Arana Gulch Habitat Management Plan
City of Santa Cruz

Year 8 (2021) 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)

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April 2022

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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) and Year 7 (2020) Annual Reports. Actions implemented in Year 8 (2021) are described in this report. The AMWG provided input to the City during the implementation of the Year 8 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 8 (2021), the City continued to focus on improving the habitat 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. Outplantings of SCT were made in January and February and the plantings were field-checked for survival and seed production. SCT seed, collected on-site in summer 2018 under an agreement between the City and the University of California, Santa Cruz (UCSC), was used to grow additional plants for outplanting in January/February 2022 and for long-term seed storage. All of these actions taken by the City are to continue progress to meet the HMP objectives.

Some management and AMWG coordination activities continued to be affected by the second year of the global Coronavirus (COVID-19) pandemic. Field operations were not affected in 2021; however, procedures for summer and fall correspondence with the AMWG was altered to accommodate Center for Disease Control (CDC) guidelines, which included outside-only field meetings and virtual (Web-based) meetings.

The habitat management activities undertaken in 2021 are summarized below.

Master Plan Improvements

In 2020 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. Oak tree plantings were also 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 8 included seasonal grazing and seasonal mowing. 1,000 SCT plants were installed in Areas A, C, and D in January and February 2021; the majority of the plants were installed in three macro-plots in Area A. Due to the SCT outplantings, as well as to evaluate a different management method, Area A was periodically mowed and was not grazed. However, as per a grazing contract and Stocking and Work Program prepared in 2014, the City continued to contract with a local rancher for seasonal grazing within Areas C and D; grazing (cow/calf) occurred from February 5 to July 24. 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 2021 SCT outplantings, as well as previous-year created SCT management areas, were field checked for SCT plants. These areas include: a molasses bucket bare spot created in 2019 in Area A, scrape plots created in 2019 in Areas A, C, and D. A scrape plot created at the Arana Gulch – Agnes Street trail junction (small island) was field-checked for coast tarweed (*Deinandra corymbosa)* seed expression.

Grassland site conditions were documented in April 2021. Photo-documentation was also conducted in April. 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 2021. Within Area A, 21 naturally-occurring SCT plants were recorded. The 21 naturally-occurring SCT is an increase from 1 plant in 2020, yet a decrease from 50 plants in 2019 and 267 plants in 2018, yet an increase from 0 plants in 2017. The natural population was recorded at 18 plants in 2013, 4 plants in 2014, and 0 plants in 2015, and 35 plants in 2016, all in Area A. The experimental SCT outplantings were also censused as part of monitoring the effectiveness of the experimental program. In Area A, by October 2021, the survival rate of SCT outplantings averaged 63%. In Area C, 33 SCT outplantings (48% survival) (in cattle exclosure) survived. In Area D (grazed area), none one the 56 SCT outplantings survived to maturity. Increasing the SCT population to above the 2006 population level of 349 plants[1] is an HMP goal. The naturally-occurring SCT plants, combined with the surviving SCT outplantings, exceeds 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 done in 2021 due to the large amount of seed in storage at UCSC Greenhouses. In November 2021, the City entered into an agreement with UCSC Greenhouses to grow more SCT plants. Approximately 1,200 plants are being grown, with an outplanting scheduled for January/February 2022.

In compliance with the HMP and an Invasive Weed Work Plan (IWWP) prepared for the management area, City staff continued to remove occurrences of invasive, non-native plant species within the central prairie/grassland. The City continued to remove/control basal rosettes and flowering stalks from thistles. Expanses of wild mustard and radish were mowed to reduce seed production.

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 2021, 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. Due to the continued COVID-19 pandemic there were no volunteer work days.

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

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; however, some clean-up activities were hampered by COVID-19 restrictions.

Management Activities Proposed for 2022 (Year 9)

The following management actions are identified for 2022:

- Implement the 2022 SCT Habitat Enhancement Work Plan, which identifies seasonal mowing in Area A and additional experimental outplanting of SCT plants. Additional activities in this management area include monitoring plant composition and plant cover, implementing removal/control of invasive weed infestations, and documenting SCT seed expression in previously created experimental plots. Within SCT-occupied areas monitor the amount of bare ground present in December, which coincides with the germination period of SCT.
- Continue seasonal cattle grazing within 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.
- 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.
- Implement seasonal mowing in Area A. Periodically mow grassland to keep canopy height below 10 inches, removing seed heads of non-native grasses.
- 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. In addition, soil salvage areas created near Area C will be monitored for any expression of SCT.
- A census of SCT will be conducted in summer and early fall 2022, including natural colonies and SCT within 2021 and 2022 outplanted areas. 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. Monitor management plots created 2021 and 2022 in Areas A, C, and D for expression of SCT.

- The City will 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.
- The City will continue to work with the AMWG to form recommendations for improving trail sections to improve walkability and deter new trails from forming.
- The City will 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.
- The City will continue to confer with the AMWG on adaptive habitat management activities in 2022 through periodic meetings and group email correspondence.
- The City will coordinate with environmental groups, such as the Natural History Museum and Earth Stewards, 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 8 (2021) due to the urgency to revitalize the SCT population. The population of SCT at Arana Gulch has varied greatly in response to previous management actions; in some years the population increased, and in some years, it dramatically decreased. In 2021, the SCT population supported 21 naturally-occurring plants. This represents an increase in the natural occurring plants from 1 plant in 2020, yet a decrease from 2019 when the SCT population was 50 plants, and a further decrease from 267 plants in 2018, yet is an increase from 0 plants in 2017. An SCT outplanting experiment to introduce SCT seed into the site to aid in species recovery was designed in early 2021. 1,000 nursery-grown SCT plants were installed on-site in January and February. The plants were installed in three macroplots in Area A, seven smaller plots in Area D, and one plot in Area C. Survival rates varied according to the experimental planting treatment (control, mowing, sheetmulch with and without mowing); however, it was estimated that over 50,000 flowerheads were produced in plots in Area A, which resulted in the release of millions of SCT seed on-site. In Area C, survivors produced

almost 200 flowerheads. None of the outplantings in Area D survived to produce flowerheads/SCT seed.

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 2021, the AMWG provided input to the City during 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 8th 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) and Year 7 [2020]) 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.

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

Figure 1. Location Map

2.2 Project Purpose and Report Organization

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 2021 which is considered to be Year 8 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 9 (2022) 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] and Year 7 [2020]) 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 2021. Two meetings were held with the AMWG in 2021; the minutes from the June 22 and November 4 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 two meetings were conducted in two parts – a field meeting and then a computer-viewed meeting. 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 2021. 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 2021 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 2021.

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 January and February 2021.

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 2021, two meetings were held with the AMWG (June and November) and there was email correspondence with AMWG members to

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

present information and solicit feedback. The City dedicated funding to 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 2021, 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.

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 2021, such as seasonal grazing, seasonal mowing in 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 plant propagation at UCSC Greenhouses and the experimental outplanting of 1,000 SCT plants onto the site in January and February 2021, the project met this target with the outplantings; however, the target was not met if only natural occurring plants are counted. Only 21 naturally-occurring SCT plants reached maturity on site in 2021, which is below the HMP goal.

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 Area A for SCT as well as for coastal prairie enhancement. Monitoring of the grassland in 2022 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. 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 2021, and whether the actions were in compliance with the HMP.

Table 1. Monitoring of Adaptive Management Variables

Objective and Variable	Actions in Year 8 (2021)	Year 8 (2021) 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 June 22 and November 4	Meeting minutes presented in Appendix A	Yes, two meetings in 2021. Email correspondence was conducted with AMWG members periodically in 2021
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, 2020 to June 30, 2021 and July 1, 2021 to June 30, 2022	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	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. Management actions were implemented to reach desired variables for SCT and coastal prairie by 2020 (not reached); alternative strategies discussed
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.	City received input from AMWG, CDFW and USFWS on SCT management actions	Outplantings of SCT monitored; additional studies identified for 2022	Yes, when additional research items are identified, the KMQ framework will continue to be used. A SCT Habitat Enhancement Work plan was prepared to reach SCT population goals and prairie management.
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 2021 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 constructed in 2014. 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. Activities associated with Master Plan improvements are described in this section. The schedule of when master plan improvements were implemented is provided in each section below.

4.1 Multi-Use Trail Construction Areas

A temporary construction access road was used in 2013 and 2014 during trail construction. The area was allowed to naturally revegetate from the existing soil seed bank. The access way is contained within Grazing Area C and was subject to periodic cattle grazing from March – August 2020. Coast tarweed colonized this area and surrounding areas. The location of this trail and other master plan improvements is presented in **Figure 2**.

Areas subject to hydromulch and hydroseeding for erosion control as part of trail construction were observed in 2021. No erosion was noted in these areas and no additional seeding was conducted in 2021. An area with construction-related gravel was scraped in December 2016 to remove the gravel; the topsoil was retained and re-scattered in place. The location of the scraped area is depicted in **Figure 2.** Coast tarweed (*Deinandra corymbosa)* continues to be observed in portions of this treated area.

4.2 Multi-Use Trail Soil Salvage Adjacent to Mapped Tarplant Areas

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. The location of the salvage and receiver sites is depicted on **Figures 3 and 4**, respectively.

No SCT plants has been observed within the Tarplant Area D receiver site. Native species observed included California poppy (*Eschscholzia californica)*, as well as non-native species include oats (*Avena spp.)*, cat's ear (*Hypochaeris sp.)*, filaree (*Erodium sp.)*, wild radish (*Raphanus sativus)*, ryegrass (*Festuca perennis)*, and ripgut brome (*Bromus diandrus)*.

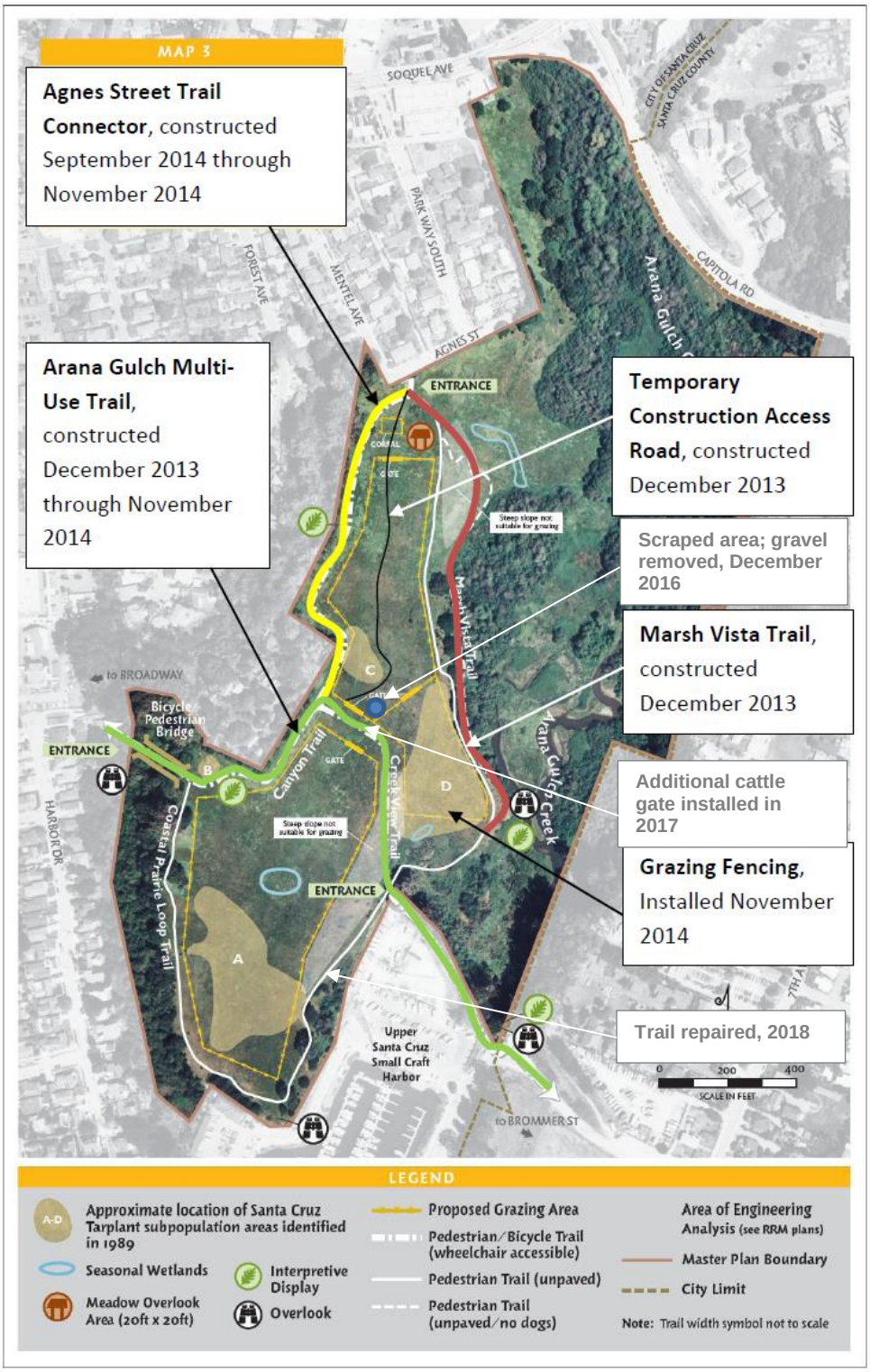

Figure 2. Master Plan Improvements, 2013 - 2021

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 was salvaged and spread onto areas southwest and northwest of Tarplant Area C. The two receiver areas encompass approximately 2,900 square feet (see **Figure 3).** Details on the soil salvage and soil depths within this placement area are presented in the Year 1 (2015) Annual Report. The location of the receiver sites, as well as data from the November 2014 soil sampling are shown in **Figure 4**.

