

# Arana Gulch Habitat Management Plan City of Santa Cruz

## Year 4 (2017) Annual Report

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

Final  
*May 4, 2018*



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*May 4, 2018*

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# 1. Executive Summary

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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 and 2016; these actions are described in the Year 1 (2014), Year 2 (2015), and Year 3 (2016) Annual Reports. Actions implemented in Year 4 (2017) are described in this report. The AMWG provided input to the City during the implementation of the Year 4 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 4 (2017), 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. In addition, the City initiated management to remove and control invasive weeds in the Arana Gulch Creek Management Area. All of these actions taken by the City are to continue progress to meet the HMP objectives. The habitat management activities undertaken in 2017 are summarized below.

## **Master Plan Improvements**

Master plan improvements in 2017 were limited to minor trail maintenance associated with the Coastal Prairie Loop Trail and Marsh Vista Trail. The Arana Gulch Multi-Use

Trail and the Agnes Street Connector Trail, completed in 2013 and 2014, respectively, were also maintained in 2017.

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. City staff maintained these plantings throughout 2017 and additional willows are scheduled to be installed along Arana Creek in January 2018.

### **Summary of Coastal Prairie/Santa Cruz Tarplant Management Area Activities**

Management actions in Year 4 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 on January 28, 2017 and extended to June 11, 2017. 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 that were installed in 2016, were monitored to see if cattle congregation created bare areas for SCT; an area of bare ground was found in an approximately 5-foot circle around these posts. A new gate was installed in Grazing Area C to facilitate transfer of animals between Grazing Areas A and C. Areas where gravel was removed from Area C in December 2016 were monitored for native plant recovery; widely spaced coast tarweed (*Deinandra corymbosa*) were found colonizing these areas in 2017.

Prairie site conditions were documented in May 2017 with plant species composition and cover values recorded at permanent transects. Photo-documentation was also conducted in May 2017. Documentation of the Year 4 conditions, using permanent transects was done in compliance with the HMP. In coordination with the AMWG, sub-management areas were identified to reflect the various plant species composition, as well as presence/absence of SCT, that may direct future management and monitoring. Canopy heights were measured in February, May, and September. Additionally, residual dry matter was assessed in October. The data was collected amid an above average rainfall season (rainfall in the 2016/17 water year was more than double the average).

As per guidelines in the HMP, seasonal mowing was conducted for grassland/prairie areas located outside the grazing fences between January and December (Tarplant Area B) and in June and July (all other areas) to reduce the canopy height of the non-native grasses and forbs to benefit the coastal prairie species diversity and habitat function. 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 recommendations from the Santa Cruz Bird Club.

A census of SCT was conducted in summer 2017; no SCT plants were found, a decrease from 35 plants in 2016. Increasing the SCT population is an HMP goal. The population was recorded at 18 plants in 2013, 4 plants in 2014, and 0 plants in 2015. This is well below a population of approximately 348 plants in 2006.<sup>1</sup> The reason for the lack of SCT is not known. The areas where SCT were observed in 2016 were subject to cattle grazing; however, plant growth could have been affected by additional grass growth associated with the above-average rainfall year or other factors not yet known. To date, site management has not resulted in the number of SCT meeting the HMP goal.

In compliance with the HMP and an Invasive Weed Work Plan (IWWP) prepared for the management area, City staff continued to implement the plan. City staff continued to remove occurrences of invasive, non-native plant species within the central prairie/grassland. The City continued to remove cotoneaster, Himalaya blackberry, and English ivy from the prairie and removed basal rosettes and flowering stalks from thistles. A large patch of cotoneaster, located near the harbor entrance trail and the Coastal Prairie Loop Trail was removed in June 2017. In addition, most of the trees around Grazing Area A, from Hagemann Bridge to the overlook above the harbor, were removed, as the trees are not desired within areas designated for grassland in compliance with the IWWP and the HMP and recommended by the AMWG. The Natural History Museum's Earth Steward's Program, a program to teach youth environmental restoration job skills, had two work days with approximately 15 students who helped remove invasive plants.

The City coordinated with the Natural History Museum and, in May 2017, conducted an educational tour with the public to discuss restoration activities. In November, the City participated in the 19<sup>th</sup> Annual Central California Invasive Weed Symposium by hosting a field trip to Arana Gulch to discuss site management.

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

Pursuant to a survey that mapped occurrences of invasive, non-native plant species within the Arana Gulch Creek Riparian Woodland and Wetland Management Area, City staff began removal and control of non-native, invasive weeds in a portion of the management area in Year 3 (2016). In 2017, City staff continued to control English ivy along the Marsh Vista Trail. The City closed the ad-hoc path along Arana Creek to prevent public access to the natural area. Straw wattles and straw were placed at the northern end of the trail to reduce run-off from the Coastal Loop Trail from entering Arana Creek.

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<sup>1</sup> See Section 3.3, page 52 of Arana Gulch HMP.



An inventory of invasive non-native plant species was conducted for the Hagemann Gulch Management Area in 2017. Occurrences of species were mapped onto an aerial photo base map. A draft invasive work plan will be prepared in 2018.

In 2014 a revegetation plan was prepared for an area along Arana Creek and Hagemann Gulch pursuant to a Streambed Alteration Agreement (SAA) with CDFW to compensate for the removal of riparian vegetation as part of the construction of the Arana Gulch Multi-Use Trail. Revegetation at/around Arana Creek was installed in January and February 2015, with some replacement plantings installed in February 2016; additional willow plantings are scheduled for January 2018. City staff maintained all plantings throughout 2017.

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.

### **Management Activities Proposed for 2018 (Year 5)**

The following management actions are identified for 2018:

- Continue seasonal cattle grazing within the prairie/SCT management area, as per the approved grazing contract and Stocking and Work Program. Additional activities in this management area include monitoring plant composition, plant cover and residual dry matter (RDM) within grazed areas, implementing removal/control of invasive weed infestations, and documenting site conditions at the permanent photo stations.
- Consider implementing interim grassland management actions (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 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 2018. Seed collection of SCT may be done if more than 50 SCT are present, pending prior approval from CDFW.
- The City will continue to implement management actions within the Arana Gulch Creek Management Area. Pending funding and staff availability, the City will begin to implement management actions within the Hagemann Gulch Management Area. The City will solicit input from the AMWG on prioritizing invasive plant removal actions within these two management areas.
- 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 continue to confer with the Resource Conservation District (RCD) on Arana Creek watershed management, including measures to reduce erosion and sediment entry into the watershed. 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 2018 through periodic meetings and group email correspondence. The tentative schedule is to hold AMWG meetings in January and November 2018.
- The City will continue to coordinate with the Natural History Museum and conduct educational tours on restoration activities. The Earth Steward's Program will continue to utilize Arana Gulch to teach students environmental restoration job skills. Other opportunities to coordinate with organizations and/or researchers will also be explored.
- The AMWG will finalize recommendations for aligning targets for the prairie, grassland, mixed, and SC tarplant areas.

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## 2. Introduction

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### 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 3 (2017) 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. Unfortunately, despite efforts from the City, the overall trend has been a decline in the population over the last two decades.

The HMP outlines various management tools for managing the three habitat areas on the site<sup>2</sup>. 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

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<sup>2</sup> See Section 3.1, page 33 of Arana Gulch HMP.

resource management activities to the City and the CCC<sup>3</sup>. In 2016, 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 4th 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 and Year 3 [2016] Annual Report) 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.

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<sup>3</sup> 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 2017 which is considered to be Year 4 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 5 (2018) 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], and Year 3 [2016]) for specific details on actions implemented in those years.



## 3. Adaptive Management Framework

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### 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 2017. One meeting was held with the AMWG in 2017; the minutes from the February 16, 2017 meeting is presented in **Appendix A**. In addition, the City coordinated and facilitated group email correspondence between AMWG members to solicit input on management activities. Email correspondence from September 2017 is presented in **Appendix A**. The HMP outlines the formation of the AMWG, voting procedures, and other procedures.<sup>4</sup> The list of current members is presented in the meeting minutes (**Appendix A**). The group is currently inquiring resource professionals for additional membership.

The AMWG provided input to the City on habitat management activities within Arana Gulch throughout 2017. 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 of seasonal perimeter mowing, the location of grazing infrastructure (i.e., rubbing posts, relocation of water troughs), tree removal, invasive weed control, drainage along the east-west trail, trail re-alignments and trail closures and other measures to protect and manage wetlands along Arana Creek.

### 3.2 Public Outreach

In 2017 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 2017.

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.

In preparation of the beginning of the grazing season in January 2017, City staff and park rangers spent time on site to discuss the grazing program and the importance of keeping dogs on-leash when they encountered violators of the rule. The City continued to provide a brochure at the entrances to the greenbelt informing the public of why grazing was being implemented and listing safety tips for human/dog and cattle interactions. The brochure was also posted on the City webpage. 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. When cattle were on site in 2017 (January through June), City staff and park rangers provided information to the public on the grazing program through park brochures

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<sup>4</sup> See pages 22-24 of Arana Gulch HMP

and on-site conversations. The City coordinated with the Natural History Museum and, in May 2017, conducted an educational tour with the public to discuss restoration activities. In November, the City participated in the 19<sup>th</sup> Annual Central California Invasive Weed Symposium by hosting a field trip to Arana Gulch to discuss site management.

### 3.3 Evaluation of Adaptive Management HMP Goals

A goal of the HMP is to maintain an adaptive management framework to allow stakeholders to conduct and evaluate actions. To meet this goal there are two objectives: conduct an annual AMWG meeting and maintain funding levels. In 2017, one meeting was held with the AMWG in February 2017 and there was email correspondence with AMWG members to present information and solicit feedback. AMWG members agreed to postpone the annual November meeting to January 2018. 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 began to re-visit prioritizing the HMP management actions in 2017, but this task was not completed. This task will be continued in 2018 and, if completed, the results of this prioritization will be included in the 2018 annual report.

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 (80%) 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 2017, 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 timescale, as no SCT were observed on site in 2017. 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 2017, and whether the actions were in compliance with the HMP.

**Table 1. Monitoring of Adaptive Management Variables**

Objective and Variable	Actions in Year 4 (2017)	Year 4 (2017) Results	Objective Met?
<b>Goal 1. Maintain an adaptive management framework that allows stakeholders to scientifically conduct and evaluate actions</b>			
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.	Meeting held February 16, 2017	Meeting minutes presented in Appendix A	Yes, one meeting in February 2017. AMWG members agreed to hold annual 2017 meeting in January 2018. Email correspondence was conducted with AMWG members periodically in 2017
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, 2016 to June 30, 2017 and July 1, 2017 to June 30, 2018	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
<b>Goal 2. Conduct a two-tracked program of management and research with built-in monitoring</b>			
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 were conducted as outlined in the HMP. Trends in biological variables were also documented. Management actions were implemented to reach desired variables for SCT (not reached in timescale) and coastal prairie by 2020
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.	No research conducted in 2017	No research conducted in 2017	Yes, when additional research items are identified, the KMQ framework will continue to be used
<b>Goal 3. Develop public educational opportunities associated with Arana Gulch and efforts to conserve and restore its rare resources</b>			
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 2017 with new information	Yes, City improved and updated website in 2017 and the webpage was periodically updated 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. 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 January through June 2016. Coast tarweed (*Deinandra corymbosa*) colonized this area and surrounding areas, as depicted in **Figure 2**. The location of this road and other master plan improvements is presented in **Figure 3**.

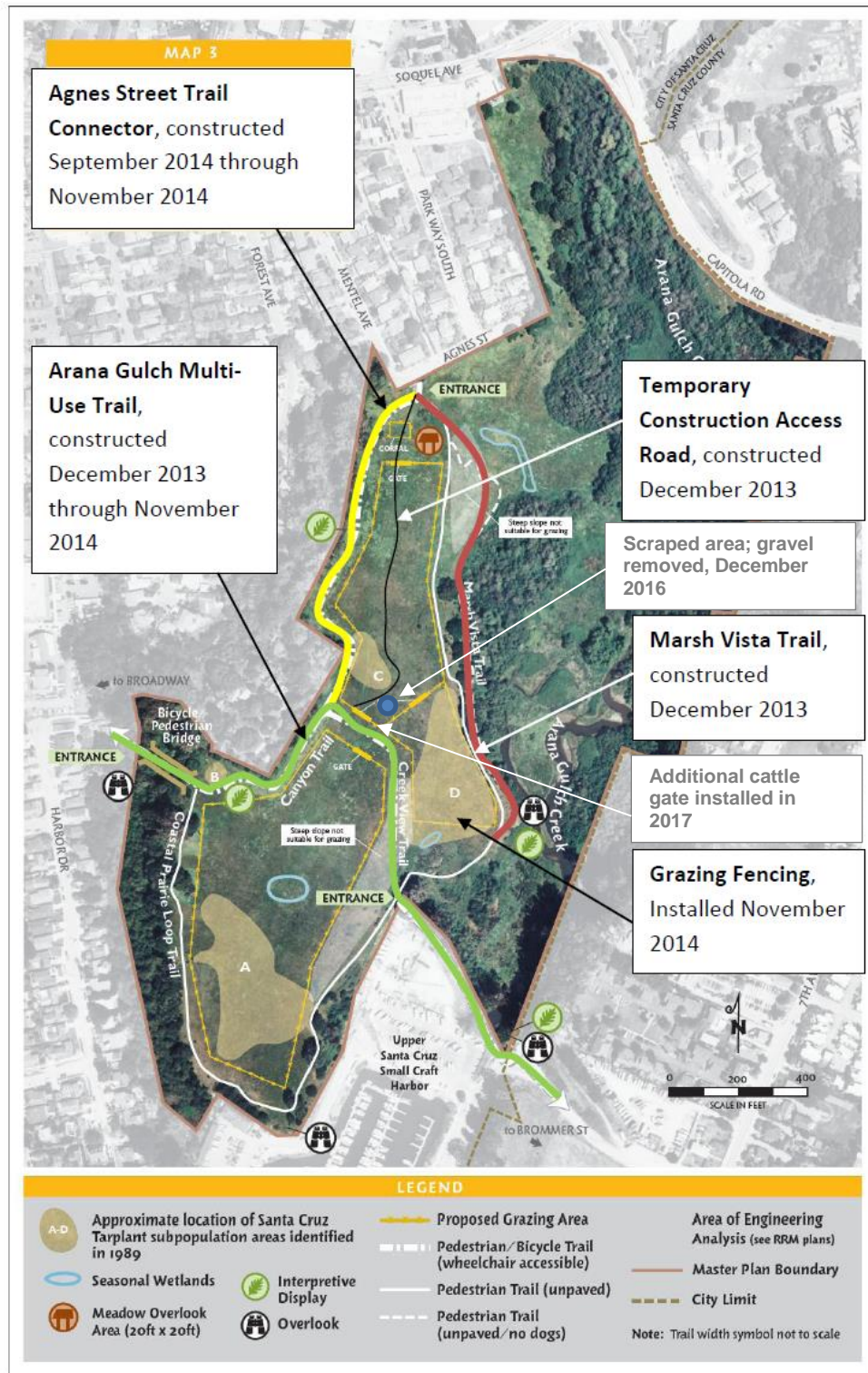
Areas subject to hydromulch and hydroseeding for erosion control as part of trail construction were observed in 2017. No erosion was noted in these areas and no additional seeding was conducted in 2017. An area with construction-related gravel was scraped in December 2016 to remove the gravel; the topsoil was retained and re-scattered in place. The location of the scraped area is depicted in **Figure 3**. **Figure 4** depicts the site after removal of the gravel. Coast tarweed (*Deinandra corymbosa*) was observed in this treated area in 2017. No other actions were done along the central construction access way in 2017.

