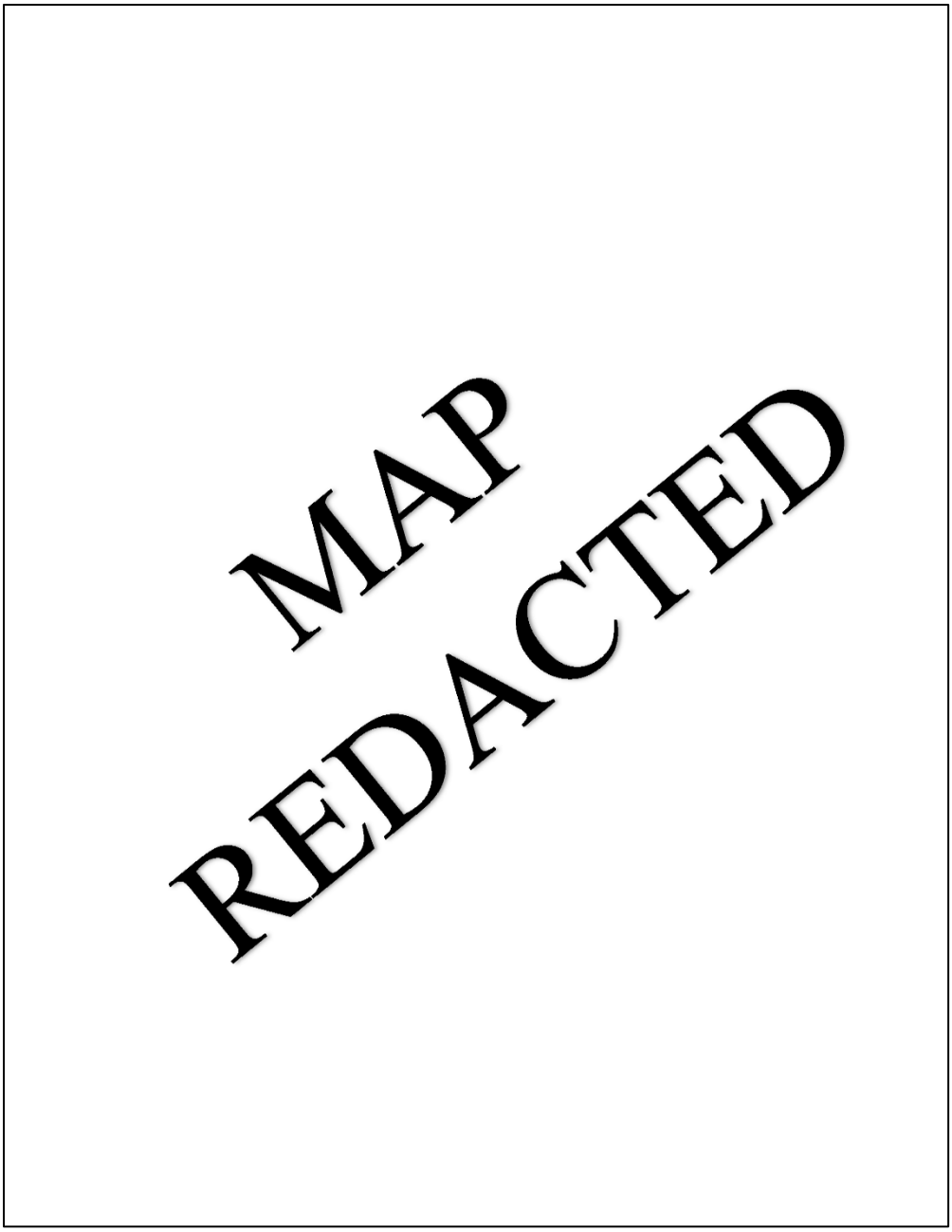

Figure 13.9. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Cottonwood Creek Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.1.1. Vernal Pool Fairy Shrimp Occurrences

There are five Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 13.8**; Diversity Database 2022). As of 2018, four of these occurrences were protected within the Stone Corral Ecological Reserve (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; four are within extant mapped vernal pool grasslands and one is outside of mapped vernal pool grasslands (Witham 2021). Of the five records, two were known at the time of listing in 1994 and three were known at the time the Recovery Plan was published in 2005; these records are located within the northeastern and southwestern units of Stone Corral Ecological Reserve and in private land adjacent to the central unit of the Ecological Reserve. The two newer records are located on adjacent portions of the northeastern and southwestern units of the Ecological Reserve, confirming that the vernal pool fairy shrimp occurs through the entire vernal pool complexes on these units.

13.7.1.2. Vernal Pool Tadpole Shrimp Occurrences

There are three Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 13.9**; Diversity Database 2022). As of 2018, all of these occurrences were protected within the Stone Corral Ecological Reserve (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant mapped vernal pool grasslands (Witham 2021). One occurrence was known at the time of listing in 1994 and two were known at the time the Recovery Plan was published in 2005; these records are located within the northeastern and central units of Stone Corral Ecological Reserve. The newer occurrence was recorded in 2008 and is also within the northeastern unit of the Ecological Reserve (Diversity Database 2022).

13.7.2. Fresno

This is a zone 2 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp. The core area is located along the northwestern edge of the Cities of Fresno and Clovis, with two smaller, disjointed polygons, one located on the southern side of Highway 168 (Sierra Freeway) and the other encompassing the Fresno Canal on either side of North Academy Avenue.

There were approximately 15,787 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 14,462 acres of vernal pool grassland remaining, with 1,324 acres lost since 2005 (see **Figure 13.10**, **Table 13.1**; Witham 2021). All losses were due to agricultural conversion, including conversion to bare plowed agricultural land (876.2 acres, 66.2%), orchards, vineyards, or eucalyptus (312.2 acres, 23.6%), agricultural residences (126.1 acres, 9.5%), and rice, row crops, dairies, or nurseries (9.9 acres, 0.7%) (see **Table 13.2**; Witham 2021). Notably, no vernal pool grasslands were identified within the two disjointed parts of this core area around Highway 165 and the Fresno Canal. The vernal pool fairy shrimp was never recorded in these locations; several vernal pool plant species were recorded there, but they were already considered extirpated by the 1980's (Diversity Database 2022). The only protected areas within this core area are the Millerton Lake State Recreation Area; note that Vollmar et al.'s (2017) mapped boundary of this area does not exactly line up with the boundary of the shapefile that the Service obtained from ArcGIS Online (**Figure**

13.11). Based on Vollmar et al.'s (2017) boundaries, which are slightly larger, roughly 18.0 acres of vernal pool grassland were protected within this core area as of 2017, representing 0.1% of the 2005 baseline.

13.7.2.1. Vernal Pool Fairy Shrimp Occurrences

There are 29 Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 13.12**; Diversity Database 2022). As of 2018, none of these occurrences were protected (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; 25 are within extant mapped vernal pool grasslands (though several of these are partially within extirpated habitat), 1 is entirely within vernal pool grasslands mapped as converted to agriculture, and 3 are outside of mapped vernal pool grasslands (Witham 2021). Of the 29 records, 2 were known at the time of listing in 1994 and 26 were known at the time the Recovery Plan was published in 2005; these records are located throughout the core area. The three newer records are located near the previously known occurrences, though one of the newer records is the occurrence that is presumed extirpated based on Witham's (2021) mapping.

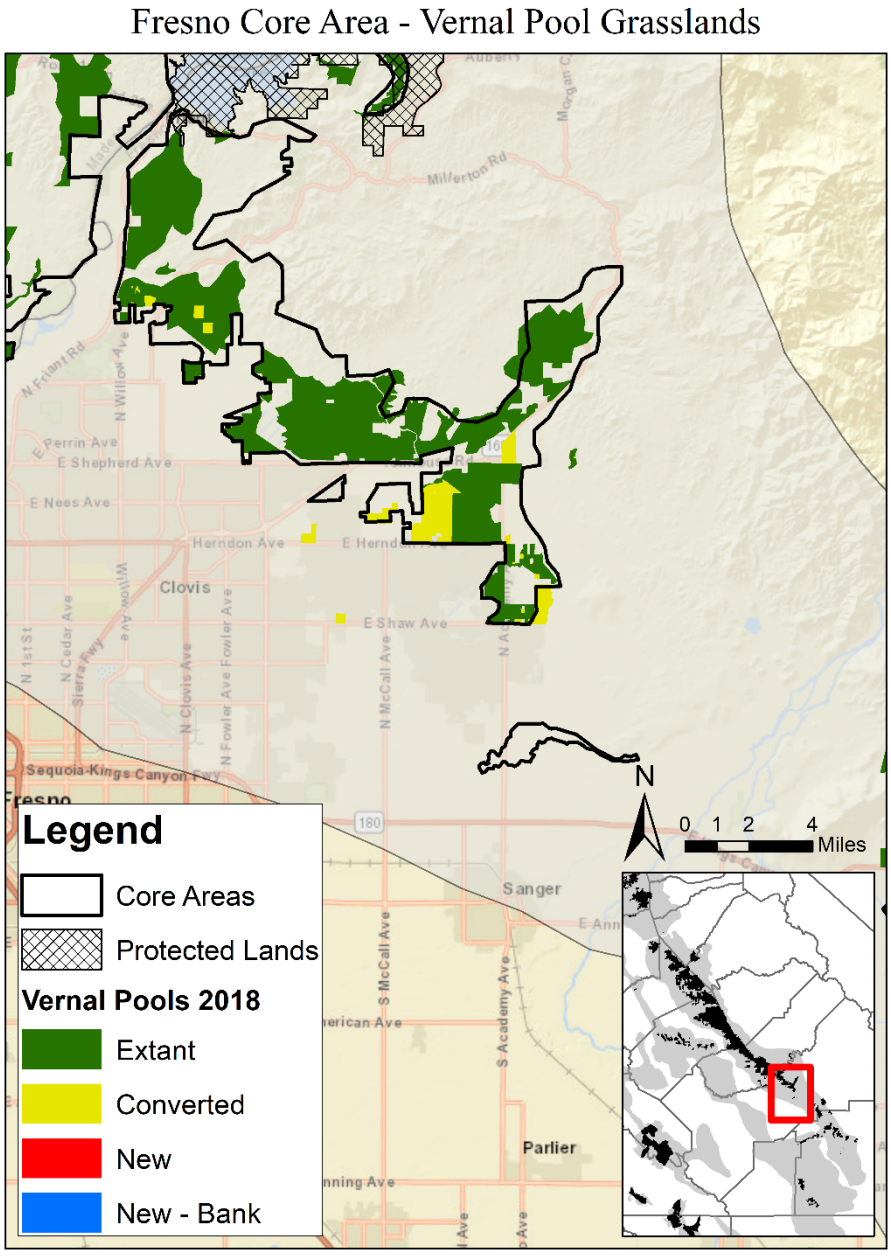

Figure 13.10. Map of vernal pool grassland habitat within the Fresno Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

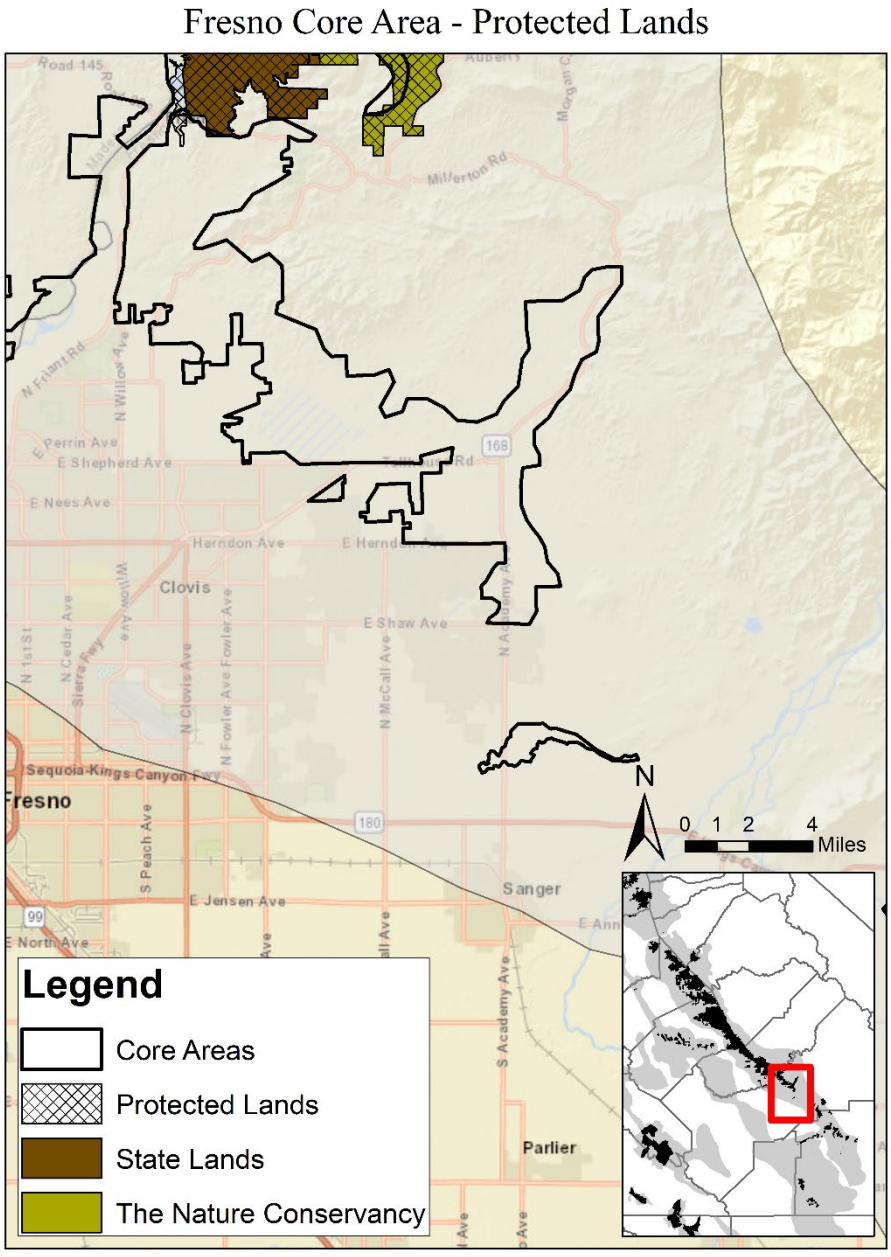

Figure 13.11. Map of protected areas within the Fresno Core Area**.** Protected lands are based on Vollmar et al. (2017).

