Annual Report
Population monitoring and protection activities for the Paintbrush Hill occurrence of Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*)
January 2026

Background and Introduction

Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*; CAAFNE; State Threatened, Federally Endangered, CNPS RPR 1B.2) is a perennial root hemiparasite in the broomrape family (Orobanchaceae). It differs from its common sister taxon, *Castilleja affinis* ssp. *affinis* (CAAFAF), in having yellow to peach-colored floral bracts, rather than orange to red-colored, smaller inflorescences (15-25mm wide in CAAFNE vs. 30-50mm wide in CAAFAF), and in its habitat restriction to serpentine soils.

At the time of its listing as federally endangered in 1995 (USFWS 1995), only 1500 plants in six populations were known to exist, including one population in Santa Clara County (Paintbrush Hill, CNDDB occurrence 7). Another nearby population, called Paintbrush Canyon, was subsequently discovered (2002, CNDDB occurrence 9). Population sizes for this taxon range from 20 to 1000 plants depending on the occurrence (CNDDB, Widener & Fant 2017), which suggests that a target population size of 2000 individuals (which is the non-taxon-specific recovery goal stated in the Santa Clara Valley Habitat Plan) may not be appropriate or attainable for this taxon and location.

The Paintbrush Hill occurrence, located on property owned and managed by the Santa Clara Valley Water District (Valley Water), has historically been documented as three separate subpopulation clusters, or polygons (Figure 1). No plants were observed in the two smaller polygons (North and South) from 1997 and 1994, respectively (see Table 1), until 2019 when plants were rediscovered near the north polygon. The number of plants in the Paintbrush Hill occurrence has fluctuated over time, with the number of plants counted per year ranging from a low of 9 individuals in 1994 to 208 or 224 in 2018, depending on count method (Creekside Science 2018). Concerns over the small population size at Paintbrush Hill, coupled with its inclusion as a covered, no-take species in the Santa Clara Valley Habitat Plan, a joint HCP/NCCP covering most of Santa Clara County, has led to increased focus on the development of recovery actions for the taxon and potential for augmentation of the two known populations in Santa Clara County.

Polygon Location	*1993*	*1994*	*1997*	*1999*	*2006*	*2009*	*2013*	*2018*
North	NA	4	27	NA	NA	NA	NA	NA
Central	17	NA	0	80	>140	103	~100	208/224
South	NA	5	0	0	NA	NA	NA	NA

Table 1. Historical reports of number of plants at Paintbrush Hill, 1993-2018. Data sources: CNDDB (1993-2013), Creekside Science (2018)

Prior to developing any plans for population augmentation or recovery or drafting prescriptive management actions, Valley Water and partners agreed to conduct a baseline assessment of the demography of and threats to the Paintbrush Hill occurrence (including 1. Population monitoring; 2. Limited seed collection and banking; 3. Basic assessment of habitat quality and threats). This was done by Valley Water between 2019 and 2023. The 2023 annual report summarized those five years of population monitoring and presented a list of future management actions for discussion and decision-making among the larger interest group. The most immediate recommendations were the instigation of

a concerted invasive plant removal effort in the immediate vicinity of the population, the implementation of fencing to protect the population from heavy current cattle impacts and potential pig impacts, and the potential addition of an associated reduced-effort follow up monitoring program to assess effectiveness and inform future decision making.

In 2024, Valley Water, Santa Clara Valley Habitat Agency (VHA), and USFWS met to discuss the results of the first five years (2019-2023) of monitoring and discuss future steps for the Paintbrush Hill population of Tiburon paintbrush. The meeting resulted in decisions to continue population monitoring on a streamlined basis (Valley Water), implement fencing as a habitat protection measure (VHA), and begin planning and implementation of an invasive plant management strategy (responsibility undecided at 2024 meeting; VHA and VW currently working together).

Protective fencing was implemented in 2025 (details below). An invasive plant reduction program is recommended in the vicinity of the population, including both noxious weeds such as yellow star thistle (*Centaurea solsitialis*) and black mustard (*Brassica nigra*), which are encroaching from surrounding non-serpentine grassland, and annual non-native grasses which contribute to thatch and may suppress germination. Planning is under way for initial control efforts to take place in 2026.