**Figure 2. Condition of temporary construction access road, June 2017**





Figure 3. Master Plan improvements, 2013 - 2017



**Figure 4. Area scraped near temporary construction access road, supporting Coast Tarweed in July 2017**



#### **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 are 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 5 and 6**, respectively.

In 2016, native and non-native plants continued to establish at the Tarplant Area D receiver site, similar to site observations in 2015. Native species observed included coast tarweed (*Deinandra corymbosa*) and California poppy (*Eschscholzia californica*) as well as non-native species include hare barley (*Hordeum murinum ssp. leporinum*), oats (*Avena spp.*), wild lettuce (*Lactuca sp.*), cat's ear (*Hypochaeris sp.*), filaree (*Erodium sp.*), wild radish (*Raphanus sativus*), ryegrass (*Festuca perennis*), and ripgut brome (*Bromus diandrus*). No SCT was documented from this receiver site in 2017.

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 6**). 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 6**.



Figure 5. Location of multi-use trail soil salvage sites, 2013 and 2014

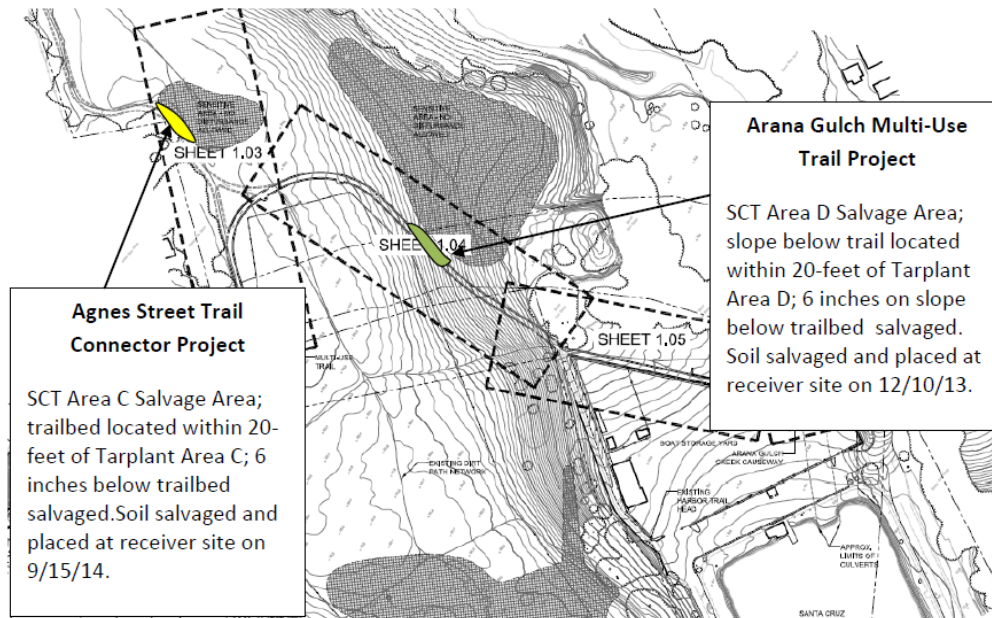


Figure 6. Multi-Use trail soil receiver sites on aerial photo, 2013 and 2014





In July and August 2017, native and non-native plants were growing at the Tarplant Area C receiver site. Native species observed included coast tarweed (*Deinandra corymbosa*) and California poppy (*Eschscholzia californica*). Non-native species include hare barley (*Hordeum murinum ssp. leporinum*), oats (*Avena spp.*), cat's ear (*Hypochaeris sp.*), filaree (*Erodium sp.*), wild radish (*Raphanus sativus*), and ryegrass (*Festuca perennis*). No SCT was documented from the receiver site in 2017. The condition of this receiver site in July 2017 is shown in **Figure 7**.

**Figure 7. Condition of soil receiver site adjacent to Tarplant Area C, July 2017**



#### **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 pervious surface, to be installed. 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. Similar to observations in previous years, individuals of the native coast tarweed (*Deinandra corymbosa*) were observed within the trail construction zone, as depicted in **Figure 8**. 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 2017.

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 2016/17 and found that they were effective.

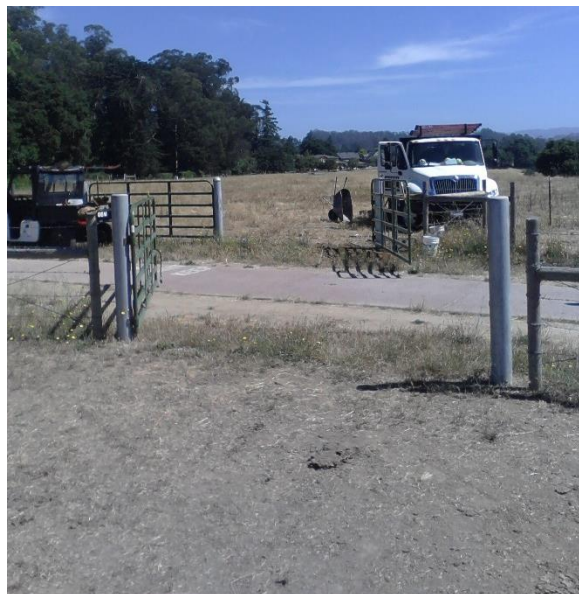
**Figure 8. Coast tarweed growing along edge of east-west trail, July 2017**



#### **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. In January, 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 2017 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). In 2017, a new gate was installed in Grazing Area C to facilitate movement of animals between this grazing area and Grazing Area A. This gate is depicted in Figure 9.

**Figure 9. New gate installed in Area C, 2017**



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

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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. Management actions in 2017 included grazing, perimeter mowing, monitoring of grazing actions, monitoring for SCT, and invasive weed control. City staff implemented most of these tasks. A log of maintenance actions is presented in **Appendix B**. The AMWG is in the process of collecting data on nearby coastal prairie reference sites that may be useful in developing performance criteria for 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. It is anticipated that these criteria will be developed in 2018 by the AMWG and CC and 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 2018 are discussed in Section 5.5.

### 5.1 Santa Cruz Tarplant

Several management actions for Santa Cruz Tarplant (SCT) were implemented in 2017, as described below.

#### 5.1.1 Management Actions

Management actions for the Santa Cruz Tarplant (SCT) consisted of seasonal grazing of the Tarplant Areas A, C and D (and surrounding grassland) and seasonal mowing of Tarplant Area B. Tarplant Areas A, C, and D were grazed between January 28 and June 11, 2017. Further details on the grazing program can be found in Section 5.3. Tarplant Area B was mowed or weed-whipped approximately every 2-3 weeks from January through December each time the grass grew more than 8 inches in height, except for August and September when SCT could be flowering. Raking of grass clippings was unnecessary this year. There was not enough accumulation because volunteers had performed a major raking and removal effort in the previous year.

### 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<sup>5</sup>. The HMP requires an annual census of the population (Goal 1) and a baseline assessment of SCT within the soil seed bank (Goal 4). Field surveys for SCT at Arana Gulch were first conducted in 1977 by botanist Randy Morgan but plant counts are lacking in the current database. In 1986, he estimated there were more than 100,000 plants on the property. In 1989, R. Doug Stone identified SCT in four locations he called Areas A-D (see **Figure 1**). These area designations have remained in use.

**5.1.2.1 Census.** A census for SCT was conducted by Kathleen Lyons, with Brett Snider and Noah Downing. 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 2017. This survey period coincided with the blooming period of SCT. A reference population at the Santa Cruz Armory was field checked on June 30; plants at this location were in flower which suggested that the species would be flowering and easily detected within Arana Gulch. 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 30, July 24, August 18, and September 15, totally approximately 24 survey hours. On September 15<sup>th</sup>, Jean Brocklebank and Michael Lewis assisted in the field survey. Staff also conducted additional surveys for SCT during this period. Brett Snider and/or Noah Downing monitored for signs of SCT growth every couple of days from May 25 to June 11 in preparation for the end of the cattle grazing period. Staff also performed bi-weekly monitoring of Tarplant Areas, primarily focused on Areas A and D, though often including Area C, from mid-June to the end of September. As per protocol, if a SCT was observed a waypoint would be taken with a handheld Global Positioning System (Garmin 60scc) 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. A map showing the survey route(s) is presented in **Appendix C (Item C-1)**.

No SCT were documented onsite in 2017. This is a decrease from 35 plants in 2016 and similar to 2015 (0 plants) and a decrease from four plants in 2014. The survey was conducted in an above-normal rainfall year. The census was conducted after approximately 3 seasons of grazing (grazing in spring/summer seasons of 2014, 2015, and 2016).

### 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 in the first year after the return of

<sup>5</sup> See Section 3.1, page 63 of Arana Gulch HMP.

grazing (i.e., summer 2016) (Objective 1A). As no SCT were observed in 2017, this HMP goal was not met.

The cattle grazing that occurred in 2014/2015/2016 appears to have improved growing conditions for SCT in that more bare ground was created and residual dry matter was reduced; however, due to the lack of SCT in 2017, conditions were apparently not conducive to SCT germination after the first significant rainfall event in early 2017. Heavy rainfall in January and February, coupled with cool weather, may have adversely affected SCT germination and growth.

The HMP has an objective to expand the distribution of SCT beyond Tarplant Area A within three years (Objective 1B). As no SCT were found in any area in 2017, Objective 1B was not met this year. The 2015, 2016, and 2017 cattle grazing occurred in Tarplant Areas A, C, and D; however, if the seedbank is depleted it could take several years for expansion to occur.

The HMP also 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.

## **5.2 Grassland/Coastal Prairie**

### **5.2.1 Management Actions**

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 9**. Perimeter fuel break mowing was also identified along the trails.

The City flail-mowed (to approximately 4" height) Tarplant Area B in March and May. The City continually weed-whipped Area B from February - June and November – December to keep the grass height as low as possible. The remaining areas were flail-mowed (to less than 3 inches in height) in June and July; however, an issue with the equipment needed to be fixed before mowing continued. Areas subject to mowing are depicted on **Figure 10**. Mowing was conducted for grassland management purposes (i.e., reduce cover by non-native plants) and also for perimeter fuel break purposes. (Note: Please refer to Section 5.3 for the grazing management).

Mowing was conducted after input from the AMWG at the February meeting. The AMWG recommended that perimeter mowing occur once a year in late May or early June but only after a botanist inspects the site to assure that native plants, especially Mariposa lilies, would not be adversely affected. Prior to mowing, the City authorized a botanical review and a

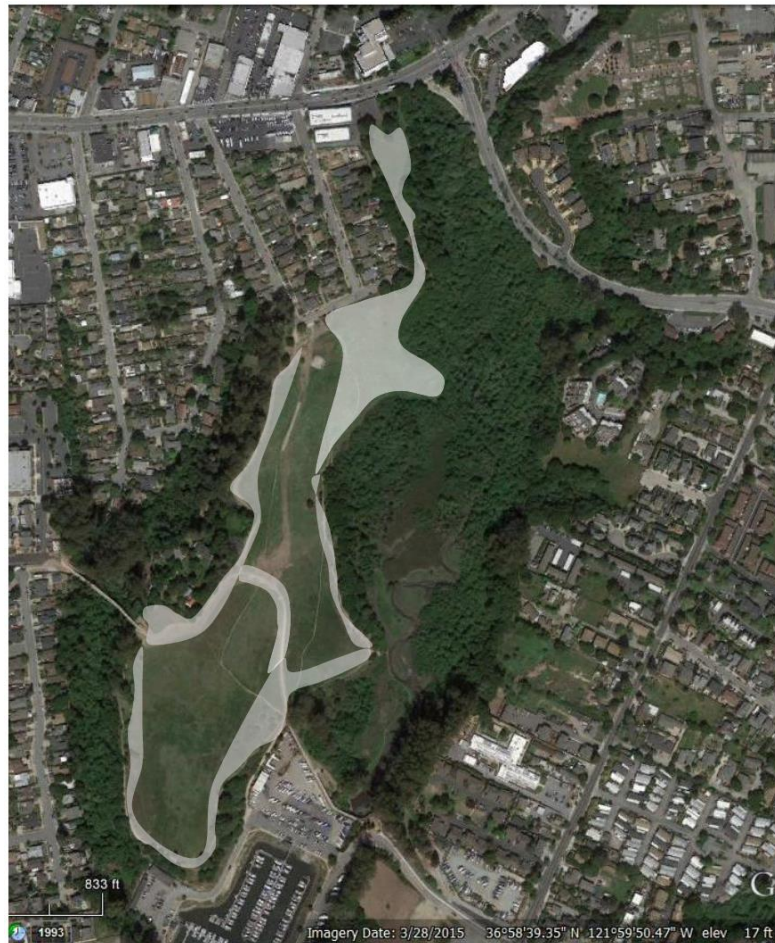


breeding bird survey of the mowing areas to ascertain if native plant species or nesting birds would be directly affected by the mowing. Kathleen Lyons, plant ecologist, conducted the botanical review and Garvin Hoefler, wildlife biologist, conducted the breeding bird survey. No rare plants or breeding birds were detected in the areas subject to mowing. The pre-mowing survey results are presented in **Appendix C (Item C-2)**. At the time of the June mowing, grass height was estimated to range 1-6 feet, based on pre-mowing visual observations. Flail mowing was conducted as close to bare ground as possible. The areas mowed in 2017 are shown on Figure 11.

**Figure 10. Delineated grassland, April 2015**



Figure 11. Areas Mowed in 2017



In 2014, the AMWG evaluated the northeast portion of the grassland (near Agnes Street) and whether this area should be retained in the delineated grassland and whether it could be restored to native grassland. Three 50x50-foot scrape plots were created in 2014 to evaluate native plant recruitment. No native plant recruitment was noted in 2015, 2016 or 2017. Due to the lack of native species, the area will to be mowed as grassland, but no other restoration is anticipated.

In 2017, based on input from the AMWG, the City continued to remove woody plant species from the delineated grassland area. Occurrences of cotoneaster (*Cotoneaster sp.*) and Himalaya blackberry (*Rubus ameniacus*) were removed from the grassland. In 2017, 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 was removed in June 2017; before and after photos of the treated area are depicted in **Figure 12**. Oak trees encroaching into the grassland were also removed in 2017. The City prevented all thistles from the grazing areas and along the Coastal Prairie Loop Trail from setting seed. This



required multiple shovel cutting, weed-whipping, and weed-eating work days from February through September.

