# Arana Gulch Habitat Management Plan
# City of Santa Cruz

## Year 2 (2015) Annual Report

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

Final

*May 17, 2016*

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# 1. Executive Summary

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

The HMP was developed as part of the California Coastal Commission's (CCC) Coastal Development Permit process for the adoption of the Arana Gulch Master Plan (Master Plan). The Master Plan includes management guidelines for access, resource management, and education. Since Arana Gulch lies with 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; these actions are described in the Year 1 (2014) Annual Report. Actions implemented in Year 2 (2015) are described in this report. The AMWG provided input to the City during the implementation of the Year 2 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 2, the City continued to focus on improving the habitat of the Santa Cruz tarplant, a federally Threatened and a California State Endangered species. The City initiated cattle grazing and implemented management to control invasive weeds from the prairie/tarplant management area. In addition, the City initiated management tasks 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 2015 are summarized below.

### Master Plan Improvements

Master plan improvements in 2015 were limited to the installation of signs and other recreational amenities associated with the Arana Gulch Multi-Use Trail and the Agnes Street Connector Trail. These trails were completed in 2013 and 2014, respectively. The AMWG provided the City with recommendations relating to the content of the park

brochures and trail signs, particularly relating to the use of cattle as a habitat management tool.

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; City staff maintained these plantings in 2015. Due to harsh growing conditions encountered at the revegetation areas; the need for some replanting was identified during the fall season monitoring. Replacement plantings at the Arana Creek site are scheduled for February 2016. Mitigation plantings identified for the Hagemann Gulch area are scheduled for installation in February 2016.

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

Management actions in Year 2 included seasonal grazing, seasonal mowing, and localized hand-raking. Livestock infrastructure was completed in January 2015. As per a grazing contract and Stocking and Work Program prepared in 2014, the City awarded a contract to a local rancher with experience grazing lands with threatened and endangered species. Cattle grazing commenced in February 2015. Additional activities in this management area included monitoring plant composition, plant cover and residual dry matter (RDM) within grazed areas, implementing removal/control of invasive weed infestations, and establishing permanent photo stations. Cattle grazed the designated grazing area from February 26 through June 17.

Prairie site conditions were documented in April 2015 with plant species composition and cover values recorded at permanent transects (Stanton, 2015). Permanent photo-points required as part of the CDP were established in April 2015. Documentation of the Year 2 conditions, using permanent transects was done in compliance with the HMP.

Boundaries of the prairie/SCT management area were delineated and subsequently approved by the AMWG in April 2015. As per guidelines in the HMP, seasonal mowing was conducted for grassland/prairie areas located outside the grazing fences in March and May to reduce the canopy height of the non-native grasses and forbs to benefit the coastal prairie species diversity and habitat function. Within Tarplant Area B, volunteers conducted biomass removal in May and June. These prairie management actions were done in compliance with the HMP.

A census of SCT was conducted in summer; no above-ground SCT plants were found. Increasing the SCT population is an HMP goal. The population has declined from 18 plants in 2013, to 4 plants in 2014, and 0 plants in 2015. This is well below a population of approximately 348 plants in 2006.[1] A report describing the results of a soil seed bank assessment was prepared by Susan Bainbridge (Bainbridge, UC Berkeley Jepson

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

Herbarium, December 2015). The report confirmed the preliminary assessment findings that no viable SCT seeds were found in Areas B and C, yet viable seeds were found in Areas A and D. There was a significant decrease in viable seeds since a previous assessment in 2001, both in number of seeds and seed density. Preliminary results indicate the SCT seed bank has been lying mostly dormant and aging over several years and genetic diversity has likely declined. Cattle grazing is expected to create suitable growing conditions for the SCT. The results of this management tool on the SCT are expected to be evident in 2016 with above-ground plants; however, to date, the HMP goal to increase the number of SCT has not yet been achieved.

In compliance with the HMP, an Invasive Weed Work Plan (IWWP) was prepared for the management area and reviewed by the AMWG. The plan identified 14 species of management concern. In May patches of invasive, non-native plant species within the central prairie/grassland were removed. This removal was done pursuant to the IWWP and input from the AMWG. The City hired a contractor to remove cotoneaster, Himalaya blackberry, and English ivy from the prairie. The City also removed flowering heads from thistles in summer and fall, in compliance with the IWWP and the HMP. Given the extensive amount of invasive plants located throughout the 67-acre property, the AMWG recommended prioritizing the initial control and removal efforts in the areas within and surrounding the SC tarplant populations in the coastal prairie areas.

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

A survey and map of occurrences of invasive, non-native plant species within the Arana Gulch Creek Riparian Woodland and Wetland Management Area was completed in 2015. Reducing the cover of non-native, invasive woody plant thickets in these two management areas are objectives of the HMP and mapping the occurrences is the first step in achieving this objective. The City conferred with the AMWG on the findings of the mapping.

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; City staff maintained these plantings in 2015. Due to harsh growing conditions encountered at the revegetation areas; the need for some replanting was identified during the fall season monitoring. Replacement plantings at the Arana Creek site are scheduled for February 2016. Mitigation plantings identified for the Hagemann Gulch area are scheduled for installation in February 2016.

## Management Activities Proposed for 2016 (Year 3)

The following management actions are identified for 2016:

- 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.

- Within the boundaries of the prairie/SCT management area, designated woody plants growing outside of the grazing area, yet within the designated grassland, will be removed and herbicide treatment will be applied, if needed. Continual treatments will need to be planned and implemented to keep woody plants from encroaching into the prairie. Three test scrape plots created in the northern portion of the greenbelt will be monitored in 2016 as to plant composition and cover to determine if these areas should be retained in the prairie management area. 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 2016. Seed collection of SCT may be done if more than 50 SCT are present, pending prior approval from CDFW.

- The City will implement management actions within the Arana Gulch Creek and Hagemann Gulch management areas. The City will begin to identify and map invasive, non-native plant species within the Hagemann Gulch Riparian Woodland Management Area, pending funding and other resources. The City will solicit input from the AMWG on prioritizing invasive plant removal actions within the Arana Gulch Creek Riparian Woodland and Wetland Management Area and will use this input to develop an Invasive Weed Work Plan for these areas. The City will begin controlling ivy under the Hagemann bridge and along the Marsh Vista Trail.

- 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 2016 through periodic meetings and group email correspondence. The tentative schedule is to hold AMWG meetings in March, July, and November 2016.

# 2. Introduction

## 2.1 Background

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

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

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

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

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

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

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

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

(f) Interim success criteria to be achieved in the first year of implementation, tied directly to the annual reporting requirement. Also, measureable 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 received the most attention in Year 2 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[2]. A key tool described in the HMP is an adaptive management framework for habitat restoration actions. Under this framework, and as required by the CDP, an Adaptive Management Working Group (AMWG) was formed to provide scientific expertise on resource management activities to the City and the CCC[3]. In 2015, the AMWG provided input to the City during implementation of several components of the HMP.

[2] See Section 3.1, page 33 of Arana Gulch HMP.
[3] See Section 2.2, Page 22 of Arana Gulch 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; however, 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 2nd 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 has just begun. 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 report (e.g., Year 1 [2014] Annual Report) is available for review on the City's website (http://www.cityofsantacruz.com/departments/parks-recreation/parks-beaches-and-open-spaces/open-spaces/arana-gulch).

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

**Figure 1. Location map**

## 2.2 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 2015 which is considered to be Year 2 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 habitat management actions associated with Master Plan improvements implemented in 2015 are described in Section 3. The adaptive management framework of the HMP is presented 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 3 (2016) 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 the Year 1 (2014) Annual Report for specific details on actions implemented in 2014.

# 3. Adaptive Management Framework

## 3.1 Adaptive Working Group (AMWG)

The City adopted an adaptive management framework for implementation of the HMP. The City facilitated and coordinated habitat management activities with the AMWG in 2015. Three meetings were held with the AMWG in 2015; the minutes from the January 28, April 15, and November 10 meetings are presented in **Appendix A**. In addition, the City coordinated and facilitated group email correspondence between AMWG members to solicit input on management activities. The HMP outlines the formation of the AMWG, voting procedures, and other procedures.[4] The list of current members is presented in the meeting minutes **(Appendix A).** A grazing specialist from UC Extension joined the AMWG in January 2015 and the group is actively searching for a wildlife biologist.

The AMWG provided input to the City on habitat management activities within Arana Gulch throughout 2015. A detailed discussion of AMWG recommendations is included in the sections for each management area. In short, the AMWG provided recommendations on the seasonal mowing of the central grassland (including monitoring techniques), the location of grazing infrastructure (i.e., salt licks and relocation of water troughs), invasive weed control, delineation of the grassland, and public outreach.

The AMWG also provided input to the City public outreach plans and materials for the re-introduction of cattle onto the greenbelt lands.

## 3.2 Public Outreach

In 2015 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 AMWG offered suggestions to the City on adding information and tools to facilitate communication of the HMP activities to the public and to receive public comment. These items are included in the AMWG meeting minutes, presented in **Appendix A.** The City periodically updated the webpage throughout 2015.

The AMWG meetings are open to the public and provide a forum for members of the public to express their ideas directly to the members and City. Public comments are also generated through the City's website and the AMWG is briefed of public comments and concerns during AMWG meetings.

In preparation of the beginning of grazing in February 2015, and in anticipation of public comments resulting from cattle in the grassland, the City implemented an outreach campaign. Rangers discussed the importance of keeping dogs on-leash when they encountered violators of the rule. The City worked with the AMWG to create a brochure informing the public of

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

why grazing was being implemented and listing safety tips for human/dog and cattle interactions. Beginning in January 2015 and continuing throughout the grazing season, the brochure was posted onsite and on the City webpage. Signage was installed 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 2015 (February through June), City staff and park rangers provided information to the public on the grazing program through park brochures and on-site conversations. The City also coordinated with volunteers to rake cut biomass and thatch from SCT Area B.

### 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 AMWG meetings and maintain funding levels. In 2015, three meetings were held with the AMWG as outlined in Objective 1A. 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 2015, but this task was not completed. This task will be conducted in 2016 and the results of this prioritization will be included in the 2016 annual report.

To meet Objective 1B, the City has dedicated Arana Gulch management as a line item in the City Parks and Recreation Departments operating budget. The City also initiated hiring a maintenance person that will be partially dedicated to the Arana Gulch greenbelt. The position is expected to be 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 2015, such as seasonal grazing and seasonal mowing, were monitored to determine their effectiveness in meeting biological variables. The City also authorized a seed bank assessment study for Santa Cruz Tarplant, which was completed in 2015. This assessment was identified as a first research need (i.e., Key Management Question)[5]. The results of the study will be used to guide future management areas. The HMP has 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). Management actions are being implemented to meet this timescale. The timescale presented in the HMP for restoration of the coastal prairie or invasive plant control is a trend 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 store 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

[5] Please refer to Page 79 of the HMP for a detailed discussion of the Key Management Question (KMQ) framework.

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 in 2015. **Table 1** presents a summary of the objectives for adaptive management, actions implemented in 2015, and whether the actions were in compliance with the HMP.

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

| Objective and Variable | Actions in Year 2 (2015) | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|
| **Goal 1. Maintain an adaptive management framework that allows stakeholders to scientifically conduct and evaluate actions** | | | |
| Objective 1A. Conduct at least 3 AMWG meetings in 2013 with a quorum of members present each time. In subsequent years, the frequency of meetings beyond an annual November meeting can be determined by the needs of the AMWG. Conduct at least 3 AMWG meetings/year with a quorum | Meetings held January 28, April 15, and November 10, 2015 | Meeting minutes presented in Appendix D | Yes, three meetings held in 2015. Meeting date(s) TBD for 2016; first meeting will be held in February or March 2016 |
| 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, 2014 to June 30, 2015 is $20,000 | Funding allocated by City for fiscal year July 1, 2014 to June 30, 2015 is approximately $50,000 (excluding personnel time); funding for next fiscal year TBD |
| **Goal 2. Conduct a two-tracked program of management and research with built-in monitoring** | | | |
| Objective 2A. Maintain a Management Track that leads to stable or increasing trend in measured biological variables over a biologically appropriate timescale. | The City incorporated many of the 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 lead to meeting desired variables for SCT by 2016 and coastal prairie by 2020 (timescale) |
| 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. | Seed bank assessment was identified as the first research need | Seed bank assessment was conducted in 2014 and report was submitted to City in 2015 | Yes, the seedbank analysis was determined to be an important research need to guide management. The KMQ framework will continue to be used when research tasks are proposed |
| **Goal 3. Develop public educational opportunities associated with Arana Gulch and efforts to conserve and restore its rare resources** | | | |
| Objective 3A. Maintain a website to communicate restoration | Webpage on City | Webpage updated | Yes, City improved and updated website in |

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

| Objective and Variable | Actions in Year 2 (2015) | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|
| efforts to the public and provide a place for documents related to the requirements of the CDP, such as Monitoring Reports. | website developed in 2013 | throughout 2015 with new information | 2015 and the webpage was periodically updated with reports and information as needed in 2015 |

# 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.

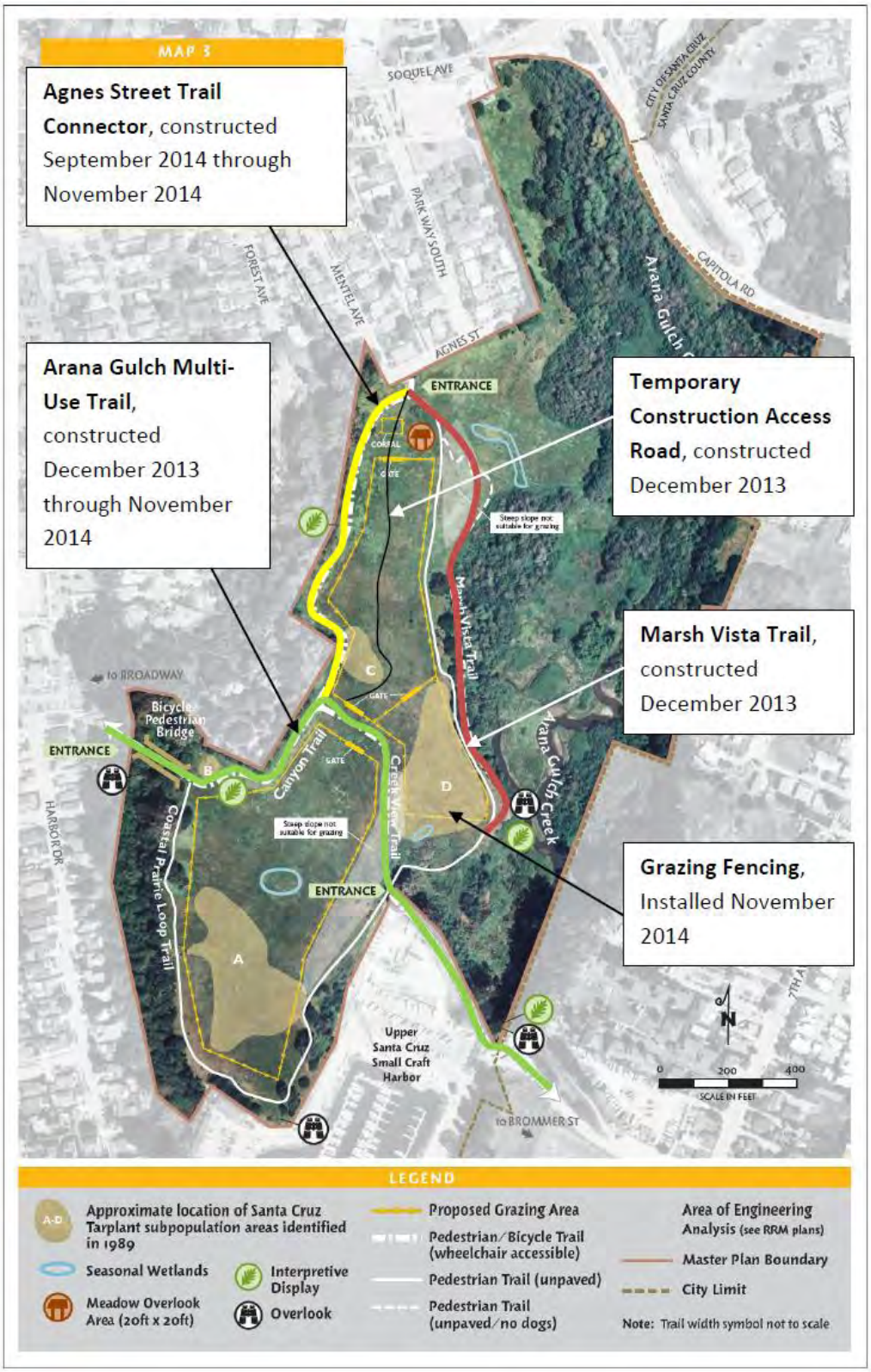
## 4.1 Multi-Use Trail Construction Areas

A temporary construction access road was used in 2013 and 2014 during trail construction. No actions were done along the central construction access way in 2015. 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 cattle grazing from February 26 -March 3, March 25-April 15, and May 20- June 3 2015. The condition of this construction assess road in depicted in Figure 2. The location of this road and other master plan improvements is presented in **Figure 3**.

Hydromulch that was applied on construction access areas adjacent to the Arana Gulch Multi-Use Trail and near the abutments of the Hageman Gulch bridge and Arana Creek causeway naturally decomposed throughout 2015. Hydroseeding, with sterile seed, done in areas identified for seeding in the CDFW-approved riparian revegetation plan (i.e., at the Arana Creek causeway and Hageman Gulch bridge abutments) was left in place for erosion control. No erosion was noted in these areas and no additional seeding was conducted in 2015.

