

SANTA CLARA VALLEY HABITAT PLAN 2023 BURROWING OWL BREEDING SEASON SURVEY REPORT

January 2024





SANTA CLARA VALLEY
HABITAT AGENCY



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EXECUTIVE SUMMARY

The western burrowing owl (*Athene cunicularia hypugaea*) is a species covered under the Santa Clara Valley Habitat Plan (Habitat Plan), and annual population monitoring during the breeding season is a required activity, as described in the Western Burrowing Owl Conservation Strategy (Appendix M of the Habitat Plan, ICF International 2012). This report presents the results of Year 10 of these breeding season surveys. Also included in the report is pertinent background information, discussion of the results, and recommendations.

In collaboration with resource agencies, cities, and other local jurisdictions who are annually surveying for breeding burrowing owls, the South Bay Burrowing Owl Survey Network (Survey Network) was formed and has jointly contributed population data for the region since 2014. Data include regional distribution, adult population size, nest success, and productivity. These data enable the Habitat Agency to monitor changes in the population over time and evaluate progress toward the primary goal for burrowing owls within the Habitat Plan study area:

To establish a burrowing owl population in the study area and the expanded study area that is first stable, then increasing over time, while accounting for normal fluctuations in population levels.

During the 2023 breeding season surveys, surveyors observed a total of 47 adult (21 pairs) and 95 juvenile burrowing owls. Average productivity was 4.4 juvenile per pair. In comparison, during the 2022 breeding season surveys, a total of 33 adult (16 pairs) and 64 juvenile burrowing owls were observed. Average productivity was 4.0 juvenile per pair. Currently, the goal of establishing a stable, then increasing owl population is not being met and the Habitat Agency will be working with the regulatory agencies and the Burrowing Owl Expert Team to explore and implement additional conservation measures in 2024.

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INTRODUCTION

The Santa Clara Valley Habitat Plan (Habitat Plan), approved in 2013, includes the western burrowing owl (*Athene cunicularia hypugaea*) as a covered species. The Habitat Plan’s primary goal for this species is to establish a population in the study area and the expanded study area (Figure 1) that is first stable then increasing over time, while accounting for normal fluctuations in population levels. The Santa Clara Valley Habitat Agency (Habitat Agency) is required to monitor the progress toward this goal and has coordinated annual breeding burrowing owl surveys in the Plan area.

In collaboration with resource agencies, cities, and other local jurisdictions who are annually surveying for breeding burrowing owls or are funding such surveys, the South Bay Burrowing Owl Survey Network (Survey Network) was formed and has jointly contributed population data since 2014. For the last few years, Talon Ecological Research Group has conducted most of the survey work. The Survey Network meets once a year in fall. During the meetings, survey results are shared, and adaptive management strategies discussed.

The Survey Network enables extensive survey area coverage and provides the Habitat Agency with confident estimates of the number of breeding burrowing owls and their reproductive rates in the region. Estimates include the number of pairs and single adults observed during the breeding season, as well as the number of juveniles produced per pair. This report presents the results of the 2023 breeding season surveys, evaluates progress toward the primary goal for this species, and informs conservation strategy implementation conducted by the Habitat Agency in coordination with the Survey Network and the Burrowing Owl Experts Team.

BACKGROUND

The number of breeding burrowing owls in the greater San Francisco Bay area—and the South Bay area in particular—is in decline (DeSante et al. 2007, Townsend and Lenihan 2007, California Natural Diversity Database [<https://www.wildlife.ca.gov/data/cnddb>]). A statewide survey for burrowing owls during 1991–1993, resulted in an estimated 150–170 pairs breeding in the San Francisco Bay area (DeSante and Ruhlen 1995; DeSante et al. 1997) and an estimated 53% decline from the previous census period of 1986–1990 (DeSante et al. 1997). Findings of the 1991–1993 statewide census showed that 75% of the burrowing owl population in the San Francisco Bay area occurred in Santa Clara County and that nearly all owls were located around the southern edge of the San Francisco Bay (DeSante et al. 1997). About a third (43–47 pairs) of these breeding pairs occurred inside what is now the Habitat Plan study area (City of San José 2000). Results of the 2006–2007 statewide census, (Wilkerson and Siegel 2010) showed similar findings in distribution of burrowing owls around the southern edge of the Bay. For the “San Francisco Bay Area Interior” survey area, which included seven counties from Sonoma in the north to Santa Clara in the south, and inland stretching from Napa to Alameda counties, the “best estimate” for the number of burrowing owl pairs in the region was 119, which represented a nearly 28% reduction from the 165 pairs estimated from the 1991–1993 survey (Wilkerson and Siegel 2010).

The Habitat Agency is implementing measures aimed at reversing the declining trend of the burrowing owl population in Santa Clara County. To date, the area of modeled nesting habitat protected in the Plan area encompasses approximately 1,982 acres and modeled protected non-breeding habitat approximately 5,242 acres. As described in the Conservation Strategy (Appendix M of the Habitat Plan, ICF International 2012), conservation actions are grouped into three “tiers” of priority, and during the first years of Plan implementation, the focus had been on Tier 1 conservation actions that were designed to stabilize the existing population by protecting and/or managing occupied burrowing owl nesting habitat in areas within 0.5 mile of established breeding sites. For the last five years, Tier 2 and Tier 3 conservation actions have also been implemented. Tier 2 actions include facilitating “growth and expansion of existing colonies, the number of colonies, and the range of the species in the permit area by

protecting and managing potential burrowing owl nesting habitat in all portions of the permit area.” Tier 3 conservation actions consist of “more experimental and active methodologies such as population augmentation and owl relocation within the permit area to increase owl numbers and expand distribution” (Appendix M of the Habitat Plan, ICF International 2012).

Surveys have also been conducted in areas currently not occupied, but containing suitable burrowing owl habitat. Collectively, these data inform adaptive management of this species and help prioritize use of funds for burrowing owl conservation under the Plan.

STUDY AREA

The Habitat Plan study area (519,506 acres) is located in Santa Clara County in the central California Coast Range (Figure 1). The primary valley in the study area is the Santa Clara Valley, extending from the south end of the San Francisco Bay to San Benito County. The Santa Clara Valley is bounded by the Diablo Range to the east, the Santa Cruz Mountains to the west, and the San Francisco Bay shoreline to the north. The study area excludes tidally influenced portions of the Baylands (Figure 1). For a description of the political, ecologic, and hydrologic factors used to define the study area, see Chapter 1 of the Habitat Plan (ICF International 2012).

During the development of the Habitat Plan, it was determined that opportunities for increasing the local population of burrowing owls were very limited within the study area. After extensive discussions with the California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), and species experts, it was decided that one way to increase the local population was to include conservation areas outside the study area. An expanded study area for burrowing owl conservation (expanded study area) was identified at the northern edge of Santa Clara County in portions of the cities of San José, Santa Clara, Mountain View, Milpitas, and Sunnyvale, as well as in Fremont in Alameda County, and in a small portion of San Mateo County (Figure 1). The expanded study area for burrowing owl conservation added 48,464 acres where burrowing owl surveys and conservation actions can occur.

The North San José/Baylands region contains the largest remaining populations of breeding burrowing owls in the South Bay area. As in previous years, surveys in 2023 were primarily conducted in this region, specifically at Shoreline at Mountain View, San José-Santa Clara Regional Wastewater Facility (RWF), Don Edwards San Francisco Bay National Wildlife Refuge – Warm Springs Unit, NASA Ames Research Center at Moffett Field, San José International Airport, Sunnyvale Baylands Park, and Sunnyvale Landfill (Figure 2). Surveys were also conducted at two new reintroduction sites in the southern section of the county; one release site is owned by Santa Clara County Parks and one is owned and operated by Peninsula Open Space Trust/Santa Clara Open Space Authority. Additional areas were surveyed opportunistically.

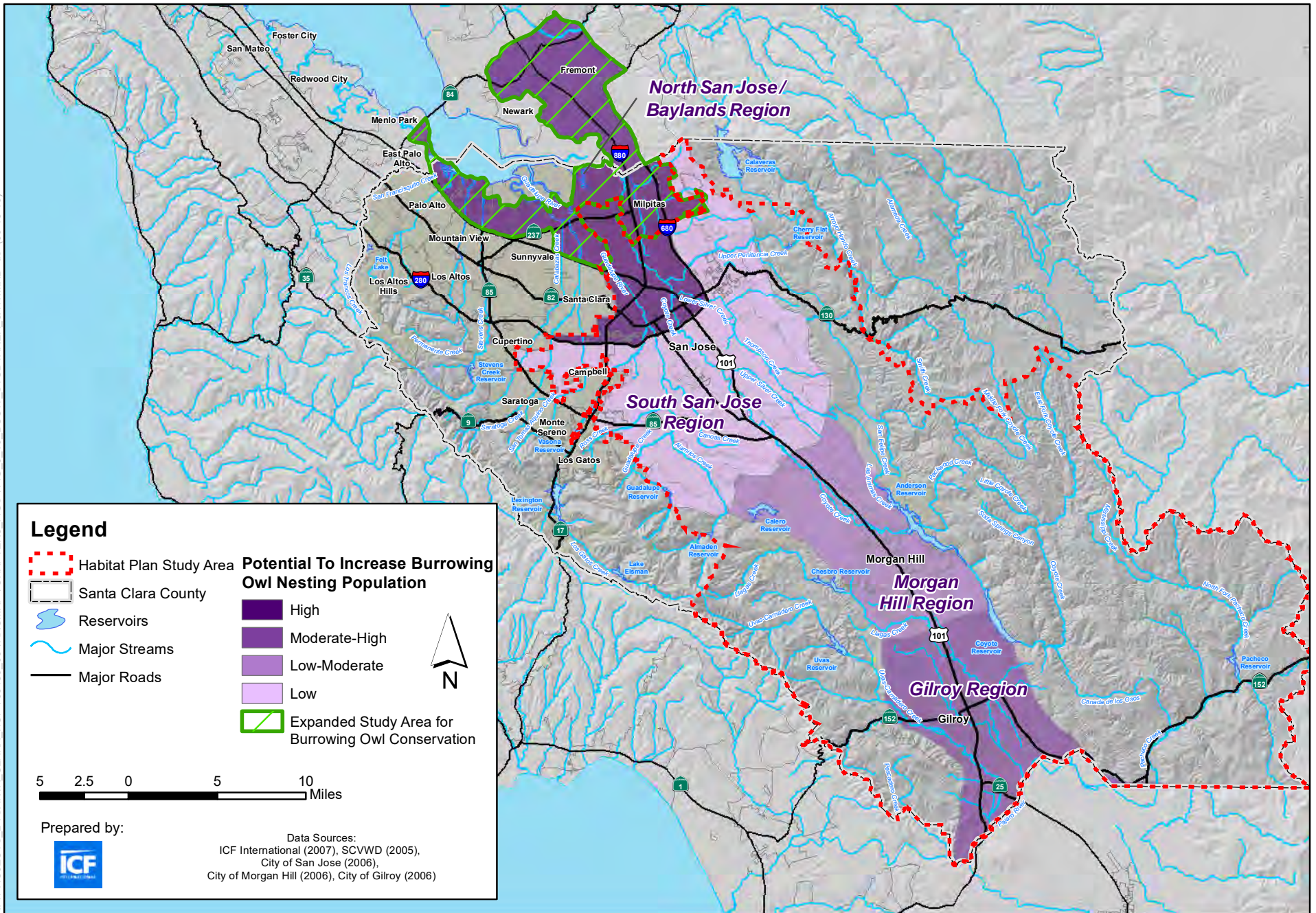
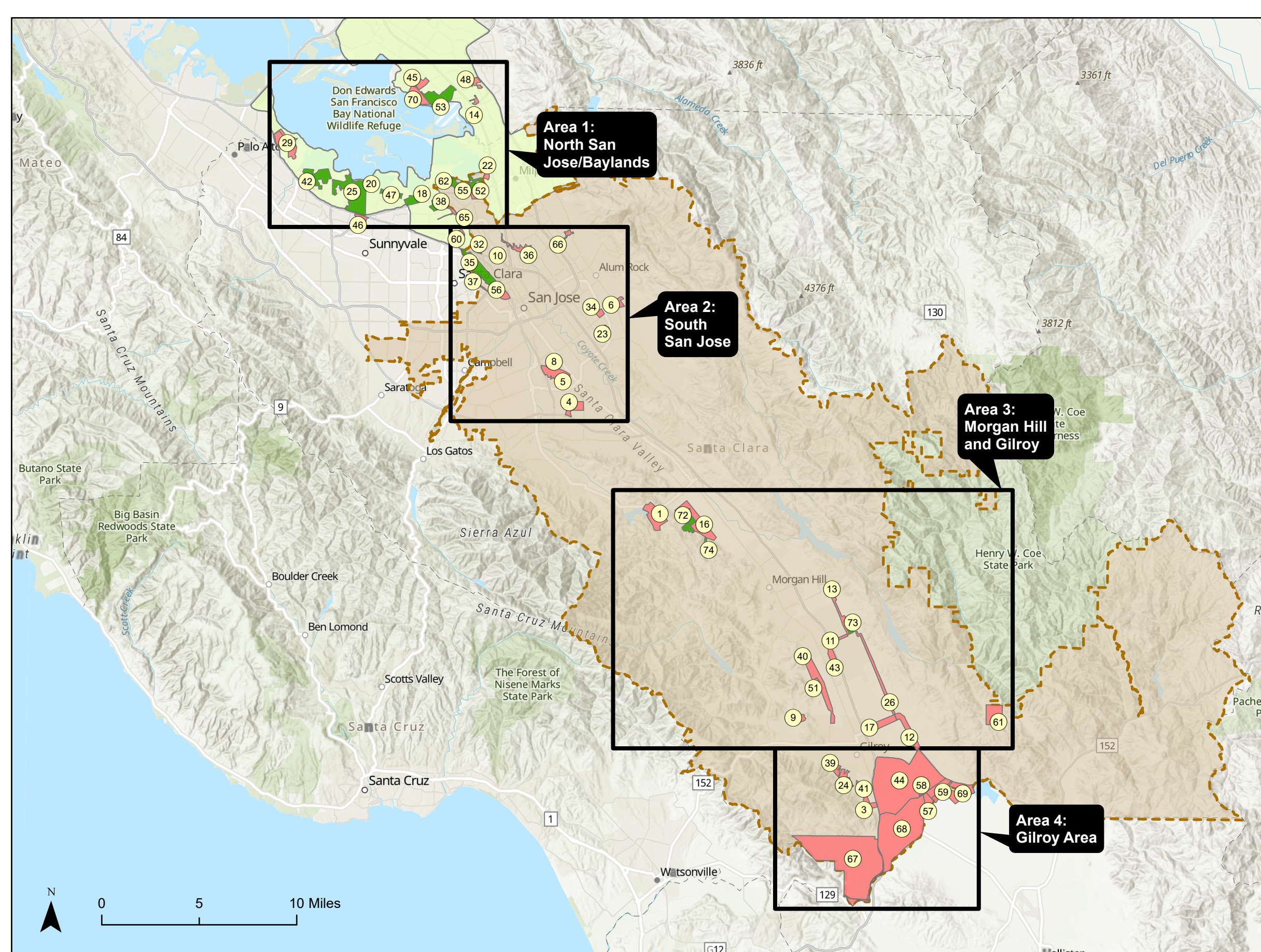


