Arana Gulch Habitat Management Plan
City of Santa Cruz

Year 7 (2020) 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)

April 12, 2021

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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) and Year 6 (2019) Annual Reports. Actions implemented in Year 7 (2020) are described in this report. The AMWG provided input to the City during the implementation of the Year 7 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 7 (2020), 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. Scrape plots created in November 2019 (within historical SCT areas) were field-checked for evidence of stimulated SCT seed expression. 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 plants for outplanting in January/February 2021 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 were affected by the global Coronavirus (COVID-19) pandemic. A County and State mandated stay-at-home order issued in mid-March 2020 affected City staff's ability to conduct some spring-season field operations. In addition, 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 a virtual meeting (computer-accessed meeting).

The habitat management activities undertaken in 2020 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.

Summary of Coastal Prairie/Santa Cruz Tarplant Management Area Activities

Management actions in Year 7 included seasonal grazing and seasonal mowing. 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. Cattle grazing commenced in mid-March and extended to mid-June. The start date was later than previous years due to contracting issues with a new rancher. In addition, grazing was conducted as a cow-calf operation, which differed from previous years. Additional activities in this management area included monitoring plant composition, plant cover, canopy height, and residual dry matter (RDM) within grazed areas, implementing removal/control of invasive weed infestations, and documenting site conditions at previously established permanent photo stations. Cattle-rubbing posts installed in 2016 were monitored to see if cattle congregation created bare areas for SCT; a small area of bare ground was found around these posts. In summer, previously 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, and a scrape plot created at the Arana Gulch – Agnes Street trail junction (small island) to stimulate coast tarweed seed expression.

Grassland site conditions were documented in May 2020. A modified assessment methodology was approved by the AMWG wherein point-intercept transects were used to assess site conditions within the 2019 experimental scraping and adjacent un-scraped areas. Photo-documentation was also conducted in April. Canopy heights were measured in February, May, and December. Additionally, residual dry matter was assessed in September. The data was collected amid a slightly below average rainfall season.

As per guidelines in the HMP, seasonal mowing was conducted for grassland/prairie areas located outside the grazing fences in June. 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 more often from June -September. Mowing was also conducted in the northern portion of Area A and in Area C to reduce weed growth (primarily wild radish). A flail 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 ensure to maintain some tall grass for birds to hide and nesting as per previous recommendations from the Santa Cruz Bird Club. Colonies of native plants were flagged so mowing could avoid these occurrences. Blue bird nest boxes installed in 2018 continued to be monitored by the Santa Cruz Bird Club, with positive nesting activity recorded in some boxes.

A census of SCT was conducted in late spring, summer, and early fall 2020. On June 5th, 17 young SCT plants were observed in Area A; however, by July 8th, only one plant survived to flower and seed set. As the area of SCT was subject to cattle grazing, it is assumed that the other plants were eaten/browsed by the cattle and died. The one surviving SCT is a decrease from 50 plants in 2019 and 267 plants in 2018, yet an increase from 0 plants in 2017. The 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. Increasing the SCT population to above the 2006 population level of 349 plants[1] is an HMP goal. The one SCT plant in 2020 is below the HMP target. To date, site management has not resulted in the number of SCT meeting the HMP goal. In addition, there were an insufficient number of SCT plants to allow collection of SCT seed (minimum of 50 plants is required as per CDFW agreement). However, under an agreement between the City and the University of California, Santa Cruz (UCSC), seed collected from plants in 2018 was used to grow plants for an outplanting. Twenty-eight plants grown at UCSC were installed in Area C in January 2020. These outplantings were monitored in 2020. By late summer, 5 of the 28 outplantings survived and were in flower/set seed. The remainder of the plantings died, most from gopher predation/disturbance. In November 2020, the City entered into an agreement with UCSC Greenhouses to grow more SCT plants for outplanting. To date, 1,000 plants are being grown, with an outplanting scheduled for January/February 2021.

In November, the City and some AMWG members visited the Shaw property in Aptos to review grassland restoration actions. The group viewed grassland areas that were restored through mowing and focused weed control and discussed management actions that might be suitable for Arana Gulch.

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

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

plant species within the central prairie/grassland. The City continued to remove/control cotoneaster, Himalaya blackberry, and English ivy from the prairie and removed basal rosettes and flowering stalks from thistles. Expanses of wild mustard 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 2020, 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 COVID-19 pandemic and County and State public health restrictions, there were no volunteer work days.

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. 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.

Management Activities Proposed for 2021 (Year 8)

The following management actions are identified for 2021:

- Implement an SCT Habitat Enhancement Work Plan, which identifies seasonal mowing in Area A and 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 2019 outplanting site in Area C.
- Consider implementing interim grassland management actions in Areas C and D (i.e., focused mowing or other management) if cattle grazing is delayed and canopy height levels are above the target objective of 2-3 inches (5-8 cm) between the months of November thru April. Within SCT areas monitor the amount of bare ground present in November/December, which coincides with the germination period of SCT.

- Implement year-round experimental 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 2021, including survival of SCT outplantings. 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 scrape plots created in Areas A, C, and D for any 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 2021 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 7 (2020) 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 2020, the SCT population decreased to one plant (natural occurrence) and 5 outplantings (plantings in Area C) reaching maturity. This is a decrease from 2019 when the SCT population was 50 plants, and a further decrease from 267 plants in 2018, yet is a very slight increase from 0 plants in 2017. Although 17 SCT seedlings germinated in 2020, only one survived to maturity. This limited presence of SCT is of concern and was the impetus for the City to develop a SCT Habitat Enhancement Work Plan in fall 2020 that evaluates other land use and management actions for recovery of the species.

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 2020, 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 7th 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) and Year 6 (2019) 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 2020 which is considered to be Year 7 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 8 (2021) 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], and Year 6 [2019]) 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 2020. Two meetings were held with the AMWG in 2020; the minutes from the March 2nd and October 22nd 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 October meeting was conducted in two parts – a field meeting and then a computer-viewed meeting. The City also facilitated a field trip for AMWG members to see the Shaw property in Aptos to aid in evaluating grassland management actions. 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 2020. 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 2020 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 2020.

The AMWG 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. Due to COVID-19 restrictions, there were no public/group work days on site.

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

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 2020, two meetings were held with the AMWG (March and October) and there was email correspondence with AMWG members to present information and solicit feedback. The City also included AMWG members in a field trip to the Shaw property to view and discuss grassland management. The City dedicated funding to implement the habitat management actions identified in the HMP based on a prioritization recommended by the AMWG in 2014. The City and the AMWG re-visited HMP management actions in 2020, particularly the role of cattle grazing and prairie/SCT recovery. The AMWG Provided input to the City during the development of the SCT Habitat Enhancement Work Plan.

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 2020, such as seasonal grazing 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 Santa Cruz tarplant with an objective of increasing the number of aboveground SCT to at least the 2006 level (348 plants) by 2016 (first year after grazing). Although management actions are being implemented to increase the number of aboveground SCT, the project has not met this target. Only one SCT reached maturity on site in 2020, which is below the goal. SCT outplantings occurred on site and 5 of these plants reached maturity, bring total SCT plant count to 6 plants. 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 third adaptive management goal is to develop educational opportunities within Arana Gulch, with efforts to conserve and restore its rare resources. 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 2020, and whether the actions were in compliance with the HMP.

Table 1. Monitoring of Adaptive Management Variables

Objective and Variable	Actions in Year 7 (2020)	Year 7 (2020) 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 March 2 and October 22	Meeting minutes presented in Appendix A	Yes, two meetings in 2020. Email correspondence was conducted with AMWG members periodically in 2020
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, 2019 to June 30, 2020 and July 1, 2020 to June 30, 2021	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 (not reached in timescale) 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	Scrape plots created in 2019 were monitored; outplantings of SCT monitored; additional studies identified for 2021	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.

Table 1. Monitoring of Adaptive Management Variables

Objective and Variable	Actions in Year 7 (2020)	Year 7 (2020) Results	Objective Met?
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 2020 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 (*Deinandra corymbosa)* 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 2020. No erosion was noted in these areas and no additional seeding was conducted in 2020. 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)*.

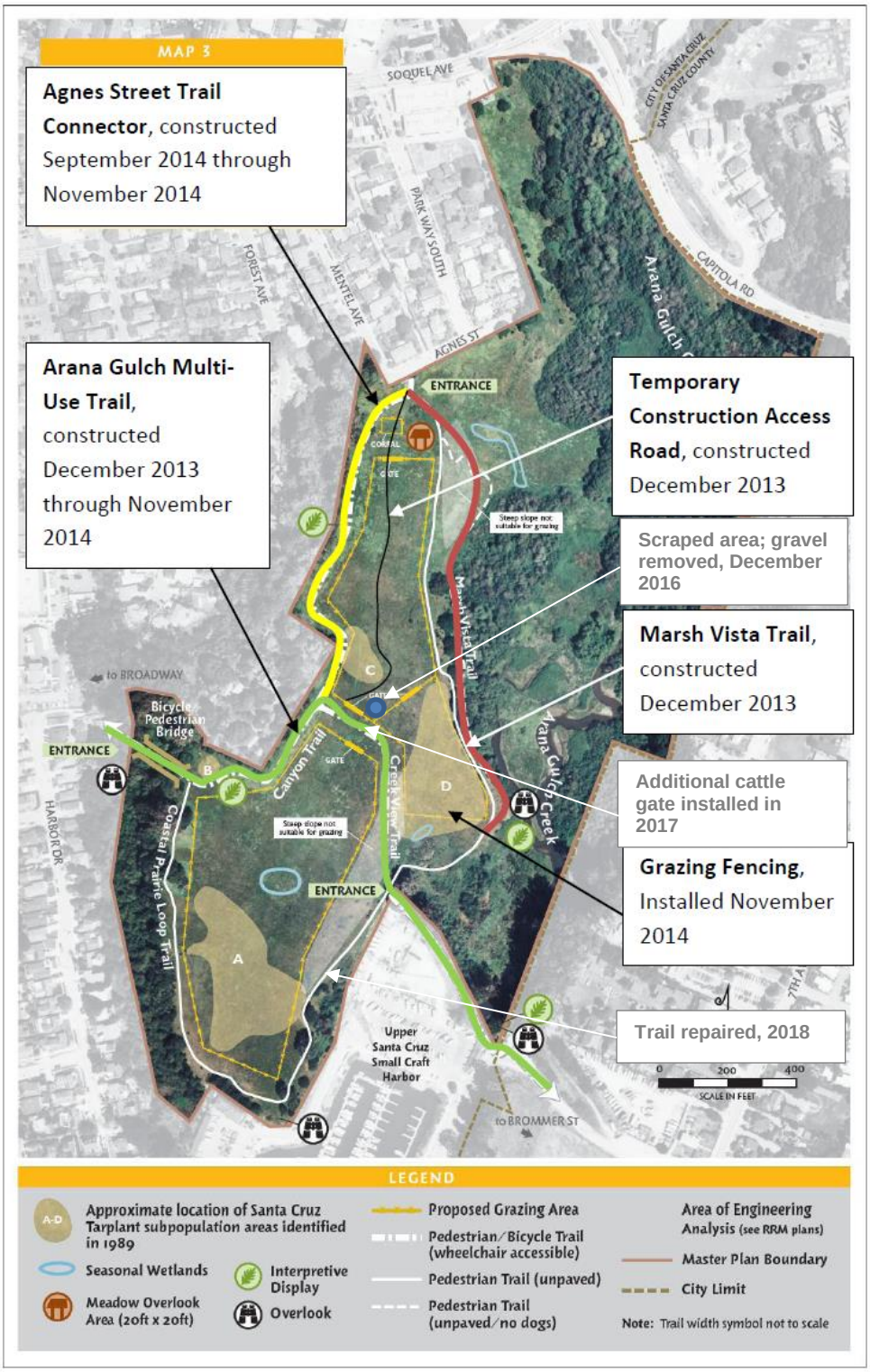

Figure 2. Master Plan Improvements, 2013 - 2020

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**.

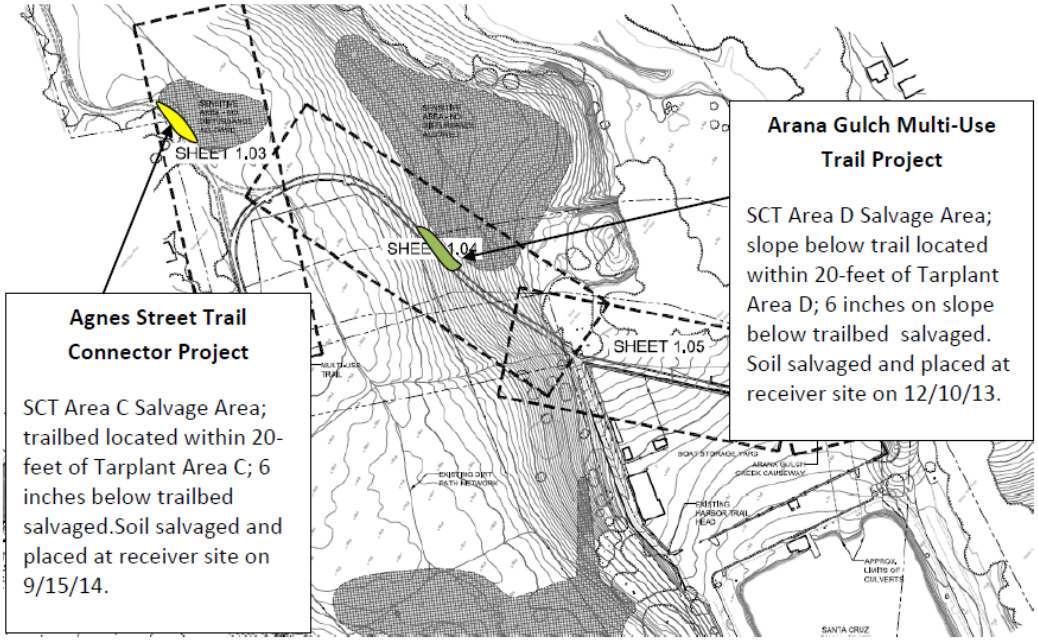

Figure 3. Location of Multi-use Trail Soil Salvage Sites, 2013 and 2014

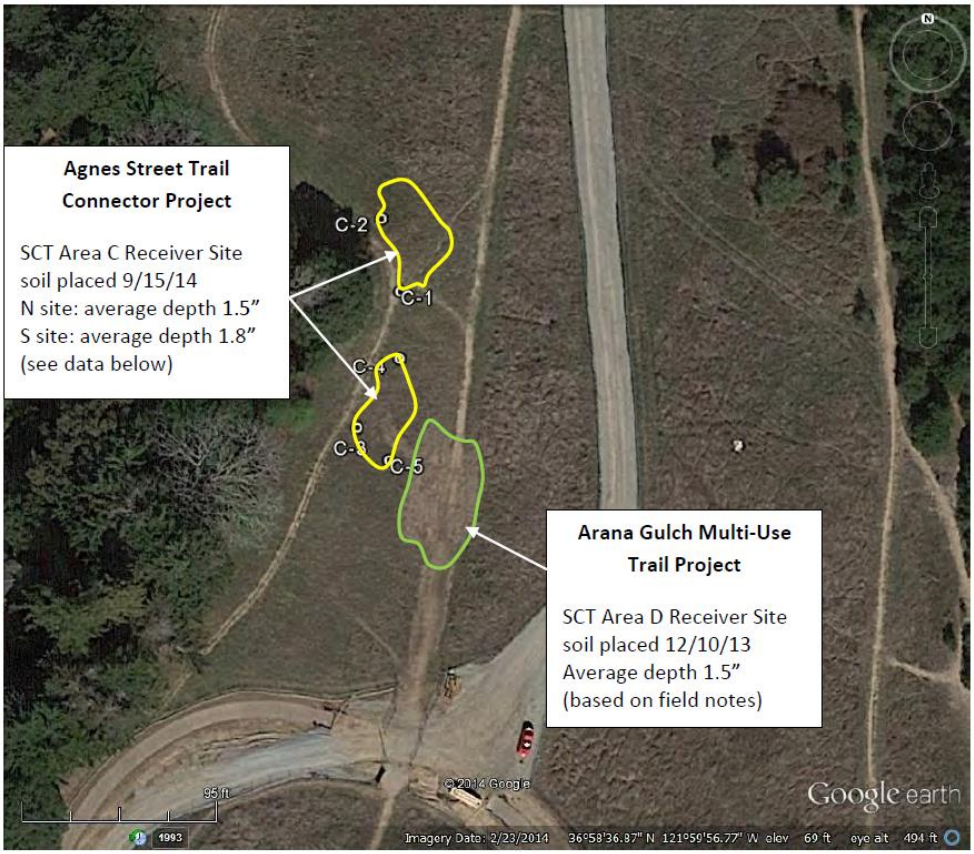

Figure 4. Multi-Use Trail Soil Receiver Sites on Aerial Photo, 2013 and 2014

In 2020, 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 2019; therefore, in January 2020, SCT outplants grown by UCSC Greenhouses were installed in the northern receiver site area. 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 2020.

