Arana Gulch Habitat Management Plan
City of Santa Cruz

Year 9 (2022) Annual Report

CDFW Permit No. 2081 (a)-13-013-RP
CDFW Permit No. 2081 (a)-18-016-RP
Coastal Development Permit No. 3-11-074 (Arana Gulch)

May 9, 2023

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May 9, 2023

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1. Executive Summary

This monitoring report evaluates the City's progress implementing the Arana Gulch Habitat Management Plan (HMP). The HMP guides the long-term restoration of the 67-acre Arana Gulch Open Space. The plan provides management goals and objectives to enhance three specific management areas: Hagemann Gulch Riparian Woodland Management Area, Arana Creek Wetland and Riparian Management Area and the Coastal Prairie/Tarplant Management Area.

The HMP was developed as part of the California Coastal Commission's (CCC) Coastal Development Permit process for the adoption of the Arana Gulch Master Plan (Master Plan). The Master Plan includes management guidelines for access, resource management, and education. Since Arana Gulch lies within the CCC's Coastal Zone, a permit was necessary to implement the Master Plan. The CCC conditionally approved the permit on December 8, 2011. Special permit conditions required, among other things, developing and implementing an HMP, establishing a technical advisory group to advise the City on habitat management actions, and submitting annual monitoring reports to document compliance with the HMP.

The City finalized and began implementing the HMP in 2013. A technical advisory group was formed, the Adaptive Management Working Group (AMWG). Actions outlined in the HMP were initiated in 2013 and 2014 and continued in 2015-2020; these actions are described in the Year 1 (2014), Year 2 (2015), Year 3 (2016), Year 4 (2017), Year 5 (2018), Year 6 (2019), Year 7 (2020), and Year 8 (2021) Annual Reports. Actions implemented in Year 9 (2022) are described in this report. The AMWG provided input to the City during the implementation of the Year 9 activities.

The purpose of this annual report is to describe the current condition of the Arana Gulch habitat areas, evaluate the performance of each area in relation to the interim performance standards outlined in the HMP and included in the CDP, and provide management recommendations for the following year to ensure progress toward and achievement of success criteria. In Year 9 (2022), the City continued to focus on improving the habitat and population of the Santa Cruz tarplant (SCT), a federally Threatened and a California State Endangered species. The City continued seasonal cattle grazing and continued to implement management to control invasive weeds from the prairie/tarplant management area. A second year of experimental outplantings of SCT was conducted in February and the plantings were monitored for survival and seed production. Outplanting is a term that refers to the process of translocation of greenhouse-grown plants to an outdoor location. The plants were propagated from seed collected on-site in summer 2018 under an agreement between the City and the University of California, Santa Cruz (UCSC). All of these actions taken by the City are to continue progress to meet the HMP objectives.

AMWG coordination activities continued to be affected by the third year of the global Coronavirus (COVID-19) pandemic. Field operations were not affected in 2022; however,

procedures for meetings and correspondence with the AMWG was altered to accommodate Center for Disease Control (CDC) guidelines, which were virtual (Web-based) meetings.

The habitat management activities undertaken in 2022 are summarized below.

Master Plan Improvements

In 2022 the City continued to maintain the Coastal Prairie Loop Trail, the Arana Gulch Multi-Use Trail, and the Agnes Street Connector Trail. No new trail projects were implemented. Trail construction over Hagemann Gulch and Arana Creek affected riparian woodland and in 2014 the City prepared a revegetation plan pursuant to a CDFW Streambed Alteration Agreement. Revegetation at/around Arana Creek was installed in January and February 2015 by City staff and volunteers; additional plants were installed in February 2016. In 2020 oak tree plantings were installed in this area as part of an Urban Tree Inventory and Planting Project.

Summary of Coastal Prairie/Santa Cruz Tarplant Management Area Activities

Management actions in Year 9 included seasonal grazing and seasonal mowing. A second year of experimental outplantings of SCT was conducted in February; 1,000 SCT plants were installed in the southern portion of Area A and 145 within an enclosure in Area C. For a second year, the cattle were excluded from the southern part of Area A and periodic mowing occurred to reduce seed-set in non-native grasses. Under the guidance of the Stocking and Work Program prepared in 2014, the City continued to contract with a local rancher for seasonal grazing within the northern portion of Area A and Areas C and D; grazing (cow/calf) occurred from December 8, 2021 through August 27, 2022. Additional activities in the management areas included monitoring plant composition, plant cover, canopy height, and residual dry matter (RDM), implementing removal/control of invasive weed infestations, and documenting site conditions at previously established permanent photo stations. In summer, the 2022 SCT outplantings, as well as previous-year created SCT management areas, were field checked for SCT plants.

Grassland site conditions were documented in early June and photo-monitoring of permanent points were conducted in April 2022. Canopy heights were measured in February, April, and December. Additionally, RDM measurements were obtained in October. The data was collected amid a significantly below average rainfall season.

As per guidelines in the HMP, seasonal mowing was conducted in June for grassland/prairie areas located outside the grazing fences. Mowing was conducted to reduce the canopy height of the non-native grasses and forbs to benefit the coastal prairie species diversity and habitat function. Area B was mowed once between June -September. A rotary mower was used. Bird surveys were completed prior to mowing and no nests were observed. Buffer areas were created near the wooded areas and islands were left in the drainage areas to maintain some tall grass for birds to hide and nesting as per previous recommendations from the Santa Cruz Bird Club. Unlike previous years, no colonies of native forbs were observed in the mowing

areas, so avoidance flagging was not needed. Blue bird nest boxes installed in 2018 were observed to be used by this species.

A census of SCT was conducted in late spring, summer, and early fall 2022. Within Area A, no SCT plants were found within the historic naturally-occurring SCT sites. This is a decrease from 21 SCT plants from 3 colonies in Area A in 2021. There was 1 SCT in 2020, 50 plants in 2019, 267 plants in 2018, and 0 plants in 2017. 2022 was the 3rd consecutive year of below average rainfall (22 inches) and the eighth season of grazing (grazing occurred in winter/spring seasons of 2015 to 2022). During this period, rainfall has been below the long-term average of 30-inches in 6 of 8 years.

The experimental 2021 SCT outplanting was monitored for recruitment. In Area A, an estimated 1,500 SCT recruited from seed naturally broadcast by the survivors of the 2021 SCT plantings. There was virtually no recruitment in the control/mow plots. Recruitment only occurred within the sheetmulch plots and resulted in mostly very small, single stem plants with only 1 or a few flowerheads each. Total flowerhead production was estimated at 4,500. In Area C, no SCT plants recruited from the 2021 planting.

Overall survival of the 2022 experimental planting in February in Area A was only 20%. This was much lower than expected when compared to the 65% survival of the 2021 planting. The low survival is likely due to persistent drought conditions; less than 4 inches of rain fell from the beginning of January through May. Herbivory by gophers also contributed to low survival. By the fall, 210 surviving SCT had produced an estimated 15,700 flowerheads. Almost 60% were concentrated in a single sheetmulch plot, illustrating the potential value of this labor-intensive planting method. In Area C, only 16% of planted SCT survived within a cattle exclosure. This planting was located along a main trail and was intended to be a demonstration plot.

An experimental hand broadcast of SCT was implemented in December 2022. Using UCSC supplied SCT seed, the City did an experimental hand broadcast of seed and chaff within a wildfire burned area in the southern portion of Area A.

Increasing the SCT population to above the 2006 population level of 267 plants[1] is an HMP goal. Together, the SCT plants that recruited from the 2021 outplantings, combined with the surviving SCT outplantings from 2022, exceed the HMP target. Although there was a sufficient number of SCT plants to allow collection of SCT seed (minimum of 50 plants is required as per CDFW agreement), no seed collection was necessary due to the large amount of seed in storage at UCSC Greenhouses. In November 2022, the City entered into an agreement with UCSC Greenhouses to propagate approximately 1,000 SCT plants for outplanting in 2023. The City also entered into an agreement with UCSC Greenhouses to propagate approximately 300 native grass plants for outplanting in 2023.

[1] See Section 3.3, Page 52 of Arana Gulch HMP

In compliance with the HMP and an Invasive Weed Work Plan (IWWP) prepared for the management area, City staff and volunteers from NOAA's Watershed Stewards Program and Earth Stewards continued to remove occurrences of invasive, non-native plant species within the central prairie/grassland. The Watershed Stewards and Earth Stewards focused on removing Himalaya berry and ivy.

Summary of Hagemann Gulch Riparian Woodland and Arana Gulch Creek Riparian Woodland and Wetland Areas Activities

The City continued to observe and manage activities within these two management areas. In 2022, actions were focused on public safety, removal/control of transient encampments and related activities. The City continued closure of the ad-hoc path along Arana Creek to discourage public access in the natural area.

The City continued to implement clean-ups from illegal camping activities, such as removing trash and waste from the northernmost portion of the Arana Gulch Creek woodland areas.

Management Activities Proposed for 2023 (Year 10)

The following management actions are identified for 2023:

- Implement periodic seasonal mowing in the southern portion of Area A to keep canopy height below 10 inches, removing seed heads of non-native grasses.
- Continue monitoring plant composition and plant cover, and implement removal/control of invasive weed infestations. Within SCT-occupied areas, monitor the amount of bare ground present in December, which coincides with the germination period of SCT.
- Conduct outplanting of SCT container-grown plants in February and monitor for final survival in the fall.
- Conduct outplantings of native grass plugs in February and monitor for survival in the fall.
- Install interpretative signage with information on the SCT planting program at the cattle exclosure in Area C.
- Continue seasonal cattle grazing within the northern portion of Area A and Areas C and D, as per the approved grazing contract and Stocking and Work Program. Additional activities in these two management areas include monitoring plant composition, plant cover, and residual dry matter (RDM), removal/control of invasive weed infestations, and documenting site conditions at the permanent photo stations. Monitor SCT expression at the previous outplanting sites in Area C.
- Consider implementing interim grassland management actions in Areas C and D (i.e., focused mowing or other management) if cattle grazing is delayed and canopy height levels are above the target objective of 2-3 inches (5-8 cm) between the months of November thru April. Within SCT areas monitor the amount of bare ground present in December, which coincides with the germination period of SCT.
- Within the boundaries of the prairie/SCT management area, designated woody plants growing outside of the grazing area, yet within the designated grassland, will

continue to be removed and herbicide treatment may need to be applied, if needed to control stump sprouting. Continual treatments will need to be planned and implemented to keep woody plants from encroaching into the prairie.

- A census of SCT will be conducted in summer and early fall 2023 and management plots created in 2021, 2022, and 2023 in Areas A, C, and D will be monitored for expression of SCT. Seed collection of SCT may be done if more than 50 SCT are present, pending prior approval from CDFW.
- Continue relationship with UCSC Greenhouses for seed storage, seed increase and plant propagules.
- Continue to implement management actions within the Arana Gulch Creek Management Area. Pending funding and staff availability, the City will continue to implement management actions within the Hagemann Gulch Management Area.
- Continue to work with the AMWG to form recommendations for improving trail sections to improve walkability and deter new trails from forming.
- Coordinate with the Resource Conservation District (RCD) on Arana Creek watershed management, including measures to reduce erosion and sediment entry into the watershed, if opportunities arise. The City provides funds to the RCD to apply for grant opportunities to implement erosion control projects.
- Continue to confer with the AMWG on adaptive habitat management activities in 2023 through periodic meetings and group email correspondence.
- Continue to coordinate with environmental groups, such as the Natural History Museum, Watershed Stewards Program, and others, as opportunities arise.

2. Introduction

2.1 Background

Arana Gulch is 67 acres of open space owned by and located within the City of Santa Cruz. The eastern half of the property features the riparian corridor of Arana Gulch Creek and a tidal wetland where the creek drains into Monterey Bay at the Santa Cruz Harbor. The western half is remnant coastal prairie grassland that supports the Santa Cruz tarplant, a federally Threatened and a California State Endangered species. A steep and narrow intermittent drainage called Hagemann Gulch crosses the property on the western boundary. The features of the greenbelt property are depicted on **Figure 1**.

The City of Santa Cruz developed a master plan for the property to improve natural resource protection and restoration, public access and education. Implementation of the Arana Gulch Master Plan required the City to obtain a coastal development permit (CDP) from the California Coastal Commission because a portion of the planning area lies within the designated Coastal Zone. The CDP (3-11-074) included both standard and special conditions, requiring, among other things, developing the Arana Gulch Habitat Management Plan (HMP) to guide the long-term restoration of the open space. Specifically, Special Condition 3 of CDP 3-11-074 states:

> Arana Gulch Habitat Management Plan. PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, the Permittee shall submit for Executive Director review and approval three copies of a final Arana Gulch Habitat Management Plan (HMP). The HMP shall provide for the restoration, enhancement, and long-term management of all Arana Gulch habitat areas (including, as referenced by the Arana Gulch Master Plan, the Coastal Prairie/Tarplant Management Area, the Arana Gulch Riparian and Wetland Management Area, and the Hagemann Gulch Riparian Woodland Management Area) as self-sustaining and functioning habitats in perpetuity. The HMP shall be prepared by a qualified expert in restoration ecology for each of the habitat types, and shall take into account the specific conditions of the site as well as restoration, enhancement, and management goals. The HMP shall be substantially in conformance with the Master Plan documents submitted to the Coastal Commission, including the August 1, 2005 document entitled "A Management Program for Santa Cruz Tarplant (*Holocarpha macradenia*) at Arana Gulch"), including that it can be submitted in a package that includes relevant Master Plan documentation with an addendum that addresses this condition, provided all language is modified to be directive (e.g., "shall" rather than "should") and it complies with the following requirements and includes:
>
> (a) A baseline assessment, including photographs, of the current physical and ecological condition of the restoration and enhancement areas. All existing topography, wet features, and vegetation shall be depicted on a map.

(b) A description of the goals of the plan, including in terms of topography, hydrology, vegetation, sensitive species, and wildlife usage.

(c) A description of planned site area preparation and invasive plant removal.

(d) Any planting either of seeds or container plants shall be made up exclusively of native taxa that are appropriate to the habitat and Arana Gulch region. Seed and/or vegetative propagules shall be obtained from local natural habitats so as to protect the genetic makeup of natural populations. Horticultural varieties shall not be used.

(e) A plan for monitoring and maintenance of habitat areas in perpetuity, including:

- A schedule.
- A description of field activities, including monitoring studies.
- Monitoring study design for each habitat type, including, as appropriate: goals and objectives of the study; field sampling design; study sites, including experimental/revegetation sites and reference sites; field methods, including specific field sampling techniques to be employed (photo monitoring of experimental/re-vegetation sites and reference sites shall be included); data analysis methods; presentation of results; assessment of progress toward meeting success criteria; recommendations; and monitoring study report content and schedule.
- Adaptive management procedures, including provisions to allow for modifications designed to better restore, enhance, manage, and protect habitat areas.
- Provision for submission of reports of monitoring results to the Executive Director for review and approval in perpetuity, beginning the first year after initiation of implementation of the plan. Such Monitoring Reports shall be submitted annually until success criteria are met, and then shall be submitted on an every 3-year basis after that. Each Monitoring Report (annual and 3-year) shall be cumulative and shall summarize all previous results. Each report shall clearly document the condition of the habitat areas, including in narrative (and supporting monitoring data) and with photographs taken from the same fixed points in the same directions as the baseline assessment and prior Monitoring Reports. Each report shall include a performance evaluation section where information and results from the monitoring program are used to evaluate the status of the restoration, enhancement, and long-term management in relation to the interim performance standards and final success criteria. To allow for an adaptive approach, each report shall also include a recommendations section to address changes that may be necessary in light of monitoring results and/or other information, including with respect to current restoration information and data related to the habitat areas in question, and to ensure progress toward and achievement of success criteria. Actions necessary to implement the recommendations shall be implemented within 30 days of Executive Director approval of each Monitoring Report, unless the Executive Director identifies a different time frame for implementation.

(f) Interim success criteria to be achieved in the first year of implementation, tied directly to the annual reporting requirement. Also, measurable goals to achieve habitat improvement over time, subject to modification by the Adaptive Management Working Group.

(g) Implementation procedures, cost estimates, identification and allotment of funding for all HMP activities, and related reporting procedures.

(h) Provisions for minor adjustments to the HMP by the Executive Director if such adjustments: (1) are deemed reasonable and necessary; and (2) do not adversely impact coastal resources.

(i) Identification of the membership of the Adaptive Management Working Group, which initial composition and any future changes shall be subject to Executive Director approval. The Adaptive Management Working Group shall guide all HMP activities under the plan.

(j) All details associated with the grazing program, subject to Adaptive Management Working Group and Executive Director approval, in substantial conformance with the proposed cattle grazing program (see Exhibit P Tab 4).

PRIOR TO COMMENCEMENT OF CONSTRUCTION, the HMP shall be implemented by establishing the Adaptive Management Working Group (AMWG), receiving prioritized first-year management recommendations from the AMWG, and initiating implementation of the highest priority recommendations in the field.

The Permittee shall undertake development in accordance with the approved Arana Gulch Habitat Management Plan.

The HMP guides management of three habitat areas within Arana Gulch: the Hageman Gulch Riparian Woodland Management Area, the Arana Creek Wetland and Riparian Management Area and the Coastal Prairie/Tarplant Management Area. Within the Coastal Prairie/Tarplant Management Area, the HMP focuses on restoration of the coastal prairie and recovery of the Santa Cruz tarplant (SCT); this management area continued to receive the most attention in Year 9 (2022) due to the urgency to revitalize the SCT population. The population of SCT at Arana Gulch has been perilously low since 2007; fewer than 50 plants have been observed in all years but 2018 (267 plants). No SCT plants emerged in 6 different years since 2010, including 2022.

The HMP outlines various management tools for managing the three habitat areas on the site[2]. A key tool described in the HMP is an adaptive management framework for habitat restoration actions. Under this framework, and as required by the CDP, an Adaptive Management Working Group (AMWG) was formed to provide scientific expertise on resource management activities to the City and the CCC[3]. In 2022, the AMWG provided

[2] See Section 3.1, page 33 of Arana Gulch HMP.
[3] See Section 2.2, Page 22 of Arana Gulch HMP.

input to the City during three meetings on implementation of several components of the HMP.

Implementation of the HMP coincided with the construction of the Arana Gulch Multi-Use Trail project. Bike paths, hiking trails, cattle grazing infrastructure, and bridges were built within the greenbelt. Most of these features were completed in 2014 and the grazing infrastructure was completed in early 2015. The construction activities associated with the multi-use trail project that are relevant to the restoration effort are fully described in the Year 1 (2014) Annual Report (City of Santa Cruz, November 2015).

This is the 9th annual report since adoption of the HMP and many objectives of the plan have not yet been realized as the long-term habitat management effort is still in its early stages. The report is intended to report on the progress of the plan in the monitoring year, provide a comparison to previous year data and trends, and prepare for future management actions. The reader is directed to previous annual reports for specific details and data implemented in these years. The previous annual reports (e.g., Year 1 [2014] Annual Report, Year 2 [2015] Annual Report, Year 3 [2016] Annual Report, Year 4 [2017] , Year 5 [2018] Annual Report), Year 6 (2019), Year 7 [2020], and Year 8 [2021]) are available for review on the City's website (http://www.cityofsantacruz.com/departments/parks-recreation/parks-beaches-and-open-spaces/open-spaces/arana-gulch).

The HMP is grounded in an adaptive management framework. Implementation actions will constantly be reviewed and improved upon. Therefore, this annual report is not intended to lay out every action to be implemented for the upcoming year. It will highlight the actions that have been identified by the City and from AMWG meetings from the monitoring year; however, additional actions may be identified by the City and during AMWG meetings throughout the upcoming year.

Figure 1. Location Map

2.2 Report Organization and Purpose

The purpose of this annual report is to describe the current condition of the Arana Gulch habitat areas, evaluate the performance of each area in relation to the interim performance standards outlined in the HMP and included in the CDP, and provide management recommendations for the following year to ensure progress toward and achievement of success criteria. In addition to activities approved under the CDP, this report also reports on activities authorized by a Scientific, Educational, or Management Permit issued by the California Department of Fish and Wildlife (Permit No. 2081 (a)-13-013-RP). This report includes all activities conducted in the calendar year 2022 which is considered to be Year 9 pursuant to actions outlined in the HMP and the CDFW 2081(a) permit.

Additionally, this report describes activities associated with the implementation of Arana Gulch Master Plan improvements where such activities intersect with the goals and objectives of the HMP. The City conferred with technical specialists, including AMWG members, regulatory agency personnel, the City of Santa Cruz Planning and Community Development Department, and members of the public while implementing adaptive habitat management activities on the greenbelt.