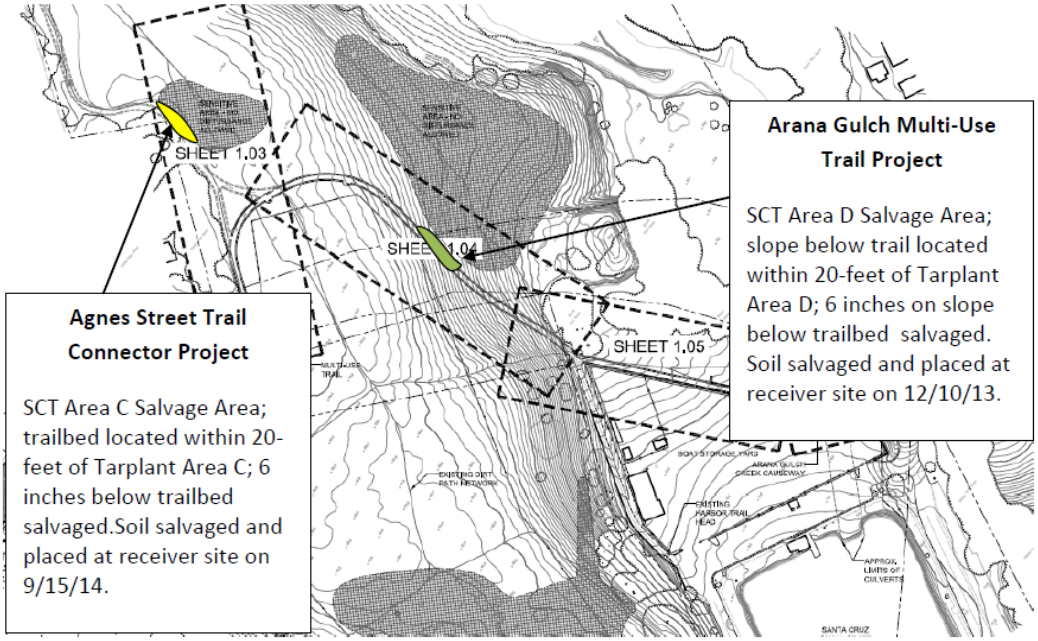

Figure 3. Location of Multi-use Trail Soil Salvage Sites, 2013 and 2014

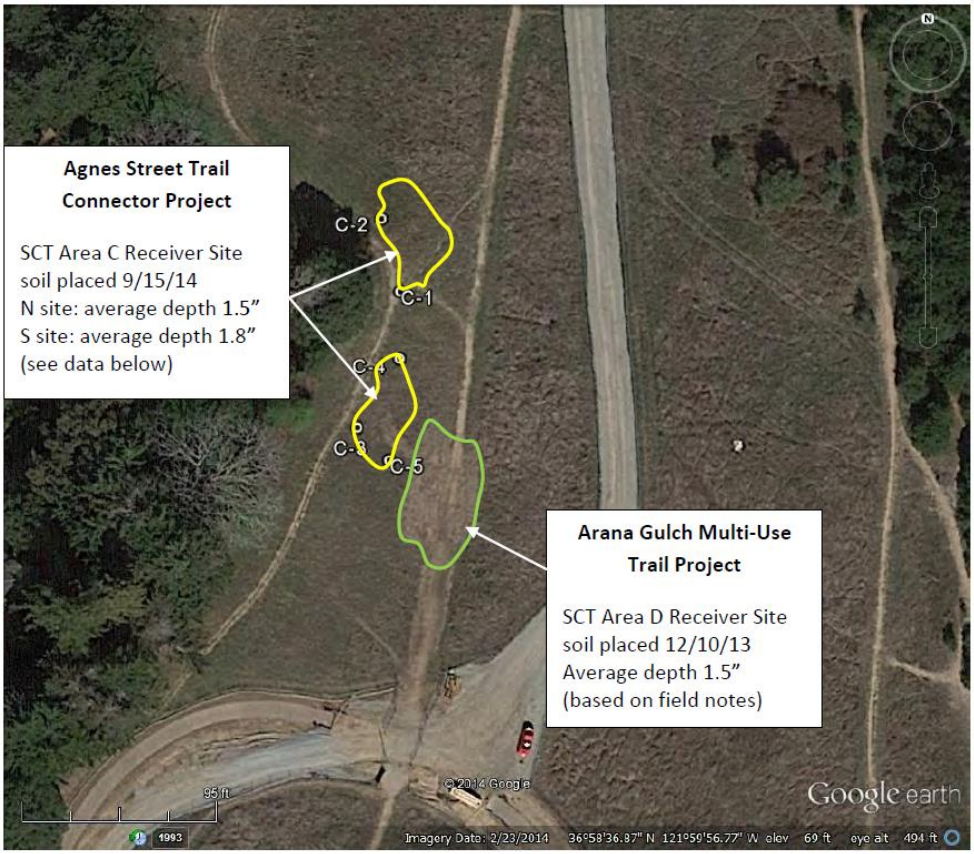

Figure 4. Multi-Use Trail Soil Receiver Sites on Aerial Photo, 2013 and 2014

In 2021, native and non-native plants continue to occupy the two Tarplant Area C receiver site. Native species observed included coast tarweed (*Deinandra corymbosa)* (south site). Species typical to the adjacent grassland occur at the site, including hare barley (*Hordeum murinum ssp. leporinum)*, cat's ear (*Hypochaeris sp.)*, filaree (*Erodium sp.)*, and ryegrass (*Festuca perennis)*. No SCT was documented from the receiver site in summer/fall 2021; however, SCT outplants grown by UCSC Greenhouses were installed in the northern receiver site area in January and February 2021. An experimental scrape plot, created in November 2019 to facilitate historic SCT seed expression was placed between the two SCT Area C soil salvage receiver sites (see Section 5.1.1.3); no SCT were observed in this scrape plot in 2021.

4.3 Natural Recruitment of Native Plants along Multi-Use Trails

The construction of the multi-use trails included removal of soil under the trail's footprint in preparation for trail materials, base rock, and the pervious surface. The excavated soil was taken off-site. Areas in close proximity to the paved trail (i.e., areas within the designated, fenced construction work area) were also disturbed. In spring and summer 2017, field observations of the Arana Gulch Multi-Use trail (east-west trail) construction area documented the presence of naturally establishing native and non-native plant species within the disturbed soil areas. Individuals of the native coast tarweed (*Deinandra corymbosa)* colonized the edge of the trail construction zone; however, over time trail use and soil

compaction has occurred and the area is less suitable for plant growth. Some coast tarweed still persists along the trail. Other plant species also naturally established in the construction area include several weedy, non-native species, such as wild oats (*Avena spp.)* and wild radish (*Raphanus sativa)*. No SCT were observed in these areas in 2021.

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Poor drainage along the edge of the 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 monitored these areas during winter 2020/2021 and found that they continue to be effective; however, this was a below-normal rainfall year.

4.4 Grazing Infrastructure and Stocking Program

Cattle infrastructure include fences, access gates, water line/water troughs and a temporary holding corral near Agnes Street. Per an agreement for cattle grazing with a local cattle rancher, cattle were brought onto Areas C and D as per the HMP Grazing Program and Stocking and Work Program. See Section 5.3 for more information on the 2021 cattle grazing program. 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).

5. Habitat Management and Monitoring - Coastal Prairie/Santa Cruz Tarplant Management Area

Activities within this management area are summarized in the following section and include actions as outlined in Section 3.0 of the HMP as well as adaptive management actions recommended by the AMWG. Field management actions in 2021 included cattle grazing, perimeter mowing, seasonal mowing in Area A, monitoring of grazing actions, monitoring natural SCT germination and growth, implementing and monitoring experimental SCT outplantings, monitoring previous-year scrape plots for SCT seed expression, monitoring a previous-year bare ground molasses plot for SCT seed expression, and invasive weed control. City staff, City consultants, and volunteers from UCSC implemented these tasks. In addition, the City and UCSC Greenhouses coordinated on SCT seed storage, SCT plant propagation, and outplantings.

In response to data indicating that HMP goals for SCT recovery are not being achieved, the City and the AMWG discussed alternative management strategies for prairie and SCT recovery. Using adaptive management processes, the City and the AMWG identified additional habitat management actions that could be implemented on site. A SCT Outplanting Experiment was developed, as further discussed in Section 5.1. The AMWG is also discussing performance criteria for coastal prairie, such as percent cover of native and non-native plants, species richness, and percent cover that is bare ground, that will be relevant to site conditions at Arana Gulch. These criteria will be applied to sub-management areas that have been identified. Once these criteria are developed by the AMWG and Coastal Commission (CC), they will be used to assess future performance of the coastal prairie at Arana Gulch.

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 SCT population and is one of only 13 populations found in Santa Cruz County (USFWS, 2015). However, the population of SCT has declined precipitously over the last two decades. 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). Each section concludes with a monitoring and performance evaluation of progress toward meeting the goals and objectives outlined in Section 3.0 of the HMP. Proposed actions for 2022 are discussed in Section 5.5.

5.1 Santa Cruz Tarplant

Several management actions for Santa Cruz Tarplant (SCT) were implemented in 2021.

5.1.1 Management Actions

5.1.1.1 Grazing and Mowing. Management actions for the SCT consisted of seasonal grazing of the historic SCT colonies in Areas C and D (and surrounding grassland), seasonal mowing in Area A, and seasonal mowing of Area B. Areas C and D were grazed from February 5 to July 24. Further details on the grazing program can be found in Section 5.3. Area B was once in June. Area A was mowed three times during April and May to attempt to keep canopy height at 8-10 inches.

5.1.1.2 Outplanting.

Background. The 2019 vegetation assessment determined that the grazing strategy is not meeting the interim biological success criteria defined in the HMP. Therefore, the City and AMWG indicated support for an adaptive management work plan to conduct experimental management actions to improve habitat conditions for SCT. In November 2019, Alison Stanton prepared a work plan that outlined potential management actions for Arana Gulch SCT habitat enhancement on the coastal prairie. 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.

As a result of the work plan, scrape plots to stimulate SCT seed germination were created in Areas A, C, and D in November 2019. Prescribed fire was also considered; however, the large CZU Complex wildfire occurred in the Santa Cruz Mountains in summer/fall 2020 and the City Fire Department subsequently declined to consider a prescribed fire on site in fall 2020, due to the unusually high regional fire danger. The lack of any SCT response in the experimental scrape plots led to revisiting the 2019 work plan. Ms. Stanton revised the plan in fall 2020, with input from the AMWG. The 2020 SCT Habitat Enhancement Work Plan was presented in the 2020 report.

The revised plan 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. Strategies to manage disturbance and stimulate the SCT and the native 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 5.2.2.2 of Year 7 [2020] Annual Report) 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. Consequently, the SCT population at Arana Gulch may be at or near some unknown threshold of extirpation at the site.

2021 Experimental Outplanting Plan. 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 UCSC Greenhouses used a portion of that seed to propagate SCT plants that generated an estimated 10,000 seeds. A pilot outplanting of 28 container-grown SCT plants 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. To further this SCT outplanting plan, UCSC Greenhouses propagated 400 SCT plants in "stubby tubes" that were hardened off and ready to plant at the end of January, 2021. An additional 600 plants were propagated for a second planting at the end of February.

Goals and Objectives for the 2021 Outplanting. The SCT population at Arana Gulch has remained low and may be at or near some unknown threshold of extirpation at the site due to the depleted seedbank. 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.

***Considerations for the 2021 Outplanting*.** The program was informed by AMWG input and the HMP, as follows:

- The southern part of Area A supports the most suitable SCT habitat, based on expression of plants over many years, and should be the main experimental enclosure.
- Increase potential for SCT survival with protection from grazing, but also plant in a grazed area for comparison. The existing cattle fence protecting the 2020 SCT pilot planting in Area C should be retained so the area can be monitored for recruitment.
- Grazing exclusion is recommended in Area A to enable California oatgrass (*Danthonia californica*) to recover. Implement periodic mowing to keep grass growth below 10 inches to reduce non-native grass seed production.
- Approach the outplantings as a pilot to learn how to best proceed with an experimental design that utilizes replicated treatments.
- Utilize replication and a small plot size to reduce differences in survival due to spatial heterogeneity and resource constraints. Small plots are also easier to hand-weed.

Additional input on outplanting was sought from the Director of the Younger Lagoon Reserve, Dr. Elizabeth Howard. The reserve includes 47-acres of Terrace Lands located on UCSC's Coastal Science Campus. Prior to their incorporation into Younger Lagoon Reserve in 2009, the Terrace Lands were farmed for nearly 70 years, then left fallow for another two decades. Since 2009, reserve staff and student interns have been working to restore this former agricultural land to native habitats. Restoration of the Terrace Lands is required by the

California Coastal Commission for development of the Coastal Science Campus. Younger Lagoon Reserve's restoration efforts are guided by a scientific advisory committee comprised of academic and professionals in the fields of restoration ecology, hydrology, and local land use history. Lessons learned from the extensive restoration efforts include the following:

- Sheet mulching with cardboard sheeting followed by a layer of wood chips is superior to tarping, herbicides, or scraping in facilitating the establishment of planted species at Younger Lagoon.
- Regular hand-weeding around planted SCT seedlings during the spring is recommended to decrease competition with weeds (even though it may increase gopher herbivory).
- Avoid irrigation of SCT seedlings to reduce potential for gopher herbivory. "Dry farming" also has a greater potential to produce more deeply rooted plants that can withstand summer drought.

Methods. A total of 400 SCT were planted on January 26, 2021 and 600 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.

Plot Locations. A total of 3 40 x 60-foot macroplots were placed in the historic SCT area in the central part of Area A (**Figure 5**). In Area D, a total of 7 10 x 10-foot plots were dispersed through the lowest portion of the pasture, closest to Arana Creek. A total of 69 SCT were also planted within the 2020 grazing exclosure in Area C.

Figure 5. 2021 Planting Plot Locations at Arana Gulch in Area A (Orange), C (Blue), And D (Red).

Planting Treatments. Planting treatments were identified that represent a gradient of management intensity. The treatments were: 1) no treatment control ("grazing release" treatment [Area A and Area C]), 2) mowing (Area A), 3) sheetmulch treatment, and 4) no

treatment, with grazing (Area D). Grazing was suspended in Area A to evaluate the treatments independent of grazing impacts. 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.

Area A Plot Layout. In January, each 40 x 60-foot macroplot was divided into 10 x 10-foot sub-plots and a stratified random approach was used to allocate 2 plots of each treatment (C=control; M=mowing; SM=sheetmulch) to each macroplot for a total of 6 replicates per treatment. A single plot of a demo treatment (D=sheet mulch and mowing) was also added to each macroplot. Although the sub-treatments were randomly positioned, it was necessary to group the mowing and demo plots into a single plane to allow mower access. In February, these plantings were repeated in vacant sub-plots. Each sub-plot received 16 SCT in January and 16-25 SCT in February. The sheet mulch subplots were configured to accommodate both the January and February planting in order to reduce the labor needed for plot preparation.

Area C Plot Layout. In January, one plot, within a cattle exclosure fence was planted as a control (grazing release). The plot received 69 SCT plants.

Area D Plot Layout. In January, seven plots were established, with 8 SCT plants per plot. A total of 56 SCT plants were installed as a control (grazing).

Implementation. Volunteers participated in the plantings, including students and staff from the UCSC Ecology and Evolutionary Biology Department (**Figure 6).** 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.

Figure 6. Volunteers from UCSC Planting on January 26, 2021.

Area A was mowed with a Toro deck mower set at 10 inches, but mowing in the treatment plots was not evenly or consistently applied. Two macroplots were mowed on 4/30 but one was not. A second mow on May 28 was also was uneven and included the macroplot that was missed the first time but not one of the others.

For the sheetmulch, wood bark chips were used rather than standard woodchips, because of availability. Some of the mulched plots were hand weeded in April and some in May. The wood bark stayed in place through the season but the cardboard appeared to disintegrate through the summer. Once the surviving SCT were seeding, the woodchip was raked to the side of 1 subplot in each macroplot on October 18 and a second subplot in each on November 4 to give the seed better access to the soil. The raked wood bark chips were left on site.

5.1.2 Monitoring and Results

A primary focus for this management area is the recovery of the SCT. The population of SCT at Arana Gulch has declined over the last two decades[5]. 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**). These area designations have remained in use.

5.1.2.1 Census. A census for SCT (natural occurrences) was conducted by Kathleen Lyons. The survey followed 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 April, May, August, and October 2021. This survey period coincided with the blooming period of SCT. Surveys were conducted by walking the grassland (includes Tarplant Area A, B, C, and D) over multiple days. Meandering walking surveys were conducted to detect SCT. Survey days were April 29, May 28, August 9, August 24, and October 18, in total 10 survey hours. 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.

On August 24, 21 SCT plants were documented from 3 colonies in Area A. Plants averaged 6.5 inches in height and were single-stemmed with 2 flower heads per plant. Total number of flower heads was 50. The 21 SCT is an increase from 1 SCT in 2020, yet is a decrease from 50 plants in 2019 and 267 plants in 2018, yet an increase from 0 plants in 2017. In previous census years there were 0 plants in 2015, 4 plants in 2014, 0 in 2015, and 35 plants in 2016.

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

The 2021 survey was conducted in a significantly below average rainfall year (18.12 inches), which followed a slightly below average rainfall year (2020/21), a slightly above average rainfall year (2019/20), a below average rainfall year (2018/19) and an above-average rainfall year (2017/18). It also follows six seasons of grazing (grazing in winter/spring seasons of 2015, 2016, 2017, 2018, 2019, and 2020).

Table 2 presents the number of plants in each patch, the size of the patch, average plant height, and number of flowering heads. **Figure 7** displays the distribution of SCT in 2021. **Figure 8** displays the location of the 2021 plants compared to the historical distribution of the species on site. **Figures 9** and **10** depict SCT plant at colony C2 and C1, respectively.