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 2020.

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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 2019/20 and found that they continue to be effective.

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. Despite a delay in getting cattle on site until March 2020, per an agreement for cattle grazing with a local cattle rancher, cattle were brought onto the site as per the HMP Grazing Program and Stocking and Work Program. See Section 5.3 for more information on the 2020 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 2020 included cattle grazing, perimeter mowing, grazing area mowing, monitoring of grazing actions, monitoring natural SCT germination and growth, monitoring survival and growth of 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 and City consultants implemented these tasks. In addition, the City and UCSC Greenhouses coordinated on SCT seed and SCT plant propagation.

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 Habitat Enhancement Work Plan 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 2021 are discussed in Section 5.5.

5.1 Santa Cruz Tarplant

Several management actions for Santa Cruz Tarplant (SCT) were implemented in 2020

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 Areas A, C and D (and surrounding grassland), and seasonal

mowing of Area B, and portions of Area A. Areas A and C were grazed between mid-March and mid-June 2020. Further details on the grazing program can be found in Section 5.3. Area B was mowed approximately monthly from June to September each time the grass grew more than 8 inches in height.

5.1.1.2 SCT Habitat Enhancement Work Plan. The 2019 vegetation assessment determined that the current 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. 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 in the plan; however, the large CZU Complex wildfire occurred in the Santa Cruz Mountains in summer/fall 2020 and City Fire Department expressed concern that the Monterey Bay Air Resources District was unlikely to approve burn permits due to air quality impacts for the regional wildfires.

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 is described herein.

Table 2 summarizes the SCT population size and management actions that have occurred since the City acquired the property in 1994. Actions have including mowing/raking, mechanical and hand scraping, and prescribed fire. One accidental fire has occurred and grazing was implemented in 2015.

Table 2. Santa Cruz Tarplant (SCT) Population Size and Management Actions 1994-2020

Arana Gulch		Management Action			
Year	**# SCT**	**Mow/Rake**	**Scrape**	**Fire**	**Grazing**
2020	1	Area C Area A (N portion)			March-June
2019	50		Nov – 6 plots A 3 plots D, 1 C		Dec-June
2018	267				Jan-June
2017	0				Feb-June
2016	35				Jan-May
2015	0				March- June
2014	4				
2013	0				
2012	16	June			
2011	32	May/Oct	Oct 3 plots		

Table 2. Santa Cruz Tarplant (SCT) Population Size and Management Actions 1994-2020

Arana Gulch		Management Action			
2010	0	May/Oct	Oct X plots		
2009	68	May/Dec			
2008	44	April/Nov			
2007	27	April/Nov			
2006	348	Oct			
2005	1,552	Experimental actions			
2004	797	Experimental actions			
2003	2,536	Experimental actions			
2002	10,230 mostly in scraped areas	Experimental actions			
2001	619	May/Aug	June/Aug	June/Oct	
2000	1,053	May			
1999	1,228				
1998	12,800 (65,000?)	yes		Oct Rx fire north of A	
1997	35,000 in scrape/fire			Oct Rx fire	
1996	7,420 in scraped area	May		Arson fire Oct	
1995	0	May-June	Bulldozer 3ac June		
1994	0				

Summary of Past Management Actions. A summary of previously implemented management actions is presented below, as prepared by Alison Stanton.

Scraping/Fire. Of all the different management tools that have been applied at Arana Gulch, soil scraping, with or without prescribed fire, has produced the most positive response in the SCT population. In June, 1995 a bulldozer scraped 3 acres in the middle of Area A. The following summer, over 7,000 SCT were found within the scraped area. Later the same season, a high intensity arson fire burned about half of the scraped area in October. In the summer of 1997, around 35,000 SCT individuals were found in the area that had been scraped and burned. The combination of the accidental fire with scraping was apparently very successful. However, it should be noted that these treatments were applied in single large blocks so results may reflect spatial differences in seed bank density rather than the relative effectiveness of each treatment. A prescribed burn conducted in October 1998 "north of Area A" and without any scraping was likely conducted in Area C and did not result in SCT recruitment.

In 2001, Bainbridge conducted a variety of experimental treatments in 20x20 meter plots comparing scraping, mowing, and burning. According to the unpublished report (Bainbridge 2003), scraping occurred on June 6 and August 7, 2001, mowing on May 24 and August 2, and burning occurred on June 19 and October 18, 2001. A "spring burn" may have also occurred, but no date was provided. Scraping resulted in a density of 20-26 SCT/m^2 regardless of timing., mowing yielded no SCT, and the burning resulted in <1 SCT/m^2. Scraping also resulted in greater cover and richness of other native species. However, the study noted that "both the early and fall burn treatments were not adequate to remove the thatch layer. Fire should not be eliminated as a possible restoration technique until fires hot enough to consume all fuel in the plots have been tested. Hotter or earlier burning may result in better removal of biomass and better SCT recruitment."

In November 2019, mechanical scraping was implemented using a standard wheel loader to remove the topsoil to a shallow depth of 1-2 inches. The 2019 Habitat Enhancement Plan specified an experimental design for a scrape-only management scenario. Prescribed fire was also considered, but there was insufficient time after receipt of the work plan to adequately coordinate and provide public notice for such an action. Six 30 x 30-foot plots were scraped in and around recently occupied SCT coastal prairie habitat in Area A and 3 plots were scraped in Area D. A single 30 x 50-foot plot was scraped in Area C in the historic SCT area (**Figure 5**).

Figure 5. Scrape Plots
In the southern portion of Area A (orange) 6 scrape plots were installed (green squares represent 30 x 30 ft. plots.) Area A north (yellow) has not supported SCT and was not scraped. Area C (blue) received a single 30 x 50ft scrape plot. Area D (red) received 3 scrape plots (30x30ft.). The dots in south Area A are locations were SCT was found in 2019.

Mowing. Mowing has occurred at Arana Gulch throughout the management period (see Table 1). Spring mowing occurred across the grassland prior to 2001. After the experimental period (2001-2005) a spring/fall mowing regime was implemented. No mowing occurred in 2013-2014 and then grazing was implemented in 2015. Since then only perimeter mowing has occurred. In 2020, Area C and the north portion of Area A were mowed due to the late start of grazing.

Grazing. Grazing first began at Arana in late February 2015 when the cattle grazing infrastructure was completed. The grazing enclosure includes about 16.6 acres as follows: Area A = 9 acres; Area C = 5.8 acres; and Area D = 1.8 acres. Typically, the City's grazing contractor brings cattle onsite in December/January and they stay until June or July.
The HMP's original estimate for cattle was 2 to 6 cow calf pairs, but it quickly became evident that this number of cattle was insufficient for the size of the pastures. As an adaptive management action, the AMWG revised its recommendation to increase the number of cattle to a level that is able to keep pace with grass growth in order to provide -the City and the rancher with more flexibility. Generally, between 10- 25 cattle have been used at Arana during the grazing period. Sometimes 10 cattle are brought to the site at the beginning of the season and more are added once the grass has gotten taller. The goal is for the grazing to make the pasture look like it has been mowed to a three-inch height.

Residual dry matter (RDM) sampling occurs in the fall to assess utilization by the cattle. The HMP specifies 3 levels: above target (>650 lbs./acre), at target (500-650 lb./acre) and below target (<500 lbs./acre). RDM sampling in several years has shown that growth remains above target in Area C and the northern portion of Area A (2019 data). However, the southern portion of Area A, where SCT recruitment has been observed, was at or below target in 2019. This may indicate that grazing intensity has not been sufficient in other areas to reduce the thatch layer and the lack of SCT recruitment may indicate that the target RDM level may be too high or may simply reflect the depleted seedbank.

Many discussions have occurred with the AMWG regarding the challenges in utilizing cattle grazing to meet the RDM targets. Maintaining adequate stocking rates is a central challenge for several reasons. Depending on weather patterns, the grass growth rate can stall or accelerate and may require the rancher to remove and add cattle from the site as conditions change. High stocking rates early in the season may also require the rancher or City to provide supplemental feed. Both options require additional labor, time and money for a very small grazing operation. After the grass growth rates jumps in April – May, more cattle often need to be brought onto the site. However, additional cattle may not be available for such a short time period before the cattle need to be removed in June. Finally, Arana Gulch is a heavily used open space in the middle of an urban area and the rancher must make decisions to add or remove certain cattle based on temperament, pregnancy status, sex, age, and other defining qualities in order to reduce the potential for negative conflicts between park users, dogs, and cattle.

Another challenge to meeting the target RDM level is the trade-off between ending the grazing season with as much bare ground as possible and exposing bolting SCT to being eaten by the cattle. SCT seedlings are very difficult to spot when they are bolting and it makes the assessment of the situation difficult. Often the decision is made to remove the cattle early in June in order to protect SCT that may be emerging.

A new rancher assumed grazing operations at Arana Gulch in 2020. The cattle were brought to the pasture much later than usual in mid-March, due to contracting and other issues. Later in the spring, the rancher was able to bring additional cattle but not as many as required to achieve optimal grazing intensity due to the COVID-19 pandemic. Given the low number of cattle and low grazing intensity, canopy heights in April were well above target in all but the southern portion of Area A, where SCT seedlings were observed as early as the March 3rd AMWG field visit. In 2020, the cattle remained in Areas A and C into July and were removed on August 2nd.

Seed Collection and Propagation. In September 2018 there were 267 SCT plants observed in the census at Arana Gulch with a combined total of 499 flower heads. The City's CDFW 2081(a) scientific collecting permit allows for collection of 5% of seed, therefore, 25 flower heads were collected. A total of 270 seeds were obtained from the collection and deposited at the UCSC Greenhouses. Under an agreement between the City and UCSC, a portion of the seed was grown into mature plants for seed increase purposes. Forty SCT plants were grown to generate approximately 10,000 seeds. This seed was cleaned and stored at the UCSC Greenhouses and UCSC Arboretum, and may be used for additional seed increase purposes, growing plants for outplanting, and for long-term seed storage. No seed was collected from the field in 2019 -2020 because the CDFW permit allows collection only when the population size is greater than 50 plants.

Although the quantity of seed currently available at UCSC could provide a sufficiently high seeding rate in a very small area, the viability of the seed has not been tested. Therefore, it would not be possible to assess whether a lack of recruitment in any seeding experiment is due to viability or some other factor. In addition, the total amount of seed available is still too low to achieve standard seeding rates on a scale that can be replicated. A direct seeding study of annual and perennial forbs conducted at 3 coastal prairie sites in Santa Cruz and Monterey County utilized seed rates of 500, 1,500, and 2,500 seeds/m^2 and resulted in extremely low establishment rates with seed yield of 1-2% at best (Holl et al. 2014). This low likelihood of recruitment from seeding, in combination with the fact that SCT is an obligate out-crossing species, makes it desirable to obtain seeds from a larger source population than the 25 flower heads collected in 2018 in order to avoid the potential for detrimental genetic consequences like inbreeding depression.

Outplanting. A pilot experimental outplanting of 28 greenhouse-grown SCT were installed in Area C on January 30, 2020. Figure 6 displays the layout of 20 1 x 1-foot plots and the number of plants installed per plot. Figure 7 depicts the site and Figure 8 shows two plantings.

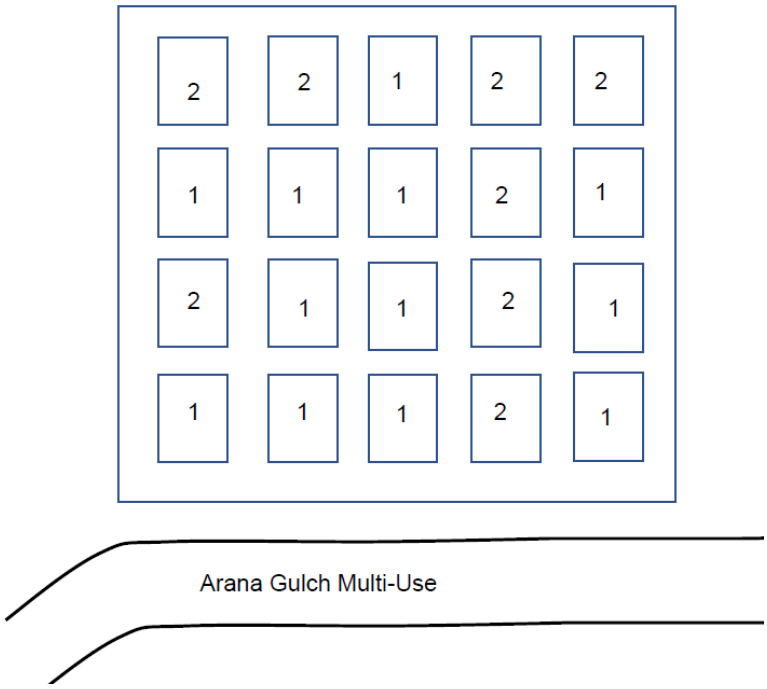


Figure 6. Layout of SCT Outplantings in Area C, Showing Number of Plants per Plot

Figure 7. Layout of SCT Outplantings in Area C

Figure 8. SCT Outplantings in Area C

Past outplantings of SCT propagules at three other coastal prairie sites in Santa Cruz and Monterey Counties during 2002-2005 were not successful (Holl and Hayes 2006). However, a series of outplantings installed from 2002 -2004 at the nearby SCT population in CA State Park Twin Lakes (0.5 mile to the east) was more successful. Propagation of site-collected seed began at the UC Jepson Herbarium in 1999 to increase the seed supply for outplanting. After three years of greenhouse propagation, a total of 15 SCT propagules were planted in 2002. After further propagation, 600 SCT were planted in 2003, and 234 in 2004. Respective survival to reproduction was 80, 57, and 74%. Survivors in 2003 produced an estimated 6,400 seeds. In 2004, estimated seed production was 29, 580 seeds. Despite this successful seed increase, a relatively rapid decline in the Twin Lakes population was observed in the years following these plantings, likely due to a decrease or lack of active management. This suggests that active management of outplantings may be necessary to insure creation of a sustainable SCT population.