The adaptive management framework of the HMP is presented in Section 3. The habitat management actions associated with Master Plan improvements are described in Section 4. Actions implementing the HMP are presented in Sections 5 through 7 under their respective management area. Each management area section includes a summary of the implemented actions as they pertain to the goals and objectives in the HMP, and a performance evaluation. Recommendations for Year 10 (2023) are summarized in Section 8. Please refer to the HMP for technical background information on the Arana Gulch greenbelt and HMP goals and objectives. Please refer to previous annual reports (i.e., Year 1 [2014], Year 2 [2015], Year 3 [2016], Year 4 [2017], Year 5 [2018], Year 6 [2019], Year 7 [2020], and Year 8 [2021]) for specific details on actions implemented in those years.

3. Adaptive Management Framework

3.1 Adaptive Working Group (AMWG)

The City adopted an adaptive management framework for implementation of the HMP. The City facilitated and coordinated habitat management activities with the AMWG in 2022. Three meetings were held with the AMWG in 2022; the minutes from the January 19, March 14, and November 7 meetings are presented in **Appendix A**. In addition, the City coordinated and facilitated group email correspondence between AMWG members to solicit input on management activities. Due to COVID-19 guidelines, the meetings were computer-viewed meetings (Zoom). The HMP outlines the formation of the AMWG, voting procedures, and other procedures.[4] The list of current members is presented in the meeting minutes **(Appendix A).**

The AMWG provided input to the City on habitat management activities within Arana Gulch throughout 2022. A detailed discussion of AMWG recommendations is included in the sections for each management area and in the meeting minutes. In short, the AMWG provided recommendations on the timing and intensity of seasonal grazing, mowing and other grassland strategies, interest in SCT management actions, and SCT seed storage and increase/out-planting.

3.2 Public Outreach

In 2022 the City maintained a webpage on the City of Santa Cruz website to communicate restoration efforts to the public and to provide a place for documents related to the requirements of the CDP. The City periodically updated the webpage throughout 2022.

The AMWG meetings (field and virtual meetings) were open to the public and provided a forum for members of the public to express their ideas directly to the members and City. Public comments were also generated through the City's website and the AMWG was briefed of public comments and concerns during AMWG meetings.

Signage was maintained onsite with a web address for notifying the City on any concerns regarding grazing or other public access issues within the greenbelt. The City also coordinated with UCSC for student volunteers for the SCT outplantings that occurred in February 2022 and with the Watershed Stewards program for invasive plant management.

3.3 Evaluation of Adaptive Management HMP Goals

A goal of the HMP is to maintain an adaptive management framework to allow stakeholders to conduct and evaluate actions. To meet this goal there are two objectives: conduct an annual AMWG meeting and maintain funding levels. In 2022, three meetings were held with the AMWG (January, March and November) and there was email correspondence with AMWG members to present information and solicit feedback. The City dedicated funding to

[4] See pages 22-24 of Arana Gulch HMP

implement the habitat management actions identified in the HMP based on a prioritization recommended by the AMWG in 2019. The City and the AMWG re-visited HMP management actions in 2022, particularly the role of cattle grazing and prairie/SCT recovery. The AMWG provided input to the City during the review of the SCT outplantings and plans for SCT outplantings in 2022 and 2023.

To meet Objective 1B, the City dedicated Arana Gulch management as a line item in the City Parks and Recreation Departments operating budget. The City also hired a maintenance person that is partially dedicated to the Arana Gulch greenbelt. The position was filled in January 2016.

A second adaptive management goal is to conduct a two-tracked program of management and research with monitoring. The management actions implemented in 2022, such as seasonal grazing, seasonal mowing in the southern portion of Area A, and perimeter seasonal mowing, were monitored to determine their effectiveness in meeting biological variables. The HMP identified a timescale for implementation of the management actions relative to the SCT with an objective of increasing the number of aboveground SCT to at least the 2006 level (348 plants) by 2016 (first year after grazing). Through receipt of $22,050 grant from USFWS, the City was able to fund experimental outplanting and ray achene germination research. Plant propagation occurred at UCSC Greenhouses and with the experimental outplanting of 1,225 SCT plants onto the site in 2021 and 1,145 in 2022, the project met this target with plant recruitment in Area A from the SCT 2021 outplanting; however, there were no SCT plants found in historic naturally-occurring areas in 2022.

The timescale presented in the HMP for restoration of the coastal prairie or invasive plant control is to progress to a more functioning system by 2020. The City implemented a mowing program in the southern portion of Area A for SCT as well as for coastal prairie enhancement. Monitoring of the grassland in 2023 will provide additional information on the effectiveness of this action for prairie enhancement.

The third adaptive management goal is to develop educational opportunities within Arana Gulch, with efforts to conserve and restore its rare resources. Students and staff volunteers from UCSC participated in the SCT outplantings and students received volunteer class credit. Volunteers from the Watershed Stewardship Program also participated in on-site habitat management. The City maintained a web page on the City's website to post information about the HMP and received input from the AMWG and the public consistent with Objective 3A. Additional recommendations for public outreach were identified by the AMWG and the public (i.e., signs for cattle grazing and developing a brochure on cattle grazing) and the City implemented them. **Table 1** presents a summary of the objectives for adaptive management, actions implemented in 2022, and whether the actions were in compliance with the HMP.

Table 1. Monitoring of Adaptive Management Variables

Objective and Variable	Actions in Year 9 (2022)	Year 9 (2022) Results	Objective Met?
Goal 1. Maintain an adaptive management framework that allows stakeholders to scientifically conduct and evaluate actions			
Objective 1A. Conduct at least 3 AMWG meetings in 2013 with a quorum of members present each time. In subsequent years, the frequency of meetings beyond an annual November meeting can be determined by the needs of the AMWG.	Meetings held January 19, March 14, and November 7	Meeting minutes presented in Appendix A	Yes, three meetings in 2022. Email correspondence was conducted with AMWG members periodically in 2022
Objective 1B. Maintain funding levels to achieve a level of habitat management that is 1) indefinitely sustainable into the future, and 2) shows a stable or increasing trend in measured biological variables over a biologically appropriate timescale.	Funding allocated by City; line item established in operating budget	Funding allocated by City for fiscal year July 1, 2021 to June 30, 2022 and July 1, 2022 to June 30, 2023	Yes, the budget funds staff, consultant, and contractor time to improve management, implement projects, conduct studies, and /or implement improvement, resulting in an increase in the measured biological variables
Goal 2. Conduct a two-tracked program of management and research with built-in monitoring			
Objective 2A. Maintain a Management Track that leads to stable or increasing trend in measured biological variables over a biologically appropriate timescale.	The City incorporated AMWG recommendations into multiple management actions including a second year of outplanting, mowing, and grazing.	Data from studies and monitoring were considered by City and AMWG during management decisions	Yes, monitoring of biological variables and trends were conducted as outlined in the HMP. Based on the data, the AMWG recommended transitioning the management focus of the coastal prairie from stimulating the seedbank to experimental outplanting of SCT.
Objective 2B. Utilize a Key Management Question (KMQ) framework to guide the Research Track when research is needed to achieve the specific goals and objectives for SCT and the coastal prairie.	An Experimental SCT Planting Plan was prepared in 2021 to guide outplantings in 2021 and 2022 to use a replicated design to test the outcomes of specific planting	1,225 SCT were installed in 2021 and 1,145 in 2022. Recruitment of the 2021 planting was observed. Additional studies were identified for 2023. The ray	Yes, the SCT Habitat Enhancement Work plan prepared in 2019 outlines potential management actions to reach SCT population goals and prairie management. The Experimental Planting Plan developed planting treatments in 2021 and 2022 that addressed specific management questions. The

Table 1. Monitoring of Adaptive Management Variables

Objective and Variable	Actions in Year 9 (2022)	Year 9 (2022) Results	Objective Met?
	strategies. A ray achene germination study was conducted,	achene germination study found successful mechanisms for germination.	treatments represented a gradient of management intensity.
Goal 3. Develop public educational opportunities associated with Arana Gulch and efforts to conserve and restore its rare resources			
Objective 3A. Maintain a website to communicate restoration efforts to the public and provide a place for documents related to the requirements of the CDP, such as Monitoring Reports.	Webpage on City website developed in 2013	Webpage updated throughout 2022 with new information	Yes, City periodically updated website with reports and information as needed

4. Implementation of Master Plan Improvements

Construction of the Arana Gulch Multi-Use Trail was initiated in fall 2013 and was completed in December 2014. This east-west trail extends from Brommer Street (east of the greenbelt) westward to Broadway Street (west side of greenbelt, across Hagemann Gulch). The Agnes Street Trail extends southward from Agnes Street to join the east-west multi-use trail midway within the greenbelt. This trail was also constructed in 2014. Cattle infrastructure was installed in 2014 including fences, access gates, water line/water troughs and a temporary holding corral near Agnes Street. The Marsh Vista Trail, a pedestrian trail located along the east side of Arana Creek, was constructed in 2013. In 2018, improvements were made to a portion of the Coastal Loop Trail. The location of this trail and other master plan improvements is presented in **Figure 2**. Figure 2 also includes the location of the historic SCT areas called A-D.

4.1 Multi-Use Trail and Infrastructure Management

4.1.1. Current Management

In response to public concern about user impacts to Area B, split-rail fencing was installed in 2021 near the Hagemann Gulch bridge to reduce off-trail use. Hydromulch and hydroseeding have been utilized in various areas for erosion control related to use along the edge of paved trails and also along user-created trails.

Cattle grazing signs, installed at each entrance and along the fence, were maintained throughout the year. The signs continue to provide contact information to the City and rules of the site. The water troughs were maintained throughout the grazing season. Some vegetation recolonized the site of the former water trough site in Area A (trough was moved southward approximately 100 feet in 2016).

4.1.2. Past Management

Project conditions of approval required the salvage of topsoil from areas within 20-feet of mapped tarplant if such areas were disturbed during trail construction. In December 2013, the upper 6 inches of topsoil from an area upslope of Tarplant Area D was salvaged and spread onto an approximately 3,750 square foot area south of Tarplant Area C. No SCT plants have been observed within the receiver site.

The Agnes Street Trail Connector construction disturbed a section of soil within 20 feet of Tarplant Area C in September 2014. On September 15, 2014, the upper 6 inches of topsoil from this area of approximately 2,900 square feet was salvaged and spread onto areas southwest and northwest of Tarplant Area C. No SCT plants have been observed within the receiver site. The temporary construction access road used during trail construction in 2013 and 2014 was allowed to naturally revegetate from the existing soil seed bank.

Poor drainage along the edge of the central east-west trail was observed in winter 2016. An AMWG member expressed concern that water was not passing under the trail, as designed, and water was prevented from reaching the downslope prairie. In 2016, City staff installed a series of small gravel drains to enable water to penetrate the engineered drainage system under the pathway. Staff believed that the clay content of the top soil was not allowing effective penetration to the drainage rocks beneath it. City staff have continued to monitored these areas.

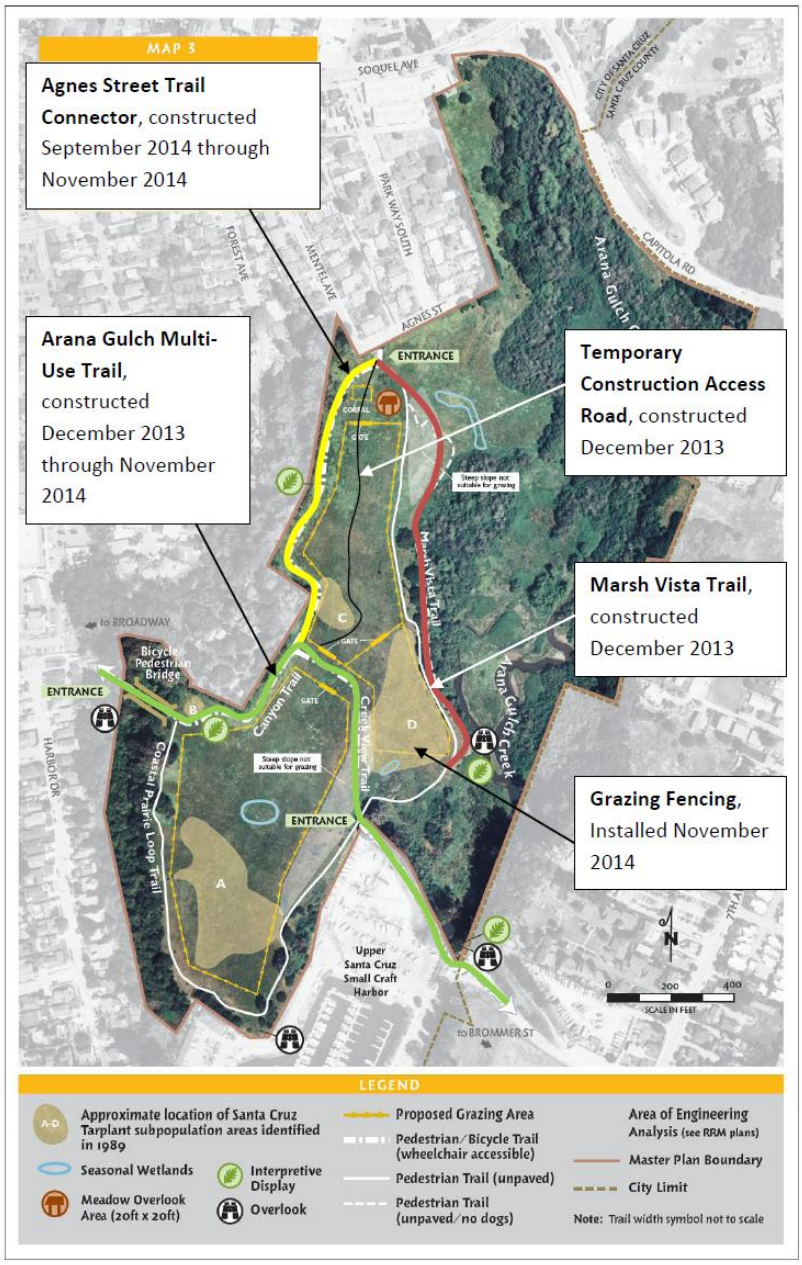


Figure 2. Master Plan Improvements, 2013 - 2022

4.2 Photo Point Monitoring

Photo points for long-term monitoring were established in April 2015. A total of 15 points are distributed throughout the coastal prairie with two additional points on the Arana Creek Causeway and two on Hagemann Bridge **(Figure 3)**. All points are located at either an interpretative sign or a fence corner for easy reference. Four photos are taken per point in a clockwise order facing into the enclosure; Photo 1 looks straight ahead, Photo 2 is to the right, Photo 3 looks straight behind, and Photo 4 to the left. All photos can be taken in about one hour, preferably when the sun is high in the sky and casting few shadows. The two points taken on the causeway looking into Arana Creek give a general idea of conditions in the riparian area. The additional points located on Hagemann Gulch Bridge look out and down into the Gulch. One extra point is taken standing in front of the entry sign at Frederick Street in order to observe the recovery from the construction. Photos are in **Appendix B**.

Figure 3. Location of Photo Points for Long-Term Monitoring

5. Coastal Prairie/Santa Cruz Tarplant Management Area

The coastal prairie occupies about 30 of the 67 acres at Arana Gulch and is essential because it has supported the third largest standing native Santa Cruz tarplant (SCT) population and is one of only 13 populations found in Santa Cruz County (USFWS, 2015). A primary focus for this management area is the recovery of the SCT, because the population at Arana Gulch has declined over the last two decades[5]. This section describes management and monitoring actions for the SCT (Section 5.1), coastal prairie grassland (Section 5.2), grazing and stocking work program (Section 5.3), and the invasive weed work plan (Section 5.4). Section 5.5 includes an evaluation of progress toward meeting the goals and objectives outlined in Section 3.0 of the HMP. Section 5.6 provides proposed actions for 2023.

Activities implemented within this management area in 2022 include: cattle grazing, perimeter mowing, seasonal mowing in the southern portion of Area A, experimental outplanting of container-grown SCT, and invasive weed control. Monitoring of these and previous year actions occurred throughout the year. City staff, City consultants, and volunteers from UCSC and Watershed Stewardship Program implemented these tasks. In addition, the City and UCSC Greenhouses coordinated on SCT seed storage, SCT plant propagation, and research on germination cues.

5.1 Santa Cruz Tarplant

The recovery actions for SCT implemented in 2022, including an annual census (5.1.1), experimental outplanting (5.1.3), and greenhouse research on germination cues (5.1.3), are described in the following sections.

5.1.1 Santa Cruz Tarplant Census

The HMP requires an annual census of the population (Goal 1) and a baseline assessment of SCT within the soil seed bank (Goal 4). Field surveys for SCT at Arana Gulch were first conducted in 1977 by botanist Randy Morgan but plant counts are lacking in the current database. In 1986, he estimated there were more than 100,000 plants on the property. In 1989, R. Doug Stone identified SCT in four locations he called Areas A-D (see **Figure 1 and 2**). These area designations have remained in use.

The census for SCT (natural occurrences) was conducted by Kathleen Lyons following guidelines from *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG, 2009), *CNPS Botanical Survey Guidelines* (CNPS, 2001), and *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Species* (UFWS (1996). Field surveys to determine the presence/absence of SCT were conducted in July, August and

[5] See Section 3.1, page 63 of Arana Gulch HMP.

September 2022. This survey period coincided with the blooming period of SCT. Surveys were conducted by walking the grassland over multiple days to detect SCT. Survey days were July 25, August 3, August 30, September 14, and September 27. As per protocol, if a SCT was observed a waypoint would be taken with a handheld Global Positioning System (Garmin 60sce) that would record the plant's patch location. If found, the protocol includes recording patch size, plant height, branching, flowering status, and number of flowering heads per plant.

Area A was not grazed in 2022, and no SCT plants were found within the historic naturally-occurring SCT sites in 2022. This is a decrease from 21 SCT plants from 3 colonies in Area A in 2021. There was 1 SCT in 2020, 50 plants in 2019, 267 plants in 2018, and 0 plants in 2017. The 2022 survey was conducted in the 3rd consecutive year of below average rainfall (22 inches) for the water year (October 1, 2021 to September 30, 2022). 2022 was the eighth season of grazing (grazing occurred in winter/spring seasons of 2015 to 2022). During this period, rainfall has been below the long-term average of 30-inches in 6 of 8 years.

No SCT seed was collected from the site during the 2022 census. As per conditions of the City's 2081 permit with CDFW, no SCT can be collected unless there are more than 50 plants. The permit is valid until December 2023. UCSC Greenhouses has enough seed in storage that additional seed collection was not needed.

5.1.2 Experimental Outplanting

Background. In May 2018, the City, with AMWG support, requested development of an adaptive management work plan to conduct experimental management actions to improve habitat conditions for SCT. Alison Stanton completed the SCT Habitat Enhancement Work Plan in November, 2019. The first iteration of the plan emphasized soil scraping and burning because those management tools have produced the most positive response in the SCT population at Arana Gulch in the past. Multiple scrape plots to stimulate SCT seed germination were created in Areas A, C, and D in November 2019, but did not lead to the emergence of any SCT in 2020. Prescribed fire was considered for fall 2020, but the large CZU Complex wildfire broke out in the Santa Cruz Mountains in August 2020. The SCT Habitat Enhancement Work Plan was revised in fall 2020, with input from the AMWG.

The revised plan, presented in the 2020 report, recommended transitioning the management focus away from disturbance strategies designed to stimulate the seedbank (such as grazing or scraping) to planting of container-grown SCT. The disturbance strategies likely failed because the aboveground SCT population at Arana Gulch has been perilously low since 2006 and seedbank data show a 100-fold decline in viable SCT seed density between 1999 and 2013 that indicates the SCT seed bank is highly depleted.

In October 2020, the City, in conjunction with the AMWG, initiated a multi-phase project to begin planting of container-grown SCT. The effort to develop a supply of container-grown SCT began in 2018 when seed was collected from the SCT population of 267 plants that were

present at Arana Gulch that year. The City established a contract with the UCSC Greenhouses to propagate SCT plants to bulk up the seed supply, generating an estimated 10,000 seeds. A pilot outplanting of 28 container-grown SCT plants from the propagation were outplanted in Area C in February 2020. Outplanting is a term that refers to the process of translocation of greenhouse-grown plants to an outdoor location. The pilot outplanting resulted in 6 plants surviving to flower. Based on the limited success of the pilot planting, the AMWG pursued an experimental outplanting in 2021.

5.1.2.1 Experimental Outplanting, 2021.

The very low census counts of the SCT population at Arana Gulch over the last 20 years suggest that it was at or nearing some unknown threshold of extirpation. Consequently, the primary goal of the 2021 experimental planting was to establish container-grown SCT plants that would survive and produce seed. The objective of the experimental design was to test planting strategies to determine which methods lead to the greatest *in situ* survival and reproduction, measured as mature SCT flower head production per plant.

The 2021 experimental planting plan was informed by AMWG input and the HMP, with additional input from the Director of the Younger Lagoon Reserve, Dr. Elizabeth Howard. Younger Lagoon Reserve has an extensive restoration program that is guided by a scientific advisory committee comprised of academic and professionals in the fields of restoration ecology, hydrology, and local land use history. Planting treatments were identified that represent a gradient of management intensity. The treatments were:

1) no treatment control ("grazing release" treatment in Area A and C),
2) mowing one time (simulated with string trim; Area A),
3) sheetmulch treatment (Area A), and
4) no treatment, with grazing (Area D).