Methods

Population Monitoring

As in prior years (2019-2024), CAAFNE individuals were identified based on the best available information for each plant. Factors taken into account included growth pattern, morphology, and distance from other plants.
Growth pattern: Plants that are close together can sometimes be distinguished because the stems all radiate from separate common centers or root crowns. Stems that angle towards a common center, even if the exact center point is obscured by rocks, can be inferred as belonging to a single plant.
Morphology: Often different plants may have different phenology (one is blooming slightly later than the other), stature (one may be taller), or coloration (plants may display differences in leaf or flower color). When plants have more than one flowering stem, those stems tend to be more like one another than stems from separate plants.
After counting, plants were marked with durable metal plant markers and assigned a number, to facilitate tracking of individual plants across years to the extent possible.

Seedlings are defined as single unflowering stems less than 10cm tall. Seedlings were tallied only (no other metrics measured).

In addition to the plant count, additional information was collected during the population monitoring for all flowering CAAFNE plants. Information collected included:

- number of stems per plant
- number of inflorescences (flowering stalks) per plant
- maximum plant height (in cm)
- qualitative observations of threats as appropriate (severe herbivory, other disturbances)

For reference, the elements of the baseline study (2019-2023) that are no longer included going forward are:

- width of inflorescences (in cm)
- dominant flower color (3 categories: pale peach/yellow, moderate orange-red, bright red)

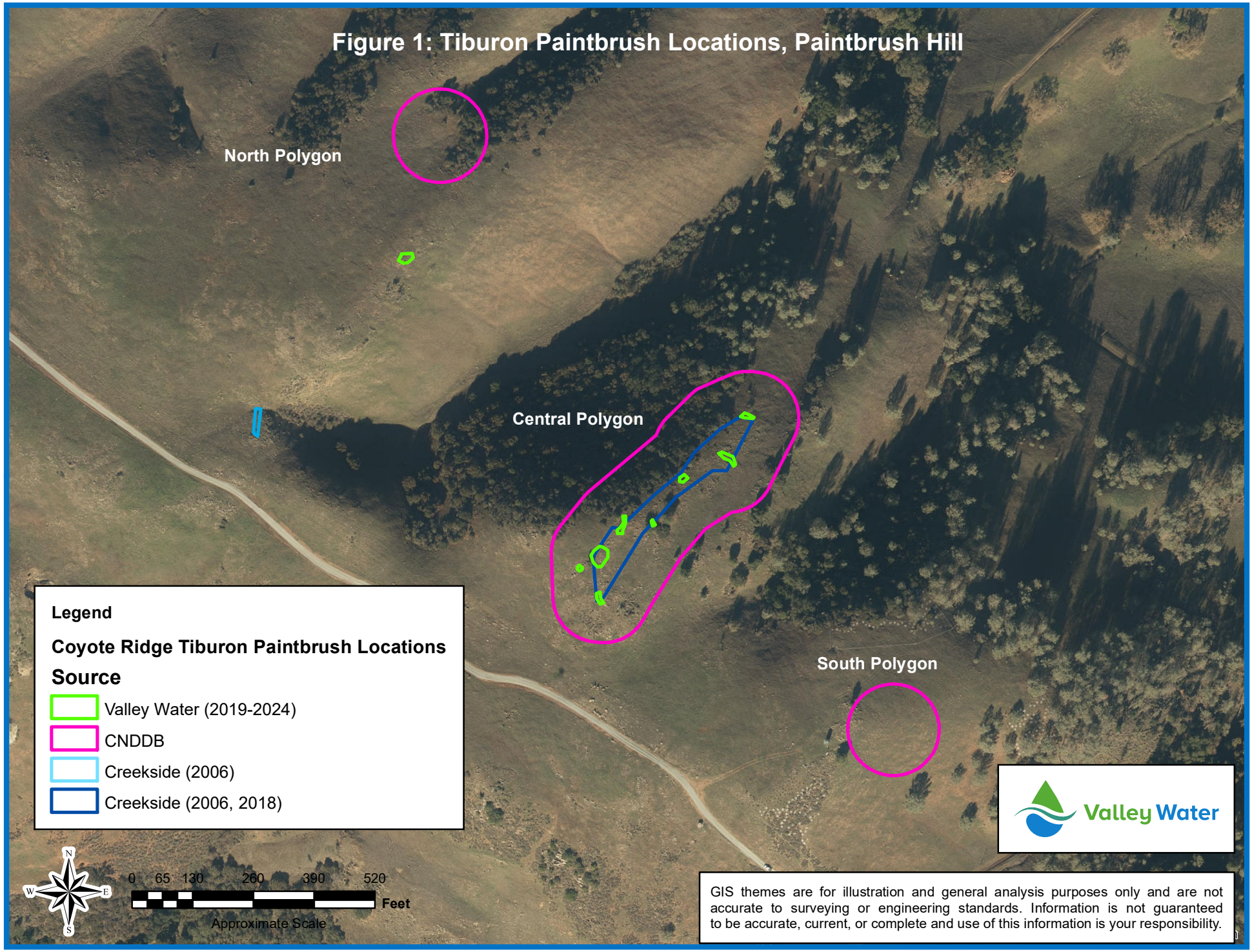
Figure 1: Tiburon Paintbrush Locations, Paintbrush Hill
North Polygon
Central Polygon
South Polygon
Legend
Coyote Ridge Tiburon Paintbrush Locations
Source
Valley Water (2019-2024)
CNDDB
Creekside (2006)
Creekside (2006, 2018)
N
W
E
S
0 65 130 260 390 520
Feet
Approximate Scale
Valley Water
GIS themes are for illustration and general analysis purposes only and are not accurate to surveying or engineering standards. Information is not guaranteed to be accurate, current, or complete and use of this information is your responsibility.