Soil and Seedbank Conditions. A summary of seedbank conditions is presented below. Quantitative data on soil conditions and the SCT seedbank at Arana Gulch indicate that a depleted seedbank and changes in soil nutrient levels may be limiting expression of SCT. Soil nutrient analysis was conducted in 2013 by Bainbridge and similar soil sampling was repeated in December 2018. Since 2013, available nitrogen and phosphorous levels have gone from optimal to very low across the prairie. In contrast, potassium has remained at optimal levels. Iron was not measured in 2013, but the level in 2018 was high and soil pH (4.8) was strongly acidic. The SCT seedbank has also been quantified twice and has sharply declined since the population explosion that occurred in the late 1990's. Bainbridge sampling in 1999 detected 21 seeds/ dc^2 (seeds per square decimeter) in Area A and 2 seeds/ dc^2 in

Area D. In 2013, only 0.2 seeds/ dc^2 were found in A and 0.03 seeds/dc^2 in Area D. This is a 100-fold decline in Area A. No seeds have been detected in Areas B or C. In these and other studies, the majority of SCT seed has been found very close to the soil surface in samples taken at 0-2.5 cm (0-1inch) depth. No or few seeds have been found in samples from a depth of 2.5-5cm (1-2 inch).

Experimental Management Work Plan. The timing and purpose of potential management actions is presented below. **Table 3** describes the general timing and purpose of potential management actions for Arana Gulch SCT habitat enhancement. Each year, the fall AMWG meeting is intended to provide an opportunity for the group to provide input and recommendations to the City for the upcoming season. The ability of the City to implement the recommendations may be by limited by funding, staffing and other constraints, including current COVID-19 pandemic restrictions.

Table 3. The Timing and Purpose of Potential Management Actions for Arana Gulch

Action	Timing	Purpose
Scraping (hand or mechanical)	Fall- prior to rain and SCT germination	Remove aboveground biomass and topsoil to a depth of less than 2" to expose SCT seed to light to stimulate germination.
Prescribed fire	Fall/ early winter	Remove biomass and increase nutrient availability prior to germination. Stimulates growth of forbs and grasses.
	Spring	May reduce non-native annual grasses that still have immature seeds on the stems and not harm desirable native forbs (SCT) still at the rosette stage.
Seeding	Fall	Hand broadcasting SCT seed after a scrape or fall fire may promote recruitment.
Outplanting	Fall-winter	Hand drilling of propagated SCT after a scrape or fall fire may promote seed production in surviving plants and increase seedbank.
Liquid smoke	Fall	Hand application of a liquid smoke solution in combination with seed application may help to break seed dormancy (ray achenes) and stimulate germination.
Grazing	Winter-summer	Grazing animals remove above ground biomass, decrease vegetation height, lower litter depths, and redistribute nutrients. Increased light penetration and soil disturbance can release seeds from the seedbank and stimulate germination.
Mowing	variable timing and frequency	Removes aboveground biomass. Repeated mowing can favor lower-statured forbs. The response of native grasses to mowing (and grazing) appears to be specific.

Grazing: In the coming germination period in 2020/2021 growing season it will hopefully be possible to return the cattle to the pasture as early as December or January. A higher stocking level, beyond the approximately 20 cows that have been used in previous years, would increase the ability of the cattle to reduce vegetation height to target levels and also promote greater bare ground, particularly in Areas C and D. In 2021, no cattle will graze Area A and the area will be mowed. The actions are intended to reduce competition for SCT and promote germination. Any of the other management actions listed below undertaken during the grazing season (January-June) must occur in consideration of ongoing grazing operations.

Prescribed Fire: Prescribed fire is a top management priority for the enhancement of SCT habitat at Arana. Following the scrapings in Area A and D burning in 2021 could remove the season's biomass, increase nutrient availability, and encourage the release of dormant natives in the seedbank, including SCT.

Implementation of prescribed fire would occur in coordination with the Santa Cruz Fire Department (SCFD). SCFD would like to conduct a burn operation at Arana Gulch and views it as an opportunity to train personnel and conduct community outreach and education. The feasibility of conducting a prescribed burn each season depends on whether or not crews are available or assigned to assist other jurisdictions with wildfires. Planning must allow sufficient time for agency coordination, permitting, notification of the public, and be subject to constraints from the public health crisis. SCFD may need at least 3 weeks or even more advanced notice to schedule a prescribed burn. Coordination between the City and local and state air quality districts to obtain a burn permit may also take weeks. Advanced public notification would be necessary given the location is in the middle of an urban area.

During the March 2020 AMWG meeting, the group discussed possible application methods for ground fire at Arana, including the use of hand-held propane drip torches and mechanized ground ignition systems. The Terra Torch is one commercial option that includes a 50- gallon ground ignition system engineered to fit on many types of vehicle (UTVs, pickups, tractor 3-point mounts, skid steers, dozers). The system is an all in one unit that includes a frame, mixing tank system, motor, 12-volt battery, pump, gel gun and hose, transfer/cleanout system, and a fire extinguisher. This type of system offers a greater amount of control over the temperature and application of fire and also creates less smoke than hand-held drip torches. However, the availability of this type of unit for use at Arana would need to be assessed and SCFD training procedures may necessitate use of hand-held drip torches. Creation of a 20-foot mowed buffer around the fire perimeter may be required to protect fencing, depending on the prescribed fire configuration. The City would likely implement the mowing in advance of the burn and generally implements mowing in late June or July after the cattle are removed

The 2020 wildfire season in California was unprecedented. The CZU lightening complex fire started in Santa Cruz and San Mateo Co. on August 16 and was active for 37 days, burning 86,509 acres. The SCU lightening complex started on August 18 and burned almost 400,000 acres in Santa Clara, Alameda, and Stanislaus Co. These and other large fires produced thick smoke throughout the region and state into mid- September. By October 2020, the ability to conduct a prescribed fire within Arana Gulch was severely limited by a host of factors related to the wildfire season and prescribe fire was not implemented. Management options for the use of prescribed fire use in future years are described below.

Area D Burn. The simplest option for a small-scale prescribed fire is to burn Area D. This Area is approximately 1.8 acres and located closest to Arana Creek at a slightly lower elevation than the rest of the prairie (see red pasture in Figure 1). Therefore, it tends to be wetter and have somewhat lower fire risk. In addition, no SCT plants have been observed in this Area since 2004 and almost no seed were detected in the 2013 seedbank study so there is little or no risk to extant or dormant SCT. However, out plantings of SCT are scheduled for this area in January/February 2021. There 3 scraped plots that would offer the opportunity to learn about the interaction of fire and scraping on a small scale.

Prescription

- Burn all of Area D, when possible
- Utilize a 20-foot mowed buffer around the perimeter to protect the fencing, resulting in a fire size of 1.5-acres or less
- Conduct fall/winter outplanting in burned areas and if possible, in areas that have been scraped and burned (i.e. within the 3 30 x 30-foot plots scraped in 2019) or have received SCT out plantings.
- Conduct follow-up monitoring including control plots

Area A Burn Options Applying prescribed fire in Area A is a management priority and also offers a learning opportunity to create plots that have been both scraped and burned. The coastal prairie in the southern portion of Area A (see orange pasture in Figure 1) is about 4 acres and contains the 4 SCT clusters (C1, C2, C3, C4) found in 2019, as well as the 6 30 x 30-foot scrape plots. However, outplantings of SCT are scheduled for this area in January/February 2021.To increase learning potential, it would be desirable to burn at least 3 of the scrape plots. Burning would likely destroy disk achenes released in the 2021 out planting plots but could potentially release dormant ray achenes (which have a hard seed coat that provides protection). If fire can stimulate germination of any dormant ray achenes the benefit could likely outweigh the risk to the seed rain expected from above-ground plants.

A second option is to apply prescribed fire only within 3 scrape plots and in 3 un-scraped plots where there are no SCT outplantings. This second option would likely result in much lower fire intensity within the plots because of the small scale and would be unlikely to

generate the heat that might be necessary to release dormant SCT ray achenes. However, the small plots could still serve as a prepared bed to receive SCT seedlings (described below).

Prescription Option 1

- Burn half of the south portion of Area A when possible, divided either longitudinally or horizontally, avoiding SCT-occupied areas
- Include 3 of the scrape plots, if possible.
- Utilize a 20-foot mowed buffer on exposed fencing, where needed, resulting in a fire size of less than 2 acres
- Conduct follow-up monitoring of a minimum of 3 plots each of burn-only, burn/scrape, and control

Prescription Option 2

- Apply prescribed fire only within 3 scrape plots and in three un-scraped plots, when possible, resulting in a patch fire of 5,400 ft^2 or 0.12 acres.
- No perimeter mowing is necessary.

Scraping/Outplanting: Since the mechanical scraping in 2019 was effective in increasing bare ground, additional scraping in October or November is indicated, primarily if burning is not implemented. Planning for the November 2019 scraping occurred over about a week and the City can choose to implement an experimental scrape relatively quickly compared to other management options. However, the timeline could be lengthened by the COVID-19 pandemic issues. Out planting of SCT within scraped plots is recommended to increase seed rain and the potential for next year germination of disk achenes. Out planting of SCT within burned areas could also be more effective than scraping alone because of the increased nutrient availability and reduced competition.

The exact design of an outplanting experiment can be quickly determined once scraping and/or prescribed fire has been implemented. The only advance planning issue is to ensure that there is a supply of SCT seedlings available in the UCSC Greenhouse. As already mentioned, approximately 10,000 clean seed are available at the UCSC Greenhouses and UCSC Arboretum. Seed would need to be planted before the end of October in order to have seedlings available for a winter planting. The City currently has a one-year agreement in place with the UCSC Greenhouse to produce seedlings. To date, 1,000 plants are being grown for outplanting in January/February 2021.

Considerations for out-planting

- When outplanting occurs, the goal should be to ensure survival with protection from grazing
- Watering SCT seedlings can increase gopher herbivory
- If watering is deemed necessary, issues with water truck access should be resolved prior to outplanting

- Hand-weeding around planted SCT seedlings may increase gopher herbivory
- Space seedlings a minimum of 50 cm apart to accommodate growth and reduce potential for competition
- Utilize a minimum of 3 replicate plots with controls if using an experimental design within an Area
- Plot size can be variable, but consistent, within an Area. Smaller plots may help to reduce differences in survival due to spatial heterogeneity and resource constraints
- If planting in a 2019 scrape plot, also install seedlings in un-scraped areas
- If prescribed burning is implemented within in scrape plots, those plots should be monitored for natural recruitment of SCT.

Seeding: Seeding can be implemented in addition to the outplanting if prescribed fire occurs. The design of the seeding experiment can be quickly determined once the burning has taken place and an assessment is made of the amount of seed available at UCSC. Less than 50% of seed should be utilized so there is sufficient seed available for continued propagation efforts. Future seed collection depends on a minimum population size of 50 SCT.

Mowing: Mowing removes aboveground biomass and may reduce resource competition during germination. Various studies in coastal grasslands in CA have shown that repeated mowing can favor lower-statured forbs, but the response of native grasses to mowing (and grazing) appears to be specific.

- Mowing of the multi-use trail perimeter should continue to reduce fire risk and maintain visibility for trail users
- Mowing within grazed areas should be considered a secondary strategy to grazing/scraping/burning
- Area C was mowed in July 2020
- Repeated mowing can be considered. In 2020, a strategy to do repeated mowing within Area A was developed. This strategy will be implemented in 2021 wherein all of Area A will be mowed to keep grass height at/less than 10 inches in height. The area will not be grazed.

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

5.1.2.1 Census. A census for SCT 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 June, July, August and September 2020. 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, which are parallel walking routes spaced 25-50 feet apart, were conducted to detect SCT. Survey days were June 5, July 8, August 27, and September 30, totally 8 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 June 5, a colony of 17 SCT seedlings were observed in Area A. Plants averaged 2 inches in height. A subsequent survey on July 8 found just one plant at this colony. It is assumed that the other plants were browsed/predated by cattle. By September 30, the one SCT plant persisted to maturity, reaching a height of 10 inches and supported 69 flower heads. The one SCT in 2020 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. The 2020 survey was conducted in a slightly below average rainfall year (24.4 inches), which followed a slightly above average rainfall years (2019/20), a below average rainfall year (2018/19) and an above-average rainfall year (2017/18). It also follows five seasons of grazing (grazing in winter/spring seasons of 2015, 2016, 2017, 2018, and 2019).

Table 4 presents the number of plants in each patch, the size of the patch, average plant height, and number of flowering heads. **Figure 9** displays the distribution of SCT in 2020. **Figure 10** displays the location of the 2020 plants compared to the historical distribution of the species on site. **Figure 11** depicts the one SCT plant at colony C1.

Twenty-eight plants grown at UCSC Greenhouses were installed in Area C in January 2020. These outplantings were censused in 2020. A total of 10 SCT were alive in early June and by October there were still 5 SCT plants, with all plants in flower. The remainder of the plantings died, most from gopher predation/disturbance. The five plants produced 51 flower heads, as of September 30, 2020. The location of the C-2019 outplantings is depicted on **Figure 9**. A mature planting is shown in **Figure 12**.

The experimental scrape plots created in fall 2019 in Areas A, C, and D, had no SCT plants in 2020.