Grazing was suspended in Area A to evaluate the treatments independent of grazing impacts, and therefore the 2021 control treatment is more specifically described as a "grazing release" treatment. Sheet mulching involves intensive plot preparation with overlapping sections of single ply B-flute cardboard (flat on one side and corrugated on the other) followed by a layer of wood chips to a depth of 2-3 inches. Sheet mulching suppresses weed germination, enhances soil moisture retention, and also increases organic matter accumulation. It is essentially a passive method of composting and creating an improved seedbed and the Younger Lagoon Reserve has had a lot of success in establishing perennial plants with the method.

Each of the treatments was developed to address a specific management question:

1) No treatment - Do planted SCT seedlings survive to reproduce with no management?
2) Mowing - If mowing is the only management option, do planted SCT seedlings survive to reproduce when regularly mowed to 10" early in the season (Feb-May)?

3) Sheet mulch- Sheet mulch has been effective with perennial plants at Younger Lagoon, but sheet mulch requires labor intensive plot preparation. Does sheet mulch improve SCT seedling survival and reproduction?
4) Demo (sheet mulch and mowing)- If sheet mulch improves survival, does mowing over the planting regularly keep weeds in check and increase survival?

The UCSC Greenhouses propagated 1,000 SCT plants in "stubby tubes" to be used in the experimental planting in January, 2021. The majority of the plants were installed within the historic SCT area in the central part of Area A (**Figure 4**). A total of 391 SCT were planted on January 26, 2021 within 10 x 10-foot sub-plots within 3 macroplots (40 x 60-feet). A second batch of 603 SCT were planted on February 22, 2021. The purpose of the two planting times was both logistical and also to take precautions against failure of one planting due to lack of rainfall or other disturbance. In Area D, a total of 56 plants were planted in January in 7 clusters of 8 plants each dispersed through the lowest portion of the pasture, closest to Arana Creek. This planting was subject to grazing. In February, a total of 69 SCT were planted within the 2020 grazing exclosure fencing in Area C and 27 were planted immediately outside the fencing. **Table 2** summarizes the number of SCT planted by treatment and area in 2021.

Figure 4. Location of 2021 experimental SCT planting plots in Area A (Orange), C (Blue), and D (Red).

Table 2. Number of SCT planted by treatment and Area in 2021

Area A January	Control	Mow	SMulch	Wchip	**Total**
# sub-plots	6	6	9		
Macro 1	32	32	48		112
Macro 2	32	32	48		112
Macro 3	32	32	48		112
					336
Area D planting 7 plots x 8 SCT each					**56**
Total planted in January					**392**
Area A February					
# sub-plots	7	7	9	2	
Macro 1	48	32	52	0	132
Macro 2	57	45	32	22	156
Macro 3	40	50	75	54	219
					507
Area C grazing exclosure					**96**
Total planted in February					**603**
Total planted in 2021					**995**

2021 Experimental Outplanting Results. The complete results of the 2021 experimental planting are presented in Section 5.1.2.3 of the 2021 Year 8 Report. Results in Area A are based on survival and reproduction within 10 x 10-foot sub-plots planted in January and February with 6-7 plots each of the control/mowing treatment and 9 of the sheetmulch. An overview of the results is presented below.

The molluscicide 'Sluggo' was applied to reduce the heavy snail herbivory that was observed in the January planting after 7-10 days. The January planting was treated again at the time of the February planting, which only received the one application. The City obtained a permit for the application of the iron phosphate only formulation of Sluggo, which is non-toxic.

In the control and mow 1x plots, the January planting had greater survivorship than February, but there was no difference in average survival between the control and the mow 1x treatment in either planting (**Figure 5**). The difference in survival was very likely due to precipitation; the January planting received 7 inches of rain immediately after planting, while the February planting received only 2.7 inches of rain after planting. Therefore, the January and February plots were combined for further analysis.

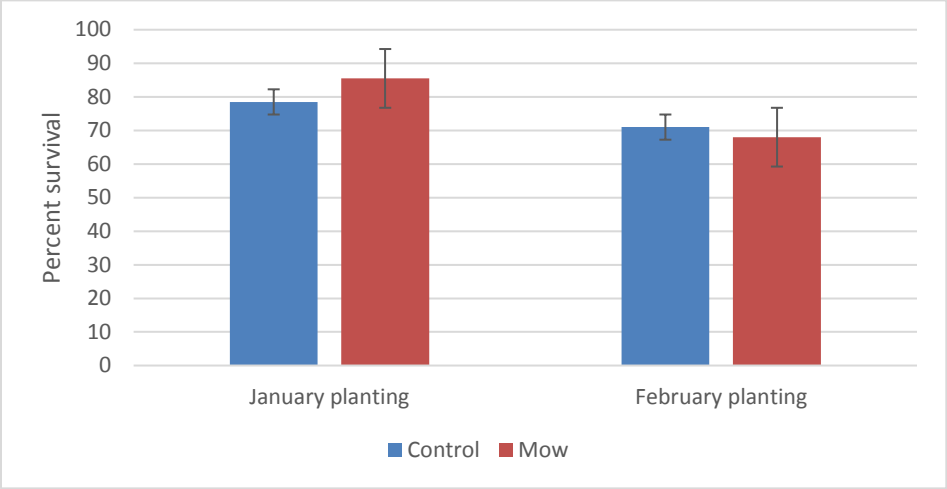


Figure 5. Average survival of the January and February plantings in the control or mow1x treatment in 2021 (N=6-7 subplots per treatment, error bar is one standard error from the mean)

Average plant height in the control and mow plots ranged between 5 and 10 inches and the number of flowerheads produced per plant ranged from 3 to 8 (**Figure 6**). SCT in Macroplot 3 were shorter and produced fewer flowers than those in Macroplots 1 and 2. Although the total number of SCT that survived was similar across the 3 Macroplots, total flowerhead production in the control/mow treatments was much lower in Macroplot 3 (**Figure 7**). The reason behind the difference in growth is not clear, but Macroplot 3 has greater cover of perennial grasses, including California oatgrass (*Danthonia californica*) and purple needlegrass (*Stipa pulchra*). **Figure 8** shows a control plot in Macroplot 3 with high cover of *Stipa*. This greater perennial cover could possibly reduce water availability for the planted SCT.

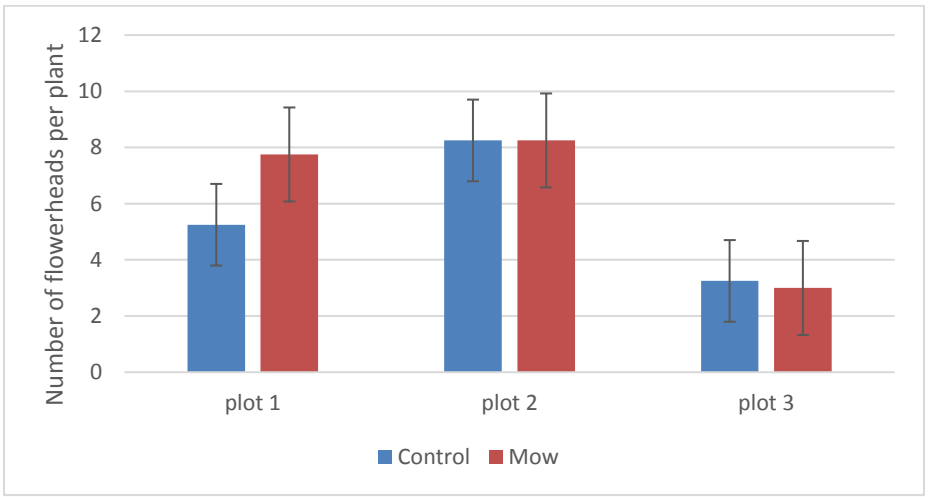


Figure 6. Average flowerheads per plant in the control or mow1x treatment in 2021 (N=6-7 subplots per treatment, error bar is one standard error from the mean)

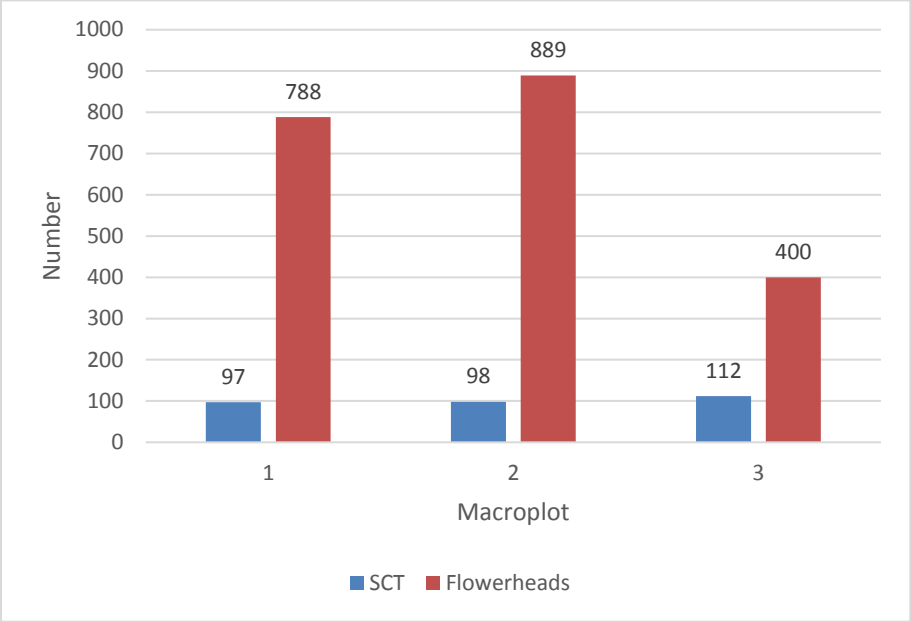


Figure 7. Total number of surviving SCT and total flowerhead production by Macroplot in 2021 mow/control plots combined in September.

Figure 8. Tall vegetation height with high *Stipa* cover in a control sub-plot in Macroplot 3 in June, 2021

Within a macroplot, the similar response in survival, growth, and reproduction in the control and mow treatments is likely due to inconsistent and uneven mowing of the macroplots. Two

of the three macroplots were mowed on April 30th. The macroplot that was not mowed was mowed a month later on May 28th. Most surviving SCT in the control/mow plots had a single stem (**Figure 9A**), but only a small number showed clear evidence of mowing with a cut point and branching (**Figure 9B**). With an average plant height of only 5 to 10-inches by September, the spring mowing likely missed many short plants. The vegetation height was visibly lower in some mowed sub-plots (**Figure 10**), but not all.

Figure 9. A) Single Stem SCT In A Control Plot

Figure 98. B) A Branching SCT In a Mowed Plot in June, 2021 *Note: The Cut Main Stem Is at The Height of the Green Marker in the Photo

Figure 10. Lower vegetation height in a mowed sub-plot in Macroplot 1 in June, 2021
(Flowering SCT are visible in the yellow circle)

In sharp contrast to the small single stem plants found in the control/mow plots, the SCT planted into sheetmulch (SM) plots grew extremely large and flowered profusely (**Figure 11**).

Figure 11. Large Flowering SCT Growing in Sheetmulch in Macroplot 1, June 2021

Average plant height ranged from 10 to 24" (individual plant height was not measured) and up to 32 stems were counted on a single plant (**Figure 12**).

Figure 12. Close-Up of Large, Flowering SCT in Sheetmulch, June 2021

The SM plots in Macroplot 1 were hand-weeded (w) 1x in April during the annual vegetation monitoring but SM plots in Macroplot 2 were left un-weeded (uw) due to lack of time. In Macroplot 3, one plot was weeded and one was not. As shown in **Table 3**, overall survival was actually higher in un-weeded plots, but average flowerhead production was lower. Counting flowerheads was deemed too time consuming (one plant had an estimated 795 flowerheads), therefore, the number of flowerheads/plant was estimated from 3 plants in each subplot. The total number of flowerheads produced was estimated by multiplying the average number of flowerheads per plant by the number of survivors. Surviving SCT in the sheetmulch plots produced an estimated 50,000 flowerheads.

Table 3. Summary of survival and flower production in sheetmulched subplots in 2021

Sheetmulched plants (w=weeded uw=un-weeded)				
Plot	**% survival**	**Avg flwrhds/ plant**	**# surviving plants**	**estimated sum flwrhds**
1w	60	355	60	21,300
2uw	75	175	75	13,125
3w	54	582	22	12,804
3uw	83	52	47	2,444
Total	**68**		**204**	**49,673**

Table 4 summarizes survival and flowerhead production in the 2021 planting. SCT planted into woodchip sheetmulch and weeded one time in the spring produced twice as many flowerheads as un-weeded plots. Surviving SCT in the control and mow one-time plots produced a combined total of only 2,000 flowerheads.

Table 4. SCT survival and flowerhead production in the 2021 planting

Treatment	**Woodchip Sheetmulch (weeded)**	**Woodchip Sheetmulch (unweeded)**	**Control/Mow**	**Total**
Area A				
Sum Flwrheads	34,104	15,569	2,077	**51,750**
Avg Flwrheads/plant	355-582	52-175	2-15	**na**
No. SCT plants	82	132	307	**521**

In Area D, none of the 56 SCT planted that were unprotected from grazing survived to flower. In Area C, a total of 33 of 69 SCT (48% survival) planted within the 2020 grazing exclosure survived to flower in August. The plot was string-trimmed in April to reduce non-native grasses and radish and definitive branching above a cut point was observed on some surviving plants. Survivors produced a total of 192 flowerheads with an average of 6 per plant. None of the 27 SCT planted immediately outside of the grazing exclosure in Area C survived to flower.

2021 Experimental Outplanting First Year Recruitment. In Area A, when the 2021 planting was first assessed for recruitment in late fall, the density of vegetation in the mow/control treatment plots made it difficult to see emerging SCT seedlings. However, very heavy seed rain was observed in the sheetmulch plots and the decision was made to rake the woodchip to the side of subplots in each macroplot on October 18. A second subplot in each macroplot was raked on November 4 and 1 plot within each microplot was left unraked.

In Area A, spring recruitment of the 2021 planting in the 2022 growing season was extremely variable. There was virtually no recruitment in the control/mow plots. Recruitment only occurred within the sheetmulch plots. In June 2022, a "lawn" of thousands of emerging seedlings was observed in a single subplot (**Figure 13**); however, only 5 SCT emerged and flowered in another subplot. Several other subplots supported SCT; the average number of SCT plants in these subplots was 90 (plants per plot). One of these subplots is shown in **Figure 14**. By the time of the final assessment in late September, the number of flowering SCT was still as variable and ranged from only 3 to an estimated 500 plants in 2 different sub-plots.

Figure 13. A "lawn" of flowering SCT recruits produced in a raked sheetmulch plot by the 2021 planting in June, 2022.

Figure 14. Subplot showing an estimated 90 SCT that recruited and flowered in a 2021 sheetmulch plot, June, 2022. SCT in yellow circles

Raking the woodchip in the fall appeared to improve recruitment. In un-raked subplots, an estimated 200 SCT recruited and flowered, producing around 900 flowerheads (**Figure 15**). Approximately 700 SCT recruited and flowered in plots raked in mid-October and 600 in plots raked in early November, producing an estimated 1,500 and 2,000 flowerheads, respectively. Overall an estimated 1,500 SCT recruited and produced 4,500 flowerheads.

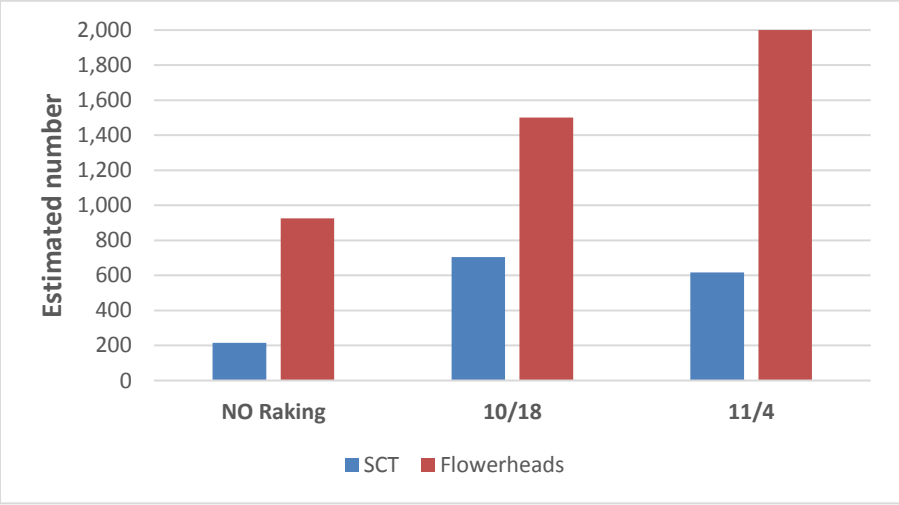


Figure 15. Estimated numbers of flowering SCT recruits and flowerheads produced by the 2021 planting cohort in plots with or without fall raking in September, 2022.

The raking regime was applied to all Macroplots, but there was less recruitment in Macroplot 2 on the eastern side of Area A across from Macroplots 1 and 3 (**Figure 16**). Macroplots 2 and 3 had similar survival and flower production in 2021, while surviving SCT in Macroplot 1 produced substantially more flowers (see Table 3). The physical or biotic factors driving the lower recruitment in Macroplot 2, relative to Macroplot 3, are not clear.

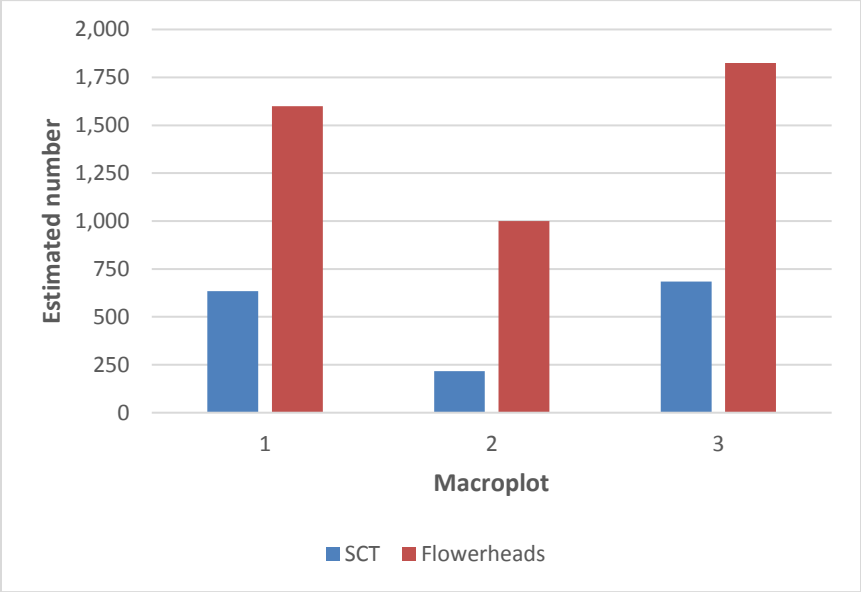


Figure 16. Estimated numbers of flowering SCT recruits and flowerheads produced in 3 macroplots by the 2021 planting cohort in September, 2022.

5.1.2.2 Experimental Outplanting, 2022

The 2021 planting was implemented with funding limited primarily to the development of the Habitat Enhancement Plan by Alison Stanton in 2020. In March 2021, the City submitted a proposal to the Ventura Fish and Wildlife Office Recovery Project requesting $22,050 funding to continue implementation of the Habitat Enhancement Plan with three main elements: additional greenhouse propagation of SCT plants at the UCSC Greenhouses, implementation of a second phase of outplanting in 2022, and laboratory research on SCT germination cues at UCSC. The primary goal of the additional round of planting in 2022 was to establish container-grown SCT plants to increase seed production and provide further protection against the possible extirpation of the population at Arana Gulch.

The Ventura Fish and Wildlife Office selected the City's proposal in June, 2021. In the fall, Alison Stanton developed an experimental design similar to the 2021 planting to test additional planting strategies to determine which methods lead to the greatest *in situ* survival and reproduction, measured as mature SCT flower head production per plant.

SCT Propagation. **T**he UCSC Greenhouses propagated approximately 1,400 SCT for use at Arana Gulch. A total of 600 SCT were planted on February 3, 2022 and 400 SCT were

planted on February 24, 2022 in Area A. The stubby tubes were removed from the SCT and dibble bars were used to create holes for each plant. Volunteers participated in the plantings, including students and staff from the UCSC Ecology and Evolutionary Biology Department (**Figure 17).** A local news outlet did a TV segment on the planting effort.