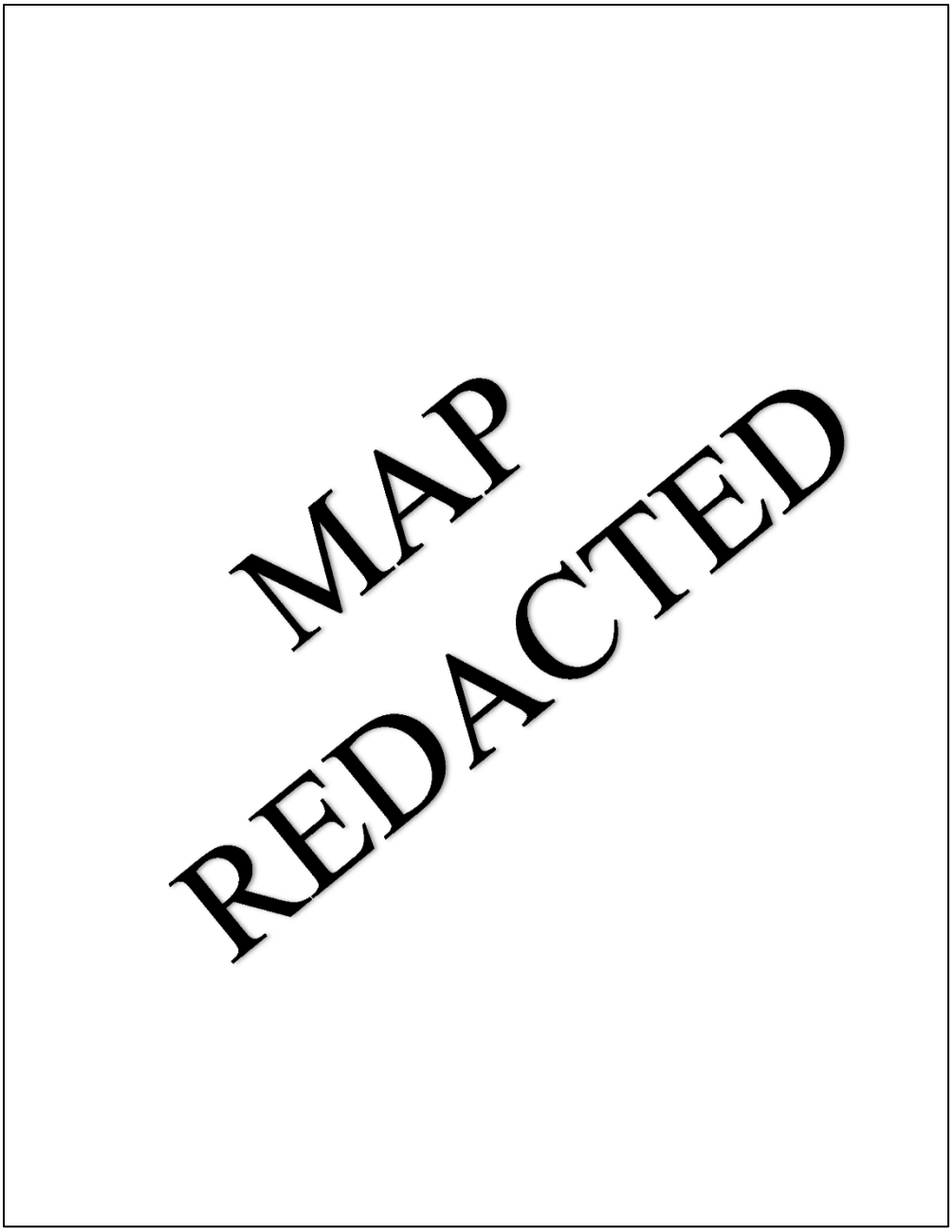

Figure 13.12. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Fresno Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.3. Kings

This is a zone 2 core area, but it was not designated for the vernal pool fairy shrimp or vernal pool tadpole shrimp in the Recovery Plan. It was designated for the spiny-sepaled button-celery (*Eryngium spinosepalum*), with a goal of protecting 85% of vernal pool habitat. The core area is located on the border of Fresno and Tulare Counties along a canal that is a tributary to the Kings River, as well as two disjoint polygons in the foothills to the east.

There were approximately 660 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 668 acres of vernal pool grassland remaining (see **Figure 13.13**, **Table 13.1**; Witham 2021). Approximately 48 acres had been lost since the Recovery Plan's 2005 baseline, though 56 additional acres were identified in 2012 aerial imagery that were either new or missed in previous mapping efforts. All of the habitat losses were attributable to agricultural conversions to bare plowed agricultural land (**Table 13.2**). The two disjoint polygons in the foothills to the east do not contain any mapped vernal pool grasslands. These areas were likely included in the core area because of nearby occurrences of spiny-sepaled button-celery; the occurrence records note that as of 1992 suitable habitat for this plant species was still present, but only in the form of an ephemeral water source and not actual vernal pool habitat (Diversity Database 2022). Roughly 342 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 51.8% of the 2005 baseline and 47.1% of the baseline plus the 56 additional acres identified in the 2012 aerial imagery.

The only protected land within this core area is the Sand Creek Conservation Bank (**Figure 13.14**). Note that Vollmar et al. (2017) mapped a slightly larger boundary for the bank than is present on the Service's shapefile.

13.7.3.1. Vernal Pool Fairy Shrimp Occurrences

There are four Diversity Database occurrence records for the vernal pool fairy shrimp within this core area and one more that is immediately adjacent (see **Figure 13.15**; Diversity Database 2022). As of 2018, 2 of these occurrences were protected within the Sand Creek Conservation Bank (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; the two within Sand Creek Conservation Bank are within extant mapped vernal pool and the other three are outside of mapped vernal pool grasslands along the banks of the canal (Witham 2021). Of the five records, none were known at the time of listing in 1994, but all five were known at the time the Recovery Plan was published in 2005, and thus the Recovery Plan likely should have designated this core area for the vernal pool fairy shrimp.

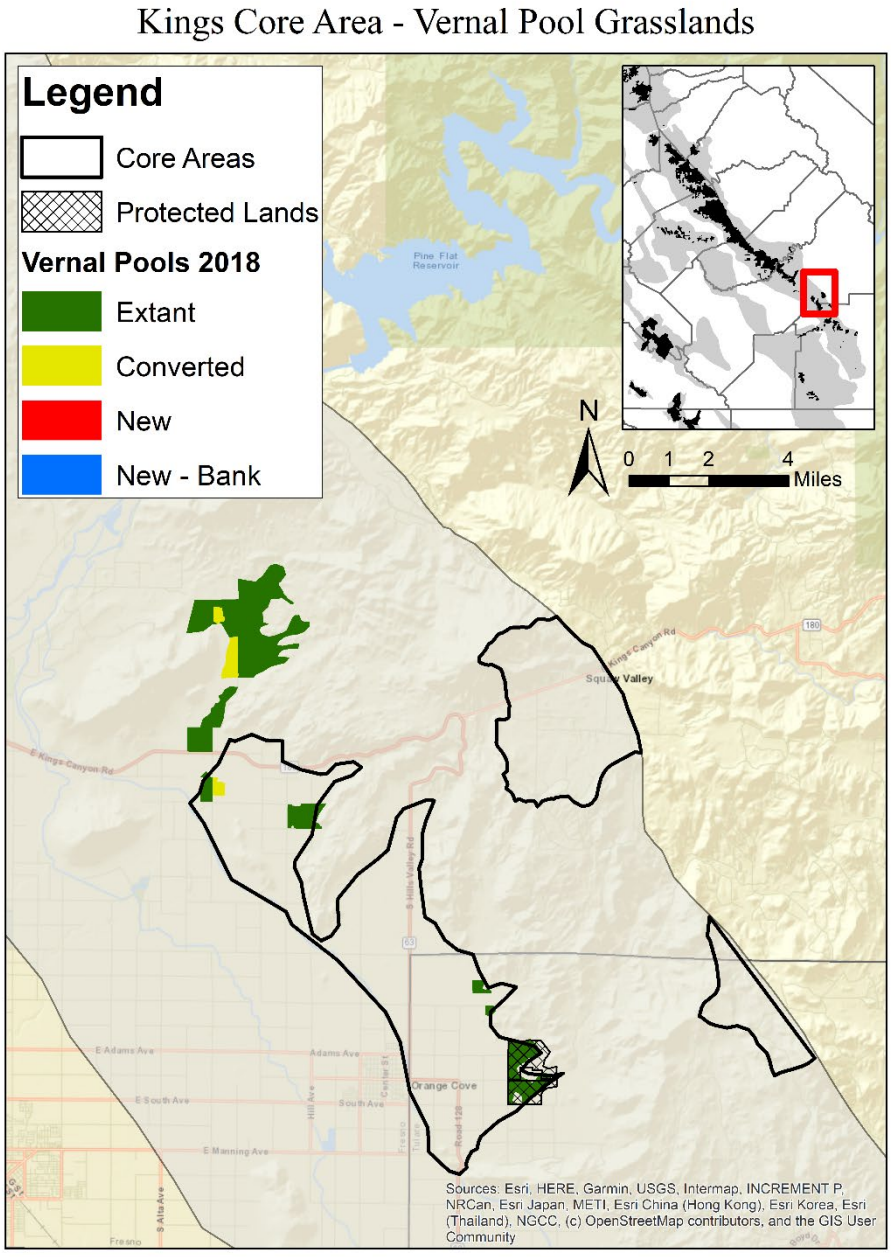

Figure 13.13. Map of vernal pool grassland habitat within the Kings Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

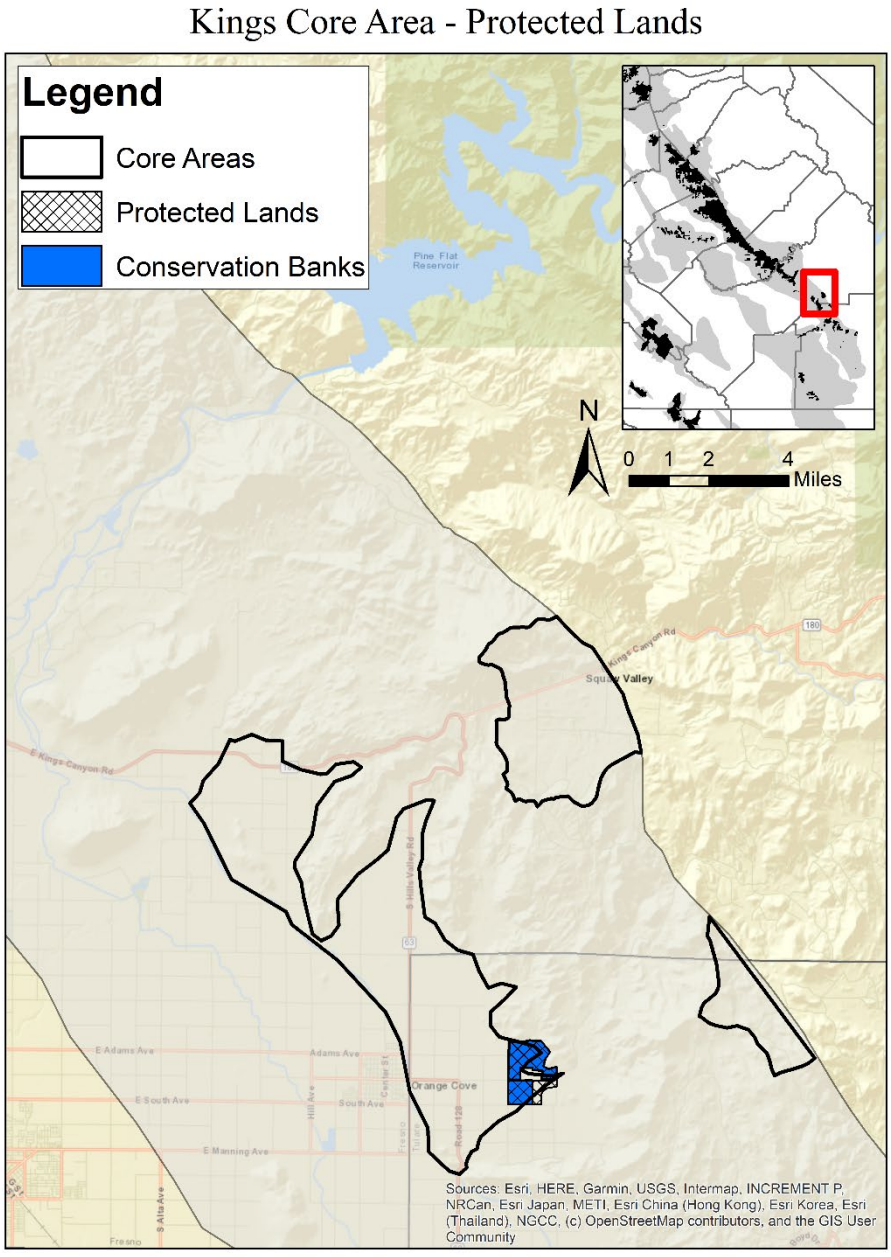

Figure 13.14. Map of protected areas within the Kings Core Area**.** Protected lands are based on Vollmar et al. (2017).

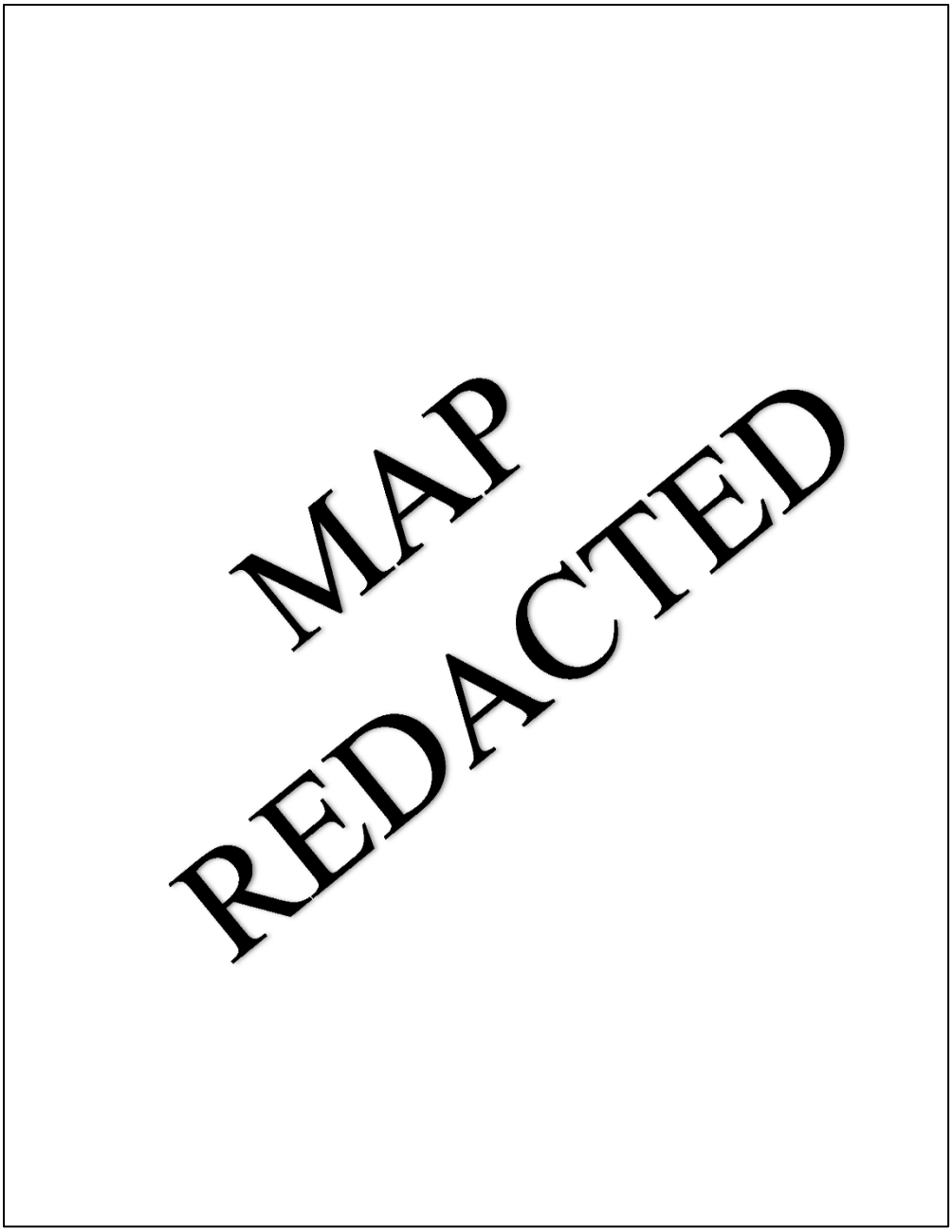

Figure 13.15. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Kings Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat. Several occurrences are located along the southern border of the core area; zoom in for finer resolution.