Table 4. SCT Census Results, September 2020

Area	Patch #	Size of Patch	Number of SCT	Average Height (in.)	Number of Flower Heads
Area A					
	C1[1]	25' x 30'[2]	1	10.0	69
Area A Total			1		
Area B	-	-	0		
Area C	-	-	0		
Area C, outplantings	C-2019	25' x 25'	5	4.5	51
Area D	-	-	0		

[1] Colony located at southeastern corner of former scrape plot (scrape plot done in October 2011)
[2] Size of patch includes location of original 17 plants observed at colony in June 2020

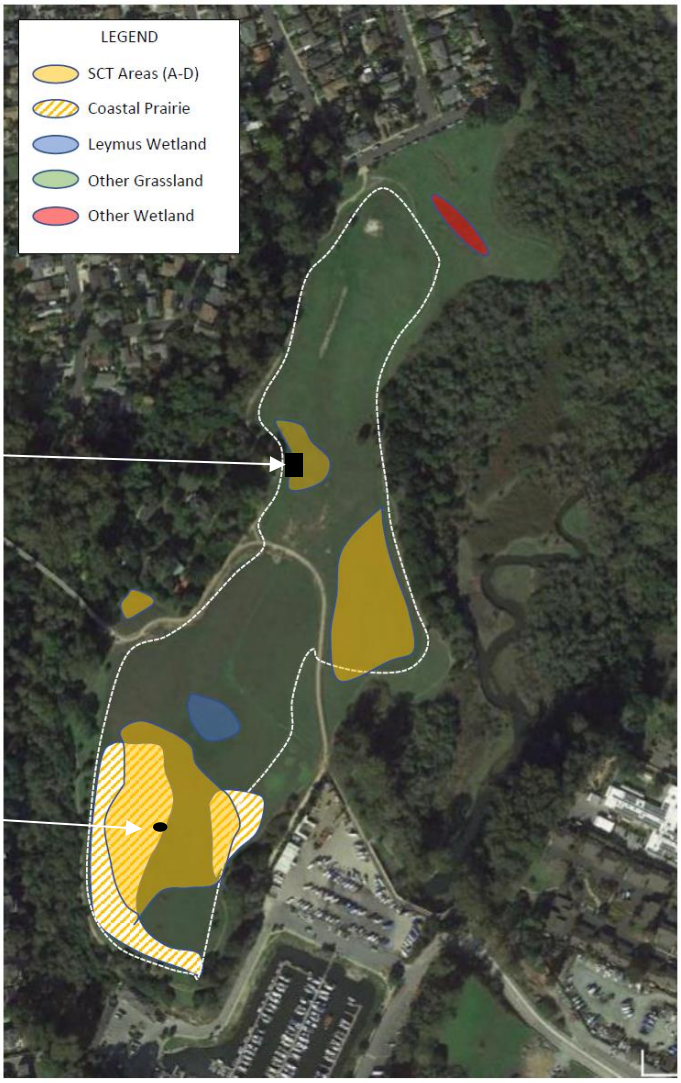


Figure 9. Distribution of SCT, 2020 (including Area C Outplantings)

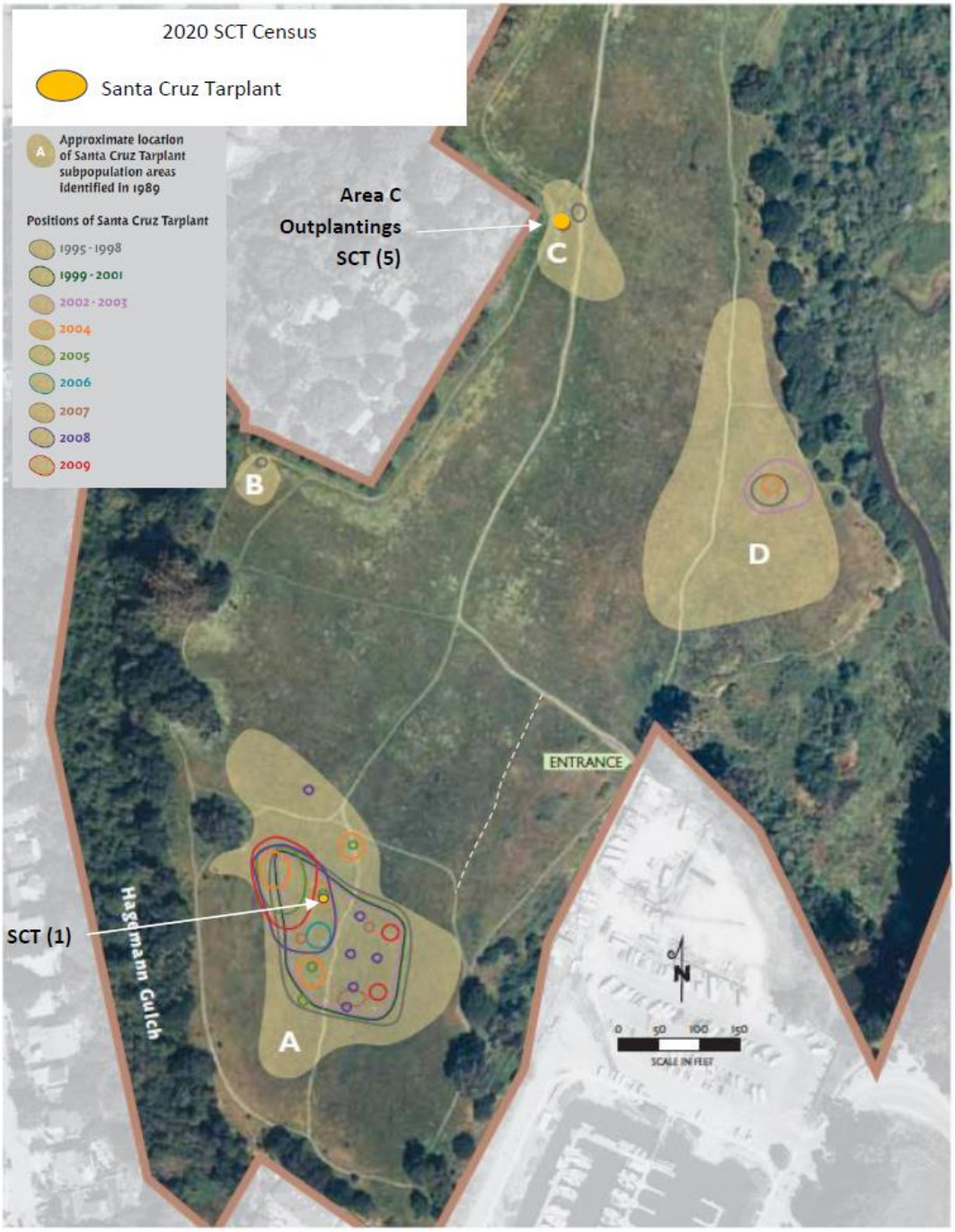


Figure 10. Distribution of SCT, including Area C Outplanting, with Historic Occurrence Data

Figure 11. Multi-branched SCT in Area A, September 2020

Figure 12. SCT at Area C Outplanting, September 2020

5.1.2.2 Seed Collection. No SCT seed was collected from the site in 2020. As per conditions of the City's 2081 permit with CDFW, no SCT can be collected unless there are more than 50 plants. However, a small amount of seed collected from the site in 2018 was deposited with UCSC Greenhouses. In 2019, under an agreement between the City and UCSC, a portion of this seed was increased wherein approximately 100,000 seeds were produced. This seed was cleaned and is stored at UCSC Greenhouse. In fall 2020, some of this seed was used to grow seedlings for outplanting. To date, 1,000 plants are being grown, with outplanting scheduled for January/February 2021. **Figure 13** shows plants being grown at UCSC Greenhouses in November 2020.

Figure 13. SCT Being Grown at UCSC Greenhouses, November 2020

5.1.2.3 Plant Cover at SCT Patches. Plant cover and species composition was documented at the one SCT patch. In September 2020, a 1-meter square quadrat was used to visually assess absolute plant cover, litter, cattle dung, and bare ground. Plant cover averages 84%, which is an increase from 71% in 2019, yet similar to the 82% recorded in 2018. Most plant cover was provided by exotic annual grasses (EAG), primarily ryegrass (*Festuca perennis)* (40%). Exotic annual forbs (EAF) were dominated by cat's ear (*Hypochaeris sp.)* (11%), and bindweed (*Convolvulus arvensis)* (6.4%). Cover by exotic perennial forbs (EPF) include birds foot trefoil (*Lotus corniculatus)* (2.9%) and loosestrife (*Lythrum hyssopifolia)* (1.7%). Cover by native species was provided by SCT (11.6%). Litter provided 5.7% cover; cow dung provided 5% cover. Bare ground represented 4%, a decrease from 23% in 2019.

Photo-documentation of SCT habitat within Area A, between 2011 and 2020 is present in **Appendix B**.

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). As only one naturally-occurring SCT and five outplantings were observed in 2020, 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 and again in 2020, the number of naturally-occurring SCT decreased. During the species germination period (December – January), December 2019 had 10.76 inches of rain, however, rainfall amounts dropped to 2.89 inches in January 2020 and even lower, to 0.01 inch in February 2020. The low rainfall

amounts in January and February may have adversely affected seed germination and plant growth. However, there may be other reasons for the poor expression of SCT, including a low soil seed bank or adverse soil conditions. In 2020, cattle predation on SCT seedlings was also observed. While some cattle browse on SCT was observed in other years, plant mortality had not occurred. In 2020, cattle browsing occurred to the soil surface and it appears this level of browse caused the mortality of 16 SCT plants in Area A.

The HMP has an objective to expand the distribution of SCT beyond Tarplant Area A within three years (Objective 1B). In 2020, SCT outplantings were installed in Area C. To date, five plants are persisting in the outplanting area. Coupled with the one SCT observed in Area A, 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.

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.

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 14**. Perimeter fuel break mowing was also identified along the trails. In addition, mowing occurred in the northern portion of Area A and the southern portion of Area C to control wild radish.

The City mowed Tarplant Area B between June and September. 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 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. Plant species flagged include Ithuriel's spear (*Tritelia laxa)*, soap plant (*Chlorogalum pomeridianum)*, yellow Mariposa lily (*Calochortus luteus)*, and pretty face (*Triteleia ixioides)*. The pre-mowing survey results are presented in **Appendix B.** At the time of the June mowing, grass height averaged 3 feet. Flail mowing was conducted as close to bare ground as possible. Areas subject to mowing are depicted on **Figure 15**. Mowing outside the Area A grazing fence is depicted in **Figure 16**. A pretty face, marked to be avoided during mowing, is depicted in **Figure 17**.

Figure 14. Delineated Grassland, April 2015

Figure 15. Areas Mowed in 2020

Figure 16. Grassland Prior to Mowing, June 2020

Figure 17. Pretty Face (*Triteleia ixioides)* along Prairie View Trail, June 2020

In 2017 a grassland sub-management area map was prepared. The map is presented as **Figure 18**.

5.2.1.2 Invasive Plant Removal. In 2020 the City continued to remove woody plant species from the delineated grassland area. Occurrences of cotoneaster *(Cotoneaster sp.)* and Himalaya blackberry *(Rubus ameniacus)* continued to be removed/controlled. In 2020, sprouts of cotoneaster and blackberry were re-treated. A thicket of cotoneaster and Himalaya berry (*Rubus ameniacus)* between the Coastal Prairie Loop Trail and the harbor that was removed in June 2017 was re-treated. The City controlled most thistles prior to seed set' however, the County and State-mandated stay-at-home order for the COVID-19 pandemic resulted in work restrictions that reduced available personnel for actions that would have typically occurred in March and April. A new invasive weed was detected in Area C in 2020. Stinkwort (*Dittrichia graveolens*) was observed in Area C in September 2020. Plants has already released seed. This species will require control actions in 2021 (hand-pulling prior to flowering).

Figure 18. Sub-management Areas in Grassland (updated draft)

5.2.2 Vegetation Assessment

The CDP requires a plan for monitoring and maintenance of habitat areas at Arana Gulch in perpetuity and implementation of adaptive management procedures to allow for modifications 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. Section 3.7 of the HMP describes the details of field sample design and data analysis for the baseline assessment. The baseline vegetation assessment was completed in 2013-2015. Repeated measures in 2016-2020 have allowed a quantitative evaluation of the response to the Grazing and Stocking Program

implemented in 2015 (discussed in section 5.3). To date, this 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". As discussed further in the next section, residual dry matter (RDM-the amount of dry plant material left standing or on the ground from the previous year's growing season) is the metric that is measured as a way to assess cattle utilization and rangeland health.

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 number of native species (Obj. D) present on the prairie. This partial lack of success indicates that the current grazing strategy is not meeting the interim biological success criteria of the HMP to improve conditions at Arana Gulch.

A Habitat Enhancement Work Plan was developed in October 2019. After review by the AMWG, the City decided to implement scrape-only plots in November 2019. Prescribed fire was also considered, but there was insufficient time after receipt of the work plan to adequately coordinate and provide public notice for such an action. As described in the next section the sampling methodology for 2020 was modified to assess response to the experimental scraping. The monitoring results are then described 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. The existing vegetation assessment methodology conducted in 2013-2019 utilized a total of 20 permanent 25-meter point-intercept transects: 11 in Area A, 5 in C, and 4 in D. These transects were not utilized in the 2020 vegetation assessment but can continue to be monitored in 2021, or at an even expanded timing interval. Instead, the sampling methodology for 2020 was modified to assess response to the experimental scraping conducted on November 20, 2019. Six 30 x 30-foot plots were mechanically scraped in and around recently occupied SCT coastal prairie habitat in Area A and 3 plots were scraped in Area D. A single 30 x 50-foot plot was scraped in Area C in the historic SCT area.

The 2020 monitoring was conducted on May 7-8th using a point intercept method modified to suit the small 30 x 30-foot scrape plots. Once the corners of a scrape plot were identified, the 25-m transect tape was stretched across the plot on the diagonal from the southwest corner to the northeast corner for a length of 13 meters. The GPS location of each end was recorded along with the compass bearing of the transect from the 0-meter end. A photo was taken at the 0-meter end looking along the length of transect with a whiteboard placed at the 0-m of the transect. The transect photos are included in **Appendix B**. Transects were sampled in all 6 of the scrape plots in Area A and in 3 un-scraped control plots in and around the 2019 SCT locations, as shown in **Figure 19**. Three scrape plots were also sampled in Area D with one control, but the scrape plot in Area C was not sampled (**Figure 20**). Sampling was not conducted in the Area C scrape plot because it was undistinguishable from the surrounding vegetation and grazing had not yet occurred at the time.

To assess vegetation and ground cover, the point intercept method was used at 0.5-m intervals, rather than at 1-m intervals, beginning at the 0.5-m mark and ending at the 12.5-m mark for a total of 25 points per transect. The standard assessment method was used where each species encountered by the sampling rod is recorded as a "hit" and the number of hits is multiplied by 4 to get percent cover for each species and ground cover category (bare ground or basal vegetation). The total number of species encountered on each transect was also tallied as a measure of species richness. Species cover values were 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 average height of the canopy layer was measured at the 2, 4, 6, and 8-meter marks. In addition to the point intercept data, a search was conducted within the entire 30 x 30-foot plot to record any plant species not encountered on the transect and more fully characterize species richness.