**Figure 12. Cotoneaster and Himalaya berry removed between Coastal Prairie Loop Trail and Harbor, June 2017**



At the February 2017 meeting, AMWG members suggested revisions to a grassland sub-management area map that was prepared in 2016. The mapping was expanded to include all of the delineated grassland and slope, as well as plant species composition and presence/absence of SCT. The updated map will be reviewed and revised/approved by the AMWG in 2018. The sub-management areas are intended to aid in the development of performance criteria for the grassland/coastal prairie. The updated draft map is presented as **Figure 13**.

**Figure 13. Sub-management areas in grassland (updated draft)**



## 5.2.2 Vegetation Assessment

**5.2.2.1 Monitoring Methods.** Monitoring in 2017 consisted of an annual vegetation assessment (May), measurements of canopy height (February, May and September), and measurements of residual dry matter (RDM) (October). Photo-documentation was conducted in May 2017. Observations of grazing infrastructure occurred throughout the grazing period (January to June). Occurrences of invasive plant species were also monitored (year-round).

The first baseline assessment of the vegetation conditions in the grassland was conducted in June 2013. Subsequent monitoring of these transects has been conducted in April or May of 2014-2017. Monthly rainfall data is available from the University of California Cooperative Extension (UCIPM) Santa Cruz weather station, which is located at the DeLaveaga Golf Course, just north of Arana Gulch. Precipitation from 2012-2016 was below the long-term average of 30 inches reported for the Santa Cruz area by the Western Regional Climate Center (**Table 2**). However, total precipitation of 53 inches during the 2016-2017 water year was the highest since 60 inches fell during the 1997-1998 year.

**Table 2. Monthly rainfall (inches) at the UCCE Santa Cruz (DeLaveaga) weather station for the 2013-2017 water years.**

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
<b>2016-2017</b>	0	0.4	0.3	4.37	2.46	8.44	15.15	12.98	5.37	3.41	0.03	0.14	53.05
<b>2015-2016</b>	0.05	0.01	0	0.03	3.33	5.29	12.86	0.17	0.31	0.69	0.22	0	22.96
<b>2014-2015</b>	0.03	0	0.92	0.84	3.83	11.49	0	2.85	0.51	1.98	0.1	0.01	22.56
<b>2013-2014</b>	0.01	0.02	0.11	0.06	0.31	0.11	1.36	2.85	0.62	0.42	0.03	0.05	5.95
<b>2012-2013</b>	0	0	0	0.11	5.97	8.96	0.92	0.32	1.7	0.88	0.02	0.03	18.91

**Vegetation Assessment.** The CDP requires annual assessment of the vegetation in the grassland until the interim success criteria specified in the HMP are met and then monitoring every three years thereafter. The fifth vegetation assessment was conducted on May 1-2, 2017 and this Year 4 report contains the full methods, results and discussion. The photo monitoring methods are described below. For the HMP performance evaluation (Section 5.2.3) the AMWG began the process in 2015 of collecting data on nearby coastal prairie reference sites in order to develop more specific performance criteria for evaluating changes in site conditions at Arana Gulch in response to management. This process is still underway so the HMP criteria remain in effect.

Vegetation transects 25 meters in length were first installed within each of the grazing enclosure areas on June 10-12, 2013. Satellite imagery from Google Earth was used to select a total of 8 starting points in Area A, 6 in Area C, and 4 in Area D using a stratified approach to get good coverage within each unit. In the field, GPS was used to locate the pre-selected starting point for each 25m transect and then used a random compass bearing to establish the line. The range of available compass bearings was limited as necessary to ensure that there was at least a 5m buffer with infrastructure, existing dirt trails, or other features that needed to be avoided.

To determine if the number of transects for each enclosure was sufficient, the field sampling and power analysis used a statistical power calculator provided by DSS Research ([http://www.dssresearch.com/toolkit/sscalc/size\\_a1.asp](http://www.dssresearch.com/toolkit/sscalc/size_a1.asp)). This enabled a test of how much change could be detected by comparing the average cover and standard deviation values recorded for the transects to a fixed value that is 2.5 or 5% greater than that value. An 80% power level ( $\beta = 0.2$ ) and  $\alpha = 0.1$  based on standard practice was accepted. In Area A, after sampling all 8 transects it was determined that an additional 3 transects would be required for a sample size of 11. For Area C, a sample size of 5 transects provided sufficient power, so no additional transect were installed. In Area D, the 4 transects were sufficient.

The point intercept method was used to assess changes in plant species cover and ground cover. This method uses a narrow diameter sampling pole that is slowly lowered to the ground at sample points spaced along a 25 meter transect. At each sample point, every plant species touched by the pin are recorded as “hits” along with the ground cover code (litter, bare, gopher disturbance, basal vegetation, rock) of the bottom “hit”. It was not possible to accurately distinguish thatch (residue from the previous year’s growth) from litter (senescent material from earlier in the growing season), so both were included in the ground cover code of litter. Percent cover is calculated by multiplying the number of hits for each plant species or ground cover class by a factor to equal 100 points. A total of 25 sample points per transect were recorded so the number of hits was multiplied by 4 to get percent cover.

The average height of the canopy layer was also measured at the 6, 12, 18, and 24 m points. A plastic dinner plate threaded on a wire pin was used and the canopy height measurement taken at the height where the plate comes to rest. In 2017, canopy height measurements were taken in February, May, and September to capture winter, spring, and summer conditions.

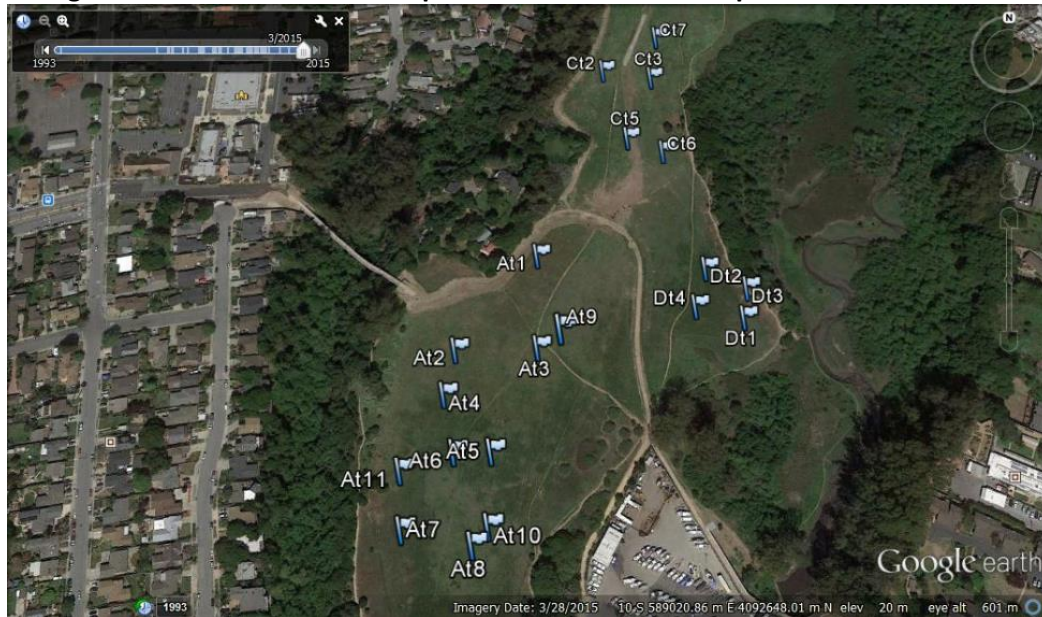
To permanently mark the transect, rebar posts one half inch in diameter were pounded into the ground at both ends and fitted with plastic rebar caps for safety. A photo was taken at the 0m end looking along the length of transect with a whiteboard held up at the 5m point labeled with the transect number and date. The transect photos are included in **Appendix C (Item C-3)**. On the data sheet, the following was recorded: GPS coordinates, compass bearing, elevation, slope, and aspect of the transect. In addition, a search was conducted within a 5m belt transect (using the transect as the centerline) to record the presence of any plant species that were not encountered on the transect. This additional method is often used to capture uncommon or rare species and more fully characterize species richness.

All of the rebar and caps were destroyed in a mowing on April 24, 2014. Therefore, it was necessary to re-install every vegetation transection in 2015 using the same GPS points and compass bearings. New rebar was required and the plastic caps were replaced with metal caps imprinted with “the City of Santa Cruz” on April 16-17, 2015. During the 2016 monitoring, some transects were missing rebar on one end and a few slight adjustments were made to



alignments, but otherwise the transects were intact. During the 2017 monitoring, some transects were again missing rebar and some adjustments had to be made. **Figure 14** shows the locations of the 11 transects in Area A, 5 in Areas C, and 4 in Area D.

**Figure 14. Permanent transect placement on the coastal prairie at Arana Gulch.**



For analysis, the transect is the sample unit and for each the percent cover was calculated by species, the total number of species encountered, and the % ground cover of litter, bare, gopher, basal vegetation, and rock or cow flop. Cover values were also summed on each transect by guild: exotic annual forb (EAF), exotic annual grass (EAG), exotic perennial forb (EPF), exotic perennial grass (EPG), native annual forb (NAF), native annual grass (NAG), native perennial forb (NPF), and native perennial grass (NPG).

Statistical tests were performed using JMP version 10 software (SAS). Data were tested for normality and equality of variance required of ANOVA using multiple tests with a significance level at  $p=0.05$ . When data were normal, change in percent cover was examined using ANOVA with a Tukey's honest significant differences post-hoc test. For non-normal data, a Wilcoxon test was used. The variances of the 2015 and 2016 canopy heights were unequal in all areas and a Welch's test was used. The mean cover values for 2015 and 2016 are presented with error bars constructed using one standard deviation from the mean.

**Photo Monitoring.** Photo points for long-term monitoring were established during the monitoring in April 2015. A total of 15 points were distributed throughout the coastal prairie with two additional points on the Arana Creek Causeway and two on Hagemann Bridge (**Figure 15**). All points were located at either an interpretative sign or a fence corner for easy reference. Four photos were 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. Using a compass and taking photos of the cardinal directions would have entailed an extra step and instead using the infrastructure as a point of reference made intuitive sense and was efficient. All photos were captured in about one hour when the sun was overhead. The two points taken on the causeway looking into Arana Creek included the revegetation area on the east bank above the culverts. The additional points located on Hagemann Gulch Bridge were taken from both sides of the bridge with a view straight out and looking down into the Gulch. One extra point was taken standing in front of the entry sign at Frederick Street in order to observe the recovery from the construction. Photos are in **Appendix C (Item C-4)**.

**Figure 15. Location of photo points for long-term monitoring established at Arana Gulch.**



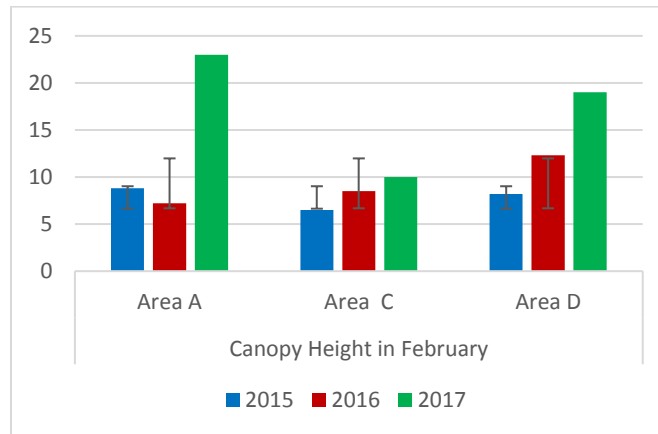
### 5.2.2.2 Monitoring Results

**Vegetation Assessment.** The 2013-2014 monitoring results are not presented because of the influence of timing in 2013 and drought in 2014. In 2013, the monitoring was conducted in July, which is too late to capture peak production. In 2014, monitoring was conducted under the worst drought conditions ever recorded (see **Table 2**). In addition, every vegetation transect was re-installed in April, 2015, not always in the exact same location. The two years of additional baseline data were presented in previous reports to the City and are available on request. The results below compare the un-grazed conditions in April of 2015 to grazed conditions in April 2016 and May 2017. Although it is not ideal to use 2015 as a baseline because the vegetation had been subject to 6 weeks of grazing when it was sampled, it is the most representative baseline dataset among the three years available. Life forms utilize the following codes: exotic annual forb (EAF), exotic annual grass (EAG), exotic perennial forb

(EPF), exotic perennial grass (EPG), native annual grass (NAG), native perennial forb (NPF), and native perennial grass (NPG).

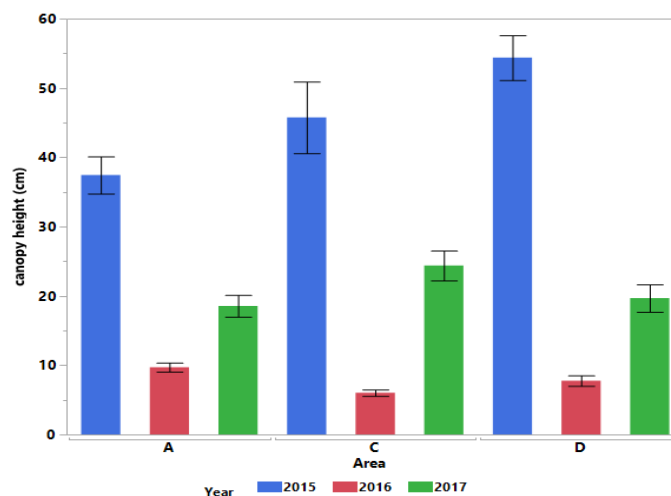
**Canopy Height.** In the HMP, Objective 3A is to reduce canopy height between the months of November thru April, to 2-3 inches (5-8 cm). In February, canopy height measurements in Area A were higher in February 2017 compared to February 2016 and February 2015. All areas were above target with canopy heights of 4 inches (10 cm) to a high of 9.2 inches (23 cm) in Area A. Mean canopy height data from February is presented in **Figure 16**.

**Figure 16. Mean canopy height (cm) in Area A, C, and D measured in February of 2015-2017. Each error bar is constructed using 1 standard error from the mean**



Average canopy heights measured in April were lower in 2016 and 2017 compared to 2015 in all three areas (**Figure 17**, Welch's test at  $p < .0001$ ). However, canopy heights of 7 to 10 inches (19-24cm) across Areas A, C, and D are greater than the target objective of 2 to 3 inches, so the objective was not met.