- potential host plant species within 12 inches
- more detailed observation of herbivory on inflorescences (present/absent, putative vector if available (e.g., insect, cattle, rabbit))

Spring field work took place on May 13 and May 19 2025, capturing early-peak flower. After this, monitoring visits occurred approximately every three to four weeks to assess fruiting phenology and determine the best time for collection of fruiting information. Summer field work took place on July 29, 2025.

Fruiting information collected included:

- number of infructescences per plant
- number of inflorescences remaining per plant on that date, if any
- number of capsules per infructescence

These are the same elements as were collected between 2019 and 2023.

Seed Collection and Banking

Seeds were not collected in 2025 and are not planned for collection in future. The seeds from the five-year-long (2019-2023) collection effort will remain at the California Botanic Garden (CBG, formerly Rancho Santa Ana Botanical Garden) seed storage facility. A backup sample has been deposited by CBG with the National Laboratory for Genetic Resources Preservation in Fort Collins, CO. The seeds collected by Valley Water will not be combined with the seed collection made by Creekside Science in 2018.

Results

2025 Population Monitoring

This year 87 adult plants and 4 seedlings between 1 and 10 cm were observed, for a total 2025 population size of 91. This included 78 adult plants and 4 seedlings in the main (central) polygon, and 9 adult plants in the northern polygon (Figure 1). This is a decrease from previous years (see Figure 2). Fifty-two plants flowered and 25 plants set fruit this year. This indicates approximately similar average reproductive effort per plant to last year (2024 56% fl 28% fr; 2025 57% fl 27% fr). The high number of seedlings from 2024 (74) do not appear to have successfully recruited to adults.

Population summary statistics (average plant height, average number of stems, inflorescences, and infructescences per flowering/fruiting individual, average number of capsules per infructescence) are listed in Table 2 (seedlings are excluded from these metrics because they are defined as single non-flowering stems less than 10cm tall). Plants this year were generally taller than previous years, but less branched and with fewer inflorescences. Average height per plant in 2025 was 20.9cm (n=87), with an average number of stems per plant of 3.6 and average number of inflorescences per flowering plant of 3.2 (n=52).

Average number of infructescences per fruiting plant was 1.7 (n=25), though only 0.7 per plant if all adult plants are included (6.5 for plants inside enclosures), and the average number of capsules per infructescence was 3.6 (5.9 for plants inside enclosures). These numbers continue the ongoing pattern showing that reproductive output is higher for plants protected by the wire enclosures. See Table 2 for comparison with 2019-2024 data.