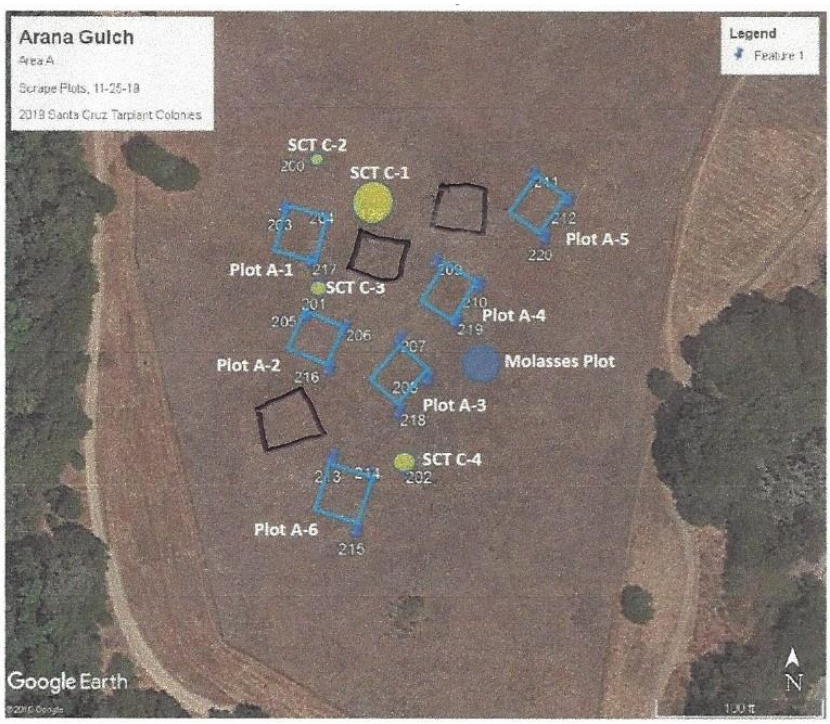


Figure 19. Location of 2019 Scrape Plots in Area A (blue) with 2020 control locations (black).

Figure 20. Location of 2019 Scrape Plots in Area C and Area D (blue) with 2020 control location (black)

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 21**). 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. Photos are in **Appendix B**.

Figure 21. Location of photo points for long-term monitoring established at Arana Gulch.

5.2.2.2 Monitoring Results

Precipitation Conditions. The long-term average precipitation for the Santa Cruz area is 30 inches (Western Regional Climate Center). **Table 5** presents monthly rainfall data from the DeLaveaga Golf Course located just north of Arana Gulch. Total rainfall for the water year to June 1st from October 1, 2019 was 24.4 inches. December was very wet (10.8 inches) but only about 3 inches of rain fell each month in January, March and April. However, no rain was recorded in February. Total precipitation for the 2019-2020 water year has been below normal.

Table 5. Monthly rainfall (inches) at the California Department of Water Resources (DWR) California Irrigation Management and Information System (CIMIS) weather station 104 (DeLaveaga) for the 2013-2019 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**

Vegetation Assessment. The results below present canopy height, bare ground cover, and native species cover and richness in scraped versus un-scraped plots. Tables present individual plot data and because of the small sample size, statistical tests on cover and canopy height data were not performed.

Canopy Height. In 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 2020, grazing did not begin until the middle of March due to the change in the grazing operator and contracting issues. Therefore, early season (i.e. February) canopy heights were not measured.

During the monitoring in early May, measured canopy heights in the scrape plots and the control plots in Area A were within target with an average of 7 cm/2.7 in. and 8 cm/3.1 in., respectively (**Table 6**). Grazing had only been underway for 6 weeks, but it effectively reduced canopy height within the confines of the delineated historic SCT area (see Figure). However, in Area D, where the effects of grazing were not at all apparent in early May, mean canopy height was well above target in the scraped areas (28 cm / 11 in.) and even higher in the single control (46 cm / 18 in.). The grazing operator confirmed that cattle had not been brought into Area D in early May, so the difference is not significant.

Table 6. Measured Canopy Heights in May 2020 in Area A and D

Scrape Plot	Canopy Height (cm.)	Control Plot	Canopy Height (cm.)
A3	4	A6	10
A6	8	A1	7
A5	7	A3/4	7
A4	4		
A1	4		
A2	16		
MEAN	**7**	**MEAN**	**8**
D1	30		
D2	25		
D3	28		
MEAN	**28**	**CONTROL**	46

In the northern portion of Area A, the effects of grazing were minimal and the canopy height was even higher (approximately 60 cm / 24 in.) due to the presence of tall wild radish and non-native grasses. Area C was un-grazed in early May and the canopy height in the vicinity of the scrape plot ranged from 76 to 90 cm (30-36 in.).

Bare Ground Cover. Bare ground cover was difficult to visually estimate because the plant canopy obscured the ground. However, the point intercept method is more objective and it produced somewhat surprising, but consistent results. In Area A, bare ground in the scrape plots ranged from 32-56%, with an average of 41% **(Table 7)**. Measured bare ground in the 3 scrape plots in Area D was essentially the same (43%). In contrast, average bare ground in the 3 control plots in Area A was 15% and there was no bare ground measured in the single control plot in Area D. This indicates that scraping significantly increased bare ground in both areas.

Table 7. Bare Ground Cover in May 2020 in Area A and D

Scrape Plot	% Bare Ground	Control Plot	% Bare Ground
A3	48	A6	12
A6	32	A1	16
A5	56	A3/4	16
A4	40		
A1	32		
A2	36		
MEAN	**41**	**MEAN**	**15**
Scrape plots	**% Bare ground**	**Control plots**	**% Bare ground**
D1	40		
D2	44		

Table 7. Bare Ground Cover in May 2020 in Area A and D

Scrape Plot	% Bare Ground	Control Plot	% Bare Ground
D3	44		
MEAN	**43**	**CONTROL**	**0**

Canopy Cover. Objective 3B is to reduce the cover of non-native species and Objective 3C is to increase the cover of native species. The 2019 data indicated that 5 years of grazing had not significantly reduced non-native plant cover or increased the cover of native species in any of the three grazing Areas. Cover of exotic annual forbs (EAF) were at 100% in 2019, and cover of exotic annual grasses (EAG) has remained greater than 80% since 2015. However, exotic perennial forbs (EPF) have declined since 2015, due to declines in English plantain (*Plantago sp.*) and common vetch (*Vicia sativa sp.*).

Native species have remained a negligible portion of the vegetation across the prairie since baseline measurements began in 2013. Area A is the only place on the prairie where measurable native species cover has been detected. Cover of native perennial forbs (NPF), represented only by California poppy (*Eschscholzia californica)*, has been 4% or less. Cover of native perennial grasses (NPG) including California oatgrass *(Danthonia californica)*, spreading rush (*Juncus patens)*, purple needlegrass (*Stipa pulchra)*, and California brome (*Bromus carinatus*) has been at 10% or less. In 2019, the diminutive toad rush (*Juncus bufonius*), a species not previously captured in the transect sampling, had 6% cover.

In 2020, native toad rush (JUNBUF) was present in all of the scraped and un-scraped plots sampled in Area A. The average cover in the scrape plots was 32% and only 15% in the control plots **(Table 8).** Toad rush cover corresponded exactly with the amount of bare ground cover (15%) in the control plots, but was somewhat lower in the scrape plots. In Area D, toad rush was present in all 3 scrape plots, but was detected with measurable cover (8%) in only one plot. It was absent from the control plot, where there was no bare ground recorded.

Table 8. Native Species Cover in Sampled Area A Plots in 2020

Scrape Plot	Native species	% cover	Control Plot	Native Species	% cover
A3	JUNBUF	40	A6	JUNBUF/STIPA	12
A6	JUNBUF	36	A1	JUNBUF	20
A5	JUNBUF/STIPA	24	A3/4	JUNBUF	12
A4	JUNBUF	36			
A1	JUNBUF/DANCAL	52			
A2	JUNBUF	4			
MEAN		**32**	**MEAN**		**15**

Toad rush is a tiny grass-like annual that is very common in moist disturbed areas and therefore it was expected that a species with this type of ecological preference would be the first native species observed colonizing newly created bare ground in the coastal prairie. However, toad rush first appeared in Area A in 2019 with 6% cover. The expansion of cover in 2020 to 32% may be a reflection of more favorable conditions in recent years; average annual rainfall for the last 4 water years (2017-2020) was 89 cm/ 35 in., compared to only 40 cm/16 in. for the previous 4 water years (2013-2016).

Species Richness. Objective 3D is to increase native species richness. Average native species richness has remained at one species or fewer across the prairie during the sampling period since 2015. Very small occurrences of native species have been observed outside of the sampling plots. In 2020, native species observed in the plots in Areas A and D that were not captured in the transect sampling included spreading rush, California oatgrass and purple needlegrass. All 3 species have been present with very low cover in the historic SCT area of Area A for most of the sampling period. Single plants of valley sky lupine (*Lupinus nanus*) were found within three of the scraped plots in Area A and two plants of lowland cudweed (*Gnaphalium palustre*) were in scrape plot A1. The appearance of these species could be due to increased bare ground from the scraping, but may also due to the slightly later timing of sampling and the lower grazing intensity in 2020. While the presence of these species is encouraging, native species remain a negligible fraction of the vegetation in the coastal prairie at Arana Gulch.

The list of species that have been detected in the sampling across the years since 2015 includes only 52 species remains dominated by non-natives and lacks diversity (**Table 9**). Only 12 native species have been recorded including one shrub, four forbs, four grasses, and two rushes.

Table 9. Plant species detected in sampling in Areas A, C and D (native species are in **bold**).

Scientific Name, TJM 2	Common Name	Life form	Family	Species Code
Anagallis arvensis	Scarlet pimpernel	EAF	PRIMULACEAE	ANAARV
Avena fatua	Wild oat	EAG	POACEAE	AVEFAT
Baccharis pilularis	Coyote brush	Shrub	ASTERACEAE	BACPIL
Briza maxima	Rattlesnake grass	EAG	POACEAE	BRIMAJ
Briza minor	Quaking grass	EAG	POACEAE	BRIMIN
Bromus carinatus	**California brome**	**NPG**	**POACEAE**	BROCAR
Bromus diandrus	Ripgut brome	EAG	POACEAE	BRODIA
Bromus hordeaceus	Soft chess	EAG	POACEAE	BROHOR
Carduus pycnocephalus	Italian thistle	EPF	ASTERACEAE	CARPYN
Cerastium glomeratum	Mouse-ear chickweed	EAF	CARYOPHYLLACEAE	CERGLO
Cirsium vulgare	Bull thistle	EPF	ASTERACEAE	CIRVUL
Convolvulus arvensis	Bindweed	EPF	CONVOLVULACEAE	CONARV
Danthonia californica	**California oatgrass**	**NPG**	**POACEAE**	DANCAL
Deinandra corymbosa	**coast tarplant**	**NPF**	**ASTERACEAE**	DEICOR
Elymus triticoides	**wild rye**	**NPG**	**POACEAE**	ELYTRI
Erodium botrys	long bill stork's beak	EAF	GERANIACEAE	EROBOT
Erodium cicutarium	red stem filaree	EAF	GERANIACEAE	EROCIC
Eschscholzia californica	**California poppy**	**NPF**	**PAPAVERACEAE**	ESCCAL
Festuca myuros	Rattail six weeks grass	EAG	POACEAE	FESMYU
Festuca perennis	Italian ryegrass	EAG	POACEAE	FESPER
Geranium dissectum	Cutleaf geranium	EAF	GERANIACEAE	GENMON
Gnaphalium palustre	**lowland cudweed**	**NAF**	**ASTERACEAE**	**GNAPAL**
Holocarpha macradenia	**Santa Cruz tarplant**	**NPF**	**ASTERACEAE**	GERDIS
Holcus lanatus	velvet grass	EPG	POACEAE	HOLLAN
Hordeum marinum	Foxtail barley	EAG	POACEAE	HORMAR
Hypochaeris glabra	Smooth cat's-ear	EAF	ASTERACEAE	HYPGLA
Hypochaeris radicata	rough cat's-ear	EPF	ASTERACEAE	HYPRAD
Juncus bufonius	toad rush	NAG	JUNCACEAE	JUNBUF
Juncus patens	**Spreading rush**	**NPG**	**JUNCACEAE**	JUNPAT
Lactuca serriola	Prickly lettuce	EPF	ASTERACEAE	LACSER
Lotus corniculatus	Bird's foot trefoil	EPF	FABACEAE	LOTCOR
Lupinus nanus	**Valley sky lupine**	**NPF**	**FABACEAE**	**LUPNAN**
Lythrum hyssopifolia	Hyssop loosestrife	EPF	LYTHRACEAE	LYTHYS
Mentha pulegium	Pennyroyal	EPF	LAMIACEAE	MENPUL

Table 9. Plant species detected in sampling in Areas A, C and D (native species are in **bold**).

Scientific Name, TJM 2	Common Name	Life form	Family	Species Code
Plantago lanceolata	English plantain	EPF	PLANTAGINACEAE	PLALAN
Poa annua	Annual blue grass	EAG	POACEAE	POAANN
Raphanus sativus	wild radish	EAF	BRASSICACEAE	RAPSAT
Rosa californica	**California rose**	**Shrub**	**ROSACEAE**	ROSCAL
Rubus armeniacus	Himalayan blackberry	Shrub	ROSACEAE	RUBARM
Rumex acetosella	Sheep sorrel	EPF	POLYGONACEAE	RUMACE
Rumex crispus	Curly dock	EPF	POLYGONACEAE	RUMCRI
Silybum marianum	Milk thistle	EPF	ASTERACEAE	SILMAR
Sonchus asper	Sow thistle	EPF	ASTERACEAE	SONASP
Stipa pulchra	**Purple needlegrass**	**NPG**	**POACEAE**	STIPUL
Tragopogon pratensis	Salsify	EPF	ASTERACEAE	TRAPRA
Trifolium campestre	Hop clover	EAF	FABACEAE	TRICAM
Trifolium dubium	Subterranean clover	EAF	FABACEAE	TRIDUB
Trifolium subterranean	Subterranean clover	EAF	FABACEAE	TRISUB
Vicia sativa	common/narrow leaved vetch	EPF	FABACEAE	VICSAT

5.2.2.3 Coordination with Other Landowners. In November, the City and some AMWG members visited a private property in Aptos to review grassland restoration on the approximately 67-acre parcel. The landowner gave a tour of a valley-bottom grassland (along an intermittent creek corridor) and upland hillside grasslands adjacent to State Route 1 and provided an overview of the restoration activities implemented on the parcel since 1986. The landowner implemented grassland management actions yearly for the past 30+ years. During the tour plant species present in the grasslands were noted; however, species were limited to perennials due to the fall/winter season. The landowner indicated that the site was subject to cattle grazing prior to his purchase.

Valley-bottom grassland is located westerly of an intermittent creek, in a low-lying area. The area supports dense stands of California oatgrass (*Danthonia californica)*, purple needlegrass (*Stipa pulchra)* and blue wild rye *(Elymus glaucus)*. According to the landowner, this area had little to no native grasses in 1986 and all species now on site have emerged from the soil seedbank. The site has been mowed prior to the site visit. Some weedy grasses and forbs were observed, including velvet grass (*Holcus lanatus)*.

Upland grasslands are located on slopes and ridges east of the main access road. On the slopes, purple needlegrass was the prominent native grass species. California oat grass was more prevalent on the ridge line and on some moister slopes and small swales. Cover by

native grasses exceed 50%, and in some areas California oatgrass cover exceeded 80%. Cover by non-native perennial forbs was low, possible less than 20%; however, actual cover by annual grasses and forbs could not be determined due to the season. Annual grasses (*Vulpia? Festuca? Briza?*) were observed between the native grass clumps, forming a dry thatch, approximately 0.5 inch thick.