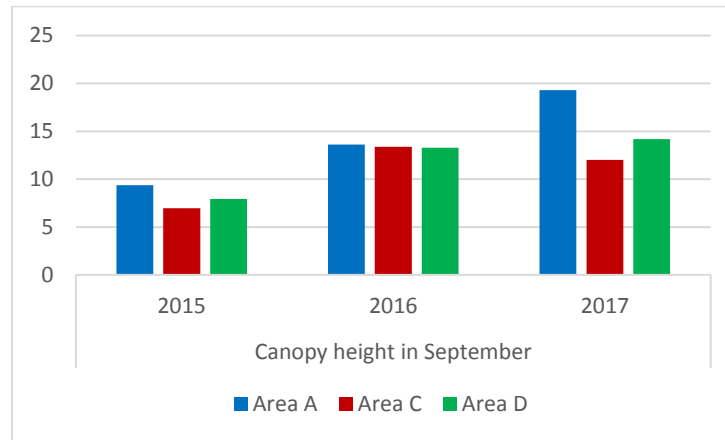
**Figure 17. Mean canopy height (cm) in Area A, C, and D measured in April of 2015-2017. Each error bar is constructed using 1 standard error from the mean**





Average canopy heights measured in September 2017 were similar to data from 2015 and 2016 in all three areas (**Figure 18**).

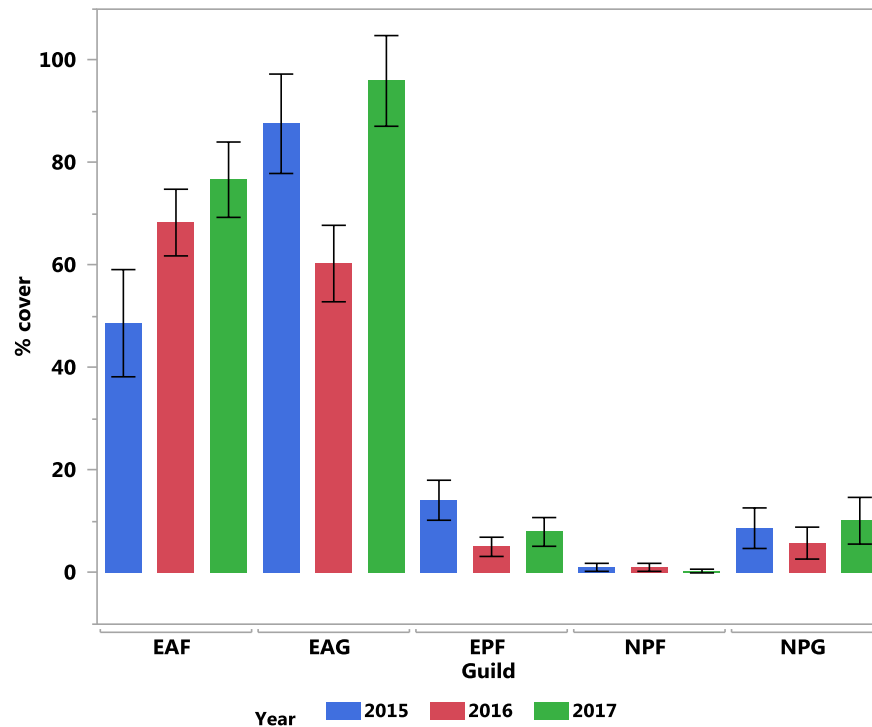
**Figure 18. Mean canopy height (cm) in Area A, C, and D measured in September of 2015-2017.**



**Canopy Cover.** Objective 3B is to reduce the cover of non-native species and Objective 3C is to increase the cover of native species. In 2017, across the three areas, non-native plant guilds were not significantly reduced and the cover of native species was not increased, so these objectives were not met.

In Area A, the increase in EAF cover from 48% in 2015 to 76% in 2017 was not significant (**Figure 19**, ANOVA  $p=0.064$ , Tukey-HSD). The fluctuation in the cover of EAG was not significant (ANOVA  $p=0.18$ ) nor was the apparent reduction in cover of EPF (Wilcoxon test,  $p=0.15$ ). The cover of native forbs and grasses was also not significantly different.

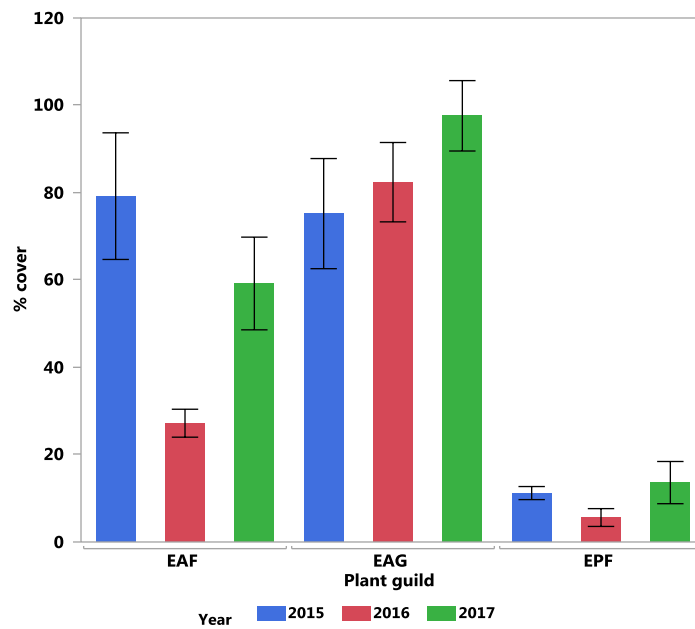
**Figure 19. Mean percent cover of 5 plant guilds in Area A in April of 2015-2017. Each error bar is constructed using 1 standard error from the mean.**



In Area C, EAF cover was significantly reduced in 2016 but it increased again in 2017 (**Figure 20**, Welch's  $p=0.017$ ). The lower cover in 2016 was likely due to significant reductions in the cover of wild radish (*Raphanus sativa*) and filaree (*Erodium cicutarium*). In 2017, the cover of wild radish increased to 29% from the low cover of only 12% in 2016 while the cover of filaree stayed around 12% in both years (see **Figure 20** for 2017 data). Only one native species has been detected in the transects in Area C (toad rush [*Juncus bufonius*] was found in 2016) but otherwise no native species have been detected in the transects. Cover of EAG and EPF have not changed significantly over the sample period from 2015 to 2017.

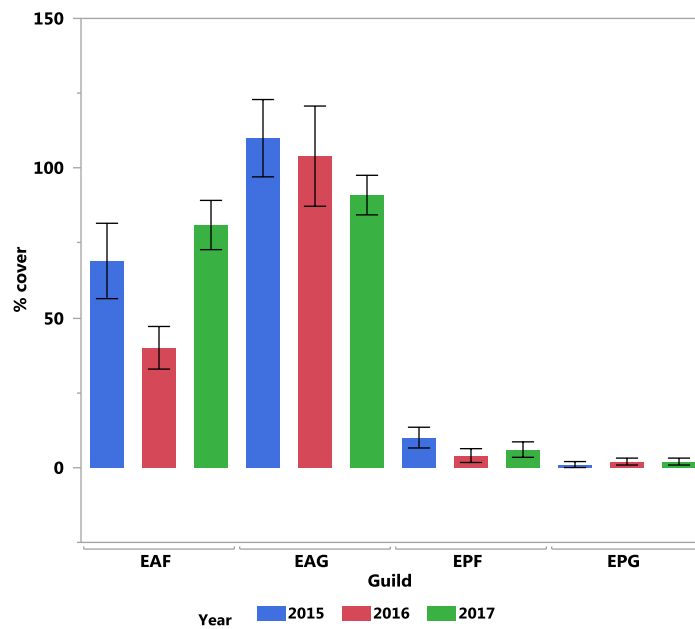
In Area D, the fluctuation in cover of EAF between 2015 and 2017 was moderately significant (**Figure 23**, Kruskal-Wallis  $p=0.06$ ). The lower cover in 2016 was likely due to a significant decline in filaree from 62% in 2015 to 35% in 2016 (data not shown). In 2017, cover of filaree increased to 54% (see **Figure 21**). Cover of the other plant guilds have not significantly changed over time.

**Figure 20. Mean percent cover of 3 plant guilds in Area C in April of 2015-2017. Each error bar is constructed using 1 standard error from the mean.**



Each error bar is constructed using 1 standard error from the mean.

**Figure 21. Mean percent cover of 4 plant guilds in Area D in April of 2015- 2017. Each error bar is constructed using 1 standard error from the mean.**



Each error bar is constructed using 1 standard error from the mean.

**Species Richness.** Objective 3D is to increase native species richness. Species richness across Areas A, C, and D is low and comprised mainly of non-natives. Of the 41 plant species detected in the sampling, only 11 are native including one tree, two shrubs, two forbs, four grasses, and two rushes (**Table 3**).

**Table 3. Plant species detected in Areas A, C, and D in sampling conducted in 2013-2017.**

Scientific Name, TJM 2	Area(s) found	Common Name	Life form	Family	Species Code
<i>Anagallis arvensis</i>	A, C, D	Scarlet pimpernel	EAF	PRIMULACEAE	ANAARV
<i>Avena fatua</i>	A, C, D	Wild oat	EAG	POACEAE	AVEFAT
<i>Baccharis pilularis</i>	A	Coyote brush	Native Shrub	ASTERACEAE	BACPIL
<i>Briza maxima</i>	A, D	Rattlesnake grass	EAG	POACEAE	BRIMAJ
<i>Briza minor</i>	A, D	Quaking grass	EAG	POACEAE	BRIMIN
<i>Bromus carinatus</i>	A	California brome	NPG	POACEAE	BROCAR
<i>Bromus diandrus</i>	A, C	Ripgut brome	EAG	POACEAE	BRODIA
<i>Bromus hordeaceus</i>	A, D	Soft chess	EAG	POACEAE	BROHOR
<i>Carduus pycnocephalus</i>	C	Italian thistle	EPF	ASTERACEAE	CARPYN
<i>Cerastium glomeratum</i>	C	Mouse-ear chickweed	EAF	CARYOPHYLLACEAE	CERGLO
<i>Cirsium vulgare</i>	A	Bull thistle	EPF	ASTERACEAE	CIRVUL
<i>Convolvulus arvensis</i>	A, C, D	Bindweed	EPF	CONVOLVULACEAE	CONARV
<i>Danthonia californica</i>	A	California oatgrass	NPG	POACEAE	DANCAL
<i>Deinandra corymbosa</i>	C	Coastal tarweed	NPG	ASTERACEAE	DEICOR
<i>Elymus triticoides</i>	D	wild rye	NPG	POACEAE	ELYTRI
<i>Erodium botrys</i>	A, C	long bill stork's beak	EAF	GERANIACEAE	EROBOT
<i>Erodium cicutarium</i>	A, D	red stem filaree	EAF	GERANIACEAE	EROCIC
<i>Eschscholzia californica</i>	A	California poppy	NPF	PAPAVERACEAE	ESCCAL
<i>Festuca (Vulpia) myuros</i>	A, C, D	Rattail six weeks grass	EAG	POACEAE	FESMYU
<i>Festuca perennis (Lolium multiflorum)</i>	A, C, D	Italian ryegrass	EAG	POACEAE	FESPER
<i>Genista monspessulana</i>	D	French Broom	Shrub	FABACEAE	GENMON
<i>Geranium dissectum</i>	D	Cutleaf geranium	EAF	GERANIACEAE	GERDIS
<i>Holcus lanatus</i>	A, C, D	velvet grass	EPG	POACEAE	HOLLAN
<i>Hypochaeris glabra</i>	A, C, D	Smooth cat's-ear	EAF	ASTERACEAE	HYPGLA
<i>Hypochaeris radicata</i>	A, C, D	Hairy cat's ear	EPF	ASTERACEAE	HYPRAD
<i>Juncus bufonius</i>	C	Spreading rush	NAG	JUNCACEAE	JUNBUF
<i>Juncus patens</i>	A, C, D	Spreading rush	NPG	JUNCACEAE	JUNPAT
<i>Lactuca serriola</i>	C, D	Prickly lettuce	EPF	ASTERACEAE	LACSER
<i>Plantago lanceolata</i>	A, C, D	English plantain	EPF	PLANTAGINACEAE	PLALAN
<i>Quercus agrifolia</i>	A	Coast live oak	Tree	FAGACEAE	QUEAGR
<i>Raphanus sativus</i>	A, C, D	wild radish	EAF	BRASSICACEAE	RAPSAT

Scientific Name, TJM 2	Area(s) found	Common Name	Life form	Family	Species Code
<i>Rosa californica</i>	A	California rose	Shrub	ROSACEAE	ROSCAL
<i>Rumex acetosella</i>	A, D	Sheep sorrel	EPF	POLYGONACEAE	RUMACE
<i>Rumex crispus</i>	A, C	Curly dock	EPF	POLYGONACEAE	RUMCRI
<i>Silybum marianum</i>	C, D	Milk thistle	EPF	ASTERACEAE	SILMAR
<i>Sonchus asper</i>	A, C, D	Sow thistle	EPF	ASTERACEAE	SONASP
<i>Stipa pulchra</i>	A	Purple needlegrass	NPG	POACEAE	STIPUL
<i>Tragopogon pratensis</i>	A, C, D	Salsify	EPF	ASTERACEAE	TRAPRA
<i>Trifolium dubium</i>	A, C, D	Shamrock clover	EAF	FABACEAE	TRIDUB
<i>Trifolium subterraneum</i>	A, C, D	Subterranean clover	EAF	FABACEAE	TRISUB
<i>Vicia sativa</i> subsp. <i>sativa/nigra</i>	A, C, D	common/narrow leaved vetch	EPF	FABACEAE	VICSAT

In Area A, total species richness has ranged from 11 to 12 species, but there has been less than one native species captured per sampling unit in all years 2015-2017 (**Table 4**).