Table 2. SCT Census Results of Naturally-Occurring Plants, August 2021

Area	Patch #	Size of Patch	Number of SCT	Average Height (in.)	Number of Flower Heads
Natural Occurrences					
Area A					
	C1[1]	25′ x 30′	15	6.5	36
	C-2	5′ x 5′	5	5.5	10
	C-4	1′ x 1′	1	10.0	4
Area A Total			**21**		**50**
Area B	-	-	0		
Area C	-	-	0		

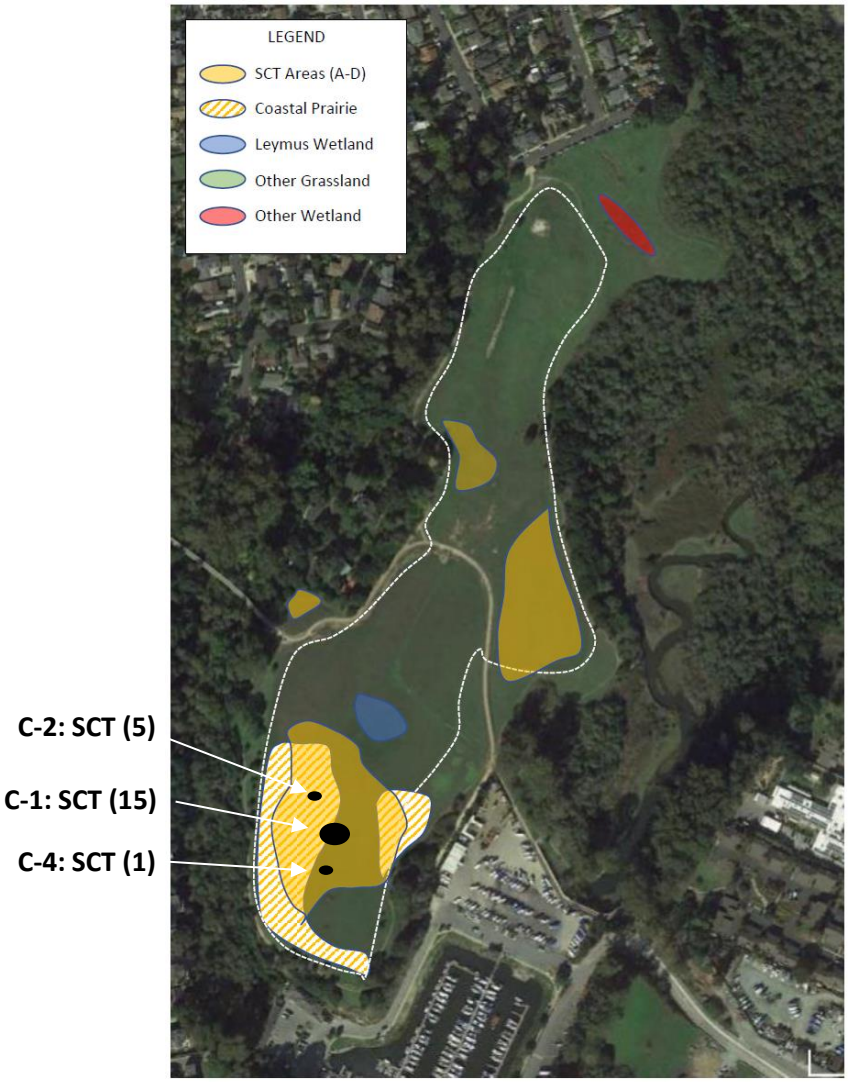


Figure 7. Distribution of Naturally-Occurring SCT, 2021

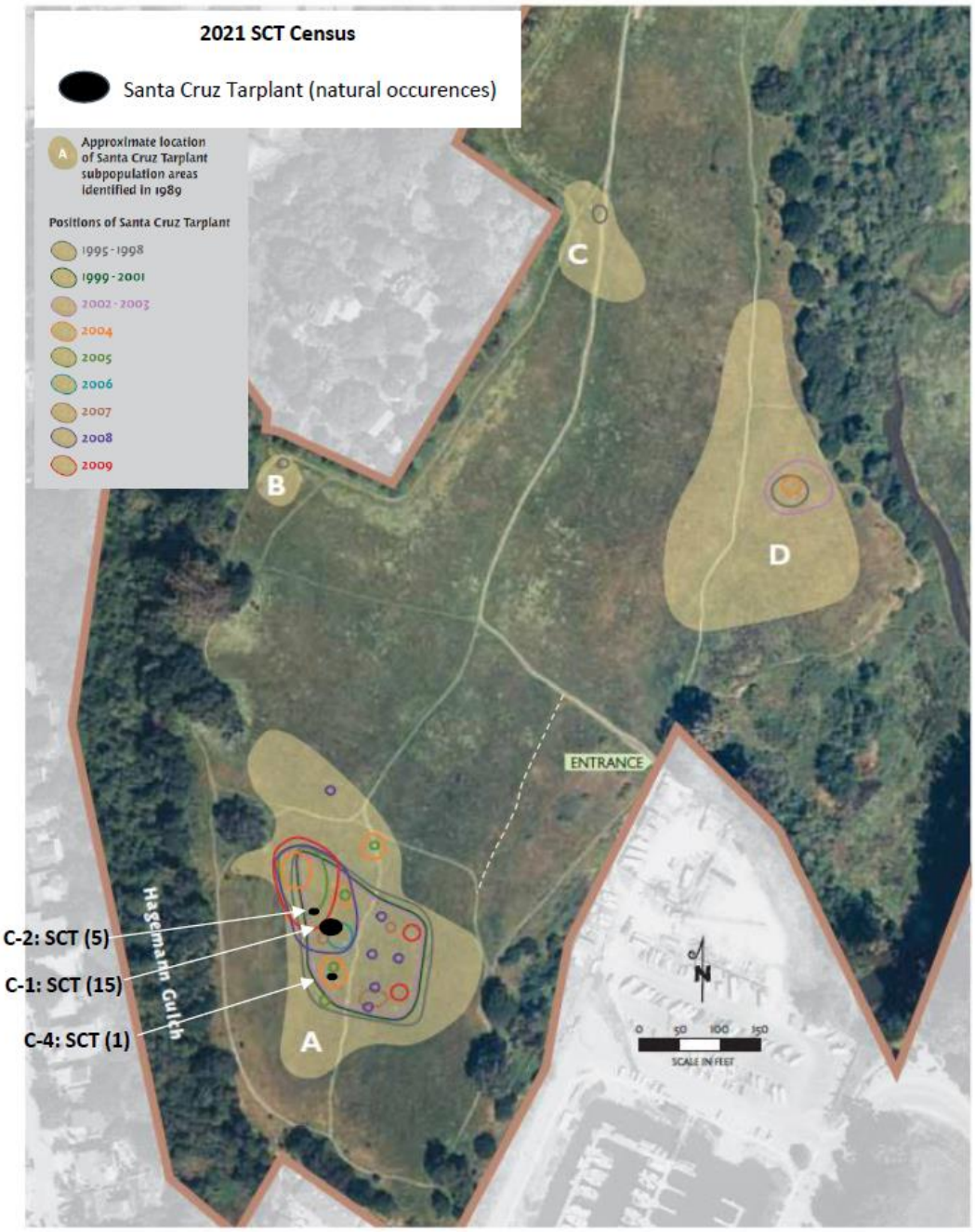


Figure 8. Distribution of SCT (naturally-occurring), with Historic Occurrence Data

Figure 9. SCT (naturally-occurring) in Area A (C-2), August 2021

Figure 10. SCT (naturally-occurring) in Area A (C-1), August 2021

5.1.2.2 Seed Collection. No SCT seed was collected from the site in 2021. 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.

5.1.2.3 Plant Cover at SCT Patches. Plant cover and species composition was documented at SCT C-1 colony in August 2021. A 1-meter square quadrat was used to visually assess

absolute plant cover, litter, cattle dung, and bare ground. Plant cover was recorded at 90%, which is an increase from 84% in 2020, 71% in 2019, and 82% recorded in 2018. Most plant cover was provided by exotic annual grasses (EAG), primarily ryegrass (*Festuca perennis)*. Exotic annual forbs (EAF) were dominated by cat's ear (*Hypochaeris sp.)*. Cover by exotic perennial forbs (EPF) include birds foot trefoil (*Lotus corniculatus)*, subterranean clover (*Trifolium subterraneum),* filaree (*Erodium botrys)*, and loosestrife (*Lythrum hyssopifolia)*. Cover by native species was provided by SCT (10%). Bare ground represented 10%, an increase from 4% in 2020, yet decrease from 23% in 2019.

5.1.2.4 Experimental Outplanting. Monitoring and results of the experimental outplanting of SCT is presented in this subsection.

Precipitation. The January 22 planting was immediately followed by active precipitation over the next 3 days. A total of 7 inches of rain was recorded at the DeLaveaga Golf Course from January 26-29 (Delaveaga monthly weather). No rainfall occurred in February before the planting, so the outplantings were watered-in the following day. A total of 2.8" of rain fell during the remainder of the growing season, starting on March 5.

Monitoring. The plots were monitored throughout the growing season. The final survival and reproduction data was primarily collected in late August. Additional follow-up monitoring occurred in the fall during peak flowering and seed set. Preliminary seedling recruitment data was collected in December.

Results.

Area A Macroplots. The data for the control/mow treatments is presented first because the surviving SCT were more typical of naturally occurring plants. The SCT planted into sheetmulch plots grew extremely large and flowered profusely.

Control/mow treatments. Overall survival in the mow/control plots (77%) was better than expected. Average survival was similar between the control treatment and the mow 1x treatment in both plantings (**Table 3**). The greater survivorship of the January planting was likely due to the 7 inches of rain received immediately after planting. The February planting received only 2.7 inches of rain after planting and surviving plants were consequently shorter and produced fewer flowers. Average plant height in late August ranged from 5 to 10". Although plants were slightly shorter in the mow plots, it is likely that average plant height early in the growing season was too short to have been impacted by the 10" mower height. The average number of flowerheads produced per plant ranged between 3 to 8 and was similar between the mow and control treatments.

Table 3. Average Survival, Plant Height, And Number of Flowers Per Plant

	Survival		# flwrs/plant		Ht (in)	
	Jan	Feb	Jan	Feb	Jan	Feb
control	79	71	7.3	3.8	9.0	7.7
mow 1x	86	68	7.8	4.8	8.2	6.7

While the mowing was not evenly applied and was only done 1 or 2 times, vegetation height in June appeared lower in mowed plots (**Figure 11**) compared to the tall, dense canopy observed in control plots (**Figure 12**). While most surviving SCT had a single stem (**Figure 13A**), a small number did show clear evidence of mowing and/or branching (**Figure 13B**).

Figure 11. Lower Vegetation Height in a Mowed Plot in Macroplot 1 in June, 2021. Flowering SCT are Visible in the Yellow Circle.

Figure 12. Tall Vegetation and Dense Canopy in a Control Plot in Macroplot 1 in June, 2021. Flowering SCT are Visible in The Yellow Circle

Figure 13. A) Single Stem SCT In A Control Plot And 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 Where the Plant Branches.**

While there was little overall difference in the mowing and control treatments, flowerhead production was lower in Macroplot 3 (**Figure 14A**). Many surviving SCT in that plot produced only 1 flowerhead. Macroplot 3 is located in the southwestern corner of Area A where there is a significant amount of perennial grass, including *Danthonia* and *Stipa*, that may have affected SCT growth. In the January planting, flower production was highest in Macroplot 2, but that did not continue with the planting in February. In Macroplot 1, mowing appeared to increase the number of flowerheads per plant (**Figure 14B**), it was not clearly due to the mowing. The lack of any pattern makes it difficult to draw conclusions about the mowing, especially since it was not evenly or consistently applied.

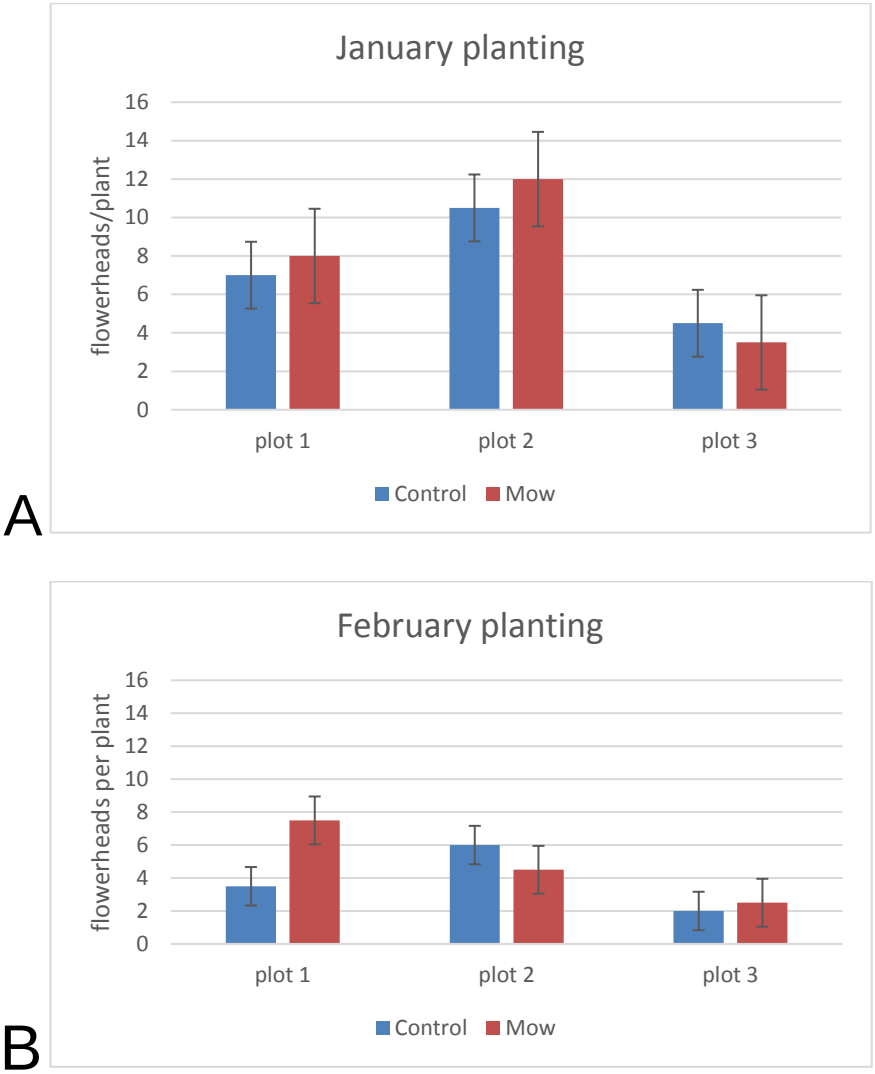


Figure 14. Average Flowerhead Production Per Plant in August of SCT Planted in January (A) or February (B).

Because of the small plant stature, it was possible to get a complete tally of the number of flowerheads produced by the survivors in the control and mow plots. When the treatments

were combined, total flowerhead production was significantly lower in Macroplot 3, despite the slightly greater survival (**Table 4**). Again, Macroplot 3 has a greater amount of perennial grasses that may have affected SCT growth and reproduction.

Table 4. Combined Survival and Reproduction in Control and Mow Treatments in 3 Macroplots

Plot	Avg survival	# surviving plants	Avg flwrhds/ plant	sum flwrhds
1		97	3-12	788
2		98	4-15	889
3		112	2-5	400
Total				2,077

Sheetmulch treatments. The sheetmulch (SM) subplots were configured to accommodate both the January and February planting in order to reduce the labor needed for plot preparation**.** However, it was not possible to accurately identify the planting date of survivors later in the growing season, so combined results are presented. A third SM plot was supposed to be mowed in each of the macroplots, but were not.

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. Macroplot 3 received an extra treatment of woodchip without cardboard. Overall survival was similar in weeded and un-weeded plots but the hand-weeding only occurred one time (**Table 5**). Lower survival in the woodchip only treatment was likely due to increased gopher activity in that area.

Table 5. Total Survival (%) in Sheetmulched Subplots That Were Weeded or Un-Weeded with Average Overall Survival. One Subplot Received Only Woodchip with No Cardboard Sheet.

Macroplot	1	1	1	2	2	2	3	3	Average
Weeded	50	72	63				54		60
Un-weeded				50	58	71	49	66	59
Woodchip only							38		

While total survivorship was lower than in the control and mow treatments, a majority of the SCT planted into sheetmulch plots grew extremely large and flowered profusely (**Figure 15**). All survivors had many stems and up to 32 stems were counted on a single plant (**Figure 16**). The average plant height of survivors was not individually measured. However, surviving SCT in the weeded subplots in Macroplot 1 were approximately 16 to 24", SCT in the un-weeded subplots in Macroplot 2 were 14-18", and the SCT was only 8 to 14" in Macroplot 3. The overall vegetation canopy height was shorter in Macroplot 3, compared to the other macroplots. Although hand-weeding one time did not appear to effect survival, the effect on growth was unclear because of the differential growth in the macroplots.

Figure 15. Large Flowering SCT Growing in Sheetmulch in Macroplot 1, June2021.

Figure 16. Close-Up of Large, Flowering SCT in Sheetmulch, June 2021.