**Figure 2. Condition of temporary construction access road, February 2015**

**Figure 3. Master Plan improvements, 2013 - 2015**

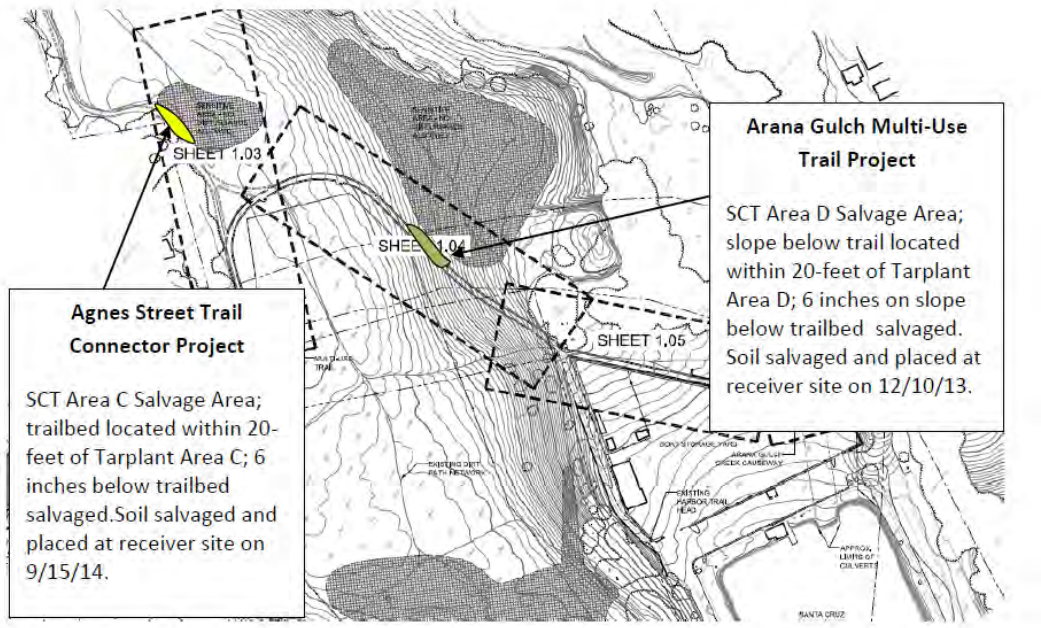


## 4.2 Multi-Use Trail Soil Salvage Adjacent to Mapped Tarplant Areas

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 4 and 5**, respectively.

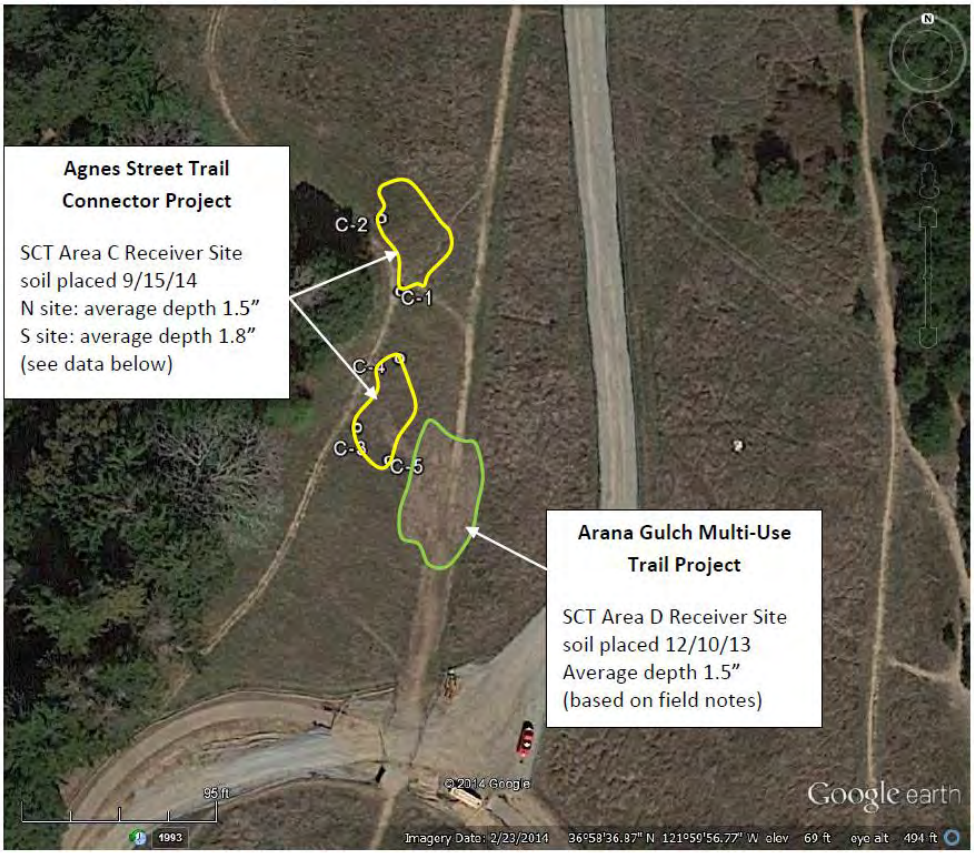
In July 2015, native and non-native plants continued to establish at the Tarplant Area D receiver site, similar to site observations in 2014. Native species observed included coast tarweed (*Deinandra corymbosa)* and California poppy (*Eschscholzia californica)* and non-native species include hare barley (*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 2015.

**Figure 4. Location of multi-use trail soil salvage sites, 2013 and 2014**




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 5**). 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 5**.

**Figure 5. Multi-Use trail soil receiver sites on aerial photo, 2013 and 2014**




In July 2015, 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 2015. The condition of this receiver site in 2015 is shown in **Figure 6**.

**Figure 6. Condition of soil receiver site adjacent to Tarplant Area C, June 2015**


## 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 2015, 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 2014, individuals of the native coast tarweed (*Deinandra corymbosa)* were observed within the trail construction zone, as depicted in **Figure 7**. Other plant species also naturally established in the construction area include several weedy, non-native species, such as wild oats (*Avena spp.)*, wild radish, milk thistle (*Silybum marianum)*, and bull thistle (*Cirsium vulgare).* No SCT were observed in these areas in 2015.

**Figure 7. Coast tarweed growing along edge of east-west trail, July 2015**

## 4.4 Grazing Infrastructure and Stocking Program

The City's trail construction contractor completed cattle infrastructure in January 2015. Features include fences, access gates, water line/water troughs and a temporary holding corral near Agnes Street. The City installed extra connectors on the underground waterline to allow for flexibility in water trough placement to respond to resource management needs. In February, 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 5.1 for more information on the 2015 cattle grazing program. **Figure 8** depicts cattle along the fence and near a grazing sign. Cattle grazing signs were installed at each entrance and provide contact information to the City and rules of the site. Smaller signs were also installed along the fence line where park users will be in close proximity to the cattle. Additional signs describing that the cattle are onsite to help the restoration of the SCT will also be installed in February 2016.

**Figure 8. Cattle along the fence and near a grazing sign.**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# 5. Habitat Management and Monitoring - Coastal Prairie/Santa Cruz Tarplant Management Area

Activities within this management area are summarized in the following section and include actions as outlined in Section 3.0 of the HMP as well as adaptive management actions recommended by the AMWG. Management actions in 2015 included grazing, monitoring of grazing actions, monitoring for SCT, and invasive weed control. 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. It is anticipated that these criteria will be developed in 2016 and will be used to assess performance of the coastal prairie at Arana Gulch.

## 5.1 Management Actions

Several grassland management actions were implemented in 2015, as described below.

### 5.1.1 Santa Cruz Tarplant

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 and raking of Tarplant Area B. Tarplant Areas A, C, and D were grazed between February 26 and June 17, 2015. Further details on the grazing program can be found in Section 5.1.5. Tarplant Area B was mowed on March 16th and May 8th; volunteers raked cut material and thatch from the area in May and June. Grazing Area C was mowed in June.

Upon receiving concurrence from the AMWG, following a May 8th mowing (see Section 5.1.2 below), volunteers (Jean Brocklebank and Michael Lewis) hand raked cut material and thatch from Tarplant Area B and the surrounding grassland to improve growing conditions for the SCT. The purpose of the work was to remove cut material and allow more light penetration through the standing vegetation and improve growing conditions for any SCT that may be present and to create bare ground that may be suitable for SCT germination in fall/winter 2015/16. They created two controlled experiments. The first experiment left 1/3 of the area, running south/north along the western edge, un-raked as a control for the raking conducted on the remaining 2/3 of Area B. They also varied how deep they raked to determine any difference in the volume of growth after the winter rains commence. Forty bags of biomass were removed from the area. The treated areas will be surveyed for presence of SCT in summer 2016. **Figures 9, 10, and 11** depict their raking work.

**Figure 9. Bags of raked biomass from Tarplant Area B, May 2015**

**Figure 10. Areas deep-raked without pulling up roots, Tarplant Area B, May 2015**

**Figure 11. Areas deep-raked with partial pulling up roots, Tarplant Area B, May 2015**

Susan Bainbridge of UC Berkeley Jepson Herbarium completed a soil seed bank assessment for SCT in 2015 (Bainbridge, 2015). Under a CDFW 2081(a) permit between CDFW and UC Berkeley, she analyzed soil and seed bank viability within Tarplant Areas A, B, C, and D. Her preliminary results were presented in 2014 and her report was completed in 2015. The

report is presented in **Appendix B**. The results of the assessment are presented in Section 5.2.1.2.

### 5.1.2 Grassland Mowing

Grassland mowing occurred outside the grazing fences in 2015. The City flail-mowed these areas in May 2015 for grassland management purposes (i.e., reduce cover by non-native plants) and also for perimeter fuel break purposes. Mowing was conducted after input from the AMWG at their April 15 meeting and after the yearly grassland monitoring. 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[6]. Mowing should be done by a flail mower to break up thatch so that it decomposes better (*ibid).* The grassland area near the alley was mowed in April as a fuel break.

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. At the time of the May mowing, grass height was estimated to range 1-3 feet, based on pre-mowing visual observations. Flail mowing was conducted at approximately 4 inches. The areas mowed in March and/or May 2015 are depicted in **Figure 12**. **Figures 13 and 14** depict the typical site conditions at the time of mowing.

**Figure 12. Areas Mowed in March and/or May 2015**

[6] Minutes from the Arana Gulch AMWAG meeting on April 15, 2015

**Figure 13. Mowing in northern grassland, May 2015**


**Figure 14. Mowing along multi-use trail, May 2015**


### 5.1.3 Grassland Delineation

In January 2015, the City and the AMWG conducted a delineation of the coastal prairie that will be maintained as grassland in perpetuity. This delineation was initiated in the field with a voting AMWG member (Tim Hyland) after the installation of the grazing fences. A preliminary grassland delineation was discussed with the AMWG at the January meeting and was finalized at the April meeting. 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 15**. Perimeter fuel break mowing was also identified along the trails.

**Figure 15. Delineated grassland, April 2015**


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. In October 2014 the City created three 50x50-foot scrape plots. In April 2015, AMWG members found no native plants in the scraped plots. The group will continue to monitor the scrape plots to see if any native plants grow before determining whether or not to keep this NE area as part of the coastal prairie. No additional vegetation sampling or scrape plots were recommended for this area **Figure 16** shows the location of the scrape plots.

In April 2015, the AMWG provided input on the removal of woody plant species from the delineated grassland area. The AMWG recommended that cotoneaster *(Cotoneaster sp.)* and Himalaya blackberry *(Rubus ameniacus)* be removed from the grassland, yet removal of oaks be held off for one more year as the rate of encroachment by these trees is slow and some members of the public questioned the need to remove the oaks trees due to the habitat they provide to trail users, wildlife, and their aesthetic values.

**Figure 16. Location of scrape plots created in October 2014**


### 5.1.4 Invasive, Non-native Plant Mapping and Control

In 2015 the City mapped the invasive plants within this management area to document the baseline condition and to guide future management activities for species removal/ control. In May an Invasive Weed Work Plan (IWWP) was prepared. 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 AMWG reviewed and provided comments on the IWWP in May and June 2015; the plan incorporated the comments received and was completed in July 2015. The IWWP is presented in **Appendix B**.

In May the City hired a contractor to remove cotoneaster, Himalaya blackberry, and English ivy (*Hedera helix)* from the coastal prairie on the hillside near the Harbor entrance. The cotoneasters were stump-grinded. **Figure 17** depicts this hillside after plant removal. As per the IWWP, the City implemented control actions in May, June and July 2015 wherein seed heads of thistles in Grazing Area A were cut and disposed of off-site. The location of the treated areas was marked on the invasive plant maps; areas treated in 2015 are depicted on **Figure 18**.

**Figure 17. Hillside after removal of cotoneaster, Himalaya blackberry, and English ivy, May 2015**

**Figure 18A. Invasive weed control, southern grassland, 2015**

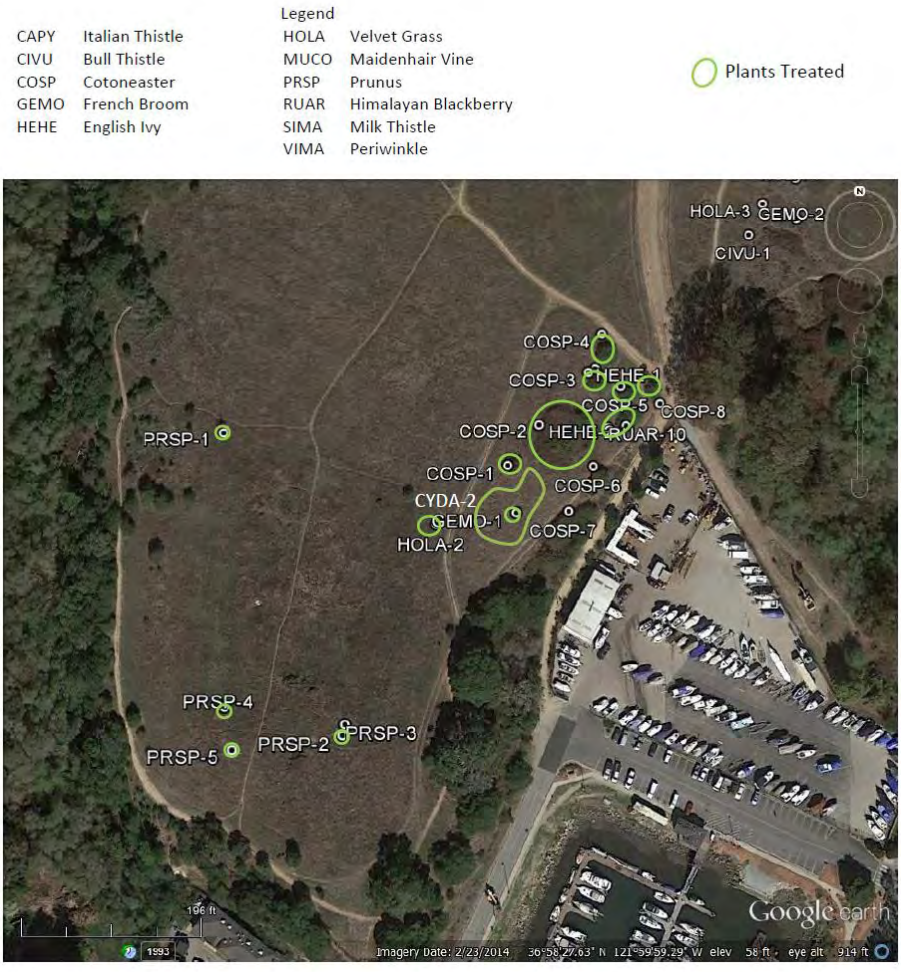

**Figure 18B. Invasive weed control, northern grassland, 2015**


### 5.1.5 Grazing and Stocking Work Program

The installation of cattle grazing infrastructure was completed in February 2015. 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. The cattle signs are presented in **Appendix B**. Additional signs indicating that the cattle graze to help restore the SCT are planned to be 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 2015. There were several incidents of cut fence lines during the first few months of cattle grazing. City rangers and Police Officers patrolled the area after the incidents; however, no one responsible for the cutting was found. After each fencing-cutting episode, the City and/or the grazing contractor repaired the fences, as needed. No cattle escaped the grazing area.

The City's grazing contractor had cattle onsite from February 26 through June 17. The original estimate for cattle was 2 to 6 cow calf pairs. However, it became evident during the 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 2015 grazing season are presented on **Table 2**.

**Table 2. Number of Cattle and Duration of Grazing Season per SCT Area in 2015**

| 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. AU Conversion (0.6) | AUM | Comments |
|---|---|---|---|---|---|---|---|---|
| February 26th-March 3rd | 0 | 0 | 0 | 7 | 1 | 0.6 | 4.2 AUM (Areas C&D) | Seven animals[7] are introduced to site. |
| March 4th - 24th | 7 | 0 | 0 | 0 | 0.66 | 0.6 | 2.77 AUM (Area A) | Seven animals are moved to Area A for focused grazing. |
| March 25th-April 15th | 7 | 0 | 0 | 7 | 0.66 | 0.6 | 2.77 AUM (Area A) 2.77 AUM (Area C&D) | An additional seven animals are introduced to areas C&D and the gate is left open to allow for more soil disturbance across the site. |
| April 15th-May 20th | 14 | 0 | 0 | 0 | 1.1 | 0.6 | 9.24 AUM (Area A) | Seven animals are moved from C&D to join the seven cows in Area A. Direction provided by AMWG at April 15, 2015 meeting. Area A is a high priority location because of its potential to restore the SC tarplant. |
| May 20th-June 3rd | 14 | 0 | 0 | 8 | .43 | 0.6 | 3.61 AUM (Area A) 2.06 AUM (Areas C&D) | An additional 8 animals are added to Area C&D. The gate is left open to increase soil disturbance across the site. The cattle spent much of their time grazing in Area D because it has better feed conditions, i.e. less thistle and blackberries and tall grass. |
| June 3rd-June 17th | 14 | 0 | 8 | 0 | .46 | 0.6 | 3.86 AUM (Area A) 2.21 AUM (Area D) | The gate is closed between Areas C&D and the animals are enclosed within Area D for more focused grazing. Coastal Tarweed began blooming in Area C. Grazing Area C was mowed on June 3rd. An area of Area C was flagged and left undisturbed because of the presence of coastal tarweed. |
| June 17th | 0 | 0 | 0 | 0 | 0 | 0 | | Animals are removed. |

[7] Class of cattle: I year old stockers and young heifers

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## 5.2 Monitoring and Performance Evaluation

Biological variables were measured within this management area in 2015 as outlined in the HMP. **Table 3** presents a summary of the biological variables monitored, the Year 2 (2015) values, and the desired direction of change. **Table 3** also identifies the interim success criteria for implementation of the HMP in the near term. The interim success criteria are a specific requirement of the CDP[8]; these criteria are short term management targets for implementing the HMP in the near term (i.e., to 2020). The monitoring methods, results, and evaluation of HMP goals for this management area are presented below.