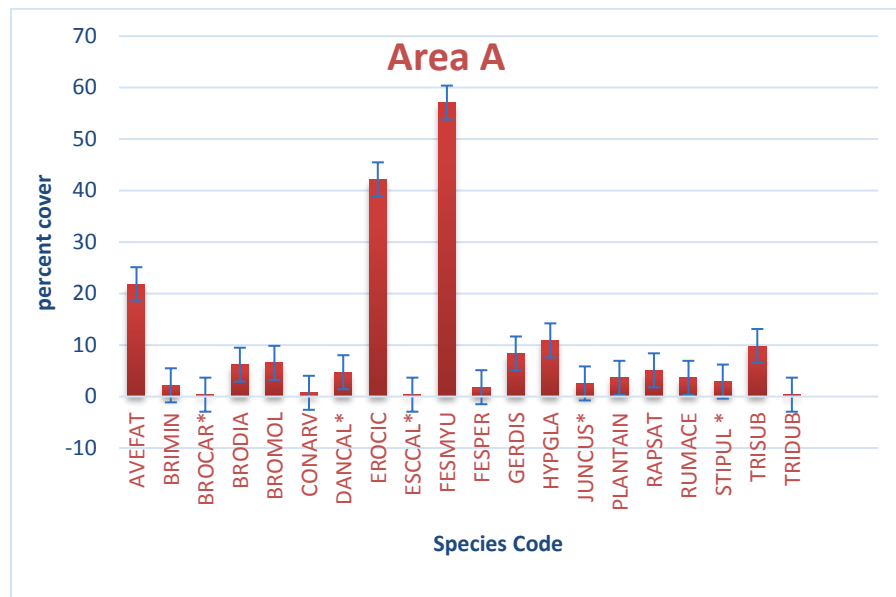
**Table 4. Mean number of species recorded along 25 m transects and detected within a 5m belt in Area A (with one standard deviation in parentheses).**

Species Richness	2015	2016	2017
# Species per transect	7.6 (2.5)	8.0 (3.4)	9.1 (2.4)
# Additional species in plot	3.6 (2.3)	2.5 (1.8)	3 (1.9)
Total # species/125 m <sup>2</sup>	11.2 (3.8)	10.5 (4.4)	12.1 (3.9)
# Native species per transect	0.7 (0.8)	0.6 (0.7)	0.9 (0.7)
# Additional native sp. in plot	0.3 (0.5)	0.5 (0.5)	0.5 (0.7)

In Area A in 2017, cover of 20 species was recorded on the transects with cover values ranging from 1 to 57% (**Figure 22**). Five native species were detected in 2017 including California oatgrass (*Danthonia californica*), California poppy (*Eschscholzia californica*), spreading rush (*Juncus patens*), purple needlegrass (*Stipa pulchra*), and California brome (*Bromus carinatus*). The native species all had less than 5% cover on the transects. Other native species detected within the belt transects include coyote brush (*Baccharis pilularis*) and California rose (*Rosa californica*).



**Figure 22. Mean percent cover of all plant species in Area A in April, 2017. Native species are marked with \*. Each error bar is constructed using 1 standard error from the mean.**

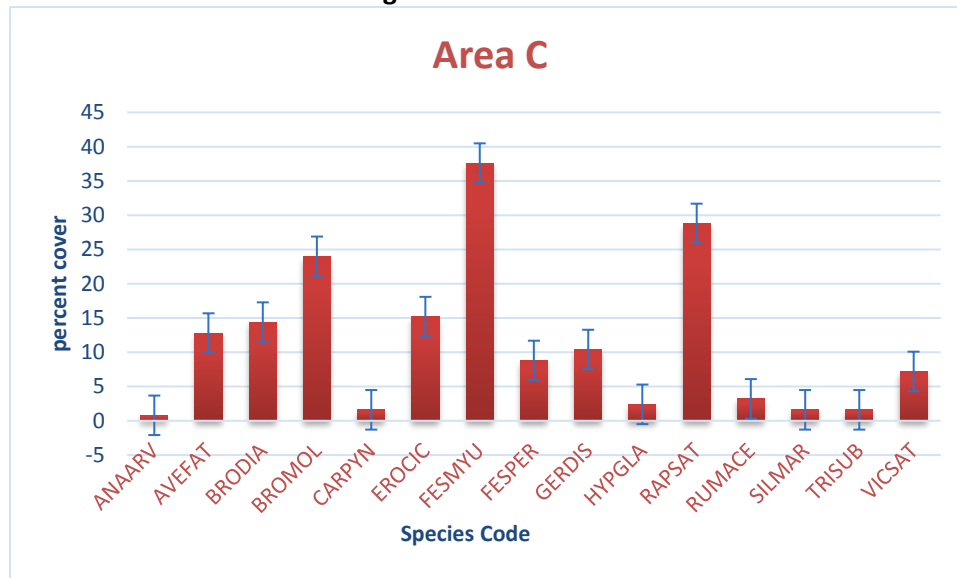


In Area C, one native species (toad rush (*Juncus bufonius*) was detected in 2016 but no native species were captured in 2015 or 2017 (**Table 5**). Total non-native species richness in 2017 (14 species) has almost doubled since 2015 and was the highest recorded across the three areas. In 2017, 15 non-native species were recorded on the transects with cover values ranging from <1 to 37 % (**Figure 23**).

**Table 5. Mean number of species recorded along 25 m transects and detected within a 5m belt in Area C (with one standard deviation in parentheses).**

Species Richness	2015	2016	2017
# Species per transect	6.0 (1.0)	7.0 (0.8)	9.3 (1.5)
# Additional species in plot	1.4 (0.9)	3.5 (2.6)	5.3 (1.7)
Total # species/125 m <sup>2</sup>	7.4 (0.9)	10.5 (2.1)	14.5 (2.6)
# Native species per transect	0	0.3 (0.5)	0
# Native species per plot	0	0.5 (1.0)	0

**Figure 23. Mean percent cover of all plant species in Area C in April, 2017. Each error bar is constructed using 1 standard error from the mean.**

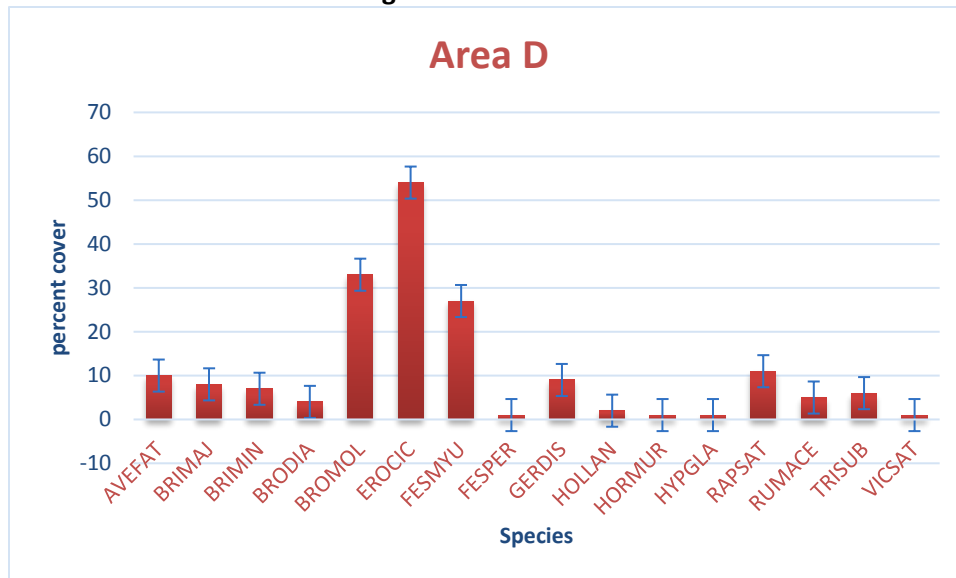


In Area D, total species richness across the sampling years has ranged from 11 to 13 species (**Table 6**). Two native species have been recorded in the belt transects; spreading rush (*Juncus patens*) was detected in 2016 and California oatgrass (*Danthonia californica*) was captured in 2017. No native species were recorded on the transects in 2017 and the cover of 16 non-native species ranged from 1 to 54% (**Figure 24**).

**Table 6. Mean number of species recorded along 25 m transects and detected within a 5m belt in Area D (with one standard deviation in parentheses).**

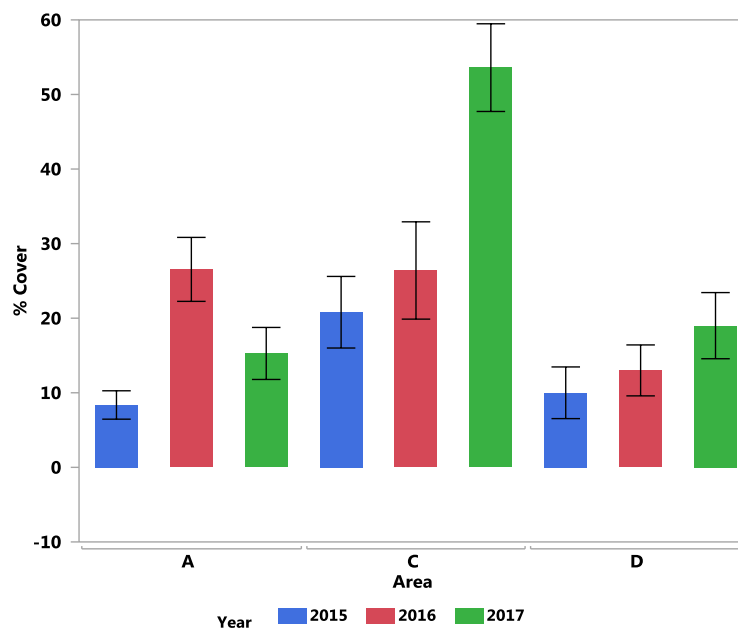
Species Richness	2015	2016	2017
# Species per transect	8.5 (2.1)	7.8 (1.7)	10 (2.2)
# Additional species in plot	3.8 (1.0)	3.5 (0.6)	3.5 (2.1)
Total # species/125 m <sup>2</sup>	12.3 (1.7)	11.3 (2.2)	13.5 (3.3)
# Native species per transect	0	0	0
# Additional native sp. in plot	0	0.8 (0.5)	0.8 (0.9)

**Figure 24. Mean percent cover of all plant species in Area D in April, 2017. Each error bar is constructed using 1 standard error from the mean.**

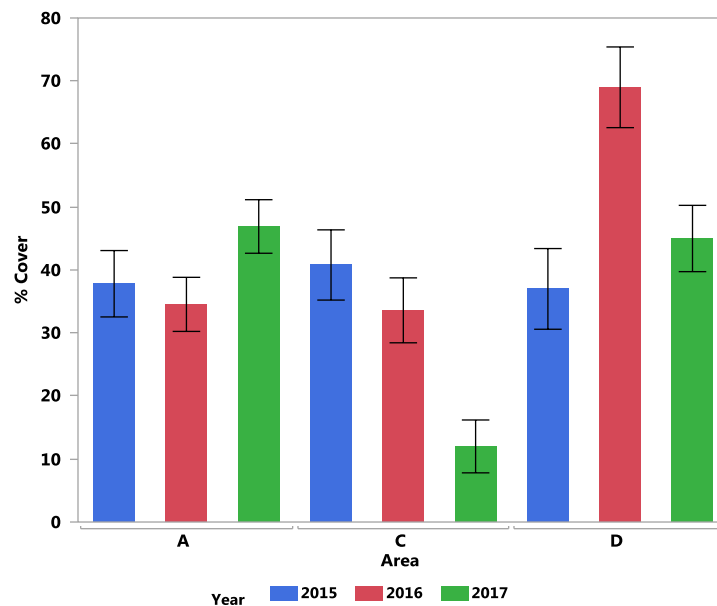


**Bare Ground.** Objective 3E is to increase the cover of bare ground, and this objective has been met in Areas A and C. The cover of bare ground Area A has increased significantly since 2015 (Figure 25, Kruskal-Wallis  $p=0.003$ ). Bare ground in Area C also increased significantly to 54% from 26% (Kruskal-Wallis  $p=0.014$ ). The cover of bare ground has slightly increased in Area D. The increase in bare ground cover in Area C may be due to a significant and large decline in litter cover to only 12% (Figure 26, Kruskal-Wallis  $p=0.007$ ).

**Figure 25. Mean cover of bare ground sampled in Areas A, C, and D in April, 2015-2017. Each error bar is constructed using 1 standard error from the mean.**



**Figure 26. Mean cover of litter sampled in Areas A, C, and D in April, 2015-2017. Each error bar is constructed using 1 standard error from the mean.**



### 5.2.3 HMP Performance Evaluation

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. Grazing was implemented 2015-2017, thus, the first two objectives have been met.

During the development of the HMP there was not yet any baseline data to quantify existing conditions at Arana Gulch so an interim restoration criterion was established to return to conditions characteristic of a “functional reference coastal prairie”. In 2017, the AMWG continued to discuss what it means to be a functioning coastal prairie. However, limited data was available on vegetation conditions at reference coastal prairies because there are so few left. In addition, vegetation conditions depend on many factors including the position of the coastal terrace, soil type, hydrology, dominant species, and past land-use history. Very few or none of the remaining coastal prairie remnants match Arana Gulch in these important characteristics. In the past, Arana Gulch experienced intensive cultivation which is one of the factors that most strongly negatively affects native cover and species richness. In the absence of acceptable data on reference coastal prairies, the AMWG may use baseline data and two years of monitoring data under grazing to begin refining the objectives under Goal 3.

After two years of grazing, most of the objectives have not been met. Objective 3A is to reduce canopy height between the months of November thru April, to 2-3 inches (5-8 cm).

Average canopy heights have been reduced in all three areas compared to pre-grazing conditions in 2015. However, in February 2017, canopy heights measured 7 to 10 inches (19-24cm) across Areas A, C, and D, so the objective was not met. However, in March, cattle grazed Area C very low to the ground. Objective 3B is to reduce the cover of non-native species and Objective 3C is to increase the cover of native species. In 2017, across the three areas, non-native plant guilds were not significantly reduced and the cover of native species was not increased, so these objectives were not met. Objective 3D is to increase native species richness. In 2017, only five native species were captured in the sampling in Area A and none in Areas C and D. Across all the sampling years, only 11 of the 41 plant species represented in the sampling are native, so the objective has not been met. Objective 3E specifies an increase in bare ground, and this objective was met in Areas A and C in 2017. Anecdotal observations of the grazing area also documented the occurrence of dwarf brodiaea (*Brodiaea terrestris*) and clarkia (*Clarkia purpurea*).

Objective 3E specifies an increase in bare ground to a level that enables SCT to complete their lifecycle. As 2017 represents the third growing season of grazing, canopy height has been decreased since the pre-grazing baseline. In addition, the amount of thatch has been reduced and there are areas of bare ground. Patches of dense vegetation still persist, yet covering less acreage than in 2015. SCT observations in 2016 were found in areas of least residual dry matter (RDM Red, <500 lbs./acre); however, in 2017 no SCT were observed in areas of green or red RDM levels, thus, the site did not meet Objective 3E this year.

### 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. Fences, access gates, and other features to support cattle grazing were inspected and maintained throughout 2017. A new gate was added in Area C to facilitate movement of animals between areas A and C.

The City’s grazing contractor had cattle onsite from January 28 through June 11. The HMP’s original estimate for cattle was 2 to 6 cow calf pairs. However, it became evident during the 2017 grazing season 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 2016 grazing season are presented on **Table 7**. At the height of the spring season, a total of 27 cattle were on site. Cattle were first brought onto Area C (January 28<sup>th</sup>), then on February 19<sup>th</sup>, they were moved in to Area A. At this time, canopy height in Area A was over 8 inches (20 cm). Cattle were left in Area A for approximately 3 weeks (until March 12), then they needed to be removed by the rancher. Fifteen new cattle were brought back into Area A after almost 2 weeks (March 29) and then were left within this grazing area until May 30. Cattle were retained in Area C until June 11 and Area D between May 22 and May 30.