The number of flowerheads/plant was estimated from 3 plants in each subplot and ranged from a low of 52 in an un-weeded subplot to a high of 582 in a weeded subplot in Macroplot 3 (**Figure 17**). Up to 795 flowerheads were counted on a single plant. While the one-time

hand-weeding appeared to increase flower production in Macroplot 3, a greater sample size with equal controls was needed.

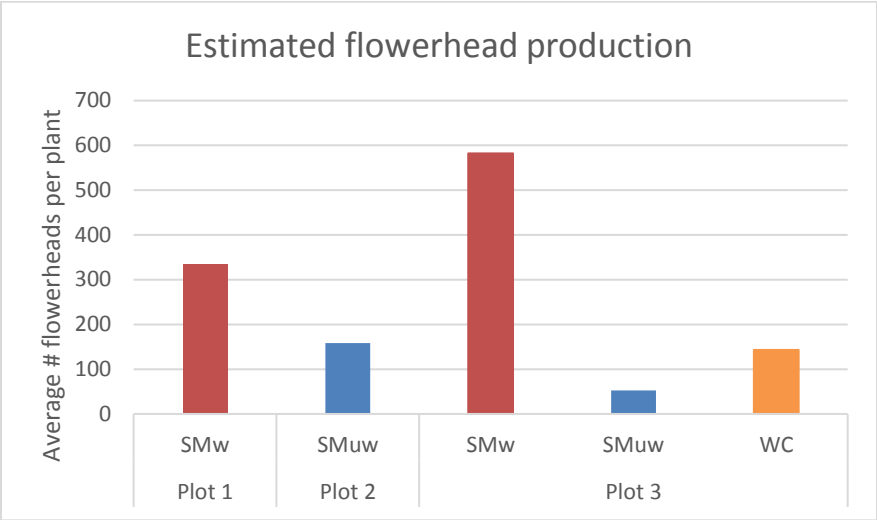


Figure 17. Average Number of Flowerheads/Plant Estimated From A Sample Of 3 Plants in Each Subplot:
N= 9 in SMw plot 1 and SMuw plot 2; N=6 in SMuw plot 3; N= 3 in plot 3 SMw and WC.

The total number of flowerheads produced by surviving SCT in SM plots was estimated by multiplying the average number of flowerheads per plant by the number of survivors. The total was over 50,000 flowerheads (**Table 6**). In contrast, surviving SCT in the control and mow plots produced a combined total of about 2,000 **(Table 4**).

Table 6. Estimated Total Flowerhead Production from a Sub-Sample of 3 SCT in Sheetmulched Plots (W=Weeded Uw=Un-Weeded).

Plot	# surviving plants	Avg flwrhds/ plant	estimated sum flwrhds
1	60	335 w	20,100
2	75	158 uw	11,850
3	93	582w 52uw	18,800
Total			50,750

SCT seedling recruitment. The density of vegetation in the mow/control treatment plots made it difficult to see emerging SCT seedlings in late fall and early winter. However, very heavy seed rain was observed in the sheetmulch plots in October and the decision was made to rake the woodchip to the side of one subplot in each Macroplot on October 18. Recruitment of seedlings was only observed easily within the sheetmulch treatment plots. A second subplot in each macroplot was raked on November 4 and 1 plot was left unraked.

The percent cover of emerging SCT seedlings was estimated for a subset of SM plots on December 16. In Macroplot 1, SCT seedling cover was estimated at 80% cover in a raked

plot (**Figure 18**), but cover was not estimated in an un-raked plot. In Macroplot 2, seedling density was estimated at 15% in the raked plot (**Figure 19**) and only 1% in the un-raked plot (**Figure 20**).

Figure 18. Macroplot 1- Estimated 80% SCT Seedling Cover in a Sheetmulch Subplot That Was Raked of Woodchips in Late October/Early November.

Figure 19. Macroplot 2- Estimated 15% SCT Seedling Cover in a Sheetmulch Subplot That Was Raked in Late October/Early November.

Figure 20. Macroplot 2- Estimated 1% SCT Seedling Cover in a Sheetmulch Subplot That Was Not Raked in Late October/Early November.

In Macroplot 3, SCT seedling cover was an estimated 35% in a raked plot (**Figure 21**) and no SCT seedlings were observed in the unraked plot. **Figures 22-23** are close-ups of SCT seedlings in plots that were raked or not.

Figure 21. Macroplot 3- Estimated 35% SCT Seedling Cover in a Sheetmulch Subplot That Was Raked in Late October/Early November.

Figure 22. Close-Up of SCT Seedling Cover in a Sheetmulch Subplot That Was Raked in Late October/Early November.

Figure 23. Close-Up of SCT Seedling Cover in a Sheetmulch Subplot That Was Not Raked in Late October/Early November.

These limited observations suggest that raking the woodchip to the side of the plots allowed for greater recruitment of SCT seedlings, as few to no seedlings were observed in the un-raked plots. However, it is difficult to draw conclusions because the raking was applied opportunistically to single plots at different times.

Area C: 69 SCT were planted in the small grazing exclosure in February. In April, an estimated 25 of the SCT were still alive (36% survival). At that time, the canopy height was 2-2.5 feet so the plot was trimmed by hand with a string trimmer to remove the non-native

grass seed heads and flowers. Some native *Bromus carinatus* was present and already in flower, so it was not trimmed. The surviving SCT were mostly single stem and small, but a few were beginning to flower already. The SCT were included in the trimming to possibly stimulate branching.

A total of 33 SCT were alive in the plots (48% survival) in the May 24 monitoring and by August 26 they had all survived to flower. Definitive branching above a cut point was observed on some plants. The 33 survivors produced a total of 192 flowerheads with an average of 6/plant.

Area D: A total of 56 plants were planted in January in 7 plots with 8 plants each. Survival on 6/21/21 totaled only 12 plants (21%). By August, the portion of Area D where the plots were located was heavily grazed and no surviving SCT were found.

5.1.3 HMP Performance Evaluation

The HMP has a goal to maintain a viable SCT population, with objectives 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). Only 21 naturally-occurring SCT were observed on site in 2021. Using just the naturally-occurring SCT plants, this goal has not yet been attained.

The seasonal cattle grazing that occurred over the past six years (2015 - 2020) was thought to have improved growing conditions for SCT in that the amount of bare ground increased and residual dry matter has been reduced. However, in 2019, 2020, and again in 2021, the number of naturally-occurring SCT remained low and below the HMP goal. Based on observations of rainfall patterns, the poor expression of SCT from experimental soil scraping and other manipulations, or adverse soil conditions, and results of the 2015 soil seedbank analysis, it appears that the lack of SCT seed in the soil seedbank is significantly impacting onsite recovery of the species.

The HMP has an objective to expand the distribution of SCT beyond Tarplant Area A within three years (Objective 1B). In 2021, SCT outplantings were installed in Area C and D. Outplantings survived to maturity in Area C (within a cattle exclosure); no SCT plant survived to maturity within Area D. With the surviving outplantings in Area C, Objective 1B was met this year. Under an agreement with the City and UCSC, a portion of the previously-collected/grown out SCT seed could be grown out for additional out-plantings in Areas A, B, C, and/or D in 2022.

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) to assessments done every 5 years (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. Future analyses of soil seed bank density will be compared to this baseline to determine compliance with this objective. To maintain a viable seed bank and to guard against an unexpected stochastic event, SCT seed collected from the site in 2018 (seed from 25 flower heads) was deposited at the UCSC Greenhouse for long-term seed storage. Under an agreement with the City and UCSC, collected/grown seed is being stored for species recovery purposes. A seed increase program was also conducted, wherein approximately 100,000 seeds were produced. 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 SCT outplanting experiment was to increase SCT seed input into the soil seedbank. It is estimated that over 50,000 SCT flowerheads containing possibly a million or more seeds were released into Area A from the experimental outplantings; seed was also released into the soil at the outplanting site in Area C, thus contributing to the HMP goal. In addition, through a grant from the USFWS, SCT seed germination trials will be conducted in 2022 at UCSC Greenhouses. The study will investigate methods to germinate the ray achenes through various treatments and stratifications.

5.2 Grassland/Coastal Prairie

5.2.1 Management Actions

5.2.1.1 Grassland Mowing. Grassland mowing occurred outside the grazing fences within areas delineated to remain as grassland. The grassland area to be maintained includes all areas within the grazing fences and areas extending to the drip line of the adjacent woodland, as depicted in **Figure 24**. In addition, mowing was conducted within Area A three times during April and May. Perimeter fuel break mowing was also identified along the trails. The City mowed Tarplant Area B once in June. Mowing was conducted for grassland management purposes (i.e., reduce cover by non-native plants) and also for perimeter fuel break purposes.

Using previous year recommendations from the AMWG, mowing of non-grazed areas (except 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 on June 5. 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 25**.

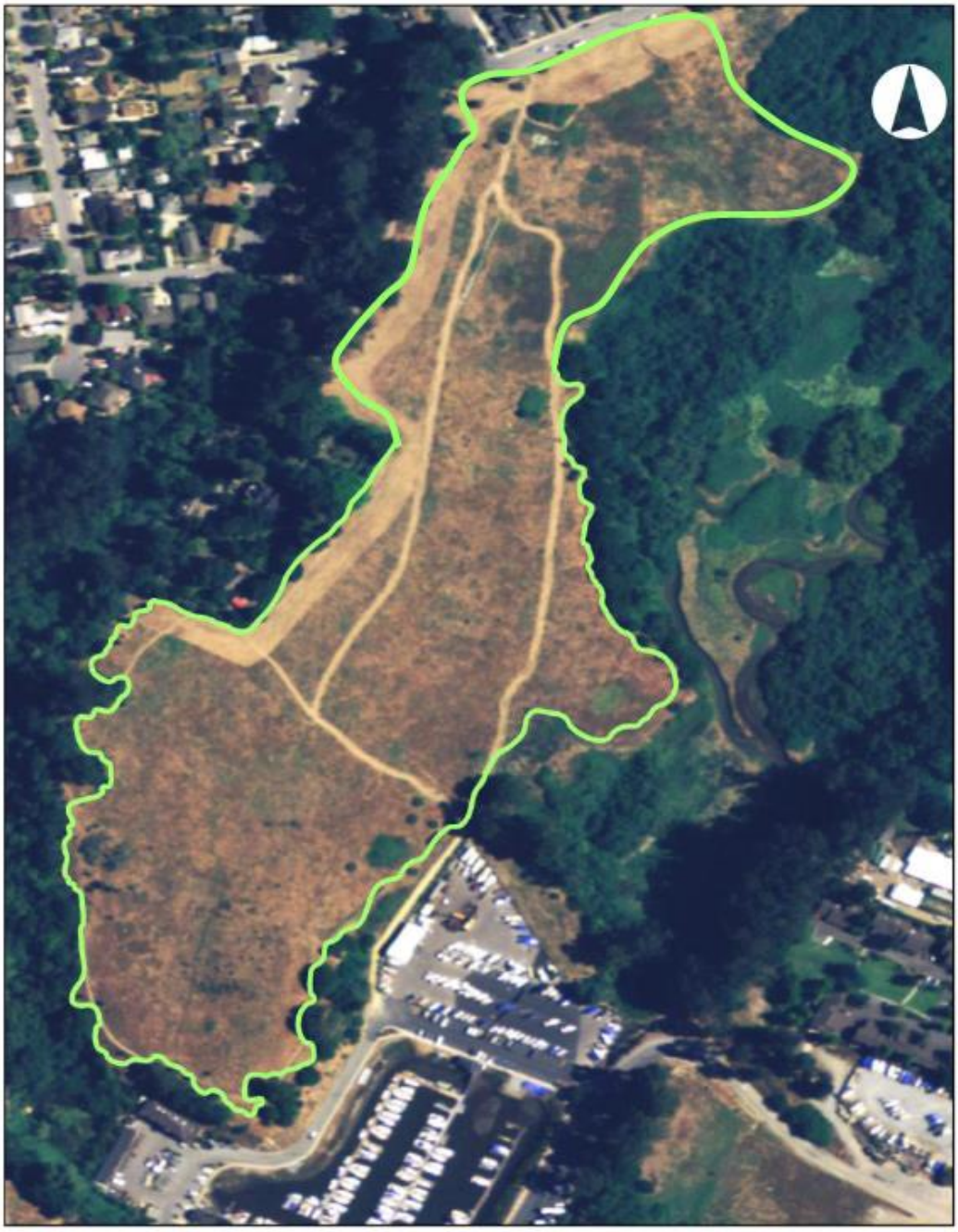


Figure 24. Delineated Grassland, April 2015

Figure 25. Areas Mowed in 2021

In 2017 a grassland sub-management area map was prepared. The map is presented as **Figure 26**.

Figure 26. Sub-management Areas in Grassland (updated draft, 2017)

5.2.1.2 Invasive Plant Removal. In 2021 the City continued to remove invasive plant species from the delineated grassland area. In May, a list of weed infestations was made to assist City crews and volunteers on potential work areas:

1. Prairie Loop Trail, by harbor: cotoneaster and Himalaya berry
2. Arana Creek Causeway, east bank: mature, flowering French broom plants growing with the willow and thick Himalaya berry.
3. Arana Creek Causeway, west bank: patches of broom amid the willows and at least one acacia re-sprout and patch of poison hemlock that should be removed.
4. Junction of Arana Trail and Prairie Loop Trail, by eucalyptus grove: scattered French broom plants, young eucalyptus saplings, and a young acacia

5. Prairie Loop Trail, wetland section: pyracantha shrub thicket; poison hemlock north and south of the trail.
6. Prairie Loop Trail, bend before Agnes Street: milk thistle and Italian thistle
7. Area C: patches of Italian thistle in the northern section of this pasture.

The City Parks Crews did thistle and Himalaya berry removal 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 in Area B to attempt to prevent/reduce off-trail pedestrians.

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 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 2019 vegetation assessment 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 Arana. The AMWG further recommended that the southern part of Area A (mapped as a coastal prairie sub-management unit- see Figure 13 in section 5.2.1) be used as the main experiment area to test outplanting strategies. Grazing exclusion was recommended 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.

For the 2021 vegetation assessment, the sampling methodology returned to the permanent transects 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. The monitoring methods and results are described below and progress in meeting the specific goals and objectives of the HMP is discussed in the last part of this section (5.2.3)

5.2.2.1 Monitoring Methods

In 2021, the spring vegetation assessment and photo monitoring was conducted on April 28-29th. Canopy height measurements were also taken in December and February to capture winter conditions for the current growing season.

The spring vegetation assessment has utilized the point intercept method on 25-meter transects to assess changes in plant species cover and ground cover. A total of 25 sample points per transect are recorded to obtain percent cover of each species encountered by the sampling rod. Ground cover (litter/thatch, bare, basal vegetation) is also recorded. The average height of the canopy layer is measured at the 6, 12, 18, and 24-meter marks using a plastic dinner plate threaded on a wire pin (recorded at the height where the plate comes to rest). Each year a photo is taken at the 0-meter end looking along the length of transect with a whiteboard held up at the 5-meter point labeled with the transect number and date. The transect photos are included in **Appendix C**. In addition to the point intercept data, a search is conducted within a 5-meter belt transect (using the transect as the centerline) to record the presence of any plant species not encountered on the transect. This additional method is often used to capture uncommon or rare species and more fully characterize species richness.

Transect ends have been permanently marked with rebar posts one half inch in diameter pounded into the ground and fitted with metal rebar caps imprinted with the transect ID. The GPS location of each end has been recorded along with the compass bearing of the transect from the 0-meter end. Many of the rebar and caps have been damaged by mowing or cattle since the first installation in 2013. Some have been replaced multiple times, but a few have not. The sample points are located each year using GPS and a metal detector.

During the initial monitoring set-up in 2013, transects were located using a stratified approach with satellite imagery from Google Earth to get a representative sample across the coastal prairie. 11 transects were established in Area A, 5 in Area C, and 4 in Area D, for a total of 20 transects, as shown in **Figure 27**. Preliminary data was collected and a power analysis was conducted using a statistical power calculator (http://www.dssresearch.com/toolkit/sscalc/size_a1.asp DSS Research) to determine the number of transects needed in each enclosure in order to assess a 5% change in percent cover at an 80% power level (with $\beta = 0.2$ and $\alpha = 0.1$, based on standard practice).