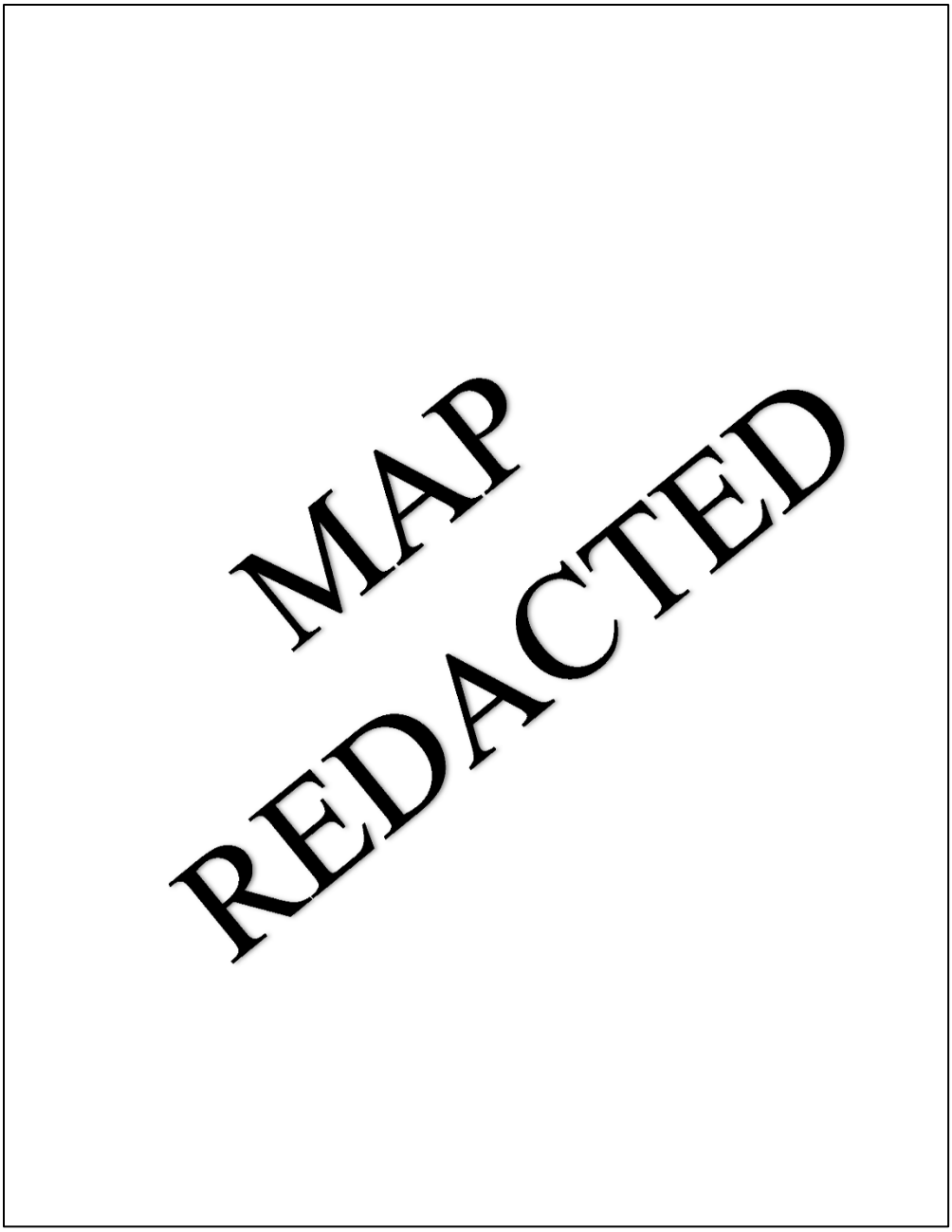

Figure 13.16. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Kings Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat. Several occurrences are located along the southern border of the core area; zoom in for finer resolution.

13.7.3.2. Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool tadpole shrimp within this core area, which is protected within the Sand Creek Conservation Bank (see **Figure 13.16**; Diversity Database 2022). The occurrence is presumed extant by the Diversity Database and within extant mapped vernal pool grasslands (Witham 2021). The occurrence was first documented in 2006, but has not been documented during several rounds of monitoring conducted since, possibly due to drought conditions (Wildlands 2015; Wildlands 2017b; Diversity Database 2022).

13.7.4. Madera

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp and Conservancy fairy shrimp. The core area is located in eastern Merced County and central Madera County, spanning the large extent of vernal pool grasslands from north of the City of Merced to east of the City of Madera and north of the City of Fresno. At 391,271 acres, the Madera Core Area is by far the largest core area designated by the Recovery Plan.

There were approximately 127,812 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013); this core area alone had more vernal pool grasslands than most Vernal Pool Regions. As of 2018, there were 117,938 acres of vernal pool grassland remaining (see **Figure 13.17**, **Table 13.1**; Witham 2021). Approximately 9,988 acres had been lost since the Recovery Plan's 2005 baseline, though 56 additional acres were created on banks that were not previously mapped as vernal pool grassland in 2005 and 299 acres were identified that were either new or missed in previous mapping efforts (Witham 2021). This was the only core area in the Southern Sierra Foothills Vernal Pool Region with losses caused by urbanization (240.5 acres, 2.4% of all losses), though the vast majority of losses were caused by agricultural conversions, mainly to orchards, vineyards, or eucalyptus (8,030.0 acres, 80.4%) (**Table 13.2**). Roughly 24,564 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 19.2% of the 2005 baseline.

There are two conservation banks with vernal pool fairy shrimp and vernal pool tadpole shrimp preservation credits in this core area: Drayer Ranch and Great Valley (**Figure 13.18**). These banks total 1,321 acres in size and have 162.22 acres of preservation credits for the two shrimp species (23.7% of which have already been sold). Other protected lands within this core area include the preserves associated with or adjacent to the UC Merced campus expansion, part of the Merced River Hatchery property, part of a mitigation site owned by Merced County Regional Waste Management Authority, a ranch with an easement held by NRCS, a ranch with an easement held by Central Valley Farmland Trust, a ranch being used as a mitigation site with an easement held by Sierra Foothill Conservancy, Caltrans' Madera Pools Mitigation Site, and two other mitigation sites with unknown landowners and easement holders (see **Figure 13.18**; Vollmar et al. 2017).

13.7.4.1. Vernal Pool Fairy Shrimp Occurrences

There are 183 Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 13.19**; Diversity Database 2022). As of 2018, 95 of these occurrences were at least partially within protected lands (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; 158 are within extant mapped vernal pool grasslands, 1 is entirely within vernal pool grasslands mapped as converted to agriculture, and 24 are outside of mapped vernal pool grasslands (Witham 2021). Of the 183 records, 21 were known at the time of listing in 1994 and 162 were known at the time the Recovery Plan was published in 2005; these records are located throughout the core area. The 21 newer records are located near the previously known occurrences, though several of the newer records are located closer to or further into the foothills to the east than the previously known occurrences.

13.7.4.2. Vernal Pool Tadpole Shrimp Occurrences

There are 26 Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 13.20**; Diversity Database 2022). As of 2018, 16 of these occurrences were at least partially within protected lands (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant mapped vernal pool grasslands (Witham 2021). Of the 26 records, 5 were known at the time of listing in 1994 and 24 were known at the time the Recovery Plan was published in 2005; these records are located throughout the northern half of the core area. The two newer records are located in Merced County in and adjacent to the Ichord family ranch.

13.7.4.3. Conservancy Fairy Shrimp Occurrences

There are nine Diversity Database occurrence records for the Conservancy fairy shrimp within this core area (see **Figure 13.21**; Diversity Database 2022). These occurrences are all considered part of the UC Merced population. As of 2018, three of these occurrences were at least partially within protected lands (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and all are within extant mapped vernal pool grasslands (Witham 2021). Of the nine records, one was known at the time of listing in 1994 and four were known at the time the Recovery Plan was published in 2005; these records are located northeast of the City of Merced near the UC Merced campus expansion. One of the five newer records is located near the previously known occurrences, while the other two are located approximately 10 miles to the southeast, east of the City of Merced and south of Highway 140.

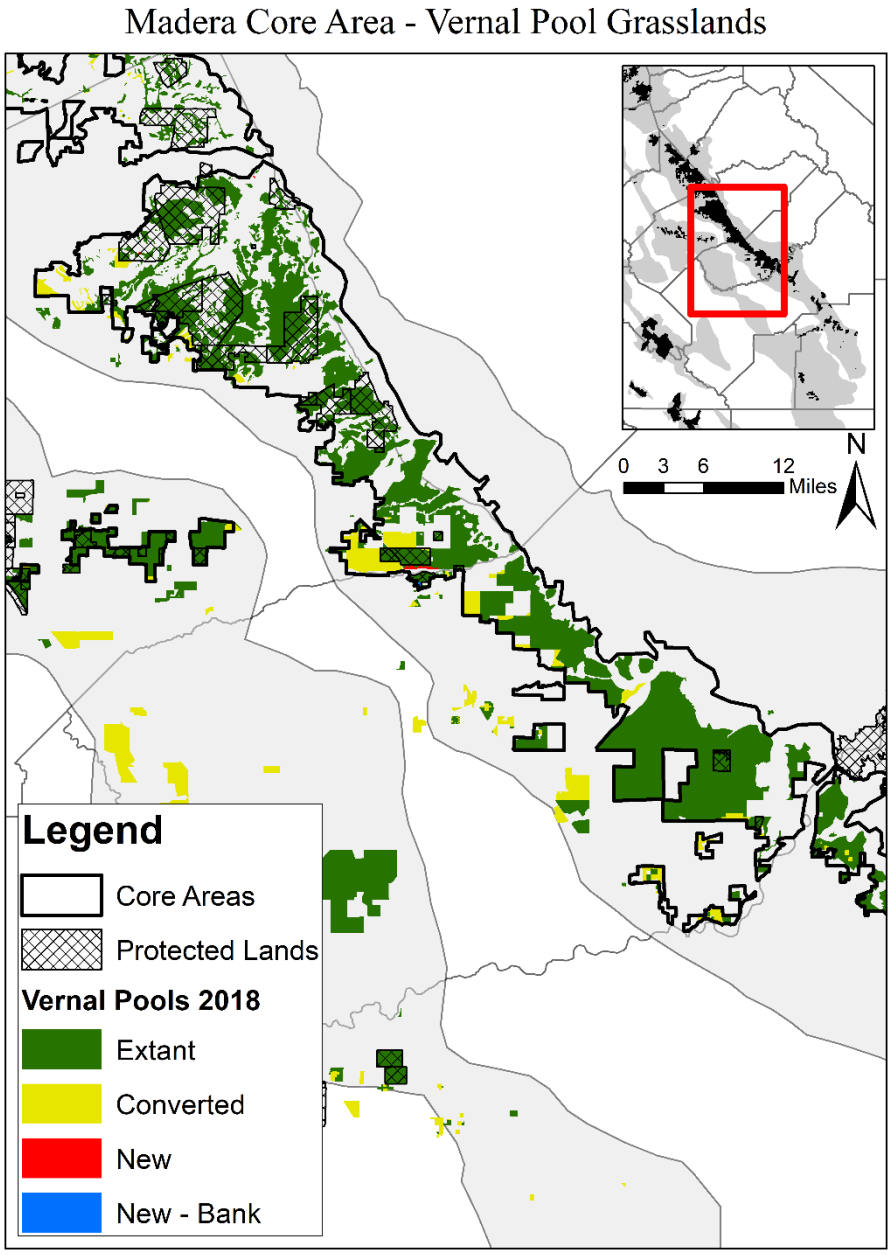

Figure 13.17. Map of vernal pool grassland habitat within the Madera Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

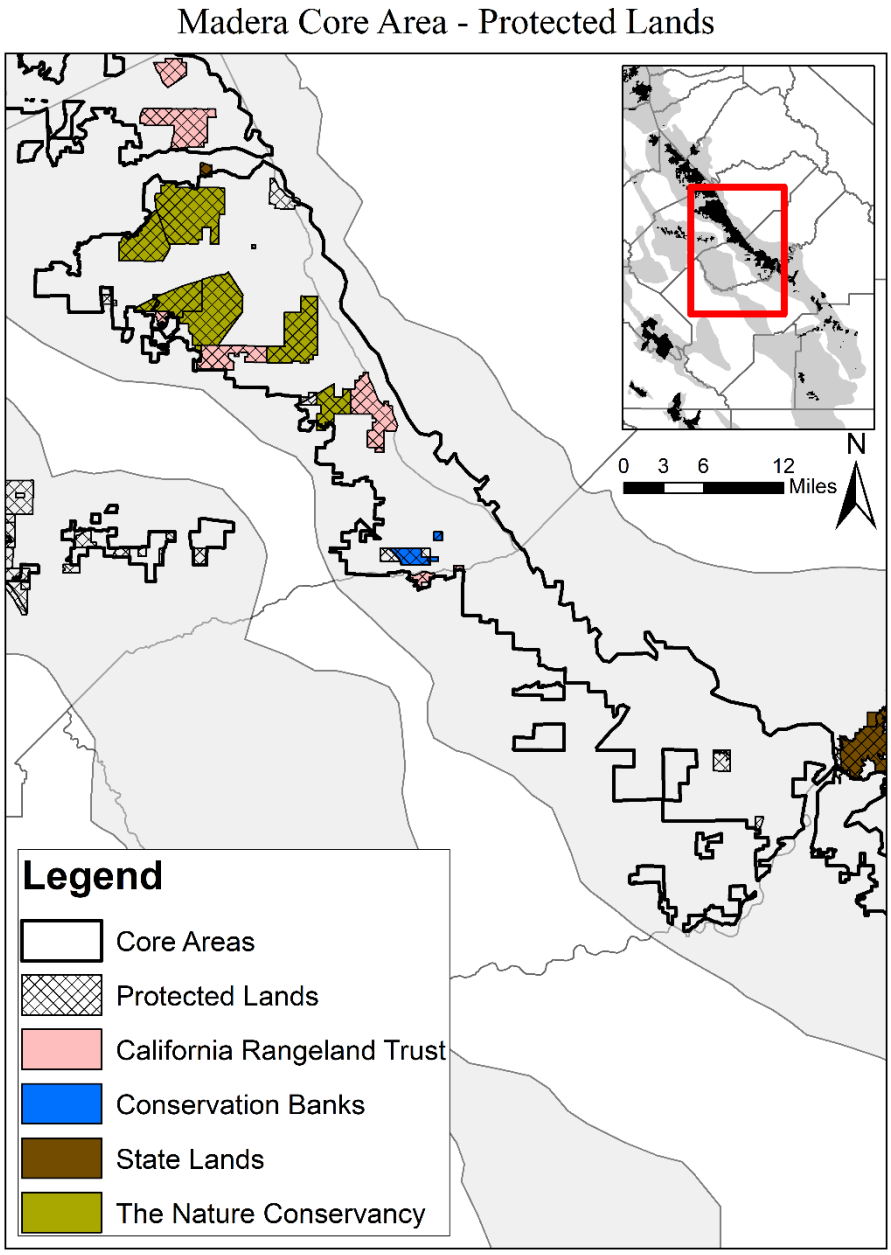

Figure 13.18. Map of protected areas within the Madera Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

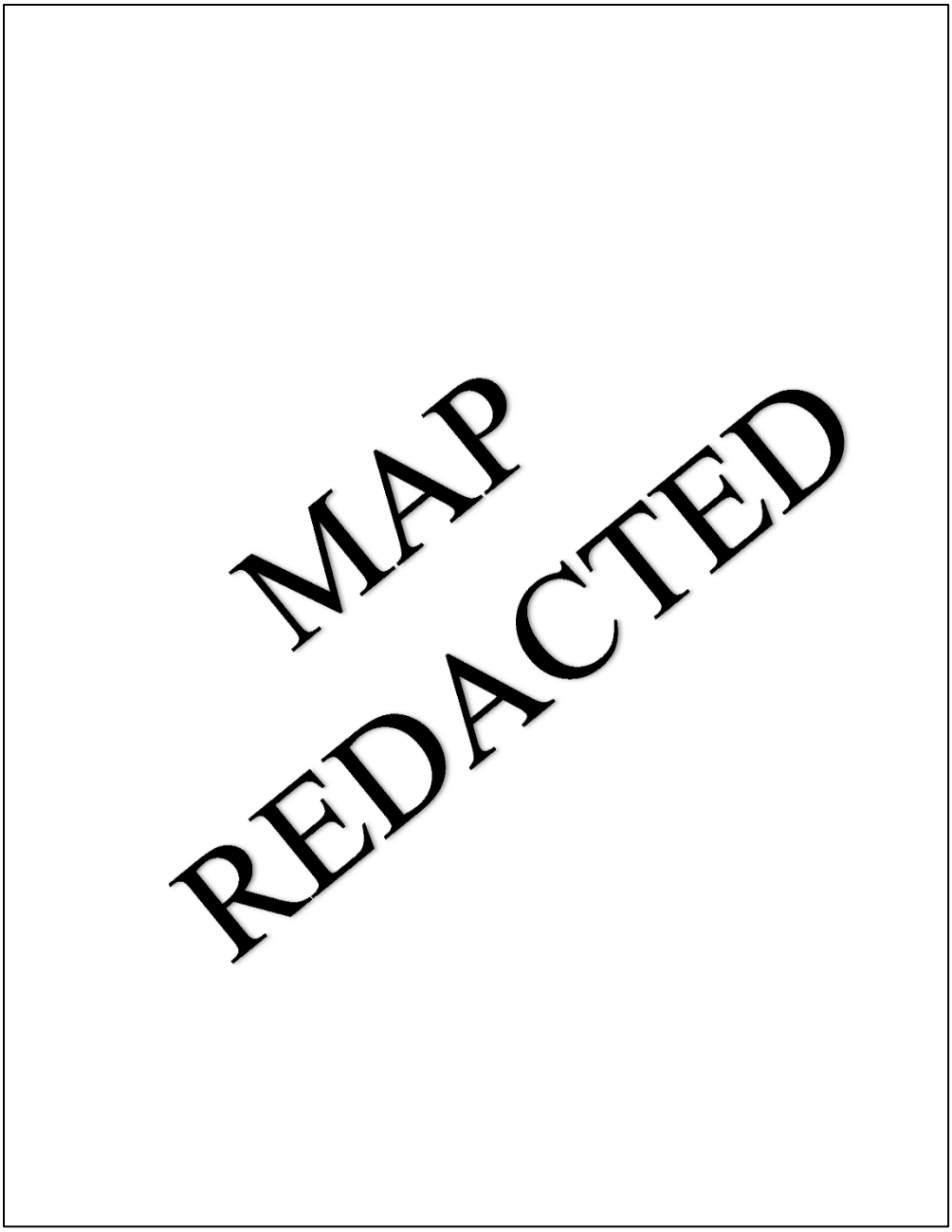

Figure 13.19. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Madera Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