Figure 17. Volunteers from UCSC planting SCT on February 3, 2022

Area A Design. Grazing was again suspended in Area A to evaluate planting methods independent of grazing impacts. The molluscicide 'Sluggo' was applied to all plots to prevent the heavy snail herbivory that was observed in the 2021 planting. Two new planting treatments using cardboard or weed-free rice straw were tested:

- **Sluggo only (S)-** control
- **Mowing (M)** –string trim 1x on April 6-7
- **Cardboard only (CB)**-2 overlapped layers of 48" B-flute cardboard affixed w/sod staples
- **Woodchip sheetmulch (WS)**- cardboard topped with 2-3" depth woodchip
- **Straw sheetmulch (SS)** - cardboard topped with 2-3" depth weed-free straw

A total of 3 25 x 60-foot macroplots (122, 222, 322) were placed in the central part of Area A near the 2021 experimental plots (121,221,321) (**Figure 18**). Each macroplot was divided into 10 sub-plots (10 x 10-feet) with 2 replicates of each of 5 treatments. Macroplots were string-trimmed before planting on February 3rd or 24th. 20 plants were installed in each subplot in a 5x4 grid spaced 1.5 ft. apart and the 2 rows of subplots were separated by 5 feet. Each macroplot received 200 SCT plants.

Figure 18. Locations of 2021 and 2022 SCT macroplots at Arana Gulch in Area A

The cardboard only treatment failed almost immediately when the cardboard blew away several days after planting. The planted SCT were not damaged so the cardboard was not replaced and these plots reverted to control plots. On February 24th, an additional 4 subplots with 25 plants each were attached to the existing macroplots: two plots each of woodchip sheetmulch and straw sheetmulch for an additional 100 plants/macroplot. A total of 100 plants were also planted adjacent to Plot 222 on the west side in groups of 10 to receive the mechanical mowing applied throughout the rest of Area A. **Table 5** summarizes the planting in Area A and C.

Area C Plot Layout. After planting Area A, an additional 145 SCT were planted in the cattle exclosure in Area C on March 7, 2022. The exclosure is comprised of 3 metal gate sections

located adjacent to the main path on the west side of Arana Gulch. The intent of this planting was to develop educational signage and have a demonstration plot for easy viewing by the public since none of the plantings in Area A are visible from any of the paths.

The plan was to install 3 replicates plots of each treatment (mowing/ woodchip sheetmulch/ straw sheetmulch) with 25 plants per plot for a total of 225 plants. However, the ground was very hard and it was difficult to create a hole with the dibbler and get the plants into the ground. A long auger bit on a hand drill would have made the planting process easier. With the limited volunteer help that was available, only 5 plots with 29 plants/plot were installed for a total of 145 SCT (**Table 5**). Treatments applied were: 2 control, 2 woodchip sheetmulch, and 1 straw sheetmulch.

Table 5. Number of SCT planted /treatment in 2022

3-Feb	Control	Mow	Straw Mulch	Wood Mulch	**Total**
# sub-plots	4	2	2	2	
Macro 1	80	40	40	40	200
Macro 2	80	40	40	40	200
Macro 3	80	32	48	40	200
					600
24-Feb					
# sub-plots	1		1-2	2	
Macro 1	25		25	50	100
Macro 2			50	50	100
Macro 3			50	50	100
					300
outside macroplot 2- subject to grazing					**100**
Area C grazing exclosure					
# sub-plots	2		1	2	
	58		29	58	**145**
Total planted					**1,145**

2022 Experimental Hand Broadcast of SCT Seed. In December 2022, SCT seed was hand-broadcast into a small wildfire-affected area in Area A. SCT seed and chaff from approximately 100 flowerheads (5-10,000 seeds) supplied by the USCS Greenhouses was spread onto three 10x20 ft hoed areas in the southern portion of Area A on December 22. The selected area was subject to a small wildlife in July 2022. Seeds (with chaff) was spread onto the three areas and lightly raked into the upper 0.5 inch of soil. The location of the seeding is

shown on **Figure 19**. **Figure 20** shows the site conditions of the plots after seeding. These plots will be monitored in 2023 for SCT seed expression.

Figure 19. Locations of 2022 SCT seeding at Arana Gulch in Area A

Figure 20. Layout of 2022 SCT seeding plots at Arana Gulch in Area A

2022 Experimental Outplanting Results

Precipitation. As mentioned above, 2022 was the 3rd consecutive year of below average rainfall (22 inches) for the water year (October 1, 2021 to September 30, 2022). There was decent rain in the fall, with 17.5 inches in October- December (**Figure 21**), but there was only 3.7-inches in the remainder of the winter and through May. No precipitation greater than a tenth of an inch fell from January 5th to March 27th.

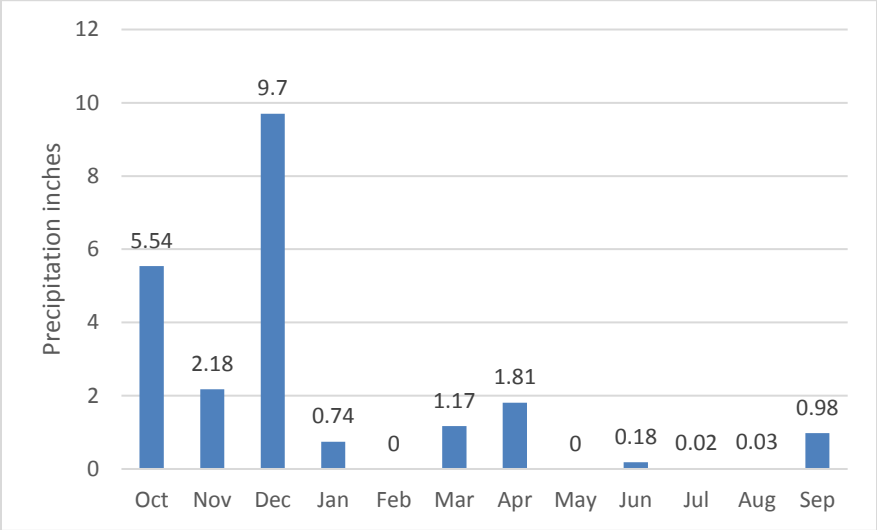


Figure 21. Monthly rainfall at the nearby Delaveaga Golf Course (Delaveaga monthly weather)

Monitoring. The macroplots were evaluated in April and the mowing treatment subplots were mowed with a string trimmer to a height of 6 to 8 inches. The mowed material was not removed. The final survival and reproduction data were collected in late September. Once the surviving SCT were seeding in the sheetmulch plots, the woodchip was raked to the side in mid-November to give the seed better access to the soil. The raked wood bark chips were left on site.

Area A Results. Survival of the 2022 planting cohort was much lower than expected. As already described, the cardboard-only treatment was discontinued almost immediately when the plots were destroyed by wind. The straw mulch treatment was only marginally more successful, with less than 10% of planted SCT surviving to flower (**Figure 22**). Average survival in other treatments was only 20 to 30%. The low survival is likely due to persistent drought conditions. Total precipitation from the beginning of January through May was only 3.7-inches, and no rainfall greater than a tenth of an inch fell from January 5th to March 27th.

In addition to drought, extensive gopher herbivory was observed along with strong competitive pressure by weeds. The straw mulch appeared to be very prone to gopher damage (**Figure 23**) and less effective at suppressing weeds (**Figure 24**). Most straw mulch plots failed completely and only 17 SCT total (7%) survived to flower out of 245 planted. Survival

in the wood sheetmulch plots was only 20% on average, with only 11 plants total surviving in Macroplot 1 and 7 in Macroplot 2. In Macroplot 3, 34 plants survived in the wood mulch treatment, but 18 were in a single subplot (**Figure 25**), accounting for 26% of total survival in the wood mulch and straw mulch treatments combined.

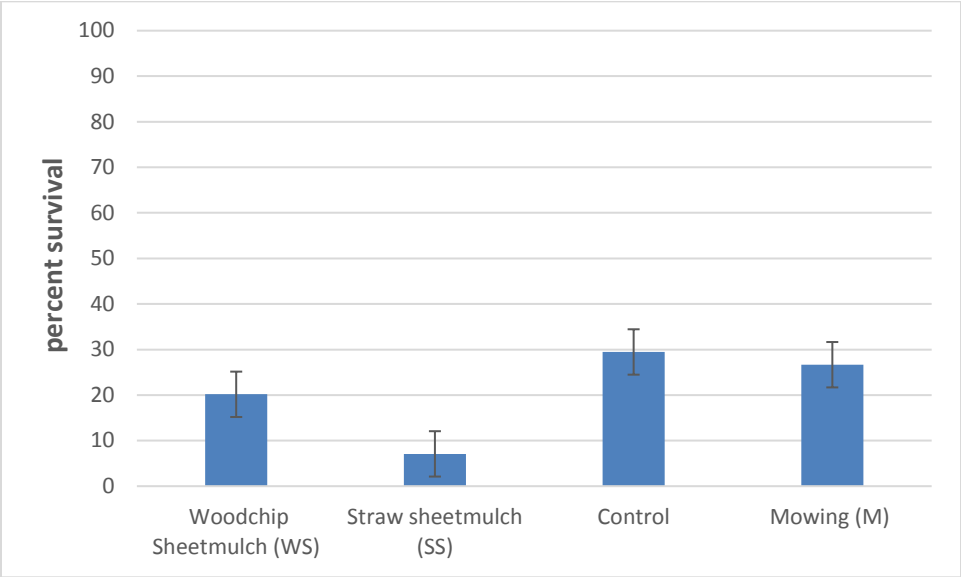


Figure 22. Average fall survival of SCT planted in February, 2022 (N=8-10 subplots per treatment, error bar is one standard error from the mean)

Figure 23. Extensive gopher damage in a straw mulch plot in June, 2022 (surviving SCT in is yellow circles)

Figure 24. Ineffective weed suppression in a straw mulch plot in June, 2022 (surviving SCT in is yellow circles)

Figure 25. Wood mulch plot with greatest survival and flowering in June, 2022

Although survival was low, the SCT that established in mulched plots mostly grew large, branched extensively, and produced abundant flowerheads. In the subplot shown in Figure 22, 18 surviving plants produced an estimated 500 flowerheads each for a total of 9,000 flowerheads, or 60% of the total production of 15,000 in all subplots (**Table 6).** This dense concentration of seed is likely to produce a first-year outcome similar to the "lawn" of single stem SCT (shown in Figure 12) that recruited in one plot from the 2021 planting. **Figure 26** shows more typical results in the woodchip mulch with only 3 surviving SCT with profuse flowering.

Figure 26. Low survival of the 2022 planting in a woodchip mulch subplot in June, 2022.

Table 6. SCT survival and flowerhead production in the 2022 planting

Treatment	Woodchip Sheetmulch (WS)	Straw sheetmulch (SS)	Control/Mow	Total
Area A				
Sum Flwrheads	11,545	2,800	625	**14,970**
Avg Flwrheads/plant	325	150	6	**na**
No. SCT plants	54	17	115	**186**
% Survival	20	7	28	
Area C				
Sum Flwrheads	365	200	135	**700**
No. SCT plants	6	7	11	**24**

At only 13%, first year survival of the 2022 plantings was lowest in Macroplot 2 (**Figure 27**). There was also less recruitment of the 2021 planting in Macroplot 2 and less flower production observed in 2022 (see Figure 15). However, in 2021, first year survival and flower production in Macroplot 2 and 3 were similar, but much lower than in Macroplot 1 (see Table 3). The reduced recruitment and survival in Macroplot 2 in 2022 could be due to multiple factors such as vegetation composition or water availability.

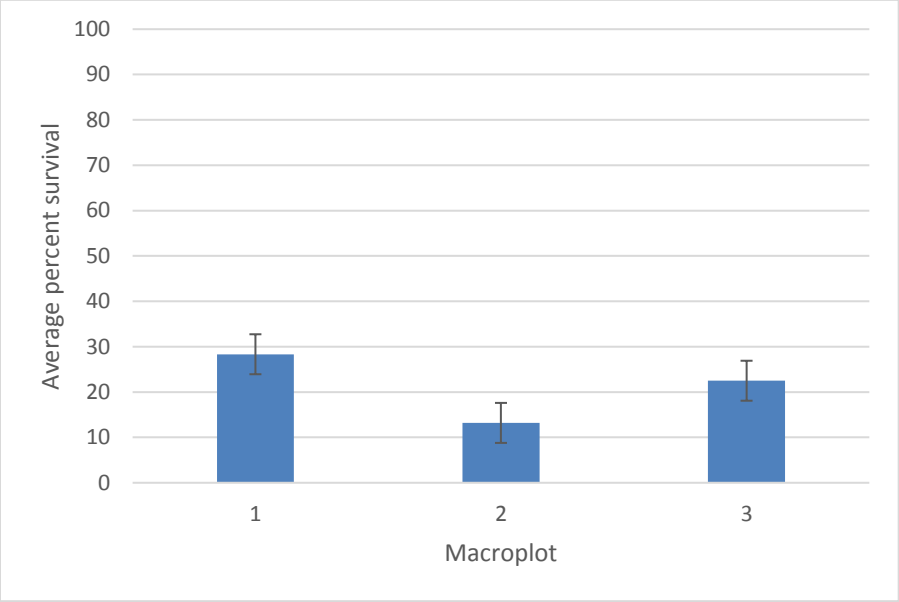


Figure 27. Average SCT survival in a Macroplot (N=14 subplots) in the 2022 planting.

Area C Results. A total of 145 SCT were planted in a grazing exclosure in Area C on March 7, 2022 in 5 treatment subplots; 2 control, 2 woodchip sheetmulch, and 1 straw sheetmulch. A total of 24 (16%) SCT survived to flower by September. Survival was equal across the treatments, with 5-7 SCT surviving in each sub-plot (**Table 6**). Several plants grew large and produced an estimated 125-175 flowerheads. Total flowerhead production was about 700. There was no SCT recruitment of the 2021 planting in Area C adjacent to the 2022 planting.

5.1.3 Greenhouse Research

SCT ray seed (achene) germination trials were conducted in 2022 at UCSC Greenhouses. The study was funded through a grant from the USFWS and investigated methods to germinate the ray achenes through various treatments and stratifications. The study found the best germination rates occurred under cold stratification temperatures of 40ºF with 12 hr. diurnal exposure to light when seeds were either scarified with sulfuric acid for 5 minutes or pretreated with gibberellic acid at 100ppm. Under these conditions, mean germination rates ranged between 36% (sulfuric acid 5-minute soak) and 43% (gibberellic acid 100ppm), which are both reasonably close to their tested batch viability rate of 40%. Under field conditions, scarification of the ray achene seed coats is the most likely trigger for germination. However,

seeds treated with sulfuric acid germinated better when exposed to light, indicating that seeds have both a physically impermeable seed coat, as well as some sensitivity to light to stimulate embryonic development. The gibberellic acid treatments did not require exposure to light, but this finding is consistent with other research where gibberellic acid overcame photosensitive species light requirement. Thus, it appears that SCT ray achenes are photosensitive and require light exposure for germination. The report, *A Germination Study: Dormancy in ray achenes of Holocarpha macradenia, a rare coastal prairie forb* (Childress, 2023) is included as **Appendix C**.

5.2 Grassland/Coastal Prairie

5.2.1 Grazing and Mowing

Management actions for the SCT consisted of seasonal grazing of the historic SCT colonies in the northern portion of Area A and Areas C and D (and surrounding grassland), seasonal mowing in the southern portion of Area A, and seasonal mowing of Area B. Areas C and D were grazed from December 8, 2021 to August 27, 2022. The northern portion of Area A was grazed April 7 to August 27. Further details on the grazing program can be found in Section 5.3.

Grassland mowing occurred outside the grazing fences within areas delineated to remain as grassland (from the fence to the drip line of the adjacent woodland), as depicted in **Figure 28**. Perimeter fuel break mowing was also identified along the trails. The City mowed Area B once in June. The southern portion of Area A was mowed twice with a Toro deck mower set at 6 inches. The first mowing was conducted over two days on February 18 and 28; the second mowing was on May 5. The purpose of the mowing was to reduce cover by non-native plants

Using previous year recommendations from the AMWG, mowing of non-grazed areas (except for southern portion of Area A) occurred once a year in June, after a botanist inspects the site to assure that native plants, such as Mariposa lilies, would not be adversely affected. Prior to the June mowing, the City authorized a botanical review and a breeding bird survey of the mowing areas to ascertain if native plant species or nesting birds would be directly affected by the mowing. Kathleen Lyons, plant ecologist, conducted the botanical review and Garvin Hoefler, wildlife biologist, conducted the breeding bird survey. No breeding birds were detected in the areas subject to mowing; however, several colonies of locally unique plants along the Coastal Loop Trail were flagged such that mowing would avoid these areas. At the time of the June mowing, grass height averaged two feet, slightly less height than 2021, which could be drought-related. Flail mowing was conducted as close to bare ground as possible. Areas subject to mowing are depicted on **Figure 29**.

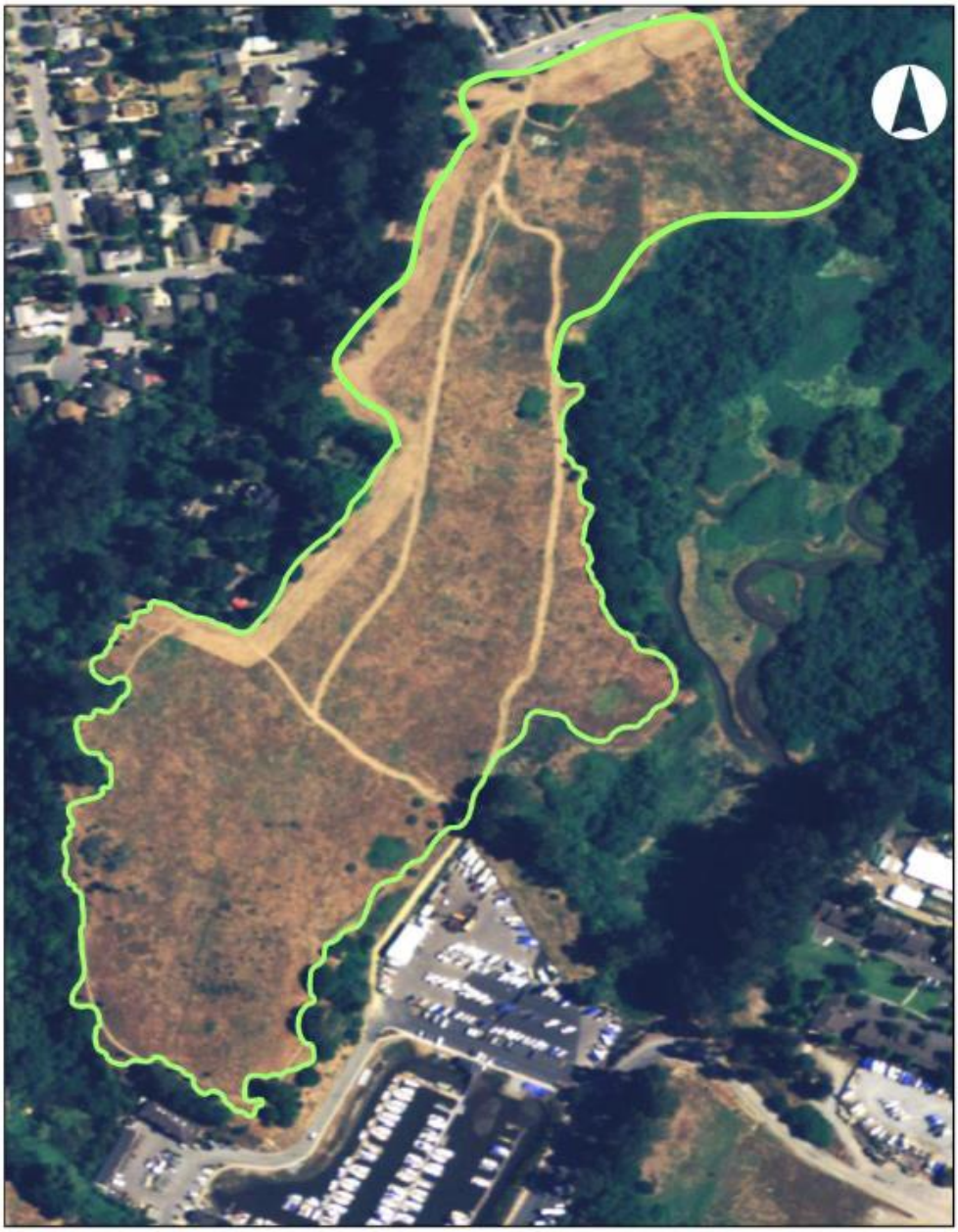


Figure 28. Delineated Grassland, April 2015

Figure 29. Areas Mowed in 2022

5.2.2 Vegetation Assessment

The CDP requires a plan for monitoring and management of habitat areas at Arana Gulch in perpetuity and implementation of adaptive management procedures to allow for modifications of management to improve outcomes. Section B (3) Special Conditions of Approval for the CDP requires annual assessment of the vegetation in the Santa Cruz tarplant

(SCT)/Coastal Prairie Management Area until the interim success criteria specified in the HMP are met, with continued monitoring every three years, thereafter.

