12. SOUTHEASTERN SACRAMENTO VALLEY VERNAL POOL REGION

All three shrimp species occur within the Southeastern Sacramento Valley Vernal Pool Region.

12.1. Vernal Pool Habitat

Approximately 136,688 acres of vernal pool grassland existed within, or immediately adjacent to, this region when the Recovery Plan was published in 2005 (see **Figure 12.1**, **Table 12.1**; Witham et al. 2013). Approximately 128,630 acres remained as of 2012, with 8,058 acres (5.9% of 2005 total) lost between 2005 and 2012 (Witham et al. 2014). However, 1,348 acres of new vernal pool grassland were created over that same period on vernal pool mitigation banks and other managed wetlands, and 354 additional acres were identified that were either not present or not visible on the 2005 aerial imagery. Of the habitat lost, 1,363 acres (16.9%) were to urbanization and 6,696 acres (83.1%) were to agricultural conversion (64.6% to bare plowed agricultural land, 15.9% to orchards, and 2.6% to other agricultural conversions) (Witham et al. 2014).

By 2018, approximately 122,790 acres of vernal pool grassland remained, with a total of 16,159 acres (11.8% of 2005 total) lost between 2005 and 2018 (see **Table 12.1**; Witham 2021). A total of 560 acres of new vernal pool grassland were identified in the 2018 aerial imagery: 396 acres on new mitigation banks created since 2012 and 164 acres that were either not present or not visible on both the 2005 and 2012 aerial imagery. Of the habitat lost since 2005, 2,976 acres (18.4%) were to urbanization and 13,184 acres (81.6%) were to agricultural conversion (38.1% to bare plowed agricultural land, 38.0% to orchards, and 5.5% to other agricultural conversions) (see **Table 12.2**; 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.

Although agricultural land conversion was the main cause of vernal pool losses, this region exhibited the highest amount of losses to urbanization of any vernal pool region (Witham et al. 2014; Witham 2021). Placer and Sacramento Counties had the highest amount of vernal pool losses to urbanization from 2005 to 2012 (682 and 600 acres, respectively) and from 2005 to 2018 (1,842 and 933 acres, respectively). The Greater Sacramento area (the six-county area surrounding the city of Sacramento) had a population of approximately 2,578,590 in 2020 (SACOG 2022), up 11.3% from 2010. The population is expected to continue growing over the next 20 years, with a projected population of 2,996,832 in 2040 (16.2% increase over 20 years) (SACOG 2020), so urbanization will likely continue to be a significant cause of habitat loss for the three shrimp species within this region.

As of 2018, roughly 43,847 acres of vernal pool grassland was estimated to be protected in this region, or immediately adjacent to it, typically under a conservation easement (see **Figure 12.1**, **Figure 12.2**, **Table 12.1**; Witham 2021; Vollmar et al. 2017). This represents 36% of the currently remaining vernal pool grassland in the region and 32% of the vernal pool grassland that existed in the region in 2005, the Recovery Plan's baseline. More parcels of vernal pool grassland have been protected since 2018, such as preserves for the South Sacramento and Western Placer County Habitat Conservation Plans and private preserves such as the Rio del Oro Onsite Preserve and Cook Unit of the Sacramento Valley Vernal Pool Preserve.

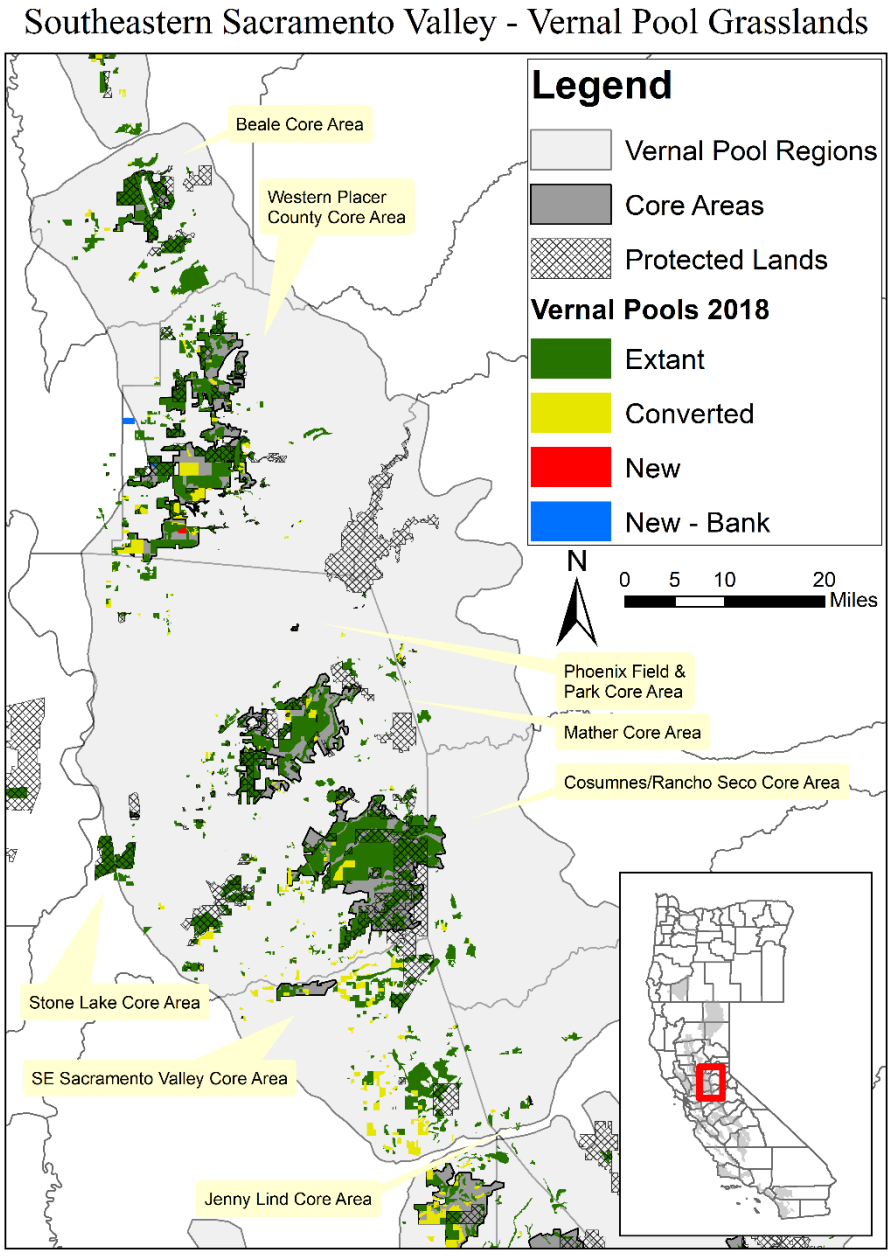

Figure 12.1. Map of vernal pool habitat within the Southeastern Sacramento Valley Vernal Pool Region mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "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.

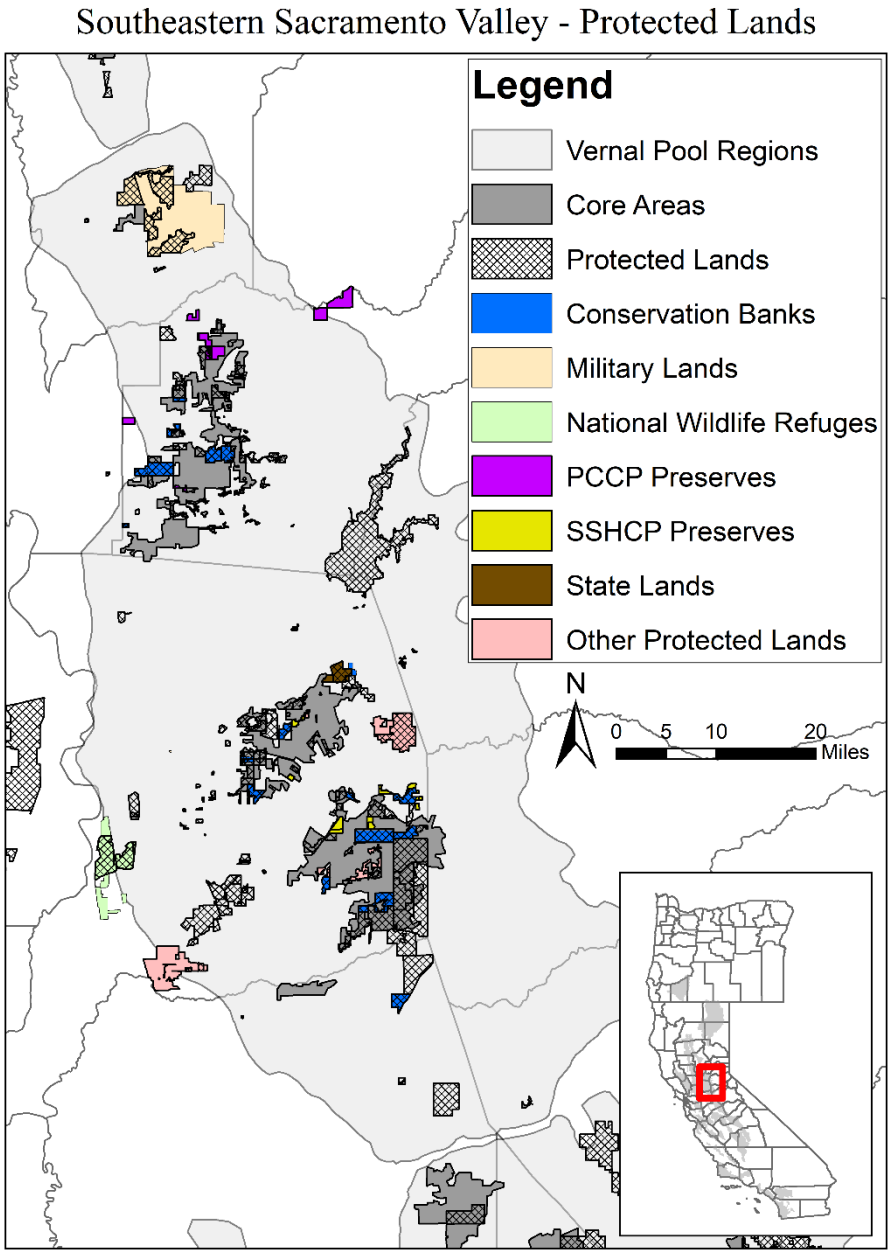

Figure 12.2. Map of protected areas that contain vernal pool grassland habitat and/or the three shrimp species within the Southeastern Sacramento Valley Vernal Pool Region**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. Zoom in for finer resolution.

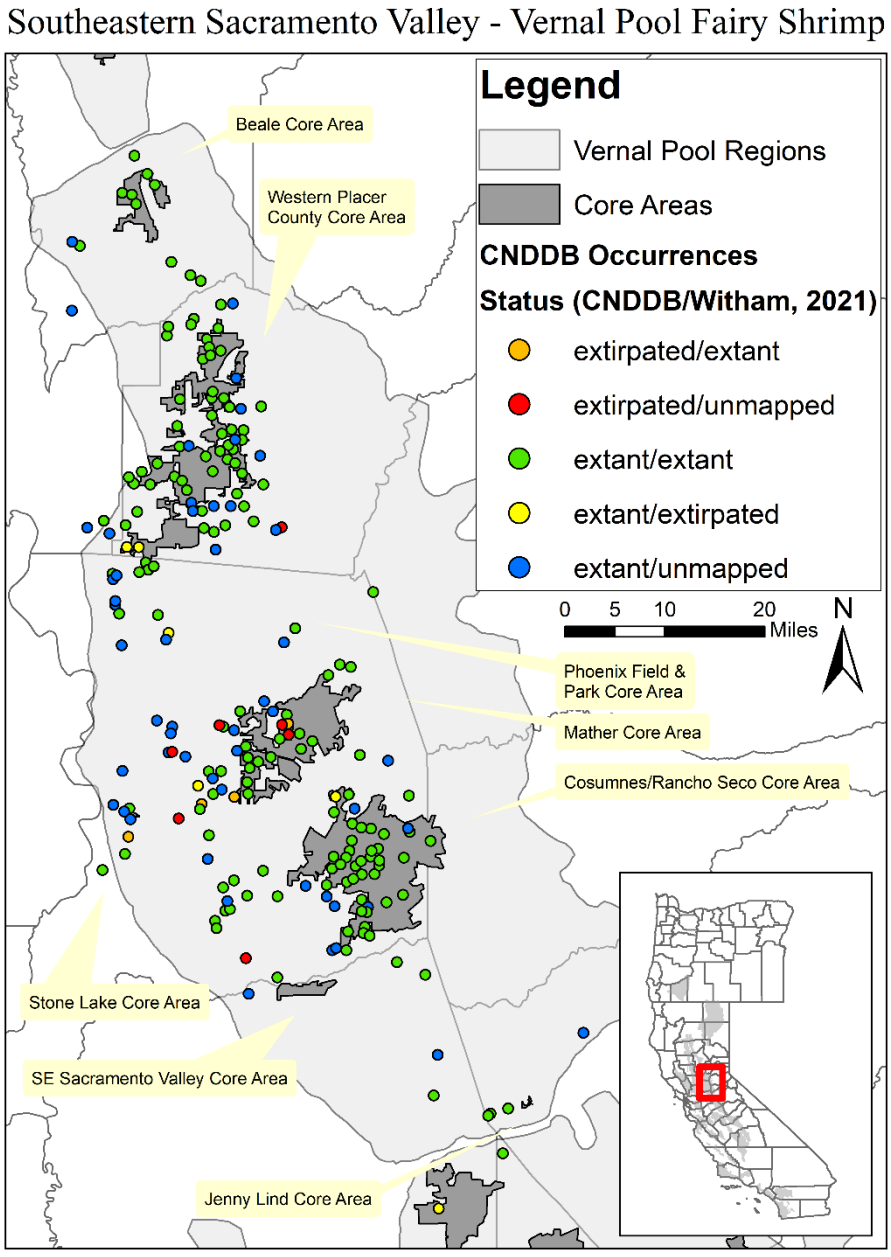

Figure 12.3. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) in the Southeastern Sacramento Valley Vernal Pool Region. Points may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both Diversity Database occurrence records and Witham's (2021) map of vernal pool habitat. All 8 core areas in the region are displayed, though not all core areas are designated for the vernal pool fairy shrimp.

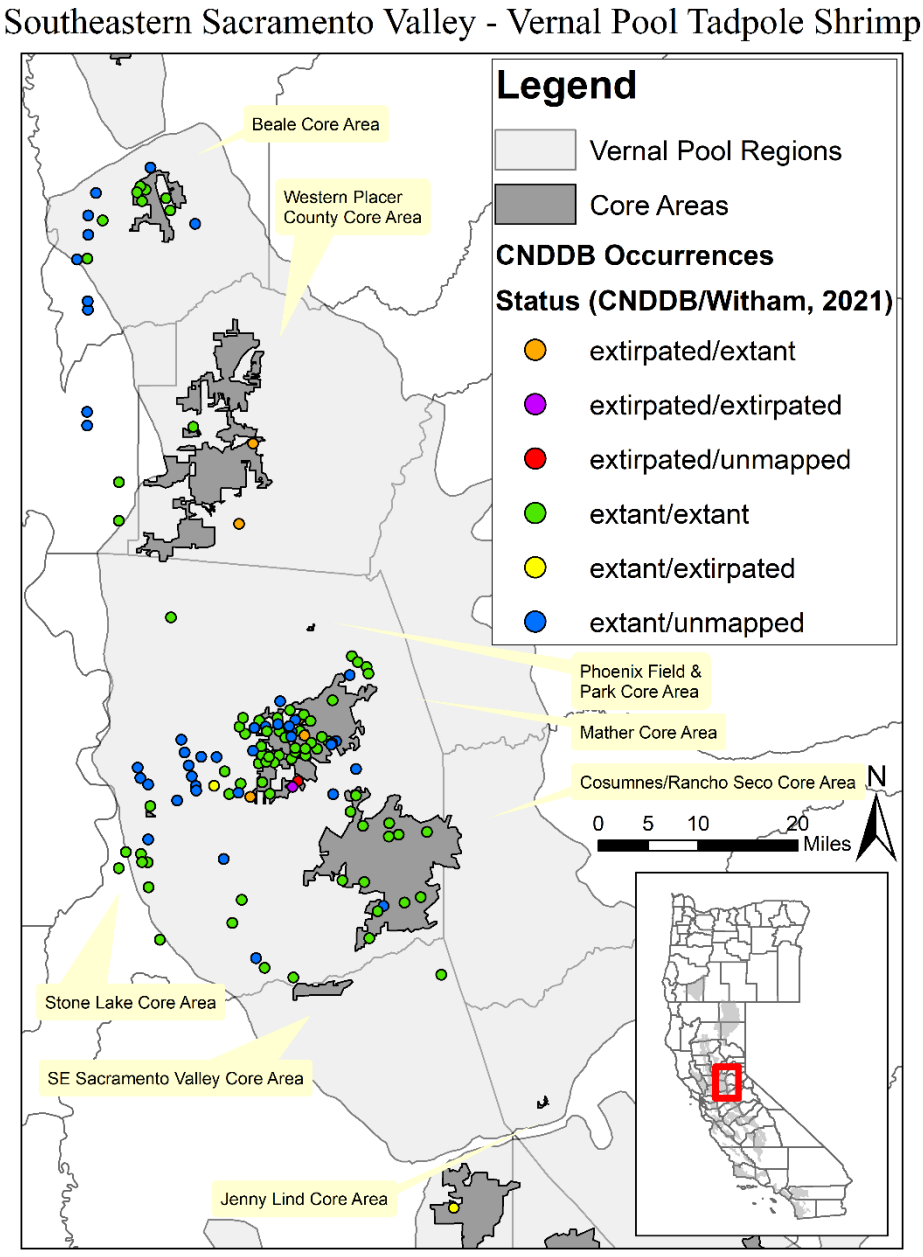

Figure 12.4. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) in the Southeastern Sacramento Valley Vernal Pool Region. Points may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both Diversity Database occurrence records and Witham's (2021) map of vernal pool habitat. All eight core areas in the region are displayed, though not all core areas are designated for the vernal pool tadpole shrimp.

Table 12.1. Acreage of vernal pool habitat and habitat converted within the Southeastern Sacramento Valley 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)
Beale	4,978.2	4,978.2	4,967.5 (99.8%)	10.7 (0.2%)	0.0 (0.0%)	3,541.4 (71.1%)
Cosumnes/Rancho Seco	30,748.5	31,188.6	30,020.6 (96.3%)	1,168.0 (3.7%)	0.0 (0.0%)	12,488.5 (40.0%)
Mather	14,036.6	14,052.0	13,330.9 (94.9%)	106.0 (0.8%)	615.0 (4.4%)	3,933.5 (28.0%)
Phoenix Field and Phoenix Park	17.7	17.7	17.7 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	17.3 (97.7%)
Southeast Sacramento Valley	921.7	921.7	734.2 (79.7%)	187.5 (20.3%)	0.0 (0.0%)	0.0 (0.0%)
Stone Lake	60.7	60.7	60.7 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	60.7 (100.0%)
Western Placer County	22,611.6	23,126.3	20,129.2 (87.0%)	1,981.5 (8.6%)	1,015.6 (4.4%)	6,742.4 (29.2%)
Southeastern Sacramento Valley Vernal Pool Region Total	**136,688.0**	**138,949.6**	**122,790.3 (88.4%)**	**13,183.7 (9.5%)**	**2,975.7 (2.1%)**	**43,847.0 (31.6%)**

Table 12.2. Acreage of vernal pool habitat losses within the Southeastern Sacramento Valley 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,	Agricultural Residential	Managed Wetlands	Total Losses	% Losses Urban Development	% Losses Agricultural Conversions
Beale	0.0	0.0	0.0	0.0	10.7	0.0	0.0	10.7	0.0%	100%
Cosumnes/Rancho Seco	0.0	233.3	0.0	918.9	0.0	15.8	0.0	1,168.0	0.0%	100%
Mather	615.0	65.5	0.0	1.7	0.0	38.9	0.0	721.1	85.3%	14.7%
Phoenix Field and Phoenix Park	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Southeast Sacramento Valley	0.0	0.0	106.8	80.6	0.0	0.0	0.0	187.5	0.0%	100%
Stone Lake	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Western Placer County	1,015.6	37.8	0.0	1,943.7	0.0	0.1	0.0	2,997.1	33.9%	66.1%
Southeastern Sacramento Valley Vernal Pool Region Total	**2,975.7**	**6,138.7**	**546.2**	**6,150.3**	**182.7**	**165.7**	**0.0**	**16,159.4**	**18.4%**	**81.6%**

12.2. Species Occurrences

12.2.1. Vernal Pool Fairy Shrimp

There are 219 occurrence records of the vernal pool fairy shrimp documented within, or immediately adjacent to, the Southeastern Sacramento Valley Vernal Pool Region in the Diversity Database (see **Figure 12.3**; Diversity Database 2022). The vast majority of these occurrences are on privately owned land and are therefore vulnerable to extirpation, though there are a large number of preserves and conservation/mitigation banks in this region, many of which are privately owned. Of these 219 occurrences, 11 are listed by the Diversity Database as extirpated or possibly extirpated, and 5 are labeled by the Diversity Database as presumed extant but are completely within extirpated vernal pool habitat based on Witham's (2021) mapping efforts. Thus, there are a total of at least 16 extirpated occurrences. There are 59 occurrences that are outside of vernal pool habitat mapped by Witham (2021), 7 of which are listed as extirpated or possibly extirpated.