### 5.2.1 Santa Cruz Tarplant

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[9]. The HMP requires an annual census of the population (Goal 1) and a baseline assessment of SCT within the soil seed bank (Goal 4).

**5.2.1.1 Monitoring Methods.** A census for SCT was conducted by Kathleen Lyons, on behalf of the City. Additional observations were made by members of the AMWG and volunteers. 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 July, August and September 2015. This survey period coincided with the blooming period of SCT. A reference population in the DeLaveaga region of the City of Santa Cruz was field checked on July 21; plants at this location were in flower which suggests that the species would be flowering and easily detected within Arana Gulch. Surveys were conducted by walking the grazing area (includes tarplant Area A, C, and D) as well as Tarplant Area B over multiple days. Meandering walking surveys, which are parallel walking routes spaced 25-50 feet apart, were conducted to detect SCT. Survey days were July 21, August 14, August 29, and September 3. If a SCT was observed a waypoint was taken with a handheld Global Positioning System (Garmin 60sce) that recorded the plant's location within the survey area. Field notes documented the height, flowering status, number of flowering heads per plant, and location of each SCT.

In addition to the field surveys, Susan Bainbridge analyzed soil and seed bank viability within Tarplant Areas A, B, C, and D under a CDFW 2081(a) permit between CDFW and UC

[8] See Page 71 of Arana Gulch HMP

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

Berkeley. She collected samples in 2014 and completed her soil seed bank assessment and report in 2015; the report is included in **Appendix B**.

**5.2.1.2 Monitoring Results.** No SCT were documented onsite in 2015. This is a reduction from four plants observed in Tarplant Area A in 2014. The census documented a continued decline in the number of SCT compared to 2013, wherein 18 plants were documented from Tarplant Area A. The survey was conducted in a below-normal rainfall year. The census was conducted after a partial year of grazing.

The SCT soil seed bank assessment found 30 viable and 27 non-viable seed (cypselae) in 52 samples. The samples consisted on 240 collection sites representing 720 soil cores. All viable and non-viable seeds were found in SCT Areas A and D and all viable seeds were in samples collected in the first 2.5 cm (1-inch) of soil. Only ray seeds were found. No disc seeds were located in any of the samples. This distinction may be important, as ray seeds are larger than disc seeds, have a tougher seed wall and may be less vulnerable to predation and have a strong dormancy mechanism. In contrast, disk seeds have more delicate seed coasts, which means they are more likely to germinate with the first rains but also more likely to be eaten (Page 34 of HMP, September 2013). The location of collection sites where viable seeds were found is shown by the orange dots on **Figure 19 (A and B)**.

**Figure 19A. Soil collection sites with viable SCT seeds, SCT Area A and D**

Figure 2. SCTP Area A: Approximate location of soil collection sites with viable SCTP seeds (orange dots) and collection sites (X).

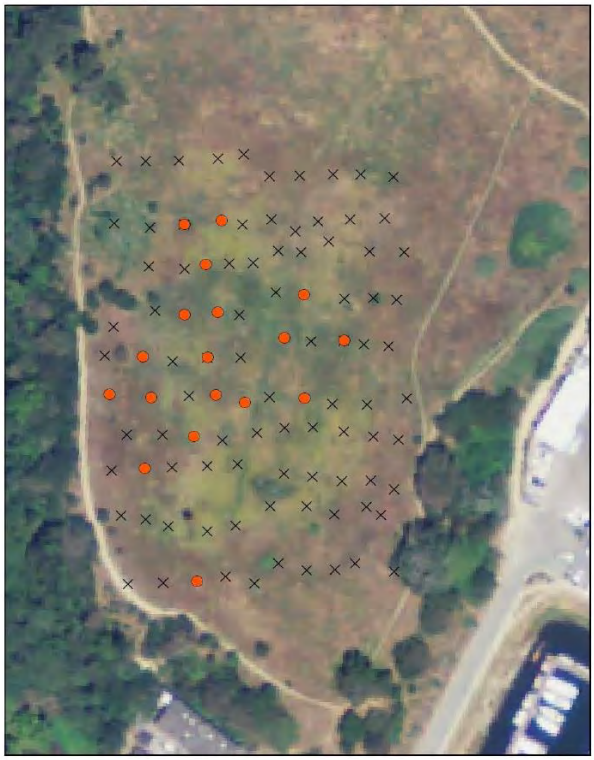
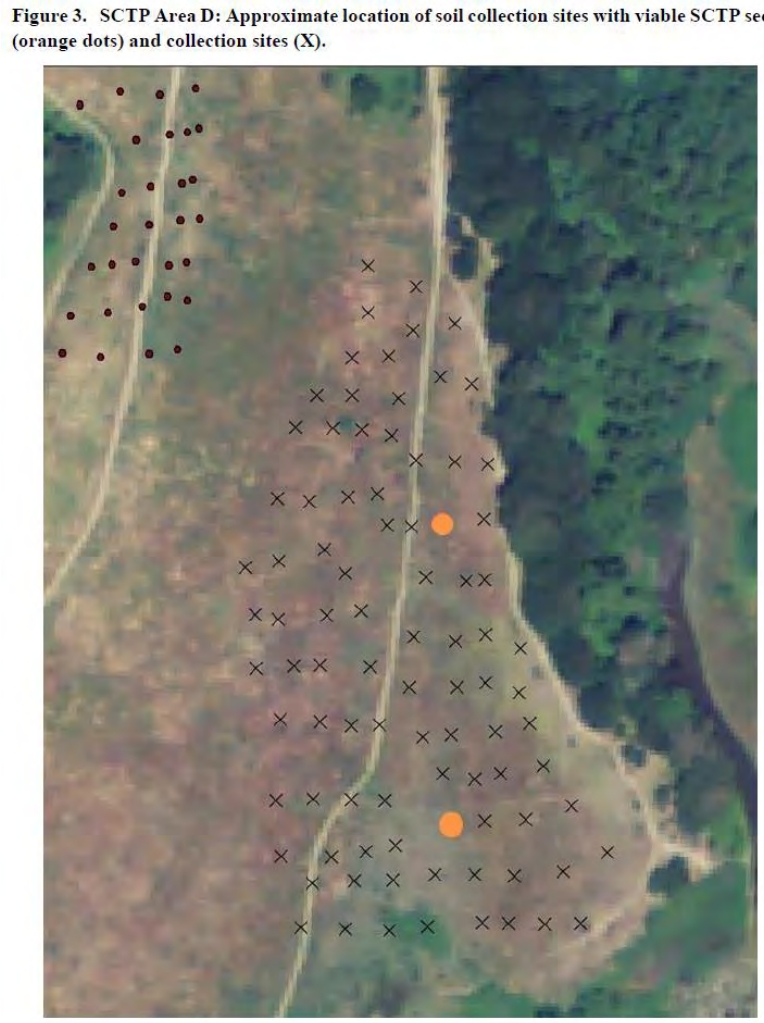


**Figure 19A. Soil collection sites with viable SCT seeds, SCT Areas A and D**




The report documents a decline in seed bank density since a previous assessment in 1999. Although both Areas A and D contained viable seeds, both areas experienced a significant decline in the density of seeds per unit area. Data from the analysis indicate that between 1999 and 2014, the seed bank density in Area A decreased from 21.4 to 0.187 seeds per square decimeter in Area A. In Area D, seed bank density decreased from 2.0 to 0.333 seeds per square decimeter. The soil seed bank assessment report indicates the decline in soil seed bank very likely resulted in loss of genetic diversity and/or allelic[10] richness in the population (Bainbridge, 2015). The soil seed bank assessment report states that the lack of detected soil seed bank in SCT Areas B and C does not necessarily mean that a seed bank is not present, but it may be in density too low for the methodology to detect. Ms. Bainbridge recommends

[10] **Allelic** richness is a measurement of genetic variation. The number of unique alleles in a population is a measure of genetic distinctiveness.

future management be focused on distribution of SCT recruitment throughout habitat rather than total numbers of individuals at the site. She also recommends habitat management (low frequency scraping and reintroduction of grazing) would help determine if a persistent soil seed bank occurs in these areas and/or if those areas serve as population sinks (Bainbridge, 2015).

**5.2.1.3 Evaluation of HMP Goals.** 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 grazing (i.e., summer 2016) (Objective 1A). No SCT were observed in 2015, a decline from 4 plants in 2014 and 18 plants in 2013. The population is well below the 2006 population level of 348 plants. The grassland management actions implemented in 2013, and 2014 (two seasonal mowing per year) and 2015 (initiation of seasonal cattle grazing) have not resulted in an increase in the population of SCT necessary to meet Objective 1A; however, the cattle grazing that occurred in 2015 is expected to improve growing conditions for SCT in 2015/16. As SCT germinate after the first significant rainfall event[11], usually in late fall, the full effects of cattle grazing management on SCT germination and plant recruitments will likely not be detected until 2016.

The HMP has an objective to expand the distribution of SCT beyond Tarplant Area A within three years (Objective 1B). As no aboveground SCT were observed on site in 2015, Objective 1B was not met this year. The 2015 cattle grazing occurred in Tarplant Areas A, C, and D. It is expected that the effects of this management action on aboveground SCT beyond Tarplant Area A will be detected after the first year of grazing (in 2016). Objective 1B specifies expansion of aboveground SCT beyond Tarplant Area A within 3 years of the grazing program (by 2017); 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 above, 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.

### 5.2.2 Grassland

**5.2.2.1 Monitoring Methods.** Monitoring in 2015 consisted of an annual vegetation assessment (April), measurements of canopy height (April and September), and measurements of residual dry matter (RDM) (October). Photo-documentation was conducted

[11] See Section 3.1.2, page 33 of Arana Gulch HMP.

in April 2015. Observations of grazing infrastructure occurred through the grazing period (February to June). Occurrences of invasive plant species were also monitored (year round).

**Vegetation Assessment.** An annual vegetation assessment at Arana Gulch is one of the requirements of the Coastal Development Permit.[12] For the assessment, botanist Alison Stanton, under contract to the City, installed the first permanent point intercept vegetation transects in June 2013 (Stanton 2014a)[13]. Data was collected from these transects in 2013 and 2014 to form the baseline condition. Data was collected from these transects in 2015.

Within the grazed areas vegetation conditions along these transects were recorded in April 2015. The area sampled encompasses approximately 18.5 acres, comprised of Area A (15 acres), Area B (4.1 acres) and Area D (2.1 acres) using the previously-approved protocol from the baseline assessment and the addition of transects in 2014. The sampling included collection of data on species richness, plant cover, canopy height, and ground cover. The point intercept method was used wherein "hits" were recorded for of each species encountered by a pole at every 0.5m along a 25m line for a total of 50 points per transect. Species were identified at each point and ground cover code (litter, bare, gopher disturbance, basal vegetation, rock) were also recorded. For each transect Stanton calculated the percent cover by species, the total number of species encountered, and the % ground cover of litter, bare, gopher, basal vegetation, and rock or cow flop. Average cover values were grouped by guilds: 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). Stanton presented mean cover values for all three sample years by species and by guild with error bars constructed using one standard deviation from the mean. The average height of the low canopy layer and the high canopy layer at the 6, 12, 18, and 24 m transect points was recorded. In 2013 and 2014, the average low canopy height and high canopy height were recorded with a meter stick. In 2015, the method was modified to utilize a plastic dinner plate threaded on a wire pin. The canopy height measurement was taken at the height where the plate comes to rest. In 2015 transects were re-marked with new rebar and metal caps. At the April sampling, thatch and litter were both included in the ground cover code of litter. In addition, a search was conducted within a 5m belt transect, using the transect as the centerline. If a new plant species (i.e., one not encountered on the transects) was observed, it was recorded. This additional method was used to capture uncommon or rare species and more fully characterize species richness. Photos were taken from the 0m with the camera at eye level and a white board with the name of the transect and compass bearing. The 2015 vegetation assessment report is included in **Appendix C**.

[12] See Section 3.7 of Arana Gulch HMP for the details of field sample design and data analysis.
[13] See Appendix B, 2014 Baseline Assessment Data for location of permanent transects.

No statistical tests were performed on the vegetation data because differences in vegetation were likely due to the sample timing (June in 2013 and April in 2014 and 2015) and a large difference in precipitation between those years. An analysis of any change in vegetation between 2014 and 2015 was not conducted as cattle had only been on the site for a short time (6 weeks) and no other management had occurred. The 2015 data will likely be used as the baseline to compare 2016 data as the vegetation will have had a chance to respond to grazing (Stanton, email to City dated May 6, 2016).

**Photo-documentation**. Photo points for long-term monitoring were established during the monitoring in April, 2015. A total of 15 points are distributed throughout the coastal prairie with two additional points on the Arana Creek causeway and two on Hagemann Bridge (Figure 3). All points are located at either an interpretative sign or a fence corner. Four photos were taken per point in a clockwise order; 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 B.

**Observations of Grazing Infrastructure.** As grazing occurred in 2015, 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 (3 times during grazing), and adherence to BMPs (see Section 3.5.6 in HMP).

**Canopy Height.** Canopy height was measured in April and September. Measurements were taken from the transects established for the vegetation asessement. The measuring method was modified in 2015 to use a plastic dinner plate threaded on a wire pin flag that comes to rest at the average vegetation height where ground shading becomes a concern. The average height of the canopy layer was measured at the 6, 12, 18, and 24 m points along each transect. The canopy height measurement was taken at the height where the plate comes to rest.

**Residual Dry Matter.** The RDM monitoring was conducted on October 13, 2015. After less than 8 weeks of grazing, cattle utilization in Area A was very patchy in April 2015 so walking surveys were conducted through and around Area A to get an idea of the variability in vegetation and ground cover conditions and several clip plots were taken to assess the RDM level. As in earlier monitoring events, it was difficult to distinguish between the current year's dry plant material and older thatch. Therefore, thatch was included and so the

mapping represents RDM/Thatch distribution. Stanton selected representative RDM measuring sites in the field based on her walking surveys.

Clipping and weighing of RDM plots was used to help calibrate visual estimates of RDM. The City purchased a clip and weigh RDM kit from Wildland Solutions that included a 13.25" diameter circular hoop plot, a Pesola gram scale, and the monitoring guide. In the field, all dry plant matter clipped from the plot was placed in plastic bag and weighed with the clip scale and the weight 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. The boundaries of the 3 RDM/ mulch categories of Above Target (blue), At Target (green) and Below Target were delineated in the field on print outs of the most recent Google Earth imagery available (Imagery Date: 3/28/2015). GPS tracks did not result in satisfactory polygons, but waypoints from clip plots and at perceived boundaries zones allowed rectification of the field map with Google Earth. Polygons drawn in Google Earth can only utilize straight lines, so the imagery was exported to PowerPoint where polygons of the RDM zones were hand-drawn. In April thatch was recorded with litter (see discussion above); however, in October, thatch was recorded as residual dry matter (RDM).

At the January 28, 2015 meeting, the AMWG members agreed that an RDM zone map, portraying the following RDM levels, provides a sufficient level of detail for aiding management and cattle grazing decisions:

- BLUE = RDM exceeds the objective
- GREEN = RDM meets the objective (500-650 lbs. per acre (plus 20% error, up to 780lbs)
- RED = RDM is below the objective

**Invasive Plant Mapping.** Invasive plant mapping was completed in 2015 and some invasive weed occurrences within the grassland were removed/controlled. The location of the treated areas was marked on the invasive plant maps.

**5.2.2.2 Monitoring Results.** The following discussion is a summary of the 2015 Coastal Prairie Assessment prepared by Alison Stanton (Stanton, 2015); the entire report is presented in **Appendix C**.

Cattle were brought to the site on February 26, 2015. The late arrival of the cattle made it possible to collect a third year of baseline vegetation data in April 2015 because only small patches of the grassland had been impacted by grazing at that point. The three years of baseline vegetation and ground cover data will be used by the City and the AMWG to evaluate progress towards meeting the goals and interim success criteria for the SCT and Coastal Prairie Management Area specified in the HMP. The 2014/15 growing season had below normal rainfall. As in 2013 and 2014, the 2015 condition of the sampled coastal

prairie vegetation at Arana Gulch was comprised almost exclusively of non-native species (Stanton, 2015). Across all years a total of 38 species were recorded as hits along each transect or within the 5m belt transects. The only native species detected were California brome (*Bromus carinatus*), California oatgrass (*Danthonia californica*), California poppy (*Eschscholozia californica*), California rose (*Rosa californica),* Great Basin wildrye *(Elymus triticoides),* purple needle grass (*Stipa pulchra),* and spreading rush *(Juncus patens).* Coyote brush (*Baccharis pilularis*) and coast live oak (*Quercus agrifolia*) were also present within Area A. All other species were non-native. Common vetch (*Vicia sativa spp. sativa*) and narrow-leaved vetch (*Vicia sativa spp. nigra)* were both present.

Of the non-native species, several are ranked by Cal-IPC (Invasive Plant Council). French broom (*Genista monspessulana*) was found in Area D. Himalaya blackberry (*Rubus armeniacus*) is the other High ranked species that was found in Area A. A total of three forb species are ranked Moderate including Italian thistle (*Carduus pycnocephalus*), bull thistle (*Cirsium vulgare*), and sheep sorrel (*Rumex acetosella*). The perennial velvet grass (*Holcus lanatus*) and three annuals grasses, wild oat (*Avena fatua*), ripgut brome (*Bromus diandrus*) and rattail six weeks grass (*Festuca myuros*), are considered Moderate because of the intense effect these grasses can have on fire regime and their ability to exclude natives.

In Area A, plant cover data was calculated for 22 species. Wild oat (*Avena fatua)* was the most dominate species with 43% cover, followed by storksbill (*Erodium cicutarium)* (36%) and six weeks fescue (*Festuca myuros)* (31%). Ripgut brome (*Bromus diandrus)* cover was 10% and all other species had 7% cover or less. Native species detected include California brome (*Bromus carinatus)*, California oatgrass (*Danthonia californica),* California poppy (*Eschscholzia californica)*, spreading rush (*Juncus patens)*, and purple needlegrass (*Nasella pulchra)*. Exotic annual grasses had the greatest cover followed by exotic annual forbs and exotic perennial forbs. California poppy (*Eschscholzia californica)* was the only native perennial forb encountered on the transects. Native perennial grass cover included spreading rush (*Juncus patens)*. Shrub cover included Himalaya blackberry (*Rubus armeniacus)* and California rose (*Rosa californica)* found on the southern end of Area A. Average bare ground was 8%.