The vegetation assessment provides a quantitative evaluation of changes in vegetation condition over time in response to management actions. A baseline vegetation assessment was completed in 2013-2015 according to the details of field sampling and analysis specified in section 3.7 of the HMP. Repeated measures in 2016-2019 and 2021 have allowed a quantitative evaluation of the response to the Grazing and Stocking Program, first implemented in late winter of 2015 (discussed in section 5.3). The AMWG has utilized the monitoring data to evaluate progress in meeting the specific goals and objectives of the HMP. To date, the monitoring strategy has been focused on 2 tandem goals in the HMP:

- Goal 2: Restore a proper disturbance regime with the reintroduction of grazing
- Goal 3: Minimize the detrimental effects of high non-native cover and restore coastal prairie species diversity and habitat function

Goal 2 was partially met in 2015 when the Grazing and Stocking Program was first implemented. However, it is not clear that grazing alone constitutes a "proper disturbance regime". Goal 3 has 5 interim success criteria (Objectives A-E) that address parameters important to the functioning of the coastal prairie and SCT competitive ability including canopy height, cover of non-native species, cover of native species, species richness, and bare ground. The repeat vegetation assessments have concluded that grazing alone since 2015 has been successful in reducing canopy height (Obj. A) and increasing bare ground (Obj. E), but has not significantly reduced the cover of non-native plants (Obj. C) or increased the relative cover (Obj. B) or number of native species (Obj. D) present on the prairie.

After 5 years of no SCT response to grazing, scrape plots were implemented in November, 2019. The sampling methodology for the 2020 annual vegetation assessment was modified to assess response to the scraping. The scraping increased bare ground and lead to a flush of the native toad rush (*Juncus bufonius*), but no SCT recruitment occurred.

The 2020 report recommended outplanting of container-grown SCT in the southern part of Area A to test outplanting strategies. The AMWG recommended grazing exclusion in Area A to protect the planted SCT and enable California oatgrass (*Danthonia californica*) to recover. The City agreed to implement periodic mowing in Area A to keep grass growth below 10 inches to reduce non-native grass seed production. In 2021, the permanent transects were monitored again to assess response to grazing release in Area A. Areas C and D were also monitored, but no new management occurred as those areas continued with grazing.

In 2022, half of Area A was mowed on February 18 and the other half on March 1st. A second mow was conducted on May 5th. Canopy height stayed low through May and then quickly dried out, such that it was not possible to identify species. Monitoring of the 25-m permanent transects in April was not conducted because many of the annual weeds at Arana Gulch typically grow back after a single mowing early in the season. Although the seed head is removed, they are able to regrow from buds found on the lower nodes of the stem. Therefore,

the variables monitored on the permanent transects such as cover of non-native grasses or forbs would not be expected to change until being mowed multiple times or until the following growing season. Monitoring the permanent transects in 2023 is recommended.

Methods. A modified vegetation assessment and standard photo monitoring were conducted on June 6-7th. The photo monitoring is discussed in Section 4.2 and the photos provided in Appendix B. Invasive weeds were mapped in Area C using GPS tracks of the perimeters of the infestations. In Area A, two areas with high cover of the native perennial *Stipa pulchra* were excluded from mowing and these were mapped with GPS tracks. Two areas with high cover of the native perennial *Danthonia californica* were also mapped, along with the perimeter of the seasonal wetland depicted on maps in the Master Plan and other documents. Canopy height measurements were taken in December and February to capture winter conditions for the current growing season Canopy heights were not taken in April.

Results. The location of the 2021-2022 planting plots in Area A (see **Figure 30)**, the areas of high *Stipa* cover that were not mowed, two areas of *Danthonia,* and the seasonal wetland. The large patches of perennial grass indicate that the grazing release in 2021 and mowing exclusion in 2022 may have allowed some recovery of these species. The map can be used in planning future outplantings, restoration, and monitoring efforts. The permanent transect locations are shown in relation to these features. A greater intensity of sampling within the southern part of Area A with an emphasis on vegetation composition and cover in past year planting plots could provide insights into differential performance of the SCT plantings. A greater sampling intensity within perennial grass areas could inform the development of coastal prairie restoration objectives.

Figure 31 presents a map of the larger weed infestations in Area C, developed to assist in prioritizing large scale weed management. The map is not comprehensive with all occurrences or species. The two most prevalent weeds are Italian thistle (*Carduus pycnocephalus*) and Himalayan blackberry (*Rubus armeniacus*). The California Invasive Plant Council (CalIPC) rates Italian thistle as a Moderate threat and blackberry as High. Several of these infestations in Area C were mechanically controlled with weed-whipping or hand treatment as described further in Section 5.4 Invasive Weed Work Plan. A few individuals of native coyote bush (*Baccharis pilularis*) were present and were mapped because preventing encroachment of woody shrubs and trees is a priority for grassland/coastal prairie management.

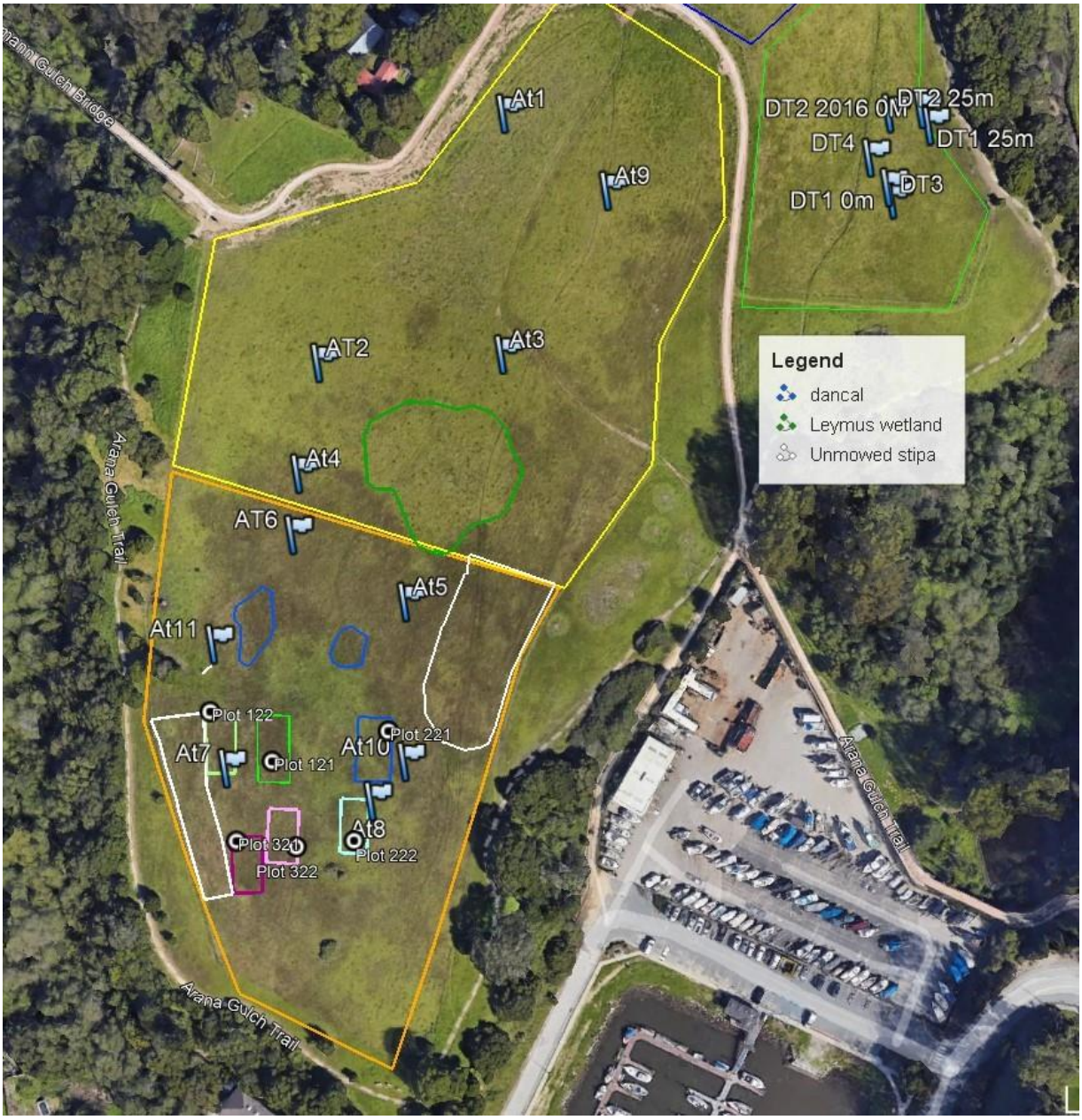


Figure 30. Location of SCT planting plots, vegetation transects, and other features in Area A in June 2022.

Figure 31. Location of weed infestations and vegetation transects in Area C in June 2022.

5.3 Grazing and Stocking Program

5.3.1 Implementation

The installation of cattle grazing infrastructure was completed in February 2015. The grazing enclosure includes about 18.75 acres (8.4 hectares), divided as follows: Area A = 15 acres (6 ha[6]); Area C = 4.1 acres (1.6 ha); and Area D = 2.1 acres (0.9 ha).

Although fences were installed in 2014, a ramp from Agnes Street to the holding coral and water hook-ups for the troughs were completed in February 2015. Large "Cattle Grazing Area" signs were installed at the three trail entrances; smaller signs were installed on the

[6] In 2021 and 2022 only the northern portion of Area was grazed.

fence posts where trails are in close proximity to the grazing area. Additional signs indicating that the cattle graze to help restore the SCT were installed in February 2016. The City received input from the AMWG on the language for these signs. In 2017, a gate was added in Area C to facilitate movement of animals between areas A and C. In 2022, a cross-fence was installed in Area A to allow cattle grazing in just northern portion of the area. Fences, access gates, and other features to support cattle grazing were inspected and maintained throughout 2022.

The City's grazing contractor had cattle onsite from December 8, 2021 through August 27, 2022. The grazer used a cow/calf program. The HMP's original estimate for cattle was 2 to 6 cow calf pairs. However, it became evident during previous grazing years that this number of cattle was insufficient to keep up with the rate of grass growth. As an adaptive management action, the AMWG revised its recommendation to the City to provide the City and the rancher with more flexibility to increase the number of cattle at the site to keep pace with grass growth. The specific number of cattle present onsite throughout the 2022 grazing season are presented on **Table 7**.

As grazing occurred in 2022, the City conducted numerous observations of grazing operations, including the entry and exit of cattle from the site, conferring with the grazing operator, observations of feed and water troughs (regularly during the grazing season), recording residual dry matter (RDM) and adherence to BMPs (see Section 3.5.6 in HMP).

In 2016, four wood rubbing posts (4x4's) were installed in the grazing area in December to encourage cattle to congregate and create additional bare ground that may be suitable for SCT germination. Small area of bare ground was found around these posts in 2020, yet no SCT have been detected in these areas. A molasses bucket was placed in Area A in May 2019 to create an area of bare ground to facilitate SCT seed expression, yet no SCT have been detected.

Table 7. Number of Cattle and Duration of Grazing Season per Grazing Area in 2022

Duration	# of Cattle in Area A (north)	# of Cattle in Area C	# of Cattle in Area D	# of Cattle in Areas C & D (open gate)	# of months grazed
December 8 – January 23	0	-	-	4 cows 1 calf	1.5
January 23– March 23	0	-	-	6 cows 1 calf	2
March 23 – March 29	0	-	-	4 cows	0.25
March 29 – April 7	0	-	-	5 cows 1 calf	0.25
April 7 – May 1	5 cows 1 calf	-	-	0	1.0
May 1 – May 7	0	-	-	5 cows 1 calf	0.25
May 7 – May 10	0	-	-	2 cows 1 calf	0.25
May 10- July 17	0	-	-	5 cows 2 calves	2.25
July 14 – August 9	6 cows 2 calves	-	-	0	0.75
August 9 -August 13	0	-	-	6 cows 3 calves	0.25
August 13 – August 27	0	-	-	3 cows 3 calves	0.50

5.3.2 Monitoring

Residual dry matter (RMD) is the amount of dry plant material left standing or on the ground from the previous year's growing season (Bartolome *et al*. 2006). RDM includes three components: 1) the current year's crop of palatable forage, 2) non-palatable plants, weeds, and the stubble of dry matter that is left behind when clipping and 3) thatch, which is dead plant material greater than one-year old. *A Mulch Manager's Guide for Monitoring Success* (Wildland Solutions 2008) provides practical information on how to assess RDM in a manner that is objective and directly related to management objectives for rangeland health. The RDM monitoring was conducted on October 18 by Kathleen Lyons. Pursuant to the methodology outlined in *Guidelines for Residual Dry matter on Coastal and Foothill Rangelands in California* (UC Publication 8092 by J. Bartolome) the grazing areas were walked along random transects. Equipment consisted of a clip and weigh RDM kit from Wildland Solutions that included a 13.25" diameter circular hoop plot, a gram scale, and measuring bag. The RDM plot was randomly tossed and the vegetation was clipped and weighed. A photo was obtained of each plot before and after clipping; noting plot number, RDM level and date on dry erase board. The measuring bag was weighed empty, summer annual plants and any tree leaves were removed from the clip plot; old thatch was not evident and not included. Plants rooted in the plot were clipped as close to the ground as possible, clippings were placed in the bag, weighed and recorded (subtracting weight of the bag). The weight of the clippings was converted to pounds per acre (grams clipped x 100 = lbs./acre RDM).

Clipping and weighing RDM plots was used to calibrate visual estimates of three RDM levels corresponding to an RDM objective of 500-650 lbs./acre (exceeds, meets, or below). Once the observer's eyes were calibrated, it was possible to assess the RDM level without a clip plot. Locations where RDM levels were assessed as well as edges of mapped boundaries were recorded with GPS waypoints.

The results were plotted onto an aerial photo to create an RDM zone map, based on GPS points mapped onto most recent Google Earth imagery available, and polygons created. The RDM zone map, portraying the following RDM levels, provides a sufficient level of detail for aiding management and cattle grazing decisions:

BLUE: Highest RDM (exceeds objective (>650 lbs./acre)
GREEN: Middle RDM (meets objective (500-650 lbs. per acre)
RED: Lowest RDM, below objective (<500 lbs./acre)

5.3.3 Results

Within the grazed areas (northern portion of Area A, Area C, and D) RDM levels were mostly in the red (<500 lbs./acre) or green RDM (500 - 650 lbs./acre) zones, which reflects the effects of seasonal grazing that occurred between December 2021 and August 2022. At most locations, thatch was not evident as cattle ingested the current and previous year's growth. Both Area C and D had lower RDM levels compared to previous years; the northern

portion of Area A had less areas with high RDM, mapped blue (>650 lbs./acre), than 2021 when the area was not grazed, nut periodically mowed.

Figure 32 exhibits the RDM map for all grazed areas (A, C, and D), as well as the southern portion of Area A that was periodically mowed. **Figures 33, 34** and **35** show clip plots with highest RDM (>650 lbs./acre), middle RDM (500-650 lb./acre) and lowest RDM (<500 lbs./acre), respectively.

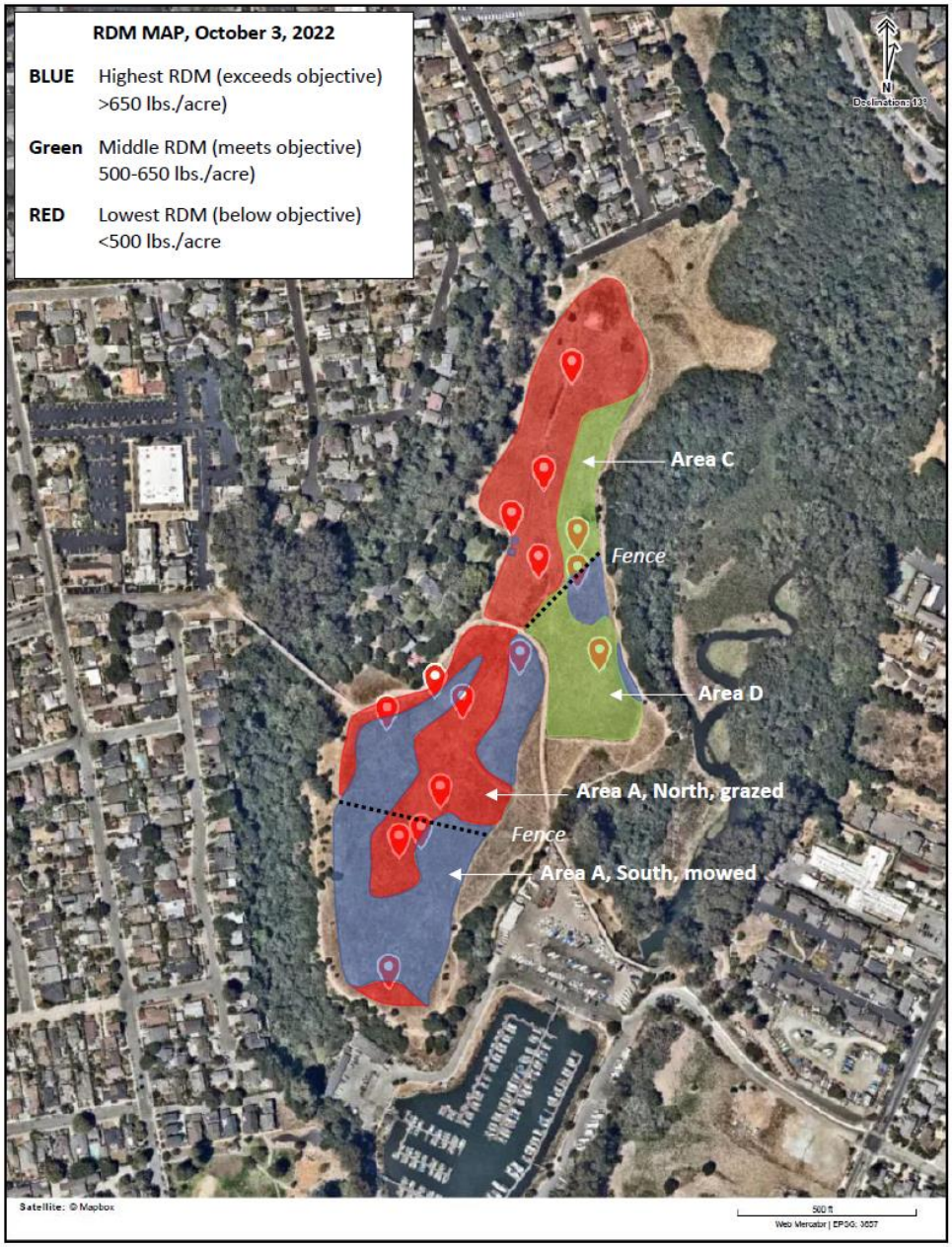


Figure 32. RDM Map for Grazing Areas, October 2022

Figure 33. Clip Plot of Highest RDM (Blue), October 2022

Figure 34. Clip Plot of Middle RDM (Green), October 2022

Figure 35. Clip Plot of Lowest RDM (Red), October 2022

5.3.4 Discussion

In 2022, cattle grazing reduced canopy height in the northern portion of Area A and Areas C and D during months the cattle were on site (December 2021 through August 2022). Grazing canopy height in mid-February averaged 1.4 inches in Area C and 2.3" in Area D. Height measurements were taken approximately 2 months after cattle were brought onto the site. The canopy height in both areas was within the desired target range for the SCT germination and emergence period (i.e., 2-3.5"). Cattle grazing was sufficient in keeping the canopy height low. Similar to previous years, once grazing was initiated, the cattle reduced biomass across the grassland and in the process also increased bare ground. Non-native species remained dominant with very high cover. RDM levels decreased in most of the grazed areas between 2015 and 2022. A comparison of RDM levels between 2015 and 2022 is presented in **Figure 36**.

Areas of lowest RDM (red) were larger in Area C since 2015. The amount of red RDM were reduced in the southern portion of Area A with the cessation of cattle grazing within this area in 2021 and 2022. Green RDM levels were recorded in Area D (a continued reduction from RDM level blue in 2019). The northern part of Area A was grazed April through August and had lower RDM than 2021, as shown by the red areas. Although no grazing happened in Area A, South (mowed area), RDM was recorded as a comparison to the grazed areas. Areas in red were in the center and then in the small burn area in the south. The southern part of Area A has higher RDM (blue) in many areas; in 2021 it was mapped as green.

The changes in biomass, canopy height, and RDM across the grassland since 2015 represents positive progress in improving vegetation conditions as well as reflecting changes in land management actions, such as cessation of grazing in Area A for 2022. As the Arana Gulch grasslands have been highly disturbed for well over one hundred years, returning the grassland and prairie to reference conditions, if possible, will take many more years.