The protected areas contain, at least partially, 112 of the 219 Diversity Database records (51%) for the vernal pool fairy shrimp in this region. However, this does not mean that 51% 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). Only 19 of the 219 Diversity Database polygons (9%) 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.

12.2.2. Vernal Pool Tadpole Shrimp

There are 127 occurrence records of the vernal pool tadpole shrimp documented within, or immediately adjacent to, the Southeastern Sacramento Valley Vernal Pool Region in the Diversity Database (see **Figure 12.4**; Diversity Database 2022). The majority of these occurrences are on privately owned land and are therefore vulnerable to extirpation, though there are a large number of preserves and conservation/mitigation banks in this region, many of which are privately owned. Of these 127 occurrences, 8 are listed by the Diversity Database as extirpated or possibly extirpated, and 1 is labeled by the Diversity Database as presumed extant but is completely within extirpated vernal pool habitat based on Witham's (2021) mapping efforts. Thus, there are a total of at least nine extirpated occurrences. There are 76 presumed extant occurrences that are within extant mapped vernal pool habitat and 42 outside of vernal pool habitat mapped by Witham (2021).

The protected areas contain, at least partially, 63 of the 127 Diversity Database records (50%) for the vernal pool tadpole shrimp in this region. Only 17 of the 127 Diversity Database polygons (13%) 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.

12.2.3. Conservancy Fairy Shrimp

The Conservancy fairy shrimp is only known from a single location in the Southeastern Sacramento Valley Vernal Pool Region: a single vernal pool within the Mariner Vernal Pool Conservation Bank, which makes up the entirety of the Mariner Ranch population (Diversity Database 2022). The Conservancy fairy shrimp was first identified at this site in 2007 and therefore the Recovery Plan (Service 2005) does not discuss the Conservancy fairy shrimp within this vernal pool region.

12.3. Federal Lands

12.3.1. National Wildlife Refuges

There is one National Wildlife Refuge with known occurrences of the vernal pool fairy shrimp within the Southeastern Sacramento Valley Vernal Pool Region: Stone Lakes National Wildlife Refuge (**Figure 12.2**). The Refuge completed a Comprehensive Conservation Plan in 2007, which covered the vernal pool fairy shrimp and included the objective to annually maintain 136 acres of vernal pools (Service 2007c). The vast majority of vernal pools within the Refuge can be found on the 1,400-acre Wetland Preserve Unit, with the rest on the North Stone Lake and Beach Lake Units. The Wetland Preserve Unit is owned in fee title by AKT Development Corporation and managed by the Refuge under a conservation easement (Service 2007c). Only 12% of the vernal pools on the Refuge are naturally occurring; the remainder were created, starting in 1993, as mitigation by AKT for vernal pool losses due to development. Vernal pool fairy shrimp and vernal pool tadpole shrimp have been found throughout the Wetland Preserve Unit (Service 2007c), as well as on a few vernal pools and other wetland features in the North Stone Lake Unit (B. Treiterer and B. McDermott, Service, *in litt*. 2021). The vernal pools created by AKT were monitored for five years after mitigation was completed, but have not been monitored regularly since (B. Treiterer, Service, *in litt*. 2022). The Service did attend a site visit to the Wetland Preserve Unit on January 21, 2022, with Dr. Shannon Kieran and Anderson Tate-Montenegro of UC Davis who were testing eDNA survey protocols; the vernal pool fairy shrimp and vernal pool tadpole shrimp were observed in a few pools during dipnetting (I. Perkins-Taylor and E. Bickerstaff, Service, pers. comm. 2022), and the Service has not yet received the eDNA results. This is the only known monitoring of the Wetland Preserve Unit since the Refuge's Comprehensive Conservation Plan was completed in 2007 (Treiterer, *in litt*. 2022). The most recent survey of vernal pools on the North Stone Lake Unit occurred in February-March 2009; the vernal pool fairy shrimp was identified in seven pools and the vernal pool tadpole shrimp was identified in four pools (Treiterer and McDermott, *in litt*. 2021).

12.3.2. Military Lands

There are two Department of Defense (DOD) installations in the Southeastern Sacramento Valley Vernal Pool Region with known occurrences of the vernal pool fairy shrimp and vernal pool tadpole shrimp: Beale Air Force Base (AFB) in Yuba County and the Navy Operational Support Center in the City of Sacramento (**Figure 12.2**). In addition, the vernal pool fairy shrimp and vernal pool tadpole shrimp are known from the former McClellan AFB in Sacramento County, which closed in 2003 and is now the privately owned McClellan Park neighborhood. Within the McClellan Park neighborhood there were at least 267 acres of vernal pool grassland

remaining in 2018 out of 339 acres that were extant as of 2005 (Witham 2021), but these vernal pool grasslands no longer have the protections afforded by the Department of Defense to natural resources on military lands.

Within Beale AFB, vernal pools cover approximately 1,380 acres on the western, central, and southern portions of the base. Vernal pool fairy shrimp were first detected in 1992 and have been consistently detected in all surveys through 2018 (DOD 2019). However, in the most recent wet season survey for winter 2020-2021, no vernal pool fairy shrimp or vernal pool tadpole shrimp were detected; this is likely because rainfall was only 37% of average and 63% of the 138 sampled vernal pools never filled during the survey period (H.T. Harvey and Associates 2021). Two restoration sites (510 acres and 156 acres) and one preservation site (257 acres) have been designated as Conservation Areas on Beale AFB, preserving 923 acres of vernal pool grassland as long as the Department of Defense continues to manage the land. There are 35 acres of man-made vernal pools at the two restoration sites on the base. Vernal pool monitoring has occurred annually since 2004 for plant and animal species, restoration/mitigation effectiveness, and other physical attributes. Beale AFB's Integrated Natural Resource Management Plan was finalized in 2019 and includes the vernal pool fairy shrimp and vernal pool tadpole shrimp (DOD 2019). The Management Plan's performance standard for the two shrimp species is to maintain or increase the populations on Beale AFB in alignment with the Recovery Plan; this will be achieved through monitoring and appropriate habitat management, including grazing and invasive plant control (DOD 2019). The vernal pool tadpole shrimp was also observed in 1997 and 2013 on the 235-acre Lincoln Receiver Site, a geographically separated unit (GSU) operated by Beale AFB in Placer County (DOD 2019). The entire site is mapped as extant vernal pool grassland (Witham 2021) and the same performance standards and management apply to this site as for Beale AFB (DOD 2019).

The Navy Operational Support Center in Sacramento is a 13.6-acre installation that is located within the former Sacramento Army Depot; the Sacramento Army Depot was closed in and most land was transferred to the city in 1995. There are 0.48 acres of vernal pools on site. An Integrated Natural Resource Management Plan was finalized in 2015 and includes the vernal pool fairy shrimp and vernal pool tadpole shrimp (DOD 2015b). The two shrimp species were not found during protocol-level wet season surveys conducted in 2012-2013 and thus were not known to occur within the Navy Operational Support Center at the time the Management Plan was finalized in 2015. However, the two shrimp species are known to occur immediately adjacent to the site to the south (Diversity Database 2022). One of the Management Plan's objectives was to conserve and monitor potential shrimp habitat within the installation. Specific measures included conducting surveys following accepted protocols and, if the vernal pool fairy shrimp or vernal pool tadpole shrimp are found, evaluating proposed projects for their likelihood to threaten or disturb habitat in order to avoid impacts. Since 2015, the vernal pool fairy shrimp has been found during surveys in 2018 and 2021; despite the drought in 2021, vernal pool fairy shrimp were identified in a pool that contained only 1 inch of water (Vollmar Natural Lands Consulting 2021). However, the vernal pools onsite are likely too shallow and too flashy to support the vernal pool tadpole shrimp.

12.3.3. Bureau of Land Management

There are no Bureau of Land Management lands with known occurrences of the three shrimp species in the Southeastern Sacramento Valley Vernal Pool Region.

12.3.4. Other Federal Lands

There are no other federal lands with known occurrences of the three shrimp species in the Southeastern Sacramento Valley Vernal Pool Region.

12.4. Conservation Banks

This region has the greatest number and total acreage of banks with vernal pool species credits, though it is second or third in terms of the number of vernal pool fairy shrimp and vernal pool tadpole shrimp preservation credits, respectively (acreage of the pools only, not the grassland complex). This region is one of only three regions with creation credits for the vernal pool fairy shrimp and vernal pool tadpole shrimp and it has the vast majority, though other regions may have artificial vernal pools created outside of banks.

There are 17 conservation or mitigation banks within the Southeastern Sacramento Valley Vernal Pool Region that provide credits for preserved and created vernal pools that support the vernal pool fairy shrimp: Antonio Mountain Ranch, Arroyo Seco, Bryte Ranch, Clay Station, Fitzgerald Ranch, Gill Ranch, Laguna Creek, Laguna Terrace East, Locust Road, Mariner Ranch, Orchard Creek, SMUD Nature Preserve, Sunrise Douglas, Toad Hill Ranch, Van Vleck Ranch, Western Placer Schools, and White Rock Road Properties – Scott Road (see **Figure 12.2**; RIBITS 2021). These banks protect a total of 10,897 acres of land, including 790.7 acres of preserved vernal pools and 212.1 acres of created vernal pools for the vernal pool fairy shrimp (Table 6). Four of the 17 banks are completely sold out of credits, and the 17 banks have sold a total of 616.9 acres (78%) of preservation credits and 153.1 acres (72%) of creation credits for the vernal pool fairy shrimp (RIBITS 2021).

There are 11 conservation or mitigation banks within the Southeastern Sacramento Valley Vernal Pool Region that provide credits for preserved and created vernal pools that support the vernal pool tadpole shrimp: Arroyo Seco, Bryte Ranch, Clay Station, Gill Ranch, Laguna Creek, SMUD Nature Preserve, Sunrise Douglas, Toad Hill Ranch, Van Vleck Ranch, Western Placer Schools, and White Rock Road Properties – Scott Road (see **Figure 12.2**; RIBITS 2021). These banks protect a total of 8,228 acres of land, including 507.3 acres of preserved vernal pools and 169.1 acres of created vernal pools for the vernal pool tadpole shrimp (Table 6). Two of the 11 banks are completely sold out of credits, and the 11 banks have sold a total of 385.2 acres (76%) of preservation credits and 132.8 acres (79%) of creation credits for the vernal pool tadpole shrimp (RIBITS 2021).

The Mariner Vernal Pool Conservation Bank (a.k.a., Mariner Ranch) contains the only known occurrence of the Conservancy fairy shrimp in the Southeastern Sacramento Valley Vernal Pool Region. This 160-acre bank is located in western Placer County, adjacent to the 531-acre Rockwell Ranch Vernal Pool Preserve, and contains approximately 374 vernal pools and associated swales that total 25.63 wetted acres (Westervelt Ecological Services 2023). This bank only provides credits for the vernal pool fairy shrimp and has been sold out and closed since

2018 (RIBITS 2021; Westervelt Ecological Services 2023). Aquatic invertebrate monitoring occurs every five years in a subset of the vernal pools. A single male Conservancy fairy shrimp was first identified on the bank in 2007 in a single vernal pool. The species was observed again during targeted surveys in 2008 and 2011 in the same pool (Helm Biological Consulting 2011). The vernal pool fairy shrimp was also found in the pool during these targeted surveys, but the two species appeared to be segregated spatially within the pool; this segregation did not appear to be due to differences in topography, vegetation, or turbidity (Helm Biological Consulting 2011). Regular monitoring of the subset of vernal pools in 2012 and 2017 again identified the Conservancy fairy shrimp in the same vernal pool, though the species was not identified in 2022 (Westervelt Ecological Services 2013; Westervelt Ecological Services 2018; Westervelt Ecological Services 2023).

12.5. Habitat Conservation Plans

There are six regional Habitat Conservation Plans (HCPs) within the Southeastern Sacramento Valley Vernal Pool Region that include the vernal pool fairy shrimp and vernal pool tadpole shrimp as Covered Species (**Figure 12.5**). Three of these HCPs also include the Conservancy fairy shrimp as a Covered Species.

12.5.1. Natomas Basin HCP

The Natomas Basin HCP covers the 53,537-acre area inside the system of levees surrounding the Natomas Basin in northern Sacramento County and southern Sutter County, and is partially within the vernal pool region (NBHCP 2002). This HCP was permitted in 2003 and has a 50-year permit term, and the permittees are the City of Sacramento, Sutter County, The Natomas Basin Conservancy, Reclamation District 1000, and Natomas Central Mutual Water Company. The purpose of the HCP is to promote biological conservation in conjunction with economic and urban development by creating a multi-species conservation program to minimize and mitigate the expected loss of habitat values and incidental take of Covered Species that could result from urban development, operation and maintenance of irrigation and drainage systems, and certain management activities associated with the reserve system. The HCP's Operating Conservation Program will result in 8,750 acres of Mitigation Lands to be preserved in perpetuity.

As of 2018, there was only a small amount of vernal pool grassland on the eastern edge of the HCP area (Witham 2021). However, pre-construction surveys for past City of Sacramento projects in the area have identified small, isolated vernal pools (NBHCP 2002). There are no known natural occurrences of the vernal pool fairy shrimp or vernal pool tadpole shrimp within the HCP area, though there are several immediately outside of the eastern boundary, and there is one occurrence from a man-made pool surrounded by industrial and agricultural land uses (Diversity Database 2022). The HCP requires that pre-construction surveys be conducted to identify any vernal pools within a project area. If vernal pools are present then the project will either avoid and dedicate the land for an onsite preserve or mitigate for vernal pool losses by purchasing credits at a conservation bank. To date there have been no impacts to the vernal pool fairy shrimp or vernal pool tadpole shrimp from Covered Activities. The Natomas Basin Conservancy has tried to construct and inoculate vernal pools for the two shrimp species, but those efforts were not successful at creating occupied habitat (J. Roberts, TNBC, *in litt*. 2021). Creation efforts may continue in the future, and obtaining inoculum from local vernal pools that

are adapted to the local soil and water conditions may be especially important given the historical deep flooding of the Natomas Basin before the levees were built (Roberts, *in litt*. 2021).

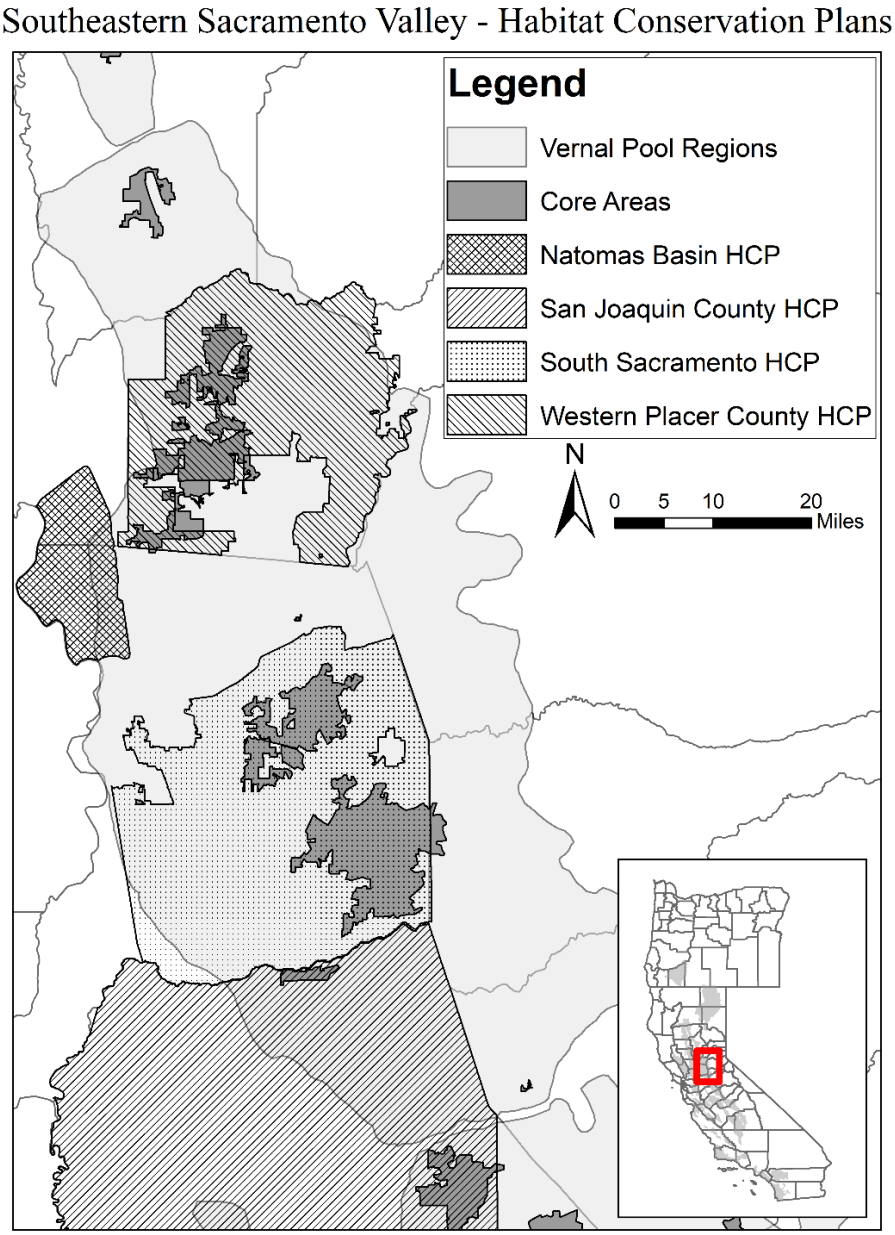

Figure 12.5. Map of the habitat conservation plans (HCPs) within the Southeastern Sacramento Valley Vernal Pool Region that include any of the three shrimp species as Covered Species. The PG&E San Joaquin Valley and PG&E Multiple Region Operations and Maintenance HCPs are not shown, but they cover San Joaquin County and the entirety of the Vernal Pool Region except for San Joaquin County, respectively.

12.5.2. PG&E Multiple Region Operations and Maintenance HCP

See section 2.5.1 for a description of this HCP.

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

See section 9.5.2 for a description of this HCP.

12.5.4. San Joaquin County HCP

See section 6.5.3 for a description of this HCP.

12.5.5. South Sacramento HCP

The South Sacramento HCP covers the southern and eastern portions of unincorporated Sacramento County as well as the Cities of Rancho Cordova and Galt, and is entirely within the vernal pool region (SSHCP 2018). This HCP was permitted in 2019 and has a 50-year permit term, and the permittees are the South Sacramento Conservation Agency, Sacramento County, City of Rancho Cordova, City of Galt, Sacramento County Water Agency, and the Southeast Connector Joint Powers Authority. The goal of the HCP is to provide development and infrastructure projects with streamlined, predictable federal and state permitting processes while creating a Preserve System to protect habitat, open space, and agricultural lands. The HCP's Conservation Strategy will result in an interconnected Preserve System totaling 36,282 acres of land preserved in perpetuity.

Habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp was modeled as all Vernal Pool (4,534 acres), Swale (1,253 acres), Stream/Creek (vernal pool invertebrate habitat) (73 acres), and Valley Grassland (135,150 acres) land cover types within the HCP area. Effects on the two shrimp species from Covered Activities include loss of vernal pool habitat and degradation due to edge effects that result in changes to hydrology of adjacent vernal pools. Over the 50-year permit term, Covered Activities will permanently affect 17,259 acres of vernal pool fairy shrimp and vernal pool tadpole shrimp modeled habitat (787 acres of vernal pools/aquatic habitat and 16,472 of surrounding grassland matrix). The HCP has a variety of biological goals, measurable objectives, and conservation actions related to protecting the two shrimp species, including: preserving 1,270 acres of aquatic modeled habitat (966 acres of Vernal Pools, 278 acres of Swales, and 26 acres of Stream/Creek vernal pool invertebrate habitat), preserving 22,014 acres of Valley Grassland within the Vernal Pool Ecosystem, mitigating impacts to vernal pools within/adjacent to the Mather and Cosumnes/Rancho Seco Core Areas within/adjacent to the Core Area, creating 389 acres of functional vernal pools including 50 acres within/adjacent to the Mather Core Area, and collecting topsoil from vernal pools to be converted by Covered Activities for later use as inoculum for the created pools.

As of September 30, 2021, Covered Activities have directly impacted 17.59 acres and indirectly impacted 1.18 acres of vernal pools, swales, and other water features that provide habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp, and 558.57 acres of valley grassland (SSCA 2022). More impacts have been authorized and had fees collected, but not all of the authorized projects have gone to construction as of the end of 2021 (K. Hudson, SSCA, *in litt*. 2021). Seven preserves with vernal pool habitat were protected in perpetuity using HCP funds by

the end of 2021: Gill Ranch (acquisitions 1 and 2), Ogden Ranch, Arista del Sol, Mahon Ranch, The Ranch, Van Vleck (acquisitions 1 and 2), and Rooney 2 (SSCA 2022).