	2019-2023 Baseline			2024			2025		
In enclosure?	All†	In	Out	All†	In	Out	All†	In	Out
Average height per plant (cm)	18.8	***24.5**	*17.6	19.6	**21.5**	19.1	20.9	14.5	**21.4**
Average # of stems per plant	6.4	6.1	**6.4**	7.1	6.8	**7.2**	3.6	2.6	**3.6**
Average # of inflorescences per plant††	2.5	***3.7**	*2.2	2.1	**2.6**	2.0	2.0	1.3	**2.0**
Average # of infructescences per plant††	1.5	***3.3**	*1.1	2.7	**4.8**	2.2	2.6	**6.5**	1.7
Average # of capsules per infructescence††	4.2	***5.4**	*3.4	4.5	**6.7**	3.3	3.6	**5.9**	1.1

Table 2: Population summary statistics of CAAFNE at Paintbrush Hill
† Reproductive plants only; seedlings not included
†† Calculated for plants with reproductive structures
* p-value for the difference between in/out of enclosure is significant at $p < 0.01$ (Welch's t-test). Tests not done for individual years.
Note: Higher value for in/out of enclosure is bold in each set of three columns

Phenology

Year	Peak Flowering Date	Fruit Maturity Date
2019	May 9	June 12
2020	May 5	July 6
2021	April 19	July 15
2022	April 13	July 6
2023	May 11	July 17-Aug 17
2024	May 21	June 27-July 18
2025	May 19	July 29

Table 3. Key phenological dates for Paintbrush Hill Tiburon paintbrush population over time.

Discussion

Number of Plants

The number of CAAFNE reported at Paintbrush Hill over time is illustrated in Figure 2. Please note that survey methods and locations have not been consistent throughout the entire period for which data are available (i.e. multiple people collected data over the period 1993-2018, followed by consistent data collection 2019-2025). The small population size and high fluctuation in plant numbers over time, coupled with usually low numbers of seedlings and low adult recruitment observed, highlight that this small population likely needs additional protection or augmentation if it is to persist or increase in size.

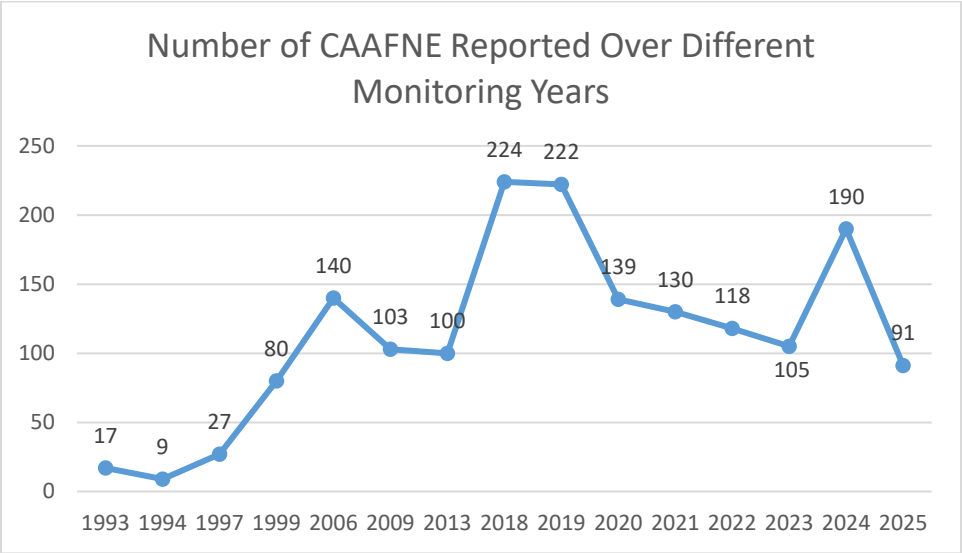

Figure 2. Number of CAAFNE plants at Paintbrush Hill, 1993-2025. Data sources: CNDDB (1993-2013), Creekside Science (2018), Valley Water (2019-2025)

Fencing Implementation

Based on observations and data analysis from 2019-2024 showing excessive grazing, trampling, and rooting pressure from cattle and pigs on the Paintbrush Hill occurrence, along with evidence of increased plant size and reproductive output inside cage enclosures (Valley Water 2019-2024), VHA and Valley Water worked together in 2025 to install protective fencing around both extant population sub-patches at Paintbrush Hill. The south polygon was not fenced because no Tiburon paintbrush individuals have been seen there since 1997 (Table 1).