Figure 1. Santa Clara Valley Habitat Plan Study Area and Expanded Study Area for burrowing owl conservation.



Site Index	Name	Results2023
1	Bailey & McKean Rd	Not Surveyed in 2023
2	Byxbee Park	Not Surveyed in 2023
3	Castro Valley Rd	Not Surveyed in 2023
4	Martial Cottle County Park	Not Surveyed in 2023
5	Communications Hill	Not Surveyed in 2023
6	Cunningham Lake West	Not Surveyed in 2023
7	Cunningham Lake East	Not Surveyed in 2023
8	Dairy Hill	Not Surveyed in 2023
9	Day Rd	Not Surveyed in 2023
10	Devon Court	Not Surveyed in 2023
11	East San Marin Ave.	Not Surveyed in 2023
12	Ferguson Rd.	Not Surveyed in 2023
13	Foothill Ave.	Not Surveyed in 2023
14	Gateway Blvd	Not Surveyed in 2023
15	Guadalupe Gardens	Not Surveyed in 2023
16	Laguna Ave	Not Surveyed in 2023
17	Leavesley Rd.	Not Surveyed in 2023
18	Legacy Terrace	Not Surveyed in 2023
19	Lick Mill Park	Not Surveyed in 2023
20	Lockheed	Not Surveyed in 2023
21	Lucy Evans Bay Lands	Not Surveyed in 2023
22	McCarthy	Not Surveyed in 2023
23	Meadow Fair	Not Surveyed in 2023
24	Miller Ave	Not Surveyed in 2023
25	NASA AMES - Moffett	Surveyed in 2023
26	New Ave.	Not Surveyed in 2023
27	OSA Coyote Valley	Surveyed in 2023
28	Palo Alto Airport (a)	Not Surveyed in 2023
29	Palo Alto Airport (a)	Not Surveyed in 2023
30	Palo Alto Golf Course	Not Surveyed in 2023
31	PG&E Warm Springs	Not Surveyed in 2023
32	Phillips	Not Surveyed in 2023
33	PK	Not Surveyed in 2023
34	Reid Hillview Airport	Not Surveyed in 2023
35	San Jose Airport	Surveyed in 2023
36	San Jose Golf Course	Not Surveyed in 2023
37	Santa Clara CalTrain Station	Not Surveyed in 2023
38	Santa Clara Golf & Tennis Club	Surveyed in 2023
39	Glen Loma Ranch	Not Surveyed in 2023
40	Santa Teresa Blvd. North	Not Surveyed in 2023
41	Santa Teresa Blvd. South	Not Surveyed in 2023
42	Shoreline Park	Surveyed in 2023
43	San Martin Airport	Not Surveyed in 2023
44	Hwys 101 to 152, Bloomfield	Not Surveyed in 2023
45	Warm Springs (Stevenson)	Surveyed in 2023
46	Sunnyvale Golf Course	Not Surveyed in 2023
47	Sunnyvale Landfill	Surveyed in 2023
48	Tesla - North	Not Surveyed in 2023
49	Tesla East	Not Surveyed in 2023
50	Tesla South	Not Surveyed in 2023
51	Turlock Ave	Not Surveyed in 2023
52	VTA - Cerone	Not Surveyed in 2023
53	Warm Springs	Surveyed in 2023
54	SJ/SC RWF - Alviso	Surveyed in 2023
55	SJ/SC RWF - East	Surveyed in 2023
56	Guadalupe Gardens North	Not Surveyed in 2023
57	OSA - Pajaro River Ag Preserve (PRAP)	Not Surveyed in 2023
58	OSA - Leung	Not Surveyed in 2023
59	TNC - Pajaro Ranch	Not Surveyed in 2023
60	Montague & 1st Street	Not Surveyed in 2023
61	W Property	Not Surveyed in 2023
62	Cisco Mitigation Area	Surveyed in 2023
64	Sunnyvale Baylands Park	Surveyed in 2023
65	River Oaks Storm Basin	Not Surveyed in 2023
66	Penitencia Creek Park	Not Surveyed in 2023
67	Sargent Ranch	Not Surveyed in 2023
68	South Gilroy	Not Surveyed in 2023
69	Pajaro Mitigation Bank	Not Surveyed in 2023
70	Tri-Cities Landfill	Not Surveyed in 2023
71	POST/OSA Shapell Property	Surveyed in 2023
72	POST/OSA Houret Property	Surveyed in 2023
73	Harvey Bear Santa Clara County Park/Martin Murphy	Surveyed in 2023
74	SCVHA Tilton Ranch/San Bruno Canyon	Surveyed in 2023

■ Not Surveyed in 2023
■ Surveyed in 2023
 Expanded Permit Area for Burrowing Owl Conservation
 Habitat Plan Permit Area

METHODS

The survey protocol was adapted from the *Burrowing Owl Survey Protocol and Mitigation Guidelines* (The California Burrowing Owl Consortium 1993), as well as the *Staff Report on Burrowing Owl Mitigation* (California Department of Fish and Game 2012) and modified to meet the biological goals and objectives of the Habitat Plan's Burrowing Owl Conservation Strategy (Habitat Plan Appendix M, ICF International 2012). The Habitat Agency, in coordination with USFWS and CDFW, uses the survey results to allocate burrowing owl conservation funds and to assess compliance with the conservation program outlined in the Western Burrowing Owl Conservation Strategy.

BREEDING SEASON SURVEYS

All sites were surveyed during the height of the breeding season (March 15–July 15). Site visits were generally conducted between morning civil twilight to 10:00 a.m., or two hours before sunset until evening civil twilight. Pedestrian surveys were conducted during weather conducive to observing owls outside their burrows by avoiding surveying during heavy rain, high winds (>20 km per hour), or dense fog. All burrowing owl sightings, occupied burrows, and burrows with owl sign (e.g., whitewash, feathers, regurgitated pellets, prey remains) were recorded and mapped. Numbers of adult and juvenile burrowing owls and their behaviors such as courtship and foraging were also recorded. Unoccupied sites were classified as having low, moderate, or high potential for breeding burrowing owls based on site conditions observed during the surveys.

Surveyors scanned the ground, all perch structures inside the survey area, and perimeter fences (if present) with binoculars or spotting scopes from various observation points. They walked each site and inspected ground squirrel burrows for signs of burrowing owl occupancy, including whitewash, nest decoration materials, prey remains, and molted feathers. The surveyors recorded the date, time, weather conditions, and observations on the survey form. They took digital photographs of most survey areas.

RESULTS

The Habitat Agency, in coordination with USFWS and CDFW, uses the survey results to allocate burrowing owl conservation funds and to assess compliance with the conservation program outlined in the Western Burrowing Owl Conservation Strategy.

SURVEYS OF CURRENTLY OCCUPIED BREEDING SITES

Similar to previous years, burrowing owls were observed at three sites in the South Bay area during the 2023 breeding season: Shoreline at Mountain View, San José-Santa Clara Regional Wastewater Facility, and NASA Ames Research Center at Moffett Field. For the first time in decades, no burrowing owls were detected at the San José International Airport. As in previous years, no breeding pairs were observed at Don Edwards San Francisco Bay National Wildlife Refuge – Warm Springs Unit.

This year, eight (4 pairs) of breeding burrowing owls were soft-released at RWF as part of the Juvenile Burrowing Owl Overwintering Project. An additional six owls (3 pairs) and three single females were soft-released at Shoreline. For the first time, we also soft-released nine pairs at two new sites in the southern part of the county that were currently not occupied by wild burrowing owls; Peninsula Open Space Trust (POST)/Santa Clara Open Space Authority (OSA) Reintroduction Site and the Santa Clara County Parks and Recreation Department (SCCP) Reintroduction Site. In total we soft-released 16 pairs, 15 of which successfully reproduced a total of 77 offspring (4.8 young per pair). An additional two pairs produced nine offspring in captivity (4.5 young per pair) as part of the Captive Breeding Program (Table 1–6). The 35 released overwintered owls represented 69% of the total breeding population in the Plan Study Area in 2023. The two pairs in the Captive Breeding Program, initiated in 2021, contributed 9% (9 of 102) of the total offspring. More detailed information on these individuals is included under the site descriptions below.

In summary, the count of burrowing owls in the Plan Area in 2023 was 51 adults, forming 23 pairs, 21 of which successfully reproduced (Table 1) a total of 102 young, resulting at a reproductive rate of 4.4 young/pair. In comparison, in 2022, surveyors observed 29 adults, forming 14 pairs, 10 of which successfully reproduced in the wild and two pairs that reproduced in captivity (Table 1). In total, the 16 pairs produced 64 young resulting at a reproductive rate of 4.0 young/pair.

Table 1. 2023 Breeding burrowing owl survey results for the Santa Clara Valley Habitat Plan Study Area and Expanded Study Area for Burrowing Owl Conservation.