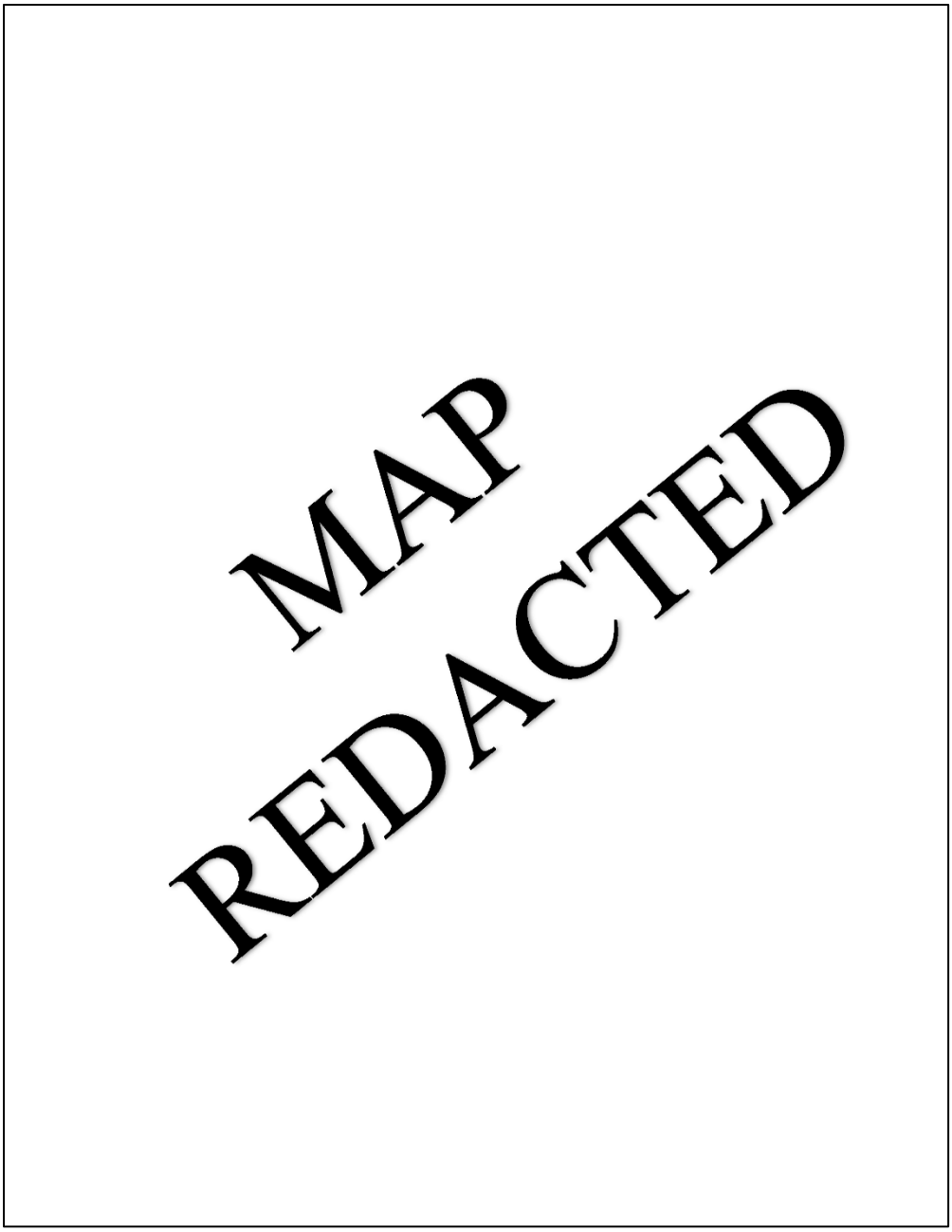

Figure 13.20. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Madera Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

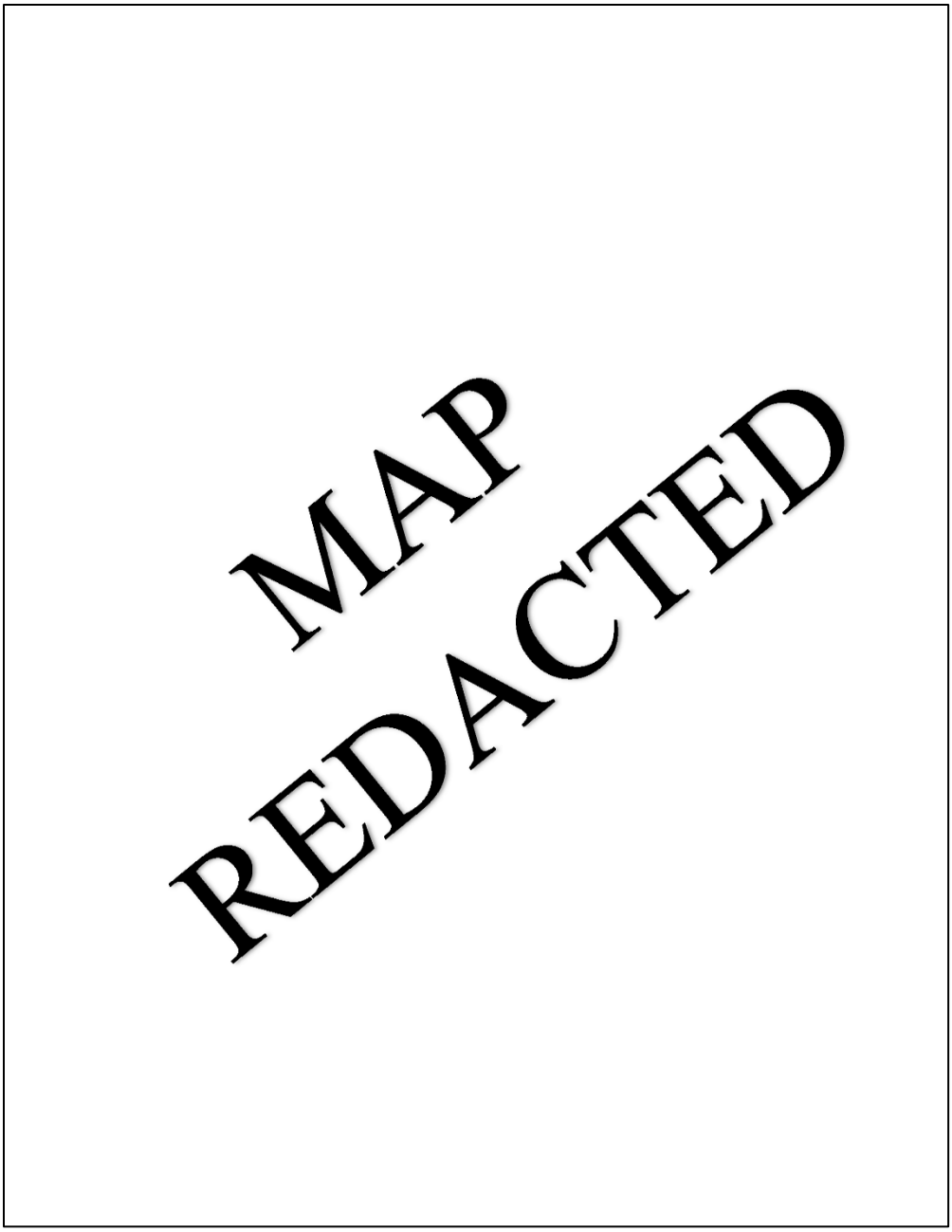

Figure 13.21. Map of known occurrences of Conservancy fairy shrimp recorded in the Diversity Database (2022) within the Madera Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.5. Merced

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp. The core area is located in eastern Stanislaus and Merced Counties with the Stanislaus River to the north, the Merced River to the south, and the Tuolumne River between the core area's two polygons. The three small, disjoint polygons on the southwestern edge of the core area are the Waterford and Turlock Core Areas.

There were approximately 20,417 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 17,293 acres of vernal pool grassland remaining (see **Figure 13.22**, **Table 13.1**; Witham 2021). Approximately 3,230 acres had been lost since the Recovery Plan's 2005 baseline, though 118 additional acres were identified that were either new or missed in previous mapping efforts (Witham 2021). This represents a loss of more than 15% of the amount of vernal pool habitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration. The vast majority of losses were caused by agricultural conversions, mainly to orchards, vineyards, or eucalyptus (2,829.4 acres, 87.6%), with a small amount of loss caused by conversion to managed wetlands (12.6 acres, 0.4%) (**Table 13.2**). Roughly 3,161 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 15.5% of the 2005 baseline.

Protected lands include a ranch with an easement held by NRCS, land owned by the County of Stanislaus, and the JCR Ranch and Richards family ranch with conservation easements held by California Rangeland Trust (**Figure 13.23**).

13.7.5.1. Vernal Pool Fairy Shrimp Occurrences

There are 29 Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 13.24**; Diversity Database 2022). As of 2018, 12 of these occurrences were at least partially within protected lands (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; 21 are within extant mapped vernal pool grasslands, 2 are partially within vernal pool grasslands mapped as converted to agriculture, and 6 are outside of mapped vernal pool grasslands (Witham 2021). Of the 29 records, 1 was known at the time of listing in 1994 and 23 were known at the time the Recovery Plan was published in 2005; these records are located in the northeastern portion of the northern polygon and in the southeastern and western portions of the southern polygon. The six newer records are located in the northwestern portion of the northern polygon and the northeastern portion of the southern polygon, expanding the known range of the vernal pool fairy shrimp in this core area.

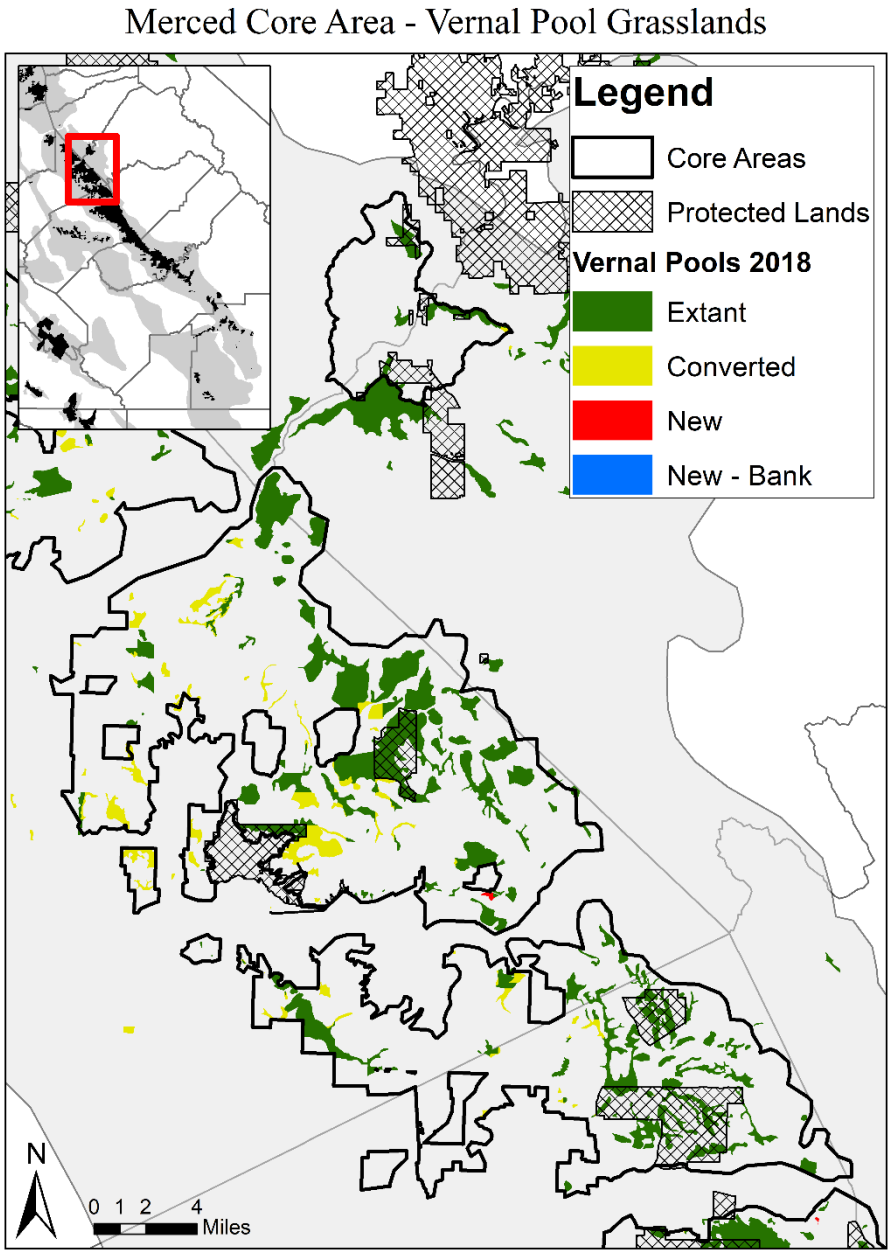

Figure 13.22. Map of vernal pool grassland habitat within the Merced Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

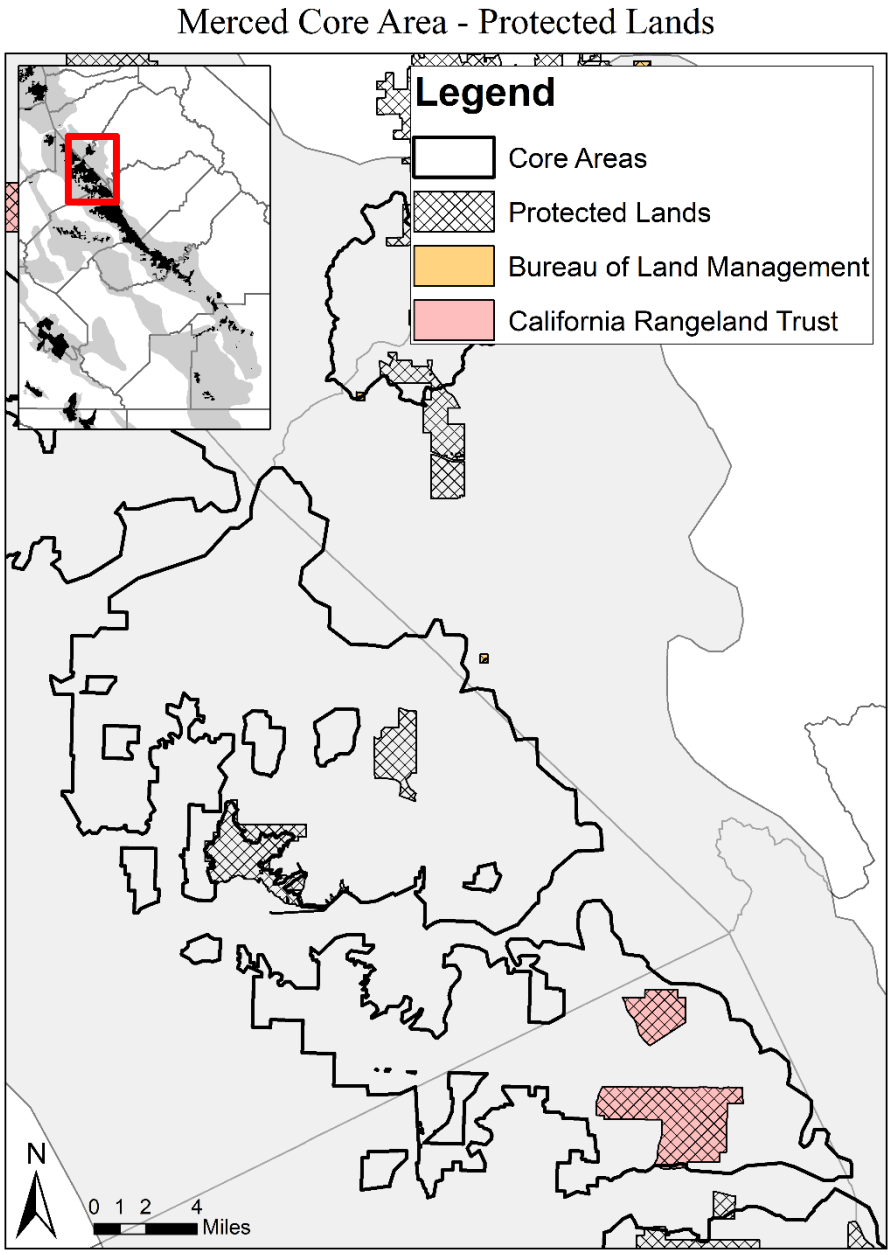

Figure 13.23. Map of protected areas within the Merced Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