In Area C, plant cover data was calculated for 11 species. The northern most transect contained Italian thistle (*Carduus pycnocephalus*). Wild radish (*Raphanus sativa)* had the greatest cover, and wild oat (*Avena fatua)*, ripgut brome *(Bromus diandrus),* storksbill (*Erodium cicutarium),* and six weeks fescue *(Festuca myuros),* all had similar cover. Cover of exotic annual grasses was somewhat greater than exotic annual forbs. Cover of exotic perennial forbs was primarily from common vetch (*Vicia sativa spp. sativa*). Average bare ground was 21% and one cow flop was encountered on a transect (Stanton, 2015).

In Area D, plant cover data was calculated for 13 species. Storksbill (*Erodium cicutarium)* had the greatest cover with 62%. Wild oat (*Avena fatua)* had 48% cover and cover of six

weeks fescue (*Festuca myuros)* was 31%. Area D has an infestation of the invasive perennial velvet grass (*Holcus lanatus)* that was captured on only one transect. French broom (*Genista monspessulana*) is beginning to emerge from the wet area but it was not captured in the plot in 2015. Exotic annual grasses and forbs had similar average cover. Perennial velvet grass (*Holcus lanatus)* comprised the entire exotic perennial grass guild. Sheep sorrel (*Rumex acetosella)* and vetch (*Vicia sativa)* were the only exotic perennial forbs. Average bare ground was 10%

The average canopy heights measured in April 2015 were well above the objective and ranged from 15 inches in Area A to 21 inches in Area D and were similar to the low canopy heights measured in 2013. Although it was not measured in 2015, the high canopy layer in April was over 3 feet high in Areas A and C, like it was in 2013. By September, grazing reduced the average canopy heights of all three Areas to about 3 inches (8 cm.) (see table below)

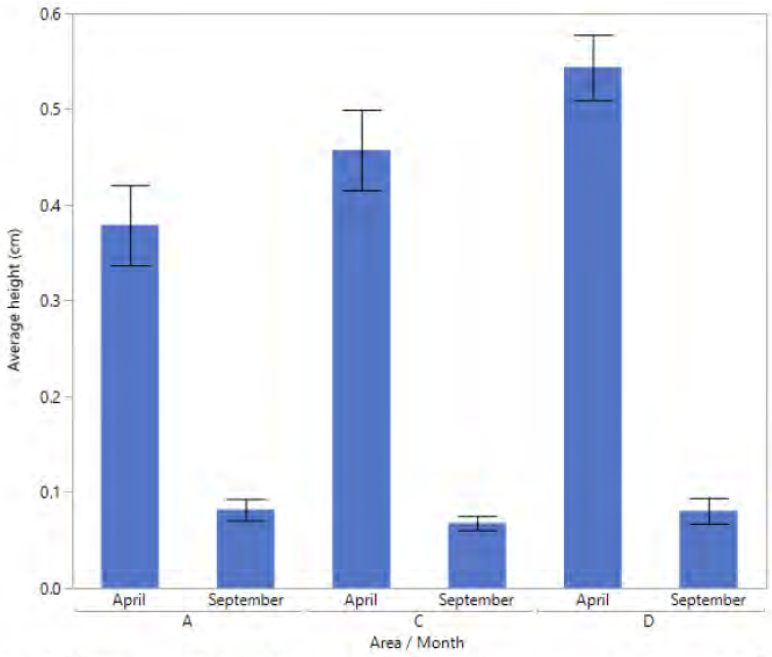



Figure 13. Mean canopy height in Area A, C, and D measured in April and September, 2015.
Each error bar is constructed using 1 standard error from the mean

Mean canopy Height, Excerpt from Vegetation Assessment Report, Stanton, 2015

In April 2015, after less than 8 weeks of grazing, RDM/Thatch distribution found Area A, about 30% of the pasture was At Target, 10% or less was Below Target, and about 60% was Above Target (Figure 14). The RDM of the Above Target zones was very high, with a heavy thatch load and was measured at over 5,000 lbs./acre in multiple clip plots (**Figure 20**). The

heavy thatch was comprised of tall annual grasses left over from the 2013 growing season. **Figure 21** depicts a clip plot of RDM Above Target in Area A.

**Figure 20. RDM map of Area A in October, 2015.**
**Blue= Above target, Green= At target, and Red= below target.**


**Figure 21. Clip plot of RDM Above Target (4,400 lbs/acre) in Area A in October, 2015.**

Within Area A in an At Target clip plot with 600 lbs./acre, bare ground was visible (**Figure 22**) and poppies were already growing in some parts of the zone (**Figure 23**). Although poppies were already in flower, ragwort (*Senecio sp.*) was also in flower in some areas where the RDM was At Target (**Figure 24**).

**Figure 22. Clip plot of RDM At Target (600 lb.s/acre) in Area A in October, 2015.**

**Figure 23. Poppies and bare ground in At Target (600 lbs./acre) RDM zone Area A in October, 2015.**

**Figure 24. Ragwort in flower and bare ground in At Target (600 lbs./acre) RDM zone Area A in October, 2015.**

The Below Target areas had mostly bare ground and were located where the cows congregated under shade trees and near water troughs (**Figure 25**).

**Figure 25. RDM clip plot Below Target in Area A in October, 2015.**


The RDM in Area C was Above Target, with areas around the former construction access road Below Target (**Figure 26**). Two areas of concrete remain and several blackberry infestations are also shown on the map. All of Area D except the perimeter adjacent to Area C was Above Target (**Figure 27**).

**Figure 26. RDM map in Area C.**
**Blue= Above target, Red= below target, Purple= blackberry infestation, and Grey = concrete. The black line is the estimated fence lines.**

**Figure 27. RDM map in Area D.**
**Blue= Above target, Red= below target. The black line is the estimated fence lines.**


Bare ground ranged from 8% in Area A, to 10% in Area D and 21% in Area C. Average amount of bare ground is 13%.

A large patch of cotoneaster, Himalaya blackberry and English ivy were brush cut and removed from the prairie upslope of the Harbor in May 2015. Seed heads of thistles were cut and removed from thistle plants growing in and adjacent to the grazing area in June and July 2015.

**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. Grazing was implemented in 2015, 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 2015 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, were implemented and [14] monitored:

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

- Due to a below-normal rainfall year, 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 February 26 and June 17, as recommended by the AMWG.
- 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 2015.
- Due to below-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. There were several incidents of cut fence lines during the first few months of cattle grazing. The City and the grazing contractor repaired the fences, as needed. 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; however, 2015 was a below normal rainfall year. There was no need to install erosion control measures, such as straw wattles, to prevent any accelerated or channelized runoff toward steep slopes.
- The grazing contractor avoided motorized vehicle use during rainy season/soil saturation to maximum extent feasible. No significant affects from his vehicle use was observed.

The purpose of Goal 3 is to minimize the deleterious effects of high non-native plant cover on species diversity and habitat function. Objective 3A identifies a reduction in canopy height during the basal rosette stage of the SCT (November through April) to 0.5 m (1.6 feet) or less. The AMWG amended Objective 3A to reduce canopy height during basal rosette stage for SCT to 2-3 inches or less, rather than 0.5m (1.6 feet) (April 2015). Drought appears to be the primary driver of the vegetation conditions observed during 2013-2015. The 5 inches of rain received in the 2013-2014 water year is the lowest on record and canopy height was dramatically reduced that year. The vegetation recovered to some degree and canopy heights were taller at the beginning of 2015 than they had been in 2014. Grazing began at Arana Gulch on February 26th, and by time of the permanent vegetation transect monitoring in April, cattle had been grazing for only 6 weeks. Grazing impacts were restricted to localized areas and measured canopy heights in all three Areas was around one half meter, far higher than the objective of 5-8cm. The cattle were on the site at various stocking levels for almost 16 weeks until June 17th. When canopy heights were re-measured in September, the average was around 3 inches for all areas. By the end of the grazing season many portions of the grazing areas met the objective of 2-3 inches or less. Objectives 3B, 3C, and 3D specify attaining cover values for native and non-native species to one more representative of a

reference functioning prairie by 2020. The three years of sampling showed greater species richness in Area A (19-22 species total) including the presence of 4-5 native species. In contrast, no-native species have been detected in Area C during the period, total species richness has remained lowest (10-14 species), and there are many invasive weed infestations including Italian thistle, Himalaya blackberry, and velvet grass. Area D has moister conditions due to its proximity to Arana Creek with moderate species richness (13-16 total species), few natives (2 species), and an infestation of velvet grass. Please refer to the Vegetation Assessment Report in Appendix A for table showing species richness for each management area. In 2015, the AMWG identified a need to establish more specific achievable objectives for the vegetation at Arana Gulch. During the development of the HMP there was not yet any baseline data to quantify existing conditions and so the interim restoration criterion was established as a return to an ideal of a functional reference coastal prairie. An AMWG task for 2016 is to better define what it means to be a functioning coastal prairie. However, limited data is 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 and few or none of the remaining coastal prairie remnants match Arana Gulch in these important characterstics. Arana Gulch experienced intensive cultivation in the past and cultivation has been identified as a factor that most strongly negatively affects native cover and species richness. 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.A trend of increasing native plant cover has yet to be detected, therefore, Objective 3A has not been met.

Objective 3E specifies an increase in bare ground to a level that enables SCT to complete their lifecycle by 2015. Across three years, the sampled coastal prairie vegetation at Arana Gulch was comprised almost exclusively of non-native species with high cover, tall canopy height, a large thatch accumulation, and almost no bare ground. The cattle were not on site soon enough to increase bare ground and influence germination of SCT. In October, the RDM levels were Above Target across a majority of the grazed Areas. A heavy thatch layer of tall grasses and wild radish was intact on large swaths of the ground and had not been broken up by hoof action. As a result, the amount of bare ground available that could facilitate germination of SCT during the coming winter and spring is less than desired. Thus, the site did not meet Objective 3E this year. The return of cattle to Arana Gulch in 2016 could increase the amount of bare ground to enable SCT germination and growth.

## 5.3 Proposed Actions for 2016

The following actions and expected timing are proposed for 2016:

- Continue the cattle grazing program, beginning in January 2016, with grazing extending to July 2016.

- Monitor grazing operation and implement the HMP-designated BMPs (see Section 3.5.6 in HMP and bullet list above) (January– July 2016).
- Refine delineated grassland area to be maintained; evaluate scrape plots in NE portion of grassland; mow or graze all delineated areas (May/June 2016).
- Continue to implement invasive plant species control as per the IWWP, focusing on removal/control of the following species:
    - Himalaya blackberry (*Rubus armeniacus)*
    - 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 2016).
- 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 2016).
- Document plant height three times a year: February, April, and August 2016
- Document RDM in September/October 2015.
- Finalize specific performance targets for percent cover of native species, nonnative species and bare ground, and species richness for coastal prairie that will be used to determine whether HMP objectives have been met. In the absence of acceptable data on reference coastal prairies, the AMWG may use these three years of baseline data and a first year of monitoring data under grazing in April, 2016 to begin refining the objectives under Goal 3.
- Document site conditions from the permanent photo-points.

**Table 3. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Interim Target Date | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|---|
| **Goal 1. Maintain a viable SCT population at Arana Gulch** | | | | | | |
| Objective 1A. Increase number of aboveground SCT to at least the 2006 level by 2015 (Note: 2006=348 plants in Area A) | # of above ground SCT plants | Yearly in Aug./Sept. | Increase | 2014 | 0 SCT | No, decrease from 4 plants in 2014 and 18 plants (54 flower heads) plants in 2013[15] |
| 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 | No SCT observed in any area | No, decrease from one patch in 2014 and two patches in 2013 |
| **Goal 2. Reintroduce grazing to restore a disturbance regime that maintains functioning coastal prairie** | | | | | | |
| Objective 2A. Implement the Grazing Program by 2014 | 2A.1 Observation of feed and water troughs | 3x during grazing | Stable | 2015 | City monitored water troughs in 2015 | Yes, recommendations to relocate one trough 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- | 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 | No, although some areas were at target; the majority of the SCT target area did not exhibit RDM levels within the desired |

[15] 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 until 2016.

**Table 3. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Interim Target Date | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|---|
| 1,500 lbs./acre) | | | | | | range |
| **Goal 3. Minimize detrimental effects of high non-native plant cover and restore coastal prairie species diversity and habitat function** | | | | | | |
| Objective 3A. Reduce canopy height during the basal rosette stage for SCT (Nov. – April) from the baseline level to 2-3 inches[16] by 2015 | Average canopy height | 3x during growing season | Reduction | 2015 | AMWG revised threshold for this objective to 2-3 inches. In April canopy height was visually estimated at 1 meter (3 feet). By September grass height was reduced to 3 inches after grazing[17] | No, cattle grazing reduced canopy height yet this occurred after the basal rosette stage |
| 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 | Cover by non-native species above objective With no significant change from 2013 or 2014 | No, cattle grazing was initiated in February 2015 to reduce cover of non-native species, yet no results detected to date |
| Objective 3C. Increase cover of native species from baseline levels to one more representative of a reference | Percent cover of native plants | Yearly at peak growth in April | Increase | 2020 | Cover of native species is <1%; reference systems have range of 20-40% cover as per Holl and Reed (2010), Hayes and Holl | No, cattle grazing was initiated in February 2015 to increase cover of native species, yet no results to date |

[16] AMWG reduced threshold from 0.5 m (1.6 feet) to 2-3 inches in January 2015
[17] The standard deviation was not calculated for the data; however, raw data is available if this calculation is needed in the future.

**Table 3. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Interim Target Date | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|---|
| functioning coastal prairie system by 2020. | | | | | (2003) | |
| Objective 3D. Increase native species richness from baseline levels to one more representative of a reference functioning coastal prairie system by 2020. | Native species richness | Yearly at peak growth in April | Increase | 2020 | Native species richness is 6 species (2013), 7 species (2014), and 10 species (2015); reference systems have range of 4 to 21 species as per Holl and Reed (2010), Hayes and Holl (2003) | Yes, meeting trend of increased native species richness; increase of three species from 2013 to 2015 |
| 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 is 15% (2013), 10% (2014), and 13% in 2015 | Yes, meeting trend of increased bare ground |
| | 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 | Yes, photo points were established approximately 8 weeks after the initiation of cattle grazing |
| **Goal 4. Maintain a genetically and demographically viable soil seed bank in perpetuity.** | | | | | | |
| Objective 4A. Increase the density of viable ray achenes | Seed bank density (#of viable ray | Yearly | Increase | 2015 | No viable seed in Areas B and C; viable seed found in | N/A, baseline determined in 2015 and will be |

**Table 3. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Interim Target Date | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|---|
| in the soil seed bank from baseline in the first 3 years and then assessed every 5 years. | achenes) | | | | Areas A and D | subsequently assesses every 5 years |

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

Activities within this management area were limited in 2015. This 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.

## 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. Six native California roses (*Rosa californica)* will be planted near the eastern bridge abutment in January 2016, as required in the CDFW-approved Revegetation Plan.

### 6.1.2 Integrated Pest Management (IPM)

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 in the IPM plan for the gulch when this plan is developed.

### 6.1.3 Fire Hazard

No management actions were implemented in 2015.

### 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 2015.

### 6.1.5 Appropriate Uses in Hagemann Gulch

No management actions were implemented in 2015. Rangers periodically patrolled open space activities in and around the bridge.

### 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 2015.

### 6.2.2 Monitoring Results

No monitoring results are available for 2015.

### 6.2.3 Evaluation of HMP Goals

**Table 4** presents a summary of the biological variables monitored, the Year 2 (2015) 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 will initiate this work in 2016 and will proceed as funding allows. Ivy growing below the bridge has been identified as a priority and removal will begin in 2016.

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 2016. This objective has not yet been met.

Protection of wildlife habitat features is a goal of the HMP (Goal 3). This goal and it associated objectives were met concurrent with construction of the trail and the bridge over Hagemann Gulch in 2014. Objective 3A requires the identification and protection of San Francisco dusky-footed woodrats with the bridge construction zone (within 25m of the bridge). No woodrat nests/houses were documented within the construction zone. No further action is required; however, the City will continue to search for nests when work is performed in the area. Objective 3B requires monitoring for sensitive bird and bat roots and/or nests occurring within 25m of the Hagemann Gulch bridge, with monitoring and protection of such resources for 3-5 years post-construction. The 2013 bat survey found that the trees in the area provide only foliage roosting habitat. No cavities or crevices were found

to support sensitive bat roosts. As the baseline is zero, no additional monitoring is required; however, the City could elect to monitor bat roosts to document if there is an increase in bat roosting after the trail and bridge project. Similarly, the 2014 nesting bird survey was negative for sensitive bird nesting. As the baseline is zero, no additional monitoring is required; however, the City could elect to monitor the area for sensitive bird nesting to document if there is an increase in such nesting after the trail and bridge project. These objectives are no longer applicable as part of the plan.

Goal 4 for this management area requires observing uses in Hagemann Gulch after trail and bridge construction and to determine if there are changes in use from site improvements. In 2015 City park rangers routinely patrolled the greenbelt to detect appropriate and inappropriate uses; other than off-leash dog use, no inappropriate uses were noted associated with the bridge. 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 2016

The following actions and expected timing are proposed for 2016:

- Monitor appropriate uses within Hagemann Gulch through periodic City ranger patrols (January– December 2016).
- Install six California rose (*Rosa californica)* as part of riparian revegetation plan (January 2016); maintain throughout year with weeding and supplemental irrigation; monitor plant survival (spring- summer 2016).
- Conduct mapping and initial weed eradication prioritization for the Arana Creek and Hagemann Gulch areas, in preparation for expansion of the Arana Gulch IWWP to include these areas.