12.5.6. Western Placer County HCP

The Western Placer County HCP covers the western portion of unincorporated Placer County and the City of Lincoln, and is almost entirely within the vernal pool region (PCCP 2020). This HCP was permitted in 2020 and has a 50-year permit term, and the permittees are Placer County, City of Lincoln, South Placer Regional Transportation Authority, Placer County Water Agency, and the Placer Conservation Authority. The purpose of the HCP is to protect and enhance ecological diversity and function, including aquatic resource functions and values, in the greater portion of western Placer County while allowing appropriate and compatible growth in accordance with applicable laws. The HCP's Conservation Strategy includes creating a Preserve System of 47,300 acres of natural and semi-natural community protected and restored habitat that will be preserved in perpetuity.

Habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp was modeled as all Vernal Pool Complex land cover type (44,278 acres), including associated wetland habitat (2,230 acres), within the Plan Area. Over the 50-year permit term, Covered Activities will result in permanent direct effects to up to 12,550 acres of vernal pool complex (including up to 580 acres of wetland habitat), temporary direct effects to up to 455 acres of vernal pool complex (including up to 30 acres of wetland habitat), and indirect effects to up to 1,796 acres of vernal pool complex and an additional 66 acres of wetland habitat. The HCP has a variety of biological goals, measurable objectives, and conservation actions related to protecting the two shrimp species, including: preserving 17,000 acres of vernal pool complex (790 wetted acres), creating or restoring 3,000 acres of vernal pool complex (minimum of 30 wetted acres, 900 wetted acres if maximum allowable loss occurs), collecting topsoil from vernal pools to be converted by Covered Activities for later use as inoculum for the created pools, and maintaining a vernal pool fairy shrimp and vernal pool tadpole shrimp occupancy rate greater than or equal to the occupancy of vernal pools lost due to Covered Activities.

As of December 31, 2022, Covered Activities have permanently impacted 600.6 acres of vernal pool complex, including 12.32 acres of wetland habitat (PCA 2023). Six preserves with vernal pool habitat were protected in perpetuity by the end of 2022: Amoruso Ranch, Bradley, East Sheridan 297, Ellis, Markham Ravine, and Redwing South. These preserves total 1,667.8 acres in size and protect 1,350.8 acres of vernal pool complex, including 181.8 acres of wetland features (PCA 2023). One of these preserves, the Markham Ravine In Lieu Fee Site, is a 297-acre vernal pool restoration site. Wetland restoration efforts were completed in 2018 and include 24.01 acres of vernal pools and 11.23 acres of seasonal wetlands and swales (vernal pool complex) (Helm Biological Consulting 2021). In 2021, the vernal pool fairy shrimp was detected in 8 of 54 wetlands sampled at Markham Ravine (Helm Biological Consulting 2021). The vernal pool fairy shrimp is also known to occur on the Amoruso Ranch, Bradley, East Sheridan 297, and Redwing South preserves (PCA 2023). The vernal pool tadpole shrimp is not yet known to occur on any of the preserves.

Habitat for the Conservancy fairy shrimp was not modeled since it is restricted to the Mariner Vernal Pool Conservation Bank and large, turbid pools are generally not found throughout Placer

County. Although currently known from only one location, surveys may detect the Conservancy fairy shrimp at additional locations in the future. Therefore, the HCP includes several conservation measures specific to the Conservancy fairy shrimp: pre-construction surveys for the species will be required in the two watersheds that straddle the known occurrence, and if take occurs due to HCP projects then two new occurrences must be protected for the first occurrence taken, and three new occurrences must be protected for any subsequent occurrences taken.

12.6. Other Preserves

Various vernal pool preserves outside of federal lands, banks, and HCP preserve systems have been established in this vernal pool region (Vollmar et al. 2017). Many of these are private preserves that were protected by landowners as part of proposed conservation measures during Section 7 interagency consultations and are thus referred to as "permittee responsible mitigation" (PRM) or "turn-key" sites. There are many PRM sites particularly in the Southeastern Sacramento Valley Vernal Pool Region due to the large number of Section 7 consultations in the Greater Sacramento area related to urban development projects. Almost all of these preserves are protected by a conservation easement with a Service-approved management plan and an endowment that covers annual monitoring and management costs. Although these PRM sites do submit annual reports to the Service, there is currently no comprehensive list of all PRM sites, their locations, species and habitat acreage present, etc. The Sacramento Fish and Wildlife Office is currently in the process of compiling a comprehensive list of preserves.

As part of larger conservation planning efforts that informed the South Sacramento and Western Placer County HCPs, these HCPs did attempt to document preserves that already existed within their jurisdictions. The South Sacramento HCP documented 64,500 acres of protected lands in southern Sacramento County as of 2018, though this included wildlife refuges and conservation banks as well as private preserves, and not all of those preserves include vernal pool grasslands (SSHCP 2018). The Western Placer County HCP documented 7,068 acres of vernal pool grassland within existing preserves in western Placer County as of 2020 (PCCP 2020), 5,421 acres of which was within the Western Placer County Core Area. This included lands preserved within the City of Roseville under the Roseville Open Space Preserve Overarching Management Plan, a city-run preserve system that the Service consulted on in 2011. The Management Plan includes annual monitoring of vernal pool invertebrates and plant species as well as outlining appropriate management practices for vernal pool grasslands related to thatch management, invasive plant management, maintaining natural vernal pool hydrology, and enhancement and restoration where applicable.

There are two State-owned lands with vernal pools in this vernal pool region. The Prairie City State Vehicular Recreation Area is an off-highway vehicle park in eastern Sacramento County operated by the California Department of Parks and Recreation (CDPR). This state park has many vernal pools and the vernal pool fairy shrimp and vernal pool tadpole shrimp have been observed there. CDPR is currently preparing a Wildlife Habitat Protection Plan for this area, which includes management of the vernal pools (CDPR 2022b). The state park hosts annual vernal pool tours for the public, which contribute to the Recovery Plan's goals for public awareness and outreach. The Phoenix Field Ecological Reserve is a small preserve owned by CDFW near Phoenix Park in the City of Fair Oaks. The vernal pool fairy shrimp and vernal pool tadpole shrimp are not known to occur within this preserve, but the land management plan does

have goals related to the protection, management, and monitoring of the vernal pool habitat and species that are known to occur on the preserve (ESA Associates 2006b).

12.7. Vernal Pool Core Areas

There are four Core Areas within the Southeastern Sacramento Valley Vernal Pool Region that are designated in the Recovery Plan for the vernal pool fairy shrimp and vernal pool tadpole shrimp: Beale, Cosumnes/Rancho Seco, Mather, and Western Placer County. None have met the target amount of vernal pool habitat protected, but as of 2018 none had lost enough habitat, compared to the baseline level of habitat that was present in 2005, to make the target unattainable (see **Table 12.1**; Vollmar et al. 2017; Witham 2021). Technically the Mather Core Area had lost 5.1% of the 2005 baseline, but the HCP's Conservation Strategy is designed to meet the six criteria for alternative conservation mechanisms in the Recovery Plan (described in the Recovery Plan Concepts section above), and therefore successful implementation of the HCP should result in meeting this core area's recovery goals at the end of the HCP's 50-year permit term.

There are also three additional Core Areas that were not designated for the vernal pool fairy shrimp in the Recovery Plan and two additional Core Areas that were not designated for the vernal pool tadpole shrimp in the Recovery Plan, but that have known occurrences of the species in the Diversity Database: Phoenix Field and Phoenix Park (vernal pool fairy shrimp only), Southeast Sacramento Valley (both species), and Stone Lake (both species) (Diversity Database 2022). All of the occurrences were known prior to 2005, but the core areas may not have been designated for the vernal pool fairy shrimp and vernal pool tadpole shrimp in the Recovery Plan due to only slight overlap with the core areas or potential extirpation. The Phoenix Field and Phoenix Park and Stone Lake Core Areas have met the 85% protection target, and the Southeast Sacramento Valley Core Area has lost more than 15% of the amount of vernal pool habitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration (see **Table 12.1**; Vollmar et al. 2017; Witham 2021).

The one known occurrence of the Conservancy fairy shrimp within the Southeastern Sacramento Valley Vernal Pool Region is located in the Western Placer County Core Area. The Recovery Plan does not provide habitat preservation goals for the Conservancy fairy shrimp in this core area, as the occurrence was not known in 2005. However, the Recovery Plan does recommend the protection of 100% of newly discovered populations as a criteria for delisting.

12.7.1. Beale

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 majority of this core area is within Beale AFB in Yuba County.

There were approximately 4,967.5 acres of vernal pool grassland within this core area as of 2018, with only 10.7 acres of habitat lost since the Recovery Plan's 2005 baseline (see **Figure 12.6**, **Table 12.1**, **Table 12.2**; Witham 2021). Roughly 3,541 acres of vernal pool grassland has been protected within this core area, representing 71% of the 2005 baseline (Vollmar et al. 2017). However, no vernal pool grasslands within this core area have been permanently

protected. Beale AFB has preserved 923 acres of vernal pool grassland within three Conservation Areas (DOD 2019), and Vollmar et al. (2017) considered most of the Air Force Base within the core area to be protected land (**Figure 2.9**). However, these areas are not protected in perpetuity under a conservation easement or deed restriction, and could conceivably be subject to changes in management if Federal priorities shift or if the base is ever closed and the land is transferred to a different landowner (DOD 2019).

12.7.1.1. Vernal Pool Fairy Shrimp Occurrences

There are five Diversity Database occurrence records for the vernal pool fairy shrimp within this core area; all are within Beale AFB, though one record represents the entire western portion of the vernal pool grasslands on Beale AFB (see **Figure 12.8**; Diversity Database 2022). Vernal pool fairy shrimp were first detected on Beale AFB in 1992 and have been consistently detected in all surveys since (2008, 2010, 2012, 2014, and 2015-2018) (DOD 2019). Surveys of 1,000 vernal pools at Beale AFB in 1995 and 1996 found vernal pool fairy shrimp in 134 of the pools (Jones and Stokes Associates 1998 as cited in DOD 2019). The southwestern portion of the core area extends outside of Beale AFB, and although there is vernal pool grassland habitat in this area (Witham 2021), no records of the vernal pool fairy shrimp have been reported to the Diversity Database (Diversity Database 2022), which may be due to lack of sampling.

12.7.1.2. Vernal Pool Tadpole Shrimp Occurrences

There are four Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area; all are within Beale AFB (see **Figure 12.9**; Diversity Database 2022). Vernal pool tadpole shrimp were first detected in 1996 and have been consistently detected in surveys through 2018 (DOD 2019). Surveys of 1,000 vernal pools at Beale AFB in 1995 and 1996 found vernal pool tadpole shrimp in 29 of the pools (Jones and Stokes Associates 1998). The southwestern portion of the core area extends outside of Beale AFB, and although there is vernal pool grassland habitat in this area (Witham 2021), no records of the vernal pool tadpole shrimp have been reported to the Diversity Database (Diversity Database 2022), which may be due to lack of sampling.

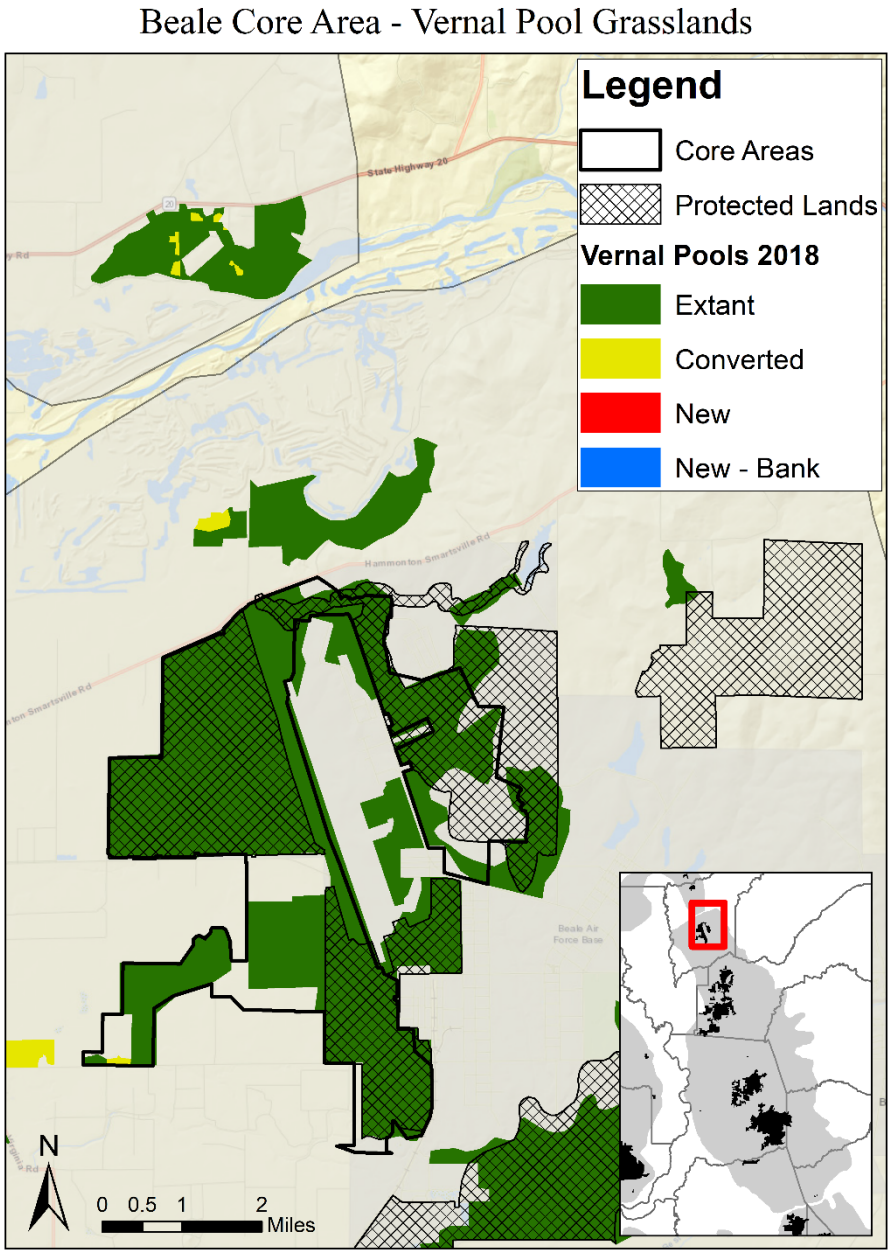

Figure 12.6. Map of vernal pool grassland habitat within the Beale Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers 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.

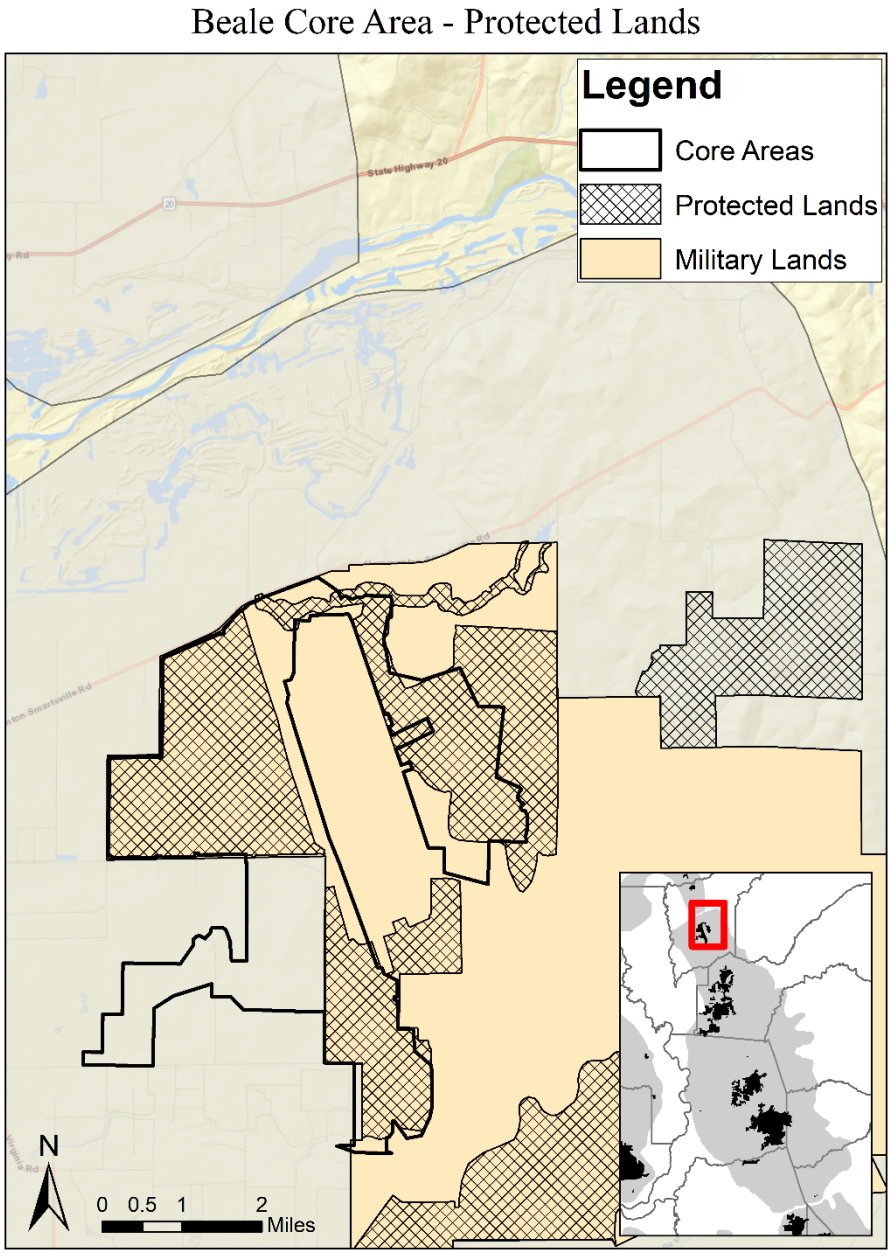

Figure 12.7. Map of protected areas within the Beale Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

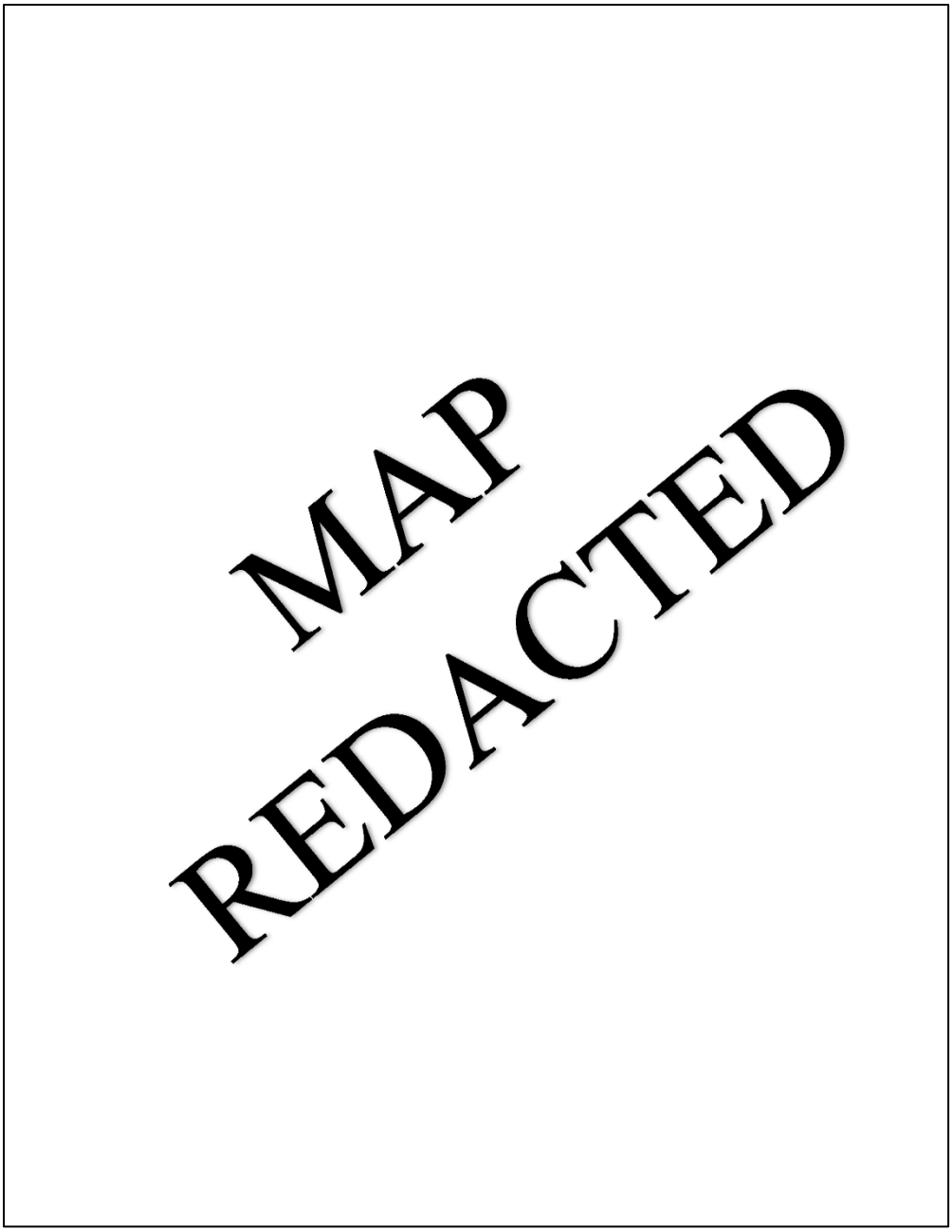

Figure 12.8. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Beale Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