From Sep 2-5, 2025, approximately 1950 linear feet of fence was installed by Southwest Fence and Supply around the central sub-patch and 144 linear feet was installed around the northern sub-patch (Figure 3). One (north sub-patch) or two (central sub-patch) fence panels were clipped with carabiners instead of wired shut to allow foot entry for monitoring and future flash grazing as needed. Approximately 0.14 acres of chaparral vegetation was cleared to allow the fence alignment to include chaparral edge habitat. Vegetation clearing was performed by Ecological Concerns, Inc. and appropriate biological training (Valley Water) and monitoring (VHA) was performed before and during the work period. Appropriate BMPs for prevention of the introduction or spread of *Phytophthora* pathogens were followed by all personnel accessing the site. Detailed specifications of fencing type or cost are available upon request.

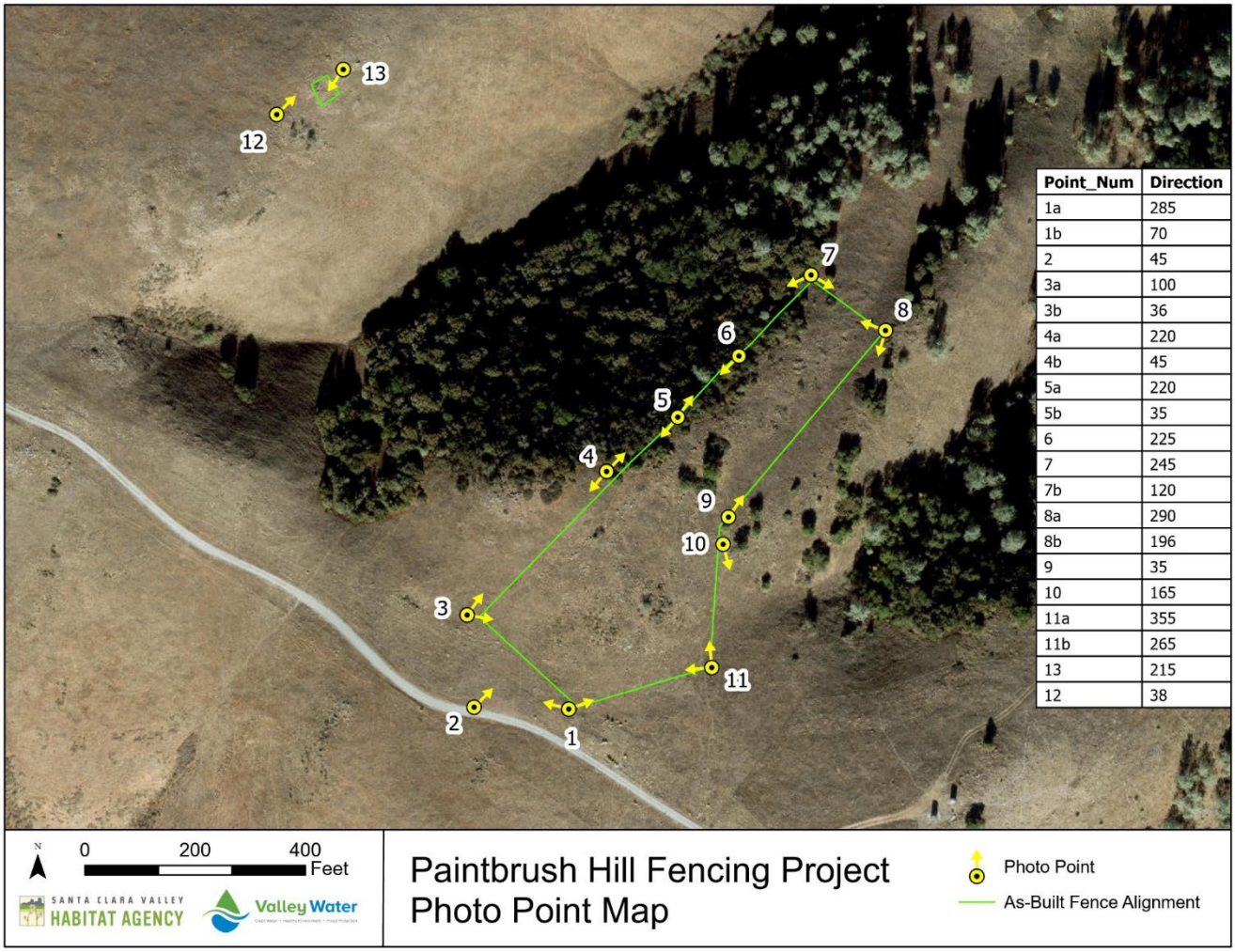

Figure 3: As-Built Fencing Alignment and Monitoring Photo Points (VHA 2025)