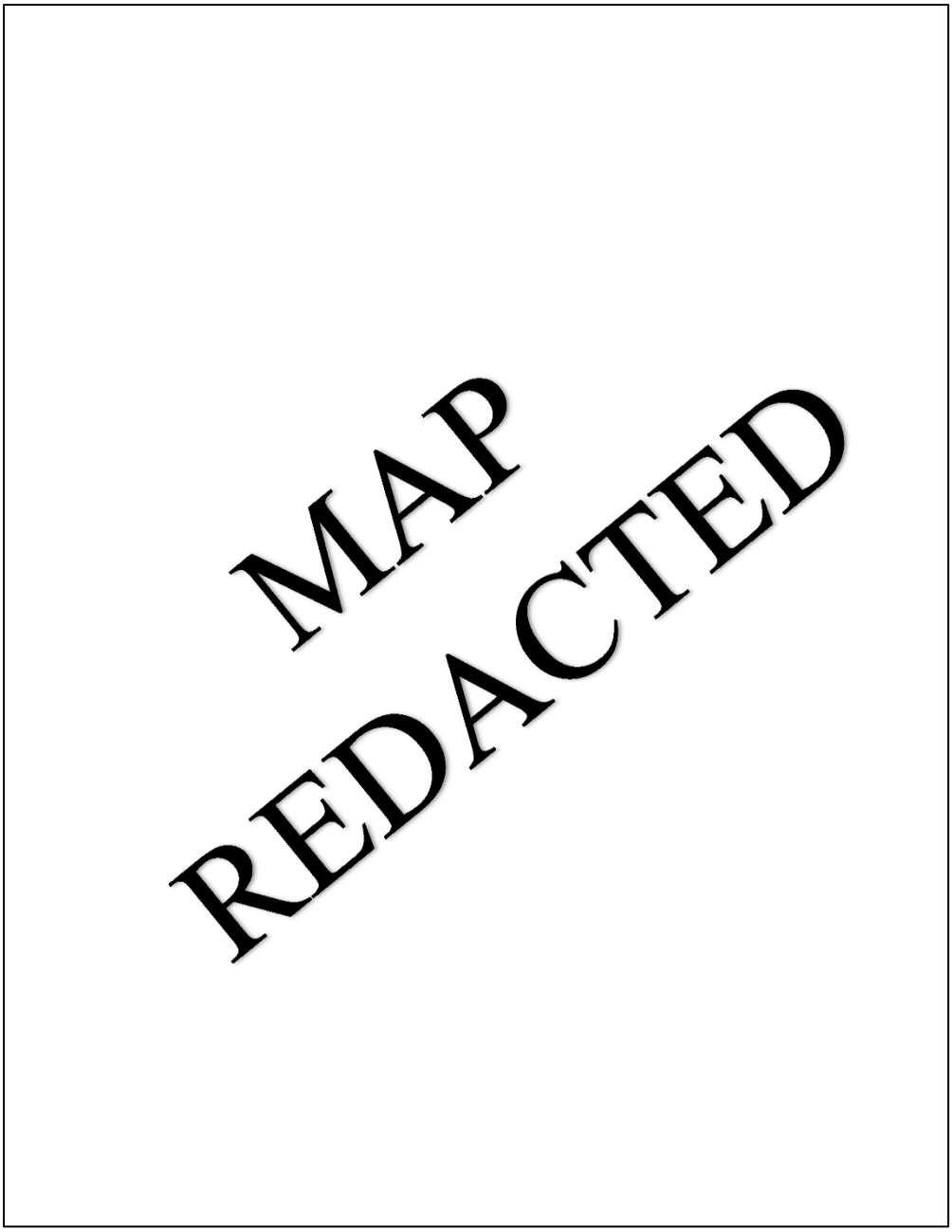

Figure 13.24. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Merced Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

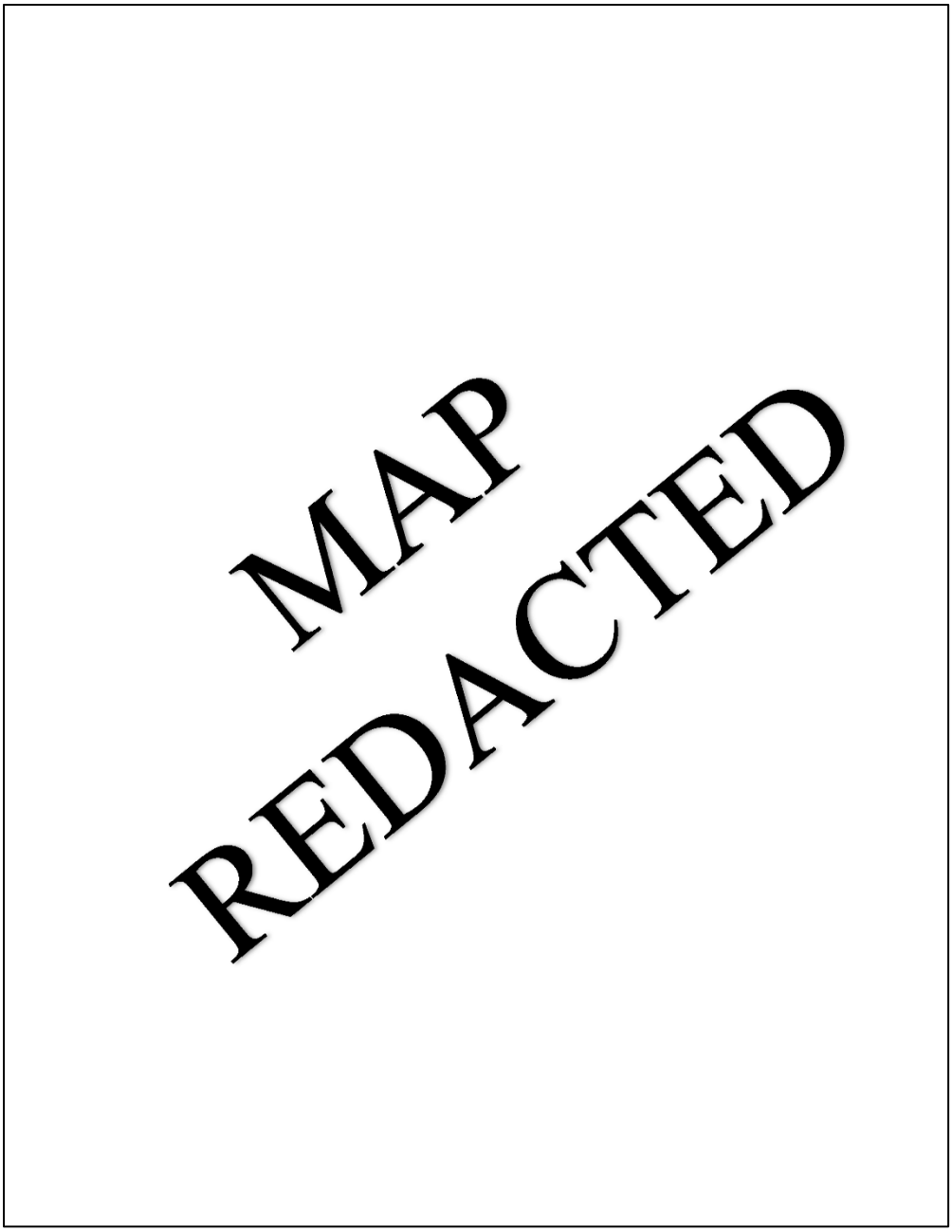

Figure 13.25. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Merced Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.5.2. Vernal Pool Tadpole Shrimp Occurrences

There are five Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 13.25**; Diversity Database 2022). As of 2018, none of these occurrences were protected (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; two are within extant mapped vernal pool grasslands and three are partially within vernal pool grasslands mapped as converted to agriculture, though these three occurrences mostly overlap extant habitat (Witham 2021). Of the five records, two were known at the time of listing in 1994 and three were known at the time the Recovery Plan was published in 2005; these records are located in the northwestern portion of the northern polygon and in the northwestern portion of the southern polygon. The two newer records are located near the other known occurrences.

13.7.6. San Joaquin

This is a zone 2 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp. This core area was not designated for the vernal pool tadpole shrimp in the Recovery Plan, but the species is known to occur there. The core area is located in eastern San Joaquin County east of the City of Stockton on either side of Escalon-Bellota Road.

There were approximately 7,259 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 4,229 acres of vernal pool grassland remaining (see **Figure 13.26**, **Table 13.1**; Witham 2021). Approximately 3,030 acres had been lost since the Recovery Plan's 2005 baseline (Witham 2021). This represents a loss of more than 15% of the amount of vernal pool habitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration. All losses were caused by agricultural conversions, with the majority due to orchards, vineyards, or eucalyptus (2,257 acres, 74.5%) (**Table 13.2**). This core area had the second largest percentage of vernal pool habitat loss since 2005 in the Central Valley. This is particularly significant given the size of the San Joaquin Core Area; the other five core areas in the top six of loss percentage were all small core areas (less than 6,000 acres) with a very small amount of vernal pool grasslands lost (less than 250 acres). At this point it is unlikely that the Recovery Plan's goal of protecting at least 6,170 acres of vernal pool grassland (85% of the 2005 baseline) will be achievable even with habitat creation or restoration. Therefore, efforts in this core area need to focus on preventing agricultural conversion of all remaining vernal pool habitat and working with landowners and other stakeholders to conserve these areas.

Roughly 937 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 12.9% of the 2005 baseline. The only protected area in this core area is the Cook Ranch, which is owned by the Cook Cattle Company with a conservation easement held by California Rangeland Trust (**Figure 13.27**).

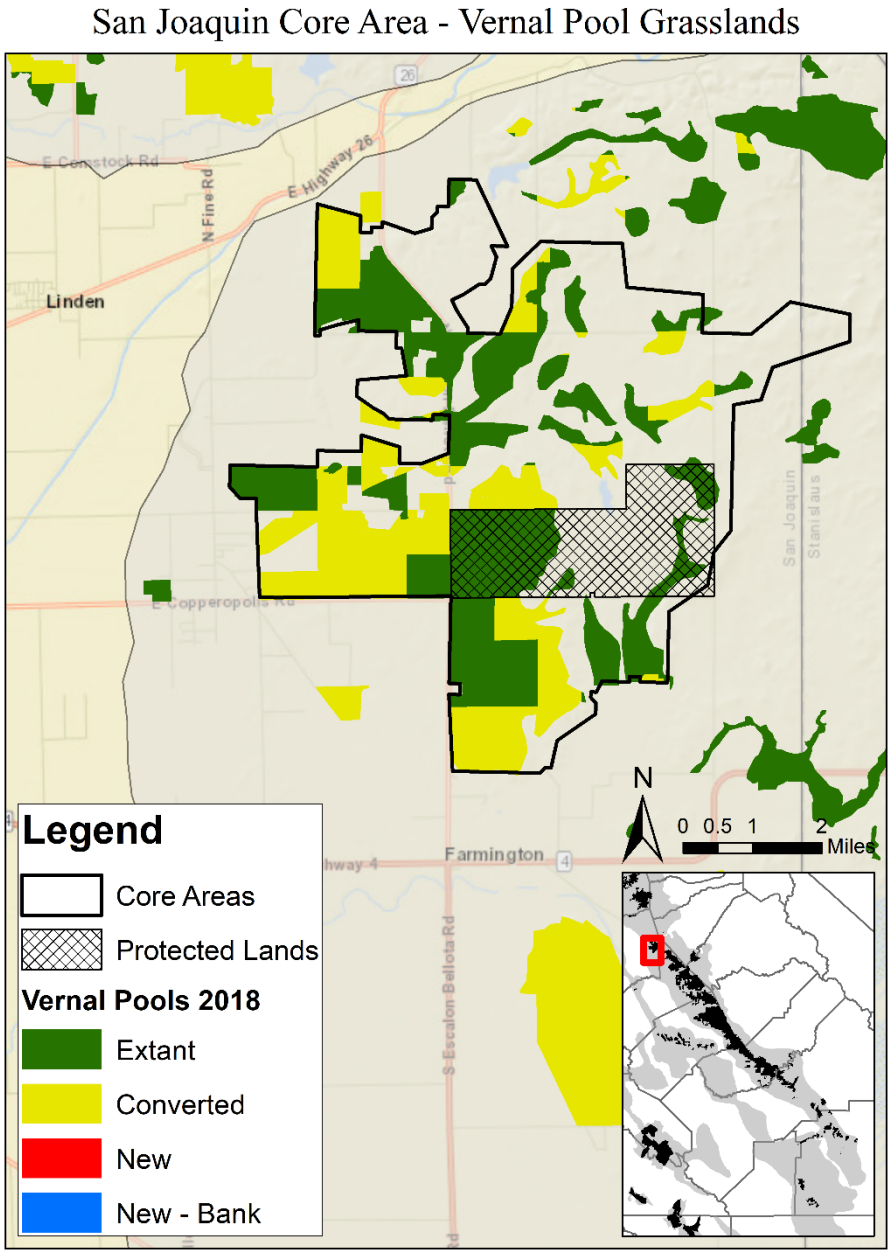

Figure 13.26. Map of vernal pool grassland habitat within the San Joaquin Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

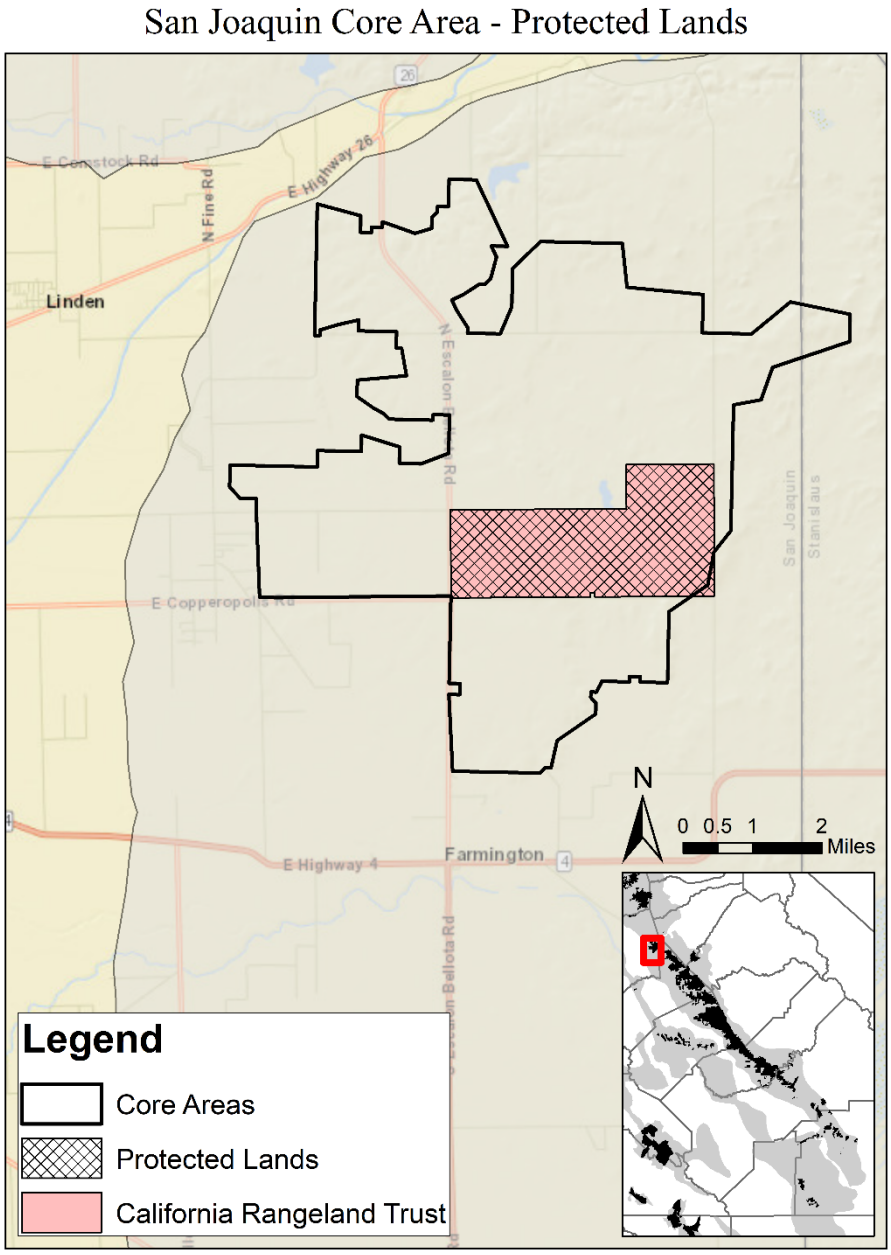

Figure 13.27. Map of protected areas within the San Joaquin Core Area**.** Protected lands are based on Vollmar et al. (2017).