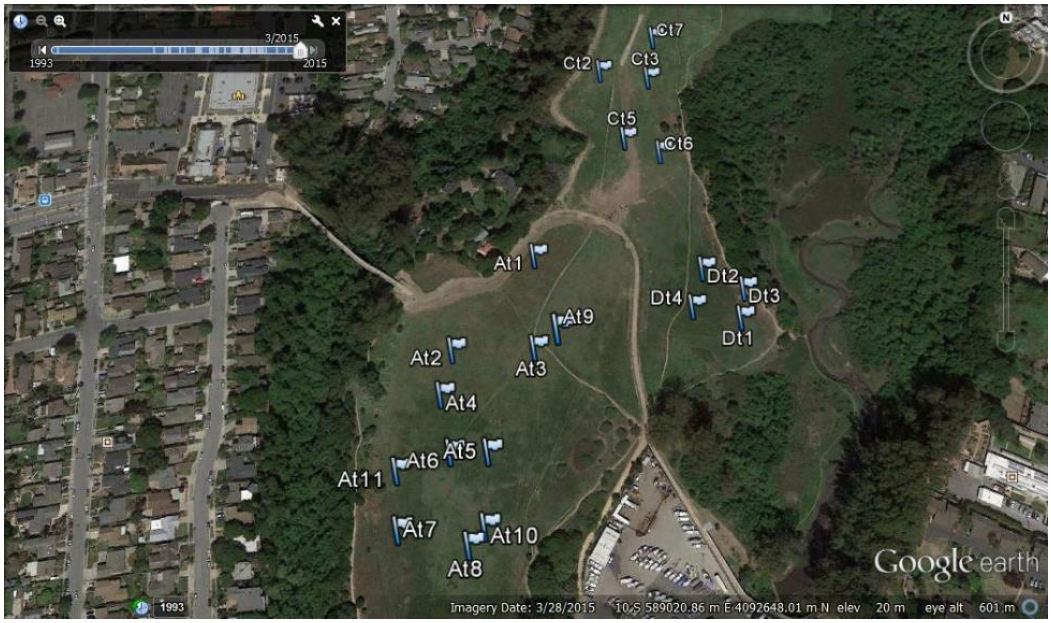


Figure 27. Permanent Transect Placement on the Grassland/Coastal Prairie.

For analysis, the transect is the sample unit and percent cover was calculated for each species encountered on the transect. The total number of species encountered on each transect was also calculated along with the percent ground cover of each category (only bare ground and litter are presented). Cover values were also summed on each transect by guild: exotic annual forb (EAF), exotic annual grass (EAG), exotic perennial forb (EPF), exotic perennial grass (EPG), native annual forb (NAF), native annual grass (NAG), native perennial forb (NPF), and native perennial grass (NPG). The mean cover values are presented with error bars constructed using one standard deviation from the mean.

Photo 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 28**). 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 C**.

Figure 28. Location of Photo Points for Long-Term Monitoring.

5.2.2.2 Monitoring Results

Precipitation Conditions. During the sampling years from 2013 to 2021, rainfall has been below the long-term average of 30 inches reported for the Santa Cruz area (Western Regional Climate Center) in seven years. **Table 7** presents monthly rainfall data from the DeLaveaga Golf Course, located just north of Arana Gulch.

Table 7. Monthly Rainfall (inches) at the California Department of Water Resources (DWR) California Irrigation Management and Information System (CIMIS) weather station 104 (DeLaveaga) for the 2013-2021 water years. (see Station 104 at https://cimis.water.ca.gov/WSNReportCriteria.aspx).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2013	0.11	5.97	8.96	0.92	0.32	1.7	0.88	0.04	0.12	0.04	0.05	0.14	**19.25**
2014	0.06	0.31	0.12	0.02	3.16	1.4	0.45	0.04	0.05	0.16	0.02	0.96	**6.75**
2015	0	3.16	11.75	0	0.01	0	0	0.09	0.05	0.06	0.01	0	**15.13**
2016	0.04	3.38	5.36	12.92	0.17	0.31	0.72	0.24	0.03	0.06	0.13	0.07	**23.43**
2017	5.79	2.56	8.26	16	14.1	4.95	3.38	0.08	0.17	0.03	0.02	0.12	**55.46**
2018	0.07	2.85	0.17	6.11	0.3	6.67	1.33	0.04	0.04	0.04	0	0.04	**17.66**
2019	0.12	5	3.7	7.75	5.08	7.01	0.85	3.26	0.15	0	0.04	0.17	**33.13**
2020	0.01	2.78	10.76	2.89	0.01	3.3	2.98	1.52	0.04	0.08	0.04	0	**24.41**
2021	0	1	2.6	8.2	1.4	2.7	0.3	0.02	0.08	0.02	0.01	0.01	**16.34**

Vegetation Assessment.

Canopy Height. The HMP Objective 3A is to reduce canopy height between the months of November thru April to 5 to 8 cm (2-3 in). This target is intended to increase the amount of light penetrating the ground and increase the ability of SCT seed to germinate.

In Area A, grazing was excluded, but canopy height was very close to target in February (**Table 8**). The first mow in Area A with a Toro deck mower set at 10 inches was conducted on April 1st. By April 28th, canopy height had increased to 36 cm. A second mow on April 30th but the canopy re-grew quickly, so a third mow occurred on April 28th. Grazing continued in Areas C and D where canopy height was within target in February and slightly above in April.

Table 8. Canopy Height Measurements (cm)

	February 25	April 28	December 16
Area A	6.7	36.0	8.7
Area C	6.8	10.0	6.1
Area D	16.9	11.8	6.5

Bare Ground. Objective 3E is to increase the cover of bare ground. This objective has been met in Areas A and D, where the average cover of bare ground has increased steadily since 2015 (**Figure 29**). However, measured bare ground cover in Area C increased one time in 2017, but otherwise has not changed significantly. Conducting additional bare ground measurements in Nov-Dec during SCT germination period may be informative. Measuring

bare ground in the outplanting plots is also recommended. Cover of litter across the prairie has fluctuated, but there has not been a declining trend (data not shown).

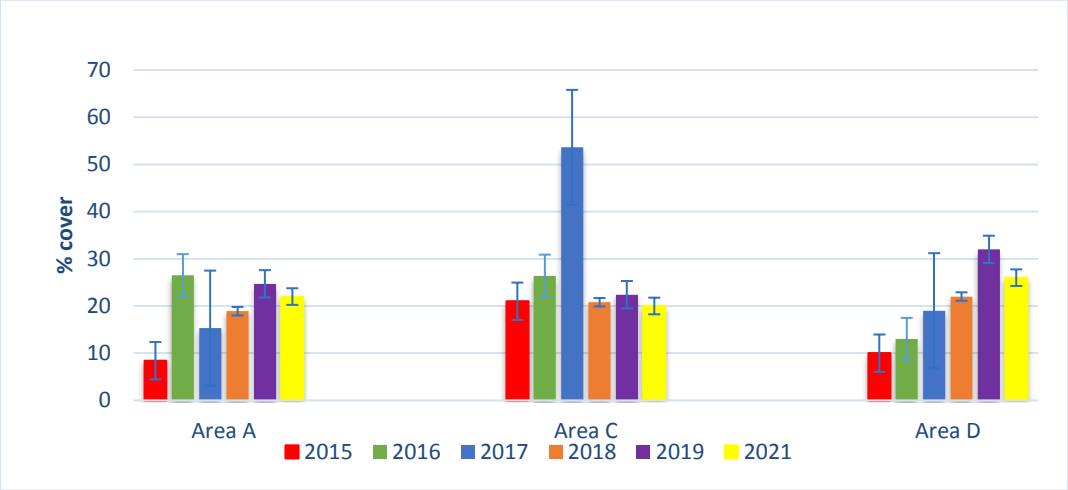


Figure 29. Mean Cover of Bare Ground Sampled in Areas A, C, And D in April, 2015-2019, 2021.
Each error bar is constructed using 1 standard error from the mean.

Canopy Cover. Objective 3B is to reduce the cover of non-native species and Objective 3C is to increase the cover of native species. Since grazing began in 2015, the grazing program has not significantly reduced non-native plant cover or increased the cover of native species in any of the three grazing Areas.

Exotic annual forbs (EAF) and exotic annual grasses (EAG) continue to dominate the vegetation in Area A and cover of EAF has increased steadily (**Figure 30**). The increase is due to an increase in clovers (*Trifolium subterraneum* and *T. dubium*), smooth and rough cat's ear (*Hypochaeris glabra*, *H. radicata*), and geranium (*Geranium dissectum*). Annual grass cover dipped sharply in 2016 due to a drop in the cover of wild oat (*Avena fatua*), but otherwise has remained greater than 80%. Exotic perennial forbs (EPF) have not declined and native species cover has not increased across the sampling years. California poppy (*Eschscholzia californica)* is the only native forb captured in the sampling and cover has been 4% or less. Cover of native perennial grasses (NPG) has been 10% or less

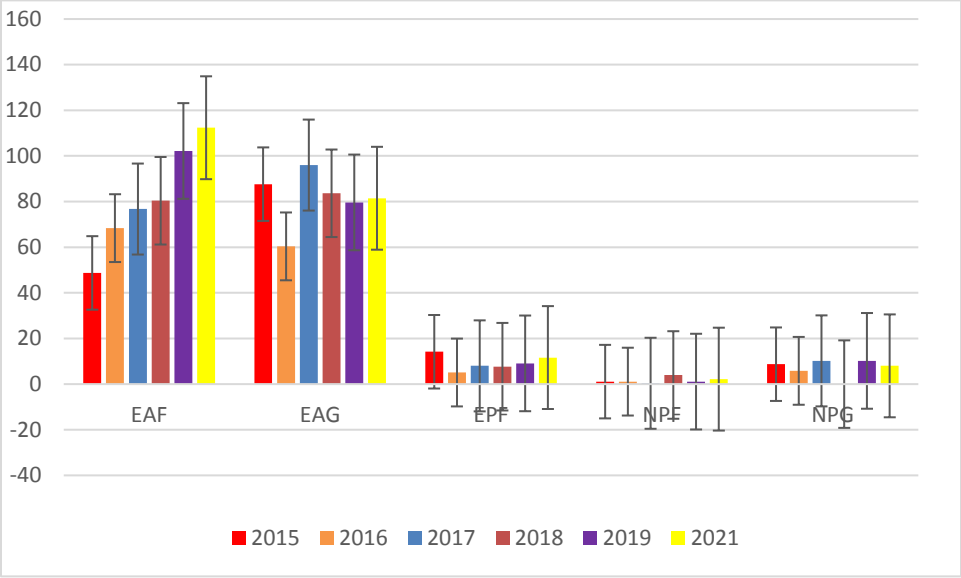


Figure 30. Mean Percent Cover of 5 Plant Guilds in Area A in April 2015-2019, 2021. Each error bar is constructed using 1 standard error from the mean.

Red stem filaree (*Erodium cicutarium*), rat-tail fescue (*Festuca myuros*), and cat's ear were the most dominant species in 2021 (**Figure 31**). These were also the most dominant species in 2019 under the grazing regime. Filaree appears to be increasing with an average 57% in 2021; cover was 34% in 2019 and ranged from 36-43% from 2015-2018. Native species cover has been limited to only a few species over the sampling period and has included California oatgrass *(Danthonia californica)*, spreading rush (*Juncus patens)*, purple needlegrass (*Stipa pulchra)*, and California brome (*Bromus carinatus*).

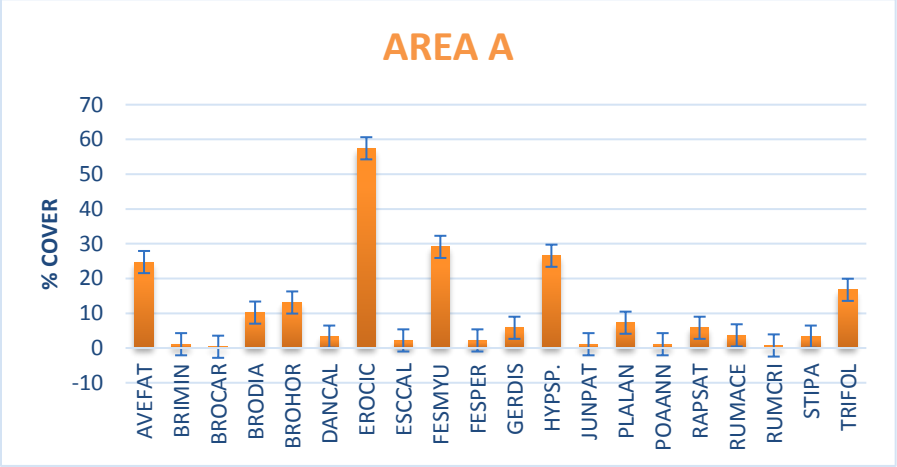


Figure 31. Mean Percent Cover of All Plant Species in Area A in April 2021. Each error bar is constructed using 1 standard error from the mean.

Area C remains dominated by non-native species and native species are still not present in measurable quantities (**Figure 32**). Cover of EAF has fluctuated since grazing commenced in 2015, but cover of EAG has increased somewhat. The only notable change in composition in Area C was the steep decline in wild radish (*Raphanus sativa*) in the first year following grazing and an increase in rat-tail fescue. Since 2016, rat-tail fescue has been the most dominant species in Area C (**Figure 33)** and the thick litter/thatch layer it creates is likely an important factor in the low overall species diversity. Cover of EPF, comprised of common vetch (*Vicia sativa)* and Italian thistle (*Carduus pycnocephalus*) has declined somewhat since 2017 due to increased management of Italian thistle, rather than grazing.

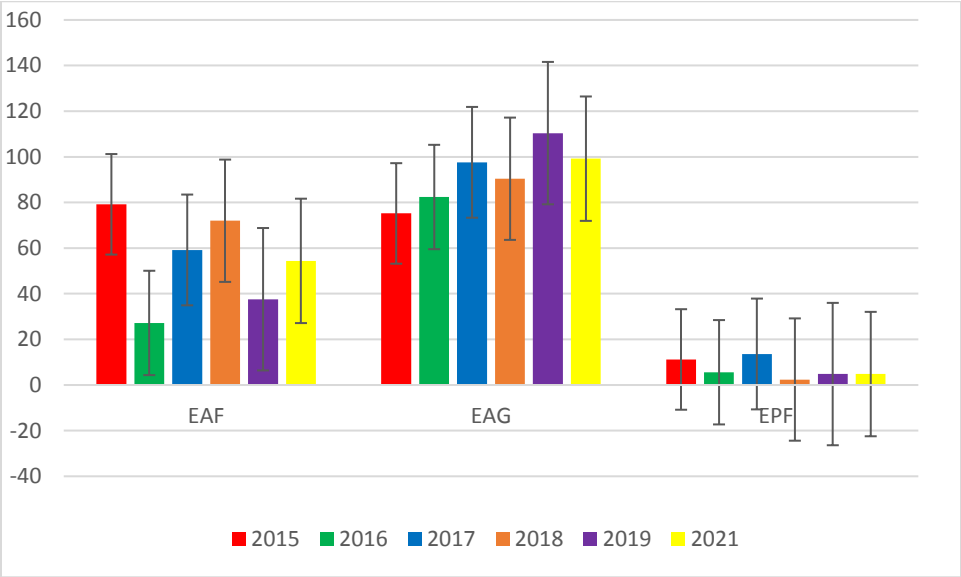


Figure 32. Mean Percent Cover of 3 Plant Guilds in Area C on April 2015-2019, 2021. Each error bar is constructed using 1 standard error from the mean.