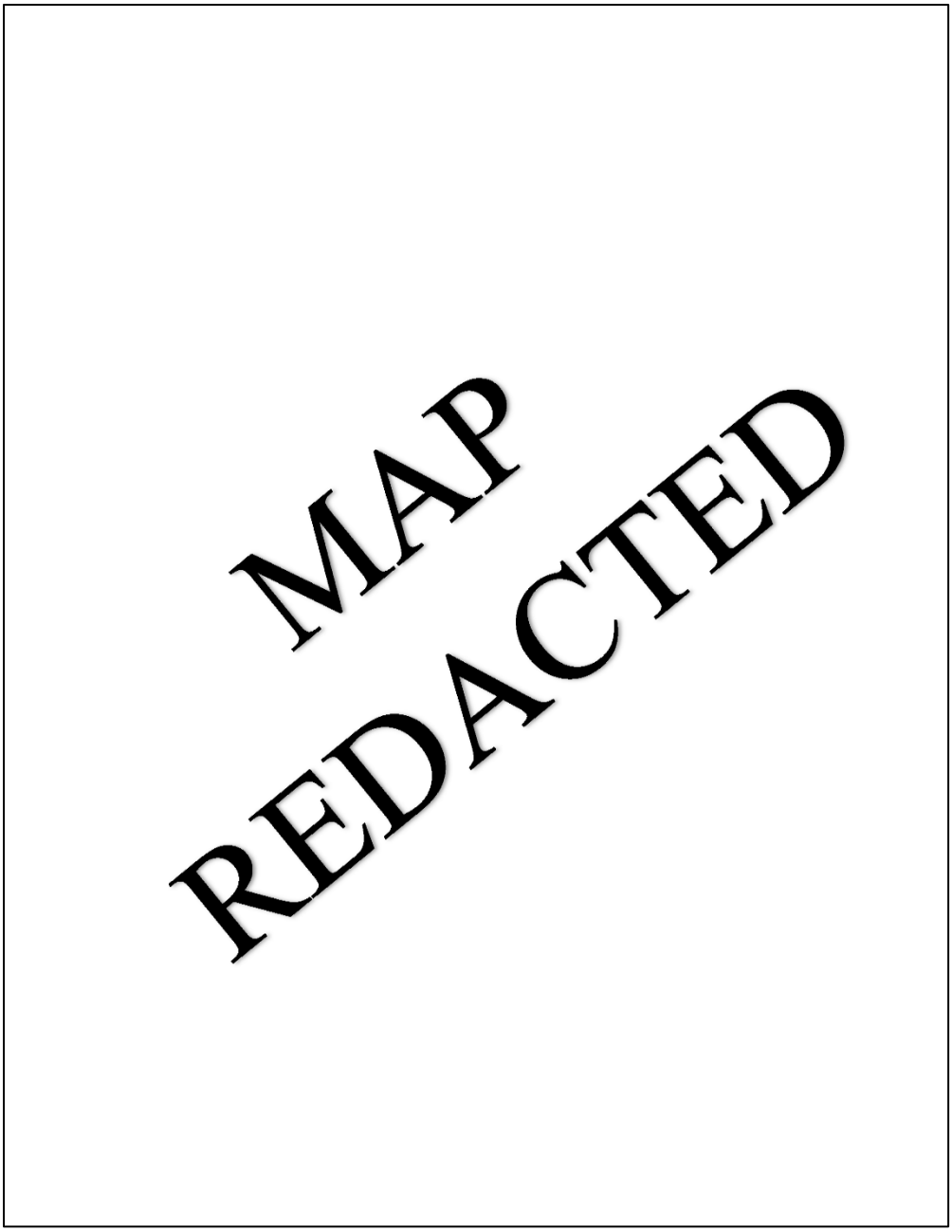

Figure 12.9. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Beale Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

12.7.2. Cosumnes/Rancho Seco

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 southeastern Sacramento County and a small portion of adjacent El Dorado County.

There were approximately 30,749 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 30,021 acres of vernal pool grassland remaining (see **Figure 12.10**, **Table 12.1**; Witham 2021). Approximately 1,168 acres had been lost since the Recovery Plan's 2005 baseline, though 440 additional acres were created on banks that were not previously mapped as vernal pool grassland in 2005. All of the habitat losses were attributable to agricultural conversions (233.3 acres [20.0%] to orchards, 918.9 acres [78.7%] to bare plowed agricultural land, and 15.8 acres [1.4%] to agricultural residences) (**Table 12.2**). Roughly 12,489 acres of vernal pool grassland were estimated to be protected within this core area as of 2017 (Vollmar et al. 2017), representing 41% of the 2005 baseline (**Figure 12.11**). There are additional areas of protected vernal pool habitat within lands that were protected after 2017 or were otherwise not captured in Vollmar et al.'s (2017) database, so the actual amount of protected habitat is higher.

This core area is entirely within the boundaries of the South Sacramento HCP, except for the small portion in El Dorado County. The HCP estimates that 53 acres of vernal pool grassland within this core area will be permanently lost due to Covered Activities (SSHCP 2018). These losses will be required to be mitigated at HCP preserves within the core area; however, additional acres of vernal pool grassland beyond what is necessary to offset the loss of these 53 acres will likely be preserved within the core area. While the Recovery Plan's goal of protecting 85%/95% of vernal pool habitat is still achievable, the Recovery Plan also acknowledges that alternative mechanisms such as HCPs may be deemed equivalent to implementation of the recovery plan if they contain the six elements specified for meeting equivalency (Service 2005a). The HCP's Conservation Strategy is designed in a way that should meet these six criteria, and therefore successful implementation of the HCP should result in meeting this core area's recovery goals at the end of the HCP's 50-year permit term even if 85%/95% protection has not been achieved. To date, the South Sacramento Conservation Agency (the entity in charge of implementing the HCP) has preserved two properties within the core area that contain vernal pool fairy shrimp habitat: Gill Ranch and Mahon Ranch (SSCA 2022).

There are five conservation banks with vernal pool fairy shrimp and vernal pool tadpole shrimp preservation credits in the core area: Clay Station, Gill Ranch, Laguna Creek, Laguna Terrace East, SMUD Nature Preserve (**Figure 12.11**). These banks total 4,327 acres in size and have 237.4 acres of preservation credits for the vernal pool fairy shrimp (63% of which have already been sold), 192.0 acres of preservation credits for the vernal pool tadpole shrimp (61% sold), and 109.7 acres of creation credits for both species (69% sold). Although most activities within the core area are covered under the South Sacramento HCP, these banks can continue to sell credits to compensate for activities that are outside of the jurisdiction of, or otherwise not covered by, the South Sacramento HCP.

Other preserves within the core area include: the South Sacramento HCP Gill Ranch and Mahon Ranch preserves, GiuTere Preserve, Silva Ranch, Borden Ranch, Gill Ranch: Vineyard Pointe,

Brown's Creek Vernal Pool Preserve, Laguna Terrace Vernal Pool Preserve, five other mitigation properties from Vollmar et al.'s (2017) database, and a large extent of private ranchland on the east side of the core area with conservation easements held by CDFW, the Natural Resources Conservation Agency, or The Nature Conservancy.

12.7.2.1. Vernal Pool Fairy Shrimp Occurrences

There are 39 Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 12.12**; Diversity Database 2022). As of 2018, 25 of these occurrences were at least partially within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database, though one occurrence was partially within areas mapped as having vernal pool habitat loss (Witham 2021). Vernal pool fairy shrimp were first detected within this core area in 1982 and new Diversity Database records were consistently reported up through 2014 (Diversity Database 2022). Of the 39 records, 5 were known at the time of listing in 1994 and 14 were known at the time the Recovery Plan was published in 2005; these records are mostly located in the central, southern, and northeastern portions of the core area. The 25 newer records are mostly located in the northwestern portion of the core area, with a few in the southern and a few in the northeastern (El Dorado County) portions. This confirms that the vast majority of vernal pool grasslands in this core area are occupied by the vernal pool fairy shrimp.

12.7.2.2. Vernal Pool Tadpole Shrimp Occurrences

There are 14 Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 12.13**; Diversity Database 2022). As of 2018, 12 of these occurrences were at least partially within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; 13 are within extant vernal pool habitat and 1 is outside of mapped vernal pool habitat (Witham 2021). Of the 14 records, 2 were known at the time of listing in 1994 and 7 were known at the time the Recovery Plan was published in 2005; these records are mostly located in the northern and southwestern portions of the core area. The seven newer records are mostly located throughout the core area, though the vernal pool tadpole shrimp has never been observed in the center of the core area.

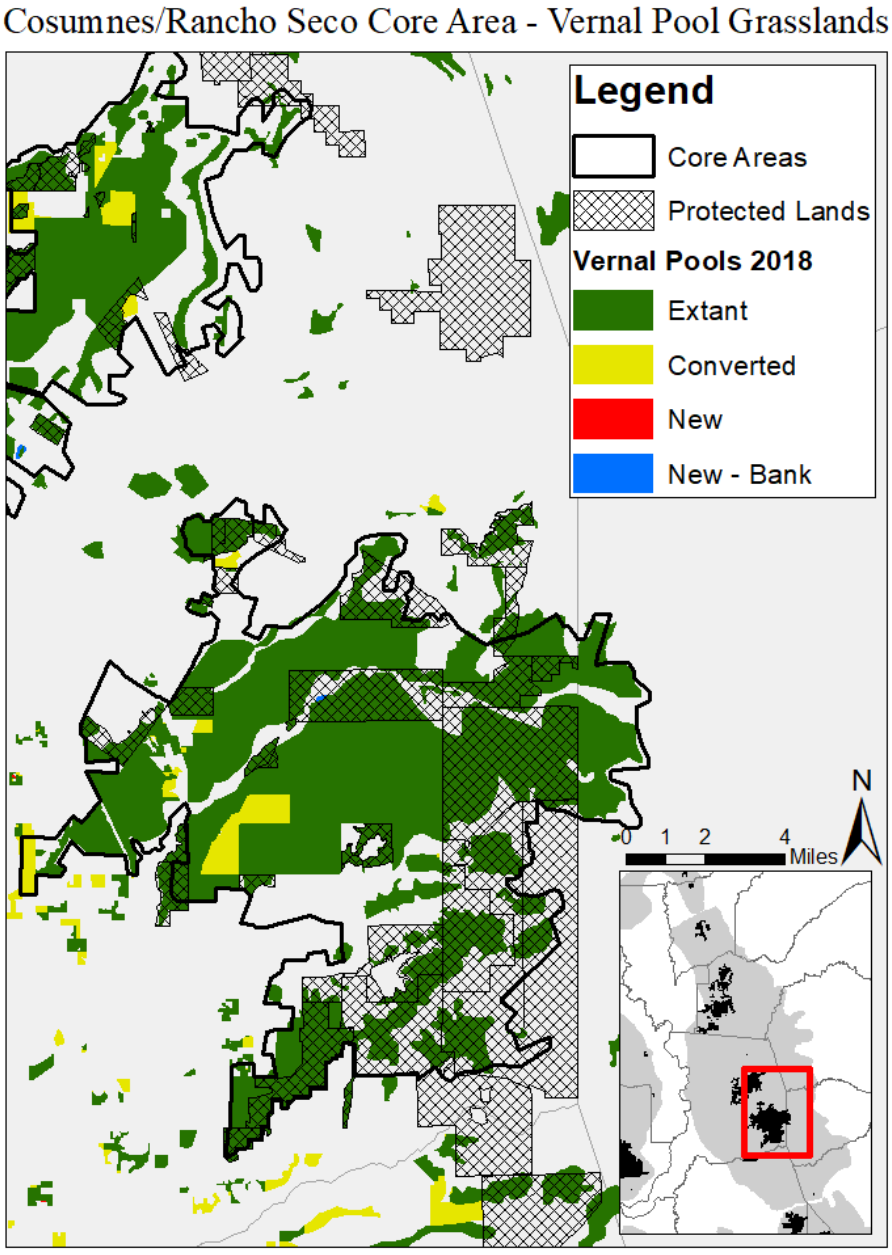

Figure 12.10. Map of vernal pool grassland habitat within the Cosumnes/Rancho Seco Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - 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.

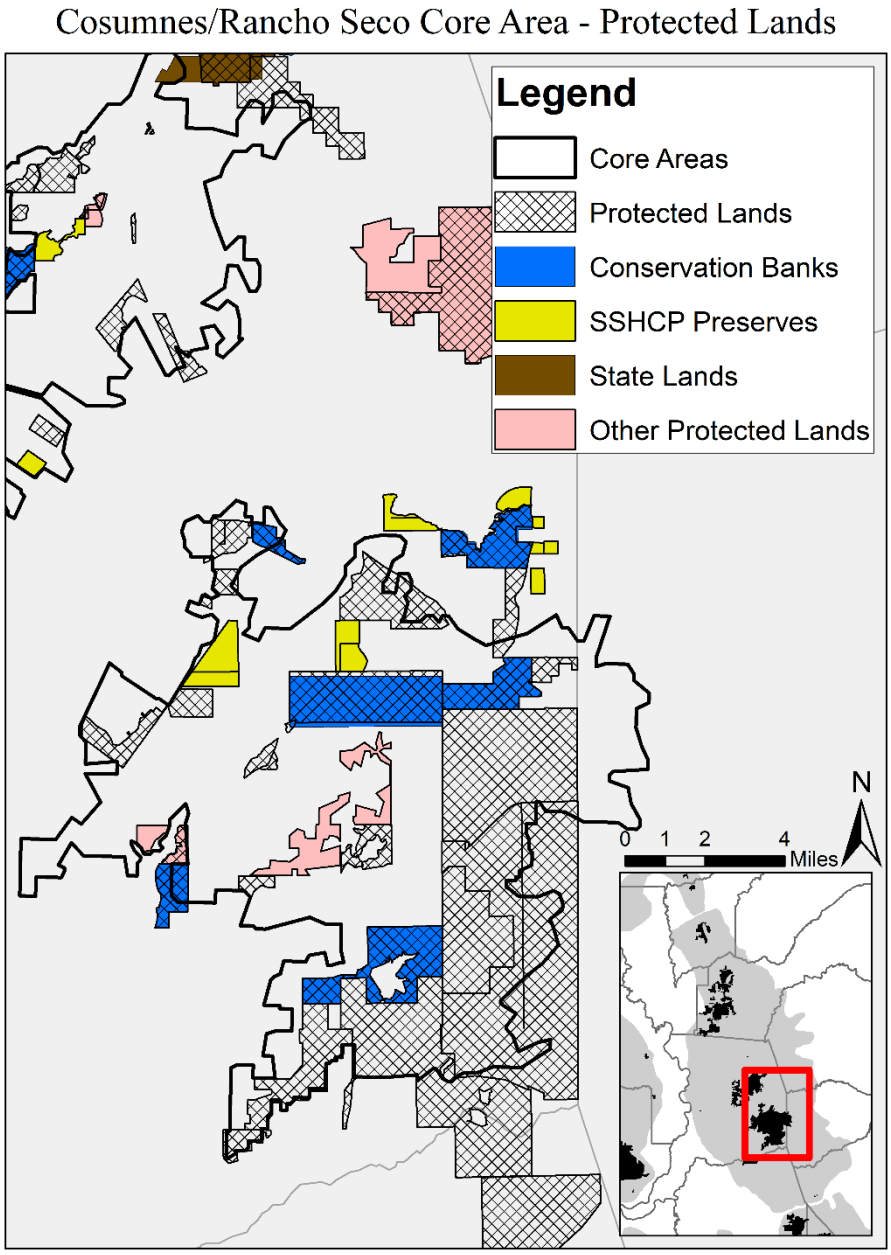

Figure 12.11. Map of protected areas within the Cosumnes/Rancho Seco Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

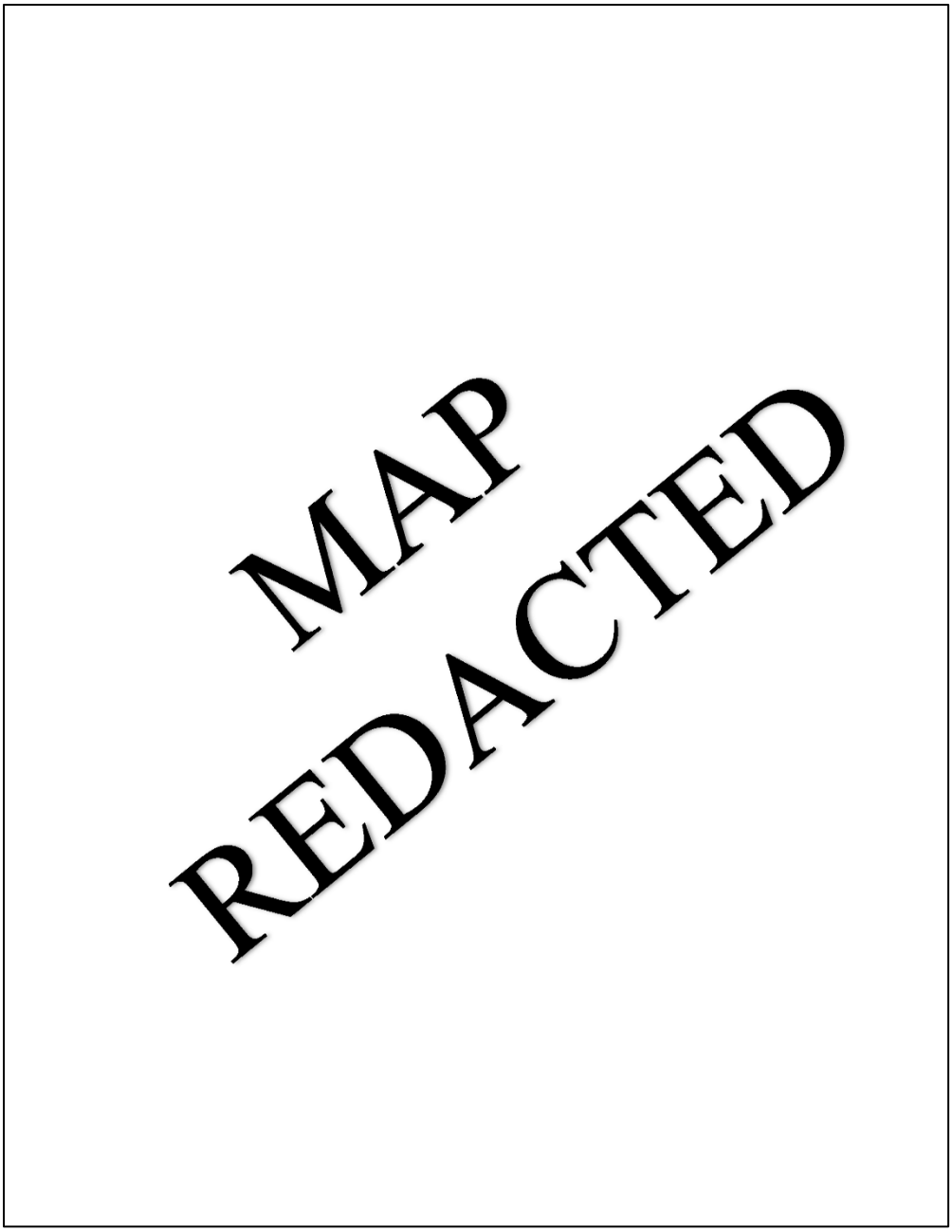

Figure 12.12. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Cosumnes/Rancho Seco Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

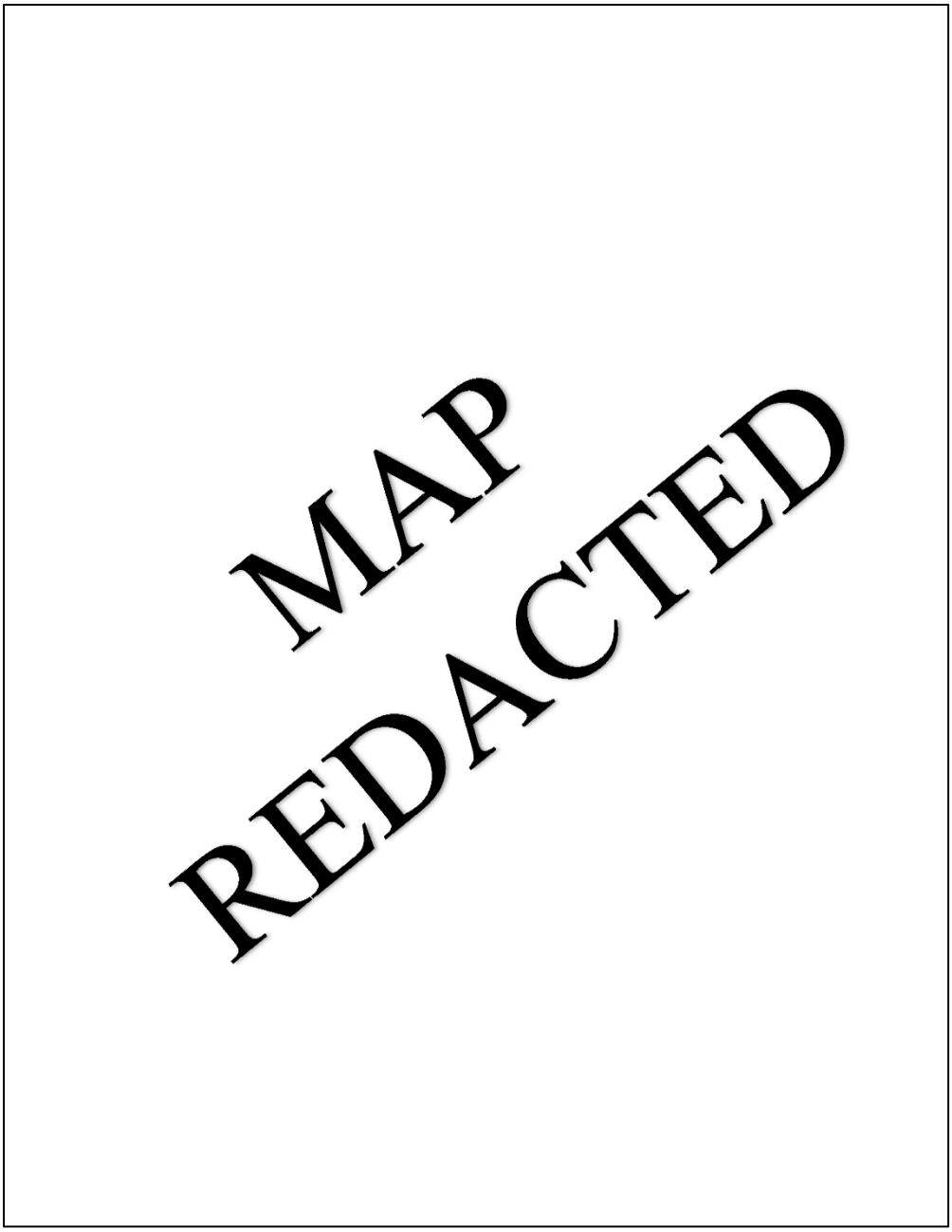

Figure 12.13. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Cosumnes/Rancho Seco Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

12.7.3. Mather

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 Sacramento County.