Site Name/Location	Number of adults	Number of juveniles	Number of pairs	Number of successful pairs
San José International Airport	0	0	0	0
San José-Santa Clara Regional Wastewater Facility	10*	23	5*	5
POST/OSA Reintroduction Site	10**	26	5	5
SCCP Reintroduction Site	8**	21	4	4
<i>Study Area subtotal</i>	<i>28</i>	<i>70</i>	<i>14</i>	<i>14</i>
Shoreline at Mountain View	17***	23	7**	5
Don Edwards SFB National Wildlife Refuge - Warm Springs Unit	0	0	0	0
NASA Ames Research Center at Moffett Field	2	0	0	0
<i>Expanded Study Area subtotal</i>	<i>19</i>	<i>23</i>	<i>7</i>	<i>5</i>
Captive Breeding Program	4	9	2	2
Totals	51	102	23	21

*8 adults (4 pairs) were released on site as part of the Juvenile Burrowing Owl Overwintering Project.

**all adults were released on site as part of the Juvenile Burrowing Owl Overwintering Project

***9 adults (3 pairs and 3 single females) were released on site as part of the Juvenile Burrowing Owl Overwintering Project.

Shoreline Regional Wildlife Area in Mountain View

This breeding site is located in the City of Mountain View between Highway 101 and south-San Francisco Bay, and includes the lands around Shoreline Amphitheater and Shoreline Golf Links. Data for this population have been collected consistently since 1998 (Figure 3). The number of adult owls observed during the breeding season has fluctuated over time with a low of two owls in 2019 to a high of 26 owls in 2003. This year, five of seven pairs successfully reproduced a total of 23 offspring. Three pairs and three single females were released on site this year as part of the Juvenile Overwintering Project as described below. Nesting success, defined as a pair raising at least one young to fledging during a breeding season, was 71% with a productivity of 3.3 young/pair. Last year, productivity was 3.0 young/pair and average productivity (1998–2023) at this site is 2.3 young/pair.

In April, we soft-released three single females and three pairs at Shoreline. Two of the three pairs reproduced; one pair had five offspring, while the other one had six. One of the soft-released single females remained at Shoreline for the duration of the breeding season and paired up with a male who had lost his previous mate; however, this pair never produced young. The other single female moved to Moffett Field, where she paired up with a male, but this pair also did not produce young. None of the single females were resighted after release.

Since 2017, supplemental feeding has been implemented at this site as well as at Moffett Field, San José-Santa Clara RWF, and Warm Springs Unit (Higgins et al. 2017–2020, Talon 2021–2023). Twice per week, we placed dead mice in nest burrow entrances at each participating site. We provided 14 mice (~255gm) per week at each nest burrow during the period from estimated pair formation until fledging, following the protocol described by Wellicome et al. (2013). Supplemental feeding begins each year when pairs typically lay eggs (March/April) and continues until young are fledged. If no offspring are observed at a nest burrow by July 1, supplemental feeding at that particular burrow ceases.

Adult and young owls have been banded at this site from 1998 to 2004, and then continuously since 2012. Banding data show at least seven instances of inbreeding in 2004, 2006, 2015, 2016, 2017, and 2020. Inbreeding is a common occurrence for small populations and has been observed at other locations within the study area.

Habitat loss and direct human disturbance have been the main observable factors for the population decline at this site. Between 2014 and 2018, a total of 56 ground squirrel burrows have been intentionally blocked at Shoreline, 16 of these were used by burrowing owls at some time. In 2017, at least two occupied burrow entrances were blocked on purpose.

Additionally, pedestrians have been observed off-trail near occupied burrows and dogs are frequently let off their leashes. With the installation of a 6-foot tall chain link fence around the NE Meadowlands in 2019, human disturbance at this location has been eliminated. During the 2023 breeding season, six of the seven pairs nested inside the fenced area. The seventh pair nested outside the fenced area on the golf course; in response to continual disturbance from photographers and birders, a temporary fence had to be installed around this nest burrow. The fence provided some protection; however, on multiple occasions the temporary fence was torn down.

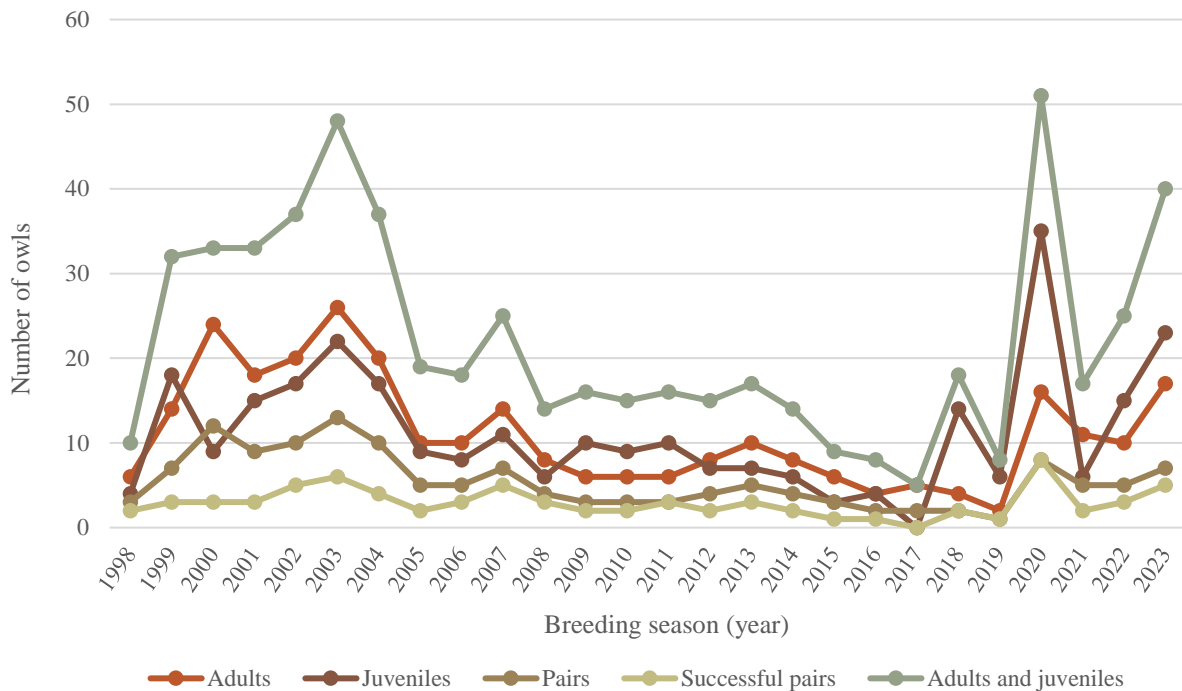


Figure 3. Shoreline at Mountain View Annual Burrowing Owl Survey Results, 1998–2023.

NASA Ames Research Center at Moffett Field

Moffett Field is located east of Shoreline, north of the intersection of Highway 101 and 237. Data for this population have been collected consistently since 1998. The number of breeding adults has fluctuated between a high of 61 adults in 1999 and a low of two single males in 2023 (Figure 4). No breeding pairs were observed at this site this year. In 2022, only one breeding pair was observed. The pair did not produce offspring. Average productivity at this breeding site was 1.9 young/pair (1998–2023). This colony has collapsed since 2018, when 15 adults (6 females and 9 males) were observed and six pairs produced a total of 30 young.

No supplemental feeding was implemented in 2023. All pairs and their young were fed throughout the breeding season each year 2017–2022 (Higgins et al. 2017–2020, Talon 2021–2023, Wellicome et al. 2013). In previous years, adult and juvenile owls were banded annually during the breeding season, but no banding occurred in 2023 because the two males were already banded. Incestuous mating and polygyny (Barclay and Menzel 2011) were documented in 2010, 2012–2014, and 2019, likely limiting genetic diversity within the colony.

The owls at Moffett Field continue to be impacted by multiple stressors. Cumulative negative effects from construction projects over the years have destroyed, degraded, and fragmented previous nesting, wintering, and foraging habitat. Other strains on this population were a lapse in non-native predator abatement (especially red foxes) and USDA’s need to balance airfield safety with wildlife management/habitat protection.

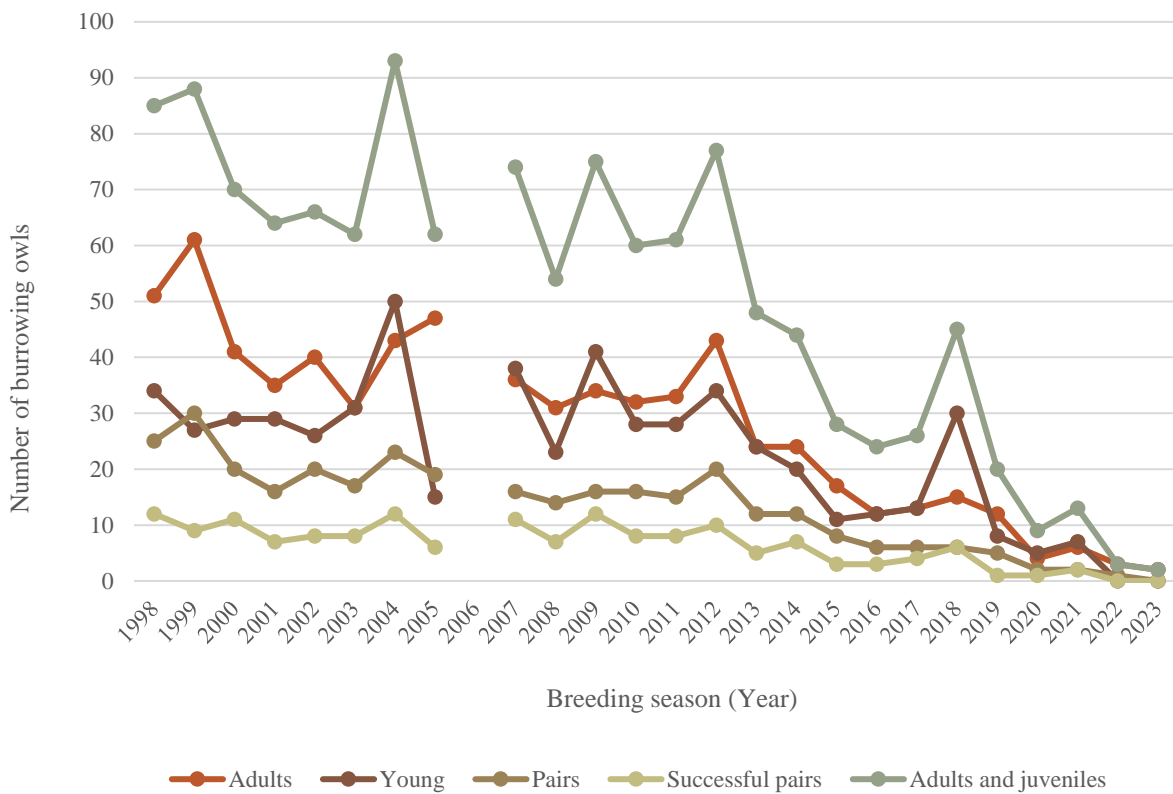


Figure 4. NASA Ames Research Center at Moffett Field Annual Burrowing Owl Survey Results, 1998–2023.

San José-Santa Clara Regional Wastewater Facility Bufferlands

The bufferlands are located in Alviso in north San José, north of Highway 237 between Coyote Creek and the Guadalupe River. Data for this population were collected opportunistically from 1996–2013 and then more consistently since 2014. The number of adult owls observed during the breeding season has fluctuated between a low of two adults in 2012 and a high of 35–37 adults in 2017 (Figure 5).

In 2023, five pairs were successful and produced a total of 23 young. Productivity was 4.6 young/pair which was higher than the average productivity of 3.5 young/pair (2015–2023) at this breeding site. We soft-released four of these pairs as part of the Juvenile Overwintering Project in April. All four pairs successfully reproduced 3–6 young each, for a total of 19 young.