According to the landowner, management actions were first focused on the removal of invasive, non-native species, such as French broom (*Genista monspessulana)*. Seasonal mowing was implemented to reduce non-native grass seed production, as cover was primarily wild oat (*Avena sp.)* and ripgut brome (*Bromus diandrus)*. For many years (decades?), the landowner employed a work crew of 12-16 full-time that focused on non-native plant control, including periodic mowing, weed-whipping, and hand removal of other weeds.

In the early years, multiple spring season mowing were used to remove non-native grass prior to them forming seed heads to reduce the non-native grass seedbank. At that time, the landowner had little concern on any adverse impacts to native grass seed production due to their absence/low cover. However, over time, as the annual non-native grasses were reduced and cover by native grasses increased, the landowner modified his mowing regime to include localized weed-whipping to control annual grass seed production, yet allow the native grasses to set seed. During this period, hand labor costs were high due to this focused work. Currently, with low levels of annual, non-native grasses, maintenance needs are reduced and actions are focused on mowing the grasslands once in the fall and controlling non-native forbs. Observations in the upland grasslands found the fall mowing height to be 3-4 inches.

Over the past 30 years, the landowner's work crew (10-16 workers, full-time) has been used to extensively hand pull annual and perennial weeds from the restored grasslands and used Round-up in previous years. The landowner is currently spot-spraying English plantain (*Plantago lanceolata)* and cat's ear (*Hypochaeris spp.)* with a post-emergent broadleaf herbicide *Spurge*. The landowner has performed limited on-site seed collection or seeding and believes most species have established from the soil seed bank.

5.2.3 HMP Performance Evaluation

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

Grazing has successfully reduced average canopy heights across the coastal prairie in all sampling years. Therefore, this interim objective was met in 2016 when grazing started. However, in May 2020, vegetation height across a majority of the prairie was well above target due to the late start of grazing in the middle of March (generally, cattle are brought to the pasture in January). By the early May monitoring, the cattle had reduced vegetation height to target levels only in the southern portion of Area A where the 10 animals primarily congregated. Areas C and D were both un-grazed in early May and were therefore mowed

during the summer to reduce canopy height and wildfire risk. In the coming 2021 season it will hopefully be possible to return the cattle to the pasture much earlier in the year. A higher stocking level, beyond the approximately 20 cows that have been used in previous years, is recommended to reduce the thick litter layer that is still present in most parts of the pastures.

In 2020, the City and the AMWG discussed implementing an experimental program in 2021 wherein Area A will be mowed periodically instead of being grazed by cattle. The mowing will be conducted to keep plant height less than 10 inches, which is expected to reduce non-native grass seed production and encourage growth by native grass species. This action is intended to improve coastal prairie conditions. The response to this management action on native grasses and SCT recruitment will be monitored in 2021.

The 2019 fall mechanical scraping resulted in significantly greater bare ground relative to the control plots. Increasing and maintaining bare ground is desirable because it increases exposure of SCT seed that may be present in the soil seedbank to light, thereby increasing the potential for germination of non-dormant disk achenes. Scraping resulted in higher than expected bare ground (42%). The similar amount of bare ground measured in both Areas A and D, despite the fact that no grazing had occurred in D, may indicate that grazing did not have any synergistic effect on the scraping. However, the scraping did not result in any SCT recruitment (Area A supported 17 SCT plants in June 2020, but by July 2020, only one remained- see section 5.1.2). Scraping lead to an increase in the tiny, disturbance-adapted toad rush, but no increase in native species. The first appearance of toad rush in 2019 and expansion in 2020 is likely a reflection of more favorable precipitation conditions in recent years compared to the drier sampling years prior to 2017. The appearance of a few native species in the scrape plots, such as the valley sky lupine and native grasses, could be due to the greater amount of bare ground present, but it may also be due to the slightly later timing of the sampling in May and the lower grazing intensity that occurred during the 2020 season.

In the October 2020 AMWG meeting, the group expressed concern that SCT seeds in the seed bank have largely lost their viability (seedbank data show a 100-fold decline in viable SCT density between 1999 and 2013). However, the AMWG has been pursuing strategies to try and stimulate the seedbank. Grazing is a strategy aimed at reducing biomass and increasing light penetration to allow for germination; however, this strategy will not work if there is no viable SCT seed. Therefore, the group recommended transitioning the management focus from trying to stimulate a depleted seedbank with grazing or other disturbance (Goal 2) to an active outplanting strategy to introduce new seed to the site. This represents a renewed focus on 2 tandem goals in the HMP:

- Goal 1: Increase the abundance and distribution of the SCT population.
- 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.

The group 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 aimed at generating seed production on site. As a consequence, the City requested development of a plan for an experimental outplanting of container-grown SCT. A plan is being developed that accommodates continued grazing, mowing, and scraping.

The City also entered a one-year agreement with the UCSC Greenhouses in November to produce 1,000 for out planting in winter January/February 2021. Plantings will be spaced to mitigate inconsistencies in weather and rainfall, which could affect seedling survival. The outplanting plan is expected to include installation of SCT plants in previous (2019) scraped areas and in newly scraped areas. SCT recruitment will also be monitored in the previous scrape plots since other site have shown SCT emergence in second year after seeding (Santa Cruz Gardens #12). Monitoring of SCT plantings will be conducted in coordination with volunteers, City staff, and the City's biologist. Results will be presented in the 2021 annual report.

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 mid-March through August 2. The start date was later than previous year as there were some contracting issues with a new grazing contractor. 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 2020 grazing season are presented on **Table 10**.

Table. 10. Number of Cattle and Duration of Grazing Season per Grazing Area in 2020

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
March 11 – March 23	0	10	0	0	0.5
March 24 – March 29	0	0	0	10	0.25
March 30 – May 4	10	0	0	6	1.0
May 5 – June 30	10	0	0	6	1.0
June 30	11	0	0	6	-
July 1	8	0	0	0	-
July 2- August 2	0	8	0	0	1.0

As grazing occurred in 2020, 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) 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 grown to facilitate SCT seed expression, yet none were detected in this area in 2020.

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 September 19 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.

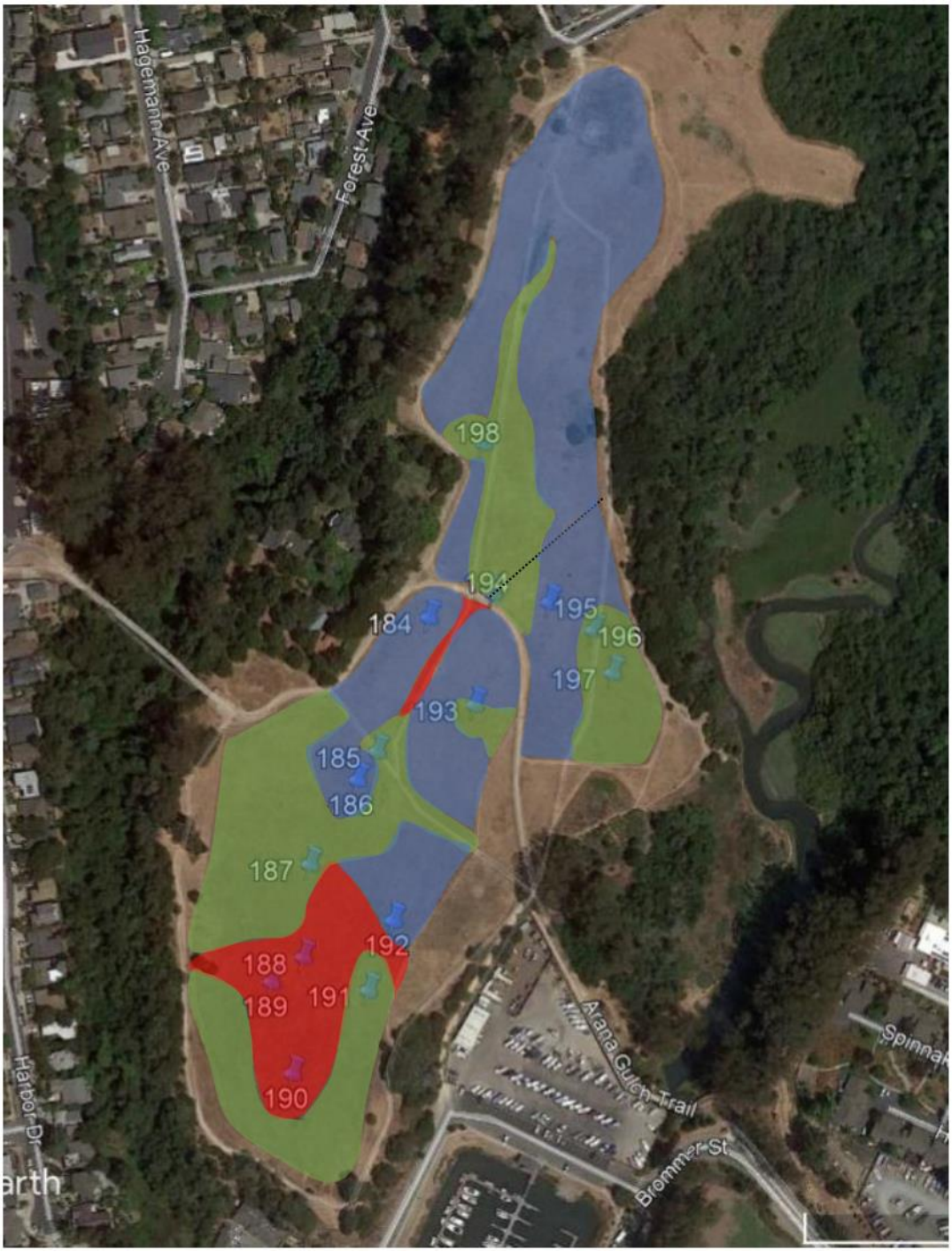
The results were plotted onto an aerial photo to create an RDM zone map, based on GPS points mapped onto most recent Google Earth imagery available, and polygons created. The RDM zone map, portraying the following RDM levels, provides a sufficient level of detail for aiding management and cattle grazing 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. In Area A, most of the southern portion of the grazing area was recorded as middle RDM (green, 500-650 lbs./acre) or the lowest RDM (red, <500 lbs./acre) which reflects the effects of seasonal grazing that occurred between March and August 2020. The northern portions of the grazing area had higher RDM values, mapped as blue and some green.

At most locations, thatch was not evident as cattle ingested the current and previous year's growth. **Figure 22** exhibits the RDM map for all grazed areas (A, C, and D). **Figures 23, 24** and **25** 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 22. RDM Map for Grazing Areas, September 2020

Figure 23. Clip Plot of Highest RDM (Blue), September 2020

Figure 24. Clip Plot of Middle RDM (Green), September 2020

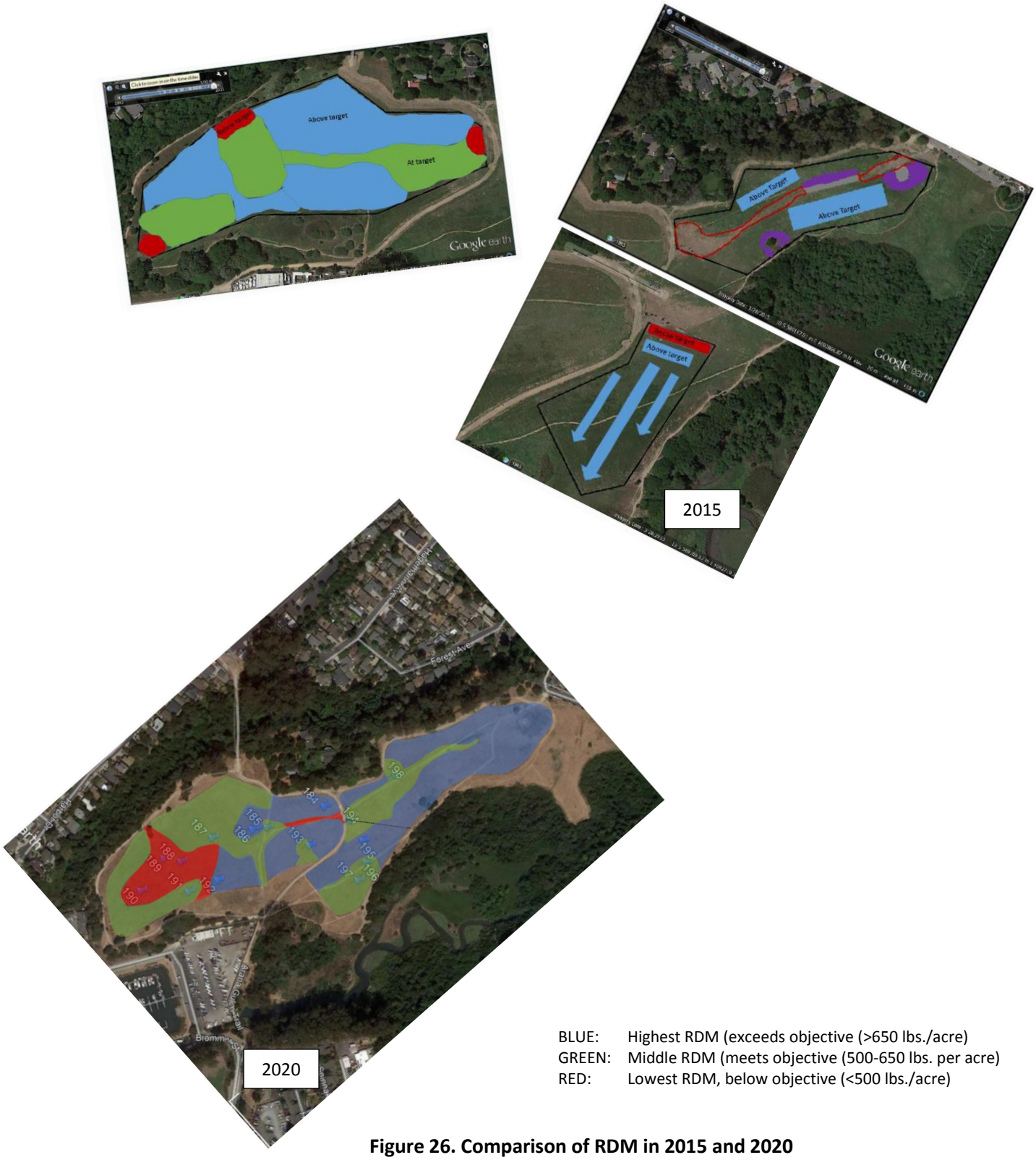
Figure 25. Clip Plot of Lowest RDM (Red), September 2020

5.3.3 Discussion

In 2020, cattle grazing reduced canopy height during months the cattle were on site (March – through July). In Area A, per-grazing canopy height in mid-February averaged 2 inches Area A, 2 inches in Area C, and 3.5 inches in Area D. When cattle were brought onto Area A in March, canopy height in the northern section had increased to 10 or more inches, with numerous radish (*Raphanus sativa)* plants. Plant height in the southern section was less, averaging 4 inches. This height was within the desired target range for the SCT germination and emergence period.