There were approximately 14,037 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 13,331 acres of vernal pool grassland remaining (see **Figure 12.14**, **Table 12.1**; Witham 2021). Approximately 721 acres had been lost since the Recovery Plan's 2005 baseline, though 13 additional acres were created on banks that were not previously mapped as vernal pool grassland in 2005 and 2 acres were identified that were either new or missed in previous mapping efforts (Witham 2021). The majority of losses were due to urbanization (615.0 acres, 85.3%), with other losses due mostly to conversion to orchards and agricultural residences (**Table 12.2**). Continuing urbanization is a major concern within this core area, as it is on the periphery of existing development in the cities of Sacramento and Rancho Cordova, and pressure to build more residential developments will likely increase as the human population continues to grow. Roughly 3,934 acres of vernal pool grassland were estimated to be protected within this core area as of 2017 (Vollmar et al. 2017), representing 28% of the 2005 baseline. There are additional areas of protected vernal pool habitat within lands that were protected after 2017 or were otherwise not captured in Vollmar et al.'s (2017) database, so the actual amount of protected habitat is higher.

This core area is entirely within the boundaries of the South Sacramento HCP (SSHCP 2018). The HCP estimates that 8,500 acres of vernal pool grassland within this core area will be permanently lost due to Covered Activities. These losses will be required to be mitigated at HCP preserves within the core area. The HCP estimated the total amount of vernal pool grassland within the core area to be 17,023 acres, which is more than Witham's (2021) estimate, but this would still represent a loss of 50% of vernal pool grasslands due to Covered Activities. However, the HCP's Conservation Strategy is designed to meet the six criteria for alternative conservation mechanisms in the Recovery Plan (described in the Recovery Plan Concepts section above), and therefore successful implementation of the HCP should result in meeting this core area's recovery goals at the end of the HCP's 50-year permit term. To date, the South Sacramento Conservation Agency (the entity in charge of implementing the HCP) has preserved several properties within the core area that contain vernal pool fairy shrimp habitat and is in the process of preserving several more, including Arista del Sol, The Ranch, Rooney 2, Werre, Silver Springs East, Tracy Ranch, and The Preserve (Satellite Preserve S-1) (SSCA 2022).

There are three conservation banks with vernal pool fairy shrimp and vernal pool tadpole shrimp preservation credits in the core area: Arroyo Seco Conservation Bank, Bryte Ranch Conservation Bank, and Sunrise Douglas Mitigation Bank (aka Anatolia Preserve) (**Figure 12.15**). These banks total 1,295 acres in size and have 262.20 acres of preservation credits for the vernal pool fairy shrimp and vernal pool tadpole shrimp (86.5% of which have already been sold). None of these banks have created vernal pools for the two shrimp species. Although most activities within the core area are covered under the South Sacramento HCP, these banks can continue to sell credits to compensate for activities that are outside of the jurisdiction of, or otherwise not covered by, the South Sacramento HCP.

Other preserves within the core area include: Sacramento Valley Vernal Pool Preserve (Werre South, Laguna, Kassis, Cook, and Sylva units), Klotz Property Open Space Preserve, Excelsior 184, Triangle Rock Vernal Pool Preserve, Laguna Creek Corridor Preserve, Illa M. Collin Conservation Preserve, Montelena Preserve, Sunridge Park Open Space Preserve, Douglas 103 Preserve, Grantline 208 Preserve, Rio del Oro Onsite Preserve, and Kiefer Landfill Wetlands Preserve. The Prairie City State Vehicle Recreation Area is also partly within the core area, though the vast majority of vernal pool habitat on this site is outside of the core area (CDPR 2022b).

12.7.3.1. Vernal Pool Fairy Shrimp Occurrences

There are 15 occurrence records from the Diversity Database for the vernal pool fairy shrimp within this core area (see **Figure 12.16**; Diversity Database 2022). As of 2018, 13 of these occurrences were within protected areas (Vollmar et al. 2017), though one was identified in the Diversity Database as possibly extirpated. All occurrences are within extant mapped vernal pool grasslands (Witham 2021). Vernal pool fairy shrimp were first detected within this core area in 1989 (Diversity Database 2022). Of the 15 records, 7 were known at the time of listing in 1994 and 12 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 in the center and southwest of the core area.

12.7.3.2. Vernal Pool Tadpole Shrimp Occurrences

There are 36 occurrence records from the Diversity Database for the vernal pool tadpole shrimp within this core area (see **Figure 12.17**; Diversity Database 2022). As of 2018, 23 of these occurrences were at least partially within protected areas (Vollmar et al. 2017), though 3 were identified in the Diversity Database as possibly extirpated. In total, 30 occurrences are presumed extant by the Diversity Database and 6 are extirpated or possibly extirpated; 31 are within extant mapped vernal pool grasslands, 1 is within extirpated vernal pool grasslands, and 4 are outside of mapped vernal pool grasslands (Witham 2021). Vernal pool tadpole shrimp were first detected within this core area in 1989 and have been consistently documented through 2015 (Diversity Database 2022). Of the 36 records, 20 were known at the time of listing in 1994 and 30 were known at the time the Recovery Plan was published in 2005; these records are located throughout the core area. The six newer records are mostly located in the center of the core area.

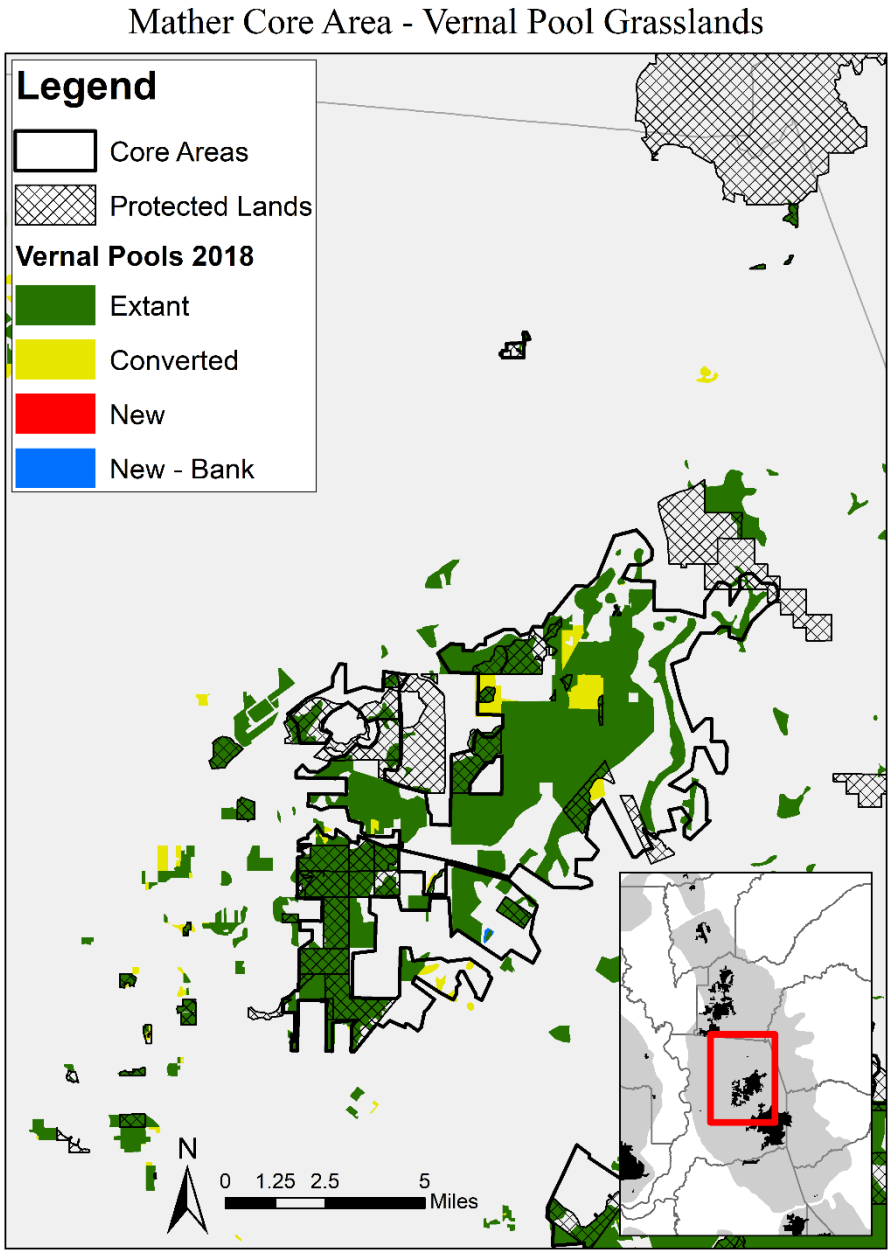

Figure 12.14. Map of vernal pool grassland habitat within the Mather Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers 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.

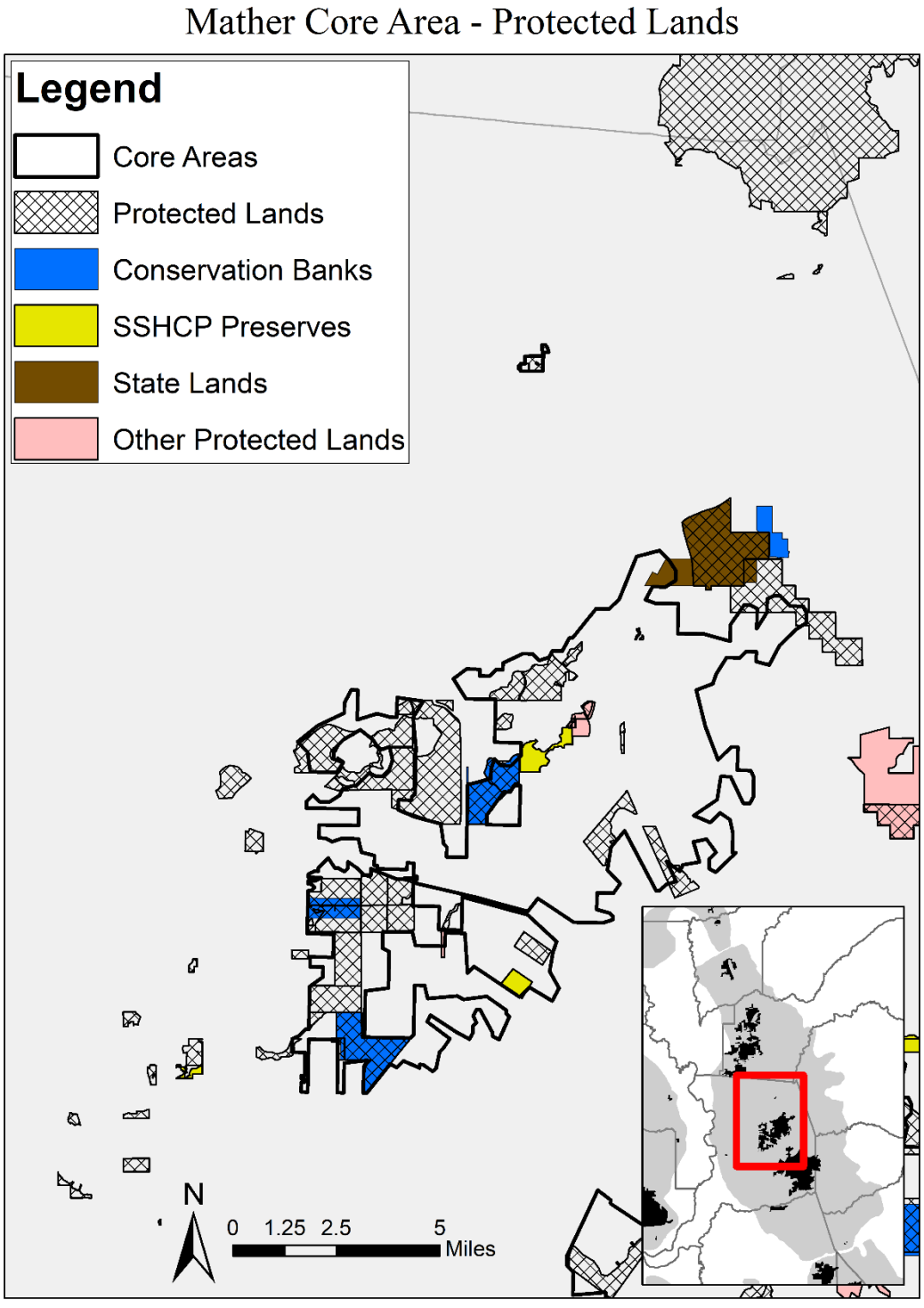

Figure 12.15. Map of protected areas within the Mather Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

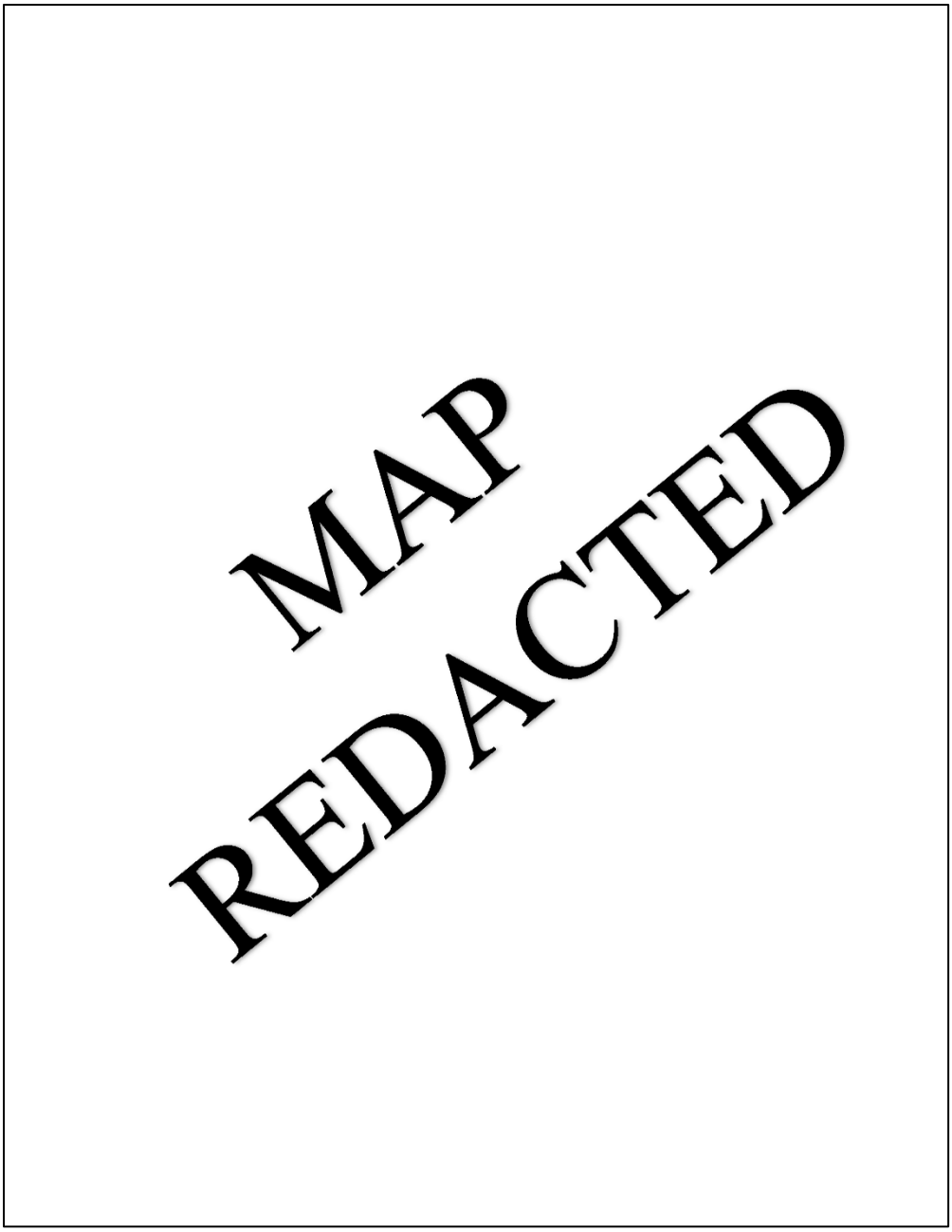

Figure 12.16. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Mather Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

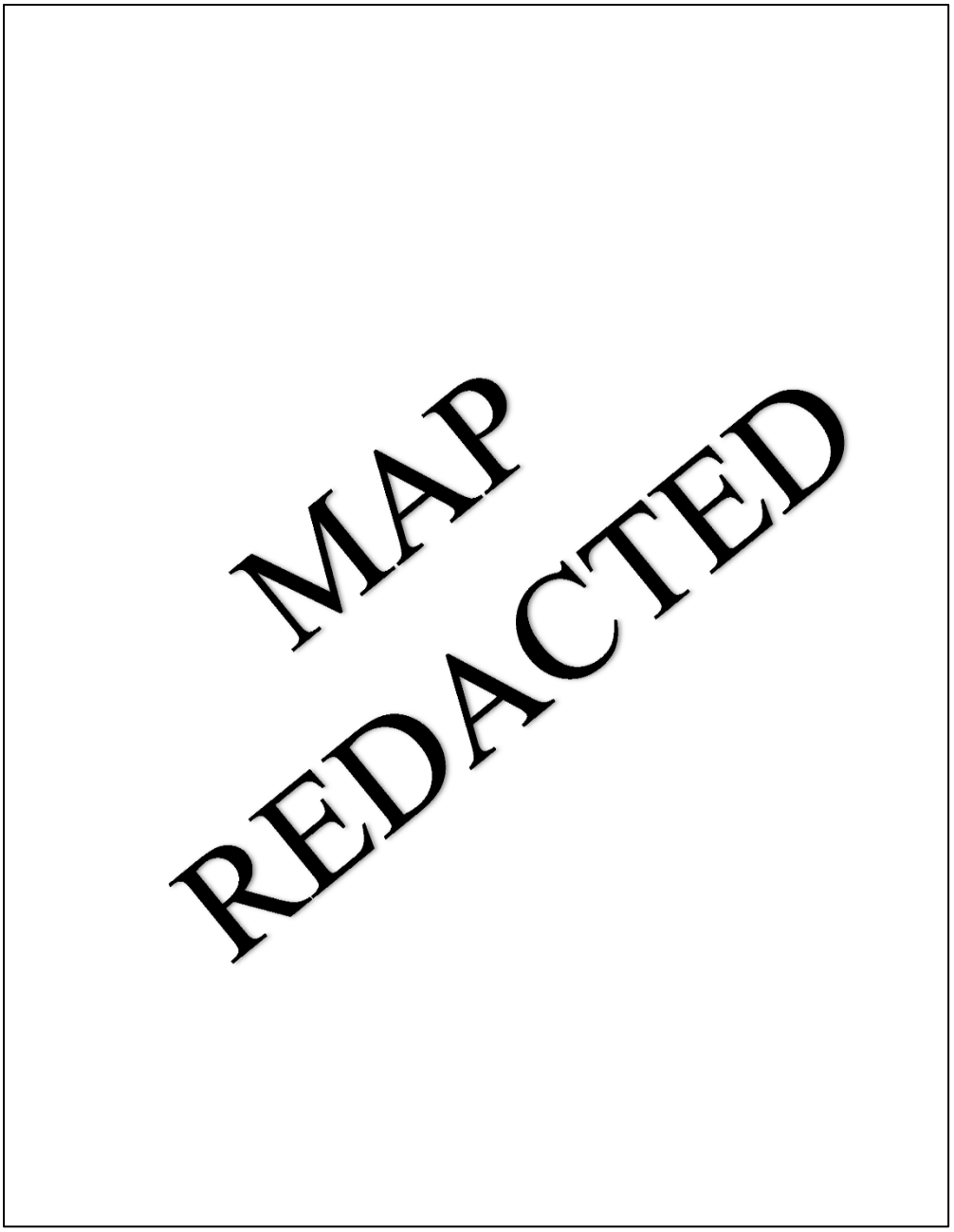

Figure 12.17. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Mather Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

12.7.4. Phoenix Field and Phoenix Park

This is a zone 1 core area, but it was not designated for the vernal pool fairy shrimp in the Recovery Plan. It was designated for Sacramento orcutt grass (*Orcuttia viscida*), California fairy shrimp (*Linderiella occidentalis*), and western spadefoot (*Spea hammondii*), with a goal of protecting 95% of vernal pool habitat. The core area is located in the City of Fair Oaks, Sacramento County, just north of the Nimbus Dam on the American River. This core area contains the Phoenix Park Vernal Pool Preserve, owned by the Fair Oaks Recreation and Park District, and the Phoenix Field Ecological Reserve, owned by CDFW.