Approximately 20% of Tiburon paintbrush plants at this occurrence were protected by the temporary enclosures installed by Creekside Science approximately ten years ago. The new fence encloses all known individuals, and a buffer around them intended to encompass known past locations and the nearby likely habitat including the chaparral edge. Fencing is expected to provide both protection to individual paintbrush plants and habitat improvement through lowered disturbance levels and decreased soil compaction from cattle. Future population monitoring will track effects on plant numbers, size and reproductive output. Brush rabbits and deer are not excluded by the fencing installed, so a low and stable level of herbivory is expected to continue. However, levels of thatch will be noted and flash cattle grazing at an appropriate time of year can be implemented as needed to reduce vegetative cover.

Photo points were set up directly after fence installation (see Figure 3 and Appendix A), and may be revisited as needed to document post-project conditions, including vegetation recovery and any erosion, weed, or fence maintenance issues that may arise. A VHA site visit in late October 2025 confirmed that no fence-associated erosion had occurred to date.

Invasive Plant Species

Invasive plant species of concern include non-native grasses, both annual (soft chess [*Bromus hordeaceus*], foxtail chess [*Bromus madritensis*], and wild oat [*Avena fatua*]) and perennial (Italian rye

grass, *Festuca perennis*), which are currently in contact with the paintbrush population and have increased in frequency since 2020, and several noxious weeds which are present in the surrounding grasslands and encroaching nearer to the paintbrush plants over time, notably including yellow star thistle, black mustard, and (in the northern polygon) tocalote (*Centaurea melitensis*).

A limited number of yellow star thistle, tocalote and black mustard plants in the immediate vicinity of the CAAFNE patches have been removed during population monitoring activities as time allowed, but a concerted effort over time is recommended in order to prevent the spread and increase in density of these plants and their encroachment into the core CAAFNE area.

Future funding for this effort is likely to be available through Valley Water's Anderson Dam/Ogier Ponds mitigation funds. Meanwhile, funding is being provided by Valley Water's Safe Clean Water Program, Project D2 (Revitalize Upland, Riparian and Wetland Habitat), supported by planning and labor from VHA, including contract labor support.

Next Steps

1. Continue annual population monitoring.
2. Monitor any changes in population dynamics and grass/thatch cover that could occur post-fencing.
3. Invasive plant control:
    a. Begin implementation of broadleaf invasive plant control (yellow star thistle, tocalote, mustard species) as phenology and conditions permit
    b. Develop a long-term vegetation management plan for the area that includes encroaching invasive species such as yellow star thistle and mustard species as well as invasive annual grasses such as soft chess and wild oat whose cover is increasing at the site and may degrade habitat quality over time.

Literature Cited

California Native Plant Society, Field Protocols and Guidelines, “Percent Cover Diagrams from two sources”, https://www.cnps.org/plant-science/field-protocols-guidelines, most recently accessed 1/18/2022. Source cited on document: CalPhase 3 Field Guide - Vegetation Diversity and Structure, April 10, 2001

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Valley Water (2020). Annual Report: Population monitoring, seed collection and banking, and habitat assessment for the Paintbrush Hill occurrence of Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*). January 2021

Valley Water (2021). Annual Report: Population monitoring, seed collection and banking, and habitat assessment for the Paintbrush Hill occurrence of Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*). January 2022