Compared to pre-grazing conditions in 2015, average canopy heights have been reduced in all three areas of the coastal prairie. In February 2020, canopy heights were within the target in all areas, yet by mid-March, canopy heights in most areas were above the target, due to the late arrival of cattle. By June, the dense growth of non-native radish reached 3 feet tall and the cattle did not eat it; therefore, the City elected to mow the radish stands in the norther portion of Area A and all of Area C. Cattle grazing in the southern portion of Area A was sufficient in keeping the canopy height low. By June, cattle browsed 17 SCT plants in Area A to a 2-inch height and also browsed the SCT outplantings in Area C. Fencing was installed around the Area C outplantings to discourage cattle access. No fencing was installed around the SCT plants in Area A, as it was expected the plants would recover and not be further browsed; however, by July, all but one SCT plant in Area A had been browsed to the ground surface and died. This was the first year that cattle grazing was observed to significantly browse SCT plants and result in mortality. In July, all cattle were moved to Area C.

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 2020, except for some areas that retained high RDM (blue RDM level). A comparison of RDM levels between 2015 and 2020 is presented in **Figure 26**.



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 26. Comparison of RDM in 2015 and 2020

Areas of lowest RDM (red) were similar to 2019, with all red areas occurring in Area A. Green RDM levels were recorded along the edges of Area A, corresponding to areas supporting two perennial grasses, purple needlegrass (*Stipa pulchra)*, and California oatgrass (*Danthonia californica)*, and area supporting creeping wild rye (*Leymus triticoides)*, and areas supporting annual grasses where grazing was intensive.

The large reduction in biomass, canopy height, and RDM across the prairie since 2015 represents positive progress in improving vegetation conditions. However, Arana Gulch has been highly disturbed for well over one hundred years and returning the prairie to reference conditions, if possible, will take many more years.

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 2a requires that the grassland achieve residual dry matter (RDM) measurements within a range appropriate for SCT growth. Seasonal grazing was continued in 2020 and many areas of the grazed areas were in the red and green RDM range, thus, the first two objectives have been met.

Observations and BMP implementation monitoring of the grazing program were implemented concurrent with grazing. The protocol for monitoring of the grazing program in 2020 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:

- The AMWG recommended that temporary fencing was not needed around the seasonal wetland within the southern grazing area or its 50-foot buffer. 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 2020.
- The 2020 grazing season was in a slightly 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 2020. There were no incidents of cut fence lines during the grazing season. The City and the

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

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 2020. There was no need to install erosion control measures, such as straw wattles, to prevent any accelerated or channelized runoff toward steep slopes.
- The grazing contractor avoided motorized vehicle use during rainy season/soil saturation.

The observations of SCT in 2020 (Area A) occurred in areas with red RDM levels, suggesting the HMP target for SCT (green RDM level) is too high for SCT establishment and growth. The SCT target RDM may need to be revisited in light of these observations. Some grazing areas were measured at the blue RDM level.

Due to the poor response of SCT recruitment from 5 years of cattle grazing, the City and the AMWG discussed alternative measures to encourage SCT germination and growth, as well as to encourage growth of other coastal prairie plant species. In 2021, grazing is expected to continue in Areas C and D; however, Area A is scheduled to be mowed.

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 2020; however, some maintenance tasks were affected by government stay-at-home orders relating to the COVID-19 pandemic. Despite staffing challenges in 2020 due to the COVID-19 pandemic, City maintenance tasks included the removal of thistles (*Cirsium sp. and Carduus pycnocephalus)*. 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, control of these species was a significant effort and the control efforts has

significantly reduced cover by these species. Large thickets of Himalaya berry (*Rubus ameniacus)* in the northern portion of the grassland were also mowed and/or weed-whipped.

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 2a 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 2020 (see **Table 11**).

5.5 Proposed Actions for 2021

The following actions and expected timing are proposed for 2020:

- Continue the cattle grazing program in Areas C and D, beginning in January 2021, with grazing extending to June, 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. Periodically mow grassland to keep canopy height below 10 inches, 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 2021).
- Mow delineated areas outside the grazing areas (May/June 2020). 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 scrape plots and SCT seed expression.
- Conduct out-plantings of SCT seeding in January/February 2021, using plants grown at UCSC Greenhouses.
- 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.
- 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 2021).
- Document canopy height three times a year: February, April/May, and December 2021
- Document RDM in September/October 2021.
- Document amount of bare ground in SCT occupied areas in December 2021 (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 11. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 7 (2020) 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	1 SCT (Area A) 5 SCT (Area C Outplanting)	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 (outplanting)	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 2020	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 September; areas were at target, yet several areas above target	Yes, some areas were above target; SCT detected in target and below 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 11. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 7 (2020) 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 February, April in southern portion of Area A; all areas in December.	Partially, cattle grazing reduced canopy height in Area A and portions of Area C.
Objective 3B. 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 in Area A, 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.
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. Native grass revegetation plot implemented in 2018 was not successful.
Objective 3D. Increase native species richness from baseline levels to one more representative of a	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	Yes, meeting trend of increased native species richness; coast tarplant and toad rush were

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

Table 11. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 7 (2020) Results	Objective Met?
reference functioning coastal prairie system by 2020.					sampling across Areas A, C, and D. Reference systems have a range of 4 to 21 species as per Holl and Reed (2010), Hayes and Holl (2003).	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, C and D	Yes, meeting trend of increased bare ground in Area A, C and D.
	Permanent photo points with GPS location and compass direction	Before, during and post construction and then yearly at peak growth	Improving	2015	Photo points established in April 2015, approximately 8 weeks after initiation of cattle grazing.	Yes, photo points were re-sampled in 2020
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	N/A, baseline determined in 2015 and will be reassessed every 5 years; SCT collected ad deposited at UCSC Greenhouses for plant propagation, seed increase, and seed storage.

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 2020, 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 27**.

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 27. 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 7 (2020) 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). The City allocated funds in 2019 for this task; and thus, these objectives were met. Removal and control of invasive, non-native plant species was implemented in 2019.

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 2020 police 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 2021:

- 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.

Table 12. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 7 (2020) 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	Thickets of *Prunus,* French broom, removed in 2019	Partial compliance; non-native thickets have been

Table 12. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 7 (2020) Results	Objective Met?
					controlled within management area
Objective 2B. Prioritize the removal of eucalyptus trees where feasible.	Area occupied by eucalyptus	After every removal effort	Decrease	Eucalyptus trees removed near western bridge abutment and along bridge sightline	Partial compliance; some eucalyptus trees removed but some stands remain on City property
Goal 3. Protect wildlife habitat features in Hagemann Gulch					
Objective 3A. The number of SF dusky-footed woodrat nests occurring within Hagemann Gulch bridge construction zone will be identified and the nests protected.	Number of SF dusky-footed woodrat nests within 25m of Hagemann Bridge construction zone	Yearly, if observed prior to construction.	Stable	None detected within construction area Hagemann Gulch bridge; unknown number within 25m of bridge	N/A. No nests were identified prior to construction
Objective 3B. Monitoring for sensitive bird and bat roosts and/or nests occurring within 25 m of the Hagemann Gulch bridge construction zone will be identified and protected and continued for 3-5 years post-construction.	Sensitive bird or bat detections within 25m of Hagemann Bridge construction zone	Yearly, if observed prior to construction.	Stable	None detected within 25m Hagemann Gulch bridge	N/A. No nests were identified prior to construction

Table 12. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 7 (2020) Results	Objective Met?
Goal 4. Increase appropriate uses in Hagemann Gulch					
Objective 4A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter.	Observation of infrastructure conditions	4x per year	Stable	Stable	Park staff periodically inspected the area in 2020; issues of illegal encampments were documented in close proximity to the bridge
Goal 5. Preserve the "Rose of Castille" historic roses					
Objective 5A. Relocation of the roses will occur only if no other alternative is feasible for development of the Hagemann Gulch Bridge. Any relocation will be done in the vicinity of the existing trees, in consultation with the City Arborist.	Presence of Rose of Castile	Yearly in June/July	Stable	Shrubs relocated to City Hall	Yes, roses were located to City Hall to ensure regular maintenance and care
Objective 5B. Address the public education benefits of identifying the Rose of Castille and providing interpretative panels.	Presence of Rose of Castile	Yearly in June/July	Stable	Decision was made.	Staff determined that identifying them would expose them to potential theft and vandalism. No additional action is necessary.

7. 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 2020.

7.1.3 Integrated Pest Management (IPM)

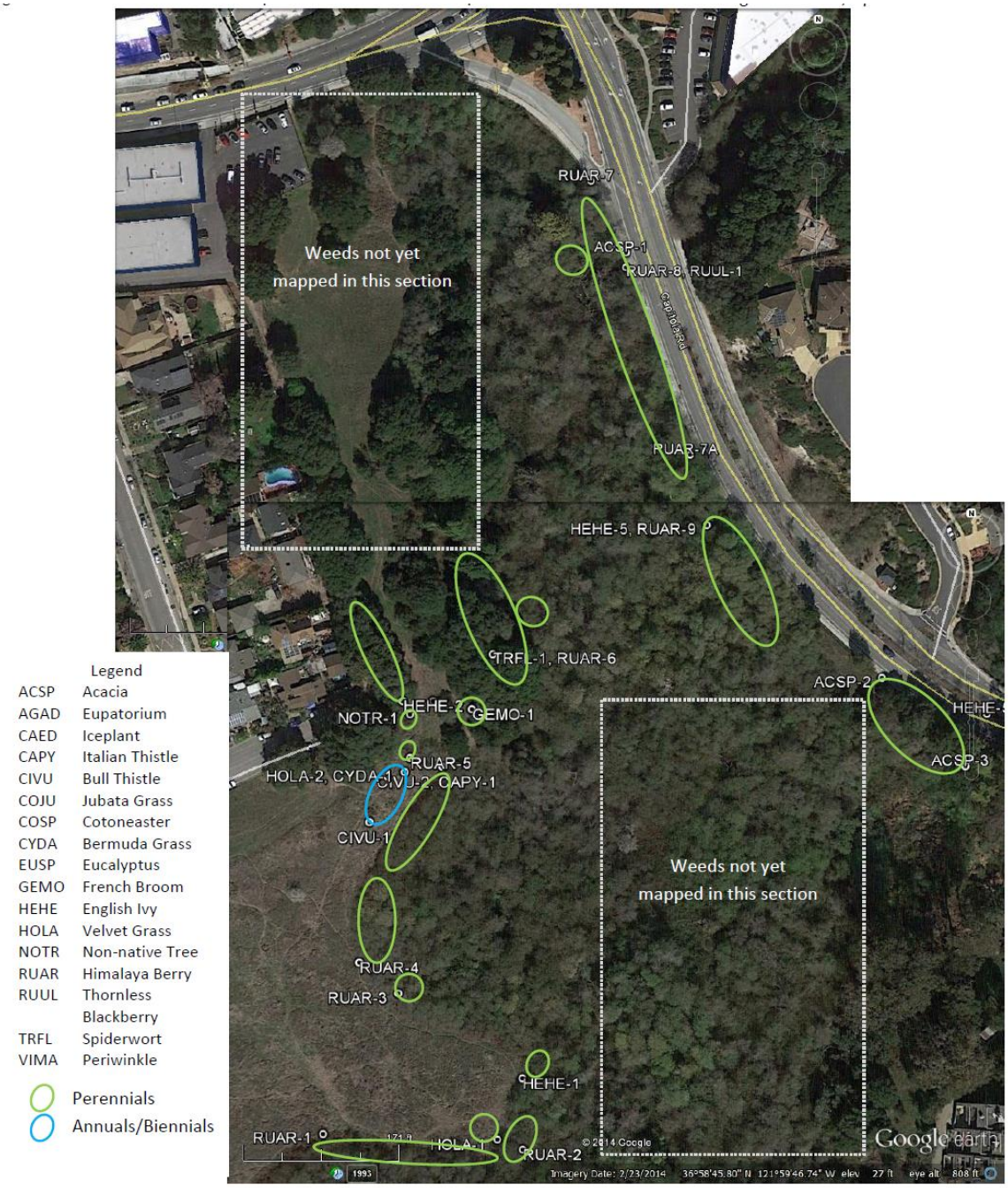
In 2014 and 2015, mapping of invasive weeds within this management area was initiated. The mapping is to guide future management activities for species removal/ control. The approximate size, density of plants (dense, moderate, and sparse) and the location of each non-native invasive species patch was documented using GPS and mapped on aerial photos. A map of data collected, and updated in 2019, is presented in **Figure 28A-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 2020, the City continued closure of the ad-hoc path along Arana Creek to discourage public access to the natural area. Straw wattles and straw 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.



Arana Gulch Greenbelt – Location of Invasive Plant Species in Arana Creek Management Area
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Figure 28A. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