There were approximately 17.7 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 17.7 acres of vernal pool grassland remaining, with no habitat losses occurring since 2005 (see **Figure 12.18**, **Table 12.1**; Witham 2021). All of the vernal pool grasslands within this core area are protected within the Phoenix Field Ecological Reserve and Phoenix Park Vernal Pool Preserve (**Figure 12.19**; Vollmar et al. 2017); the exact acreage protected is reported as 17.3 acres in **Table 12.1**, but this is simply due to slight boundary discrepancies between the shapefiles for vernal pool habitat and protected lands.

12.7.4.1. Vernal Pool Fairy Shrimp Occurrences

There is one occurrence record from the Diversity Database of the vernal pool fairy shrimp in this core area (see **Figure 12.20**; Diversity Database 2022). This occurrence record is from 1982, was identified by Denton Belk, and encompasses all of Phoenix Park. The Service is not aware of any more recent surveys that have identified the vernal pool fairy shrimp within this core area (E. Kleinfelter, CDFW, *in litt*. 2022) and the most recent management plan does not include the vernal pool fairy shrimp as a known species within the park or reserve (ESA Associates 2006b). Although this occurrence was known at the time the Recovery Plan was published, the lack of subsequent data confirming the 1982 identification is likely why this core area was not designated for the vernal pool fairy shrimp.

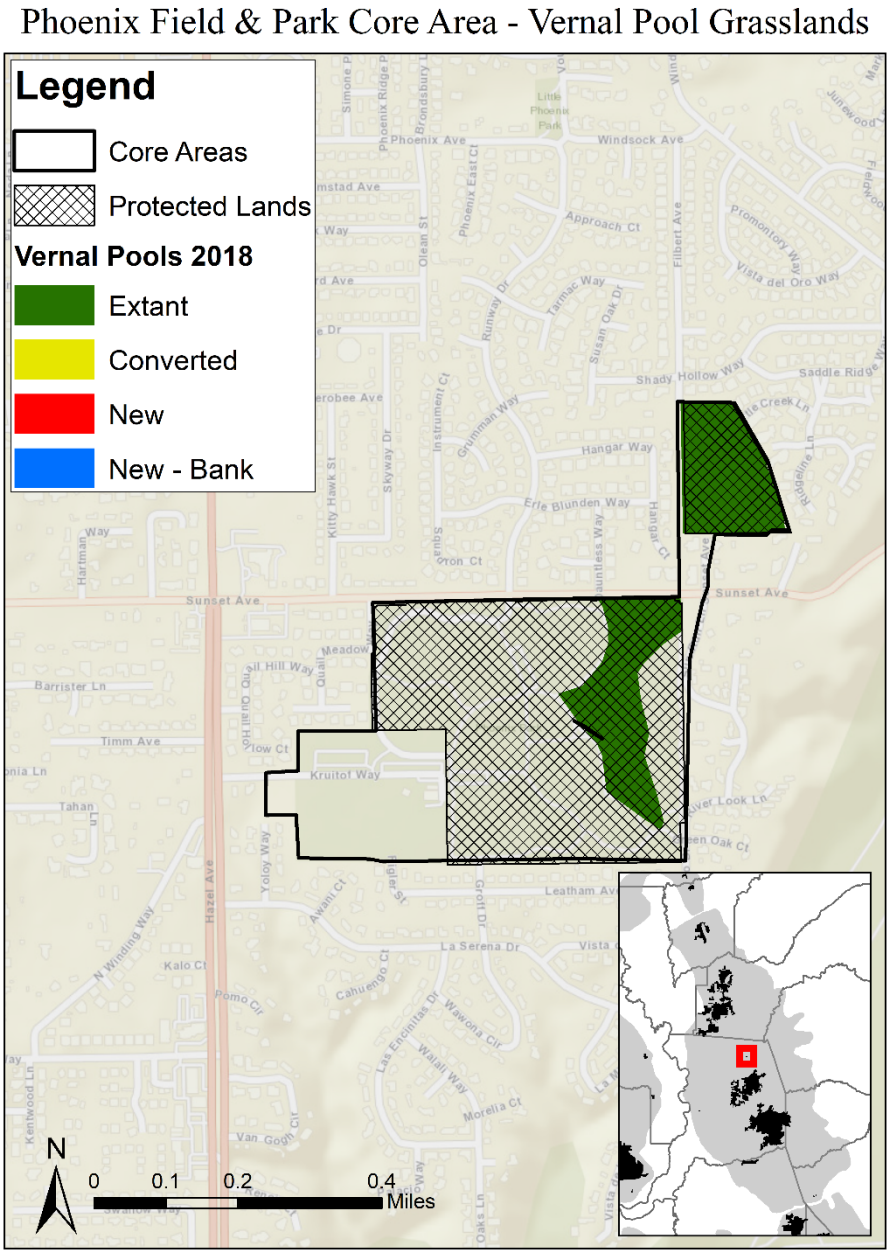

Figure 12.18. Map of vernal pool grassland habitat within the Phoenix Field and Park Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - 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.

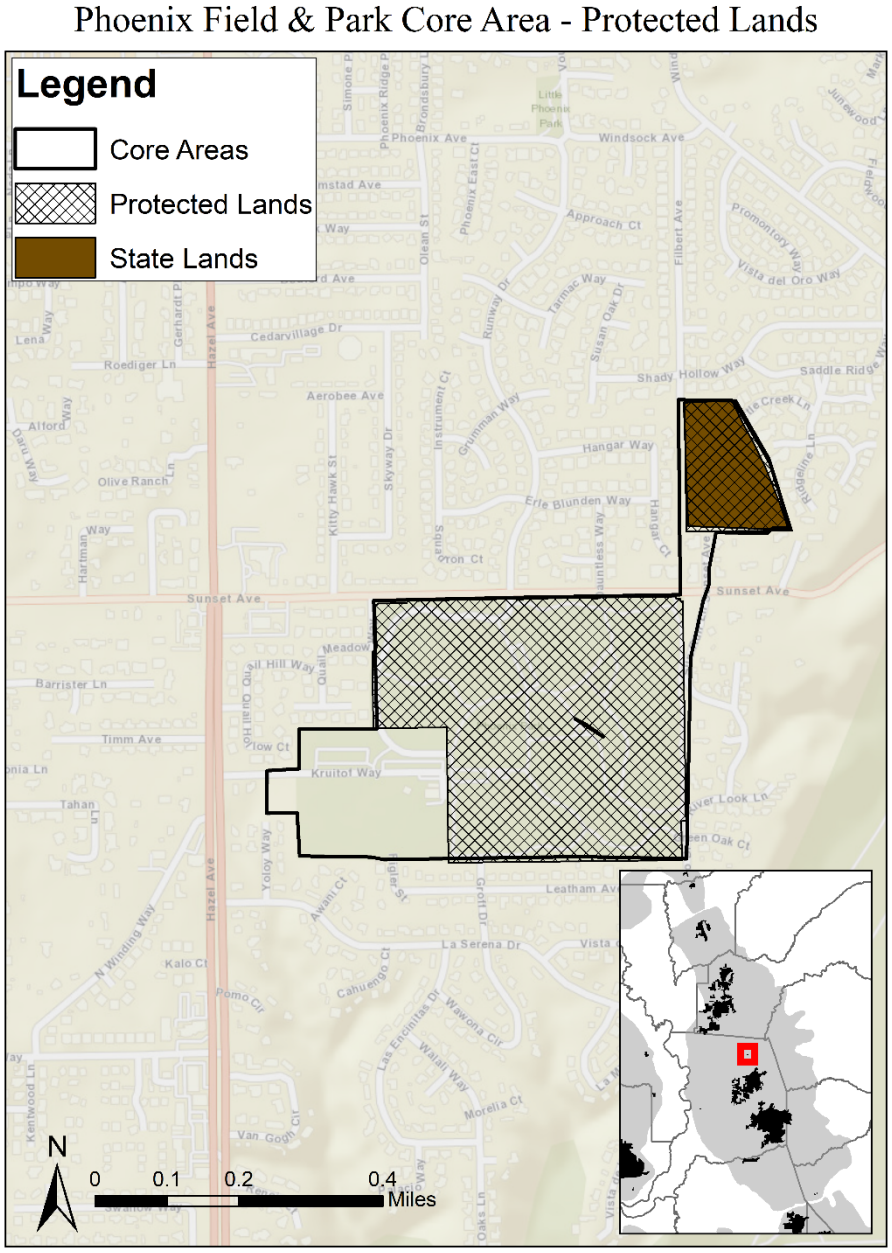

Figure 12.19. Map of protected areas within the Phoenix Field and Park Core Area**.** Protected lands are based on Vollmar et al. (2017).

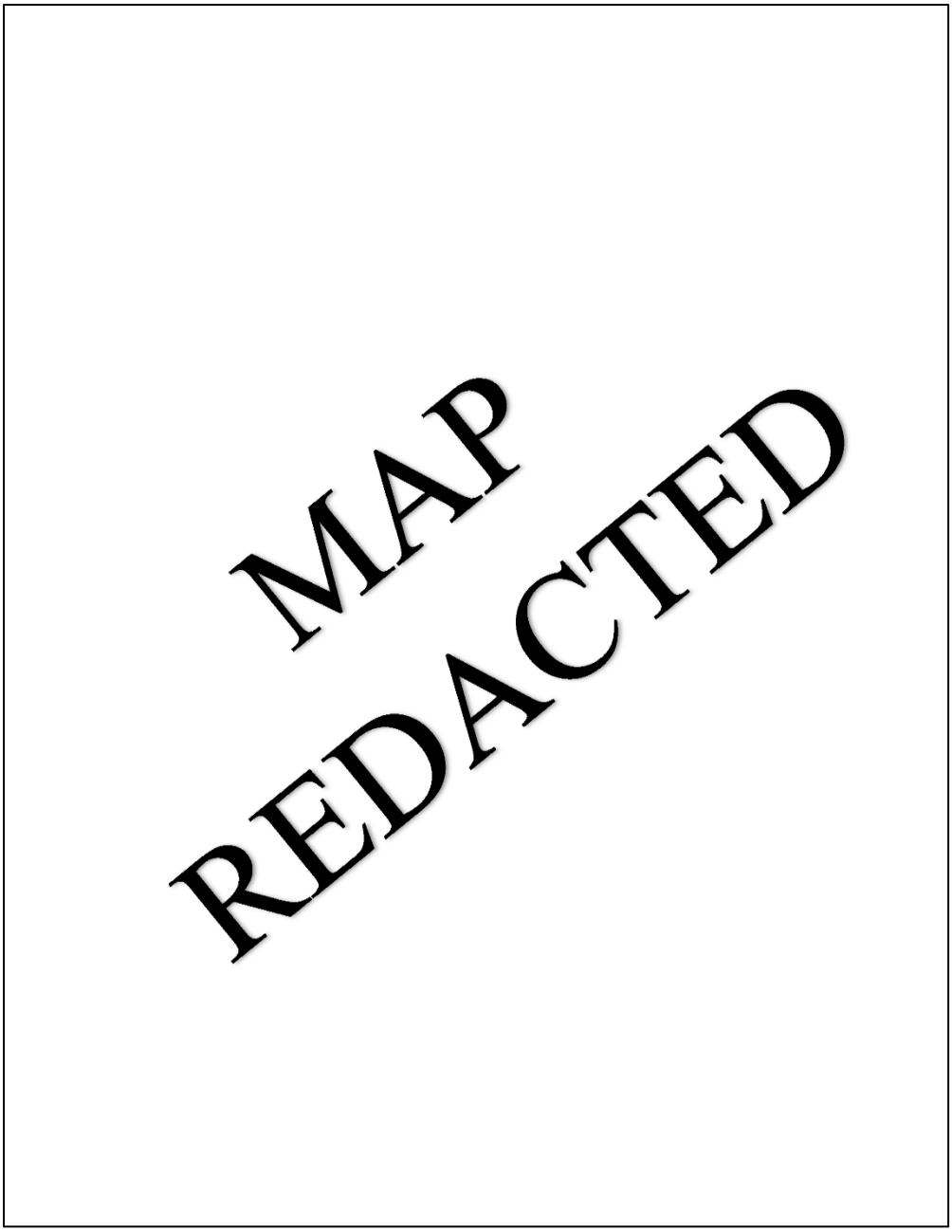

Figure 12.20. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Phoenix Field and Park Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

12.7.5. Southeast Sacramento Valley

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 fleshy owl's-clover (*Castilleja campestris* ssp. *succulenta*), with a goal of protecting 85% of vernal pool habitat. The core area is located in San Joaquin County just south of the border with Sacramento County, southeast of the City of Galt, and northeast of the City of Collierville.

There were approximately 922 acres of vernal pool grassland present in this core area in 2005, and only 734 acres remained as of 2018 (see **Figure 12.21**, **Table 12.1**; Witham 2021). This loss of 20% of vernal pool habitat precludes the goal of preserving 85% of habitat without habitat creation or restoration. Vollmar et al. (2017) did not document any protected lands within this core area. The Recovery Plan mentions that the Angraves Nature Study Area is within the core area (Service 2005a), but the Service could not find any further information about this site, indicating that it likely no longer exists.

12.7.5.1. Vernal Pool Fairy Shrimp Occurrences

There is one Diversity Database occurrence of the vernal pool fairy shrimp that slightly overlaps this core area (see **Figure 12.22**; Diversity Database 2022). This occurrence record documents the vernal pool fairy shrimp along the Central California Traction railroad tracks. Given the proximity of this occurrence to extant vernal pool grasslands, it is possible that the vernal pool fairy shrimp may occur throughout this core area.

12.7.5.2. Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence of the vernal pool tadpole shrimp that slightly overlaps this core area (see **Figure 12.23**; Diversity Database 2022). This occurrence record documents the vernal pool tadpole shrimp along the Central California Traction railroad tracks. Given the proximity of this occurrence to extant vernal pool grasslands, it is possible that the vernal pool tadpole shrimp may occur throughout this core area.

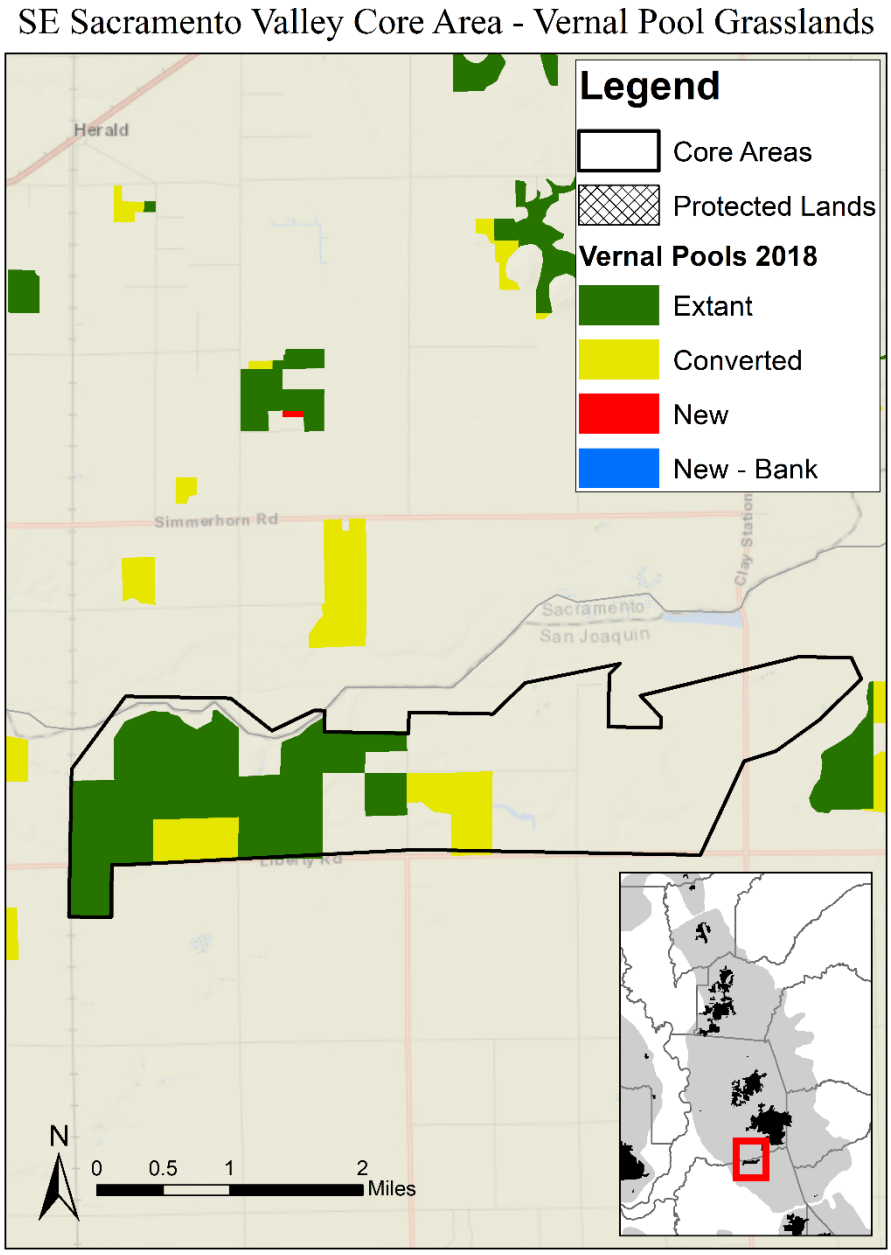

Figure 12.21. Map of vernal pool grassland habitat within the Southeast Sacramento Valley Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "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.