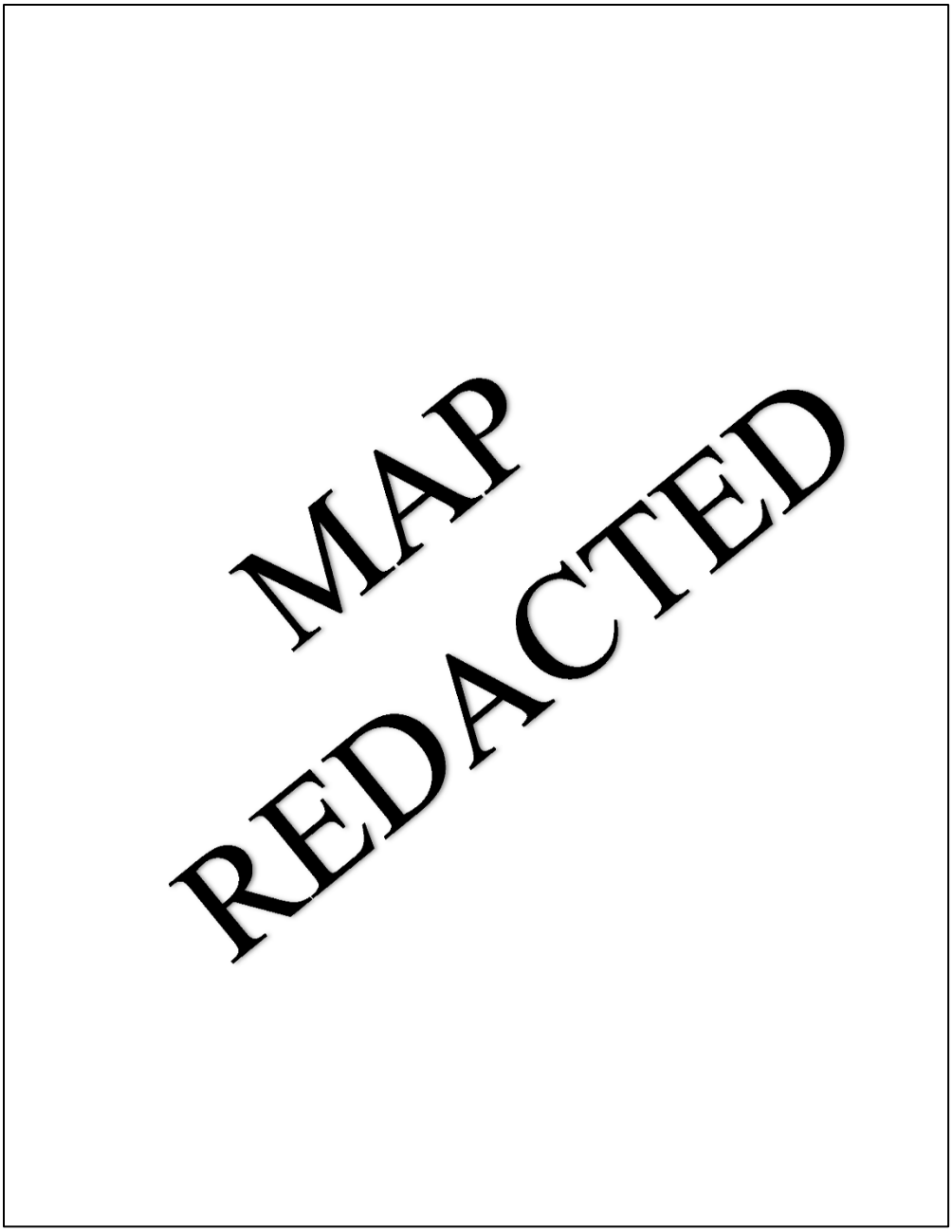

Figure 13.28. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the San Joaquin Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

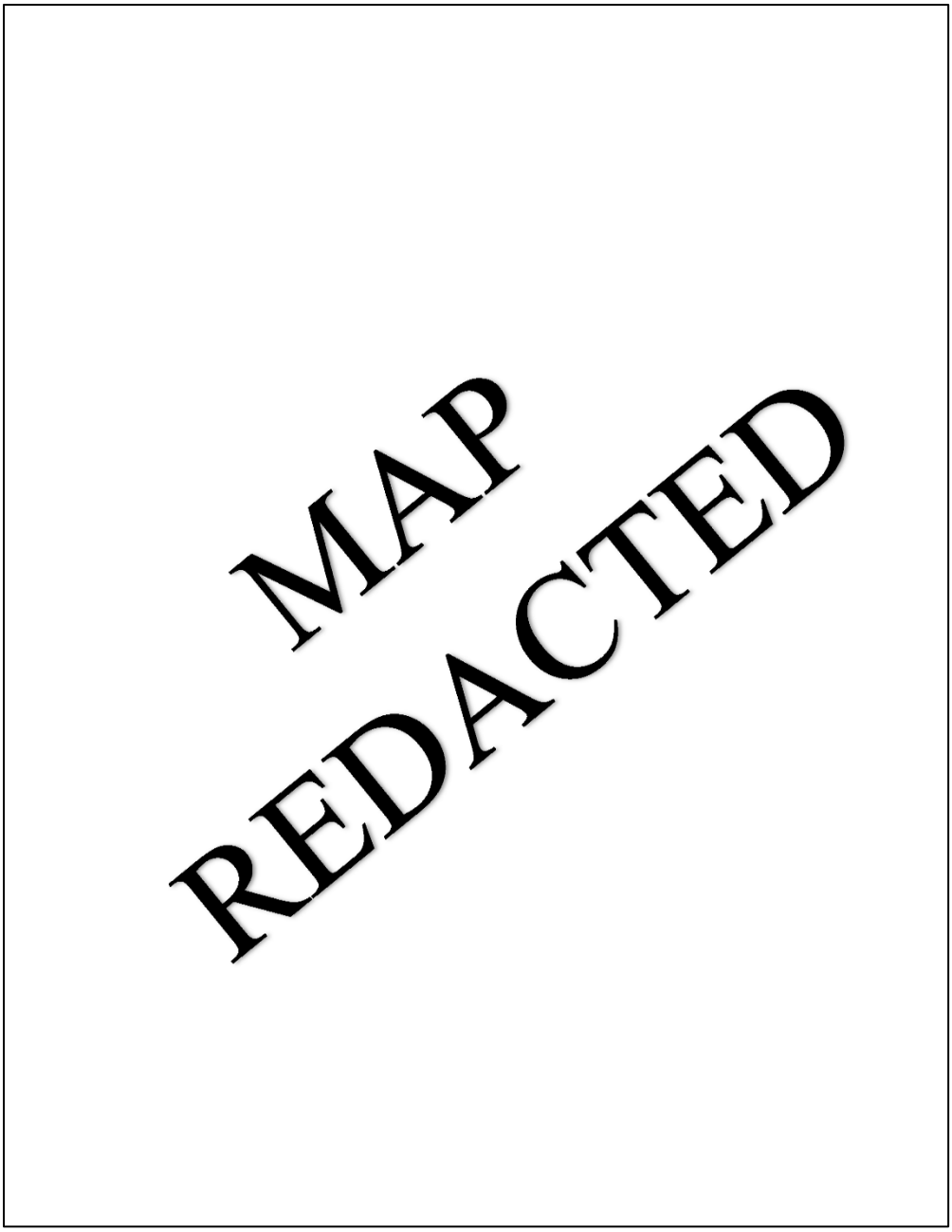

Figure 13.29. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the San Joaquin Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.6.1. Vernal Pool Fairy Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool fairy shrimp within this core area (see **Figure 13.28**; Diversity Database 2022). This occurrence is not protected (Vollmar et al. 2017). It is presumed extant by the Diversity Database; it slightly overlaps extirpated vernal pool grasslands, but is primarily within extant mapped vernal pool grasslands (Witham 2021). This occurrence was recorded in 1997, after listing but prior to the Recovery Plan being published in 2005, and was subsequently observed in 1999 and 2011 (Diversity Database 2022).

13.7.6.2. Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool tadpole shrimp within this core area (see **Figure 13.29**; Diversity Database 2022). This occurrence is not protected (Vollmar et al. 2017). It is presumed extant by the Diversity Database; it slightly overlaps extirpated vernal pool grasslands but is primarily within extant mapped vernal pool grasslands (Witham 2021). This occurrence was recorded in 2011, after the Recovery Plan was published, and was noted at the time as threatened due to nearby land conversion (Diversity Database 2022).

13.7.7. Table Mountain

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp. The core area is located on Table Mountain in Fresno County and Kennedy Table in Madera County on either side of the San Joaquin River north of Millerton Lake.

There were approximately 1,738 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were still 1,738 acres of vernal pool grassland remaining, with no habitat losses occurring since 2005 (see **Figure 13.30**, **Table 13.1**; Witham 2021). Roughly 1,460 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 84.0% of the 2005 baseline.

Protected lands within this core area include BLM's Table Mountain and Kennedy Table areas of ecological importance, CDFW's Big Table Mountain Ecological Reserve, the Sierra Foothill Conservancy's Ruth McKenzie Table Mountain Preserve, the Kennedy Table Conservation Bank, and the California Rangeland Trust's conservation easement over the Van Alen family ranch (**Figure 13.31**).

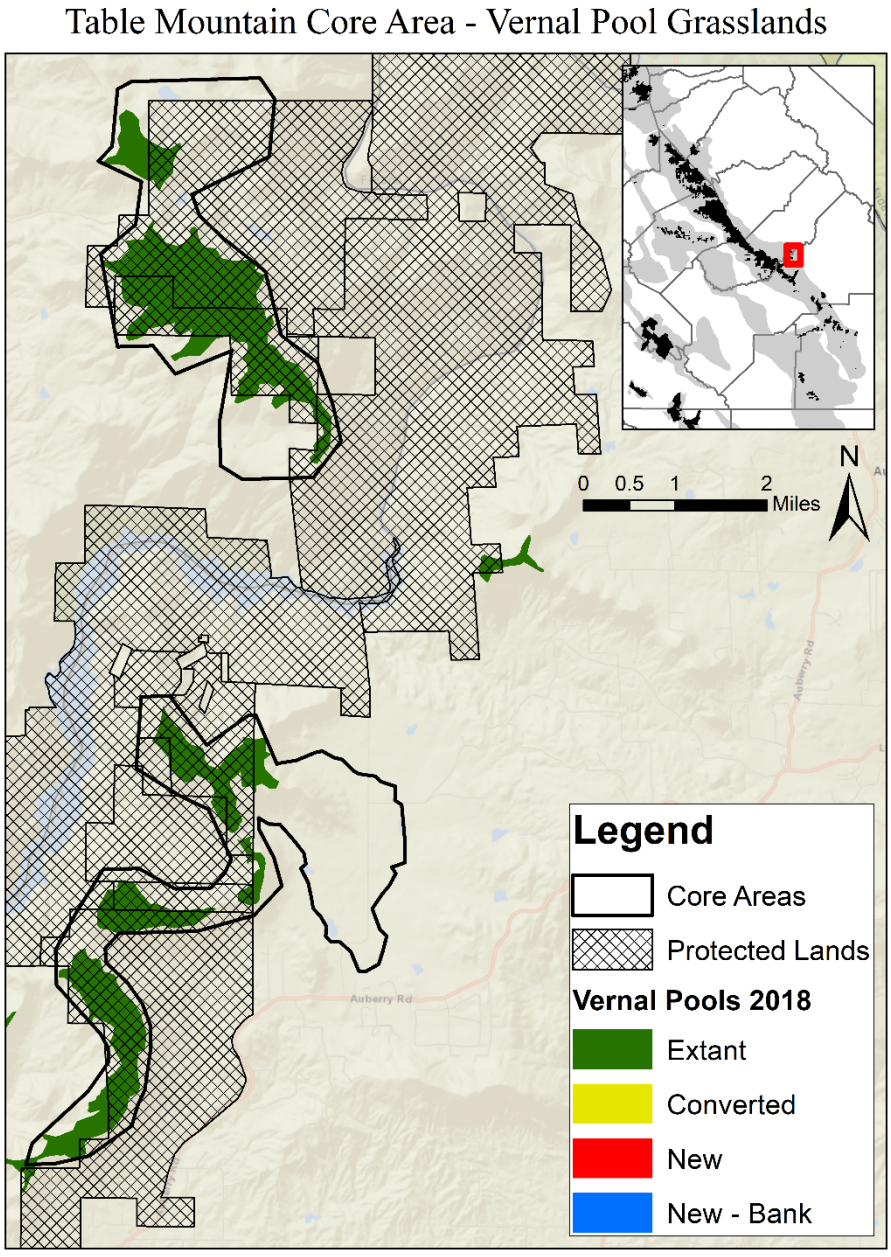

Figure 13.30. Map of vernal pool grassland habitat within the Table Mountain Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

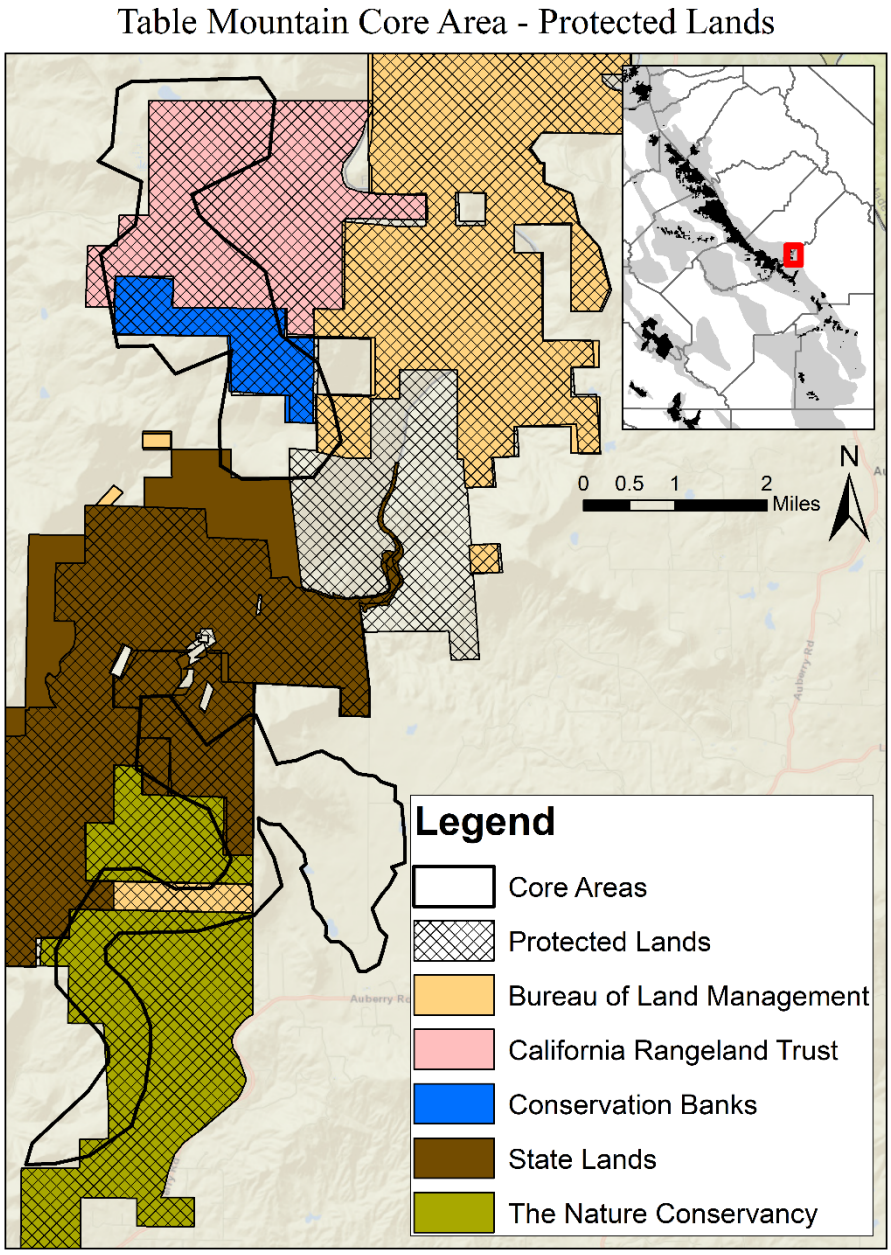

Figure 13.31. Map of protected areas within the Table Mountain Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