**Table 4. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|
| **Goal 1. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in Hagemann Gulch** | | | | | |
| Objective 1A. Use a combination of methods to reduce the cover of non-native invasive woody plant thickets from baseline levels in the first year. | Non-native invasive woody plant cover | Before and after every removal effort | Decrease | Eucalyptus trees removed near western bridge abutment and along bridge sightline | Partial compliance; some eucalyptus trees removed but 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 |

**Table 4. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|
| **Goal 2. Reduce the fire hazard within Hagemann Gulch** | | | | | |
| Objective 2A. Reduce the cover of woody thickets as per Objective 1A to reduce overall fire risk. | Non-native invasive woody plant cover | Before and after every removal effort | Decrease | Eucalyptus trees removed near western bridge abutment and along bridge sightline | Partial compliance; some eucalyptus trees removed but large stands remain |
| 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 |
| **Goal 3. Protect wildlife habitat features in Hagemann Gulch** | | | | | |
| Objective 3A. The number of SF dusky-footed woodrat nests occurring within Hagemann Gulch bridge construction zone will be identified and the nests protected. | Number of SF dusky-footed woodrat nests within 25m of Hagemann Bridge construction zone | Yearly, if observed prior to construction. | Stable | None detected within construction area Hagemann Gulch bridge; unknown number within 25m of bridge | N/A. No nests were identified prior to construction |
| Objective 3B. Monitoring for sensitive bird and bat roosts and/or nests occurring within 25 m of the Hagemann Gulch bridge | Sensitive bird or bat detections within 25m of Hagemann | Yearly, if observed prior to construction. | Stable | None detected within 25m Hagemann Gulch | N/A. No nests were identified prior to construction |

**Table 4. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|
| construction zone will be identified and protected and continued for 3-5 years post-construction. | Bridge construction zone | | | bridge | |
| **Goal 4. Increase appropriate uses in Hagemann Gulch** | | | | | |
| Objective 4A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter. | Observation of infrastructure conditions | 4x per year | Stable | Stable | Park rangers and maintenance staff periodically inspected the area in 2015; Infrequent calls were received regarding graffiti and camping, primarily within close proximity to the bridge |
| **Goal 5. Preserve the "Rose of Castille" historic roses** | | | | | |
| Objective 5A. Relocation of the roses will occur only if no other alternative is feasible for development of the Hagemann Gulch Bridge. Any relocation will be done in the vicinity of the existing trees, in consultation with the City Arborist. | Presence of Rose of Castile | Yearly in June/July | Stable | Shrubs relocated to City Hall | Yes, roses were located to City Hall to ensure regular maintenance and care |
| Objective 5B. Address the public education benefits of identifying the Rose of Castille and providing interpretative panels. | Presence of Rose of Castile | Yearly in June/July | Stable | Decision was made. | Staff determined that identifying them would expose them to potential theft and vandalism. No additional action is |

**Table 4. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|
| | | | | | necessary. |

# 7. Habitat Management and Monitoring - Arana Gulch Creek Riparian Woodland and Wetland Management Area

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

### 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 2015.

### 7.1.3 Integrated Pest Management (IPM)

In October 2014, mapping of invasive weeds within this management area was initiated. Additional invasive weed mapping was conducted in 2015. Access is limited in several areas of the management area and future field surveys are needed to map occurrences in these areas, pending access. The mapping will be used to guide future management activities for species removal/ control.

The mapping in 2015 used visual searches from accessible locations within the management area to detect invasive, non-native plant species. Species documented were those identified as priority weeds by (Cal-IPC and/or the Bay Area Early Detection Network). 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 28**.

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 (*Cortederia jubata)*, cotoneaster (*Cotoneaster sp.*), Bermuda grass (*Cynodon dactylon*), eucalyptus (*Eucalyptus sp.)*, French broom(*Genista monspessulana*), English ivy (*Hedera helix*), velvet grass (*Holcus lanatus*), Himalayan blackberry (*Rubus armeniacus* ), thornless blackberry (*Rubus ulmifolius)*, spiderwort (*Tradescantia fluminensis)*, and periwinkle (*Vinca major)*.

**Figure 28A. 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 28B. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**

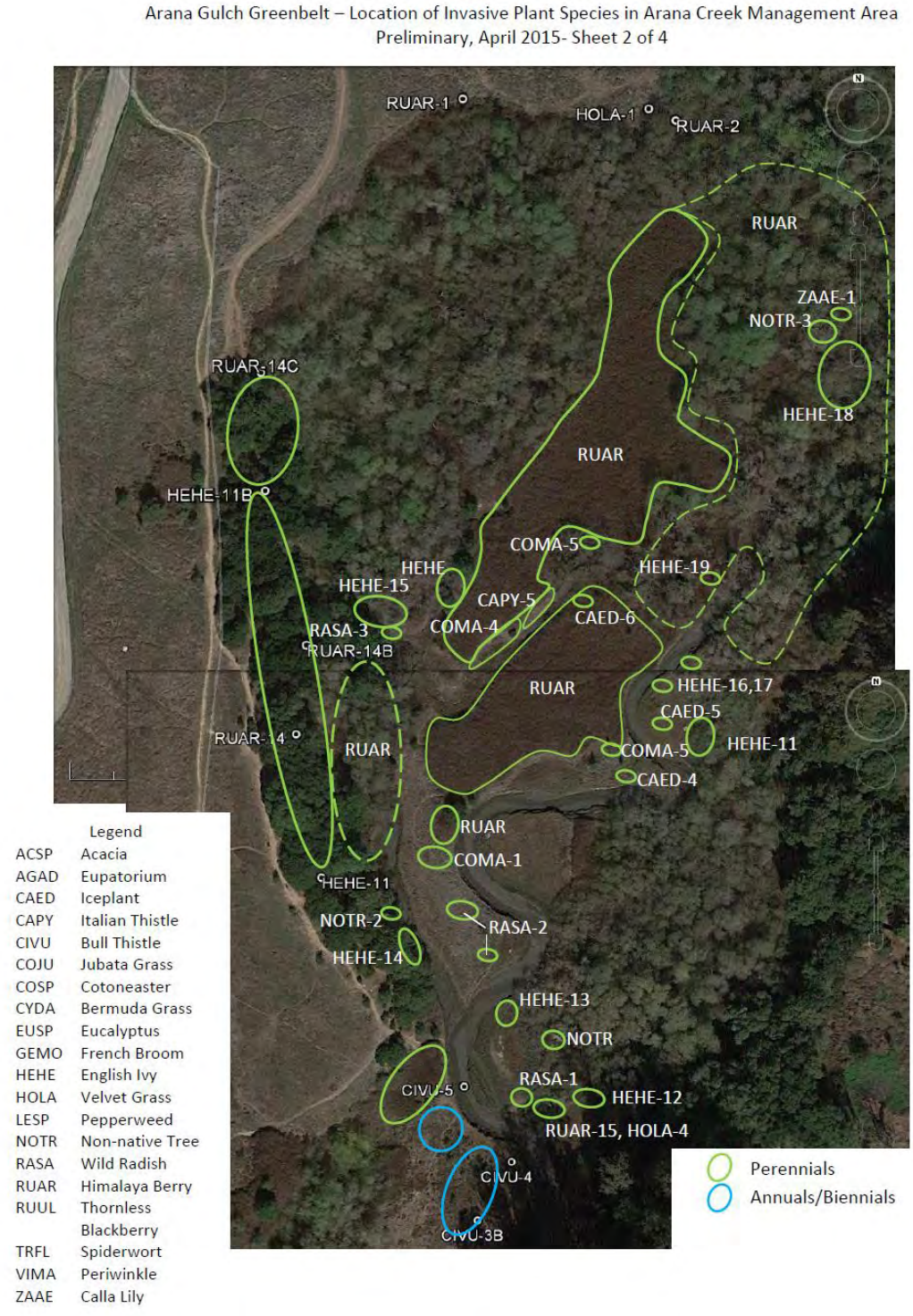
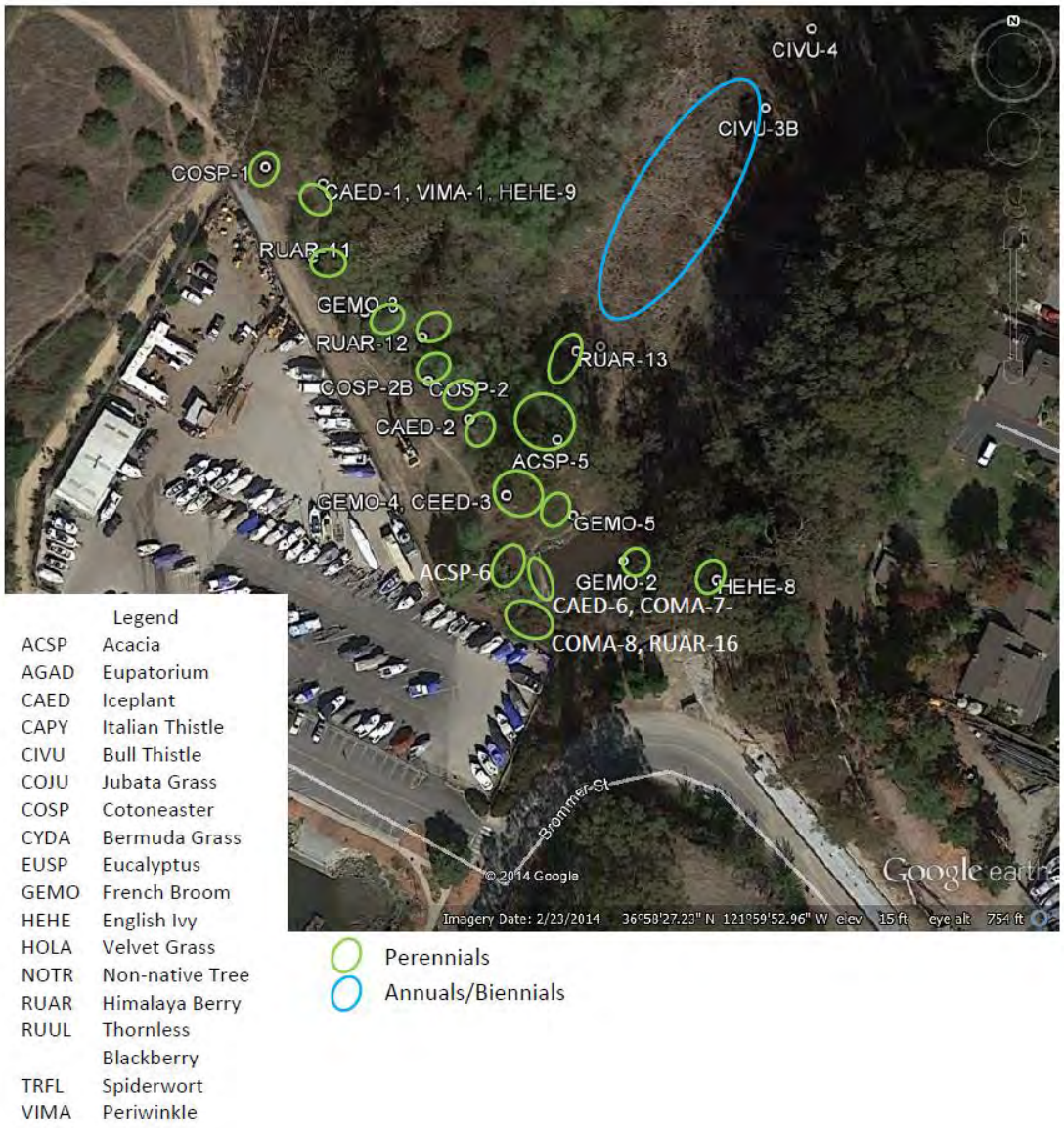
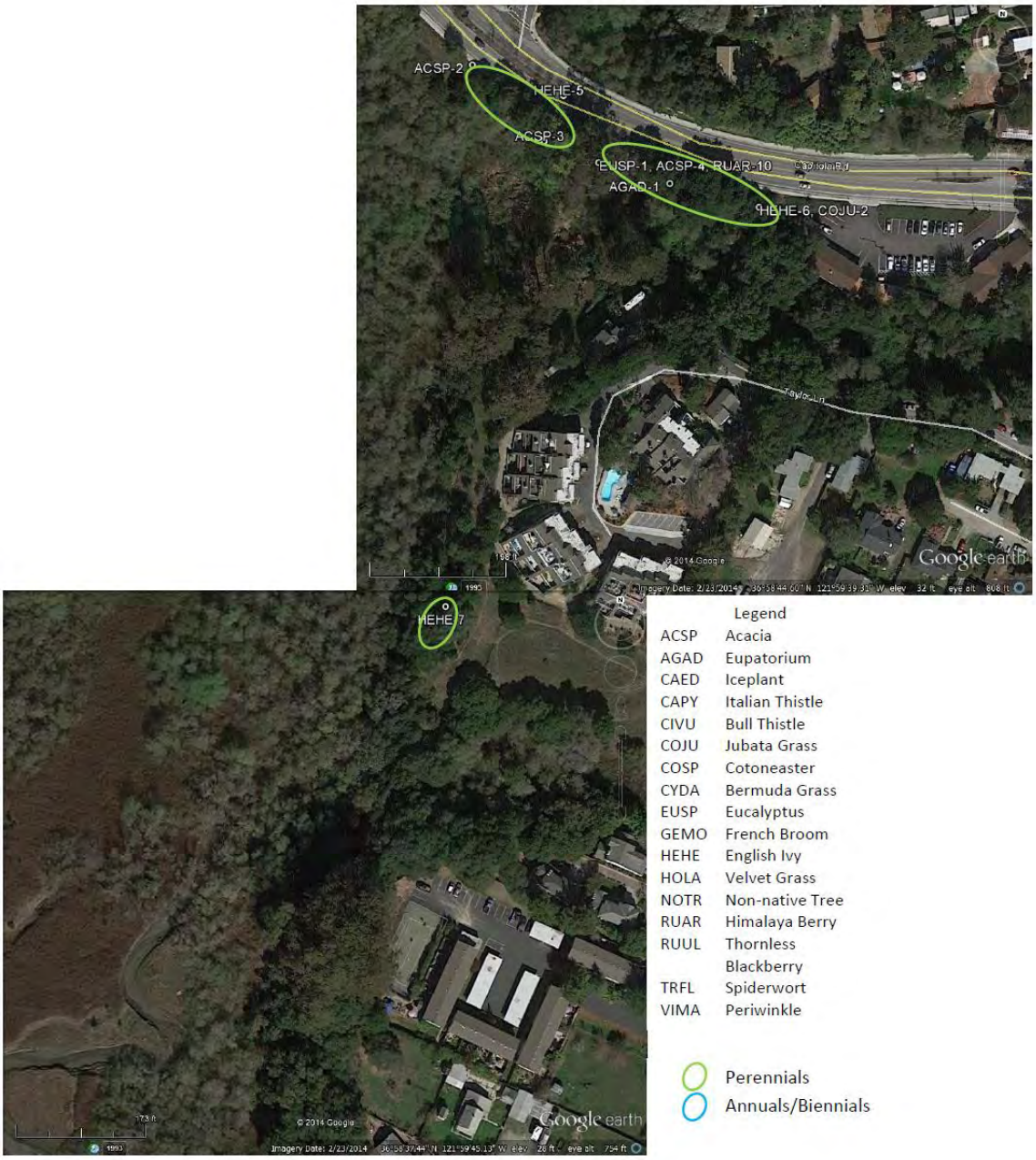


**Figure 28C. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**




Arana Gulch Greenbelt – Location of Invasive Plant Species in Arana Creek Management Area
Preliminary, April 2015- Sheet 3 of 4

**Figure 28D. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, April 2015**



#### 7.1.4 Coordination with the RCDSCC

The City coordinated with the RCDSCC in 2015 on measures to improve habitat conditions in the watershed. The RCDSCC was awarded a contract by the Santa Cruz Port District and the City to complete Arana Gulch Watershed Coordinator tasks. These tasks included:

- Convening a TAC and conducting stakeholder outreach to assess restoration priorities
- Prepared grant applications
- Conducted watershed reconnaissance surveys, and
- Conducted outreach and community activities.

In 2014/2015, the RCDSCC convened a TAC meeting that included a discussion of watershed issues that have the potential to deliver significant amounts of new sediment to the harbor (two gullies in upper watershed). The TAC also found that Arana Gulch is not currently considered a high priority stream for salmonid recovery, which reduces potential grant funding sources. The watershed may provide groundwater recharge opportunities and the RCDSCC is pursuing studies on this. A reconnaissance of the Arana Gulch watershed, comparing existing conditions to the 2002 Arana Gulch Enhancement Plan is scheduled for 2016. The results of that study will be summarized in the 2016 annual report. The RCDSCC attended the April 2015 AMWG meeting and presented a summary of activities completed in the watershed in 2014/15. A summary of activities completed by the RCDSCC in 2014/15 is presented in **Appendix D**.

### 7.2 Monitoring and Performance Evaluation

#### 7.2.1 Monitoring Methods

The riparian revegetation areas were monitored in November 2015. 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 November 2015 monitoring found a dense cover of hydroseeded barley on the slope; plant cover was dominated by the seeding barley and naturally-establishing blackberry was also present. At the toe of the slope the willow cuttings exhibited a 15% survival rate. Plant cover within the revegetation area was recorded at is 95%, provided by willow (*Salix lasiolepis)* (20%), Himalaya berry (*Rubus ameniacus)* (25%), grasses and forbs (50%) (see **Table 5**). This area does not meet the required 80% native woody cover required by CDFW.

Within Area B, 40 creeping wild rye (*Elymus triticoides)* were planted. At the November monitoring plant cover was recorded at 80%, with cover provided by willow (*Salix lasiolepis)*

(10%), Himalaya berry (*Rubus ameniacus)* (5%), creeping wild rye (*Elymus triticoides)* (70%), and ryegrass (*Lolium multiflorum)* (15%). This area meets the required 80% native cover required by CDFW. Within Area C, 40 creeping wild rye (*Elymus triticoides)* 16 California rose (*Rosa californica)*, 16 mugwort (*Artemisia douglasiana),* and 3 coast live oak (*Quercus agrifolia)* were planted. At the November monitoring plant cover was recorded at 80%, with cover provided by California rose (*Rosa californica)* (3%), mugwort (*Artemisia douglasiana)* (2%), creeping wild rye (*Elymus triticoides)* (20%), and non-native grasses and forbs (60%). These data is depicted on **Figure 5**. This area does not meet the required 80% native cover required by CDFW. Additional plantings and maintenance are planned for 2016.