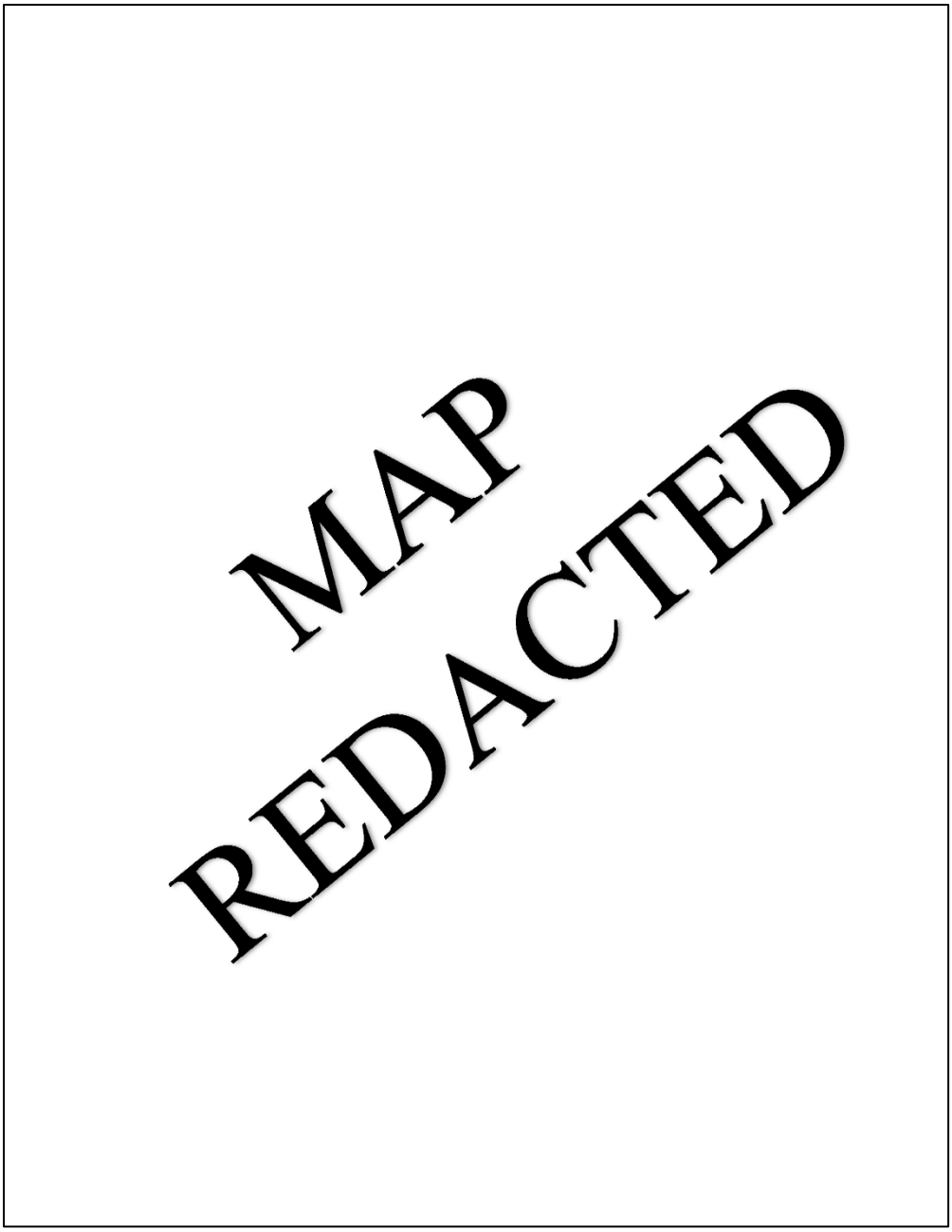

Figure 12.22. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Southeast Sacramento Valley Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

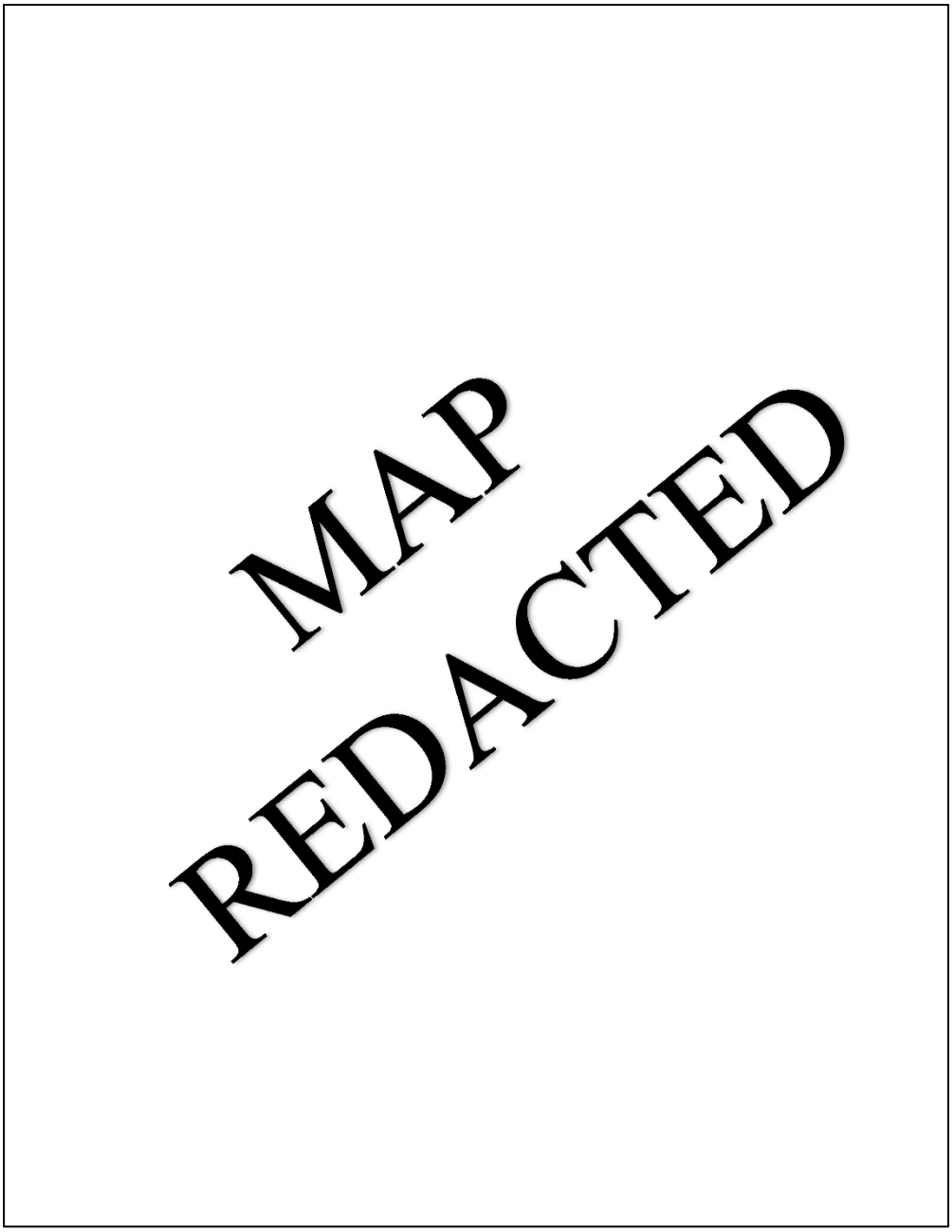

Figure 12.23. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Southeast Sacramento Valley Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

12.7.6. Stone Lake

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 legenere (*Legenere limosa*), with a goal of protecting 85% of vernal pool habitat. The core area is located entirely within the Sacramento Regional County Sanitation District's (Regional San) Bufferlands open space area in southern Sacramento County, just west of the City of Elk Grove, northeast of the Stone Lakes National Wildlife Refuge, and east of the Regional San wastewater treatment plant.

There are approximately 66 acres of vernal pool grassland that occur within this core area (see **Figure 12.24**, **Table 12.1**; Witham 2021), and all of this habitat was considered to be protected by Vollmar et al. (2017) due to being on public land owned by Regional San (see **Figure 12.25**). A master plan for the Bufferlands was published in 2000 to establish a long-term management direction that would maintain the existing buffer zone around the wastewater treatment plant, provide for future expansion and changes in operation of the plant, and protect and enhance the area's environmental resources (Carollo Engineers 2000). While the plan describes the vernal pool habitat and associated species known to occur onsite, it does not provide specific management recommendations for the vernal pools.

12.7.6.1. Vernal Pool Fairy Shrimp Occurrences

There is one Diversity Database occurrence of the vernal pool fairy shrimp, composed of multiple polygons, that partially overlaps this core area (see **Figure 12.26**; Diversity Database 2022). This occurrence record documents the vernal pool fairy shrimp within vernal pools that occur on either side of the railroad tracks that separate the Regional San facility on the west and Regional San's Bufferlands, which includes all of the Stone Lake Core Area, on the east. While the vernal pools within the core area have not been surveyed for the vernal pool fairy shrimp (besides the ones along the railroad tracks), it is likely that this species is present given the detection of the species along the adjacent railroad tracks.

12.7.6.2. Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence of the vernal pool tadpole shrimp that encompasses the entirety of the Regional San Bufferlands, including this core area (see **Figure 12.27**; Diversity Database 2022). The vernal pool tadpole shrimp was documented within vernal pools that occur on either side of the railroad tracks that separate the Regional San facility on the west and Regional San's Bufferlands on the east in 1992, 1993, and 2012 (Diversity Database 2022). The species was also documented within 19 wetted acres of vernal pools throughout the 732-acre Bufferlands in 2000; specific locations were not given, so it is unclear how many of these pools are within the core area (Diversity Database 2022).

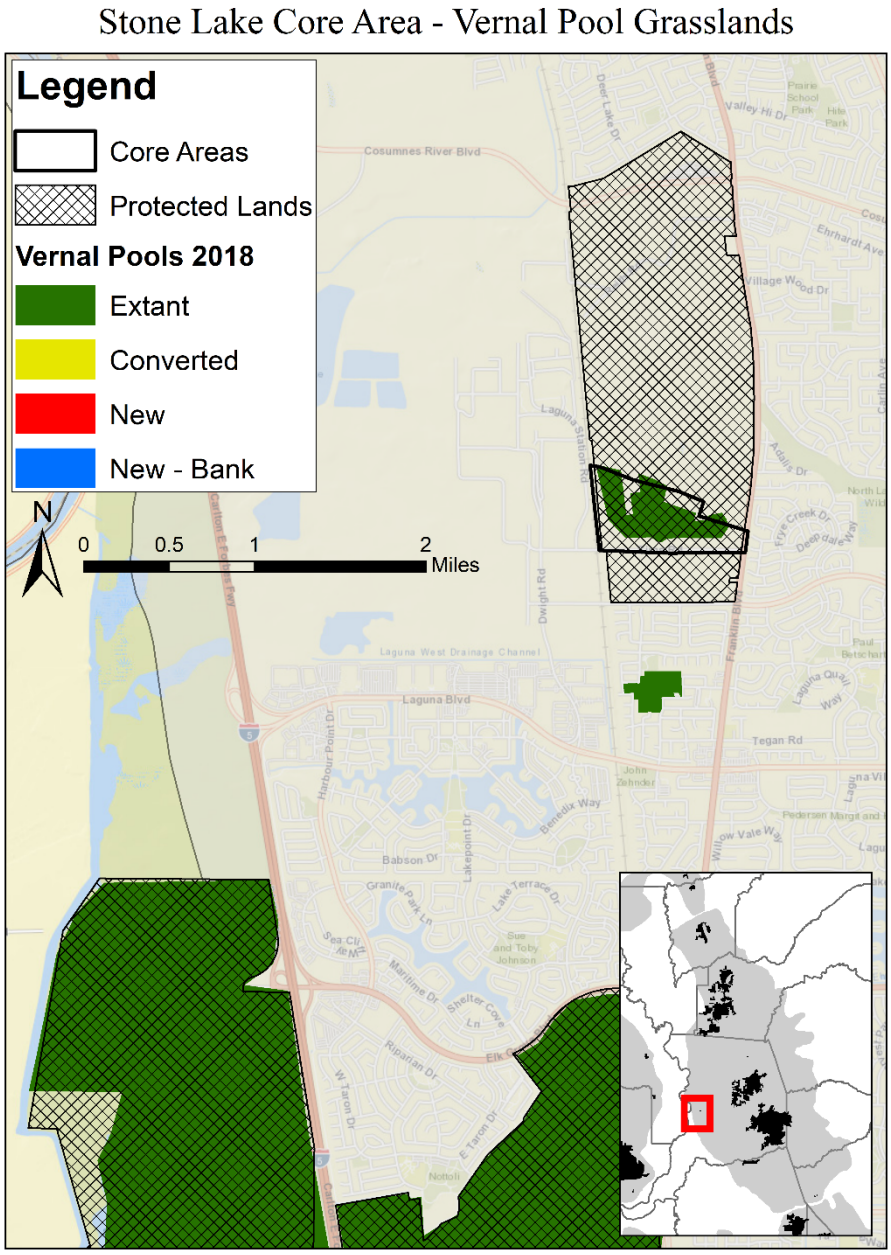

Figure 12.24. Map of vernal pool grassland habitat within the Stone Lake Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" 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.

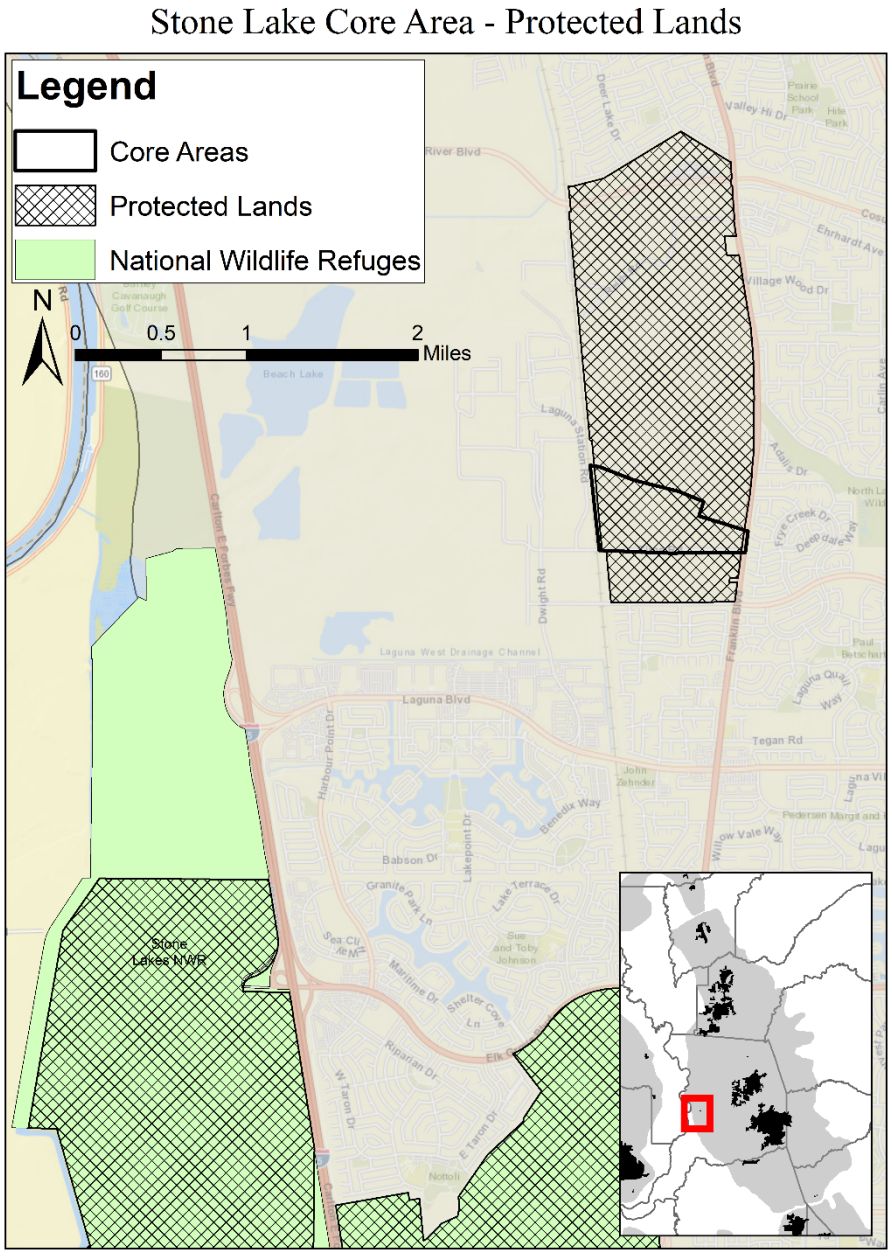

Figure 12.25. Map of protected areas within the Stone Lake Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

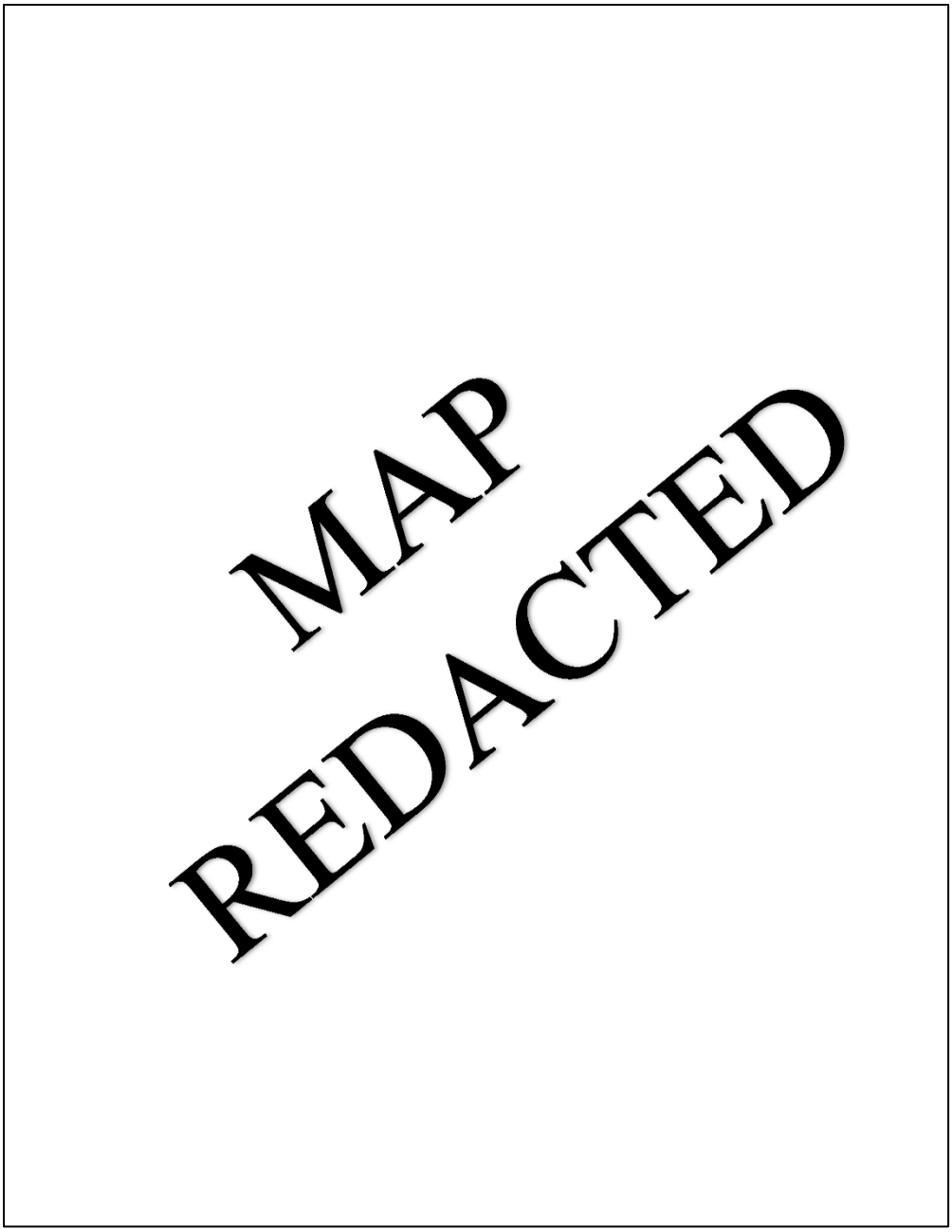

Figure 12.26. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Stone Lake Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

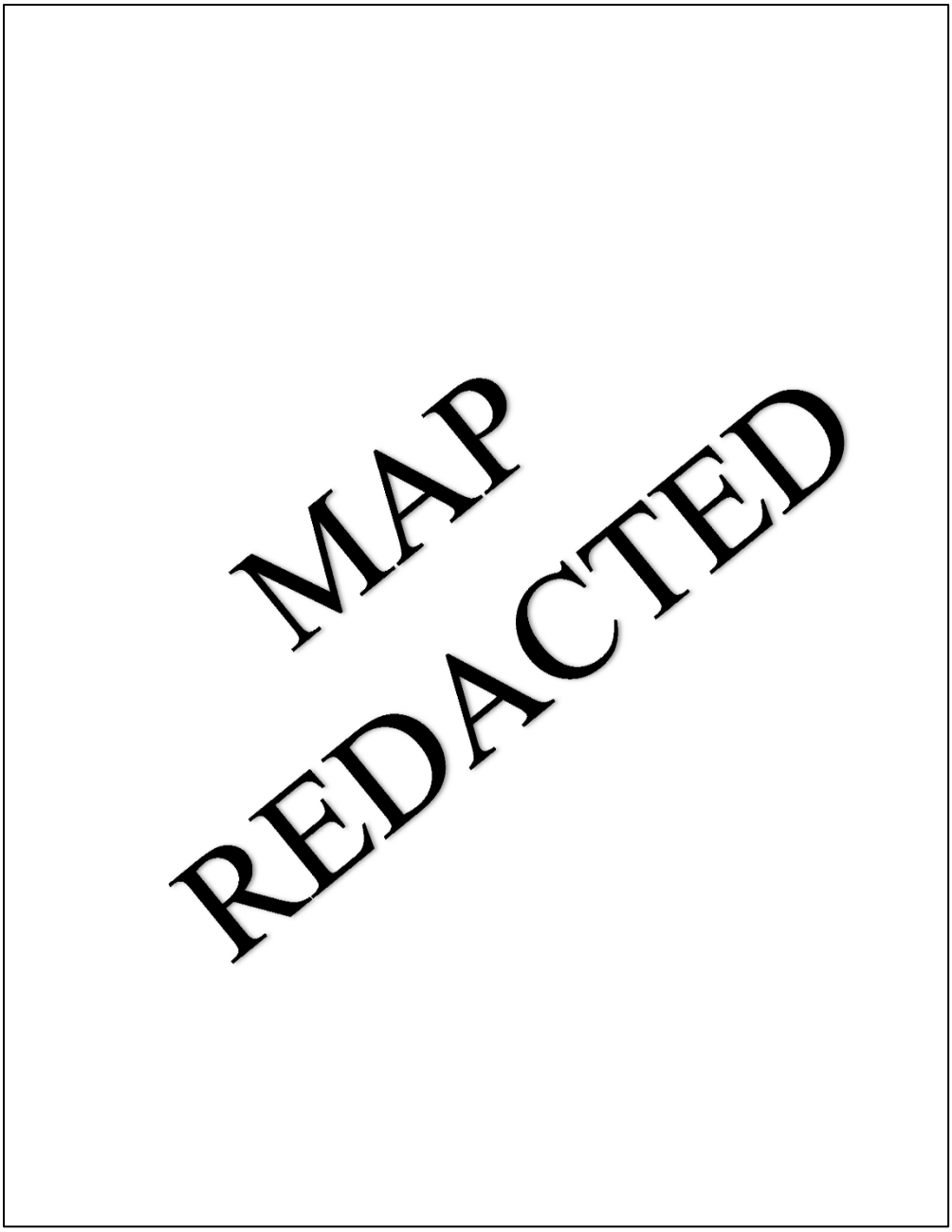

Figure 12.27. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Stone Lake Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

12.7.7. Western Placer County

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. This core area was not designated for the Conservancy fairy shrimp in the Recovery Plan, but the species is known to occur there. The core area is located in western Placer County and a very small portion of adjacent Sacramento County.