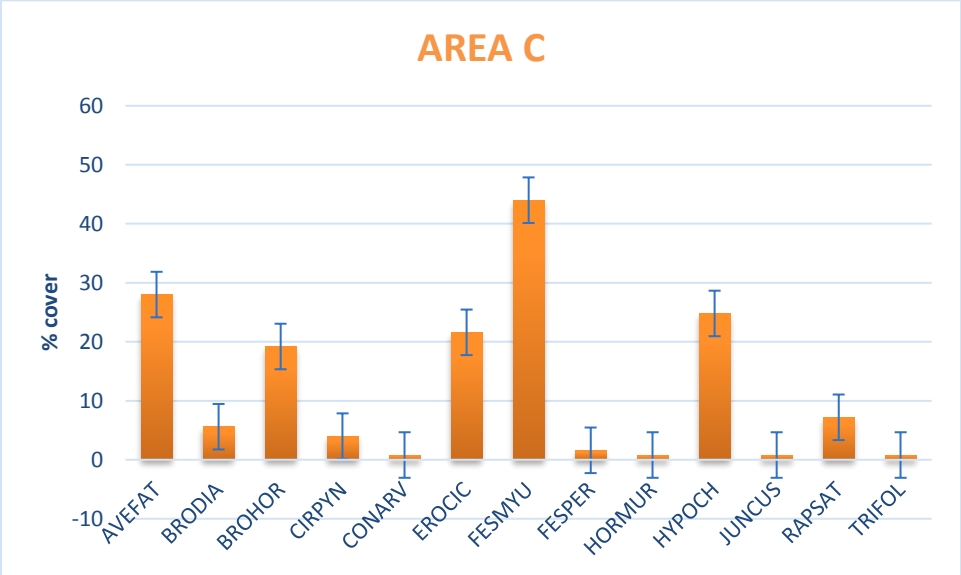


Figure 33. Mean Percent Cover of All Plant Species in Area C in April 2021. Each error bar is constructed using 1 standard error from the mean.

Area D is also dominated by non-native species and spreading rush is the only native species that has been measured on the point intercept transects across the sampling years. While cover of EAF has fluctuated over the sampling period, mainly due to changes in filaree, cover of EAG has declined somewhat (**Figure 34**). Filaree remains the most dominant species in Area D (**Figure 35**) and has been since 2016. Cover of EPF is mainly sheep's sorrel (*Rumex acetosella)* and EPG is velvet grass (*Holcus lanatus).*

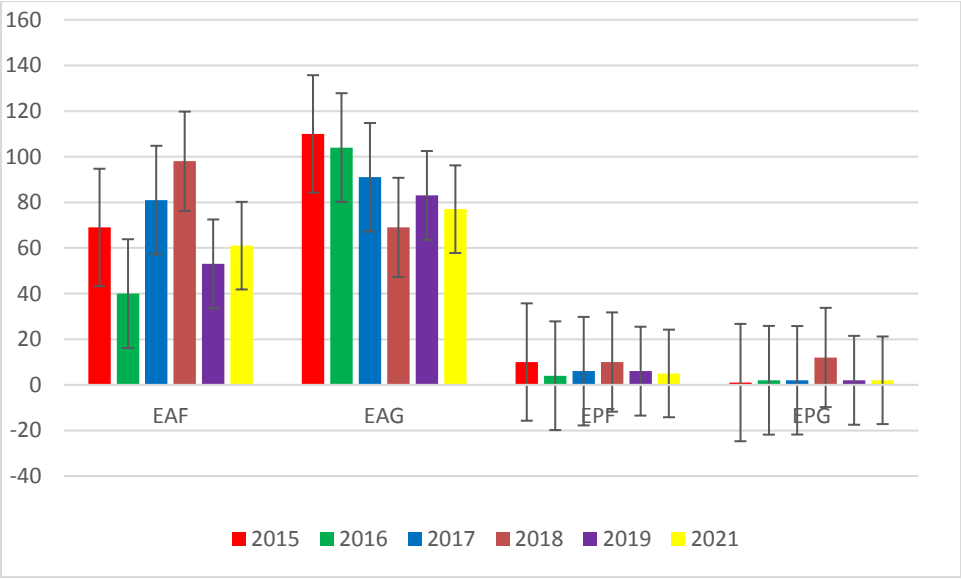


Figure 34. Mean Percent Cover of 4 Plant Guilds in Area D in April 2015- 2019, 2021. Each error bar is constructed using 1 standard error from the mean.

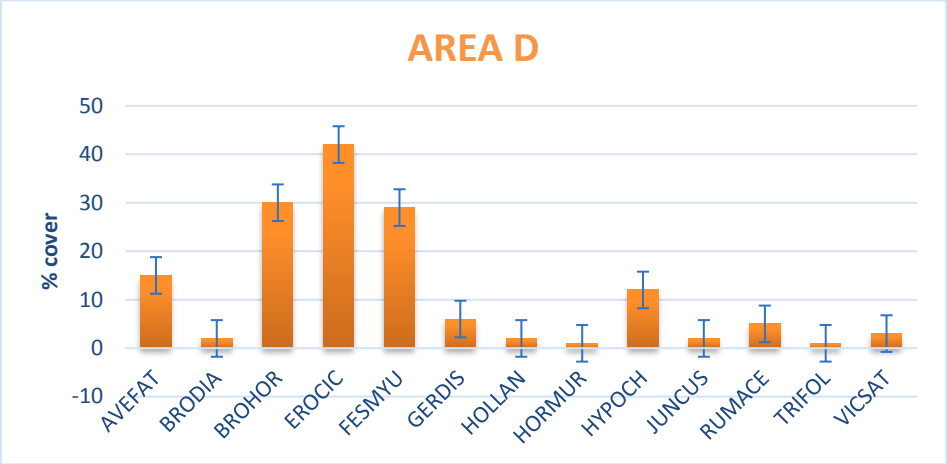


Figure 35. Mean Percent Cover of All Plant Species on Area D in April, 2021. Each error bar is constructed using 1 standard error from the mean.

Relative Native Cover. The relative cover of native species was examined by transect in Area A and it appears higher across the sampling years in Transects 10,11,7, and 8 than in the other transects (**Table 8**). Those 4 transects are located within the confines of the delineated coastal prairie habitat shown in Figure 26 in Section 5.2.2 (see page 44). When these four transects are combined, relative cover in the prairie transects is higher than in the 7 grassland transects with the exception of 2018 (**Figure 36**). Additional sampling within the coastal prairie is recommended.

Table 9. Relative Percent Cover of Native Plant Species in Each of the 11 Sampling Transects Located in Area A in April from 2015- 2019, 2021.

	Native % relative cover						
	2015	**2016**	**2017**	**2018**	**2019**	**2021**	**mean**
T1	0	0	0	0	0	0	**0**
T2	0	0	0	0	0	0	**0**
T3	7	6	2	0	0	11	**4**
T4	2	3	0	0	2	0	**1**
T6	0	0	0	0	0	0	**0**
T9	0	0	2	0	6	1	**2**
T5	7	3	3	0	0	4	**3**
T8	13	7	4	4	8	4	**7**
T7	22	13	16	2	17	18	**15**
T10	3	0	10	2	7	2	**4**
T11	12	23	24	13	16	9	**16**
Mean	**7**	**5**	**6**	**2**	**5**	**4**	

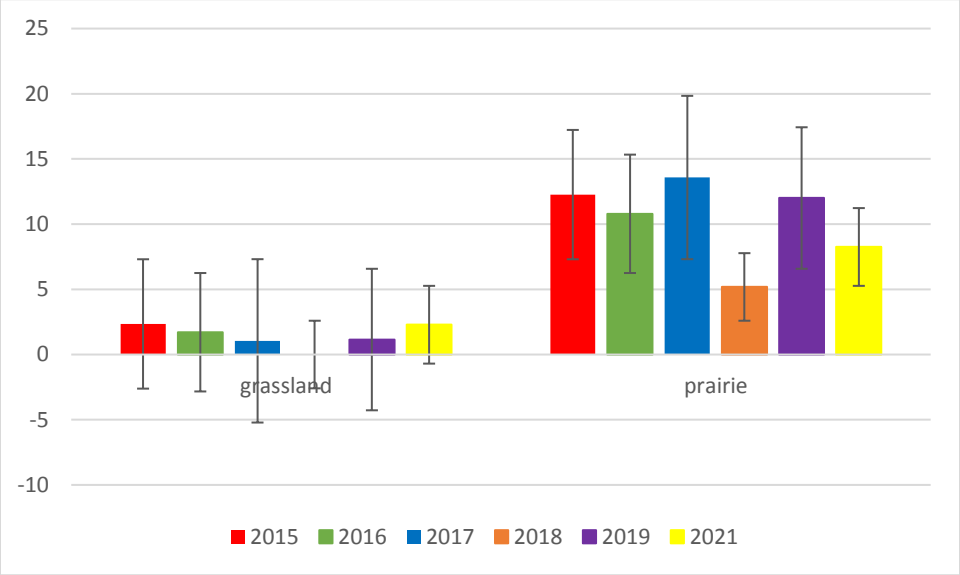


Figure 36. Relative Percent Cover of Native Plant Species in Area A in April, 2021 In Sampling Transects Located in the Coastal Prairie or the Annual Grassland. Each error bar is constructed using 1 standard error from the mean.

Species Richness. Objective 3D is to increase native species richness. Average native species richness has remained at one species or fewer across the Areas and the sampling period (**Table 10**). Very small occurrences of native species have been observed outside of the sampling plots. Increases in total species richness has been due to non-native species.

Table 10. Species Richness in Areas A, C, And D in Sampling Conducted In 2015-2019, 2021.

Species Richness	2015	2016	2017	2018	2019	2021
AREA A						
Total # species/125 m^2	11.2 (3.8)	10.5 (4.4)	12.1 (3.9)	13.3 (3.2)	13.5 (3.6)	12.8 (3.4)
# Native species/ 125 m^2	1.0 (1.1)	1.0 (0.9)	1.3 (1.0)	1.4 (1.3)	0.8 (0.8)	0.6 (0.8)
AREA C						
Total # species/125 m^2	7.4 (0.9)	10.5 (2.1)	14.5 (2.6)	12.4 (2.3)	13.2 (1.1)	10 (1.6)
# Native species/ 125 m^2	0	0.8 (1.5)	0	0.4 (.9)	0.3 (.5)	0.2 (.4)
AREA D						
Total # species/125 m^2	12.3 (1.7)	11.3 (2.2)	13.5 (3.3)	13.5 (3.3)	12.7 (2.8)	11.7 (3.3)
# Native species/ 125 m^2	0	0.8 (0.5)	0.8 (0.9)	0.75(1.0)	0.5 (1.1)	0.6 (0.7)

5.2.3 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 quantity 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.

Five years of 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 5.2.2.2) 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 planting was better than expected; 75% of SCT in the control plots and 77% in the mow 1x plots survived in Area A and produced and estimated 2,000 seeds. Although restoration plantings into sheetmulch at Younger Lagoon have very good performance, most of the species are perennial and it was not known if the practice would translate to an annual plant like SCT. While survival of the SCT planted in sheetmulch was somewhat lower (62%), the growth of the survivors greatly exceeded expectations; plants grew very large and flowered profusely. The 228 surviving SCT plants produced an estimated 50,000 seeds and was hopefully an important first step in increasing the seedbank (Goal 4). Whether or not this seed production translates into an increased population in 2022 won't be known until data on SCT recruitment within the 2021 planting is available this fall.

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. The mowing regime must be improved in the experimental 2022 planting in order to better differentiate effects from the control and additional types of sheetmulch can also be explored. Monitoring of vegetation conditions within the 2021 planted plots may provide explanatory information for observed differences in SCT recruitment among the different treatments. Mowing the 2021 plots may reduce competition for recruiting SCT seedlings and hand-weeding is recommended if volunteer labor is available. A more targeted mowing regime in Area A in 2022 is recommended to reduce seed production in non-native grasses. Shifting the vegetation monitoring to later in the season may be more informative.

5.3 Grazing and Stocking Program

5.3.1 Management Actions

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); 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 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. Fences, access gates, and other features to support cattle grazing were inspected and maintained throughout 2020.

The City's grazing contractor had cattle onsite from February 5 to July 24. 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 2021 grazing season are presented on **Table 11**.

As grazing occurred in 2021, 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 was 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.

Table. 11. Number of Cattle and Duration of Grazing Season per Grazing Area in 2021

Duration	# of Cattle in Area A	# of Cattle in Area C	# of Cattle in Area D	# of Cattle in Areas C & D (open gate)	# of months grazed
February 5 – July 24	0		0	3	6.0

Residual Dry Matter. 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:

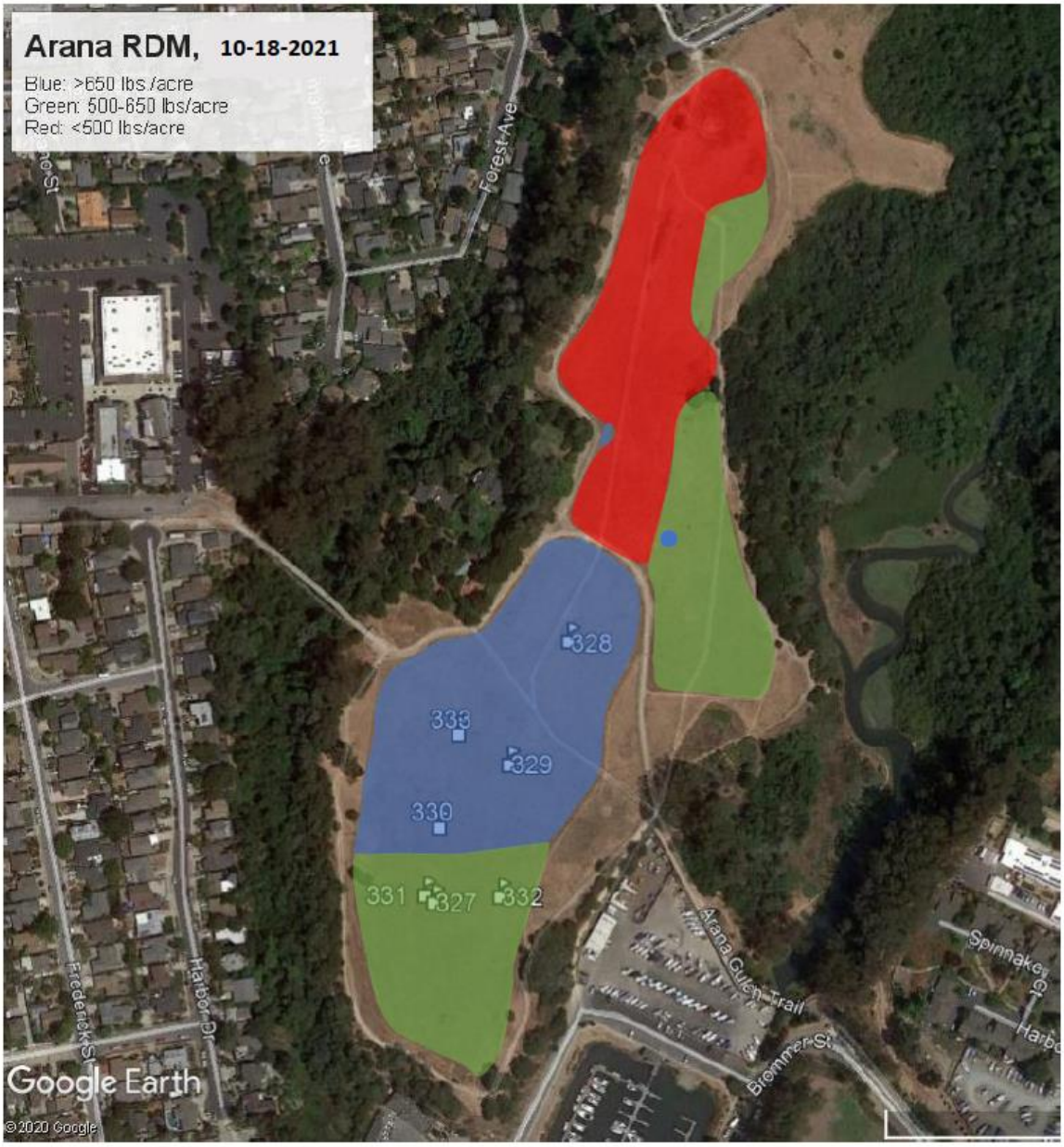
BLUE: Highest RDM (exceeds objective (>650 lbs./acre)
GREEN: Middle RDM (meets objective (500-650 lbs. per acre)
RED: Lowest RDM, below objective (<500 lbs./acre)

5.3.2 Monitoring Results

Residual Dry Matter. Within the grazed areas (Area C and D) RDM levels were mostly in the green (500-650 lbs./acre) or red, the lowest RDM (<500 lbs./acre) which reflects the effects of seasonal grazing that occurred between February and July 2021. 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.

Within Area A (not grazed in 2021), the northern portion was recorded in RDM zone blue (>650 lbs./acre), whereas the southern portion was mapped as RDM green (500-600 lbs./acre). These values are higher than previous years when cattle grazed the area.