**Table 5. Monitoring Results from Riparian Revegetation Area, Arana Creek**

| Species | Plant Survival | Plant Cover |
|---|---|---|
| **Area A** | | |
| Willow | 15% | 25% |
| Himalaya Blackberry | - | 25 |
| Grasses and Forbs | - | 50 |
| **Area B** | | |
| Willow | - | 10% |
| Himalaya Blackberry | - | 5% |
| Creeping Wild Rye | - | 70% |
| Ryegrass | - | 15% |
| **Area C** | | |
| Creeping Wild Rye | - | 20% |
| California Rose | - | 3% |
| Mugwort | - | 2% |
| Grasses and Forbs | | 60% |

### 7.2.3 Evaluation of HMP Goals

**Table 6** presents a summary of the biological variables monitored, the Year 2(2015) 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 2015 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 2016

The following actions and expected timing are proposed for 2015:

- Continue to engage with the RCDSCC on watershed and greenbelt projects through annual meeting with the RCDSCC. (January– December 2016).
- In January 2016, install replacement plantings within riparian revegetation Areas A and C near the trail and causeway, consisting of additional creeping wild rye (*Elymus triticoides)*, California rose (*Rosa californica)*, mugwort (*Artemisia douglasiana),* and coast live oak (*Quercus agrifolia)* to achieve additional native plant cover as per the riparian revegetation plan; maintain throughout year with weeding and supplemental irrigation; monitor plant survival (summer/fall 2016).
- Confer with the AMWG of prioritizing removal and control of invasive, non-native plant species within the management area.

**Table 6. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|
| **Goal 1. Reduce sedimentation and improve steelhead habitat conditions within the Arana Creek watershed** | | | | | |
| Objective 1A. High priority sediment-related projects identified in the Arana Creek watershed enhancement plan area implemented. | # of completed sediment-related projects with the RCDSCC | Yearly | Increase | 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 |
| **Goal 2. Stabilize the tidal reach of Arana Gulch Creek** | | | | | |
| Objective 2A. Engage the RCDSCC Arana Gulch Working Group staff to attend targeted AMWG meetings to identify possible solutions for the tidal reach of Arana Gulch Creek. | RCDSCC attendance at AMWG meetings | Yearly | Increase | City has engaged with RCDSCC | Yes. City will continue to coordinate with RCDSCC in 2016 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 6. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area**

| Objective | Variable | Measurement Frequency | Desired Direction of Change | Year 2 (2015) Results | Objective Met? |
|---|---|---|---|---|---|
| **Goal 3. Restore the eroded Greenbelt Gully** | | | | | |
| Objective 3A. Work with the RCDSCC staff to pursue funding for the Greenbelt Gully restoration project. | Funding level for the Greenbelt Gully project | Yearly | Obtain/increase | Funding provided to RCD to seek grant funding and help prioritize projects. | No |
| **Goal 4. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of non-native species in the Arana Gulch Creek Management Area** | | | | | |
| Objective 4A. Remove and reduce the cover of non-native invasive species in the riparian woodland relative to baseline conditions including: black acacia found near the culverts, dense thickets of Himalayan berry, scattered French broom, tall white top, and periwinkle. | Non-native invasive woody plant cover | Yearly | Decrease | Initiated mapping of invasive plants in October 2014 | No, but initiated mapping of invasive, non-native plant species |
| **Goal 5. Provide education opportunities and increase appropriate uses** | | | | | |
| Objective 5A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter. | Observation of infrastructure conditions | 4x per year | Stable | Conditions were monitored. | First year of monitoring was 2015 |

# 8. Conclusions from Year 2 and Recommendations for Year 3 (2016)

## 8.1 Conclusions from 2015

The City continued its initiation of the HMP in 2015 (Year 2). Many of the management actions in this first 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 2015 as management actions and monitoring protocols were decided upon. The City communicated with users of the greenbelt on the cattle-grazing and provided a ranger patrols to encourage/enforce regulations and deter vandalism.

### 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 June. Implementing cattle grazing is in compliance with the HMP. 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 was conducted in March and May. 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 2015; no above-ground plants were documented from the greenbelt. The HMP objective of reaching 348 plants was not met in 2015. A soil seed bank assessment report was completed in winter 2015; results indicate the seed bank has been lying dormant and aging for several years and seed bank density has declined since 1999. Volunteers hand raked cut biomass and thatch from Tarplant Area B.

### 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 2015. Components of an IPM plan were conducted for the Arana Creek area through the identification and mapping of invasive, non-native plant species, in compliance with the HMP, yet objectives for removal and control have not yet been met. 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 2015 through three meetings as well as email correspondence. The City received input from the AMWG on management actions and implemented the requested management actions. Consultation with the AMWG in 2015 was done in compliance with the HMP. 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, 2015 to June 30, 2016 ($50,000, excluding personnel time and costs). The City has established a maintenance position for the greenbelt, effective in January 2016. Establishing funding for management actions is in compliance with the HMP.

### 8.2 Recommendations for 2016

The City will discuss with the AMWG recommendations for management actions for 2016 at the January 2016 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 2016 (Year 3) 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 also 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 2016. 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 2016 (Year 3) 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 occur in January 2016. Plantings will be maintained and monitored throughout 2016 as per the SAA.

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

HMP activities identified for 2016 (Year 3) 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. Replacement riparian revegetation as per an approved CDFW Streambed Alteration Agreement (SAA) will occur in January 2016 such that plant cover standards are achieved for the revegetation areas. Plantings will be maintained and monitored throughout 2016 as per the SAA.

### 8.2.4 AMWG and Public Outreach

In 2016 the City will continue to confer with the AMWG on adaptive habitat management activities throughout the year through scheduled meetings and group email correspondence. The AMWG will provide recommendations to the City on management priorities, grazing monitoring and public outreach. The City will solicit input from the public on HMP actions through the City webpage and through public input at the scheduled AMWG meetings.

### 8.2.5 Schedule and Budgeting

**Table 7** presents a schedule for the HMP actions scheduled for 2016. The City has allocated funds for fiscal year July 1, 2015 to June 30, 2016 ($50,000, excluding personnel allocations); funding for fiscal year July 1, 2016 to June 30, 2017 has yet to be determined.

**Table 7. Timeline for Habitat Management Actions Proposed for Year 3 (2016)**

| | 2016 | | | | | | | | | | | | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Task** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** |
| **Coastal Prairie/Santa Cruz Tarplant Management** | | | | | | | | | | | | | |
| Objective1. Santa Cruz tarplant census | | | | | | | | | | | | | |
| Objective 2. Monitor grazing program and variables | | | | | | | | | | | | | |
| Objective 3. Monitor baseline condition and photo points | | | | | | | | | | | | | |
| **Hagemann Gulch Riparian Woodland Management** | | | | | | | | | | | | | |
| Objectives 1 and 2. Implement IPM Plan and reduce fire hazard | | | | | | | | | | | | | |
| Objectives 3 and 4. Document wildlife habitat features and implement infrastructure monitoring[18] | | | | | | | | | | | | | |
| Objective 5A and 5B. Monitor survival of Rose of Castille shrubs | | | | | | | | | | | | | |
| **Arana Gulch Creek Riparian Woodland and Wetland Management** | | | | | | | | | | | | | |
| Objectives 1, 2, and 3. Collaborate with RCDSCC | | | | | | | | | | | | | |
| Objective 4. Implement removal/control of invasive non-native woody plant species and | | | | | | | | | | | | | |

[18] Includes completion of riparian revegetation at bridge and implementing year-long maintenance and monitoring.

**Table 7. Timeline for Habitat Management Actions Proposed for Year 3 (2016)**

| | 2016 | | | | | | | | | | | | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Task** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** |
| target weeds | | | | | | | | | | | | | |
| Objective 5. Infrastructure monitoring[19] | | | | | | | | | | | | | |
| **Adaptive Management** | | | | | | | | | | | | | |
| Objective 1. Conduct AMWG meetings | | | | | | | | | | | | | |
| Prepare Yearly Monitoring Report | | | | | | | | | | | | | |

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

# 9. References

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Stanton, Alison. 2014a. Arana Gulch Coastal Prairie Baseline Assessment Study: Summer 2013. Prepared for the City of Santa Cruz Planning Department, Department of Parks and Recreation, and the Arana Gulch Adaptive Management Working Group. January 2014.

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# Appendix A AMWG Meeting Minutes, 2015

A-1: AMWG Meeting Minutes for:
January 28, 2015
April 15, 2015
November 10, 2015

# Minutes

## Arana Gulch Adaptive Management Working Group Meeting

Planning Conference Room 809 Center Street, Room 107 Center Street Santa Cruz, CA

## 9-4 pm January 28, 2015

**Participants:**
Kate Huckelbridge, Ecologist, CA Coastal Commission
Tim Hyland, Ecologist, CA State Parks
Kathy Lyons, Biotic Resources Group
Suzanne Schettler (CNPS alternate)
Susan Bainbridge, Researcher, University and Jepson Herbarium
Lena Chang, USFWS
Sheila Barry, UC Cooperative Extension Range Specialist
Alison Stanton, Research Botanist, Facilitator
Noah Downing, Planner, City of Santa Cruz Dept of Parks and Recreation
Mike Ferry, Planner, City of Santa Cruz Dept of Planning and Community Development
Mauro Garcia, Parks Superintendent, City of Santa Cruz

ABSENT:
Grey Hayes, CNPS
Melissa Farinha, Biologist, CDFW

OBSERVERS: Jean Brocklebank and Michael Lewis, FOAG; Richard Stover, Debbie Bulger CNPS, Paul Schoellhamer

## SUMMARY OF ACTION ITEMS

1. New quorum was adopted (5 of 11 members).
2. CCC- Kate will renew search for a wildlife biologist and request info on candidates via email. Suzanne has a potential candidate
3. The group will schedule a meeting in April to finalize the grassland delineation. Before meeting Suzanne agreed to visit the UCSC library/USGS website to obtain old images of Arana. LIDAR data needs processing
4. Kathy will continue weed mapping according to AMWG recommendations
5. Alison will conduct April vegetation monitoring
6. The City will implement a mowing recommendation and document the number of times the site gets mowed
    - Mow the 7-8 foot spaces between the paths and the fences to a 4inch height, “as needed”, from now until the April meeting. Arana is first site in the daily schedule, so that the equipment is clean.

7. Action items for gathering data on reference prairies:
   - Sue/Lena will look for data availability for tarplant hill
   - Debbie Bulger offered to get the CNPS plant list for Arana
   - Alison will digest the data from the YLR study.
   - Kate will look into the compliance issue of establishing grazing enclosures.
8. The grazing will begin when there has been one more inch of rain/more grass growth.
9. Tommy Williams is working with Grey to hold a neighborhood meeting on Feb 7th.
10. The City will issue a press release after the cattle settle into the site.
11. Alison will incorporate comments from today and send a paragraph on grazing for quick AMWG review before it is posted on the website.
12. Agendas will be sent to AMWG 3 weeks in advance and posted on website 1 wk before meetings.
13. The City will implement the following during FY2016
    - CCC Annual Reporting
    - Vegetation monitoring
    - AMWG facilitation
    - Woody plant removal
    - Weed control
    - Grazing program
    - Fuel break and other mowing

**Agenda item detail**

**1. Quorum and decision-making rules**

Sheila Barry has joined the group as a t4echnical advisor but Devii Rao will take over in March. As of the January 28 2015 meeting there are now 11 members, but one previously voting member (Kathy Lyons) has withdrawn from voting. The group first clarified that in practice there are only 5 voting members: Kate from CCC, and the 4 technical advisors. Lena and Melissa will generally not vote.

The group adopted the following new quorum by unanimous vote:

A quorum is 5 of 11 members including

- 1 of 3 regulatory agencies: Kate for CCC, Lena for USFWS, and/or Melissa for CDFW,
- 2 of 4 technical advisors: Sue, Tim, Grey or Suzanne for CNPS, Sheila/Devii
- 2 of 4 non-voting members: One from City and Alison as Facilitator

The decision making process remains informal consensus. If consensus cannot be reached support from 3 of 5 voting members will be sufficient to decide any issues. As previously adopted, every effort will be made to obtain advance input from all members via email on any issues requiring a decision on a recommendation. If this approach leads to conflict or inaction then it can be modified within the group, as necessary, without CCC Exec Director approval.

**2. CCC Business**

Kate reported on the status of the Year One Annual Report. She is working with the City to agree on how to best incorporate AMWG comments. Once the City has completed a new draft, Kate will review again and determine if additional AMWG review is needed. A specific timeline has not been set.

Kate will renew search for a wildlife biologist and request info on candidates via email. Suzanne has a good candidate and will inquire about willingness to participate before she forwards the contact info.

3. **Prioritize goals of the HMP**

The AMWG completed a group exercise to develop a broad prioritization of the existing HMP goals for all 3 management areas. The objective was not to revise any goals or to develop a specific management recommendation, only to get a sense of where the entire group would like to focus through FY2016. First, we learned that the Santa Cruz County Resource Conservation District (RCDSCC) are actively pursuing funding for restoration projects in the tidal reach and the eroded gully. For now, we agreed to define the 2 goals to "engage" the RCDSCC as having a representative come to an AMWG meeting each year to provide us with an annual update on their activities. Since these goals could be addressed with ~~are now~~ an action item to issue an invitation, we removed them from the ranking process, leaving 11 goals to prioritize.

We discussed how the goals to increase appropriate use in the park had largely been met by the completion of the project itself. Additionally, the City intends to partner with the Natural History Museum to lead tours or conduct other educational programs. Alison also reminded the group that some of these goals are very specific to required mitigation i.e. the wildlife objectives for Hagemann Gulch. ~~and all agreed that we would need to re-visit the goals at an appropriate time.~~ During the exercise, the group agreed that the goals for Arana Creek and Hagemann Gulch need to be revised at an appropriate time.

When people were done, we took an informal hand vote. All but one person raised their hands in response to "Were your top 3 goals in the Coastal prairie"? There was some discussion about how people prioritized. A total of 9 worksheets were submitted anonymously at the end of the

meeting. The goals are listed below by priority (1st to 11th) along with the number of votes cast for that goal to be ranked at that rank OR HIGHER. Therefore, the priority of each goal reflects majority opinion (at least 5 of 9 votes).

1) Increase SCT population size 7 votes
2) Restore disturbance regime with grazing 6 votes
3) Reduce non-native species in Coastal prairie 6 votes
4) Increase seedbank 5 votes

5/6th tie

Reduce sedimentation and improve steelhead habitat on the property 6 votes
Control non-native understory in riparian area 6 votes

7) Reduce non-native understory in Hagemann 6 votes

8/9th tie

Maintain SF dusky woodrat nests and sensitive bird and bat nesting features 7 votes
Provide educational opportunities and increase appropriate uses in riparian area 7 votes

10) Reduce fire hazard in Hagemann 6 votes
11) Increase appropriate use in Hagemann 9 votes

The informal process revealed that i~~I~~ncreasing the SCT population and restoring the coastal prairie are the top priority of the AMWG for the next year and a half. The next priorities lie in addressing sedimentation and invasive plants in the Arana Creek riparian zone. Kate mentioned that even though these areas are lower priority, there still may be activities we want to pursue towards achieving these goals in the near future. For instance, the weed removal recommendation for spring 2015 may include some species in the riparian area. The group also agreed in the discussion that educational outreach on management for Arana as a whole is a high priority which is not an existing goal. Hagemann Gulch is clearly the lowest priority for now. Tim stated that he thought the fire hazard there is very low and the goal to increase appropriate use needs clarification so quite a few people said that it was easy to place these as 10 and 11th.

4. **The City will implement these AMWG recommendations for grassland management in 2015**

- Alison will conduct April vegetation monitoring
- The group wants to schedule a meeting in April to finalize the grassland delineation prior to woody plant removal in late-April, May
- Kathy will continue weed mapping according to AMWG recommendations
- Weed removal after April meeting
- Grazing will begin ( see item 8)
- Mowing will occur (see item 6)

Most of the items were mentioned only as updates. The group agreed to provide guidance on mowing after public comment.

**5. Public Comments**

Five members of the public offered comments. These are summarized below. Most of the audience left after the break and the AMWG agreed that having public comment early in the meeting worked really well. During the break there was an opportunity for members to directly interact with the public and address specific concerns. The AMWG also agreed that we want members of the public to feel heard and that taking comment early in the meeting and then having a break facilitated that process.

- How will the City fulfill other elements of the Master Plan? Is there going to be continued construction?
- There needs to be more education on Himalaya berry.
- The first interpretative sign near Agnes St has been perceived as racist by one person because the native people are not fully formed and lack faces while the current users were white and have full facial features.
- The Watsonville airport mowing regime of mowing weekly or bi-weekly for 6 weeks in mid-April through May results in millions of SCT in many years. The plants are most dense on the edges of the runways and in areas with the greatest amount of disturbance. It should be possible to test this at Arana with an experimental approach.
- There is a need for baseline data for Hagemann Gulch and Arana Creek.
- It would be a good idea to fence off the SCT within the grazed area.
- The AMWG needs a wildlife biologist (also an avian ecologist and an entomologist) to join the group.
- Cape ivy needs attention.
- Erosion on the hillside between the Coastal Prairie Loop trail and Arana Creek from vistors using ad-hoc trails is going to continue- is it possible to close them?
- People have started walking the fence lines in the prairie. And several fences have been cut.
- Hand mowing will be required along the fences to get underneath and in areas the machines can't reach.
- The soil at the western intersection was profoundly disturbed and offers an opportunity to observe primary succession.

**Break 10:30 -10:45**

**10:45- 12:00**

**Response to public comment**

Mauro explained that it is difficult to close-off trails connecting the loop trail to Arana Creek because the community members will continue to use them and blocking them may lead to additional issues. The AMWG said that they should discuss solutions to the erosion concerns onsite during the April meeting.

Mowing was discussed later in the agenda.

6. **Clarify HMP grassland Goals and Objectives (part 2) 55 min**

The AMWG began the discussion on the goals and objectives for the grassland by returning to the issue of the delineation. The AMWG then wanted to address mowing that could occur before the April meeting.

**Grassland delineation**

Tim said that the problematic sections were in the south where large oaks had died and now it is no longer grassland and in the NE corner. These are the areas where the AMWG can focus in the April site visit. Tim and Noah showed the group a map of what has already been delineated on 2005 NAIP imagery which was the oldest available (need to send map to AMWG).Several said they would like to see the grazing fences on this map and all agreed it would be good to obtain even older images of the site from the UCSC library. Suzanne agreed to visit the library. LIDAR data exists for the site and might be very useful if it was processed. This should be able to be done by city GIS staff.