There were approximately 22,612 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 20,129 acres of vernal pool grassland remaining (see **Figure 12.28**, **Table 12.1**; Witham 2021). Approximately 2,997 acres had been lost since the Recovery Plan's 2005 baseline, though 254 additional acres were created on banks that were not previously mapped as vernal pool grassland in 2005 and 267 acres were identified that were either new or missed in previous mapping efforts (Witham 2021). The majority of losses were due to conversion to bare plowed agricultural lands (1,944 acres, 64.9%), with the remaining losses mainly due to urbanization (1,016 acres, 33.9%) (**Table 12.2**). Although losses to urbanization were not the majority, urbanization was a greater threat in this area than throughout the Southeastern Sacramento Valley Vernal Pool Region in general, where losses of vernal pool grassland to urbanization represented only 18.4% of losses.

Roughly 6,742 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 30% of the 2005 baseline. The Western Placer County HCP documented 5,421 acres of vernal pool grassland that were protected within the core area on existing preserves as of 2020 (PCCP 2020). Witham (2021) and the HCP did not use the same methodology to map vernal pool habitat so this number is not directly comparable to the 2005 baseline or the amount of protected habitat estimated by Vollmar et al. (2017). Six Western Placer County HCP preserves have been established, though one of these properties (Ellis Reserve) is already captured in Vollmar et al.'s (2017) database. These preserves protect 1,351 acres of vernal pool complex; very little of this habitat occurs on the Ellis Reserve. Thus, a total of approximately 8,093 acres of vernal pool grassland have been preserved in this core area as of 2023, representing 35.8% of the 2005 baseline.

This core area is entirely within the boundaries of the Western Placer County HCP, except for the 0.14 square mile portion of the core area in Sacramento County (PCCP 2020). Land cover mapping efforts for this HCP mapped 25,526 acres of vernal pool complexes within the core area, slightly higher than Witham's (2021) estimate. Combined with existing protected vernal pool complexes (5,421 acres, as estimated in the HCP), implementation of the HCP will result in protection of 51% of the vernal pool complexes in the core area. This falls short of the 85% goal of the Recovery Plan. However, the HCP will result in 27,068 acres of protected and restored vernal pool complexes throughout all of western Placer County, which is greater than the 85% (26,420 acres, as estimated in the HCP) of protected acreage recommended by the Recovery Plan. Section 5.4.11.3 of the HCP describes how the HCP meets the six criteria for alternative conservation mechanisms from the Recovery Plan (described in the Recovery Plan Concepts section above), meaning that successful implementation of the HCP should result in meeting this core area's recovery goals at the end of the HCP's 50-year permit term.

There are five conservation banks with vernal pool fairy shrimp preservation and/or creation credits in the core area: Antonio Mountain Ranch Mitigation Bank, Mariner Vernal Pool Conservation Bank, Orchard Creek Conservation Bank, Toad Hill Ranch Mitigation Bank, and Western Placer Schools Conservation Bank (**Figure 12.29**). These banks total 3,426 acres in size and have 194.21 acres of preservation credits and 74.79 acres creation credits for the vernal pool fairy shrimp (78.7% and 72.1% of which have already been sold, respectively). Although most activities within the core area are covered under the Western Placer County HCP, these banks can continue to sell credits to compensate for activities that are outside the jurisdiction of, or otherwise not covered by, the Western Placer County HCP.

Other preserves within the core area include: six Western Placer County HCP preserves (Amoruso Ranch, Bradley, East Sheridan 297, Ellis, Markham Ravine, and Redwing South), East Sheridan Vernal Pool Preserve, Yankee Slough, Doty Ravine, Swainson's Preserve, Lincoln Open Space Preserve (Foskett Ranch Open Space Preserve, Three D South Preserve, Lincoln Crossing Preserve, RG-1 Rodeo Grounds Preserve, and Sterling Pointe Preserve units), Rockwell Ranch Vernal Pool Preserve, Twelve Bridges Open Space Preserve, Orchard Creek, Moore Ranch Preserve (aka Woodcreek West and Highland Reserve North), Aitken Ranch, John D. Vincent, Reason Farms Environmental Preserve, and West Roseville Specific Plan Preserves. At least 776 acres of these are within the City of Roseville and are managed under the Roseville Open Space Preserve Overarching Management Plan, which the Service consulted on in 2011.

12.7.7.1. Vernal Pool Fairy Shrimp Occurrences

There are 41 occurrence records from the Diversity Database for the vernal pool fairy shrimp within this core area (see **Figure 12.30**; Diversity Database 2022). As of 2018, 25 of these occurrences were at least partially within protected areas (Vollmar et al. 2017). All are presumed extant by the Diversity Database, though two occurrences were partially within areas mapped as having vernal pool habitat loss (Witham 2021). Vernal pool fairy shrimp were first detected within this core area in 1980 and new Diversity Database records have been consistently reported up through 2016 (Diversity Database 2022). The vernal pool fairy shrimp has been found in vernal pool grasslands throughout the entire extent of this core area.

12.7.7.2. Vernal Pool Tadpole Shrimp Occurrences

There are two occurrence records from the Diversity Database for the vernal pool tadpole shrimp within this core area (see **Figure 12.31**; Diversity Database 2022). As of 2018, one of these occurrences was within protected areas (Vollmar et al. 2017). One is presumed extant by the Diversity Database and one is presumed extirpated; both are within extant vernal pool grassland (Witham 2021). The extant occurrence is located on the U.S. Air Force's Lincoln Receiver Site and adjacent Western Placer Schools Conservation Bank. It was first detected in 1994 and was consistently observed through 2013 (Diversity Database 2022). The presumed extirpated occurrence is located adjacent to Industrial Avenue just south of Highway 65. One cyst was detected during dry-season surveys in 2002. The occurrence is presumed extirpated because the pool where the cyst was found was paved over for a road expansion project, though it is possible that undisturbed vernal pools in the surrounding vernal pool complex may also support the vernal pool tadpole shrimp (Diversity Database 2022).

12.7.7.1. Conservancy Fairy Shrimp Occurrences

There is one occurrence record from the Diversity Database for the Conservancy fairy shrimp within this core area (Diversity Database 2022). The occurrence is protected within the Mariner Vernal Pool Conservation Bank (**Figure 12.29**). The species was first detected in 2007 and has been found during monitoring consistently through 2017. The Conservancy fairy shrimp has not been detected anywhere else within this core area despite numerous surveys conducted over the last 30 years associated with projects, conservation, and research activities.

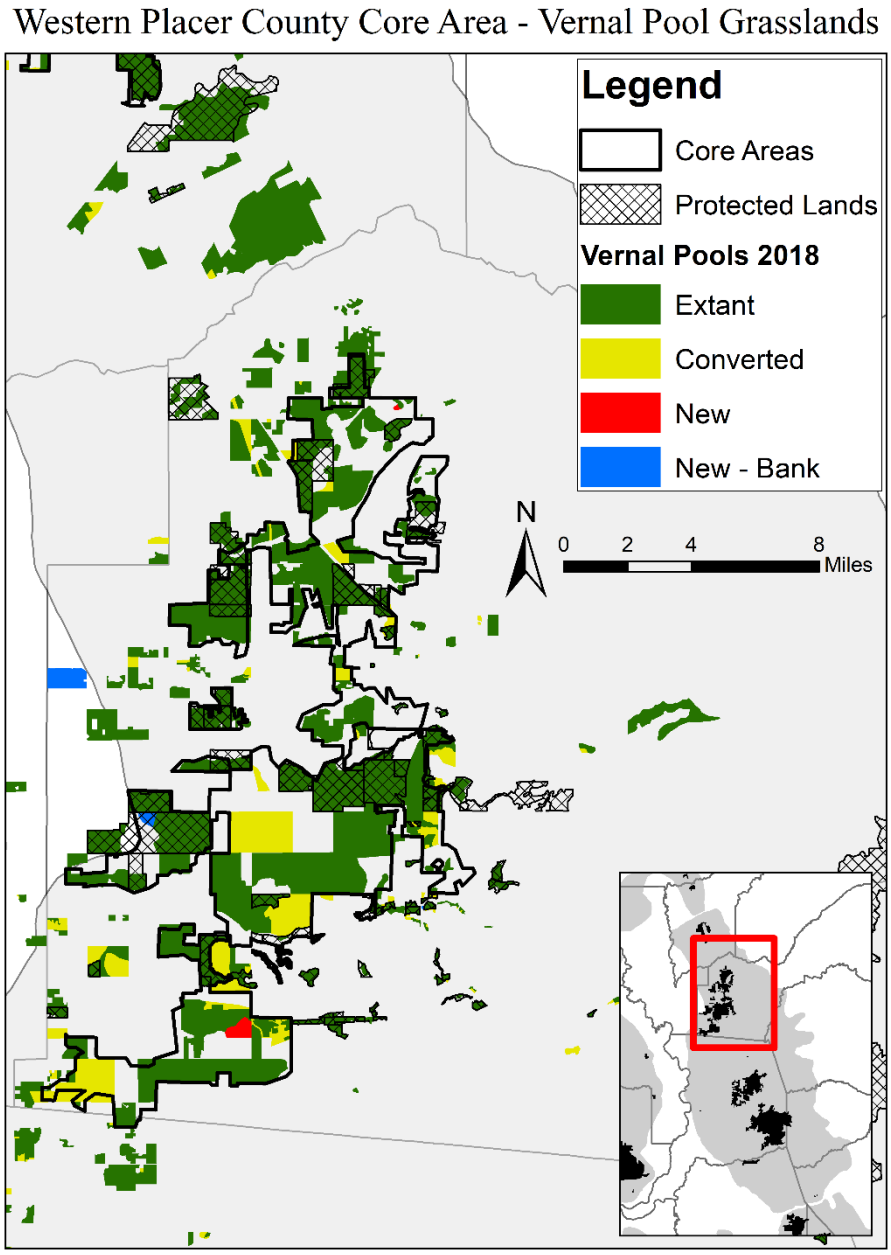

Figure 12.28. Map of vernal pool grassland habitat within the Western Placer County Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - 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.

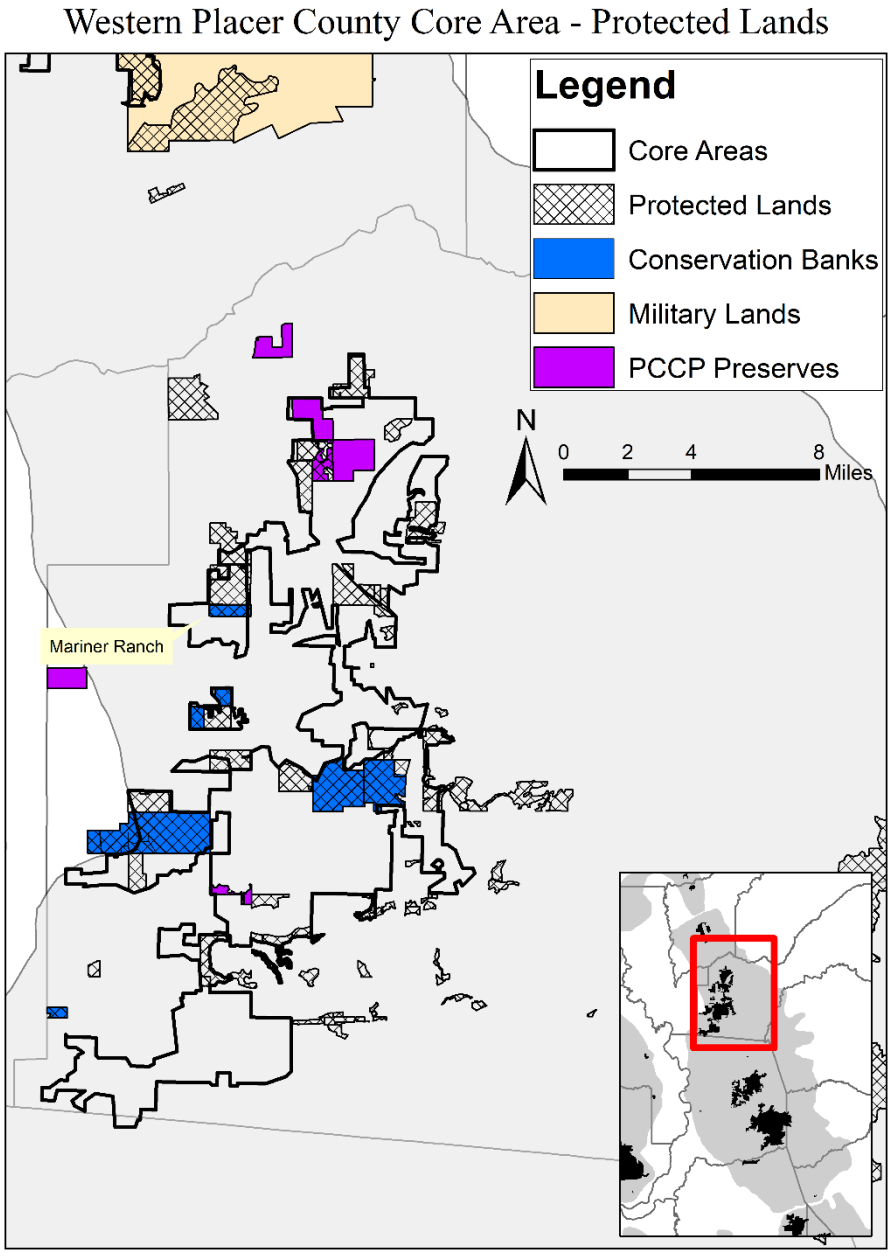

Figure 12.29. Map of protected areas within the Western Placer County Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves.

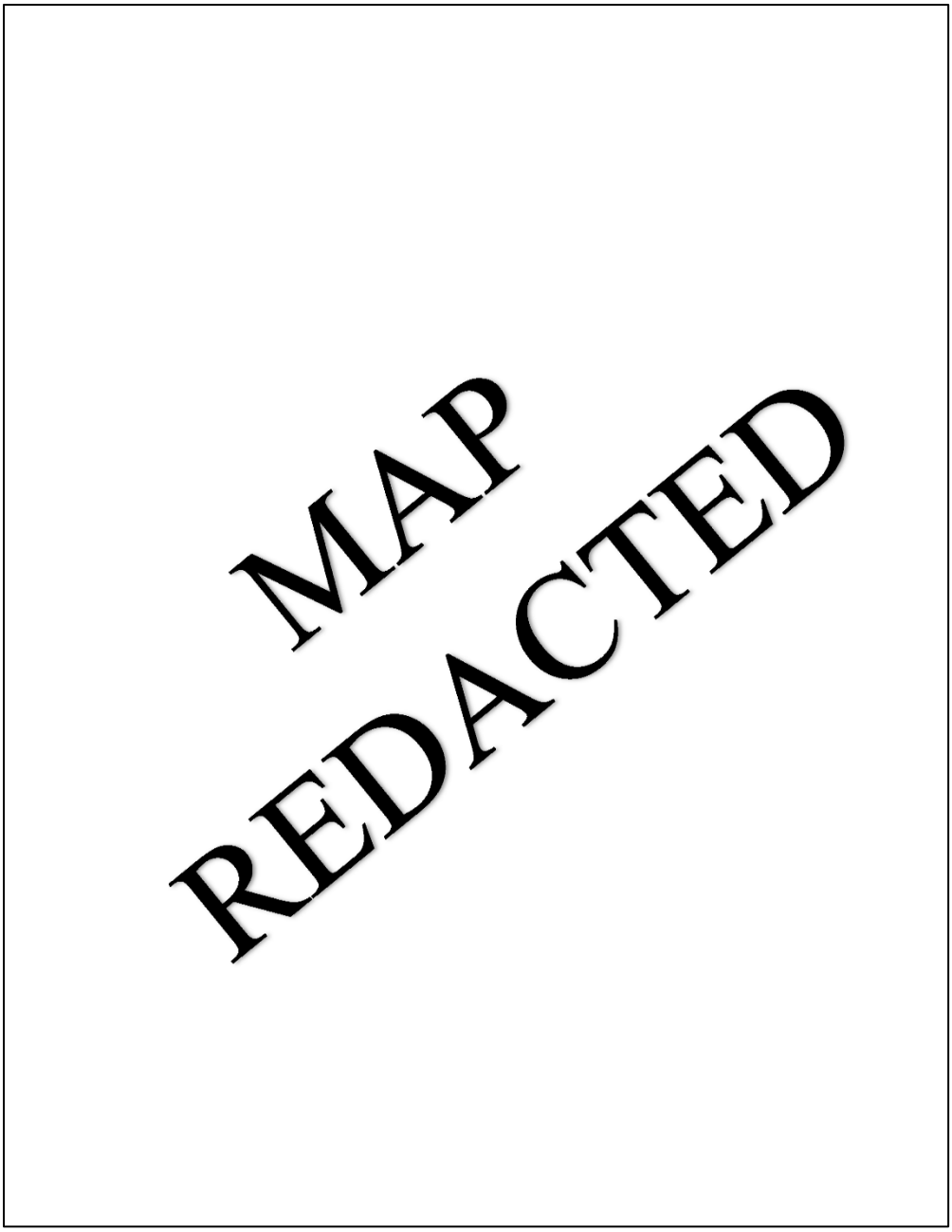

Figure 12.30. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Western Placer County Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

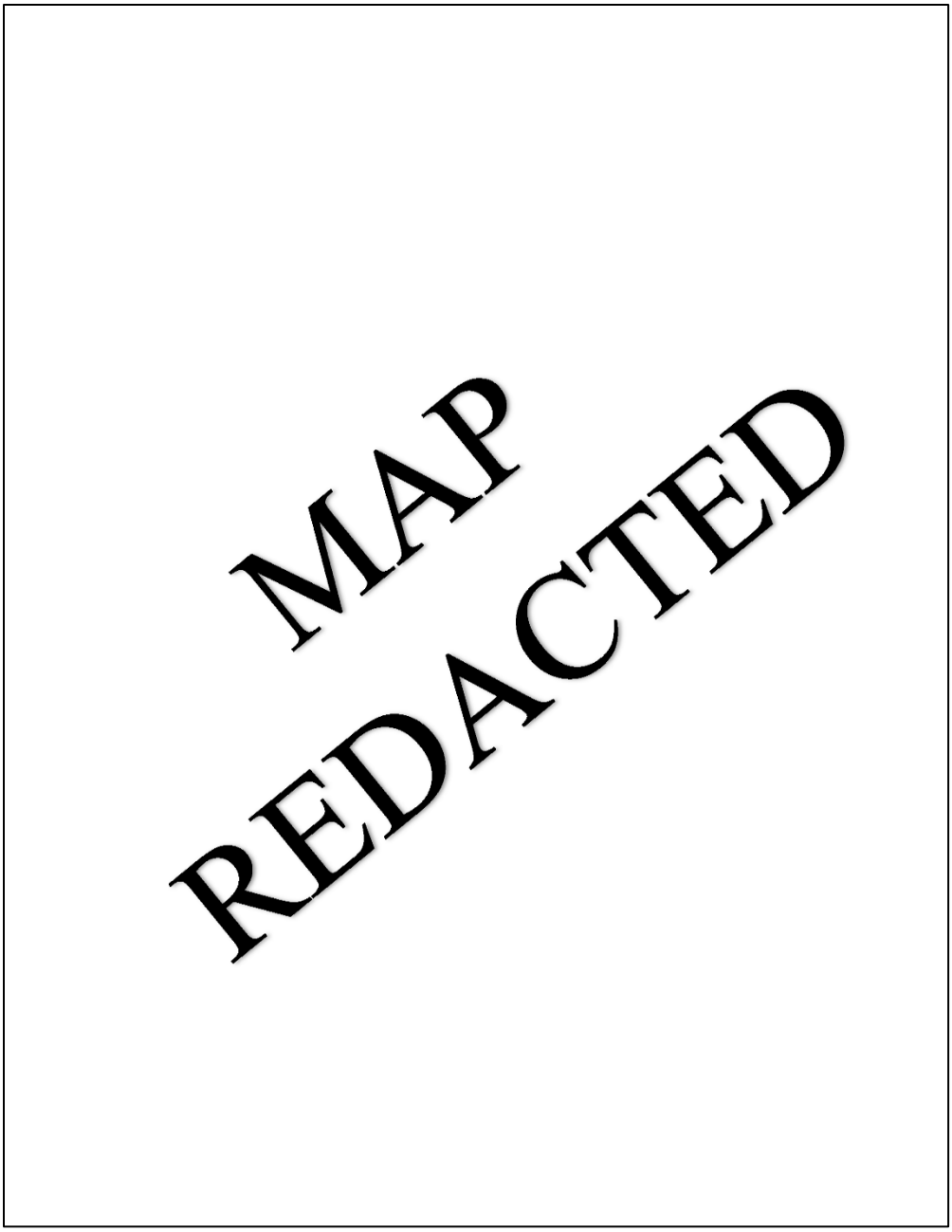

Figure 12.31. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Western Placer County Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.