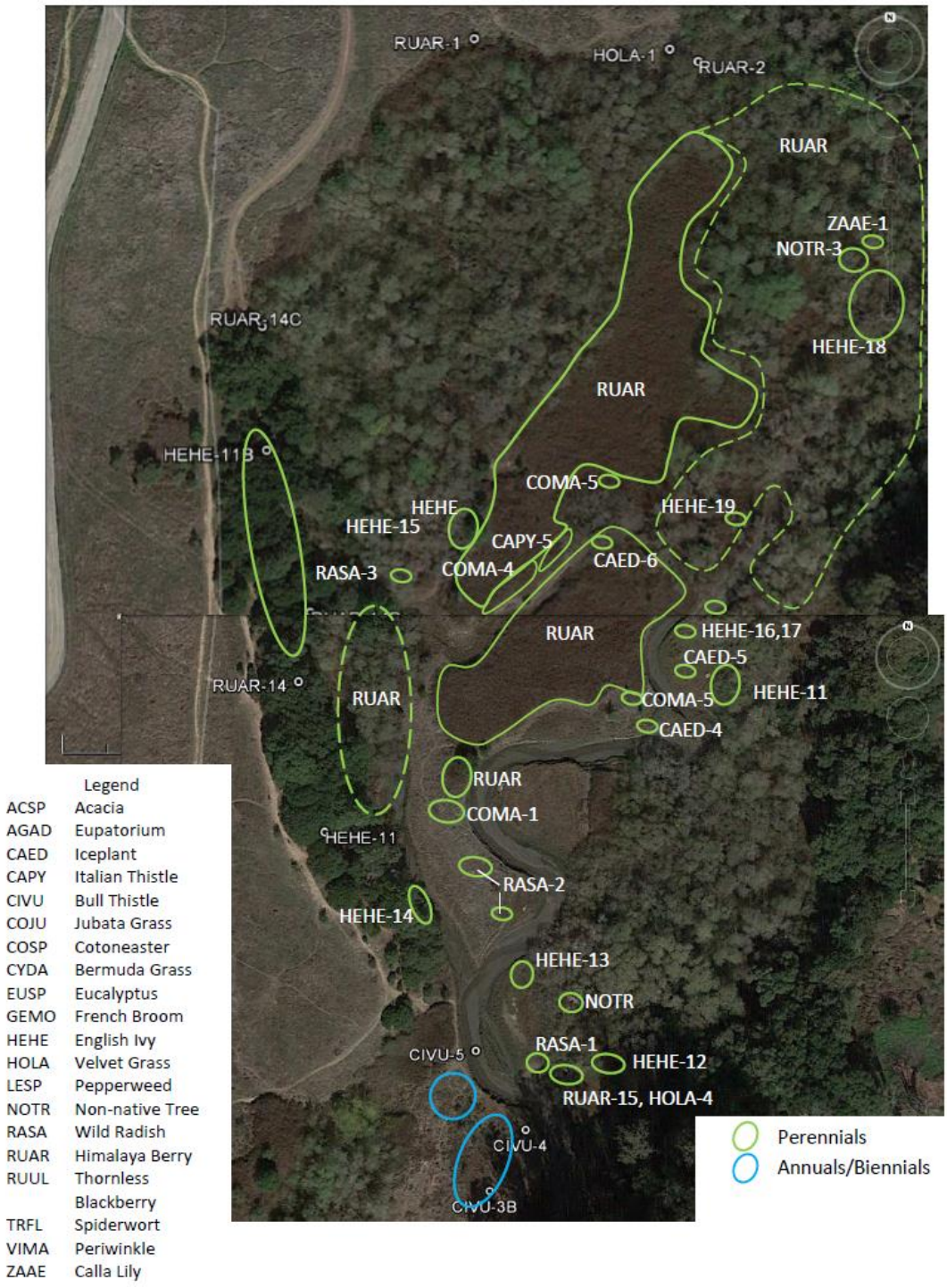

Figure 28B. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

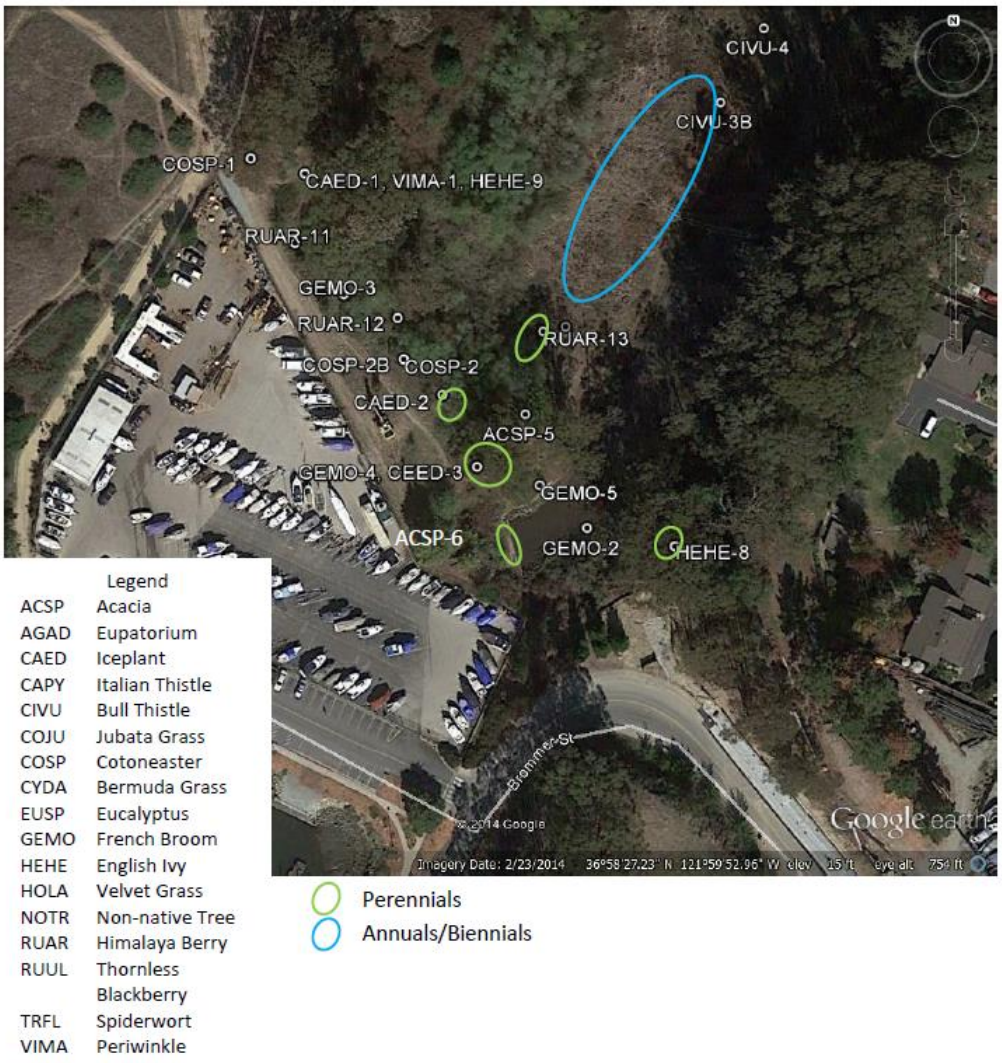

Figure 28C. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

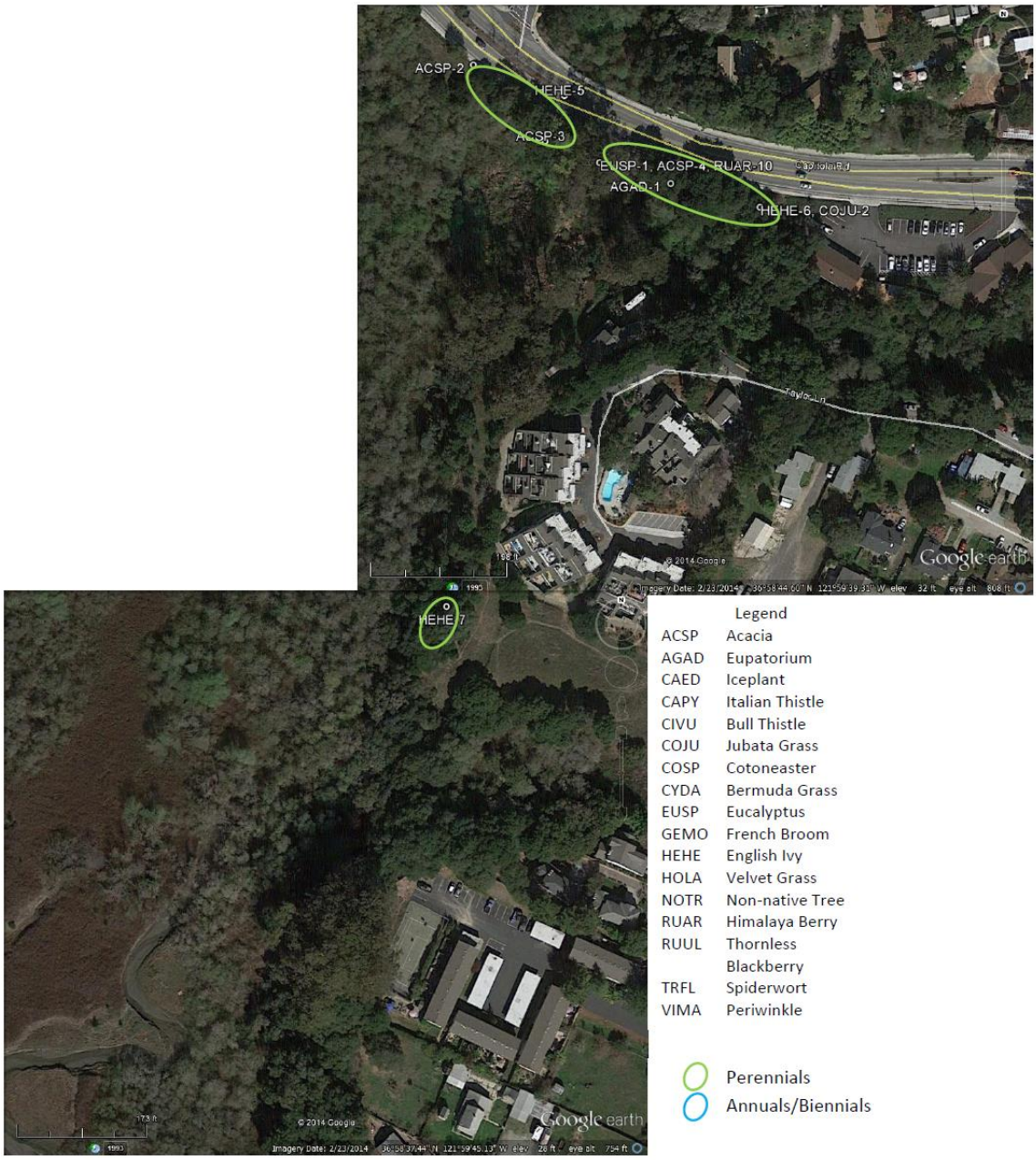

Figure 28D. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area

7.1.4 Coordination with the RCDSCC

No actions between the City and the RCDSCC were conducted in 2020.

7.2 Monitoring and Performance Evaluation

7.2.1 Monitoring Methods

The riparian revegetation areas were monitored in 2020. A plant survival count was conducted in December 2020. The revegetated areas are required to meet 80% absolute cover of native species (including planted and naturally regenerating species) and less than 5% of invasive weeds; therefore, plant cover within the revegetation area was documented by a visual assessment using the CDFW Combined Vegetation Rapid Assessment and Releve Field Form.

7.2.2 Monitoring Results

Within Area A, the 2020 monitoring found a dense cover of naturally-establishing Himalaya berry (*Rubus ameniacus)*, and poison oak (*Toxicodendron diversilobum)*, and planted willow (*Salix lasiolepis).* Willow cuttings exhibited a 30% survival rate; six of the 20 willow cuttings were found to be alive. Plant cover within the revegetation area was recorded at is 95%, provided by Himalaya berry (*Rubus ameniacus)*, willow (*Salix lasiolepis)*, and poison oak (*Toxicodendron diversilobum).* Eucalyptus, which provided cover in 2017 have been removed. This area does not yet meet the required 80% native woody cover required by CDFW.

Within Area B, 40 creeping wild rye (*Elymus triticoides)* were planted in 2015. Due to poor survival and poor growing conditions; these plantings were abandoned and additional shrubs were installed in Area C; however, pre-existing creeping ryegrass plants are still present in the area, which is reflected in the plant cover measurements (see **Table 13**). Within Area C. plant cover was recorded at 80%, with cover provided by California rose (*Rosa californica)* (40%), mugwort (*Artemisia douglasiana)* (15%), creeping wild rye (*Elymus triticoides)* (20%), coast live oak (5%) and grasses and forbs (40%). These data are depicted on **Table 13**. This area meets the required 80% native cover required by CDFW.

Table 13. Monitoring Results from Riparian Revegetation Area, Arana Creek, 2020

Species	# Installed Plants Alive, 2020	Plant Cover
Area A		
Willow	6	30%
Himalaya Blackberry	-	60
Poison Oak	-	20
Grasses and Forbs	-	10
Area C		
Creeping Wild Rye	-	20%
California Rose	38	40%
Mugwort	17	15%
Coast Live oak	2	5%
Grasses and Forbs		70%

7.2.3 Evaluation of HMP Goals

Table 14 presents a summary of the biological variables monitored, the Year 7 (2020) 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 conferred with the RCDSCC to discuss management activities within the watershed and within the greenbelt property. The City coordination with the RCDSCC is in compliance with goals of the HMP, yet the goal has not yet been met.

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 2021

The following actions and expected timing are proposed for 2021:

- 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 7 (2020) 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 2020.	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 2020.	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 2020.	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 2020.	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 7 (2020) 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 2020.	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	Several areas of Invasive plants have been removed/controlled	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 7 and Recommendations for Year 8 (2021)

8.1 Conclusions from 2020

The City continued implementation of the HMP in 2020 (Year 7). Actions were conducted in all of the management areas; however, some actions were hampered by COVID-19 pandemic restrictions and resulting staffing shortages. Cattle were grazed in the coastal prairie for SCT management and invasive weed control was implemented in all management areas. There was effective and efficient coordination between the City and the AMWG in 2020 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 on site from mid-March to August. Implementing cattle grazing is in compliance with the HMP. Grazing was successful in maintaining the desired canopy height in portions of Area A, yet the late start of the grazing allowed for the growth of tall radish plants in the northern portion of Area A and Area C. 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.

Grassland management actions were implemented in areas not subject to seasonal grazing. Flail mowing of the perimeter was conducted in June/July. In addition, mowing was conducted in the northern portion of Area A and Area C to control wild radish. 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 2020. Seventeen above-ground plants were documented from Area A in June 2020, yet this number was reduced to one by September. Twenty-eight SCT outplantings in Area C in January were reduced to five in September 2020. The HMP objective of reaching 348 plants was not met in 2020. A management action plan was prepared in November 2020 to address outplantings and other actions to encourage expression of SCT in Areas A, C, and D; this plan is expected to be implemented in January/February 2021. SCT seed deposited at UCSC Greenhouses in 2018 was used for seed storage and plant propagation (plants expected to be installed in January/February 2021).

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 2020, 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 2020 through meetings in March and October 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, 2019 to June 30, 2020 and fiscal year July 1, 2020 to June 30, 2021. 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 2021

The City will discuss with the AMWG recommendations for management actions for 2021 at a minimum of two meetings in 2021. Depending upon COVID-19 pandemic restrictions, these meetings may be field-only and/or virtual (computer-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 2021 (Year 8) is the continuation of seasonal cattle grazing within portions of the prairie/grassland. The City will continue to implement the Stocking and Work Program. Management activities will include monitoring plant composition, plant cover and residual dry matter (RDM) within the grazed areas, grassland conditions along the permanent transects, 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. In addition, for 2021 the City is scheduled to replace cattle grazing in Area A with periodic mowing, as an experimental approach to prairie enhancement and SCT recruitment.

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 2021. Seed collection of SCT may occur depending on the SCT population and prior approval from

CDFW. Seed and/or plants grown at UCSC Greenhouses may be installed within management areas in 2021. 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 2021 (Year 7) 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 2021 (Year 8) will be continued removal and control of invasive, non-native plant species. Riparian revegetation as per an approved CDFW Streambed Alteration Agreement (SAA) will be maintained in 2021.

8.2.4 AMWG and Public Outreach

In 2021 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 2021. The City has allocated funds for fiscal year July 1, 2020 to June 30, 2021 and funding for fiscal year July 1, 2021 to June 30, 2022.

Table 15. Timeline for Habitat Management Actions Proposed for Year 8 (2021)

	2021												2021
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 8 (2021)

	2021												2021
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, 2020

NOTE: Please see the separate Appendix document

A-1: AMWG Meeting Minutes for:

March 2, 2020
October 22, 2020

Appendix B Coastal Prairie/Santa Cruz Tarplant Management Area

NOTE: Please see the separate Appendix document

B-2. Pre-mow Plant and Breeding Bird Survey

B-3. Plant Cover Data, SCT Sites

B-5. Photo Monitoring

Appendix C Arana Gulch Creek Riparian Woodland and Wetland Management Area and Hagemann Gulch Riparian Woodland Management Area

NOTE: Please see the separate Appendix document

C-1: Arana Creek Revegetation Areas: Revegetation Monitoring Results: CNPS and CDFG Combined Vegetation Rapid Assessment and Releve Field Forms