**Spring 2015 mowing**

Mauro told us that there is a City crew that mows parks every week and he can easily assign them to mow Arana with any frequency we specify. The group developed the following recommendation for mowing:

- Mow the 7-8 foot spaces between the paths and the fences - keep low to prevent invasives
- Rest of site - Mow to a 4inch height, “as needed”, from now until the April meeting
- Arana should be the first site mowed at the beginning of the day when the equipment is clean
- Document the number of times the site gets mowed
- The date of the first mow is not critical, but the last mow needs to coincide with the end of the annual grass growing season to be most effective in reducing seed set.

- Most native plants and especially any SCT that might germinate will be less than 4 inches and will not be harmed by the mowing. However, some native species ( e.g annual lupinus) will be >4" if they recruit.

**Coastal Prairie Goals and Objectives**

The following questions included in the agenda came out of the review of the HMP annual report.

- What is the target cover of a reference coastal prairie system?
- What is the appropriate species richness of a functioning coastal prairie system?
- Which management actions will increase the density of viable ray achenes in the soil seedbank?

The outstanding need in the objectives is to identify appropriate references coastal prairie sites for Arana Gulch. We need to begin the process of determining targets for the variables covered by the objectives under Goal 3: canopy height, % cover of native species, specie richness, and % bare ground and also for RDM.

A canopy height of 0.5m is way too high. Target is 2-3 inches.

RDM of 1,200 lbs is way too high. Target is 500-650lbs/acre.

Is there a site on the first terrace that is similar and can we monitor it in the same year? Could we get trend lines on %cover of native species and species richness values? Monitoring does not need to be annual.

Suzanne said that she had conferred with Grey about reference sites and he offered 3 sites as potential references:

- Porterville ranch- grazed
- Pt Lobos- not grazed but burned
- Whitehouse Cyn in Ano Nuevo

Moore Creek was also offered, it is being monitored for Ohlone Tiger beetle and has both grazed and ungrazed areas, but it is on the 2$^{nd}$ and even 3$^{rd}$ terrace.

Tarplant Hill is also a very degraded site like Arana. The group Watsonville Wetlands Watch has conducted some mowing and scraping and observed SCT in response. The site has been managed for 6-7 years and we need to get data if there is any.

Sheila described that a small section of coastal prairie at Arana Gulch could be sectioned-off and retained as a no-management comparison. Many in the group thought that this would be a good option. Kate noted that this approach may be problematic with respect to permit compliance. The HMP requires Arana to meet targets/goals that are similar to an appropriate reference site. Terrace Point, the addition to the Younger Lagoon Reserve might also be a good site. The AMWG wants to use the same process as the YLR Scientific Advisory Committee to use our expert opinion to arrive at the target values for Arana for the metrics already mentioned. To do this we need some data.

Action items for gathering data on reference prairies:

- Sue/Lena will look for data availability for tarplant hill
- Get the plant list for Arana from the EIR- Alison has it
- Debbie Bulger offered to get the CNPS plant list for Arana
- Alison will digest the data from the YLR study. It is referenced in the HMP but not at the level of detail that we need.
- Kate will look into the compliance issue of establishing some grazing enclosures as a reference " no management zone". If it is possible to have no management as an interim reference, then we could compare progress with grazing while we work on developing more specific metrics.

7. **Grassland monitoring 20min**

Vegetation transects and photo points- How do we effectively monitor to meet the goals and objectives?

- How often to measure canopy height and who will do it? – It needs to be measured monthly from Nov-May. We can train City staff on the paper plate method and specify a sample size.
- RDM methodology- Sheila has the most experience with this and will confer with Alison. Permanent monitoring points are not necessary. The data is best represented as a color map, i.e. green polygons are meeting the target RDM and red ones are not.
- Photopoint placement-Sheila also has the most experience with this and will advise Alison. Alison will go to Arana tomorrow and at least get photos in areas that could get mowed before April.

12-12:30 lunch

**12:30-2:00**

8. **Grazing program:** 60min

Noah introduced Tommy Williams and each member introduced themselves. Members asked many questions in the discussion. We learned the following about the initial grazing strategy:

- Water lines need to be pressure tested before everything is connected. System should be ready in one to two weeks.
- The curb on Agnes St near the entrance to the corral will be rolled and painted red. Tommy will back his rig (20 ft truck with 30ft trailer) over the curb to offload the cattle.
- Cattle will remain in the grazing area near Agnes Street for 2 to 3 days to settle before moving to Area A.
- Cattle will be 5 Black Angus weighing 500-650 lbs each, marked with a large tag in right ear.
- Cows with calves weigh 1200 -1400 lbs and are very protective of the babies and need large quantities of forage or supplemental hay so Tommy does not want to use them for now.
- Tommy has been working the 5 animals with dogs to get them used to dog interactions. He does herd with dogs so more dog-trained cattle are available if we need to increase the number of cattle on site in the future.
- Ideally we wait until there is another inch of rain and more grass growth before the start of grazing. That way Tommy can avoid bringing the cattle in and out if there is not enough to eat.
- The fence between area C and D will be open by default and only closed if needed to prevent negative impacts under very wet conditions.
- Heavy rains in February and March would not trigger automatic removal of the cattle. Everyone agreed that lots of rain would be great!

The AMWG wanted Tommy to know that we are in no way wanting to micro-manage his operation and we all want to make sure that his operation is viable. Our management objectives are: plant height of 2-3 inches, RDM of 500-650lbs, and an increase in bare ground. Cows could be removed in May or June before SCT boltsThere was also a lot of discussion about the use of supplemental feed. If it is dispersed then it has no noticeable impact. If concentrated it can be used as a way to get bare ground. It can also be used to target weeds, but with limited results. For instance, cattle will only eat thistles from the root up once they are dead and knocked down so we cannot expect them to control the infestation of the Italian thistle in the north part of Area C. Likely, no supplemental feed will be needed until the end of the grazing period, but it totally depends on the weather.

Mauro shared with the group that the fences had already been cut several times. They have been quickly repaired. We can only speculate about whether the fences will get cut when the cows are inside. Obviously, it will be a big problem if the cows are getting out 3 times a week.

Alison cautioned the group about spending too much time addressing a contingency. She has installed several fences on the beaches of Lake Tahoe and expected them to be vandalized and they were not. The process at Arana is in place to contact Tommy if the cows do get out. Tommy is willing to deal with it if it happens occasionally, and if it does become a problem, the AMWG will re-visit the subject.

**Break 2:00-2:15**

**2:15-4:00**

9. **Communications with the public** 30 min

**Community outreach over grazing**

The signs on cattle/dog/human interaction are at the printer. Several members pointed out that the animal on the sign is a dairy cow and that sends an inaccurate message. Noah described that the dairy cow was selected as a tribute to the history of the dairy farm which used to be at Arana Gulch and described conversations with members of the public who remember visiting the dairy cows there during their childhood. We discussed that we need to get better information on the website about the purpose of grazing. The public does not generally understand how disturbance can benefit native plants due to messages in the public conscious like “take only photos. Leave only footprints”. Grazing also has a negative image from the “old days” when over-grazing was more common.

The City has implemented several community outreach measures regarding the cattle grazing:

- the brochure was mailed to surrounding property owners
- the brochure was emailed to a citywide Arana Gulch distribution list,
- the grazing was announced to 450 attendees at the ribbon cutting ceremony and staff distributed the brochure at the event
- the brochure is available onsite and on the AMWG webpage.
- Tommy mentioned that he was working with Grey to hold a neighborhood meeting on the 7$^{th}$.
- a press release will be planned for after the cattle settle-in to the site.

**Action item:** Alison has already written a paragraph on grazing and will incorporate comments from today and send that out for a quick AMWG review.

**Arana Gulch webpage- updates and recent comments from website/email for AMWG**

The City’s standard procedure is to respond to comments from the website or email and only solicit AMWG response if needed for a technical reason. Two comments were discussed. One

commenter offered to help plant the sides of the trails with “wildflowers”. The AMWG agreed this is not a good idea. The other comments centered on how people and bikes are now compressed on one trail. Mauro said he is working on getting clearer signs and will monitor the situation.

**Agenda development and posting**

Alison proposed a 4,3,2,1 strategy and the AMWG accepted.

- 4 weeks before a meeting, Alison will confer with City on agenda items
- At 3 weeks, the AMWG receives a draft agenda
- At 2 weeks comments are due to Alison. She will re-confer with the City
- One week before a meeting, the final agenda is sent to the AMWG and posted on the webpage.

10. **Looking ahead to FY 2016:** 45 min

The City has agreed to implement the following over the next year and a half.

- CCC Annual Reporting
- Vegetation monitoring
- AMWG facilitation
- Woody plant removal
- Weed control
- Grazing program
- Fuel break and other mowing

Several AGWG technical advisors indicated ballpark information about the cost of management and the budget is useful for understanding limits and prioritizing tasks. Alison explained that the AMWG is expecting a process where Mauro gives us a dollar amount to work with and we develop recommendations for how to best use the funds. However, the funding comes from multiple funding streams which are decided upon through the budget process. While Mauro has dollar amounts specified for most of the above items, they are not necessarily line items and are instead embedded within a large budget package that he will take forward to the City Manager and Finance Director within the next two weeks. With the completion of the project, the status of Arana Gulch has changed within the budget framework. In addition to habitat management actions, additional staff time and maintenance will need to be funded to maintain park.

Kate re-iterated that it is not within the purview of the AMWG to ask for detailed accounting and review the City budgeting process. As an advisory group, we make recommendations on

management actions for Arana Gulch and assign priorities to those actions. If the City runs out of funding, the lower priority actions may be delayed. Mauro assured the AMWG that all of the items listed above will be funded in FY2016 and additional items could be added if necessary.

**11. Time of learning** 15 min

- What went wrong with the Area C soil salvage and how can we improve outcomes of recommended management actions?

At the July 16, 2014 meeting Mauro explained that when the contractor was asked in the field to implement the AMWG recommendation to "thinly spread" the top 6 inches of soil by hand the contractor demanded a contract amendment. The City was not willing to do that and so instead the decision was made in the field to proceed with spreading the soil with a skip loader. Kathy's measurements of the soil revealed that it varied from 1.5 to 6 inches deep. To improve the outcome, the recommendation could have been more specific. Kathy was not at the March meeting and "Thinly spread" could have been stated as "one inch deep or less" to give her numeric guidance.

Several members stressed that the minutes are very important for communicating recommendations and for annual reporting. All agreed that members are obliged to closely review the minutes for accuracy and specificity and this will help ensure better management outcomes.

12. **Debriefing of objectives and outcomes and timing for next AMWG meeting-** Please see action items.

Adjourn meeting at 3:45

# Minutes
# Arana Gulch Adaptive Management Working Group Meeting
Fredrick Street/Broadway Avenue Park Entrance to Arana Gulch
## 9-4 pm April 15, 2015

**PARTICIPANTS:**
Kate Huckelbridge, Ecologist, CA Coastal Commission
Kathy Lyons, Biotic Resources Group
Suzanne Schettler (CNPS alternate)
Susan Bainbridge, Researcher, University and Jepson Herbarium
Lena Chang, USFWS
Douglass Cooper, USFWS
Devii Rao, Livestock and Natural Resources Advisor, UC Cooperative Extension
Alison Stanton, Research Botanist
Noah Downing, Planner, City of Santa Cruz Dept of Parks and Recreation
Mike Ferry, Planner, City of Santa Cruz Dept of Planning and Community Development
Mauro Garcia, Parks Superintendent, City of Santa Cruz
Grey Hayes, CNPS
Melissa Farinha, Biologist, CDFW

**ABSENT:**
Tim Hyland, Ecologist, CA State Parks

**AGENDA ITEMS AND DISCUSSION TOPICS:**

1. **Public input received.**
   Noah summarized the public comments that had been received since the last AMWG meeting in January, including reports of vandalism, fence cuttings, and off-leash dog issues; an inquiry about the City's plans for the removal of the remnant concrete slabs; and concern that the planned removal of the oak trees encroaching on the coastal prairie may create opposition to the grazing program.

2. **Grassland delineation and woody plant removal discussion along the Coastal Loop Trail from Hagemann Bridge to the overlook above the harbor.**
   The group stopped at intervals along the trail to discuss the grassland delineation and the planned woody plant removal. Members agreed that the trail is an appropriate boundary for this segment of the coastal prairie and confirmed that any tree less than 6 inches dbh would need to be removed at a future date. Sue commented that the purple needle grass between the trail and the fences may be a good photo opportunity to post

on the webpage. The discussion of woody plant removal was deferred until the Invasive Species Removal discussion later in the agenda.

**3. Grazing recommendations.**

The group discussed the current grazing approach with the rancher. It is difficult to assess the appropriate grazing regime during the first year of grazing a new site. The rancher informed the group that the rate of grass growth at other grazing sites is nowhere near the rate at Arana Gulch. Presently, seven cows are located in Grazing Area A and seven are located in Grazing Area C. The cattle are not catching-up to the grass growth in either area. Additionally, Grazing Area C, near Agnes Street, is full of weeds which the cattle do not eat. The weeds could be sprayed with molasses later in the season after they dry-up, mowed now before they seed, or grazed by goats or sheep. The group discussed the possibility of bringing additional cattle to the site to catch-up and the issues associated with it. The group decided that it would be best to keep all 14 cows in grazing Area A since it has the most potential to restore the SC Tarplant population. More cattle can be added at a later date to Grazing Areas C and D. Additionally, the group recommended to mow the weeds in Grazing Area C. Next year, more cattle can be placed in the grazing areas to keep pace with the grass growth. All in all, the group agreed that it is important to allow flexibility to the rancher for determining the best course of action.

The group also discussed the end of the grazing period and how to maximize benefits to the SC Tarplant. Keeping the cattle onsite after the SC Tarplant has been spotted is not an issue. Protective fencing is not needed to prevent the cattle from disturbing the SC Tarplant.

**4. Timing and locations of perimeter mowing.**

The timing and locations of perimeter mowing discussion was moved up on the agenda. The group decided that the perimeter grassland should be mowed once per 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. The group re-affirmed that mowing should take place with a flail mower to break up thatch so that it decomposes better.

**5. Continue the grassland delineation and woody plant removal discussion from the overlook above the harbor to the Coastal Loop Trail near Area D.**

The group stopped at intervals along the Coastal Loop Trail to discuss the grassland delineation and the planned woody plant removal. For the most part, the trail was an appropriate delineator for the coastal prairie. However, two open areas, on the harbor

side of the trail near the overlook, are important to maintain as coastal prairie, especially given the view corridor to the harbor. The group agreed that an aerial photograph would be used to delineate the grassland boundary for future management reference.

6. **Observe erosion issues resulting from the use of an ad-hoc trail at Arana Creek.**
The group discussed the erosion issues. The City shared concerns that closing the connection to Arana Creek, although an un-permitted trail, may lead to adverse impacts and additional public criticism. The ad-hoc trail is heavily used, and closing it may lead to additional trails being created and additional erosion challenges. One idea would be to add erosion control measures and improve access. However, there may be permitting issues with that approach. Some members expressed interest that the trail should be closed. The City will try to identify minor changes that may be able to occur within the permit condition framework and will need the group to help determine if they demonstrate a positive benefit to the restoration effort. The Coastal Commission will also need to review the measures and determine if they can be allowed. The group reiterated the need for a wildlife biologist on the AMWG, as this type of expertise is needed to inform issues such as this, where recreation may conflict with wildlife.

7. **Continue the grassland delineation and woody plant removal discussion to the NE section of the grassland.**
The group stopped at intervals along the Coastal Loop Trail to discuss the grassland delineation and planned woody plant removal. The trail segment adjacent to the Marsh Vista Trail is an appropriate delineator. The group then walked to the three scrape plot areas in the NE area. No native plants were found. The group will continue to monitor the scrape plots to see if any native plants grow before determining whether or not to include the NE area as part of the coastal prairie. No additional vegetation point intercept transects will be added in this area and no additional scrape plots are necessary.

Debbie Bulger, CNPS, discussed a potential volunteer planting effort to plant locally collected coast live oak trees along Agnes Street. There was some concern about the location and alternatives were discussed. The City will work with Debbie and the group on finding a location for the trees.

8. **<u>Discussion Topic Added</u>, Grazing trough locations.**
The group discussed the location of the grazing trough in Area A. The close proximity of the grazing trough to the fence-line creates use conflicts. The cattle spend a lot of time near the grazing area and unsavory smells linger around the bike trail. Additionally, the

cattle are more vulnerable to dog confrontations because owners tend to spend time there. The City and rancher discussed the possibility of extending the water line 100 to 150 ft into Area A. The group discussed the benefit of increasing the bare ground in other areas of the grazing site. Since cattle are going to create bare ground from walking along the fence-line anyway, the water trough can be relocated as a means to create additional bare ground away from the fence. The City will move forward with the project after the cattle have been removed.

**9. Updates on establishing a reference site for Arana Gulch.**

The group discussed collecting and analyzing data from other coastal prairie sites to create more precise targets in the HMP. Group members will send Kate contact information for others collecting coastal prairie data, so she can maintain a reference site spreadsheet to be used in the assessment. In future studies, it is important to include the standard of error and range, as well as to stratify the areas which were previously disturbed or native prairie. Additionally, it is important to consider the original plant list so diversity does not decline. A no management zone will not be pursued.

**10. Grassland monitoring.**

Alison will be re-sampling the vegetation transects this week. This year will essentially represent a third year of baseline data, as the vegetation has not had a chance to respond to the grazing. The higher precipitation may make this a more representative year. This year's data will be incorporated into the cumulative baseline assessment report which describes all data analysis methods.

Alison also has identified about 25 photopoint locations. The group would like to have the photos presented in a way which enables cross comparison between years.

The main purpose of measuring canopy height was explained to help determine how height at different times of the year corresponds to native plants repopulating. Alison already measures canopy height during the April vegetation transect monitoring. Alison and the City will from here out measure canopy height using a plastic dinner plate anchored on a pin flag in February and August. The City will need to work with the group to determine which transects to be used for monitoring.

The discussion of the RDM methodology raised questions as to how the site should be managed and the trade-offs between ensuring a sustainable grazing operation by allowing grass heights to recover versus establishing as much bare ground as possible to help the native wildflowers. Devii Rao discussed RDM strategies ranging from photos illustrating low, medium, and high scenarios to measuring grass clippings to quantify

pounds per acre. Alison will work with Devii on developing an approach to RDM monitoring sometime between the end of September and October and then train staff members on the measurement method.