In 2022, six pairs were successful and produced a total of 36 young. We soft-released five of these pairs as part of the Juvenile Overwintering Project. All five pairs successfully reproduced 4–8 young each, for a total of 29 young. 2021 and 2020 were the least productive years, with nine young each year since consistent data collection began in 2014.

All pairs and their young were supplementally fed throughout 2023 breeding season (Higgins et al. 2017–2020, Talon 2021–2023, Wellicome et al. 2013). This was the fifth year that supplemental feeding was implemented at RWF. Adult and juvenile owls have been banded at this site since 2015. Analysis of banding data revealed that one pair was inbreeding in 2019; a female mated with her male offspring and produced five young (Chromczak 2015–2020).

Adjacent foraging habitat for this colony has been reduced in recent years. During 2016 and 2017, grassland areas to the northeast along Disk Drive were fully developed. Increased use of anticoagulant rodenticides leading to secondary poisoning in these newly urbanized areas is of concern to burrowing owl survival. During the 2018 breeding season, two burrowing owl pairs closest to the new development failed to produce fledglings; the cause for this failure is unclear. In 2019, six nestlings were orphaned in the same area; the fate of their parents was unknown. Fortunately, we were able to capture all six orphans and transfer them to the Wildlife Care Center at the Peninsula Humane Society in Burlingame where they were cared for as part of the Juvenile Burrowing Owl Overwintering Project.

Vegetation management at this site has varied over the years, from minimal maintenance to intensive sheep grazing, to regular mowing. Habitat enhancements at this site include the installation of artificial burrows, mounds and berms, vegetative islands, and brush piles. In 2017, 2019, and 2023, extended periods of flooding at the start of the breeding season reduced the availability of breeding and foraging habitat.

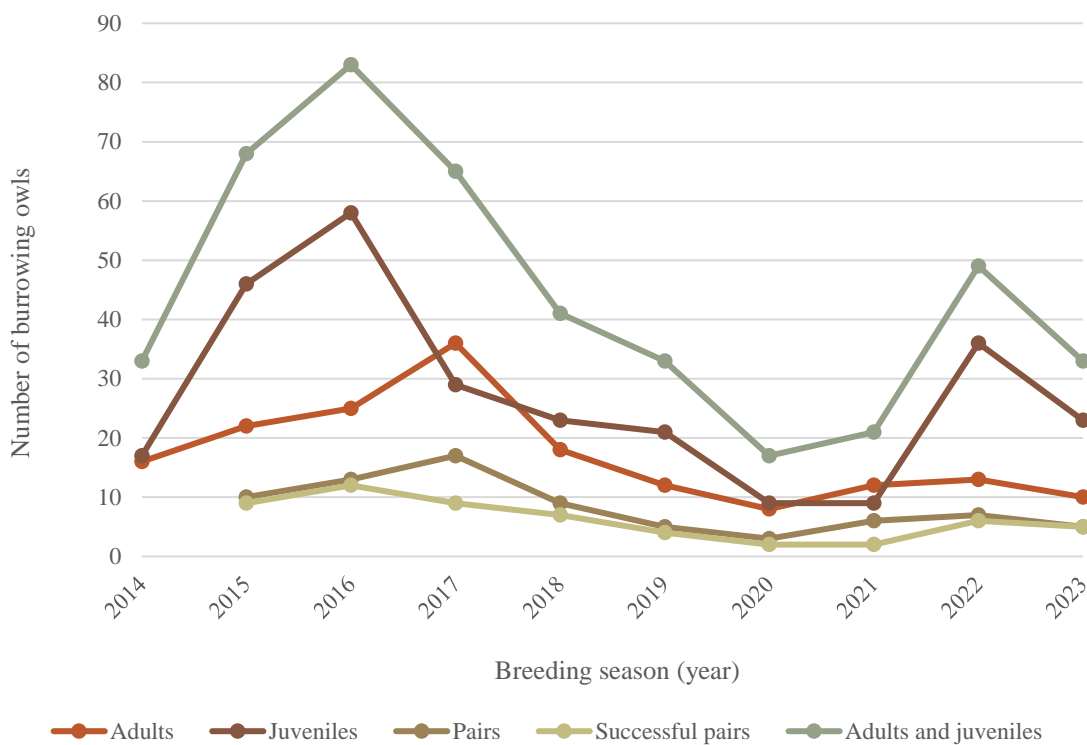


Figure 5. San José-Santa Clara Regional Wastewater Facility Annual Burrowing Owl Survey Results, 1996–2023.

Don Edwards San Francisco Bay National Wildlife Refuge – Warm Springs Unit

The Warm Springs Unit of the refuge is located along the southeastern side of San Francisco Bay, west of Highway 880. Of the recent extant owl colonies in the South Bay, the Warm Springs Unit has the greatest amount of suitable, undisturbed habitat for burrowing owls. Data for this colony have been collected somewhat consistently 2001–2007 and more consistently since 2013. Adult and juvenile owls have been banded at this site annually 2015–2019. In 2023, limited surveys were conducted at this site and surveys will be discontinued during coming breeding seasons because of the absence of breeding owls in recent years.

The number of adult owls observed during the breeding season has fluctuated between a high of 64 adults in 2008 and a low of two single adults in 2020 (Figure 6). Since 2021, we observed no breeding burrowing owls at this site. Warm Springs provides essential habitat for migrating burrowing owls during winter.

Vegetation management at Warm Springs included cattle grazing and, in some years, targeted application of herbicide to control non-native weed species. Vegetation conditions were favorable throughout the year. Urban development has increased around the Warm Springs Unit. Construction of the Pacific Commons development, adjacent to the north, has been completed; development is planned along Auto Mall Parkway. Increased use of anticoagulant rodenticides leading to secondary poisoning in these newly urbanized areas is of concern to burrowing owl survival. The site is now mainly surrounded by habitat unsuitable for owls; with salt ponds to the southwest and urban development everywhere else.

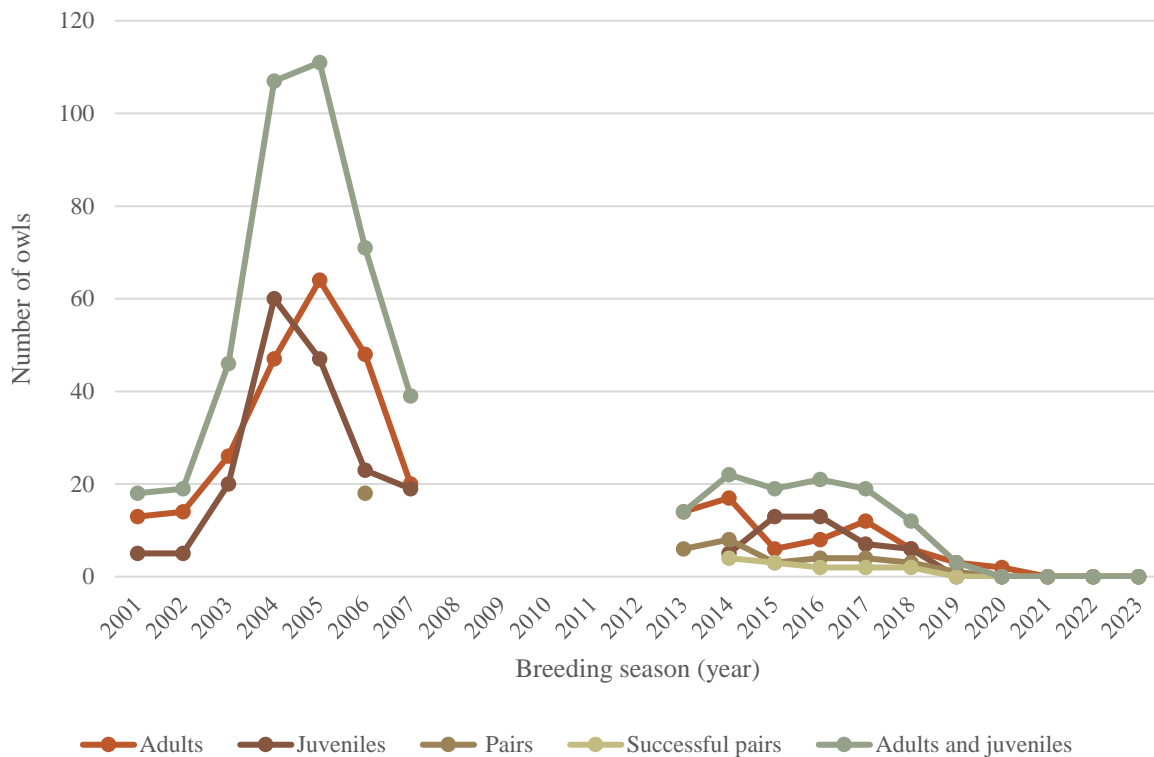


Figure 6. Don Edwards San Francisco Bay National Wildlife Refuge – Warm Springs Unit Annual Burrowing Owl Survey Results, 2001–2023.

San José International Airport

San José International Airport is located just south of Highway 101 and west of Highway 880. Data for this population were collected consistently during 1990–2012 (Barclay et al. 2011), and somewhat consistently since then by U.S. Department of Agriculture. The number of adult owls observed during the breeding season at this site has fluctuated between a high of 82 adults in 2002 and a low of three adults in 2022 (Figure 7). In 2023, no breeding burrowing owl were observed. In 2022, one pair produced three offspring and in 2021 two pairs produced 10 offspring.

This site once provided suitable habitat for a thriving colony of burrowing owls. For the last decade, owls at this site faced a variety of stressors, including habitat loss, cessation of active management, airfield traffic/strike hazard, and USDA’s need to balance airfield safety with wildlife management/habitat protection. Between 1997 and 2012, the burrowing owl population was actively managed by installing and maintaining artificial burrows along taxiways and at the end of runways where the strike hazard of burrowing owls with aircraft is lowest (Barclay 2007, Barclay et al. 2011). Burrowing owls chose to occupy artificial burrows more frequently than natural burrows and breeding success was greater at artificial burrows than at natural burrows. However, annual surface maintenance and regular maintenance of the entire artificial burrow are essential for longer-term occupancy (Menzel 2018), but artificial burrow maintenance has not been at this site since 2013.

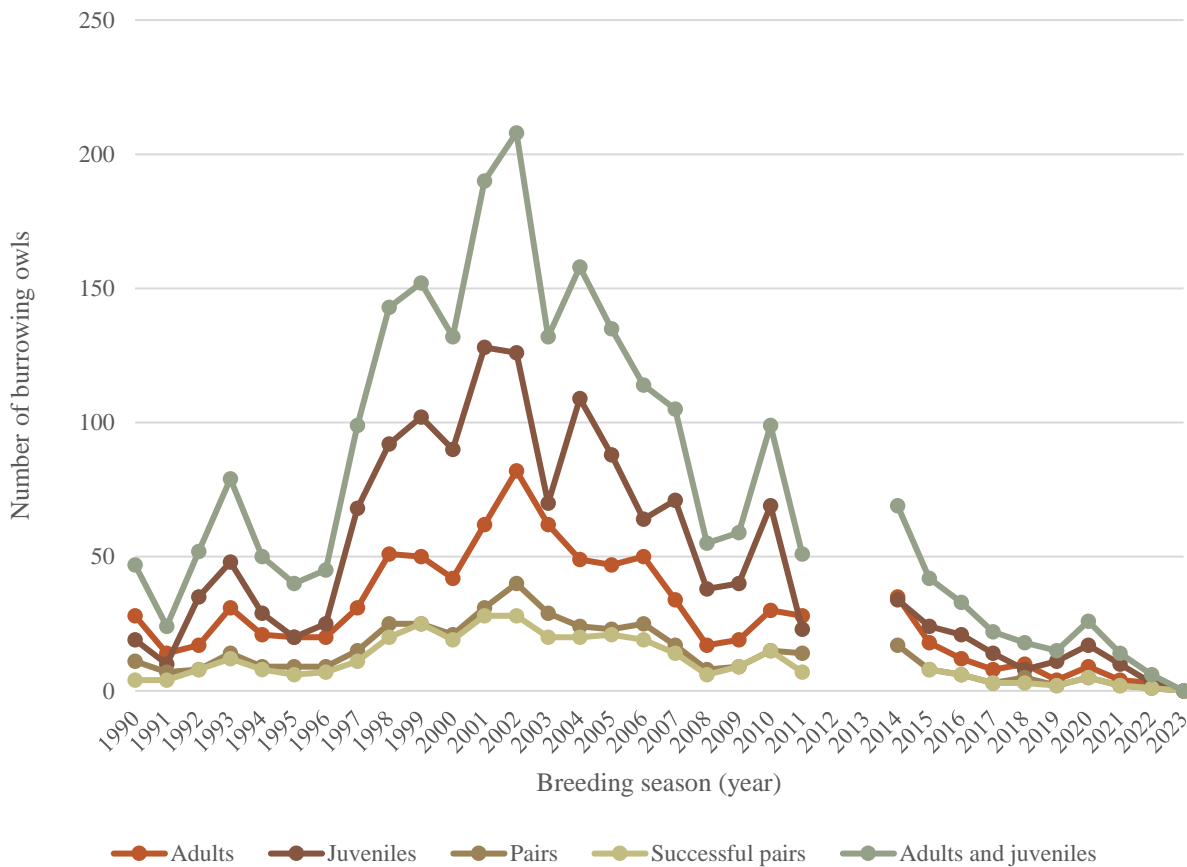


Figure 7. San José International Airport Annual Burrowing Owl Survey Results, 1990–2023.