As grazing occurred in 2017, 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. Two posts were installed in Area A, one in Area C and one in Area D. The posts are intended to encourage cattle to congregate and create additional bare ground that may be suitable for SCT germination. An area of bare ground was found in an approximately 5-foot circle around these posts in 2017.

**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.

**Table 7. Number of Cattle and Duration of Grazing Season per SC Tarplant Area in 2017**

Duration	# of Cattle in Tarplant Area A	# of Cattle in Tarplant Area C	# of Cattle in Tarplant Area D	# of Cattle in Tarplant Areas C&D (open gate)	# of months grazed	The cattle were 600 lb heifers and steers. AU Conversion (0.6)	AUM	Comments
January 28 to February 18	0	0	0	10	0.73	0.6	7.3	Grass height visually observed at 8 to 10 inches before cows began grazing.
February 19 – March 12	10	0	0	0	0.7	0.6	7	Moved cows to Area A after they settle into site.
March 4 to March 29	0	0	0	15	0.8	0.6	12	Cattle removed from site because one was about to deliver. Fifteen new cattle brought in.
March 29 to May 8	15	0	0	0	0.37	0.6	5.55	Moved to A to graze for remainder of season. No feed left in C&D.
May 9 to May 21	15	0	0	12	1.3	0.6	19.5 for Area A 15.6 for Areas C&D	Keeping up with Area A. Twelve more cattle were brought in to keep up with area C&D. Grass height jumped in late-April.
May 22 to May 30	15	0	12	0	0.27	0.6	4.05 for Area A 3.24 for Area D	Locked 12 in Area D to focus grazing.
June 1 to June 11	0	0	0	27	0.37	0.6	9.99	SC tarplant observed at Santa Cruz Armory. Moved cattle from A to C&D to finish season. Removed cattle from site on June 11 <sup>th</sup> .

The RDM monitoring was conducted on October 2 by Kathleen Lyons and Brett Snider. 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 Pesola gram scale, The RDM plot was tossed down and sampled to record an RDM level of blue, green or red. The condition at each level was noted such that the observers eye was calibrated to recognize the three levels. The grazing areas were mapped as blue, green and red. Where needed, samples were taken within each area to confirm the designation. The edge of each mapping areas was recorded with GPS waypoints. Sampling consisted of clip plots within each mapped level. A photo was obtained of each plot before and after clipping; note 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 ground as possible, clippings were placed in the bag, weighed and recorded (subtracting weight of bag). The weight of clippings was converted to pounds per acre (grams clipped x 100 = lbs./acre RDM).

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 February and June. The northern portions of the grazing area had higher RDM values. At most locations, thatch was not evident as cattle ingested the current and previous year's growth. **Figure 27** exhibits the RDM map for Area A. **Figure 28** displays the RDM map for Areas C and D. **Figures 29, 30,** and **31** show clip plots with highest RDM (>650 lbs./acre), middle RDM (500-650 lb./acre) and lowest RDM (<500 lbs./acre), respectively.

Figure 27. RDM map for Grazing Area A, October 2017



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 28. RDM map for Grazing Areas C and D, October 2017



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 29. Clip plot of highest RDM (Blue), October 2017**



**Figure 30. Clip plot of middle RDM (Green), October 2017**





**Figure 31. Clip plot of lowest RDM (Red), October 2017**



### 5.3.3 Discussion

In 2017, cattle grazing significantly reduced canopy height; however, as cattle were not brought onto the site until the end of January (and into Area A until February 19<sup>th</sup>), canopy heights were high (and above target) during the germination and emergence period for SCT. The City and rancher monitored the grass height and cattle were brought onto the site when there was enough feed. According to the rancher, there was not enough grass feed in January, despite the grass height being above the target height.

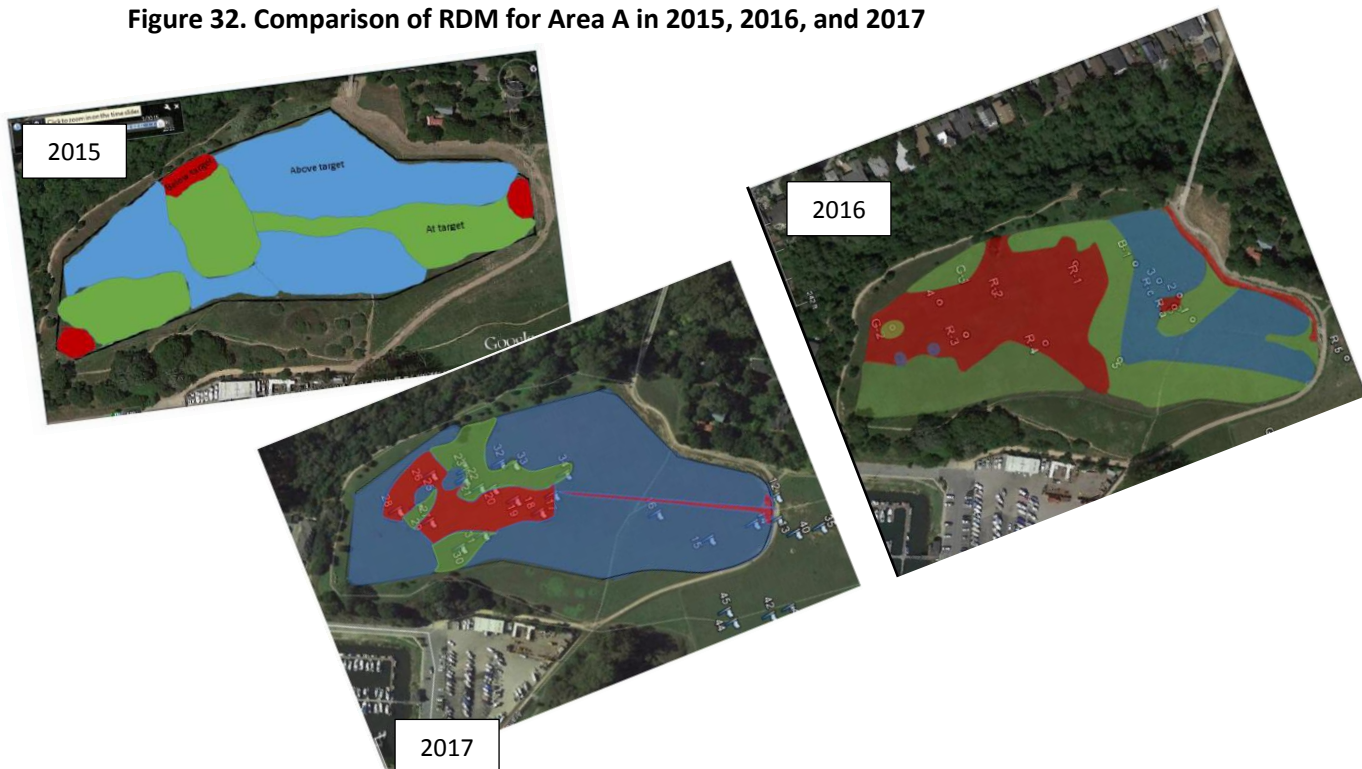
Canopy height in February in all areas were above the target objective of 2-3 inches (5-8 cm). Once grazing was initiated, the cattle reduced biomass across the prairie and in the process also increased bare ground. Non-native species remained dominant with very high cover, but a few reductions were observed. Several species with high forage value declined or were lost in the sampling. By the May sampling, in Area A, wild oat (*Avena fatua*) cover stayed steady and wild vetch (*Vicia sp.*), a nitrogen fixing legume and a superior food source, was not

detected in the sampling in 2017 (similar to 2016). In Area C, cover of the high value forage filaree (*Erodium sp.*) was similar to 2016, yet wild radish (*Raphanus sativa*) cover increased from 12% to 28%. Cover by soft chess (*Bromus hordeaceus*) increased from 10% to 22%. Cover by six week's fescue (*Festuca myuros*) was over 50% and red stem filaree (*Erodium cicutarium*) was over 40%.

Native species cover did not increase, but three natives were found in Area A (similar to 2016). Spreading rush (*Juncus patens*) is one of the primary native species that is found throughout the prairie in all Areas. It has been observed in Area C. The appearance of the other species may be more directly related to the construction and/or grazing. A big bloom of coastal tarweed (*Dienandra corymbosa*) along the margin of the east-west multi use central in the spring of 2015 was in apparent response to the grading for the trail. In 2017, several rosettes were detected within the belt of CT5, located on the periphery of the large area of cattle disturbance near the gate that is closest to the multi-use trail (see **Figure 1**). The tarweed along the trails was observed at significantly lesser quantities than the first year after trail construction.

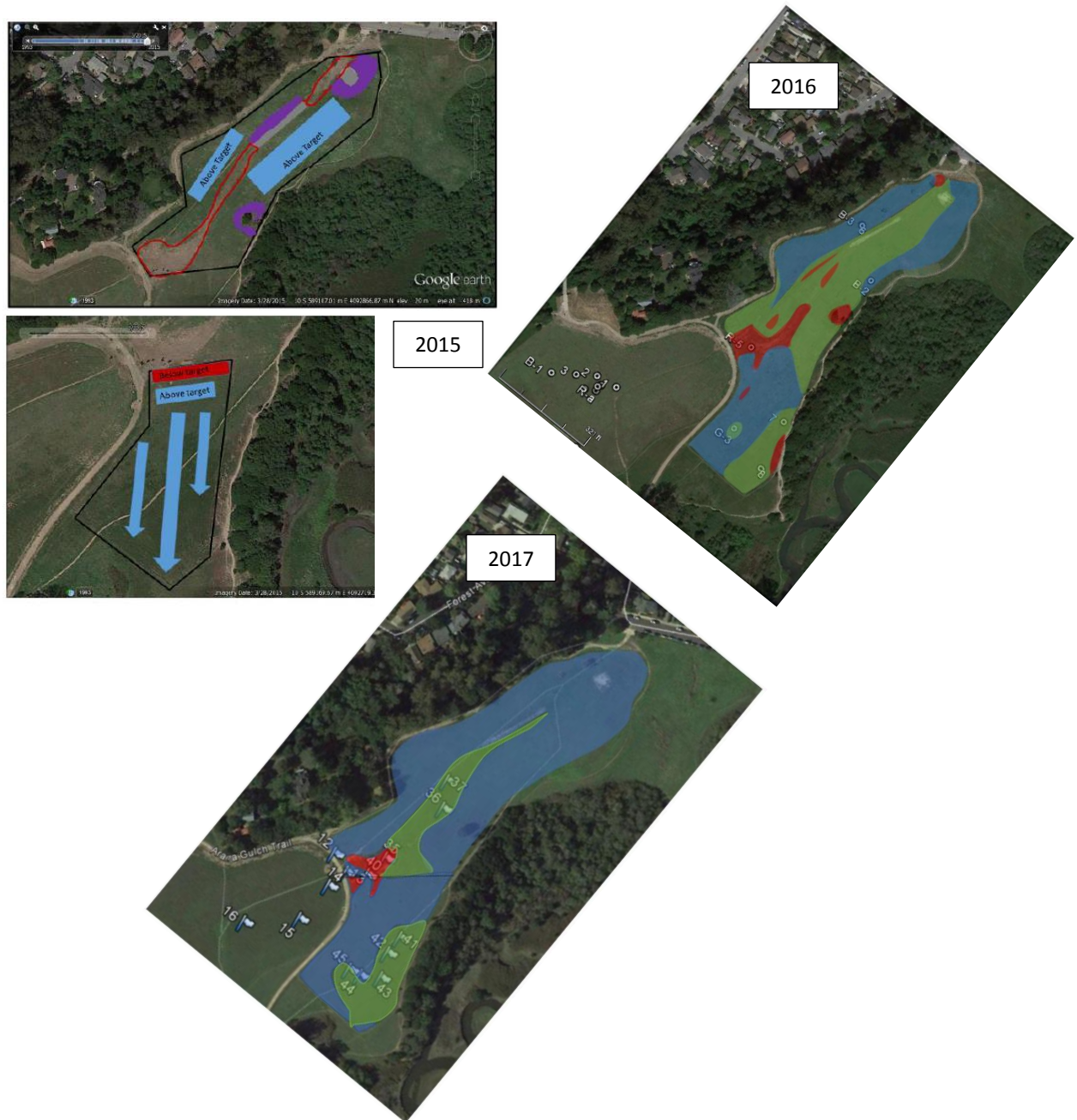
RDM levels decreased in most of the grazed areas between 2015 and 2016, yet RDM levels increased (blue RDM level) in 2017, presumably due to the high rainfall year and abundant grass growth. A comparison of RDM levels between 2015 and 2016 is presented in **Figures 32** (Area A) and **Figure 33** (Areas C and D).

**Figure 32. Comparison of RDM for Area A in 2015, 2016, and 2017**





**Figure 33. Comparison of RDM for Areas C and D in 2015, 2016, and 2017**



Areas of lowest RDM decreased in Area A from 2016 to 2017, likely due to the high rainfall year and abundant grass growth. Despite the tall grass height, the rancher found there was insufficient feed for cattle in January and cattle grazing started in Area A in February 2017 versus January in 2015 and 2016. Green and red RDM levels were recorded in the central portion of the grazing area where cattle were encouraged to graze to benefit the SCT. More



areas with blue RDM levels were recorded in Areas C and D in 2017 than in 2016, likely resulting from the high rainfall year and abundant grass growth.

The large reduction in biomass, canopy height, and RDM across the prairie 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.

**5.2.2.3 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 2017 and many areas of the grazed areas were in the 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 2017 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<sup>6</sup>, 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 January and June.
- 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 2017.
- Although 2017 was an above-normal rainfall year, 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 2017. There were two incidents of cut fence lines before the grazing season began but none during the grazing season. The City and the grazing contractor repaired the fences before the grazing season began. 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 despite 2017 being an above-normal rainfall year. There

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<sup>6</sup> See page 68 (Section 3.5.6) of Arana Gulch HMP.

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.

## 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 2017. Maintenance tasks included the continued removal re-sprouts of cotoneaster (*Cotoneaster sp.*), Himalaya blackberry (*Rubus ameniacus*), and English ivy (*Hedera helix*) from the coastal prairie on the hillside near the Harbor entrance. **Figure 34** shows this area in October 2017.

**Figure 34. Hillside after removal of cotoneaster, Himalaya blackberry, and English ivy, October 2017**



In addition, significant maintenance was provided to remove and control thistles from the grassland, including the grazing areas. In spring 2017, thistle rosettes were routinely shovel

cut and/or weed-whipped from the grassland. 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 widespread on site, control of these species was a significant effort and the control efforts reduced cover by these species. Large thickets of Himalaya berry (*Rubus ameniacus*) in the northern portion of the grassland were also routinely mowed and/or weed-whipped. Occurrences of ivy (*Hedera helix*) and non-native vines were removed/controlled along the western property line. Trees encroaching into the designated grassland were cut in December. Most of the trees around Grazing Area A, from Hagemann Bridge to the harbor overlook were cut as trees are not desired in the designated grassland. None of the trees were heritage trees as defined by the City's municipal code. A log of the City's maintenance actions is presented in **Appendix B**.