Figure 37 exhibits the RDM map for all grazed areas (A, C, and D). **Figures 38, 39** and **40** show clip plots with highest RDM (>650 lbs./acre), middle RDM (500-650 lb./acre) and lowest RDM (<500 lbs./acre), respectively.



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 37. RDM Map for Grazing Areas, October 2021

Figure 38. Clip Plot of Highest RDM (Blue), October 2021

Figure 39. Clip Plot of Middle RDM (Green), October 2021

Figure 40. Clip Plot of Lowest RDM (Red), October 2021

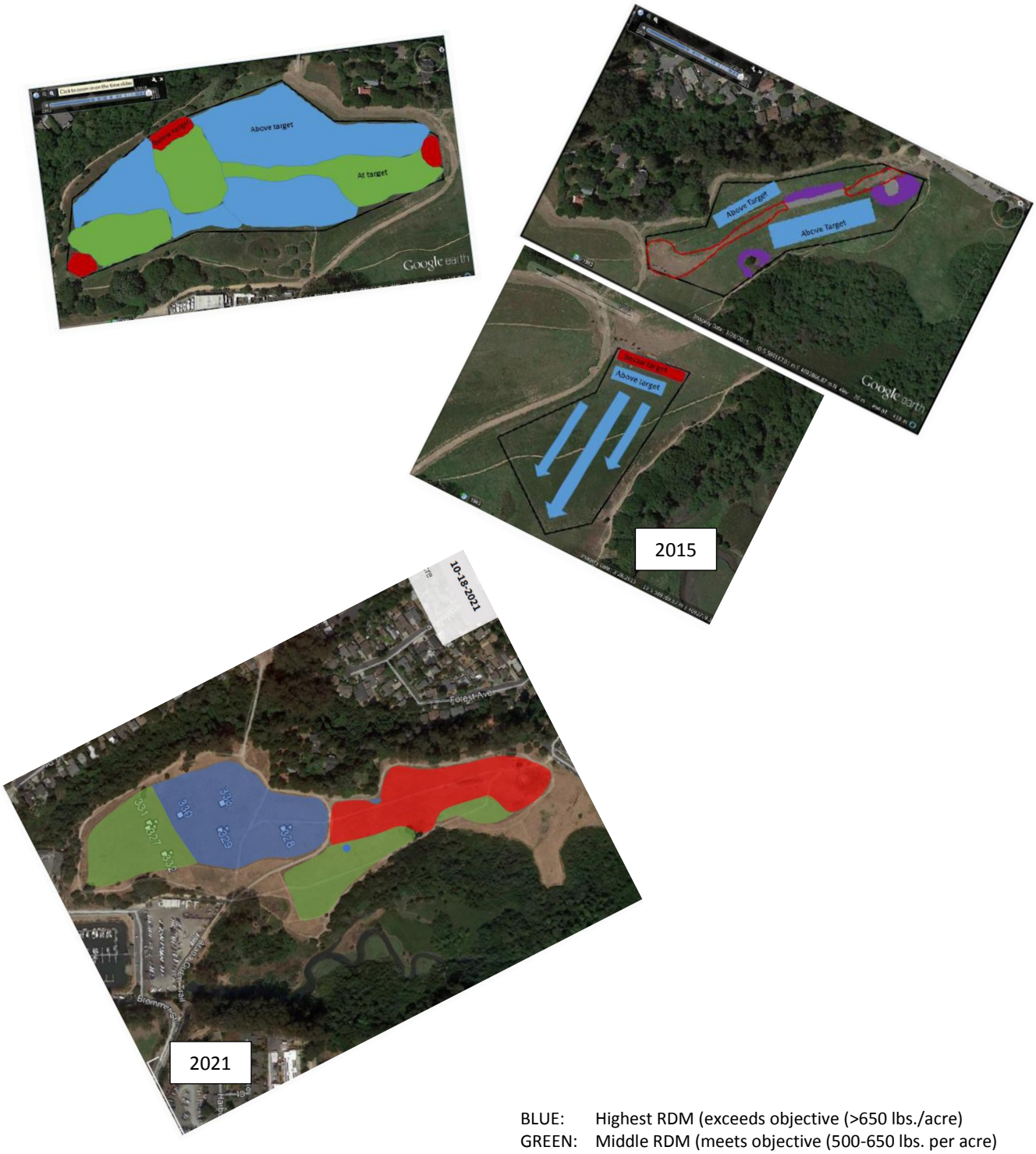
5.3.3 Discussion

In 2021, cattle grazing reduced canopy height in Areas C and D during months the cattle were on site (February through July). Grazing canopy height in mid-February averaged 2.7 inches in Area C and 6.6" in Area D. Height measurements were taken approximately 3 weeks after cattle were brought onto the site. The canopy height in Area C was within the desired target range for the SCT germination and emergence period (i.e., 2-3.5").

Compared to pre-grazing conditions in 2015, average canopy heights have been reduced in both Area C and Area D. In February 2021, canopy heights were within the target in Area C and by mid-March, canopy heights were within target in Area D. 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 2021. A comparison of RDM levels between 2015 and 2021 is presented in **Figure 41**.

Areas of lowest RDM (red) were larger in Area C since 2015. The amount of red RDM areas were reduced in Area A with the cessation of cattle grazing within this area in 2021. Green RDM levels were recorded in Area D (a reduction from RDM level blue in 2019) and the southern section of Area A (an increase from RDM level red in 2020).

The changes in biomass, canopy height, and RDM across the prairie 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 2021. 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 41. Comparison of RDM in 2015 and 2021

5.3.4 Evaluation of HMP Goals

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 Area C and Area D in 2021 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 cease cattle grazing in Area A in 2021 to accommodate the SCT Experimental Outplanting Program, as the outplanting experiments would have been adversely affected by cattle activity. Area A was periodically mowed as an alternative grassland/prairie management action.

Observations and BMP implementation monitoring of the grazing program in Areas C and D were implemented concurrent with grazing. The protocol for monitoring of the grazing program in 2021 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[6] , 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.
- 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 2021.
- The 2021 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 2021. 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.

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

- The grazing contractor avoided motorized vehicle use during rainy season/soil saturation.

The observations of natural occurrences of SCT in 2021 occurred in Area A. Area A was not subject to grazing in 2021 and occurred in an area identified with a green RDM level. Previous SCT observations were in areas with a red RDM level; however, 2021 represents a grazing-release condition, which may not be indicative of future SCT performance.

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). 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)*, Himalaya blackberry (*Rubus ameniacus)*, and milk thistle (*Silybum marianum).* The IWWP is presented in the Year 2 Annual Report, Appendix B.

In 2016 the City filled a park maintenance position with dedicated hours for Arana Gulch. Park maintenance continued throughout 2021. Despite some staffing challenges in 2021 due to the second year of the COVID-19 pandemic, City maintenance tasks included the removal of thistles (*Cirsium sp. and Carduus pycnocephalus)* from the grasslands. As per the IWWP, the City implemented control actions and if seed heads of thistles were observed, they were cut and disposed of off-site. As thistles (*Cirsium, Silybum,* and *Carduus spp.)* were previously widespread on site and control efforts has significantly reduced cover by these species. Large thickets of Himalaya berry (*Rubus ameniacus)* in Area C were mowed or weed-whipped in 2021 by Earth Steward volunteers.

5.4.2. Evaluation of HMP Goals. 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. These objectives have been met for some of the management area in 2021 (see **Table 12**).

5.5 Proposed Actions for 2022

The following actions and expected timing are proposed for 2022:

- Continue the cattle grazing program in Areas C and D, beginning in January 2022, with grazing extending to June/July, depending upon presence of SCT flowers. 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 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 2022). 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 year scrape plots and 2020 and 2021 outplanting sites for SCT seed expression.
- Conduct out-plantings of SCT seedlings in January/February 2022, using plants grown at UCSC Greenhouses, as per the 2022 SCT Experimental Outplanting plan.
- 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 2022); add transects in the mapped coastal prairie (Area A) to better document site vegetation in these areas.
- Document canopy height three times a year: February, April/May, and December 2022
- Document RDM in September/October 2022.

- Document amount of bare ground in SCT occupied areas in December 2022 (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.

Table 12. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 8 (2021) 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	21 SCT (Area A) Area A and C Outplantings	No [7]
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	SCT in Area A and Area C (natural in Area A and outplantings in Area A and C)	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 2021	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

[7] HMP acknowledges that number of aboveground SCT is not likely to increase until after grazing program is implemented; SCT increase from grazing may not be fully detected for several seasons.

Table 12. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 8 (2021) Results	Objective Met?
Goal 3. Minimize detrimental effects of high non-native plant cover and restore coastal prairie species diversity and habitat function						
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 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	There was continued decline in the cover of EAG, yet increase in EAF Total non-native cover was well above 100% in all 3 areas.	No, cattle grazing reduced cover of some non-native plant guilds and a few select species but total cover remains very high and non-native species dominate the plant communities. Additional transects to be establish in coastal prairie areas in 2022 to better document these areas.
Objective 3Bii. Cover of native perennial grasses 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	There has not been a significant increase in NPG project wide; yet release of cattle from Area A allowed NPG to recover.	No, cover of NPG remains low, except for areas mapped as coastal prairie. Additional Transects to better document coastal prairie

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

Table 12. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 8 (2021) Results	Objective Met?
						areas is proposed for 2022
Objective 3C. Increase cover of native species from baseline levels to one more representative of a reference functioning coastal prairie system by 2020.	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 Reed (2010), Hayes and Holl (2003).	No, cover of native species has not increased significantly and native plants are encountered very infrequently. Additional transects to be establish in coastal prairie areas in 2022 to better document these areas.
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	11 native species including one tree, two shrubs, two forbs and six grasses have been detected in the sampling across Areas A, C, and D.	Yes, meeting trend of increased native species richness; coast tarplant and toad rush were detected for the second time since 2016.
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	Average cover of bare ground increased in Areas A and D	Yes, meeting trend of increased bare ground in Area A and D.
	Permanent photo points with GPS location and	Before, during and post construction and	Improving	2015	Photo points established in April 2015, approximately 8 weeks	Yes, photo points were re-sampled in 2021

Table 12. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 8 (2021) Results	Objective Met?
	compass direction	then yearly at peak growth			after initiation of cattle grazing.	
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 and then assessed every 5 years.	Seed bank density (#of viable ray achenes)	Yearly	Increase	2015	No viable seed in Areas B and C; viable seed found in Areas A and D	Seedbank not reassessed; however experimental SCT outplantings are intended to increase soil seedbank.

6. Habitat Management and Monitoring - 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, consistent with Goal 5 of the HMP and 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.

In 2021, the City monitored visitor use activities in this area. No other management plan actions occurred.

6.1 Management Actions

6.1.1 Bridge Construction Project

Management actions associated with the bridge construction project were in place until the completion of bridge construction, which was December 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 bridge project. This plan was contained in the Year 1 Monitoring Report. The plantings, six native California roses (*Rosa californica)* were planted near the Arana Creek causeway in 2018.

6.1.2 Integrated Pest Management (IPM)

The extent of invasive plant species was mapped in the management area in 2017. The following species were identified in the gulch: eucalyptus (*Eucalyptus sp.)*, elm (*Ulmus sp.)*, poplar (*Poplar sp.)*, privet *(Ligustrum sp.)*, English ivy (*Hedera helix)*, Cape ivy (*Delairea odorata)*, nasturtium (*Tropagaluem majus)*, Himalaya berry (*Rubus ameniacus)*, French broom (*Genista monspessulana)*, poison hemlock (*Conium maculatum)*, Monterey pine (*Pinus radiata)*, cotoneaster (*Cotoneaster sp.)*, and *Prunus.* The distribution of invasive plant species is depicted on **Figure 42**.

6.1.3 Fire Hazard

No fire hazard management actions were implemented in 2020; however, the invasive plant removal reduced cover by invasive, non-native plant species which reduced the fire hazard within the areas treated.

6.1.4 Wildlife Protection

Prior to construction of the bridge over Hagemann Gulch, measures were implemented to avoid impacts to wildlife. These measures were completed in 2014. With the exception of surveying for nesting birds prior to vegetation management actions, no additional wildlife management actions were implemented in 2020.

6.1.5 Appropriate Uses in Hagemann Gulch

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. Branches were placed to block areas that appeared to be used for unauthorized access to the riparian area.

6.1.6 Rose of Castille Bushes

The "Rose of Castille" bushes located near the Hagemann Gulch bridge construction area were relocated to City Hall in 2013, in consultation with the City Arborist. The roses receive regular maintenance and care and are thriving in their new location. Staff has decided that adding interpretive signage is too risky and may lead to vandalism or theft. The potential risks to the plants outweigh the educational benefits from the signage.

Figure 42. Updated Distribution of Invasive Plant Species, Hagemann Gulch Management Area

6.2 Monitoring and Performance Evaluation

6.2.1 Monitoring Methods

No actions.

6.2.2 Monitoring Results

No actions.

6.2.3 Evaluation of HMP Goals

Table 13 presents a summary of the biological variables monitored, the Year 8 (2021) 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 2021.

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 2021

The following actions and expected timing are proposed for 2022:

- Monitor appropriate uses within Hagemann Gulch through periodic police patrols (January– December 2021).
- Continue to remove and control invasive, non-native plant species within the management area, as resources allow.

Table 13. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 8 (2021) 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 2021	Partial compliance; non-native thickets have been controlled within management area

Table 13. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 8 (2021) Results	Objective Met?
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
Goal 4. Increase appropriate uses in Hagemann Gulch					
Objective 4A. Observe the condition of all improvements at least 4 times per year in	Observation of infrastructure conditions	4x per year	Stable	Stable	Park staff periodically inspected the area in 2021; issues of illegal

Table 13. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 8 (2021) Results	Objective Met?
the first 3 years and at least twice a year thereafter.					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. Habitat Management and Monitoring - 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 2021.

7.1.3 Integrated Pest Management (IPM)

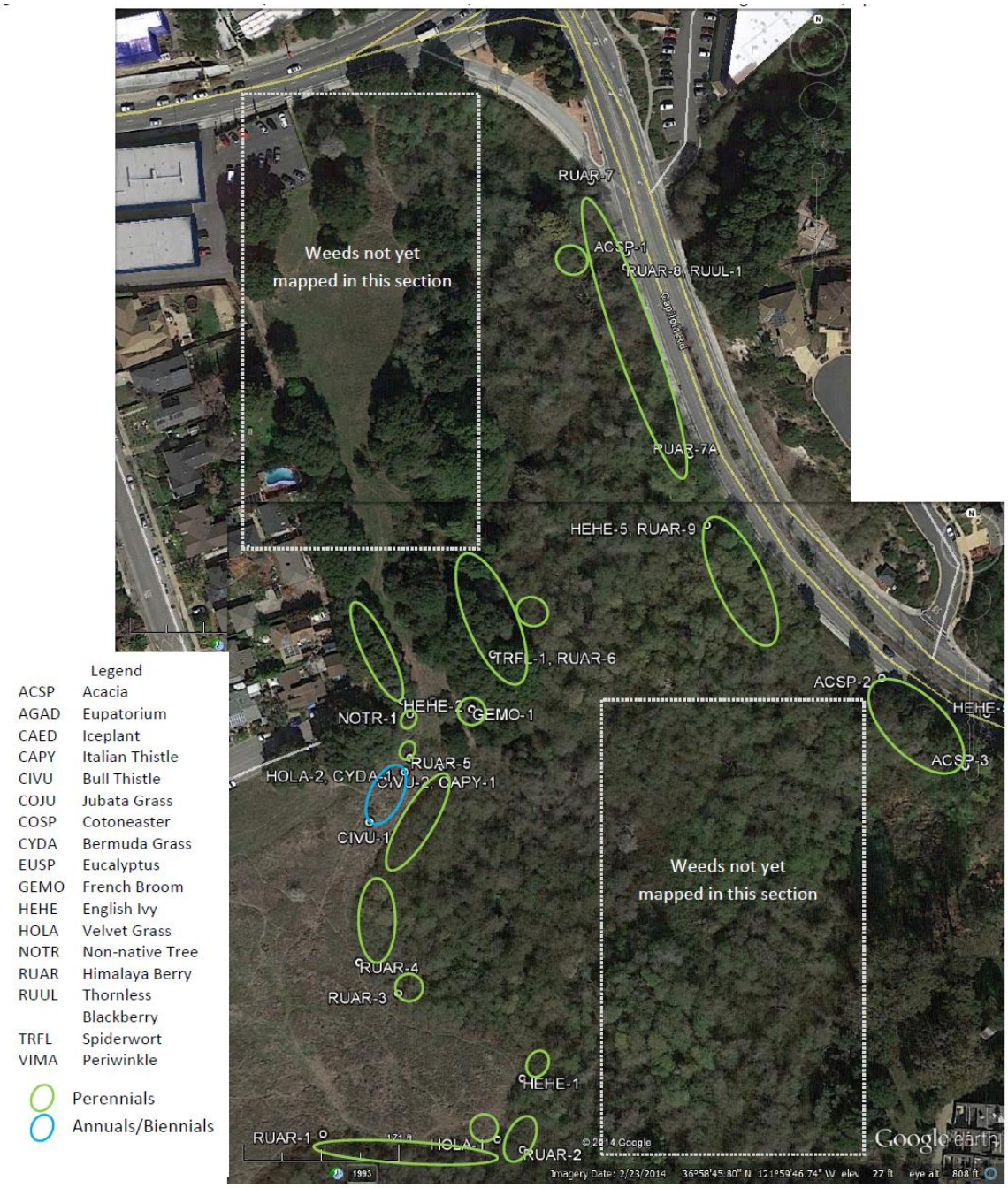
In 2014 and 2015, mapping of invasive weeds within this management area was initiated. The mapping is to guide future management activities for species removal/ control. The approximate size, density of plants (dense, moderate, and sparse) and the location of each non-native invasive species patch was documented using GPS and mapped on aerial photos. A map of data collected, and updated in 2019, is presented in **Figure 43A-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 2021, 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 43A. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