BURROWING OWL REINTRODUCTION IN CURRENTLY UNOCCUPIED HABITAT IN COYOTE VALLEY

As a Tier 3 conservation action, Talon Ecological Research Group initiated reintroduction of burrowing owls at two sites in Coyote Valley. They soft-released a total of nine pairs (Figure 8) as part of the Juvenile Overwintering Project in the southern part of the county that were currently not occupied by wild burrowing owls; Peninsula Open Space Trust (POST)/Santa Clara Open Space Authority (OSA) Reintroduction Site and the Santa Clara County Parks and Recreation Department (SCCP) Reintroduction Site. Both sites are protected in perpetuity and the Habitat Agency signed long-term management agreements with SCCP and POST/OSA. Funding for habitat management, maintenance, and monitoring is provided through the SCVHA for the duration of the HCP/NCCP. California ground squirrels are present at both sites. Vegetation management included cattle grazing at both sites. Pairs were placed into hacking enclosures in April. All pairs successfully produced a total of 47 offspring. As of December 2023, owls remained at both sites. We are planning on releasing additional pairs at each site in 2024.

POST/OSA Reintroduction Site

The property is owned by POST and managed by OSA. The 100-acre property, located north of Morgan Hill, is flat and on the valley floor with Fisher Creek demarking the eastern property line. The treeless upland habitat contains native and non-native grassland flora and is grazed and/or mowed. The property is fenced and is not open to the public. Adjacent lands provide excellent foraging habitat for burrowing owls. Land uses include agricultural fields, and cattle and horse ranching. Overall, the property and surrounding parcels provide high quality habitat for nesting burrowing owls.

SCCP Reintroduction Site

The Santa Clara County Parks and Recreation Department offered an approximately 31-acre site east of Morgan Hill as a reintroduction site for burrowing owls. The site is flat at approximately 330 ft above sea level on the Coyote Valley floor. The treeless habitat contains native and non-native grassland flora and is grazed annually by cattle. The parcel is fenced and is not open to the public. Adjacent lands provide excellent foraging habitat for burrowing owls. Land uses include agricultural fields, cattle and horse ranching, and county park land. The reintroduction site and surrounding parcels provide high quality habitat for nesting burrowing owls.

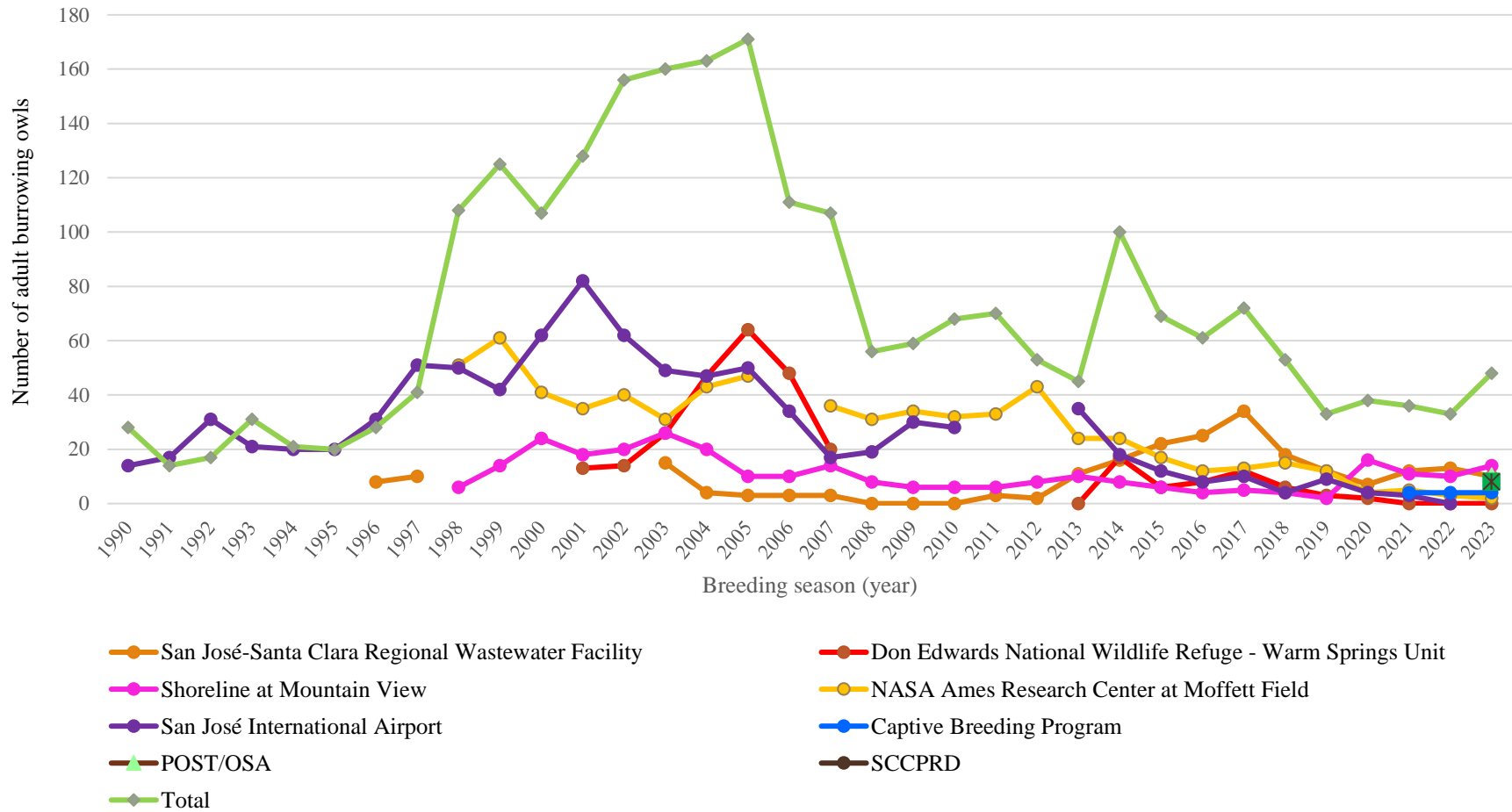


Figure 8. Number of adult owls observed at five breeding sites in the Santa Clara Valley Habitat Plan Study Area and Expanded Study Area for burrowing owl conservation, 1991–2023.

ADDITIONAL SURVEY AREAS

Besides the five breeding sites described above, Talon Ecological Research Group surveyed eight additional sites during the breeding season (Table 2). No breeding owls were observed within any of these areas.

Table 2. Summary of burrowing owl and ground squirrel observations at additional survey locations within the Habitat Plan Permit Area during the 2023 breeding season.

Survey location (site index)	Survey frequency	No. of burrowing owls observed	Abundance of ground squirrels	Vegetation height
OSA Coyote Valley (27)	1 survey	None	High	Medium-tall
Santa Clara Golf & Tennis Club (38)	4 surveys	None	Medium	Medium-tall
Sunnyvale Landfill (47)	Monthly surveys, April–August	None	Medium	Short
SJ-SC RWF East (55)	2 surveys	None	Medium	Medium-tall
Sunnyvale Baylands Park (64)	Quarterly surveys, April and July	None	Low	Medium-tall
POST/OSA Houret Property (72)	1 survey	None	None	Short/tilled
Harvey Bear Santa Clara County Park/Martin Murphy (73)	2 surveys	None	Low	Medium-tall
SCVHA Tilton Ranch/San Bruno Canyon ((74)	2 surveys	None	High	Short-medium

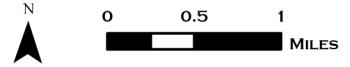
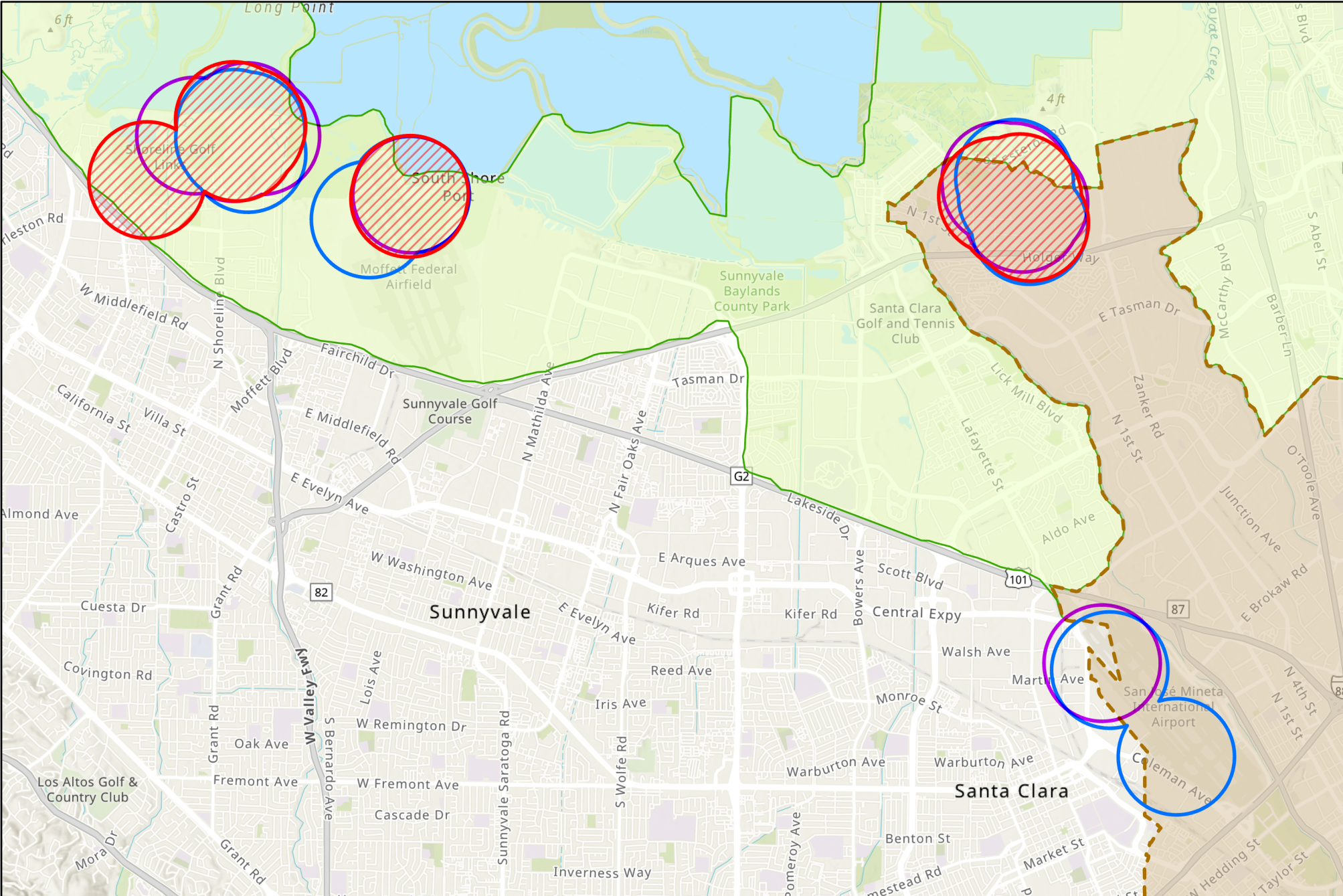
OCCUPIED BURROWING OWL HABITAT

The area of occupied burrowing owl habitat, which includes foraging habitat within a 0.5-mile radius around each nest location, has been calculated (Table 3) and delineated (Figure 9) annually to aid revision of the burrowing owl conservation fee map (Appendix 6). Based on the recent distribution of breeding burrowing owls in the study area and the propensity of burrowing owls to forage within 0.5 mile of nest locations during the breeding season (Haug and Oliphant 1990, Rosenberg and Haley 2004), the Habitat Plan area contained an estimated 2,453.4 acres of occupied nesting habitat in 2023; the POST/OSA and SCCP reintroduction sites were not included in this calculation. Last year an estimated 2,707.2 acres were occupied nesting habitat. The acreage of occupied habitat in the Plan area has significantly decreased from 8,607.5 acres since 2017 (Table 3).