BLUE: Highest RDM (exceeds objective (>650 lbs./acre)
GREEN: Middle RDM (meets objective (500-650 lbs. per acre)
RED: Lowest RDM, below objective (<500 lbs./acre)

Figure 36. Comparison of RDM, 2015 and 2022

5.4 Invasive Weed Work Plan

5.4.1 Management Actions

In 2015 the City mapped the invasive plants within this management area and prepared an Invasive Weed Work Plan (IWWP). In 2016, the City filled a park maintenance position with dedicated hours for Arana Gulch. The IWWP outlined methods for the removal and control of invasive, non-native plant species in the management area. Species addressed in the plan include: Italian thistle (*Carduus pycnocephalus),* bull thistle (*Cirsium vulgare),* poison hemlock (*Conium maculatum),* cotoneaster (*Cotoneaster sp.),* Bermuda grass (*Cynodon dactylon),* French broom (*Genista monspessulana),* English ivy (*Hedera helix),* velvet grass (*Holcus lanatus),* Harding grass (*Phalaris aquatica), Prunus sp.,* pyracantha (*Pyracantha sp.),* wild radish (*Raphanus sativa),* Himalayan blackberry (*Rubus ameniacus),* and milk thistle (*Silybum marianum).* The IWWP is presented in the Year 2 Annual Report, Appendix B.

In 2022, despite some staffing challenges, the City removed invasive plant species from the delineated grassland area. Weed infestations in Area C were mapped as part of the vegetation assessment in June (see **Figure 31).** Italian thistle and Himalayan blackberry are the two most prevalent weeds. On July 16, several large thickets of Himalayan blackberry in Area C were mowed or weed-whipped in 2022 by 28 volunteers with the Watershed Stewardship Program. Earth Stewards did a full day of invasive plant removal on November 17th. The City Parks Crews removed some Italian thistle and several small patches of Himalaya blackberry in Area A and northeast of Area A. In addition, the City's Summer Youth Trail Program crew did some weed control and built a fence extension in Area B to prevent/reduce off-trail pedestrian use (**Figure 37**). Control actions for thistles in the IWWP, specify that when seed heads of thistles are observed, they are cut and disposed of off-site. Thistles (*Cirsium, Silybum,* and *Carduus spp.)* were previously widespread on site and control efforts have significantly reduced cover of these species.

Figure 37. Removal of Himalaya berry by the City's Summer Youth Trail Program

5.5 HMP Performance Evaluation

The purpose of the detailed vegetation monitoring is to assess progress toward meeting the goals and interim success criteria specified in the HMP.

- Goal 1: Increase the abundance and distribution of the SCT population.
- Goal 2: Restore a proper disturbance regime with the reintroduction of grazing
- Goal 3: Minimize the detrimental effects of high non-native cover and restore coastal prairie species diversity and habitat function.
- Goal 4: Increase the size of the SCT seed bank to a level that will ensure a high probability of persistence for 100 years, or in perpetuity.

While Goal 2 was partially met when grazing was re-introduced in 2015, it is not at all clear that grazing alone constitutes a proper disturbance regime. Grazing has successfully reduced average canopy heights and increased bare ground but has not reduced cover of non-native plants or increased native species richness or cover. Therefore, Goal 3 to minimize the detrimental effects of non-natives has not been met. The grazing release in Area A in 2021 allowed the perennial grasses like California oatgrass to recover, but the limited mowing regime likely did not reduce seed set in non-native species or lead to a composition change. It is recommended that future monitoring recognize the delineated coastal prairie within Area A as a distinct sampling unit and increase sampling intensity. In addition, work is needed to quantify the levels of native species cover and richness that is 'representative of a reference functioning coastal prairie system' as specified in the HMP Objectives under Goal 3. The AMWG has maintained interest in acquiring this information.

Seasonal cattle grazing at Arana Gulch has not sufficiently improved conditions to allow for recruitment of SCT or other native species. Strategies to manage disturbance and stimulate the SCT and other native species seedbank have likely failed because the aboveground SCT population at Arana Gulch has been perilously low since 2006 (see long-term census data in section 5.2.2) and seedbank data show a 100-fold decline in viable SCT seed density between 1999 and 2015 that indicates the SCT seed bank is highly depleted. Consequently, the SCT population at Arana Gulch may be at or near some unknown threshold of extirpation at the site.

In 2021, the shift in management focus from trying to stimulate a depleted seedbank with grazing or other disturbance to an outplanting strategy to introduce seed to the site represents a renewed focus on Goal 1 and Goal 4. The overall performance of the 2021 planting was better than expected; 535 SCT survived and produced an estimated 52,000 flowerheads. Survival within the control (77%) and mow 1x plots (75%) in Area A was very high. The 307 surviving SCT produced an estimated 2,000 flowerheads. Survival of the SCT planted in sheetmulch was somewhat lower (62%), but the growth of the survivors greatly exceeded expectations; plants grew very large and flowered profusely. Similar restoration plantings into sheetmulch at Younger Lagoon have had very good performance, but most of the species

are perennial and it was not known if the practice would translate to an annual plant like SCT. The 228 surviving SCT plants in the sheetmulch treatment produced an estimated 50,000 seeds and was hopefully an important first step in increasing the seedbank (Goal 4).

In June 2021, the City received a grant from the Ventura Office of the USFWS that supported late summer-fall monitoring of the 2021 planting in addition to the implementation of a second phase of propagation and outplanting of 1,000 container-grown SCT at Arana Gulch in 2022. Recruitment of the 2021 planting only occurred in the sheetmulch plots. An estimated 1,500 SCT established and produced an estimated 4,500 flowerheads.

Survival of the 2022 planting cohort was much lower than expected. The cardboard-only treatment was discontinued immediately when the plots were destroyed by wind. Less than 10% of SCT planted into the straw sheetmulch treatment surviving to flower. Average survival in the control/ mow 1x/ and wood sheetmulch ranged between 20 to 30%. Overall, only 186 of 1,000 plants survived to reproduce. The 2022 survivors produced an estimated 15,000 flowerheads, the majority in the wood sheetmulch treatment. The low survival is likely due to persistent drought conditions and extensive gopher herbivory.

The HMP has a goal to maintain a viable SCT population, with an objective (1A) to increase the number of aboveground SCT to at least the 2006 level (348 plants) in the first year after the return of grazing (i.e., summer 2016) (Objective 1A). Although no naturally-occurring SCT were observed in historic colony sites in 2022, 1,535 SCT were found to naturally recruit in the 2021 SCT wood sheetmulch plots in Area A. The recruits produced an estimated 4,425 flowerheads. Only 210 SCT from the 2022 planting survived to reproduce. An estimated 15,700 flowerheads were produced. The combined total of all SCT plants at Arana Gulch from 2 years of outplanting was approximately 1,745 (only 24 SCT from the 2022 planting in Area C survived). The HMP objective to increase the population above the 2006 level has been attained. However, the lack of naturally-occurring SCT in the historic colony sites continues to indicate a lack of viable SCT seed in the soil seedbank.

A second HMP objective (1B) is to expand the distribution of SCT beyond Tarplant Area A within three years. In 2022, 145 SCT were installed in Area C within a cattle exclosure. Only 24 survived to maturity and there was no natural recruitment of SCT plants from the 2021 planting. The lack of recruitment suggests that the SCT is not currently sustainable. Additional SCT outplantings in Areas A, C, and/or D in 2023 are recommended. The City entered a third agreement with UCSC Greenhouses to propagate plants for planting in 2023.

The HMP has a goal to maintain a genetically and demographically viable soil seed bank in perpetuity (Goal 4), with an objective to increase the density of viable ray achenes in the soil seed bank from the baseline (first 3 years) and conduct assessments at 5-year intervals (Objective 4A). As discussed in the Year 2 (2015) Annual Report, a baseline seed bank density study was conducted by Dr. Bainbridge in 2014 /2015 that demonstrated a 100-fold

decline from data collected in 1999. Additional soil seed bank density analysis has not been conducted.

To maintain a viable seed bank and to guard against an unexpected stochastic event, SCT seed was collected from the site in 2018 (seed from 25 flower heads collected from 267 plants) and deposited at the UCSC Greenhouse for long-term seed storage. Under an agreement with the City and UCSC, approximately 100,000 additional seeds were produced through a seed bulking effort This seed increase is one tool to maintain a genetically and a demographically viable seed bank, which could be used at a later date to enhance the soil seed bank.

A goal of the 2021-2022 SCT outplanting experiments was to further increase SCT seed input into the soil seedbank. An estimated 50,000 SCT flowerheads, with possibly a million or more seeds, were released into Area A from the experimental 2021 outplanting. Approximately 15,000 more flowerheads are estimated to have been released from the 2022 outplanting, thus contributing to the HMP goal.

The HMP has three goals that apply to the coastal prairie and are not specific to the SCT (which is addressed in the previous section). Goal 2 seeks to maintain a functioning coastal prairie through the reintroduction of grazing and the resultant disturbance regime. Objective 2A identifies implementation of the grazing program by 2014 and Objective 2B requires that the grassland achieve residual dry matter (RDM) measurements within a range appropriate for SCT growth. Seasonal grazing was continued in the northern portion of Area A, Area C and Area D in 2022 and many areas of the grazed areas were in the red and green RDM range, thus, meeting Objectives 2A and 2B. The City elected to continue another year of not grazing the southern portion of Area A in 2022 to accommodate the continued SCT Experimental Outplanting Program, as the outplanting experiments would have been adversely affected by cattle activity. The southern portion of Area A was periodically mowed as an alternative grassland/prairie management action.

Observations and BMP implementation monitoring of the grazing program in the northern portion of Area A and Areas C and D were implemented concurrent with grazing. The protocol for monitoring of the grazing program in 2022 are outlined in the HMP and include observations of feed and water troughs (3 times during grazing), adherence to BMPs (see Section 3.5.6 in HMP), and documenting residual dry matter (once a year in September or October). The following BMPs, as identified in the HMP[7] , were implemented and monitored:

- Temporary fencing was not needed around the seasonal wetland within Area A or its 50-foot buffer, as no cattle were in this pasture in 2021. In previous years grazing was allowed in the seasonal wetland area between March and July.

[7] See page 68 (Section 3.5.6) of Arana Gulch HMP.

- Water troughs were placed adjacent to grazing area gates and away from the top of steep slopes; the troughs were located outside of sensitive areas (occupied SCT areas/seasonal wetland). No supplemental feed was used in 2022.
- The 2022 grazing season was in a significantly below average rainfall year and the number of animals on site did not result in any erosion. There was no significant volume of cattle waste due to the relatively low number of animals on site during the grazing season.
- The City and the grazing contractor conducted regular visual inspections of fence lines to ensure cattle remained within the designated grazing area in 2022. There were no incidents of cut fence lines during the grazing season. The City and the grazing contractor monitored the fences during the grazing season; at no time did any cattle escape the grazing area.
- During rainfall events, the City conducted visual inspections (by foot) to document whether there was any rilling or other erosion within and from the grazing area. No erosion issues were detected in 2021. There was no need to install erosion control measures, such as straw wattles, to prevent any accelerated or channelized runoff toward steep slopes.
- The grazing contractor avoided motorized vehicle use during rainy season/soil saturation.

The observations of SCT in 2022 occurred in the southern portion of Area A and a small fenced portion of Area C. Area A and the small fenced portion of Area C were not subject to grazing in 2022 and occurred in an area identified with a red RDM level.

5.5.1 Status of SCT Recovery, Years 1-9

At the conclusion of the 9th year of implementation of the HMP, it can be shown that the SCT population has achieved the HMP threshold of 348 plants. This threshold has taken many years and pathways and its continued success is not assured without continued human intervention and site management.

As presented in **Table 8,** the first five years of HMP implementation were focused on grassland management (through cattle grazing) to create suitable habitat conditions for SCT seed germination and plant growth. By Year 6 it was determined that the extant seedbank was too depleted and continuing the grazing program, by itself, was not going to meet the required HMP goals for the species. Habitat management actions were then re-focused on species recovery. Recovery actions included on-site seed collection, seed increase, plant propagation, experimental SCT outplantings, and experimental direct seeding. These actions were implemented over a period of three years, resulting in over 2,000 SCT plants installed and one plot hand-seeded. By the end of 2022, approximately 1,700 SCT plants had flowered at Arana Gulch, comprised of 200 plants from the current-year outplanting and 1,500 plants from natural seed recruitment in previously-planted plots.

These early stages of SCT recovery have been successful; however, many habitat management questions remain. The next stage of species recovery needs to determine the management that can maintain and/or increase both the SCT population and its areal extent into the future. There are questions on optimum SCT seedbank density and viability, optimum grassland management techniques, as well as the need for long-term seed collection, plant propagation, outplanting, and direct seeding.

Population Maintenance Seedbank Density

- Determine if planting container-grown SCT is a viable method to increase population and maintain/increase soil seedbank.
- What is required seedbank density for long-term preservation of SCT on site; how often should SCT outplanting occur to reach desired seedbank density?
- How much seed production is needed each year to maintain desired seedbank density?

Grassland Management for SCT

- Effect of mowing/grazing on SCT population, including how many above-ground SCT plants are needed to maintain (or increase) SCT population, taking into account herbivory and/or plant/seed losses
- Amount of bare ground needed in winter for SCT seed germination
- Optimum cropping height for SCT to increase branching and subsequent flower and seed production
- Evaluate vectors for seed dispersal and SCT establishing outside of planted plots.

Table 8. Status of SCT Recovery, Years 1-9

Year	Action	Rationale	Results and Recommendations
Years 1-5 (2014-19)	Seasonal grazing, Jan – July (typical)	HMP premise was that there was viable SCT seed in the soil seedbank and that grazing would be suitable management to create soil disturbance and reduce weed cover to stimulate germination of the soil seedbank.	Grazing had no obvious effect on expression of extant SCT seedbank, as SCT occurrences were limited to old, pre-grazed scrape plots. Determination was made that extant seedbank is too depleted for species to recover with just grazing management. In Year 5, it was determined that re-introduction of SCT seed into the habitat is required for species recovery.
Years 5-6 (2018-19)	Collection of on-site SCT seed	Seed increase at UCSC Greenhouses for later outplanting to re-introduce SCT seed into the system	Collection of 24 seed heads from extant plants. Successful seed increase, generating approximately 10,000 seeds, in storage at UCSC Greenhouses. In Year 6, decision was made to conduct experimental SCT plant propagation for outplanting in Year 7.
Year 7 (2020)	Experimental Greenhouse Propagation and Outplanting of SCT	Successful growth of SCT in nursery. Experimental outplanting of 28 SCT Plugs in Area C	Survival of 6 SCT; approx. 200 flowerheads (FH) produces with seed released onto site (Area C). Decision made to increase SCT plant propagation and outplanting for Year 8, using stored seed.
Year 8 (2021)	Nursery Propagation and Experimental Outplanting of SCT	Propagation and outplanting of 1,000 SCT plugs in Areas A, C, and D. Macro-plots used to evaluate various methods of mulch, with and without grazing, and control	60% survival of outplantings in Area A and C; 0% survival in Area D; approx. 52,000 FH with seeds released in Area A and Area C. No natural recruitment of SCT in previous year outplanting site (Area C). Decision made to repeat SCT plant propagation and outplanting for Year 9, using stored seed.
Year 9 (2022)	Nursery Propagation and Experimental Outplanting of SCT Experimental Mowing of Previously Year Plots (Area A)	Outplanting of 1,400 SCT Plugs in Areas A and C, using macro-plots to evaluate various methods of mulch and control. No grazing. Experimental seeding in Area A. Previous year plots in Area A subject to seasonal mowing February – May.	20% survival of outplantings in Area A And Area C; approx. 15,000 FH and seeds released in Area A and Area C. Natural recruitment of SCT in previous year outplanting plots in Area A (1,500 SCT; approx. 4,500 FH with seed released). Mowing caused branching and more flower/seed production on SCT plants tall enough to cut. Decision made to repeat SCT plant propagation and outplanting for Year 10, using stored seed.
Year 10 (2023)	Nursery Propagation and Outplanting of SCT (scheduled) Mowing of Previously Year Plots (Area A) (scheduled)	Outplanting of 1,000 SCT Plugs in Areas A and C, using wood chip mulch plots. No grazing. Previous year plots subject to seasonal mowing February-Ma.	To be reported in Year 10 (2023) Annual Report

Table 9. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 9 (2022) Results	Objective Met?
Goal 1. Maintain a viable SCT population at Arana Gulch						
Objective 1A. Increase number of aboveground SCT to at least the 2006 level by 2015 (Note: 2006=348 plants in Area A)	# of above ground SCT plants	Yearly in Aug./Sept.	Increase	2014	186 planted SCT survived in Area A in 2022 and approximately 1,500 recruited from 2021. 24 planted SCT survived in Area C in 2022	Yes
Objective 1B. Expand the distribution of SCT beyond Area A within 3 years (Note: Year 3 = 2017)	Distribution of SCT plants	Yearly in Aug./Sept.	Expansion	2017	24 planted SCT survived in Area C in 2022	Yes
Goal 2. Reintroduce grazing to restore a disturbance regime that maintains functioning coastal prairie						
Objective 2A. Implement the Grazing Program by 2014	2A.1 Observation of feed and water troughs	3x during grazing	Stable	2015	City monitored water troughs in 2022	Yes
	2.A.2 BMP implementation monitoring	3x during grazing	Stable	2015	City monitoring plant height and other BMPS through grazing season	Yes, BMPs were implemented
Objective 2B. Maintain RDM within a range that allows SCT to complete its lifecycle and protects coastal prairie grassland from erosion (700-1,500 lbs./acre)	Residual dry matter (RDM)	Yearly in Sept./Oct.	Maintain within range	2017	RDM measured in October; most areas in C and D were at target	Yes, some areas were above target; SCT detected in target areas
Goal 3. Minimize detrimental effects of high non-native plant cover and restore coastal prairie species diversity and habitat function						

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 9 (2022) Results	Objective Met?
Objective 3A. Reduce canopy height during the basal rosette stage for SCT (Nov. – April) from the baseline level to 2-3 inches[8] by 2015	Average canopy height	3x during growing season	Reduction	2015	Canopy heights were at target in Area A and C in February, within Areas C and D and southern portion of Area A in April; all areas in December.	Partially, cattle grazing reduced canopy height in northern portion of Area A and Areas C and D.
Objective 3Bi. Reduce cover of non-native species in the coastal prairie from the baseline to one more representative of a reference functioning coastal prairie system by 2020	Percent cover of non-native plants	Yearly at peak growth in April	Reduction	2020	Mowing in Area A was only conducted twice and plant cover was not assessed. Non-native cover has not been reduced by grazing.	No, cattle grazing has altered non-native composition somewhat but non-native species dominate the plant communities. Additional monitoring in coastal prairie areas is proposed in 2023 to better document these areas.
Objective 3Bii. Cover of native perennial grasses (NPG) increases from baseline levels to one more representative of a reference intact coastal prairie system"	Percent cover of native perennial grasses	Yearly at peak growth in April	Increase	2020	Grazing exclusion in Area A appeared to allow several NPG species to flourish	No, cover of NPG remains low. Additional monitoring in coastal prairie areas is proposed in 2023.
Objective 3C. Increase cover of native species from baseline levels to one more representative of a reference functioning	Percent cover of native plants	Yearly at peak growth in April	Increase	2020	Cover of native species remains at <1%. Reference systems have range of 20-40% cover as per Holl and	No, cover of native species has not increased significantly and native plants are encountered very infrequently.