**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 2017.

## 5.5 Proposed Actions for 2018

The following actions and expected timing are proposed for 2018:

- Continue the cattle grazing program, beginning in January 2018, with grazing extending to June or July 2018, depending upon presence of SCT flowers.
- Consider implementing interim grassland management actions (i.e., focused mowing or other management) in winter (December – January) 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.
- Monitor grazing operation and implement the HMP-designated BMPs (see Section 3.5.6 in HMP and bullet list above) (January– July 2018).
- Mow or graze all delineated areas (May/June 2018).
- Evaluate and update, as needed, the draft sub-management area map.
- 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*)

- Conduct census for SCT (August/September 2018).
- Monitor plant cover, canopy height, species richness, bare ground at permanent transects and compare data to previous years and HMP desired direction of change (April/May 2018).
- Document canopy height three times a year: February, April/May, and August/September 2018
- Document RDM in September/October 2018.
- 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.
- Maintain the restoration plantings near Arana Creek.

**Table 8. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 4 (2017) Results	Objective Met?
<b>Goal 1. Maintain a viable SCT population at Arana Gulch</b>						
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	0 SCT	No, decrease from 35 plants in 2016. <sup>7</sup>
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 limited to Area A (2016 detections)	No
<b>Goal 2. Reintroduce grazing to restore a disturbance regime that maintains functioning coastal prairie</b>						
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 2017	Yes, one trough relocated in 2016
	2.A.2 BMP implementation monitoring	3x during grazing	Stable	2015	City monitoring plant height and other BMPS through grazing season	Yes, BMPs were implemented
Objective 2B. Maintain RDM within a range that allows SCT to complete its lifecycle and protects coastal prairie grassland from erosion (700-1,500 lbs./acre)	Residual dry matter (RDM)	Yearly in Sept./Oct.	Maintain within range	2017	RDM measured in October; areas were at target, yet several areas above target	Yes, more areas were above target; yet no SCT detected in target or below target areas

<sup>7</sup> 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 8. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 4 (2017) Results	Objective Met?
<b>Goal 3. Minimize detrimental effects of high non-native plant cover and restore coastal prairie species diversity and habitat function</b>						
Objective 3A. Reduce canopy height during the basal rosette stage for SCT (Nov. – April) from the baseline level to 2-3 inches <sup>8</sup> by 2015	Average canopy height	3x during growing season	Reduction	2015	Canopy heights were above target in February and April.	No, cattle grazing was initiated at the end of January and did not reduce canopy height in April to less than 2 inches in Areas A, C, and D.
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 and in EAF cover in Area C and of one non-native species in Area D. 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.
Objective 3D. Increase native species richness from baseline levels to one more representative of a reference functioning	Native species richness	Yearly at peak growth in April	Increase	2020	11 native species including one tree, two shrubs, two forbs and six grasses have been detected in the sampling across Areas A,	Yes, meeting trend of increased native species richness; coast tarplant and toad rush were

<sup>8</sup> AMWG reduced threshold from 0.5 m (1.6 feet) to 2-3 inches in January 2015

**Table 8. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 4 (2017) Results	Objective Met?
coastal prairie system by 2020.					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 C and D, decreased in Area A	Yes, meeting trend of increased bare ground in Area C and D, but not in Area A.
	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 2017
<b>Goal 4. Maintain a genetically and demographically viable soil seed bank in perpetuity.</b>						
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

## 6. Habitat Management and Monitoring - Hagemann Gulch Riparian Woodland Management Area

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Activities within this management area were limited in 2017. Bridge and trail construction was 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 completed in 2017.

### 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*) will be planted near the eastern bridge abutment in early 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 (*Tropaeolum 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 35**. The eucalyptus trees that were trimmed to accommodate the bridge were field checked for re-sprouts. Minor re-sprouting of eucalyptus branches from some of the trees were noted. These sprouts will be included in the IPM plan for the gulch when this plan is developed.

#### 6.1.3 Fire Hazard

No management actions were implemented in 2017.

#### 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. No additional management actions were implemented in 2017.

**Figure 35. Distribution of Invasive Plant Species, Hagemann Gulch Management Area, October 2017**



#### 6.1.5 Appropriate Uses in Hagemann Gulch

No management actions were implemented in 2017. Rangers 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.

### **6.2 Monitoring and Performance Evaluation**

#### **6.2.1 Monitoring Methods**

No surveys or monitoring was conducted in 2017.

#### **6.2.2 Monitoring Results**

No monitoring results are available for 2017.

#### **6.2.3 Evaluation of HMP Goals**

**Table 10** presents a summary of the biological variables monitored, the Year 4 (2017) 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 has not begun this task; and thus, these objectives have not been met; however, the AMWG has suggested that the City initiate this task by identifying the invasive, non-native plant species growing within the gulch. The City began this work in 2016 and continued this task in 2017. The extent of invasive plant species was mapped in the management area in 2017. Ivy growing below the bridge has been identified as a priority and removal will begin in 2018, or as funding allows.

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 has not implemented the IPM plan for the removal of the woody invasive plant species that would address the fire hazard. The City will initiate this work as funding allows; however, this may not be feasible until 2018. This objective has not yet been met.

Protection of wildlife habitat features is a goal of the HMP (Goal 3). This goal and its 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 roosts 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 2017 City park rangers routinely 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 2018**

The following actions and expected timing are proposed for 2018:

- Monitor appropriate uses within Hagemann Gulch through periodic City ranger patrols (January– December 2018).
- Install six California rose (*Rosa californica*) as part of riparian revegetation plan; maintain plantings throughout year with weeding and supplemental irrigation; monitor plant survival (spring- summer 2018).
- Prioritize invasive, non-native plant species control and eradication and begin removal/control work.

**Table 9. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 4 (2017) Results	Objective Met?
<b>Goal 1. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in Hagemann Gulch</b>					
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 large stands remain
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 to be considered in IPM plan when plan is developed
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
<b>Goal 2. Reduce the fire hazard within Hagemann Gulch</b>					
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	Eucalyptus trees removed near western bridge	Partial compliance; some eucalyptus trees removed but large stands remain

**Table 9. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 4 (2017) Results	Objective Met?
				abutment and along bridge sightline	
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 large stands remain
<b>Goal 3. Protect wildlife habitat features in Hagemann Gulch</b>					
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 9. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 4 (2017) Results	Objective Met?
<b>Goal 4. Increase appropriate uses in Hagemann Gulch</b>					
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 rangers and maintenance staff periodically inspected the area in 2016; issues of illegal encampments were documented in close proximity to the bridge
<b>Goal 5. Preserve the “Rose of Castille” historic roses</b>					
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

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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. Consistent with Goal 3 of the HMP, the City continued to work with the Resource Conservation District of Santa Cruz County (RDCSCC) on measures to implement habitat enhancement actions within the Arana Gulch watershed. In addition, the City continued on the development of a plan to reduce the non-native understory in the management area by completing maps showing the distribution of invasive weeds, consistent with Goal 4 of the HMP.

### 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 within 2015, 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. Additional willow pole cuttings (25) were installed along the slope above Arana Creek to replace previous plantings that died. These plantings were maintained throughout 2017. Additional willow plantings are scheduled for installation in January 2018.

#### 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 2017.



### 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, as of April 2015, is presented in **Figure 36A-D**.

Invasive non-native plant species documented to date in the management area include: (*Acacia spp.*), perennial pepperweed (*Lepidium latifolium*), eupatorium (*Ageratina adenophora*), iceplant (*Carpobrotus edulis*), Italian thistle (*Carduus pycnocephalus*), bull thistle (*Cirsium vulgare*), jubata grass (*Cortaderia 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 2017, English ivy (*Hedera helix*) was removed/controlled from along the Marsh Vista Trail, as noted on **Figure 36B**. In December 2017, acacias were removed/cut from the upper banks of Arana Creek, near the causeway/trail.

**Figure 36A. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**

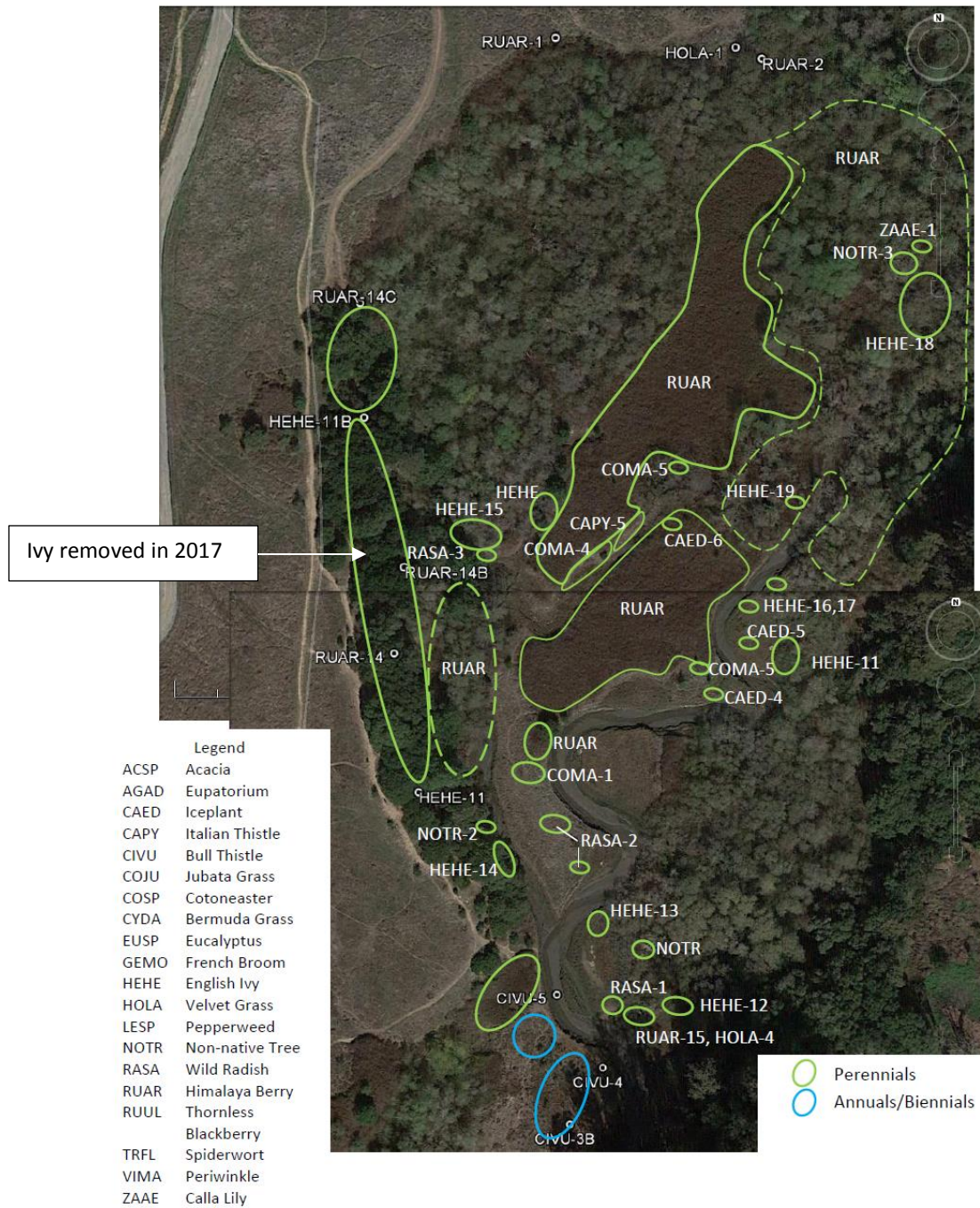


Arana Gulch Greenbelt – Location of Invasive Plant Species in Arana Creek Management Area  
April, 2015 - Sheet 1 of 4

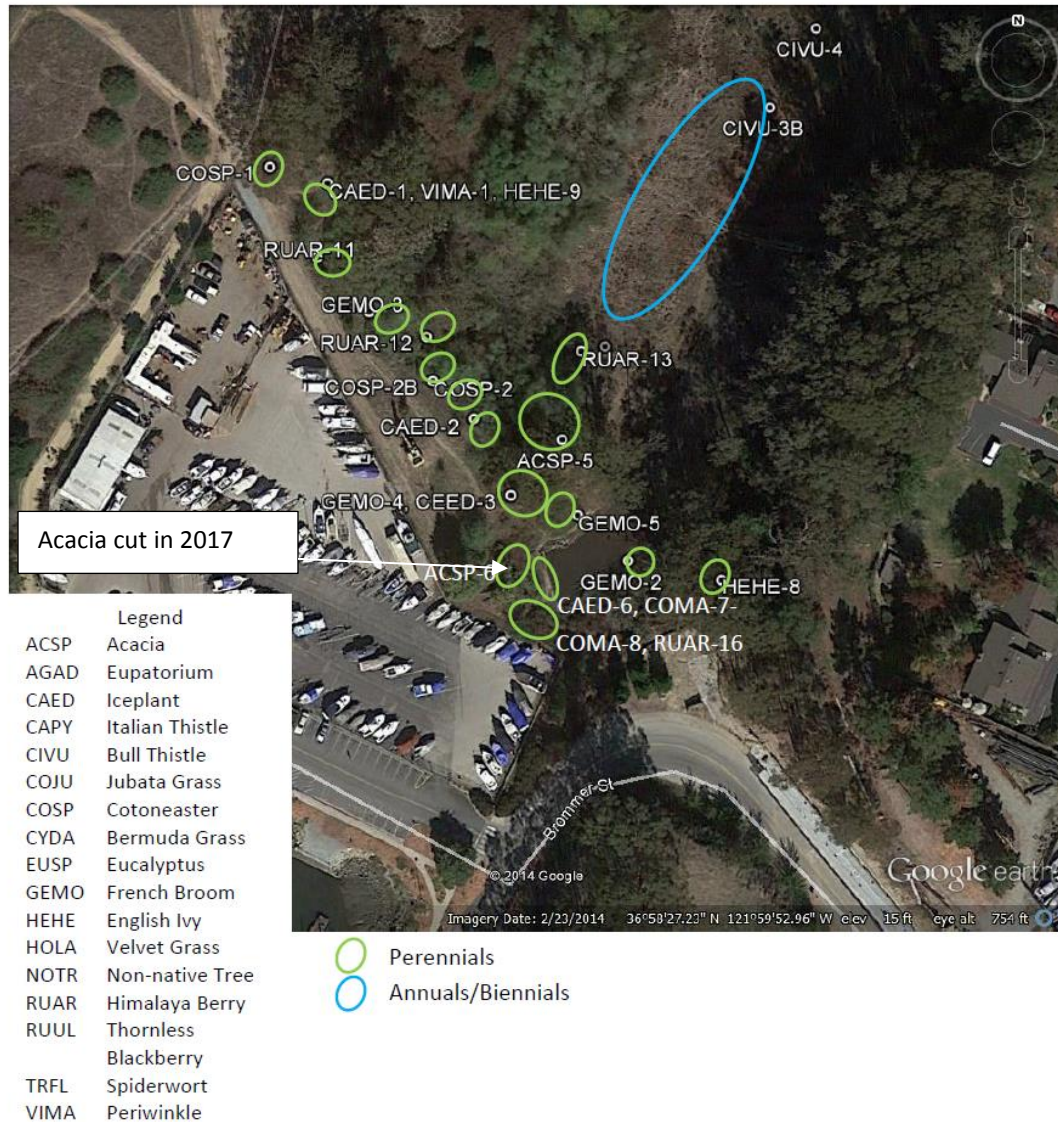


**Figure 36B. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**

Arana Gulch Greenbelt – Location of Invasive Plant Species in Arana Creek Management Area  
Preliminary, April 2015- Sheet 2 of 4