In 2022, RES Pajaro Mitigation Bank was no longer included in the occupied habitat area calculations and was removed from the fee zone map. The site previously supported breeding burrowing owls, last incidentally observed there 2014–2017. In 2017, a year with record rainfall, a pair was displaced due to flooding and no nesting owls were observed thereafter.

Table 3. Area of occupied burrowing owl habitat in the Santa Clara Valley Habitat Plan Study Area and Expanded Study Area for burrowing owl conservation, 2014–2023. Acreage includes a 0.5-mile buffer around each occupied nest burrow.

Year	Acres
2014	5,095.8
2015	5,533.6
2016	8,375.1
2017	8,607.5
2018	6,568.4
2019	3,830.3
2020	3,394.1
2021	3,244.6
2022	2,707.2
2023	2,453.4



Occupied Burrowing Owl Habitat in the Santa Clara Valley Habitat Plan Study Area and Expanded Study Area, 2021-2023

- Habitat Plan Permit Area
- Expanded Permit Area for Burrowing Owl Conservation
- 2023 Occupied Habitat
- 2022 Occupied Habitat
- 2021 Occupied Habitat

DISCUSSION

Since 2014, the South Bay Burrowing Owl Survey Network has supported the Habitat Agency in meeting the Habitat Plan’s survey goals. During this tenth annual breeding season survey, the number of owls has increased from a total of 33 adults in 2022 to 51 adults in 2023 (Table 4). The number of young increased from 64 to 102 during the same timeframe. Nonetheless, small populations such as this are inherently more vulnerable to external environmental perturbations, inbreeding, and chance fluctuations in local survival and fecundity (Keller and Waller 2002).

Table 4. Comparison of adult burrowing owls observed in the Santa Clara Valley Habitat Plan area during the breeding season, 2014–2023. In parentheses are the number of owls released as part of the Juvenile Burrowing Owl Overwintering Project, 2020–2023.

Location	Year									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
San José International Airport	34	18	12	8	10	4	9	4	3	0
Regional Wastewater Facility	16	22–23	25–26	35–37	18	12	8 (3)	12 (9)	13 (11)	10 (8)
Shoreline at Mountain View	6	6	4	5	4	2	16 (10)	11	10 (6)	17 (9)
Don Edwards-Warm Springs Unit	11	6	8	11–12	5–6	3	2	0	0	0
Moffett Field	24	17	12	13	15	12	4	6	3	2
Other Locations	16	5	0	2	0	0	0	0	0	0
POST/OSA reintroduction site	—	—	—	—	—	—	—	—	—	(10)
SCCP reintroduction site	—	—	—	—	—	—	—	—	—	(8)
Captive Breeding Program	—	—	—	—	—	—	—	4	4	4
Total	107	75	62	77	52–53	33	38	36	33	51

Of the 51 breeding adults, 35 (69%) were released as part of the Juvenile Burrowing Owl Overwintering Project in 2023 (Figure 10). In 2022, 17 of 35 adults (51.5%) were released as part of the Juvenile Burrowing Owl Overwintering Project and in 2021, nine of 36 adults (25%). Without protection of these juveniles in captivity, 50–75% of them would likely have perished during fall and winter and the number of breeding adults in 2023 would likely have been lower.

In 2021, we also initiated a Captive Breeding Program. Four owls from the Juvenile Overwintering Project were retained in 2021 to form two breeding pairs. These two captive pairs successfully reproduced in 2021 and 2022 (Figure 7). In 2023, both pairs were soft-released at Shoreline in Mountain View and we retained four different owls from the Overwintering Project for the 2023 Captive Breeding Program; both pairs successfully produced a total of nine offspring. The success of the Juvenile Burrowing Owl Overwintering Project and the Captive Breeding Program are essential for maintaining, and hopefully increasing, a source population in the Plan area.

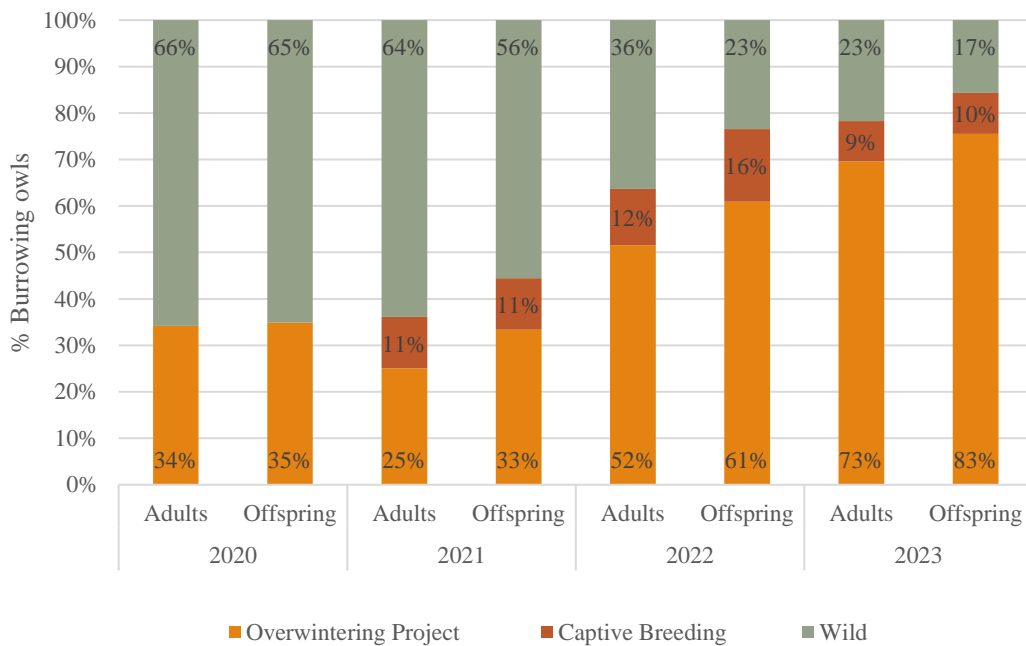


Figure 10. The total number of breeding burrowing owls and their offspring observed in the Santa Clara Valley Habitat Plan area 2020–2023, represented in percentages based on source affiliation: owls breeding in the wild, released as part of the Juvenile Overwintering Project, or retained for the Captive Breeding Program.

Inbreeding has been observed at several sites over the last decade and may contribute to the overall population decline through *inbreeding depression*. Inbreeding depression is the reduction in the average fitness of offspring born to parents that are closely related to each other, compared to the fitness of offspring born to unrelated parents. Inbreeding depression occurs because closely related parents share more genes, and thus their offspring are more likely to receive two copies (one from each parent) of alleles that cause deleterious traits or genetic diseases. Inbreeding data from bird and mammal populations suggest that inbreeding depression often significantly affects birth weight, survival, reproduction, resistance to disease, predation, and environmental stress (Keller and Waller 2002). Releasing breeding pairs as part of the Juvenile Overwintering Project, alleviates some of the inbreeding depression. Each pair is selected based on genomic analysis and the least related individuals are paired up.

In addition to a low number of individuals, wild pairs of burrowing owls in the South Bay were limited to only two breeding sites. This regional contraction in range exposes the breeding population to stochasticity and therefore a high risk of local extirpation, especially because all these sites are facing increasing pressure from encroaching development. While burrow availability and foraging habitat have been reduced, the rate of disturbance and predation pressure has increased. Habitat protection and management at current breeding sites is imperative.

Additional pressures arose from the effects of climate change and extreme weather conditions. During the 2022/2023 winter, the area experienced record precipitation levels and widespread flooding. Groundwater levels were high into April and ground squirrel burrows and artificial burrows were flooded. Conversely, the previous three years brought extreme drought conditions. During drought years, prey availability for burrowing owls is limited and competition for these reduced resources is increased. During 2021 and 2022, some grass species were dormant or had limited growth and we noticed an increased distribution of some invasive weedy species (mustard spp., stinkwort, and pepperweed) at most sites. In addition, we observed few if any grasshoppers during transect surveys. In prior years, grasshoppers were abundant during the summer. Grasshoppers and other invertebrates are essential prey items for burrowing owls during the breeding season while adults feed their young. Scarcity of invertebrates during these drought years could have contributed to the reduced number of breeding owls in the Plan area. Severe and changing weather events, including precipitation and temperature patterns, must be anticipated in the future, but will be challenging to predict/alleviate.

RECOMMENDATIONS

We recommend that the Habitat Agency continue to organize the South Bay Burrowing Owl Survey Network's breeding season surveys in 2024. We suggest continuing with one in-person fall meeting each year.

Recommended activities in 2024 include the following:

1. Continue surveys in occupied burrowing owl habitat (Figure 9) in the Habitat Plan area (locations with known occurrences in the last 3 years).
2. Implement measures as described in Tier 2 and Tier 3 conservation actions in the Habitat Plan to help achieve the goal of a stable, then increasing breeding burrowing owl population. Special emphasis should be placed on:
 - Working with stakeholders to minimize disturbance near occupied nest burrows.
 - Preventing the use of harmful rodenticides on lands actively managed for breeding burrowing owls.
 - Reducing the threat from non-native predators (e.g., feral cats, red fox).
 - Continuing the Juvenile Burrowing Owl Overwintering Project, initiated in 2019, to reduce juvenile mortality rates.
 - Increasing reproductive success through supplemental feeding.
 - Continuing the Burrowing Owl Captive Breeding Program, initiated in 2021.
 - Continue reintroductions of overwintered burrowing owls at sites in the southern part of Santa Clara County.
 - Increasing California ground squirrel distribution and abundance through habitat enhancements and reintroduction programs, as necessary.

- Implementing prey-base enhancement projects. This may include unmowed/ungrazed areas, islands with native plants, and rock and brush piles.
- Installation of additional artificial burrows (ABs) at all extant sites to augment natural ground squirrel burrows. ABs are structurally more likely to withstand damage from vehicles and/or large grazing animals. ABs also offer more protection from some terrestrial predators trying to excavate and access the nesting chambers.

ACKNOWLEDGMENTS

The Santa Clara Valley Habitat Agency thanks the following entities and their staff for their ongoing collaboration and their commitment to burrowing owls in Santa Clara County.