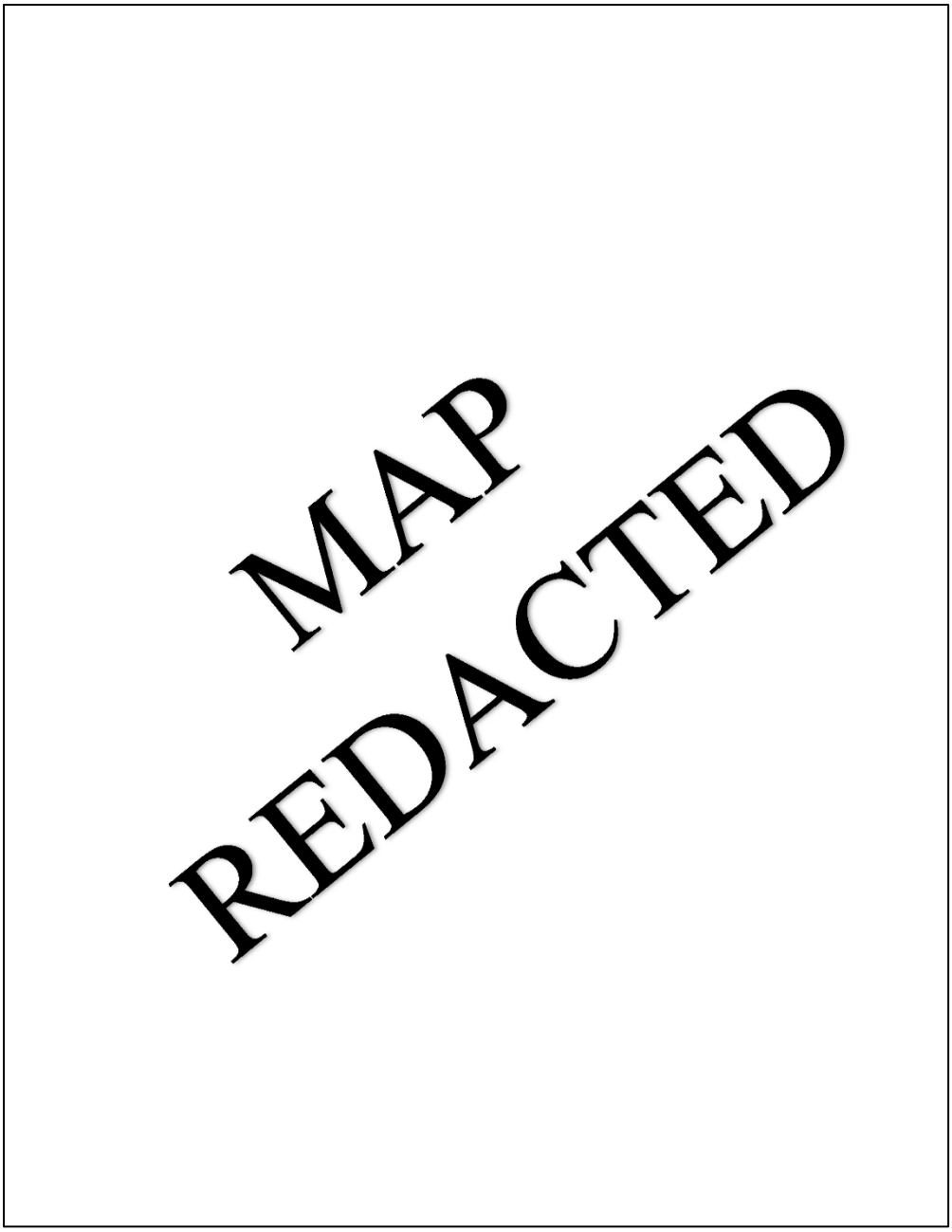

Figure 13.32. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Table Mountain Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

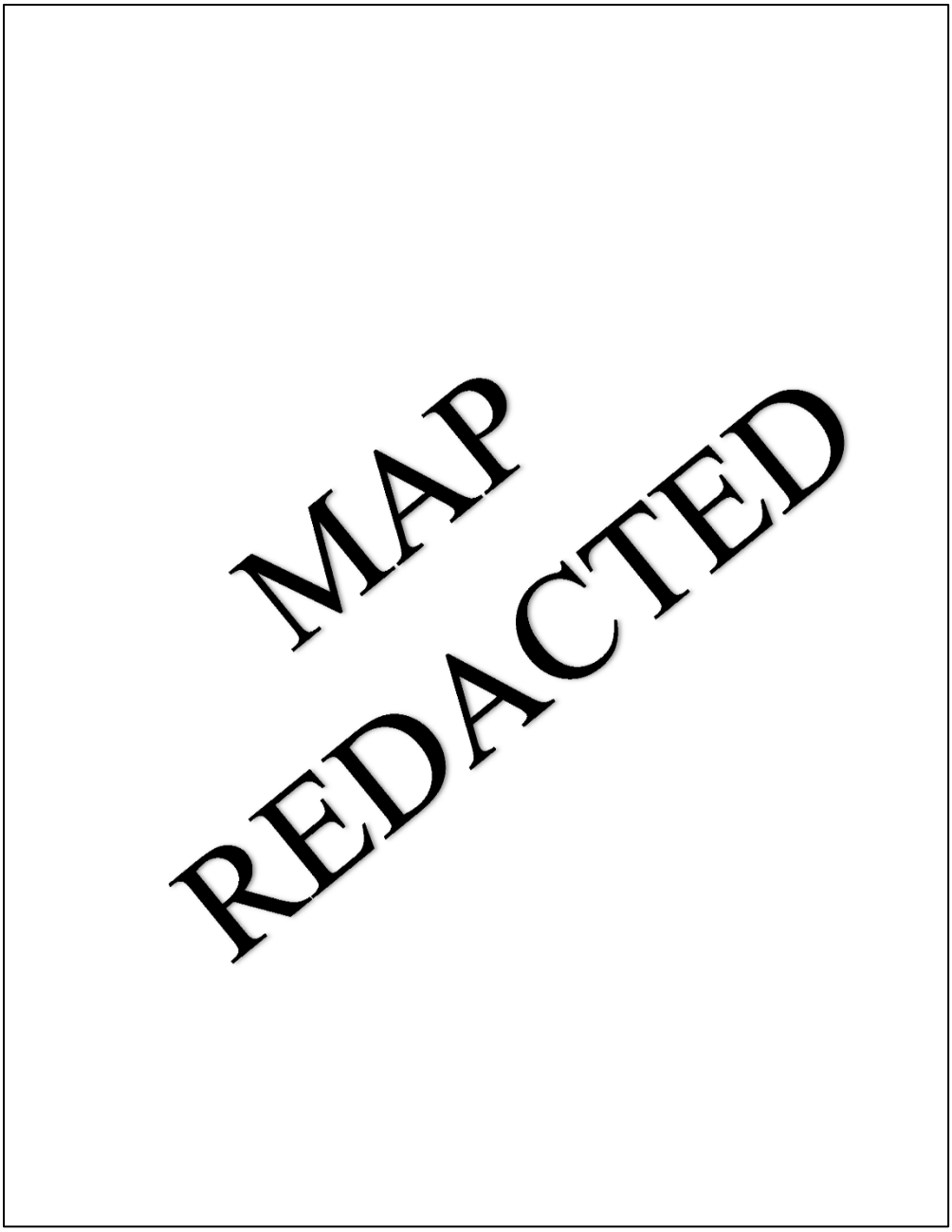

Figure 13.33. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Table Mountain Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.7.1. Vernal Pool Fairy Shrimp Occurrences

There are three Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 13.32**; Diversity Database 2022). As of 2018, all of these occurrences were protected (Vollmar et al. 2017). All three occurrences are presumed extant by the Diversity Database and are within extant mapped vernal pool grasslands (Witham 2021). Of the three records, none were known at the time of listing in 1994 and two were known at the time the Recovery Plan was published in 2005. One of these records is located in the central portion of Kennedy Table within the Kennedy Table Conservation Bank, and the other is located in the northern portion of Table Mountain within CDFW's Big Table Mountain Ecological Reserve. The one newer record was recorded in 2010 on BLM land in the southern portion of Kennedy Table.

13.7.7.2. Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool tadpole shrimp within this core area (see **Figure 13.33**; Diversity Database 2022). As of 2018, the occurrence was protected within CDFW's Big Table Mountain Ecological Reserve (Vollmar et al. 2017). The occurrence is presumed extant by the Diversity Database and within extant mapped vernal pool grasslands (Witham 2021). The occurrence was first observed in 1995 and has been routinely observed since (Diversity Database 2022).

13.7.8. Tulare

This is a zone 2 core area, but it was not designated for the vernal pool fairy shrimp in the Recovery Plan. It was designated for Hoover's spurge (*Chamaesyce hooveri*), San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), and spiny-sepaled button-celery (*Eryngium spinosepalum*), with a goal of protecting 85% of vernal pool habitat. The core area is located in Tulare County on either side of Highway 245 east of Long Creek and north of the City of Woodlake.

There were approximately 1,584 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were still 1,584 acres of vernal pool grassland remaining, with no habitat losses occurring since 2005 (see **Figure 13.34**, **Table 13.1**; Witham 2021). The Service is not aware of any protected vernal pool habitat within this core area (Vollmar et al. 2017).

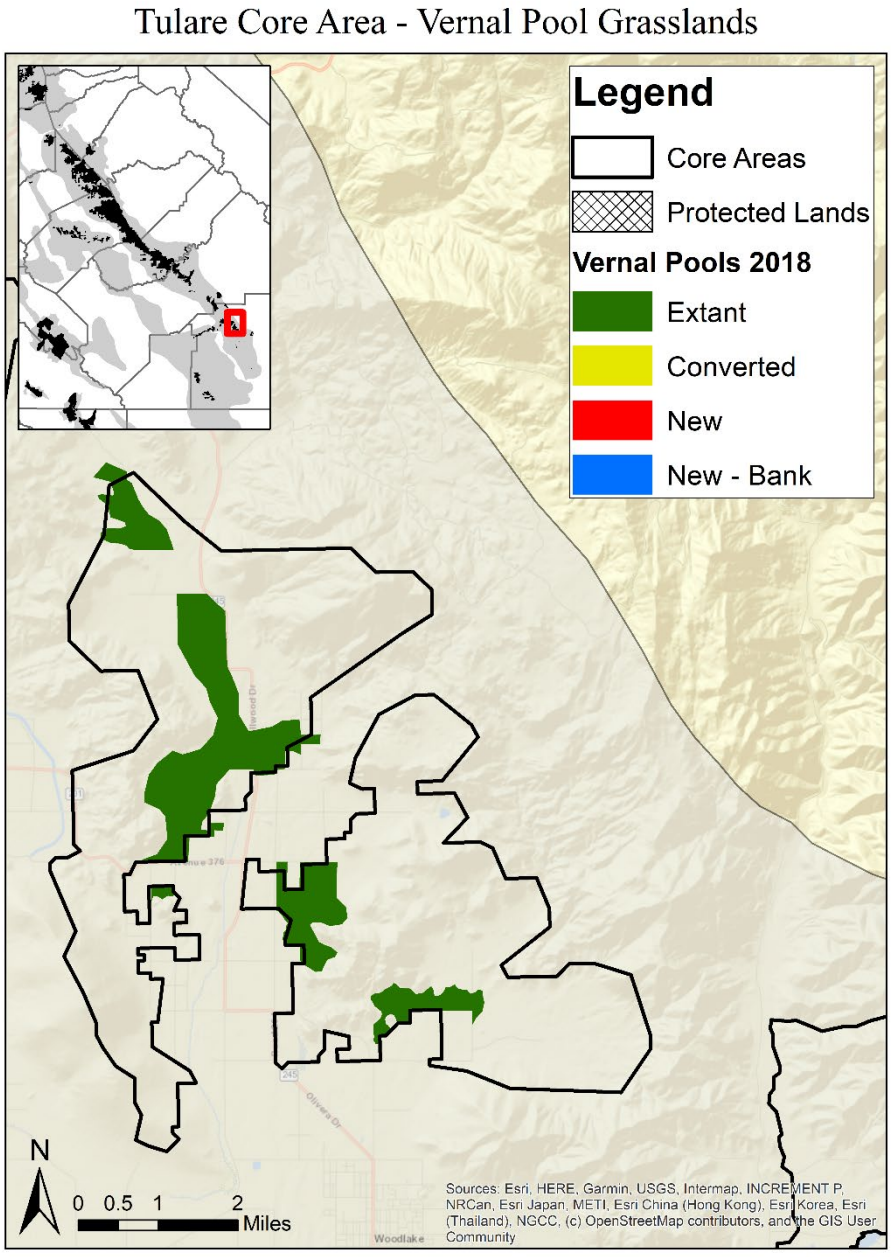

Figure 13.34. Map of vernal pool grassland habitat within the Tulare Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

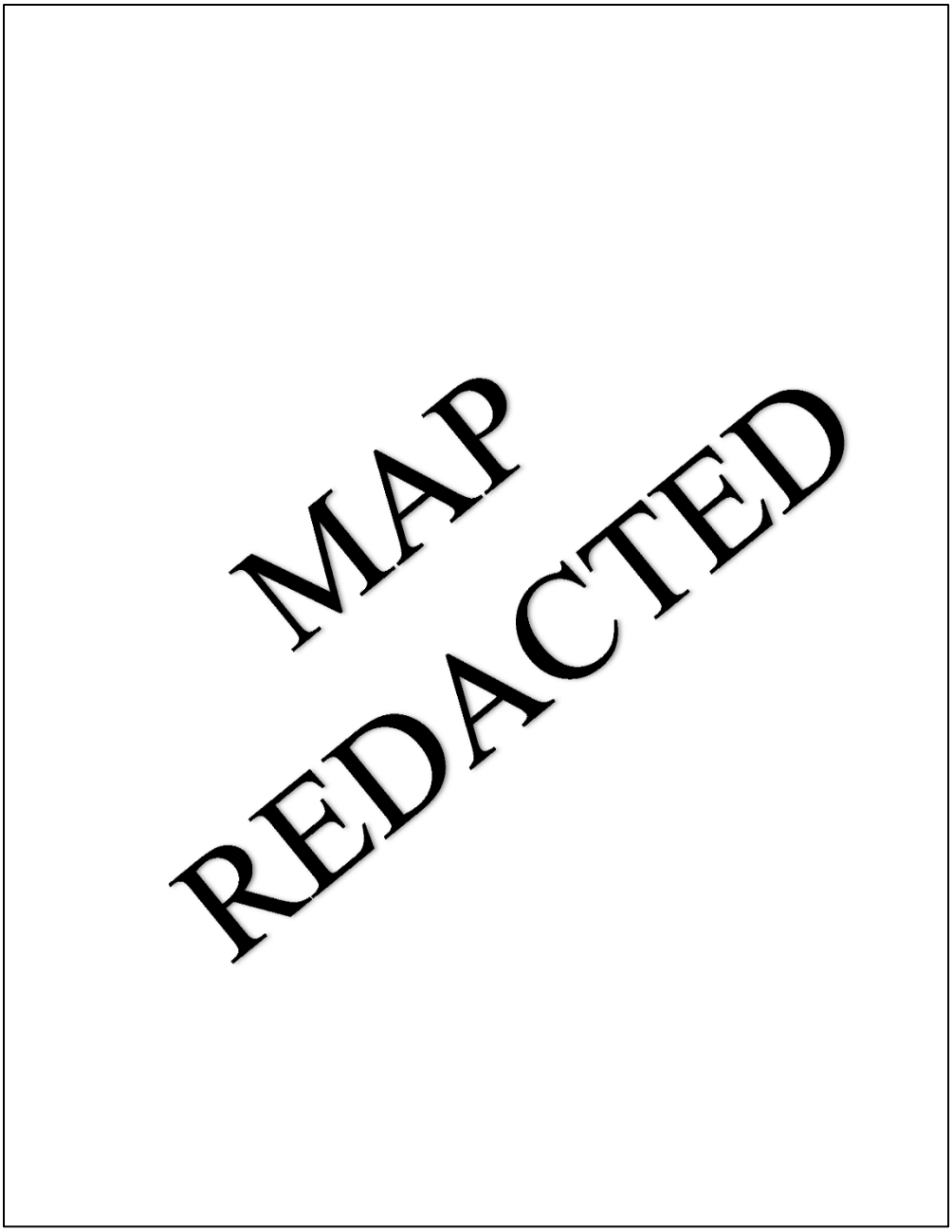

Figure 13.35. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Tulare Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