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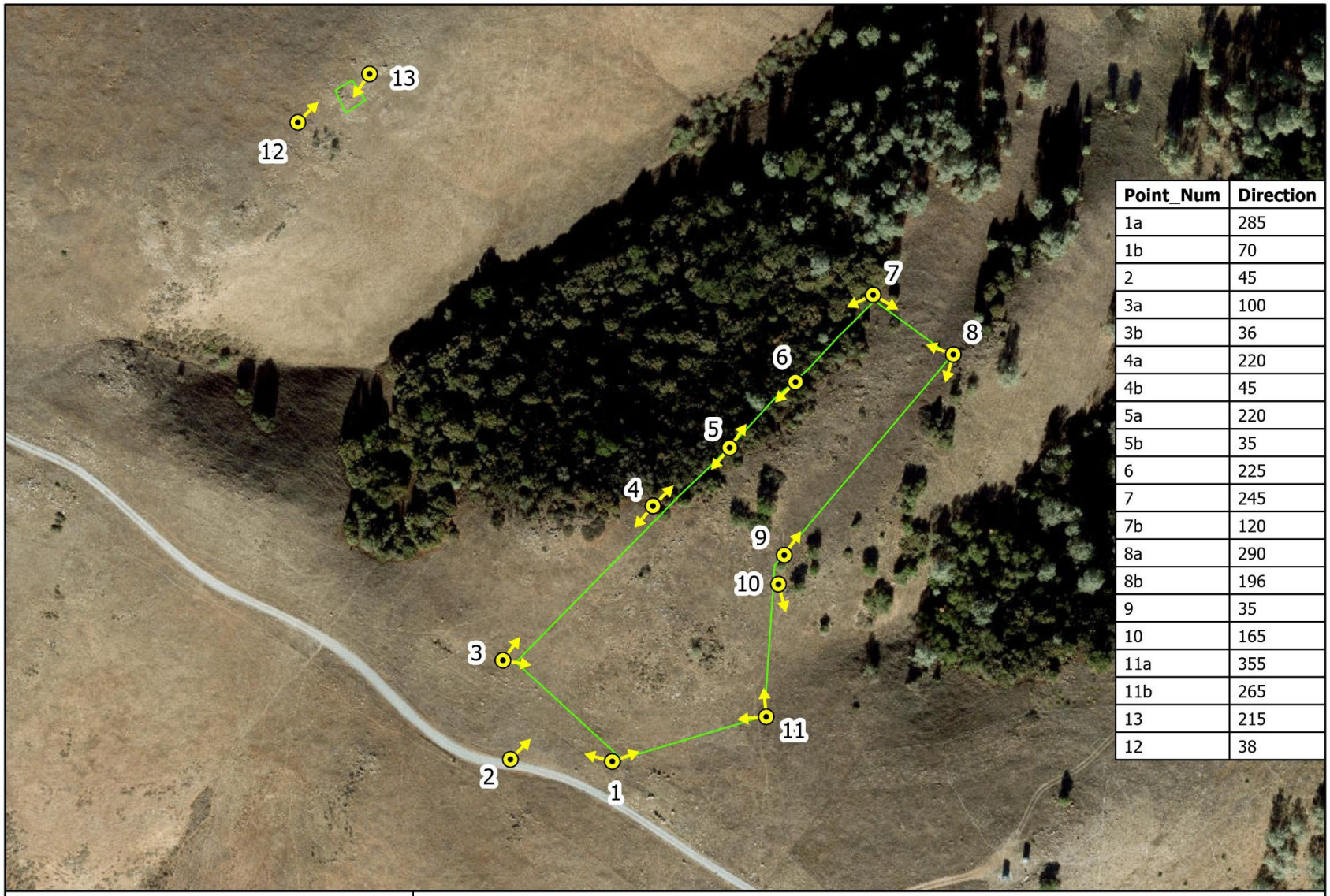
Valley Water (2025). Annual Report: Population monitoring, seed collection and banking, and habitat assessment for the Paintbrush Hill occurrence of Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*). January 2025

Widener, L. & J.B. Fant (2017). Genetic differentiation and diversity of two sympatric subspecies of *Castilleja affinis*; a comparison between the endangered serpentine endemic (spp. *neglecta*) and its widespread congener (ssp. *affinis*) Conserv. Genet. 19 (2): 365-381

Appendix A
Photo Documentation
September 8, 2025
(Conducted by VHA)



Point_Num	Direction
1a	285
1b	70
2	45
3a	100
3b	36
4a	220
4b	45
5a	220
5b	35
6	225
7	245
7b	120
8a	290
8b	196
9	35
10	165
11a	355
11b	265
13	215
12	38

N

0 200 400 Feet

SANTA CLARA VALLEY HABITAT AGENCY

Valley Water

Paintbrush Hill Fencing Project Photo Point Map

Photo Point

As-Built Fence Alignment

Photo 1a

Photo 1b

Photo 2

Photo 3a

Photo 3b

Photo 4a

Photo 4b

Photo 5a

Photo 5b

Photo 6

Photo 7a

Photo 7b

Photo 8a

Photo 8b

Photo 9

Photo 10

Photo 11a

Photo 11b

Photo 12

Photo 13