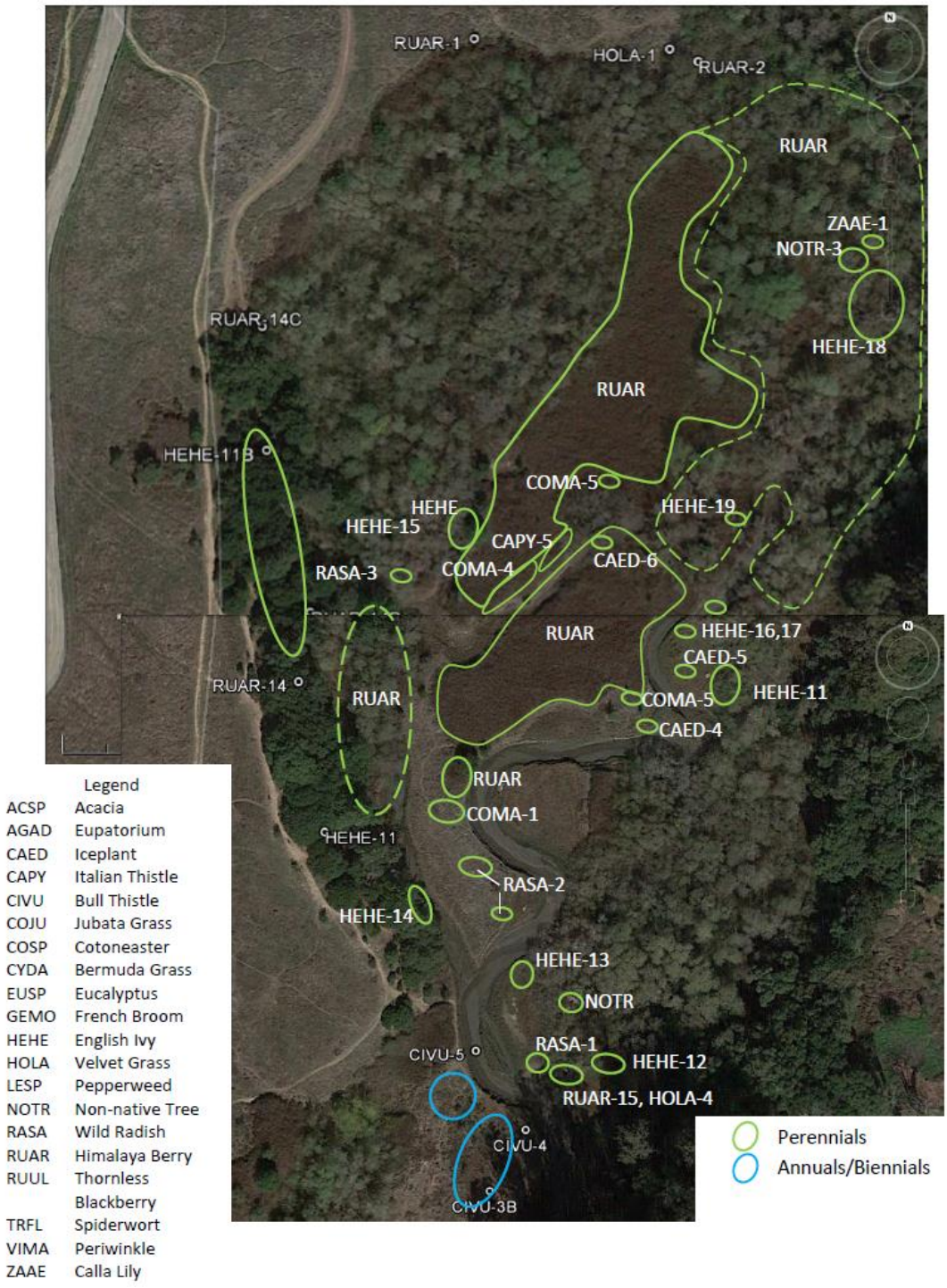


Figure 43B. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

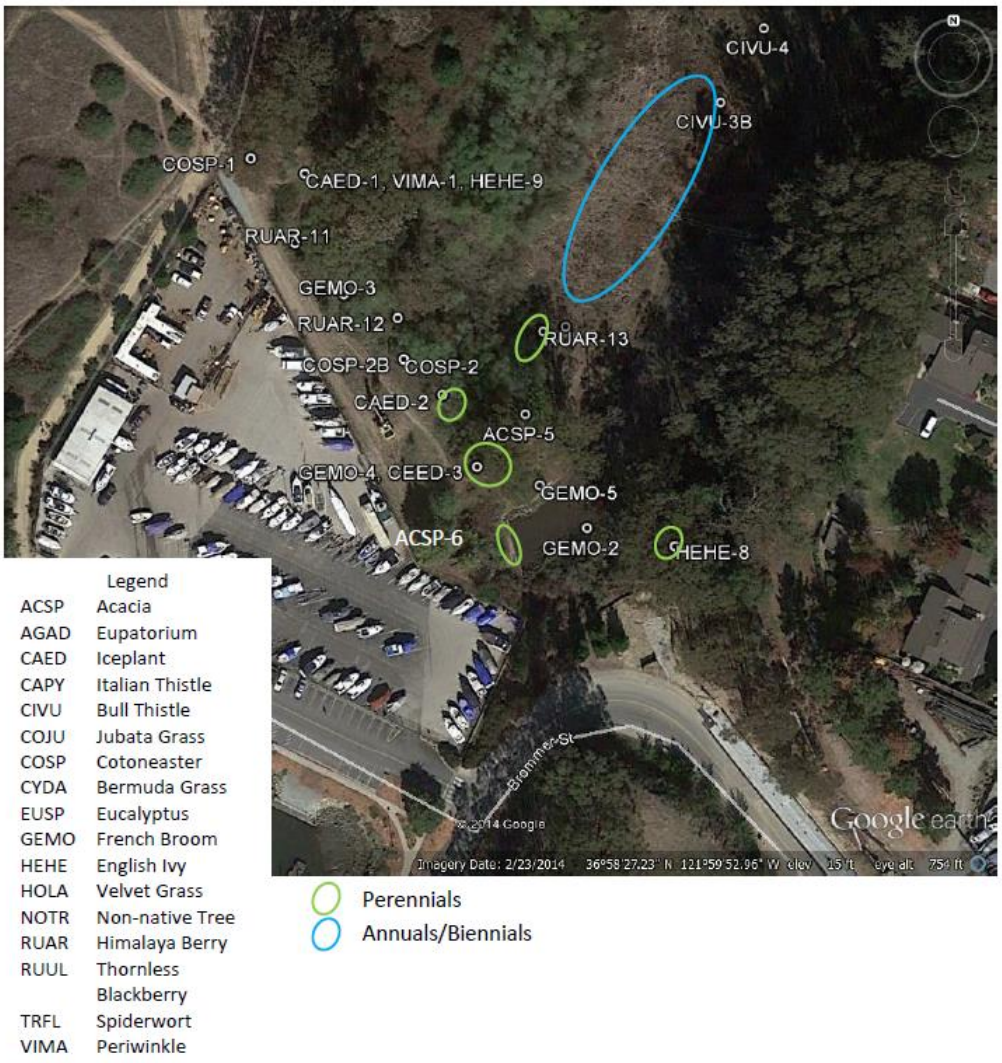


Figure 43C. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

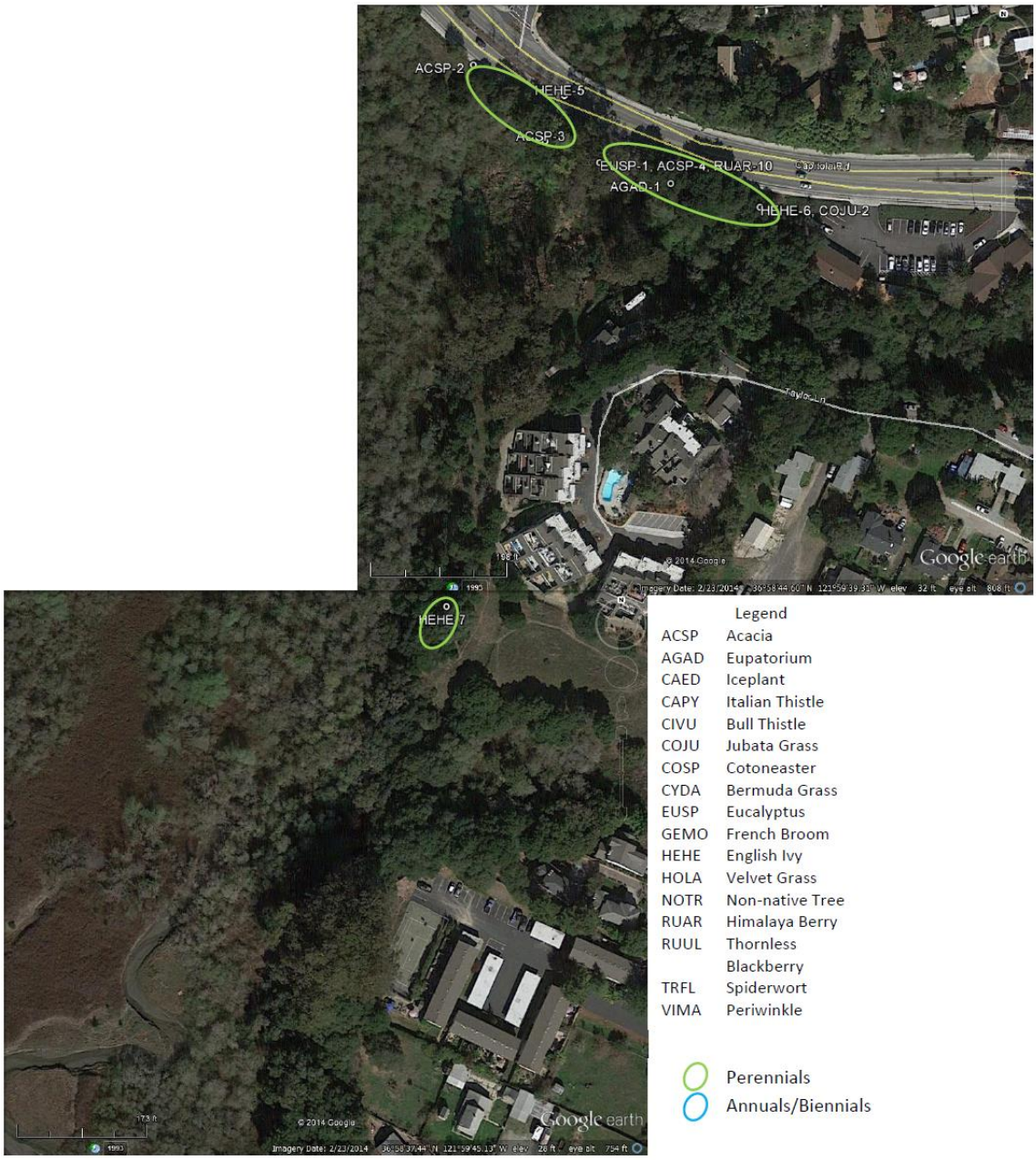


Figure 43D. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

7.1.4 Coordination with the RCDSCC

No actions between the City and the RCDSCC were conducted in 2021.

7.2 Monitoring and Performance Evaluation

7.2.1 Monitoring Methods

No monitoring was performed in 2021. 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 8 (2021) 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 2022

The following actions and expected timing are proposed for 2022:

- Be available to engage with the RCDSCC on their watershed and greenbelt projects, as proposed by the RCDSCC. (January– December 2021).
- Continue to remove and control occurrences of invasive, non-native plant species within the management area.

Table 14. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 8 (2021) 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 2021.	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 2021.	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 2021.	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 along the tidal reach of Arana Gulch Creek.	Funding level for the tidal reach restoration	Yearly	Obtain/increase	No action in 2021.	No

Table 14. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 8 (2021) Results	Objective Met?
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 2021.	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	No action in 2021	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 8 and Recommendations for Year 9 (2022)

8.1 Conclusions from 2021

The City continued implementation of the HMP in 2021 (Year 8). Actions were conducted in all of the management areas; however, some actions were hampered by the continued COVID-19 pandemic which affecting City staffing. Cattle were grazed in the grassland in Areas C and D for SCT and overall grassland management. Area A was mowed for grassland/prairie management. An experimental SCT outplanting plan was implemented, with SCT outplantings installed in Areas A, C, and D. The surviving SCT outplantings in Areas A and C produced over 5000,000 seeds which were released into the soil seedbank. There was effective and efficient coordination between the City and the AMWG in 2021 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 Areas C and D from February through July. 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 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. Flail 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 2021. Twenty-one SCT plants were documented from three colonies in Area A in August 2021. No natural occurrences of SCT were found in Areas B, C, or D. The HMP objective of reaching 348 plants was not met in 2021. An SCT Experimental Outplanting plan was developed and implemented in 2021, wherein 1,000 SCT plants were installed on site in January and February 2021. The experimental SCT outplantings yielded mature SCT plant in Areas A and C. None of the SCT outplantings in Areas D survived to maturity.

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 2021, by way of police patrols and City staff actions to monitor visitor uses.

8.1.3. Adaptive Management and Public Outreach

The City engaged with the AMWG in 2021 through field and web-based meetings in March 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, 2020 to June 30, 2021 and fiscal year July 1, 2021 to June 30, 2022. 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 2022

The City will discuss with the AMWG recommendations for management actions for 2022 at a minimum of two meetings in 2022. 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 2022 (Year 9) 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 Areas C and D. Periodic grassland mowing will occur in 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 2022.

Naturally-occurring colonies, as well as recruitment of SCT plants from the 2021 outplantings, 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 2022. The City will consider implementing additional management actions to encourage SCT seed expression.

8.2.2 Hagemann Gulch Riparian Woodland Management Area

HMP activities identified for 2022 (Year 9) 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 2022 (Year 9) will be continued removal and control of invasive, non-native plant species.

8.2.4 AMWG and Public Outreach

In 2022 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 2022. The City has allocated funds for fiscal year July 1, 2021 to June 30, 2022 and funding for fiscal year July 1, 2022 to June 30, 2023.

Table 15. Timeline for Habitat Management Actions Proposed for Year 9 (2022)

	2022												2023
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													

Table 15. Timeline for Habitat Management Actions Proposed for Year 9 (2022)

	2022												2023
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, 2021

NOTE: Please see the separate Appendix document

A-1: AMWG Meeting Minutes for:

June 22, 2021
November 4, 2021

Appendix B Coastal Prairie/Santa Cruz Tarplant Management Area

NOTE: Please see the separate Appendix document

B-1. Plant Cover Data, SCT Sites

B-2. Photo Monitoring