[8] AMWG reduced threshold from 0.5 m (1.6 feet) to 2-3 inches in January 2015

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 9 (2022) Results	Objective Met?
coastal prairie system by 2020.					Reed (2010), Hayes and Holl (2003).	
Objective 3D. Increase native species richness from baseline levels to one more representative of a reference functioning coastal prairie system by 2020.	Native species richness	Yearly at peak growth in April	Increase	2020	Species composition was not assessed, but few additional native species have been detected.	No. Additional monitoring in coastal prairie areas is proposed in 2023.
Objective 3E. Increase cover of bare ground in the coastal prairie from baseline level to a level that enables SCT plants to complete their lifecycle by 2015.	Percent bare ground	3x during growing season	Increase	2015	Grazing was excluded in Area A and bare ground was not assessed.	Yes, a trend of increased bare ground has been detected in Areas A and D.
	Permanent photo points with GPS location and compass direction	Before, during and post construction and then yearly at peak growth	Improving	2015	Photo points established in April 2015, approximately 8 weeks after initiation of cattle grazing.	Yes, photo points were re-sampled in 2022
Goal 4. Maintain a genetically and demographically viable soil seed bank in perpetuity.						
Objective 4A. Increase the density of viable ray achenes in the soil seed bank from baseline in the first 3 years	Seed bank density (#of viable ray achenes)	Every 5 years	Increase	2015	No viable seed in Areas B and C; unlikely to have viable seed in Area D; viable seed in Area A and C from outplantings	Seedbank not reassessed; however, recruitment from the 2021 SCT outplanting was occurred in Area A

5.6 Proposed Actions for 2023

The following actions and expected timing are proposed for 2023:

- Continue the cattle grazing program in the northern portion of Area A and in Areas C and D, beginning in January 2023, with grazing extending to June/July, depending upon presence of SCT flowers and forage. Consider implementing interim grassland management actions (i.e., focused mowing or other management) in winter if cattle grazing is delayed and canopy height levels are above the target objective of 2-3 inches (5-8 cm) between the months of November thru April. Evaluate need to mow in fall to reduce canopy height.
- Implement year-round experimental mowing in the southern portion of Area A concurrent with implementation of the 2022 SCT Experimental Outplanting Plan. Periodically mow grassland to keep canopy height below 10 inches, with the goals of removing seed heads of non-native grasses.
- Monitor grazing operation and implement the HMP-designated BMPs (see Section 3.5.6 in HMP and bullet list above) (January– June 2022).
- Mow delineated areas outside the grazing areas (May/June). Conduct pre-mowing surveys for breeding birds and locally unique flora.
- Continue to implement invasive plant species control as per the IWWP, focusing on removal/control of the following species:
    - Himalaya blackberry (*Rubus ameniacus)*
    - Cotoneaster *(Cotoneaster sp.)*
    - French broom (*Genista monspessulana)*
    - Velvet grass (*Holcus lanatus)*
    - Thistles (*Cirsium sp., Carduus sp., Silybum marianum)*
    - Medusa head (*Elymus caput-medusae)*
    - Stinkwort (*Dittrichia graveolens)*
- Using soil sampling test data evaluate soil deficiencies that may affect the growth of SCT and other native plant species.
- Review results of prior outplanting plots for SCT seed expression. Consider additional research to address questions on population maintenance and seedbank density.
- Conduct out-plantings of SCT seedlings in January/February 2023, using plants grown at UCSC Greenhouses, as per the 2023 SCT Experimental Outplanting Plan.
- Conduct outplanting of native grass plugs in Area A to increase native plant cover.
- Conduct census for SCT and monitor plant cover at occupied sites.
- Collect SCT seed if there are more than 50 plants; store seed for seed increase, storage, and possible out-planting, if needed.
- Monitor plant cover, canopy height, species richness, and bare ground at permanent transects and compare data to previous years and HMP desired direction of change (April/May); conduct additional monitoring in the mapped coastal prairie of Area A
- Document canopy height three times a year: February, April/May, and December.
- Document RDM in September/October.

- Document amount of bare ground in SCT occupied areas in December (SCT germination period).
- Evaluate and update, as needed, the draft sub-management area map and develop/finalize specific performance targets for percent cover of native species, nonnative species and bare ground, and species richness for coastal prairie that will be used to determine whether HMP objectives have been met. In the absence of acceptable data on reference coastal prairies, the AMWG may use these three years of baseline data and a first year of monitoring data under grazing in April 2016 to begin refining the objectives under Goal 3.
- Document site conditions from the permanent photo-points.

6. Hagemann Gulch Riparian Woodland Management Area

Bridge and trail construction were completed in 2014 and erosion control and wildlife protection measures were implemented, consistent with Goal 3 of the HMP. Historic "Rose of Castille" bushes were relocated to City Hall in 2013, consistent with Goal 5 of the HMP. A riparian revegetation plan was prepared and approved by CDFW to compensate for impacts of the bridge project. Mapping and identification of invasive, non-native plant species was completed in 2017.

6.1 Management Actions

6.1.1 Integrated Pest Management (IPM)

In summer 2022 the City's Summer Youth Trail Program crew did some weed control (removal of Himalaya berry) within Hagemann Gulch along the Marsh Vista Trail, as shown in **Figure 38**. The extent of invasive plant species was mapped in the management area in 2017 as shown in **Figure 39.**

Figure 38. Removal of Himalya berry from Hagemann Gulch

6.1.2 Fire Hazard

No fire hazard management actions were implemented in 2022.

6.1.3 Wildlife Protection

If necessary, prior to the implementation of vegetation management actions, conduct surveys for nesting birds by qualified biologist.

6.1.4 Appropriate Uses

In 2022, the City monitored visitor use activities in this area. Police and City maintenance staff periodically patrolled open space activities in and around the gulch for transient encampments and other illegal activities. Encampments were removed as needed.

Figure 39. Invasive Plant Species mapped in Hagemann Gulch Management Area in 2017

6.2 Monitoring and Performance Evaluation

6.2.1 Monitoring Methods and Results

No actions.

6.2.2 Evaluation of HMP Goals

Table 13 presents a summary of the biological variables monitored, the Year 9 (2022) values, and the desired direction of change.

The HMP has a goal to seek funding to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in Hagemann Gulch (Goal 1, Objectives 1A, 1B, and 1C). No active removal and control of invasive, non-native plant species was implemented in 2022.

Goal 2 (Objective 2A) of the HMP for this management area identifies the need to reduce the fire hazard within the gulch. The objectives include reducing the cover of woody thickets (comprised of invasive, non-native species) and prioritize the removal of eucalyptus trees, as feasible. Construction of the multi-use bridge resulted in the removal of a several eucalyptus trees near the western abutment and from the central gulch; however, several large stands of eucalyptus trees remain. As noted above, the City began implementation of the IPM plan for the removal of the woody invasive plant species, consistent with this objective.

Protection of wildlife habitat features is a goal of the HMP (Goal 3). This goal and it associated objectives were met concurrent with construction of the trail and the bridge over Hagemann Gulch in 2014. Objective 3A requires the identification and protection of San Francisco dusky-footed woodrats with the bridge construction zone (within 25m of the bridge). No woodrat nests/houses were documented within the construction zone. No further action is required; however, the City will continue to search for nests when work is performed in the area. Objective 3B requires monitoring for sensitive bird and bat roots and/or nests occurring within 25m of the Hagemann Gulch bridge, with monitoring and protection of such resources for 3-5 years post-construction. The 2013 bat survey found that the trees in the area provide only foliage roosting habitat. No cavities or crevices were found to support sensitive bat roosts. As the baseline is zero, no additional monitoring is required; however, the City could elect to monitor bat roosts to document if there is an increase in bat roosting after the trail and bridge project. Similarly, the 2014 nesting bird survey was negative for sensitive bird nesting. As the baseline is zero, no additional monitoring is required; however, the City could elect to monitor the area for sensitive bird nesting to document if there is an increase in such nesting after the trail and bridge project. These objectives are no longer applicable as part of the plan.

Goal 4 for this management area requires observing uses in Hagemann Gulch after trail and bridge construction and to determine if there are changes in use from site improvements. In 2021 police periodically patrolled the greenbelt to detect appropriate and inappropriate uses;

off-leash dog use and periodic illegal encampments were noted in/around the bridge and other areas in/around the gulch. Objective 4A has been met.

Goal 5 of the HMP is to preserve the "Rose of Castille" bushes located near the Hagemann Gulch bridge construction area. To preserve these shrubs, the City elected to relocate them to City Hall in 2013, in consultation with the City Arborist. The shrubs are in excellent condition and Objectives 5A and B have been met.

6.3 Proposed Actions for 2023

The following actions and expected timing are proposed for 2023:

- Monitor appropriate uses within Hagemann Gulch through periodic police patrols (January– December 2023).
- Continue to remove and control invasive, non-native plant species within the management area, as resources allow.

Table 10. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 9 (2022) Results	Objective Met?
Goal 1. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in Hagemann Gulch					
Objective 1A. Use a combination of methods to reduce the cover of non-native invasive woody plant thickets from baseline levels in the first year.	Non-native invasive woody plant cover	Before and after every removal effort	Decrease	Eucalyptus trees removed near western bridge abutment and along bridge sightline	Partial compliance; some eucalyptus trees removed but some stands remain on City property
Objective 1B. Monitor re-sprouting of removed vegetation and recruitment of new seedling on a regular basis, for at least 5 years after initial removal efforts.	Re-sprout and seedling emergence of target weeds	After every removal effort	Decrease	Minor re-sprouting of eucalyptus branches from trees limbed for the bridge placement	Yes, re-sprouts were monitored; re-sprouts included in IPM plan that was developed in 2017
Objective 1C. If passive restoration is not adequately controlling erosion, use revegetation with appropriate native species or other cultural methods to limit the amount of exposed soil and the potential for re-infestation and erosion.	Area of exposed soil (bare ground)	After every removal effort	Decrease	No action; no erosion detected	Yes, no erosion has been detected; no actions needed at this time
Goal 2. Reduce the fire hazard within Hagemann Gulch					
Objective 2A. Reduce the cover of woody thickets as per Objective 1A to reduce overall fire risk.	Non-native invasive woody plant cover	Before and after every removal effort	Decrease	No action in 2022	Partial compliance; non-native thickets have been

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 9 (2022) Results	Objective Met?
					controlled within management area
Objective 2B. Prioritize the removal of eucalyptus trees where feasible.	Area occupied by eucalyptus	After every removal effort	Decrease	Eucalyptus trees removed near western bridge abutment and along bridge sightline	Partial compliance; some eucalyptus trees removed but some stands remain on City property
Goal 3. Protect wildlife habitat features in Hagemann Gulch					
Objective 3A. The number of SF dusky-footed woodrat nests occurring within Hagemann Gulch bridge construction zone will be identified and the nests protected.	Number of SF dusky-footed woodrat nests within 25m of Hagemann Bridge construction zone	Yearly, if observed prior to construction.	Stable	None detected within construction area Hagemann Gulch bridge; unknown number within 25m of bridge	N/A. No nests were identified prior to construction
Objective 3B. Monitoring for sensitive bird and bat roosts and/or nests occurring within 25 m of the Hagemann Gulch bridge construction zone will be identified and protected and continued for 3-5 years post-construction.	Sensitive bird or bat detections within 25m of Hagemann Bridge construction zone	Yearly, if observed prior to construction.	Stable	None detected within 25m Hagemann Gulch bridge	N/A. No nests were identified prior to construction

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 9 (2022) Results	Objective Met?
Goal 4. Increase appropriate uses in Hagemann Gulch					
Objective 4A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter.	Observation of infrastructure conditions	4x per year	Stable	Stable	Park staff periodically inspected the area in 2021; issues of illegal encampments were documented in close proximity to the bridge
Goal 5. Preserve the "Rose of Castille" historic roses					
Objective 5A. Relocation of the roses will occur only if no other alternative is feasible for development of the Hagemann Gulch Bridge. Any relocation will be done in the vicinity of the existing trees, in consultation with the City Arborist.	Presence of Rose of Castile	Yearly in June/July	Stable	Shrubs relocated to City Hall	Yes, roses were located to City Hall to ensure regular maintenance and care
Objective 5B. Address the public education benefits of identifying the Rose of Castille and providing interpretative panels.	Presence of Rose of Castile	Yearly in June/July	Stable	Decision was made.	Staff determined that identifying them would expose them to potential theft and vandalism. No additional action is necessary.

7. Arana Gulch Creek Riparian Woodland and Wetland Management Area

The Arana Gulch Multi-Use Trail including the causeway over Arana Gulch Creek was completed in 2014. This construction project required the implementation of erosion control, wildlife protection measures prior to construction, and revegetation of areas near the causeway consistent with construction permit conditions. Riparian revegetation was implemented in 2015.

7.1 Management Actions

7.1.1 Trail and Causeway Construction Project

In 2014, the City prepared a riparian revegetation plan which was reviewed by the AMWG and approved by CDFW to compensate for impacts to native trees and shrubs by the causeway construction. Three areas were designated for revegetation. In 2014, Area A, the slope by the causeway, was hydroseeded with sterile seed as per the CDFW-approved revegetation plan. Twenty dormant willow cuttings were installed at the toe of the slope in December 2014. In Area B, located near the northwestern causeway abutment, 40 creeping wild rye (*Elymus triticoides)* were planted (March 2015). In Area C, a flat area north of the causeway, was planted with 40 creeping wild rye (*Elymus triticoides)*, 16 California rose (*Rosa californica)*, 16 mugwort (*Artemisia douglasiana)*, and 3 coast live oak (*Quercus agrifolia)* were planted (March 2015). The plantings were installed by City staff and volunteers recruited by the RDCSCC. The City maintained these plantings, implementing periodic weeding and hand-watering; however, plant survival of the willows in Area A was low and the area was replanted in winter 2016. Plant survival of the creeping wild rye was low in Area B; therefore, the City elected to install additional native shrubs in Area C, where growing conditions were considered to be better. Roses for the Hagemann Gulch Bridge project were also planted in this area. Additional willow pole cuttings (25) were installed along the slope above Arana Creek to replace previous plantings that died.

7.1.2 Wildlife Protection

Prior to construction of the Arana Gulch Multi-Use Trail, measures were implemented to avoid impacts to wildlife. These measures were completed in 2014. No additional management actions were implemented in 2022.

7.1.3 Integrated Pest Management (IPM)

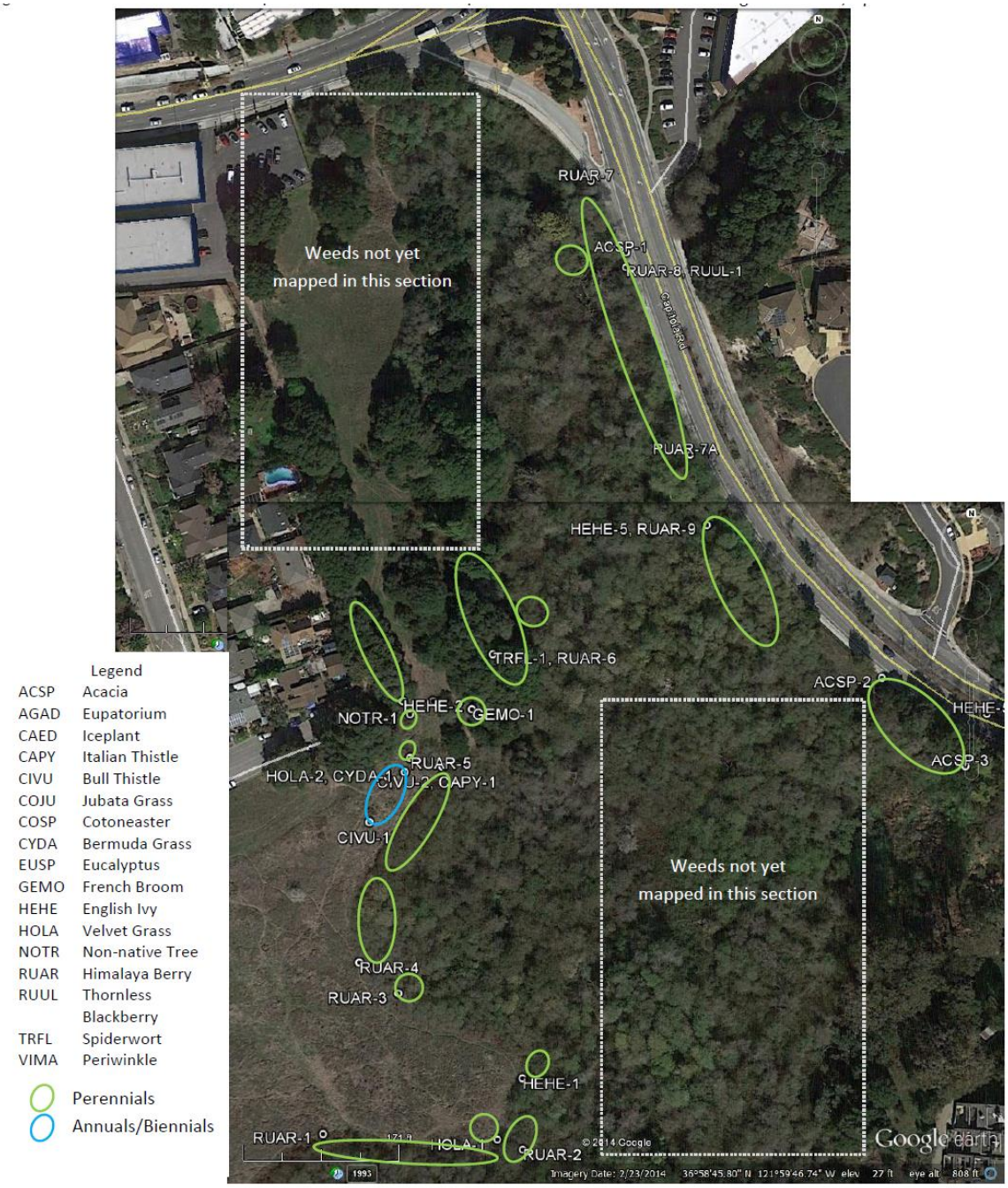
In 2014 and 2015, mapping of invasive weeds within this management area was initiated. The mapping is to guide future management activities for species removal/ control. The approximate size, density of plants (dense, moderate, and sparse) and the location of each non-native invasive species patch was documented using GPS and mapped on aerial photos. A map of data collected, and updated in 2019, is presented in **Figure 40A-D**.

Invasive non-native plant species documented to date in the management area include: (*Acacia spp.)*, perennial pepperweed (*Lepidium latifolium*), eupatorium (*Ageratina adenophora)*, ice plant (*Carpobrotus edulis)*, Italian thistle (*Carduus pycnocephalus)*, bull thistle (*Cirsium vulgare)*, jubata grass (*Cortederia jubata)*, cotoneaster (*Cotoneaster sp.*), Bermuda grass (*Cynodon dactylon*), eucalyptus (*Eucalyptus sp.)*, French broom(*Genista monspessulana*), English ivy (*Hedera helix*), velvet grass (*Holcus lanatus*), Himalayan blackberry (*Rubus ameniacus*), thornless blackberry (*Rubus ulmifolius)*, spiderwort (*Tradescantia fluminensis)*, and periwinkle (*Vinca major)*.

In 2022, the City continued closure of the ad-hoc path along Arana Creek to discourage public access to the natural area. Straw wattles were maintained at the northern end of the trail to reduce run-off from the Coastal Loop Trail from entering Arana Creek.

Clean-ups from illegal camping activities were performed to remove trash and waste, primarily from the woodland areas. In some instances, vegetation was removed to improve the line-of-sight from the public right-of-way into the area, deterring illegal activity and improving law enforcement patrolling and monitoring. Extensive trash and waste removal occurred near the intersection of Capitola Road and Soquel Drive. Unfortunately, the activities necessitated more staff time and resources to be diverted to daily trash and waste removal.

In 2020, Santa Cruz County Department of Public Works repaired the culvert where Capitola Road crosses Arana Creek. The project included riparian restoration plantings in the construction staging areas and along Arana Creek, which are maintained by the County of Santa Cruz.