- San José-Santa Clara Regional Wastewater Facility/City of San José
- City of Mountain View/Shoreline at Mountain View
- NASA Ames Research Center at Moffett Field
- San José International Airport/US Department of Agriculture
- US Fish and Wildlife Service/Don Edwards San Francisco Bay National Wildlife Refuge
- City of Sunnyvale
- Santa Clara Valley Open Space Authority
- Peninsula Open Space Trust
- Santa Clara County Parks & Recreation Department
- Santa Clara Valley Audubon Society
- Wildlife Rehabilitation and Education Center (WERC)
- Peninsula Humane Society Wildlife Care Center
- Grassroots Ecology
- Resource Environmental Solutions (RES)
- Land Trust of Santa Clara Valley
- Debra Chromczak, independent Burrowing Owl Consultant
- Dr. Lynne Trulio at San José State University
- ICF
- Albion Environmental, Inc.
- Talon Ecological Research Group

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APPENDICES

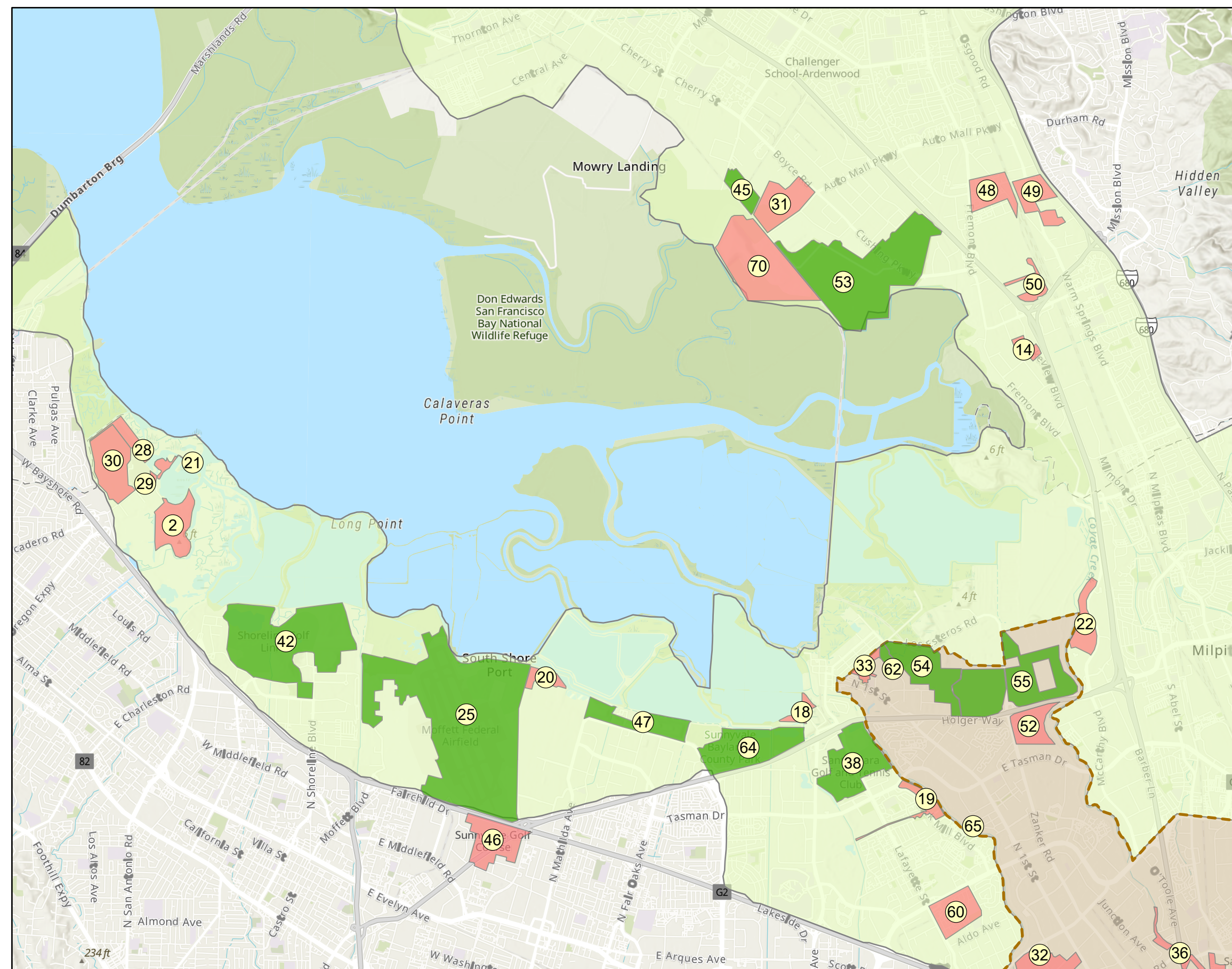
Appendix 1. Burrowing owl survey form.

Site Info	Surveyor(s) and contact info:			Site Name/Desc:			
	Map sheet #(s):			Survey method: <input type="checkbox"/> On foot <input type="checkbox"/> In car			
	Distance covered:			Total time surveyed:			
	Date	/ /	Time	Temp	Wind	Sky (% cover)	Weather last 24 hrs
	Sun(rise/set):	Start:					
		End:					
Habitat Plan Region:			<input type="checkbox"/> Occupied Site (within last 3 years) <input type="checkbox"/> Occurrence older than 3 years <input type="checkbox"/> Within Habitat Plan Study Area <input type="checkbox"/> Within Expanded BUOW Study Area <input type="checkbox"/> Suitable habitat but no recorded occurrences				
Habitat Conditions/Assessment	Land cover (Check all that apply & add additional types if needed)						
	<input type="checkbox"/> Grasslands	<input type="checkbox"/> Agricultural		<input type="checkbox"/> Oak Woodland			
	<input type="checkbox"/> Developed	<input type="checkbox"/> Orchard		<input type="checkbox"/> Aquatic feature			
	<input type="checkbox"/> Urban-Suburban	<input type="checkbox"/> Vineyard		<input type="checkbox"/> Marsh/Wetland			
	<input type="checkbox"/> Rural-Residential	<input type="checkbox"/> Grain, Row Crop, Hay and Pasture, Disked/Short-Term		<input type="checkbox"/> Pond			
	<input type="checkbox"/> Landfill	<input type="checkbox"/> Fallowed		Other Land Cover Types :			
	<input type="checkbox"/> Golf Course/Urban Park	<input type="checkbox"/> Agriculture Developed					
	<input type="checkbox"/> Barren						
	Approximate height of grasses and/or other plants within site: <input type="checkbox"/> <6" <input type="checkbox"/> 6-12" <input type="checkbox"/> >12"						
	Presence and abundance of ground squirrels: <input type="checkbox"/> None <input type="checkbox"/> Low (1-4) <input type="checkbox"/> Medium (5-10) <input type="checkbox"/> High (>10)						
Suitable foraging habitat adjacent to site (any barriers to movement):							
Existing land use practices:							
Dominant Surrounding Land Use:							
Notes (potential measures to improve and expand available habitat):							
Photo #(s):							
Breeding Season Survey	Percentage of site covered during survey :			Access restrictions?			
	<input type="checkbox"/> 0-25% <input type="checkbox"/> 26-50% <input type="checkbox"/> 51-75% <input type="checkbox"/> 76-100% <input type="checkbox"/> Unknown						
	Burrows observed? <input type="checkbox"/> Yes <input type="checkbox"/> No		Burrow condition:		Other suitable nesting substrate (culverts, rock piles, etc.):		
	#						
	Owls observed? <input type="checkbox"/> Yes/ <input type="checkbox"/> No		Behavior (check all observed):				
	# of adults:	Band	<input type="checkbox"/> Courtship	<input type="checkbox"/> Feeding young	<input type="checkbox"/> Peeking out of burrow		
	# of juveniles:	observed?	<input type="checkbox"/> Copulation	<input type="checkbox"/> Perching	<input type="checkbox"/> Standing next to burrow		
M/F (If known):	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Foraging	<input type="checkbox"/> Preening				
# of pairs:		<input type="checkbox"/> Flying	<input type="checkbox"/> Calling				
Other owl sign observed (check all observed): <input type="checkbox"/> Molted feathers <input type="checkbox"/> Whitewash <input type="checkbox"/> Cast pellets							
<input type="checkbox"/> Eggshell fragments <input type="checkbox"/> Prey remains <input type="checkbox"/> Other:							
Location info and other notes (other species observed):							
Photo #(s):							

QA/QC _____
 Date _____

Area 1: North San Jose/ Baylands

Site Index	Name	Results2023
2	Byxbee Park	Not Surveyed in 2023
14	Gateway Blvd	Not Surveyed in 2023
18	Legacy Terrace	Not Surveyed in 2023
19	Lick Mill Park	Not Surveyed in 2023
20	Lockheed	Not Surveyed in 2023
21	Lucy Evans Bay Lands	Not Surveyed in 2023
22	McCarthy	Not Surveyed in 2023
25	NASA AMES - Moffett	Surveyed in 2023
28	Palo Alto Airport (a)	Not Surveyed in 2023
29	Palo Alto Airport (a)	Not Surveyed in 2023
30	Palo Alto Golf Course	Not Surveyed in 2023
31	PG&E Warm Springs	Not Surveyed in 2023
33	PK	Not Surveyed in 2023
38	Santa Clara Golf & Tennis Club	Surveyed in 2023
42	Shoreline Park	Surveyed in 2023
45	Warm Springs (Stevenson)	Surveyed in 2023
46	Sunnyvale Golf Course	Not Surveyed in 2023
64	Sunnyvale Baylands Park	Surveyed in 2023
48	Tesla - North	Not Surveyed in 2023
49	Tesla East	Not Surveyed in 2023
50	Tesla South	Not Surveyed in 2023
52	VTA - Cerone	Not Surveyed in 2023
53	Warm Springs	Surveyed in 2023
54	SJ/SC RWF - Alviso	Surveyed in 2023
62	Cisco Mitigation Area	Surveyed in 2023
55	SJ/SC RWF - East	Surveyed in 2023
47	Sunnyvale Landfill	Surveyed in 2023
65	River Oaks Storm Basin	Not Surveyed in 2023
70	Tri-Cities Landfill	Not Surveyed in 2023



2023 Burrowing Owl Survey Atlas Detail

■ Not Surveyed in 2023
■ Surveyed in 2023

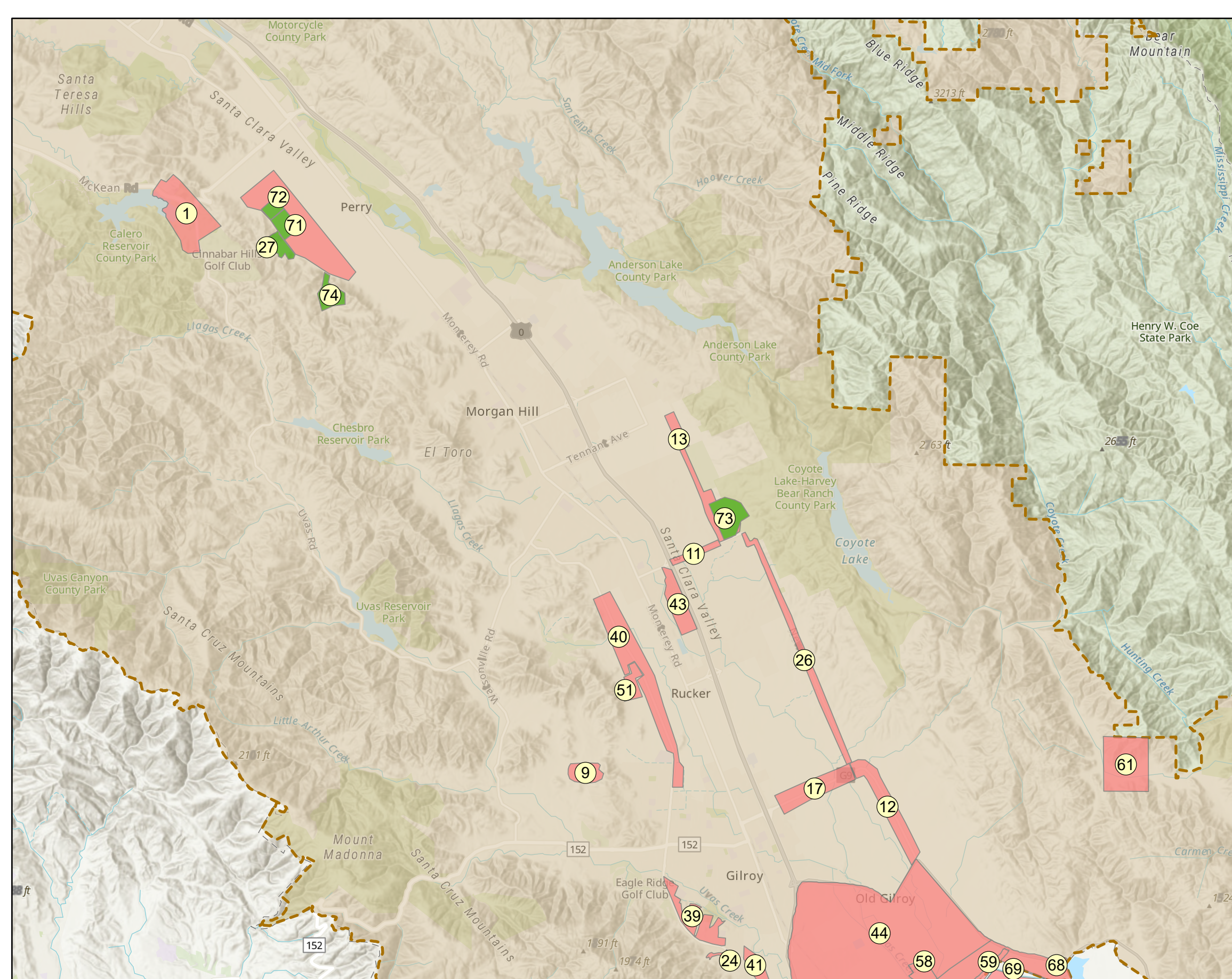
 Expanded Permit Area for
Burrowing Owl Conservation
 Habitat Plan Permit Area