13.7.8.1. Vernal Pool Fairy Shrimp Occurrences

There are four Diversity Database occurrence records for the vernal pool fairy shrimp within this core area and one additional occurrence immediately adjacent to it (see **Figure 13.35**; Diversity Database 2022). As of 2018, none of these occurrences were protected (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; three are within extant mapped vernal pool grasslands and two are outside of mapped vernal pool grasslands (Witham 2021). These five occurrences were all first documented between 2010 and 2012 after the Recovery Plan was published, representing an expansion of the known range of the vernal pool fairy shrimp. The occurrences are all located in the southern portions of the core area, only having been documented within the two smallest patches of mapped vernal pool grasslands or along roads outside of mapped vernal pool grasslands (Witham 2021; Diversity Database 2022). Although the vernal pool fairy shrimp has not yet been documented within the larger expanses of vernal pool grassland in this core area, that may be due to a lack of survey effort, as very few occurrences of any vernal pool species have been recorded in the Diversity Database in these areas (Diversity Database 2022).

13.7.9. Turlock

This is a zone 2 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp. However, there are no known occurrences of the species within this core area, so this designation may need to be reconsidered. This core area was also not designated for the vernal pool tadpole shrimp, but that species is discussed below. The core area is composed of two small, disjoint polygons southwest of the Merced Core Area; one is in Stanislaus County east of the City of Hickman and south of the Tuolumne River, and the other is in Merced County at the eastern terminus of Monte Vista Avenue north of Dry Creek.

There were only 6.6 acres of vernal pool grassland mapped within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were still 6.6 acres of vernal pool grassland remaining, with no habitat losses occurring since 2005 (see **Figure 13.36**, **Table 13.1**; Witham 2021). The Service is not aware of any protected vernal pool habitat within this core area (Vollmar et al. 2017). The Recovery Plan states that this core area includes the Hickman vernal pool complex, although the majority of this complex is within the Merced Core Area. Based on aerial imagery, the northern polygon contains one 245-acre property that is composed of vernal pool grassland (Google Maps 2023b), though Witham et al. (2013) only mapped the two most prominent vernal pools on the property as 6.6 acres of vernal pool grassland. The southern polygon does not have any occurrences of vernal pool species within it and does not appear to have any vernal pool grassland based on aerial imagery or Witham et al. (2013), so it is unclear why this area was included in the core area's boundaries.

13.7.9.1. Vernal Pool Fairy Shrimp Occurrences

There are no occurrence records for the vernal pool fairy shrimp within this core area; the nearest known occurrence of the species is near the Merced Core Area between the two polygons of the Turlock Core Area, approximately 3 and 5 miles from the northern and southern polygons of the core area, respectively (see **Figure 13.37**; Diversity Database 2022). It is unclear why the vernal pool fairy shrimp was included in this core area; it may have been assumed that the species could

be present due to a lack of survey effort and known occurrences nearby, but this same logic does not seem to have been applied to other relevant core areas.

13.7.9.2. Vernal Pool Tadpole Shrimp Occurrences

There are no occurrence records for the vernal pool tadpole shrimp within this core area; the nearest known occurrence of the species is 1 mile to the east within the Hickman vernal pool complex on Robinson Ranch in the Merced Core Area (see **Figure 13.38**; Diversity Database 2022). Despite being designated for the vernal pool fairy shrimp, there are also no known occurrences of that species within the core area. The Recovery Plan says that this core area includes the Hickman vernal pool complex, so given that both the vernal pool fairy shrimp and vernal pool tadpole shrimp are known to occur in the adjacent portions of the Hickman vernal pool complex, the two species should be treated the same with regards to the Turlock Core Area. Either the vernal pool tadpole shrimp should be included in the core area or both species should be removed from the core area's designation.

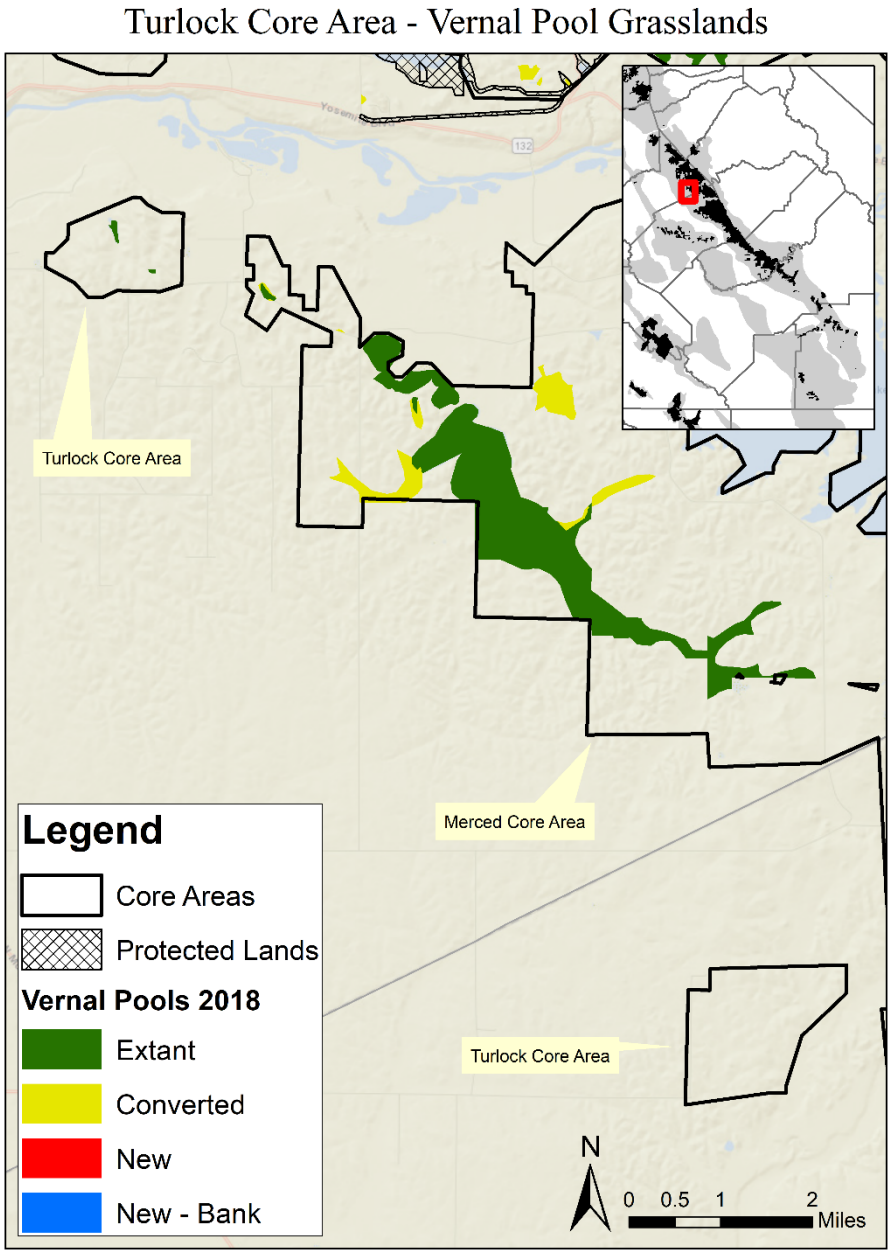

Figure 13.36. Map of vernal pool grassland habitat within the Turlock Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

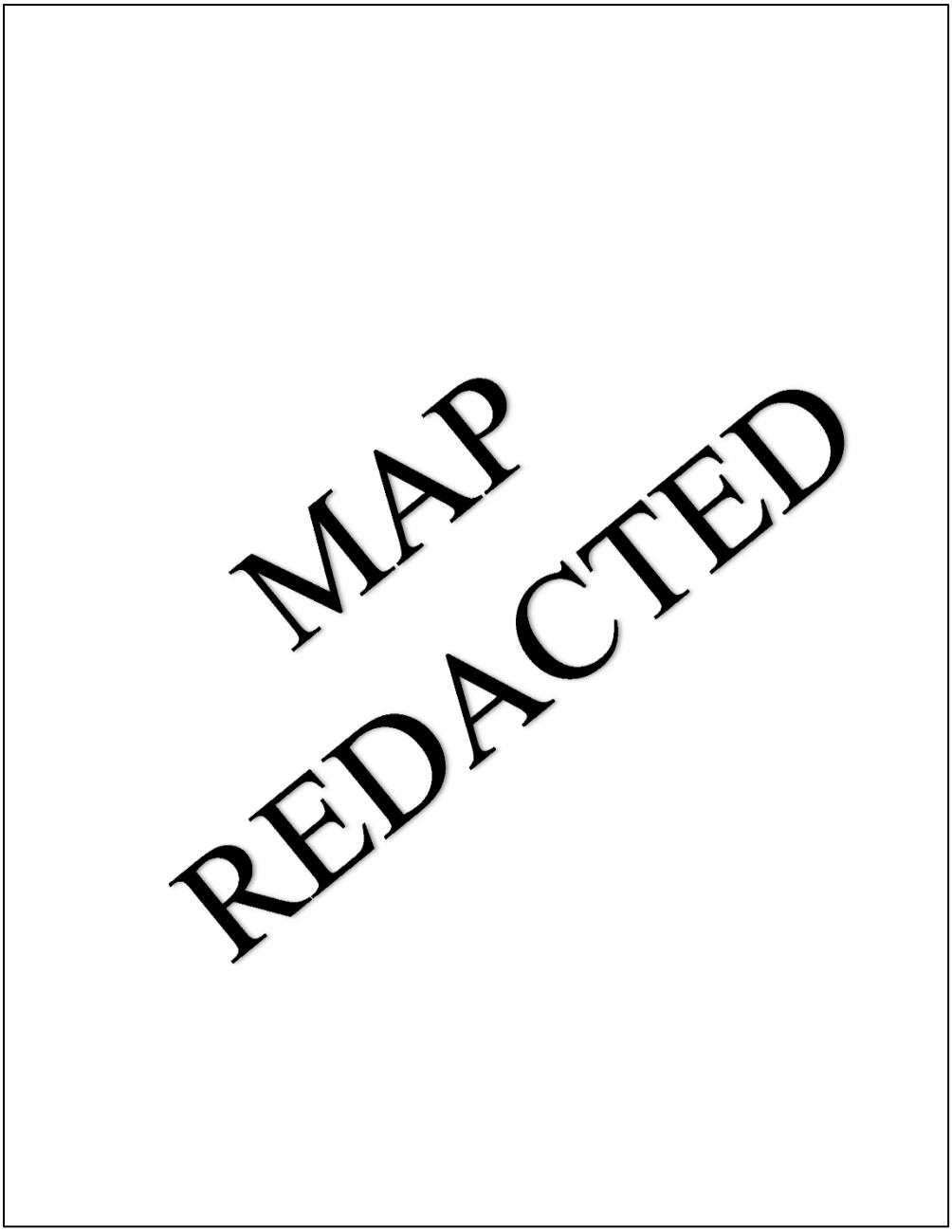

Figure 13.37. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) near the Turlock Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

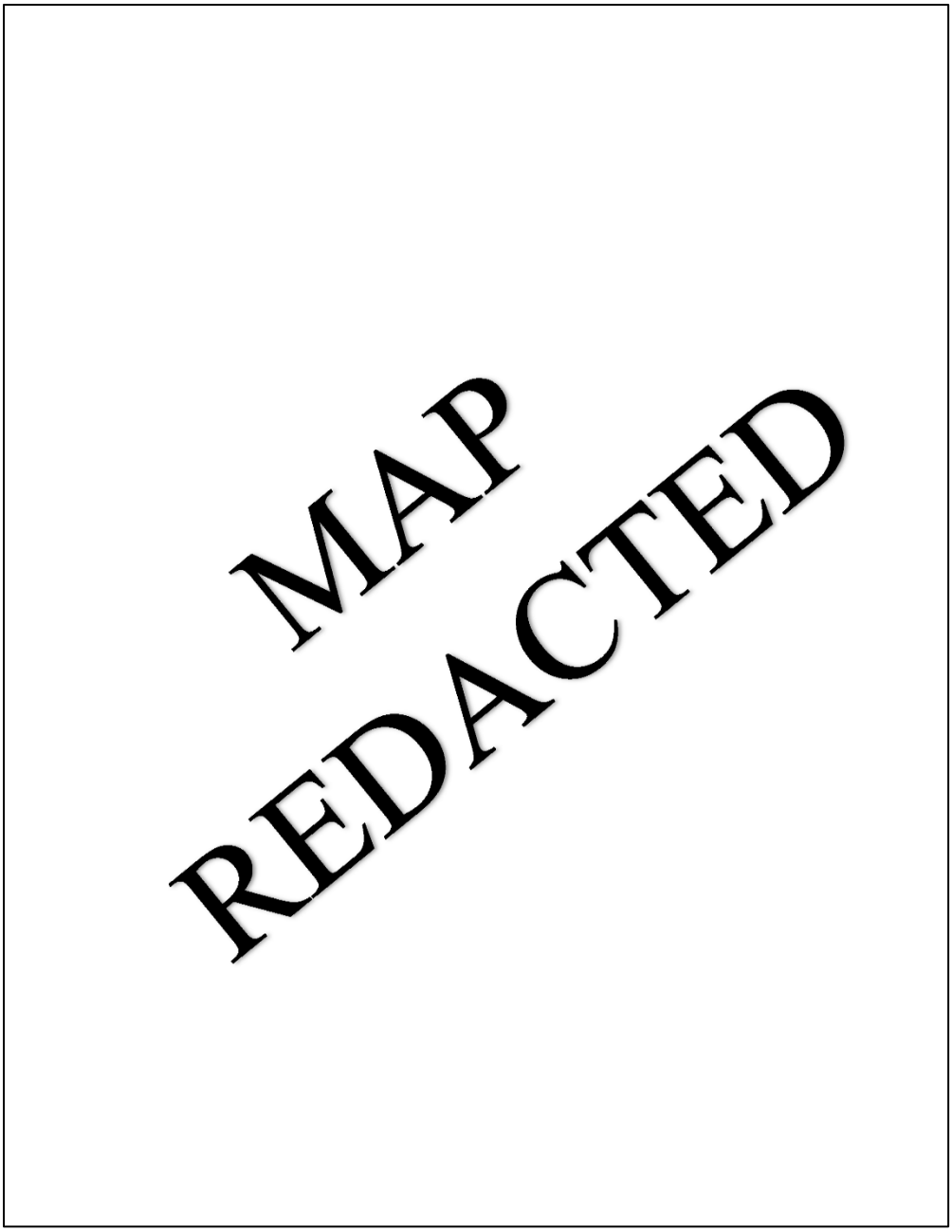

Figure 13.38. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) near the Turlock Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.