Arana Gulch Greenbelt – Location of Invasive Plant Species in Arana Creek Management Area
April, 2015 - Sheet 1 of 4

Figure 40A. **Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area**

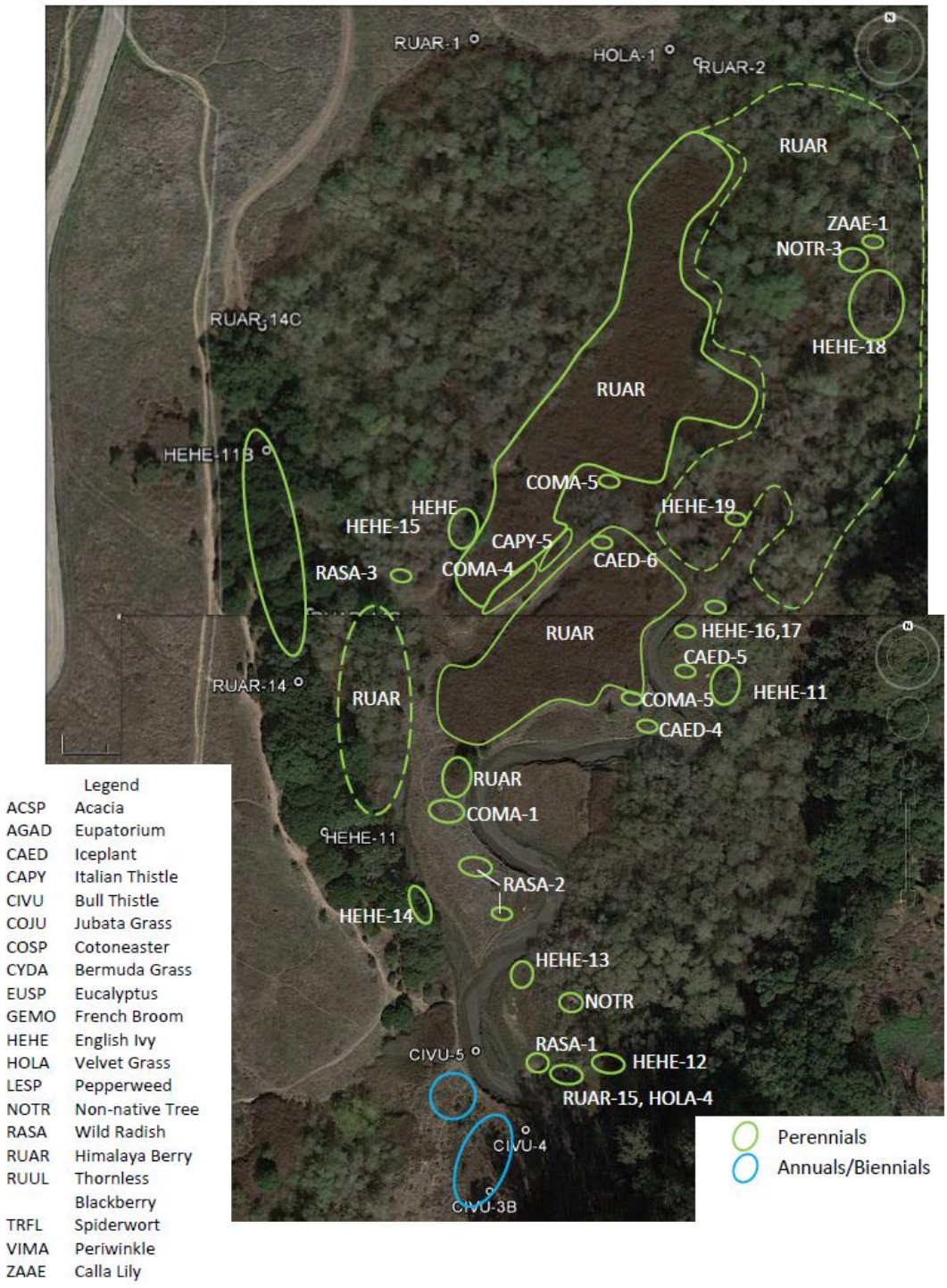


Figure 40B. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

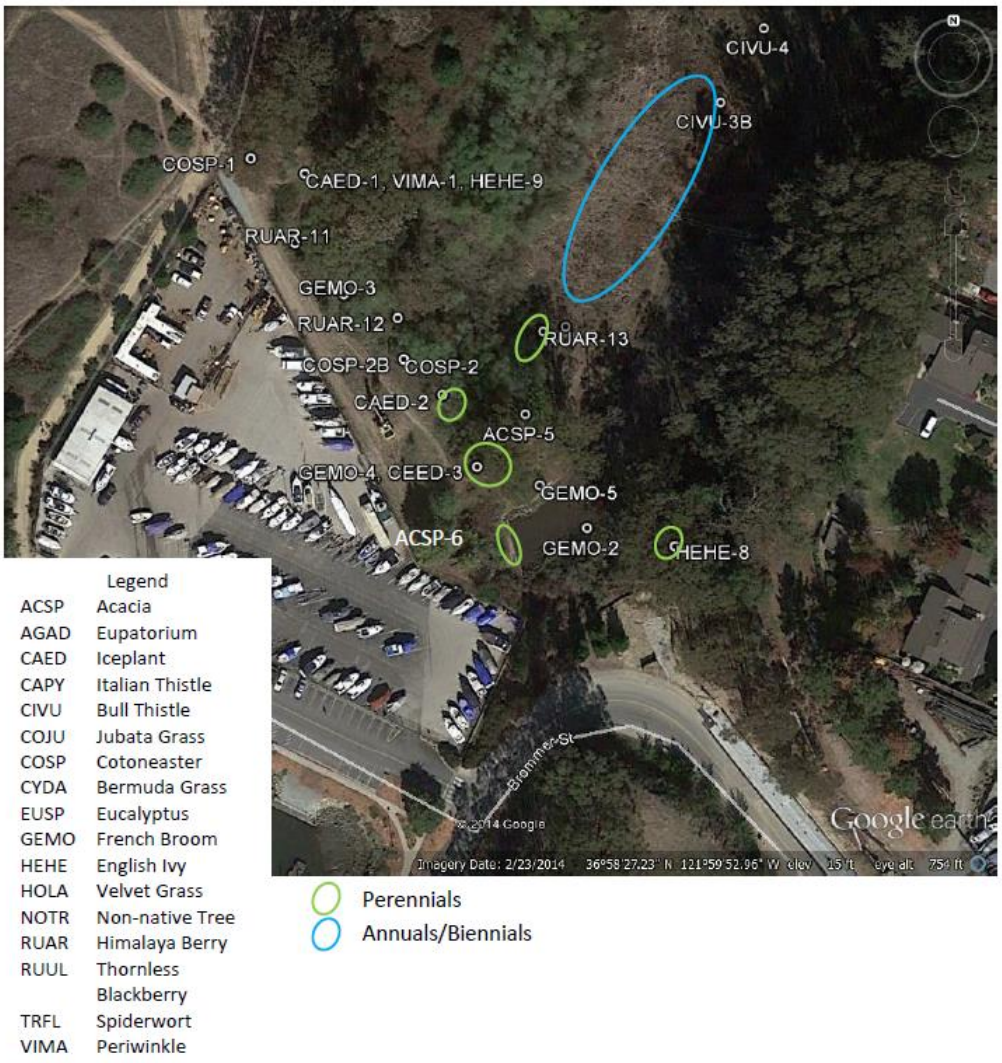


Figure 40C. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

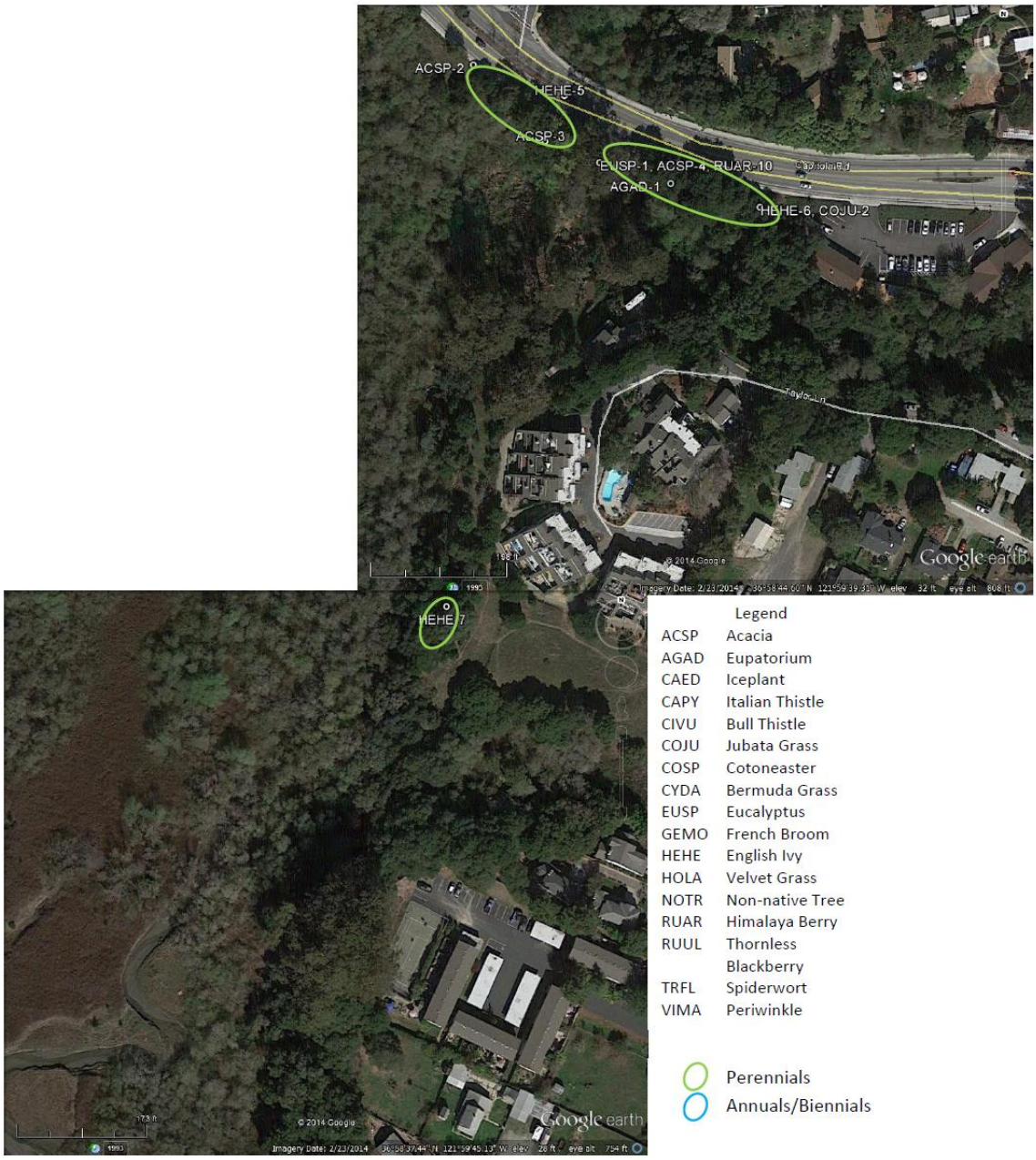


Figure 40D. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

7.1.4 Coordination with the RCDSCC

No actions between the City and the RCDSCC were conducted in 2022.

7.2 Monitoring and Performance Evaluation

7.2.1 Monitoring Methods

No monitoring was performed in 2022. Monitoring of the riparian revegetation areas was completed in 2020 (5-years).

7.2.2 Monitoring Results

None.

7.2.3 Evaluation of HMP Goals

Table 14 presents a summary of the biological variables monitored, the Year 9 (2022) values, and the desired direction of change.

The HMP has a goal to seek funding to reduce sediment and improve steelhead conditions within the Arana Gulch watershed (Goal 1 of HMP), a goal to stabilize the tidal reach of Arana Gulch Creek (Goal 2), and to restore the eroded gully on the greenbelt (Goal 3). To meet this goal, the City has conferred with the RCDSCC in previous years to discuss management activities within the watershed and within the greenbelt property. There was no active coordination in 2021.

Goal 4 is to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in the management area (Goal 4). The City continued to make progress on this task by removing occurrences of invasive, non-native plant species growing within the management area in compliance with goals of the HMP.

7.3 Proposed Actions for 2023

The following actions and expected timing are proposed for 2023:

- Be available to engage with the RCDSCC on their watershed and greenbelt projects, as proposed by the RCDSCC. (January– December 2023).
- Continue to remove and control occurrences of invasive, non-native plant species within the management area, as resources allow.

Table 11. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 9 (2022) Results	Objective Met?
Goal 1. Reduce sedimentation and improve steelhead habitat conditions within the Arana Creek watershed					
Objective 1A. High priority sediment-related projects identified in the Arana Creek watershed enhancement plan area implemented.	# of completed sediment-related projects with the RCDSCC	Yearly	Increase	No action in 2022.	No
Objective 1B. High priority steelhead habitat improvements identified in the Arana Creek watershed enhancement plan area implemented.	# of completed steelhead habitat improvement projects with the RCDSCC	Yearly	Increase	No action in 2022.	No
Goal 2. Stabilize the tidal reach of Arana Gulch Creek					
Objective 2A. Engage the RCDSCC Arana Gulch Working Group staff to attend targeted AMWG meetings to identify possible solutions for the tidal reach of Arana Gulch Creek.	RCDSCC attendance at AMWG meetings	Yearly	Increase	No action in 2022.	Yes. City will continue to coordinate with RCDSCC to meet goals, as projects are proposed
Objective 2B. Work with the RCDSCC staff to obtain funding to design and implement a bank restoration project that reduced head cutting and bank erosion	Funding level for the tidal reach restoration	Yearly	Obtain/increase	No action in 2022.	No

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 9 (2022) Results	Objective Met?
along the tidal reach of Arana Gulch Creek.					
Goal 3. Restore the eroded Greenbelt Gully					
Objective 3A. Work with the RCDSCC staff to pursue funding for the Greenbelt Gully restoration project.	Funding level for the Greenbelt Gully project	Yearly	Obtain/increase	No action in 2022.	No
Goal 4. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of non-native species in the Arana Gulch Creek Management Area					
Objective 4A. Remove and reduce the cover of non-native invasive species in the riparian woodland relative to baseline conditions including: black acacia found near the culverts, dense thickets of Himalayan berry, scattered French broom, tall white top, and periwinkle.	Non-native invasive woody plant cover	Yearly	Decrease	Himalaya berry removed from near the Marsh Vista Trail	Partial, invasive, non-native plant species are being removed and controlled
Goal 5. Provide education opportunities and increase appropriate uses					
Objective 5A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter.	Observation of infrastructure conditions	4x per year	Stable	Conditions were monitored.	First year of monitoring was 2015

8. Conclusions from Year 9 and Recommendations for Year 10 (2023)

8.1 Conclusions from 2022

The City continued implementation of the HMP in 2022 (Year 9). Actions were conducted in all of the management areas. Cattle were grazed in the grassland in the northern portion of Area A, and Areas C and D for SCT and overall grassland management. The southern portion of Area A was mowed for grassland/prairie management. A 2nd year of experimental SCT outplanting plan was implemented, with SCT outplantings installed in Areas A and C. The surviving SCT outplantings in Areas A from 2021 produced over 50,000 flowerheads with seeds released into the soil seedbank and resulting in approximately 1,500 SCT plants to naturally establish in the plots in 2022. The SCT plants that survived the 2022 outplantings in Area A and Area C produced over 15,000 flower heads with seeds released into the soil seedbank. There was effective and efficient coordination between the City and the AMWG in 2022 as management actions and monitoring protocols were discussed. The City communicated with users of the greenbelt on the cattle-grazing and provided police patrols to encourage/enforce regulations and deter vandalism and illegal camping.

8.1.1. Coastal Prairie/Santa Cruz Tarplant Management Area

Within the Coastal Prairie/SCT Management Area cattle grazing occurred in the northern portion of Area A and Areas C and D from December 2021 through August 2022. Implementing cattle grazing is in compliance with the HMP. Grazing was successful in maintaining the desired canopy height in Areas C and D. Periodic mowing was used in the southern portion of Area A for grassland management and this management action was compatible with the SCT Experimental Outplanting actions. Monitoring of plant cover and residual dry matter was implemented and some objectives were met in some areas for these variables. Objectives of the HMP relating to improving the coastal prairie to a more functioning system have not yet been met; however, additional monitoring transects are proposed in Area A to better capture coastal prairie plant composition and distribution. Grassland management actions were implemented outside of Areas A, C, and D. Mowing of the perimeter was conducted in June. Management of the grassland is required under the HMP; therefore, the City is in compliance with the HMP.

A census of SCT was conducted in 2022. No SCT plants were documented from the historic SCT colony sites; however approximately 1,535 SCT plant naturally established in the 2021 plots and approximately 210 of the 2022 SCT outplantings survived to flowering and seed set. The HMP objective of reaching 348 plants was met in 2022.

8.1.2. Hagemann Gulch Riparian Woodland and Arana Gulch Creek Riparian Woodland and Wetland Management Areas

Management actions were conducted in the Arana Creek Riparian Woodland and Wetland Management Area and the Hagemann Gulch Riparian Woodland Management Area in 2022, by way of police patrols, City staff actions to monitor visitor uses, and volunteer actions to remove invasive, non-native plant species.

8.1.3. Adaptive Management and Public Outreach

The City engaged with the AMWG in 2022 through field and web-based meetings in three meetings (January, Marsh and November) as well as via email correspondence. The City received input from the AMWG on management actions and implemented the requested management actions. The City maintained a web page on the City's website for public outreach and responded to comments from the public and the AMWG on ways the site could be improved. These actions were in compliance with the HMP.

8.1.4 Schedule and Budgeting

The City established a line item in their operating budget for Arana Gulch and allocated funds for fiscal year July 1, 2021 to June 30, 2022 and fiscal year July 1, 2022 to June 30, 2023. The City established a maintenance position for the greenbelt, which became effective in January 2016. Establishing funding for management actions is in compliance with the HMP.

8.2 Recommendations for 2023

The City will discuss with the AMWG recommendations for management actions for 2023 at a minimum of two meetings in 2023. Depending upon COVID-19 pandemic restrictions, these meetings may be field-only and/or virtual (web-based) meetings. The AMWG will provide input to the City on actions based on management priorities. The following summary of actions is preliminary and may be revised based on input from the AMWG and available funding.

8.2.1 Coastal Prairie/Santa Cruz Tarplant Management Area

HMP activities for 2023 (Year 10) is the continuation of seasonal cattle grazing within portions of the prairie/grassland. The City will continue to implement the Stocking and Work Program in the northern portion of Area A and Areas C and D. Periodic grassland mowing will occur in the southern portion of Area A, concurrent with implementation of the SCT Experimental Outplanting actions. Management activities will include monitoring plant composition, plant cover and residual dry matter (RDM) within the grazed areas, grassland conditions along the permanent transects (including additional transects within mapped coastal prairie areas), documenting conditions from the permanent photo-stations, and continuing to remove and control high-priority invasive, non-native plant species. The City will consider implementing additional management actions if cattle grazing is delayed and canopy height exceeds the height limits established for the period November through April.

The City will also continue to implement seasonal mowing outside the grazing fences that are to be retained as grassland. A census of the SCT will be conducted in summer 2023. Naturally-occurring colonies, as well as recruitment of SCT plants from the outplanting plots, will be censused. Seed collection of SCT may occur depending on the SCT population and prior approval from CDFW. Plants grown at UCSC Greenhouses are scheduled to be installed within management areas in 2023. The City will consider implementing additional management actions to encourage SCT seed expression.

As stated in Chapter 5, the early stages of SCT recovery have been successful; however, many habitat management questions remain. The next stage of species recovery needs to determine the management that can maintain and/or increase both the SCT population and its areal extent into the future. There are questions on optimum SCT seedbank density and viability, optimum grassland management techniques, as well as the need for long-term seed collection, plant propagation, outplanting, and direct seeding.

Population Maintenance Seedbank Density

- Determine if planting container-grown SCT is a viable method to increase population and maintain/increase soil seedbank.
- What is required seedbank density for long-term preservation of SCT on site; how often should SCT outplanting occur to reach desired seedbank density?
- How much seed production is needed each year to maintain desired seedbank density?

Grassland Management for SCT

- Effect of mowing/grazing on SCT population, including how many above-ground SCT plants are needed to maintain (or increase) SCT population, taking into account herbivory and/or plant/seed losses
- Amount of bare ground needed in winter for SCT seed germination
- Optimum cropping height for SCT to increase branching and subsequent flower and seed production
- Evaluate vectors for seed dispersal and SCT establishing outside of planted plots.

8.2.2 Hagemann Gulch Riparian Woodland Management Area

HMP activities identified for 2023 (Year 10) will be to monitor appropriate uses within the gulch concurrent with public use of the trail and bridge. City police will monitor use as per their regular patrol duties within the greenbelt. Invasive plant control measures will be continued, pending funding and staffing.

8.2.3 Arana Gulch Creek Riparian Woodland and Wetland Management Area

HMP activities identified for 2023 (Year 10) will be continued removal and control of invasive, non-native plant species.

8.2.4 AMWG and Public Outreach

In 2023 the City will continue to confer with the AMWG on adaptive habitat management activities throughout the year through scheduled meetings and group email correspondence. The AMWG will provide recommendations to the City on management priorities, grazing monitoring and public outreach. The City will solicit input from the public on HMP actions through the City webpage and through public input at the scheduled AMWG meetings.

8.2.5 Schedule and Budgeting

Table 15 presents a schedule for the HMP actions scheduled for 2023. The City has allocated funds for fiscal year July 1, 2022 to June 30, 2023 and funding for fiscal year July 1, 2023 to June 30, 2024.

Table 12. Timeline for Habitat Management Actions Proposed for Year 10 (2023)

	2023												2024
Task	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Coastal Prairie/Santa Cruz Tarplant Management													
Objective1. Santa Cruz tarplant census, measure plant cover and soil moisture; document bare ground (Nov/Dec); outplantings of grown SCT; seed collection.													
Objective 2. Monitor grazing program and variables; implement other grassland management actions (mowing)	✶												
Objective 3. Monitor baseline condition and photo points													
Hagemann Gulch Riparian Woodland Management													
Objectives 1 and 2. Implement IPM Plan and reduce fire hazard													
Arana Gulch Creek Riparian Woodland and Wetland Management													
Objectives 1, 2, and 3. Collaborate with RCDSCC													
Objective 4. Implement removal/control of invasive non-native woody plant species and target weeds													

	2023												2024
Task	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Objective 5. Infrastructure monitoring[9]													
Adaptive Management													
Objective 1. Conduct AMWG meetings													
Prepare Yearly Monitoring Report													
✶ Initiate grassland management actions if cattle grazing does not meet canopy height targets between November and April													

[9] Includes riparian revegetation and implementing year-long maintenance and monitoring.

9. References

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Appendix A AMWG Meeting Minutes, 2022

NOTE: Please see the separate Appendix document

A-1: AMWG Meeting Minutes for:

January 19, 2022
March 14, 2022
November 7, 2022

Appendix B Photo Monitoring

NOTE: Please see the separate Appendix document

Appendix C SCT Germination Study

NOTE: Please see the separate Appendix document