0 1 2 Miles

Area 3: Morgan Hill and Gilroy

Site Index	Name	Results2023
1	Bailey & McKean Rd	Not Surveyed in 2023
9	Day Rd	Not Surveyed in 2023
11	East San Marin Ave.	Not Surveyed in 2023
12	Ferguson Rd.	Not Surveyed in 2023
13	Foothill Ave.	Not Surveyed in 2023
16	Laguna Ave	Not Surveyed in 2023
17	Leavesley Rd.	Not Surveyed in 2023
26	New Ave.	Not Surveyed in 2023
27	OSA Coyote Valley	Surveyed in 2023
40	Santa Teresa Blvd. North	Not Surveyed in 2023
43	San Martin Airport	Not Surveyed in 2023
51	Turlock Ave	Not Surveyed in 2023
61	W Property	Not Surveyed in 2023
71	POST/OSA Shapell Property	Surveyed in 2023
72	POST/OSA Houret Property	Surveyed in 2023
73	Harvey Bear Santa Clara County Park/ Martin Murphy	Surveyed in 2023
74	SCVHA Tilton Ranch/ San Bruno Canyon	Surveyed in 2023



2023 Burrowing Owl Survey Atlas Detail

■ Not Surveyed in 2023
■ Surveyed in 2023

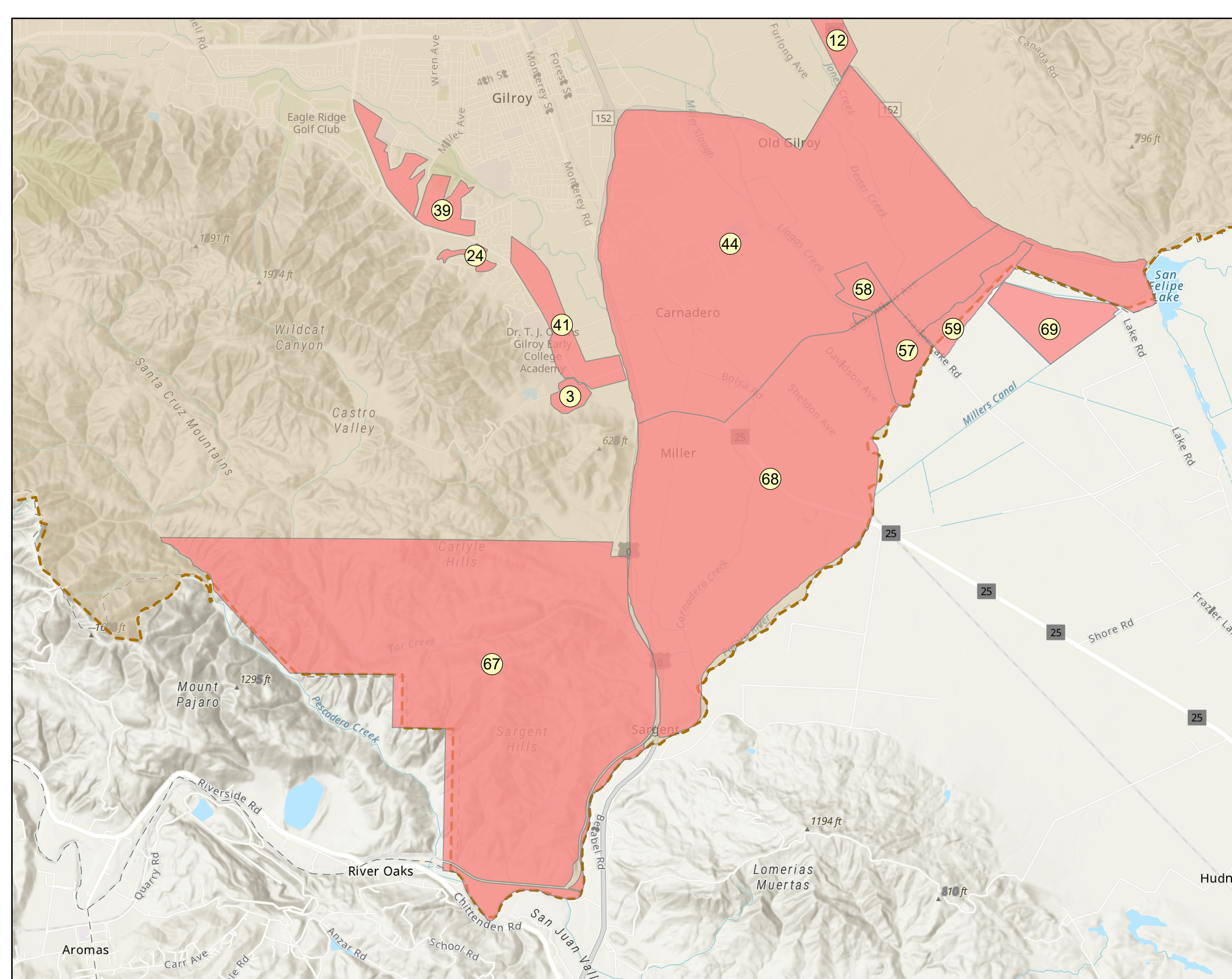
Expanded Permit Area for Burrowing Owl Conservation
 Habitat Plan Permit Area



0 2 4 Miles

Area 4: Gilroy Area

Site Index	Name	Results2023
3	Castro Valley Rd	Not Surveyed in 2023
12	Ferguson Rd.	Not Surveyed in 2023
24	Miller Ave	Not Surveyed in 2023
39	Glen Loma Ranch	Not Surveyed in 2023
41	Santa Teresa Blvd. South	Not Surveyed in 2023
57	OSA - Pajaro River Ag Preserve (PRAP)	Not Surveyed in 2023
58	OSA - Leung	Not Surveyed in 2023
59	TNC - Pajaro Ranch	Not Surveyed in 2023
67	Sargent Ranch	Not Surveyed in 2023
68	South Gilroy	Not Surveyed in 2023
69	Pajaro Mitigation Bank	Not Surveyed in 2023
44	Hwys 101 to 152, Bloomfield	Not Surveyed in 2023



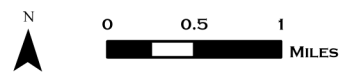
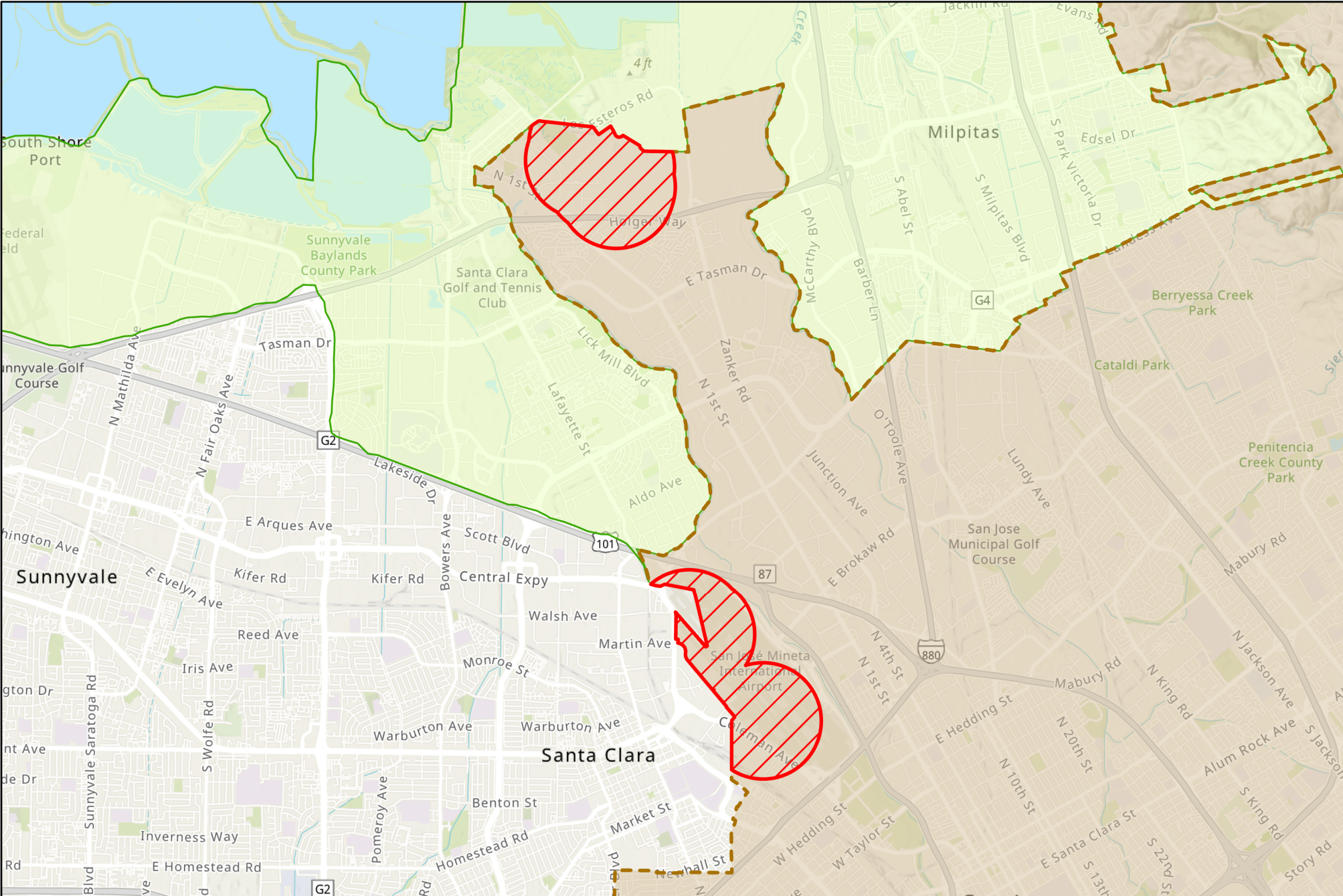
2023 Burrowing Owl Survey Atlas Detail

■ Not Surveyed in 2023
■ Surveyed in 2023




 Expanded Permit Area for Burrowing Owl Conservation
 Habitat Plan Permit Area



0 1 2 Miles



2024 Burrowing Owl Conservation Fee Zones

-  Habitat Plan Permit Area
-  Expanded Permit Area for Burrowing Owl Conservation
-  2024 Burrowing Owl Conservation Fee Zone