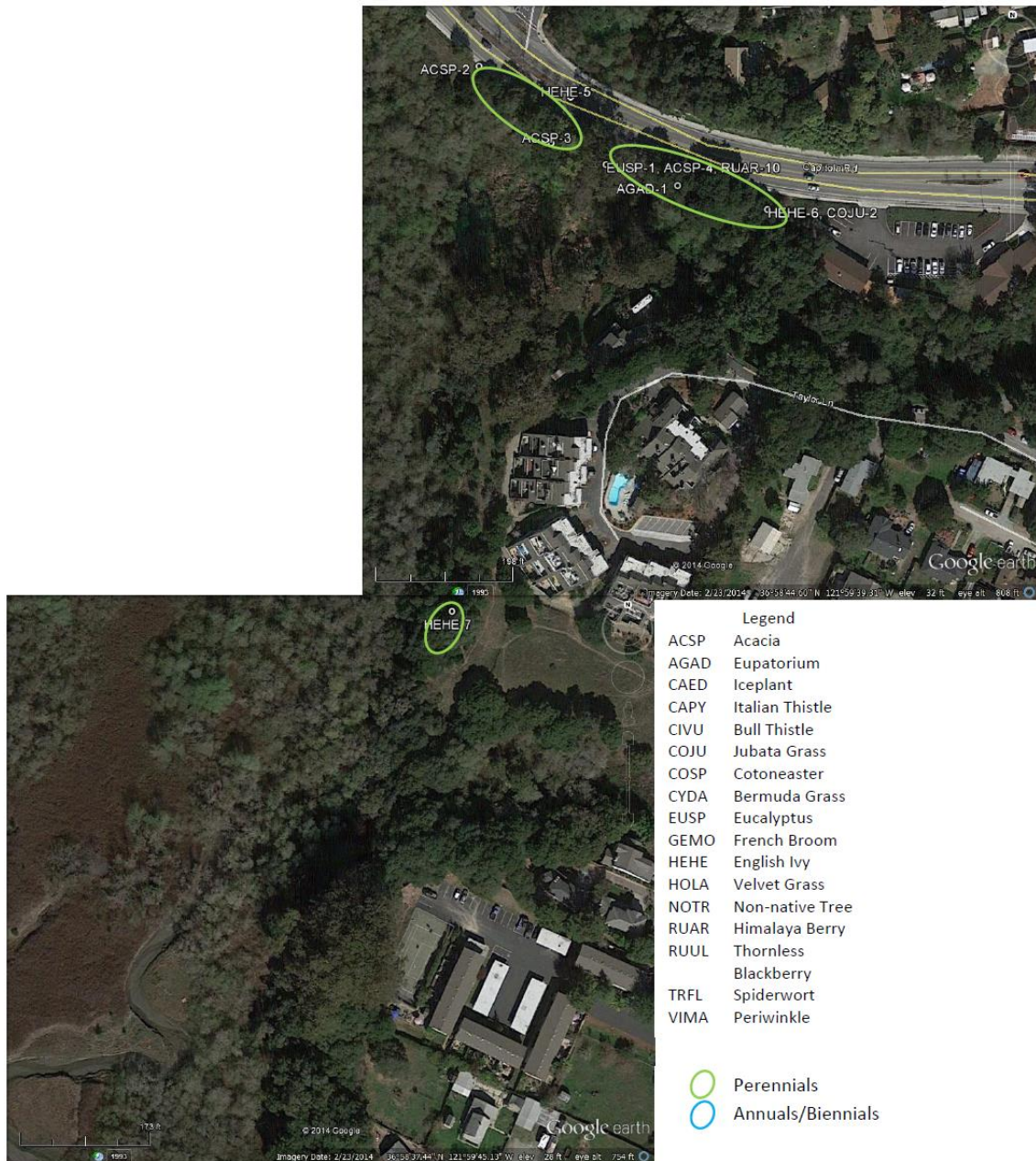
**Figure 36C. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**





**Figure 36D. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**

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





#### 7.1.4 Coordination with the RCDSCC

The City continued to coordinate with the RCDSCC on measures to improve habitat conditions in the watershed. This coordination followed outreach conducted in 2016, wherein the RCDSCC attended an AMWG field meeting and had their consultants (Balance Hydrology) present their findings on a watershed sediment study and a discussion on erosion problems in the management area. A more recent watershed study evaluated watershed issues that have the potential to deliver significant amounts of new sediment to the harbor (two gullies in upper watershed) and compared existing conditions to the 2002 Arana Gulch Enhancement Plan. The results of that study were not available at the time of this report. Based on discussions about erosion and sediments in Arana Creek, the City closed the steep and eroding ad-hoc trail along the bank of Arana Creek.

## 7.2 Monitoring and Performance Evaluation

### 7.2.1 Monitoring Methods

The riparian revegetation areas were monitored in October 2017. A plant survival count was conducted on October 11, 2017. 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. A copy of these forms is presented in **Appendix D**.

### 7.2.2 Monitoring Results

Within Area A, the October 2017 monitoring found a dense cover of naturally-establishing Himalaya berry (*Rubus ameniacus*) and French broom (*Genista monspessulana*). Willow cuttings exhibited a 35% survival rate; seven of the 20 willow cuttings were found to be alive. Additional willow plantings will be installed in January 2018. Plant cover within the revegetation area was recorded at 95%, provided by Himalaya berry (*Rubus ameniacus*) and French broom (*Genista monspessulana*) (60%), willow (*Salix lasiolepis*) (10%), and eucalyptus (*Eucalyptus sp.*) (5%) (see **Table 11**). This area does not meet the required 80% native woody cover required by CDFW; removal of invasive plants is needed. It is recommended that the French broom (*Genista monspessulana*) and *Eucalyptus* trees be removed.

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 11**). Within Area C, plant cover was recorded at 80%, with cover provided by California rose (*Rosa californica*) (15%), mugwort (*Artemisia douglasiana*) (15%), creeping wild rye (*Elymus triticoides*) (20%), coastal live oak (5%) and grasses and forbs (40%). These data are depicted on **Table 11**. This area does not yet meet the required 80% native cover required by CDFW. Additional

growth is needed for the plantings to provide additional cover; the plantings will be maintained throughout 2018.

**Table 10. Monitoring Results from Riparian Revegetation Area, Arana Creek, 2017**

Species	# Installed Plants Alive, 2017	Plant Cover
<b>Area A</b>		
Willow	7	10% <sup>1</sup>
Himalaya Blackberry, French Broom, Eucalyptus	-	80
Grasses and Forbs	-	10
<b>Area C</b>		
Creeping Wild Rye	-	20%
California Rose	44	15%
Mugwort	16	15%
Coast Live oak	3	5%
Grasses and Forbs		60%

### 7.2.3 Evaluation of HMP Goals

**Table 11** presents a summary of the biological variables monitored, the Year 4 (2017) 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 in 2017 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 mapping occurrences of invasive, non-native plant species growing within the management area in compliance with goals of the HMP.

### 7.3 Proposed Actions for 2018

The following actions and expected timing are proposed for 2018:

- Continue to engage with the RCDSCC on watershed and greenbelt projects through annual meeting with the RCDSCC. (January– December 2018).
- Maintain all plantings throughout year with weeding and supplemental irrigation; monitor plant survival in fall 2018.
- Confer with the AMWG of prioritizing removal and control of invasive, non-native plant species within the management area.

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

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 4 (2017) Results	Objective Met?
<b>Goal 1. Reduce sedimentation and improve steelhead habitat conditions within the Arana Creek watershed</b>					
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	Funding provided to RCD to seek grant opportunities and help prioritize projects.	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	Funding provided to RCD to seek grant funding and help prioritize projects.	No
<b>Goal 2. Stabilize the tidal reach of Arana Gulch Creek</b>					
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	City has engaged with RCDSCC	Yes. City will continue to coordinate with RCDSCC in 2018 to meet goals
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	Funding provided to RCD to seek grant funding and help prioritize projects.	No

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

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 4 (2017) Results	Objective Met?
<b>Goal 3. Restore the eroded Greenbelt Gully</b>					
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	Funding provided to RCD to seek grant funding and help prioritize projects.	No
<b>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</b>					
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	Initiated mapping of invasive plants in October 2014	No, but initiated mapping of invasive, non-native plant species
<b>Goal 5. Provide education opportunities and increase appropriate uses</b>					
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

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## 8. Conclusions from Year 4 and Recommendations for Year 5 (2018)

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### 8.1 Conclusions from 2017

The City continued its initiation of the HMP in 2017 (Year 4). Many of the management actions in this year were associated with the management actions within the coastal prairie and SCT management as cattle grazing was initiated. Invasive weed control was also started in this management area. There was effective and efficient coordination between the City, the AMWG, and the RCDSCC in 2017 as management actions and monitoring protocols were discussed. The City communicated with users of the greenbelt on the cattle-grazing and provided a ranger 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 February through May. Implementing cattle grazing is in compliance with the HMP; however, grazing was not successful in maintaining the desired canopy height from November through April to support SCT. Problems with the grazer bringing cattle onto the site in early January occurred and cattle were pulled from Area A for approximately 2 weeks in mid-season. These issues hampered the cattle's ability to reduce grass heights to target levels. 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. 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 2017; no above-ground plants were documented from the site in 2017. The HMP objective of reaching 348 plants was not met in 2017.

#### 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 2017. An IPM Plan was prepared for the Arana Gulch Creek area in 2015, in compliance with the HMP, yet objectives for removal and control have not yet been met. Invasive plant mapping was conducted in 2017 for the Hagemann Gulch area, yet, management actions in the Hagemann Gulch Riparian Woodland Management Area have not yet been implemented. These objectives of the HMP have not yet been met. The City coordinated with the RCDSCC on management issues within the Arana Gulch watershed in compliance with the HMP.



### **8.1.3. Adaptive Management and Public Outreach**

The City engaged with the AMWG in 2017 through one meeting in February 2017 as well as email correspondence. The City received input from the AMWG on management actions and implemented the requested management actions. The AMWG agreed to postpone the annual fall 2017 meeting to January 2018. 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, 2016 to June 30, 2017 and fiscal year July 1, 2017 to June 30, 2018.

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 2018**

The City will discuss with the AMWG recommendations for management actions for 2018 at the January 2018 meeting. 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 2018 (Year 5) is the continuation of seasonal cattle grazing within 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.

The City will also continue to implement seasonal mowing within the non-grazed areas that are to be retained as grassland. A census of the SCT will be conducted in summer 2018. Seed collection of SCT may occur depending on the SCT population and prior approval from CDFW.

### **8.2.2 Hagemann Gulch Riparian Woodland Management Area**

HMP activities identified for 2018 (Year 5) will be to monitor appropriate uses within the gulch concurrent with public use of the trail and bridge. City park rangers will monitor use as per their regular patrol duties within the greenbelt. Riparian revegetation as per an approved CDFW Streambed Alteration Agreement (SAA) will be planted and maintained in 2018.

Plantings will be maintained and monitored throughout 2018 as per the SAA. Invasive plant control measures will be initiated, pending funding and staffing.

### **8.2.3 Arana Gulch Creek Riparian Woodland and Wetland Management Area**

HMP activities identified for 2018 (Year 5) will be consultation with the AMWG on prioritizing removal/control of invasive, non-native plant species and then initiating removal/control of high-priority infestations. Riparian revegetation plantings will be maintained and monitored throughout 2018 as per the SAA.

### **8.2.4 AMWG and Public Outreach**

In 2018 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 annual fall meeting for 2017 will be conducted in January 2018 and the 2018 annual meeting will be held in November 2018. 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 12** presents a schedule for the HMP actions scheduled for 2018. The City has allocated funds for fiscal year July 1, 2017 to June 30, 2017 and funding for fiscal year July 1, 2017 to June 30, 2019.

**Table 12. Timeline for Habitat Management Actions Proposed for Year 5 (2018)**

	2018												2019
Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
<b>Coastal Prairie/Santa Cruz Tarplant Management</b>													
Objective 1. Santa Cruz tarplant census													
Objective 2. Monitor grazing program and variables	*												
Objective 3. Monitor baseline condition and photo points													
<b>Hagemann Gulch Riparian Woodland Management</b>													
Objectives 1 and 2. Implement IPM Plan and reduce fire hazard													
Objectives 3 and 4. Document wildlife habitat features and implement infrastructure monitoring <sup>9</sup>													
Objective 5A and 5B. Monitor survival of Rose of Castille shrubs													
<b>Arana Gulch Creek Riparian Woodland and Wetland Management</b>													
Objectives 1, 2, and 3. Collaborate with RCDSCC													
Objective 4. Implement removal/control of invasive													

<sup>9</sup> Includes completion of riparian revegetation at bridge and implementing year-long maintenance and monitoring.

**Table 12. Timeline for Habitat Management Actions Proposed for Year 5 (2018)**

	2018												2019
Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
non-native woody plant species and target weeds													
Objective 5. Infrastructure monitoring <sup>10</sup>													
<b>Adaptive Management</b>													
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													

<sup>10</sup> Includes riparian revegetation and implementing year-long maintenance and monitoring.

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## 9. References

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- USFWS, 1996. Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Species. September 23, 1996.



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## Appendix A                      AMWG Meeting Minutes, 2017

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**NOTE: Please see the separate Appendix document**

A-1: AMWG Meeting Minutes for:

February 2017

Email correspondence, September 2017

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## Appendix B                      Restoration Maintenance Activity Log

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**NOTE: Please see the separate Appendix document**

B-1. Arana Gulch Restoration Maintenance and Activity Log

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## Appendix C                      Coastal Prairie/Santa Cruz Tarplant Management Area

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**NOTE: Please see the separate Appendix document**

C-1. SCT Survey Route Map

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

C-3. Transect Photos

C-4. Photo Monitoring

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## Appendix D      Arana Gulch Creek Riparian Woodland and Wetland Management Area and Hagemann Gulch Riparian Woodland Management Area

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**NOTE: Please see the separate Appendix document**

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