**11. Work plan for invasive species removal.**

Noah discussed the creation of a work plan to remove invasive weeds. It will focus on the high priority invasives in the coastal prairie near grazing areas A and D and then evolve into other areas. It is intended to be a straight-forward document to help coordinate work crews and volunteers. It will identify the species, location, method of removal, timing of removal, and monitoring of regrowth. Grey suggested beginning with a 3 year time timeframe and to also focus on any areas with Bermuda grass or cape ivy. Additionally, the group had previously identified Himalayan blackberry, cotoneaster, French broom, thistles, and medusa head as priority invasive plants. Noah will work with Kathy on the creation of the first phase of the plan and then send it to the AMWG for review and approval.

The group discussed woody plant removal. Jean Brocklebank, a member of the public, expressed concern that the City would lose support of the project because the public had endured so much change in the previous year. Holding-off for one more year to remove the trees would not be an issue as the rate of encroachment is slow. Members of the group asked for the City's confirmation that funding would still be available if the group decided to hold-off for one year. The City stated that funding would not be an issue. The group decided to hold-off with the Oak removals but to still remove the cotoneaster and blackberry as planned.

**12. <u>Discussion Topic Added</u>, Signage.**

The group discussed adding small SC Tarplant signs to be placed near the small grazing area signs. Debbie Bulger, CNPS, will send the group the wording to place on the signs. Noah will work with a sign vendor to create the signs.

**NEXT STEPS:**

- Noah with send out a doodle request for scheduling the next AMWG meeting in November.
- Noah will coordinate the next mowing of Area B and the off-site removal of the grass clippings.
- Noah will coordinate with Parks maintenance personnel to continue to mow along the bike path.

- Noah will hire a contractor to remove the cotoneaster and blackberry and mow the weeds in Grazing Area C.
- Debbie will email sign language to the group for review. Noah will work with a sign vendor on the signage.
- Noah will continue to work with the rancher to meet the grass height goals and will send updates to the group.
- Kathy will monitor the grazing areas for SC Tarplants.
- Alison will complete the transect study and the reference photo points.
- AMWG members will send SC Tarplant reference site data to Kate for inclusion in a master spreadsheet to inform the targets.
- Noah will hire a contractor to mow the grassland outside of the grazing areas and within Grazing Area C in late-May or early-June.
- Kathy will work with Noah to create a work plan for invasive species removal. The draft of the first phase will be sent to the AMWG for review and comments via email.
- Noah will create a map of the final grassland delineation.
- Noah will coordinate the work to be performed on the waterline extension for the water trough in Area A. The work will occur after the cattle have been removed from the site, only after it has been determined that no SC Tarplants have been identified in the area.
- Noah will work with Debbie on the identification of a location within Arana Gulch for a volunteer effort to plant the 30 coast live oak trees collected onsite as acorns.
- Noah will use a plastic 10” dinner plate to measure grass height along transects in August.

# Minutes

## Arana Gulch Adaptive Management Working Group Meeting

Tony Hill Conference Room, Santa Cruz Civic Auditorium, 307 Church Street

**9:00 a.m. – 2:00 p.m. on November 10, 2015**

**PARTICIPANTS:**
Kate Huckelbridge, Ecologist, CA Coastal Commission
Kathy Lyons, Biotic Resources Group
Tim Hyland, Ecologist, CA State Parks
Noah Downing, Planner, City of Santa Cruz Dept of Parks and Recreation
Mike Ferry, Planner, City of Santa Cruz Dept of Planning and Community Development
Mauro Garcia, Parks Superintendent, City of Santa Cruz
Grey Hayes, CNPS
Suzanne Schettler (CNPS alternate)
Melissa Farinha, Biologist, CDFW

**ABSENT:**
Susan Bainbridge, Researcher, University and Jepson Herbarium
Lena Chang, USFWS
Devii Rao, Livestock and Natural Resources Advisor, UC Cooperative Extension

**AGENDA ITEMS AND DISCUSSION TOPICS:**

**1. Resource Conservation District of Santa Cruz County**

Angie Gruys and Chris Coburn of the Resource Conservation District of Santa Cruz County presented on the work their organization has undertaken and plans to undertake to reduce sediment and erosion issues in the Arana Creek watershed. They described that they meet with a Technical Advisory Group and conduct watershed surveys to assess restoration priorities. They are constantly seeking grant funding to implement high priority projects. They provide outreach on riparian and drainage issues to property owners adjacent to the watershed and have worked to streamline the permit process to help shovel ready projects move forward. They are hoping that future mitigation dollars from projects can be spent in the local watersheds they directly affect. They explained that grant funding is difficult to obtain for the Arana Gulch watershed because it is not a high priority steelhead fishery. Salmonids prefer clean gravel and the sediment is too sandy. Some of their priorities for seeking projects are based on a high discharge, high sedimentation, and large number of project partners. They mentioned that the tsunami in 2011 created bank erosion and slumping within Arana Gulch. They indicated that much of the sediment coming from outside of the stream has been

controlled and that most is coming from erosion within the stream. They can help organize volunteers to help with Arana Gulch projects.

The AMWG would like to provide input to help RCD's work plan process. They would like to tour Arana Creek within the Arana Gulch Open Space and identify erosion issues that they can help the City address, such as invasive plant removals and erosion control projects. They asked for a follow-up from RCD as to whether or not there is tidewater goby habitat in Arana Gulch, the best timing to meet with them to help inform their work plan, and to schedule a time to walk the creek to identify erosion issues and other concerns.

**2. Public Comments**

Michael Lewis has been watching the trails and there is increasing erosion from bicycle and foot traffic, a breakdown of trails, and potential for sedimentation during rains. He also described that there is an area on the bluff face near the RV park above the harbor with drainage issues.

Name unknown. A member of the public explained that the trails are widening because of the extensive amount of use and was hoping that cattle gates can be installed to allow public access into the grazing areas.

Jean Brocklebank presented photos showing the widening of the trails in high trafficked coastal prairie areas and asked if split-rail fencing can be placed to protect them. She also described that the ivy on the trees should be removed on the Marsh Vista Trail.

The AMWG discussed the comments. Kate explained that the project approvals required closing-off access to the cattle grazing areas, and opening-up access would require an amendment to the permit. Noah described his reservations for the City pursuing a time-consuming and costly amendment and questioned how the potential change would affect the restoration efforts. Grey described that Santa Cruz tarplant would not be adversely impacted if access is allowed in the grazing areas.

The group discussed potential techniques to improve the trail widening situations, such as laying down logs, adding d.g. to certain sections to clearly identify the trail, and avoiding mowing around those sections of the trail to keep the grass high and less desireable to walk on. Questions were also asked about increased enforcement, if hardening of the soil is good biologically, and if it was better to discuss these types of improvements with all potential projects that could occur to make sure they do not pull

funds away from high priority projects. A group member asked if adding d.g. was allowed. The permit allows some flexibility for maintaining trails.

**3. CCC Business (Kate)**

- Kate has not received any willing Wildlife Biologists to become part of the group. AMWG members provided the names of some potential candidates. A member mentioned it would be helpful if staff from RCD could attend any meeting when topics of erosion are discussed.
- The City recently received the Year One Annual Report comments. The City will be working towards finalizing the report. As soon as it is complete, City staff will begin work on the Year Two Annual Report which will be sent out to the group in January.

**4. Monitoring Results**

Noah described that the intention was to send the group the monitoring results and photo points before the meeting. Unfortunately, there were some issues and the report will need to be emailed out after the meeting. A summary of the monitoring results was provided. The grass heights were mostly meeting the 5-8 cm objective, but the amount of RDM data was higher than anticipated. The grass heights will need to be continually measured annually in February, April, and August (AMWG April 15, 2015 Meeting Minutes) to help establish a long-term trend. Sue Bainbridge's work on the seedbank viability and density study will be helpful to inform future management decisions and the creation of coastal prairie targets.

**5. Grazing and Invasive Plant Removal Summary for this Year to Date**

- Grazing—An overview of the first year of grazing was provided and the Number of Cattle and Grazing Season was summarized in a table. AMWG members would like the table updated to include Animal Unit Months and type of cattle, heifers. The table will be included in the Year Two Annual Report. A video was shown attempting to document the conditions of the grazing areas on July 18$^{th}$, the day after the cattle had been removed.
- Lessons learned from the first year of grazing—It was evident early on that more cattle would be needed. Tommy was extremely responsive to the changing needs throughout the grazing period, and has been extremely flexible in trying to meet the goals outlined by the group. The group discussed whether or not it was necessary to screen SC tarplant from the cattle at the end of the grazing season. If there are large blooms of the SC tarplant, it would not be feasible to screen all the plants. There are also differences of opinion about whether or not the cattle would harm or help promote more branches

and flower heads from clipping the SC tarplant during its early growth stages. The proximity of the grazing trough in Area A to the Multi-Use Trail invites conflicts between cattle and dogs and the irrigation line will be extended 50-100 ft further into the grazing area.

- Approach for 2nd year of grazing--Kathy and Noah will provide the group locations where SC tarplant have been observed in the past but have not grown in recent years as well as areas where there are weeds. The mineral blocks will help create more bare ground from the cattle congregating around the mineral block location. After the cattle create bare ground, the mineral blocks will be shifted to other areas for the same effect. Since this approach is more experimental, mineral blocks will not be placed in the most recent SC tarplant locations to make sure there are no negative effects to those areas. They will neither be placed near steep slopes which could cause erosion issues, nor near the fence-line to ensure the bare ground area created by the cattle is maximized.
- Area B mowings and rakings--Area B was mowed on March 16th and May 8th. Jean and Michael volunteered to mow and rake Area B and 40 bags of biomass were removed and will be explained in more detail in the Year 2 Monitoring Report.
- Cotoneaster removal—The cotoneasters, ivy, and Himalaya blackberry were removed from the coastal prairie on the hillside near the Harbor entrance. The area will need further attention in future years to prevent the invasive species from reclaiming the area.
- Thistle head removal—In July, thistle heads were removed from approximately 75 percent of the thistles in Grazing Area A. The populations are not as prevalent as in Grazing Area C.

**6. Refining Coastal Prairie Targets (Kate)**

Kate provided a handout summarizing the objectives in the habitat management plan and the need for more informed targets. The group discussed the difficulties in finding a good reference site for a lower terrace coastal prairie. Noah inquired as to why targets are necessary at this point in time because the existing targets are not met and the focus should be on restoration work. Group members described that the existing targets should be refined to account for the differences in the type of strategies for coastal prairie and SC tarplant. Additionally, it may be better for some areas to have less diversity, such as a single species of native grass. It also may be good to identify the areas that are more difficult to restore and create more realistic targets. A group exercise of targeted mapping may be necessary. Tim offered to begin studying Twin Lakes in more detail to help. A group member suggested that the City may want to study its own coastal prairie open spaces to gather information to help inform the targets. The

potential for college students to help with the studies was suggested. Work should begin now to plan for an improved set of targets by 2020.

**7. Goals and Actions for 2016**

- Grazing—Grazing will begin as soon as possible.
- Woody plant removal—The City is in the process of hiring a maintenance worker to help with the restoration effort. The worker will be trained on searching for bird nests and for identifying native species to avoid any impacts from the restoration work. The trees less than six inches in diameter which are encroaching into the coastal prairie will be removed in September-October. The worker will help implement the Weed Management Plan and cut ivy from trees in the Marsh Vista Trail and Hagemann Gulch areas.
- Implementation of the Weed Management Plan in the coastal prairie—Group members discussed whether or not the Weed Management Plan should be expanded to include Arana Creek. The City described its plan to implement the recently created Weed Management Plan for the coastal prairie which was set as a priority in past meetings, and questioned the practicality of creating another plan with another focus before the invasive weeds had been contained in the priority area. Some members believed that the weeds surrounding the coastal prairie would not take a lot of effort to control, with the exception of the thistles. Staff will monitor progress of the Weed Management Plan to see how much time is spent removing weeds within the coastal prairie area. Staff will also begin removing Ivy from trees within Hagemann Gulch and the Marsh Vista Trail.
- Perimeter mowing—Perimeter mowing will continue to occur in Late May and Early June. Bird nests and rare native plants will be flagged to avoid disturbance.
- Annual Monitoring Report for 2015—As soon as the Year One Annual Report is complete, the City will works towards completing the Year Two Annual Report.
- Vegetation monitoring—The City will continue to monitor the vegetation. Group members described that monitoring seedbank density/viability is too expensive and unnecessary to monitor annually. The City will send out Sue's seedbank viability/density study as soon as it has been completed.
- AMWG Meetings—The group discussed the scheduling of the meetings. January is a good time to meet onsite to check-out grazing conditions and erosion concerns and kick-start the new year. The April meeting is a good time to meet onsite to see the conditions of the grazing areas and help plan for the end of the grazing season as well as help staff prepare for future budgeting.
- Erosion Control—Jute netting and barley seed will be placed on the slope on the hillside near the harbor entrance. Hay wattle replacements will be installed on the slopes with bare ground near Hagemann bridge.

**Next Steps:**

- Noah will send out the monitoring report as soon as it has been submitted and will follow-up on the Seedbank Viability/Density Study.
- Noah and Angie will discuss how to best schedule meetings to assist RCD's work plan and schedule a walk of Arana Creek.
- Noah will send out a doodle request to help schedule the next AMWG meeting.
- Noah and Kathy will identify some areas for the placement of mineral blocks and send it out for AMWG comments.
- Noah will work with the rancher to begin cattle grazing.
- Noah will work with the maintenance worker on invasive plant removal and trough relocation in Area A.
- Noah and Kathy will complete the Year One Annual Report and send out a draft of the Year 2 Annual Report for review by AMWG members.
- Kate will continue to seek out a Wildlife Biologist to serve on the group.

# Appendix B Coastal Prairie/Santa Cruz Tarplant Management Area

B-1: Status of Soil Seed Bank of Santa Cruz Tarplant (Bainbridge, 2015)

B-2: Invasive Weed Work Plan (Biotic Resources Group, 2015)

B-3: Grazing Signs

# Status of the Soil Seed Bank of Santa Cruz tarplant (*Holocarpha macradenia* Greene), Arana Gulch Open Space, Santa Cruz , CA

Submitted to:
City of Santa Cruz, Dept. of Parks and Recreation, July, 2013

Submitted by:

Susan Bainbridge, Jepson Herbarium, 1001 VLSB #2465, University of Califronia, Berkeley, CA 94720-2465

December 2015

This work was conducted under agreement 036281 between the City of Santa Cruz and the UC Regents and permit issued to UC Berkeley from California Department of Fish and Wildlife (California Endangered Species Act, Scientific, Educational, or Management Permit No. 2081(a)-13-011-RP).

**OBJECTIVE:**

The objective of this project was to estimate the current density of the soil seed bank of Santa Cruz Tarplant (SCTP) in SCTP Areas A - D at Arana Gulch Open Space, Santa Cruz, CA.

**BACKGROUND:**

The density of the soil seedbank of SCTP has been estimated at Arana Gulch at least three times. The estimates were done for various purposes, in different areas at Arana Gulch, and by various sampling configurations. Rexford Palmer estimated an average density of 27 ray cypselae (fruits) per square decimeter in the first 2.5 centimeters of soil, and 3.8 at 2.5 to 5 centimeter depth (Palmer 1982). It is unclear if he tested viability of the cypselae. He collected the samples for his dissertation which was finished in 1982. The location of the 20-meter transect he used to collect soil samples is not recorded, but most likely it would have been from SCTP Area A.

In 1999, density of the soil seed bank was estimated in SCTP Areas A-D as part of a comparison of soil seed bank density between several SCTP populations (Bainbridge, unpublished) and estimated to be 21.4 viable ray cypselae per square decimeter in SCTP Area A, and 2 in Area D (combining samples for soil depths 0-2.5 and 2.5-5.0 cm). The sampling configuration is described below. No soil seed bank was detected in SCTP Areas B or C, but only 4 samples were taken from each area (12 cores from B and 36 from C).

In 2002, soil seed bank density was estimated in experimental plots established in 2001 in SCTP Areas A and D and in an area north of SCTP Area A (Bainbridge, unpublished). The purpose was to monitor effects of management treatments (fire, mowing, scraping, no treatment) on the seed bank. The area north of SCTP Area A had not been previously sampled and no soil seed bank was detected. Combining results from plots in Areas A and D indicated densities for each Area in 2001 were the same magnitude as in 1999, although the sampling configuration was different than in 1999 and the two samples are not statistically comparable.

**METHODS:**

**Collection of seed bank samples.** Soil samples were collected from designated SCTP Areas A-D because SCTP has been recorded in these areas more recently (since 1996) and viable seed would more likely be found in these areas. In each of the SCTP Areas, samples were collected in configurations similar to the 1999 soil seed bank assessment with the following exceptions: 1) sample density was greater in 2013-2014 to increase the probability of finding viable seeds and 2) transects in the northeast corner of SCTP Area D were truncated because construction had already started and that area had been altered. Sampling in SCTP Areas B-D occurred in December of 2013. Sampling in SCTP Area A occurred in February 2014, after the assumed germination period, so that samples reflected the persistent soil seed bank and would not include seeds that may germinate in the winter.

The size of the approximate area that was targeted for sampling, the sample number, number of sample points and soil cores and the sample density for each SCTP Area is summarized in Table 1. In SCTP Areas A and D, 122-meter baselines +/- bisecting the long axis of the areas was placed in approximately the same location as 1999; GPS points and aerial photos were used to relocate the baselines. One transect was placed and perpendicular to these baselines from a random location along the baseline in every 6 meter segment for a total of 20 transects per baseline. The transect direction from the baseline was also randomly selected.

In SCTP Area A, transects were 50-meters long with 5 soil collection points per transect, and in Area D, transects were 40-meters with 4 soil collection points/transect. Soil collection points were recorded with a Garmin GPS (> 3-meter error). In SCTP Area B, soil collection points were located using regularly spaced transects, rather than random samples. The 6 transects were 5 meters apart and 25 meters long. In SCTP Area C, a 60-meter baseline was placed on the northeast edge of the Area and the starting locations for six 30-meter transects were randomly selected. Soil was collected at 5 collection points per transect.

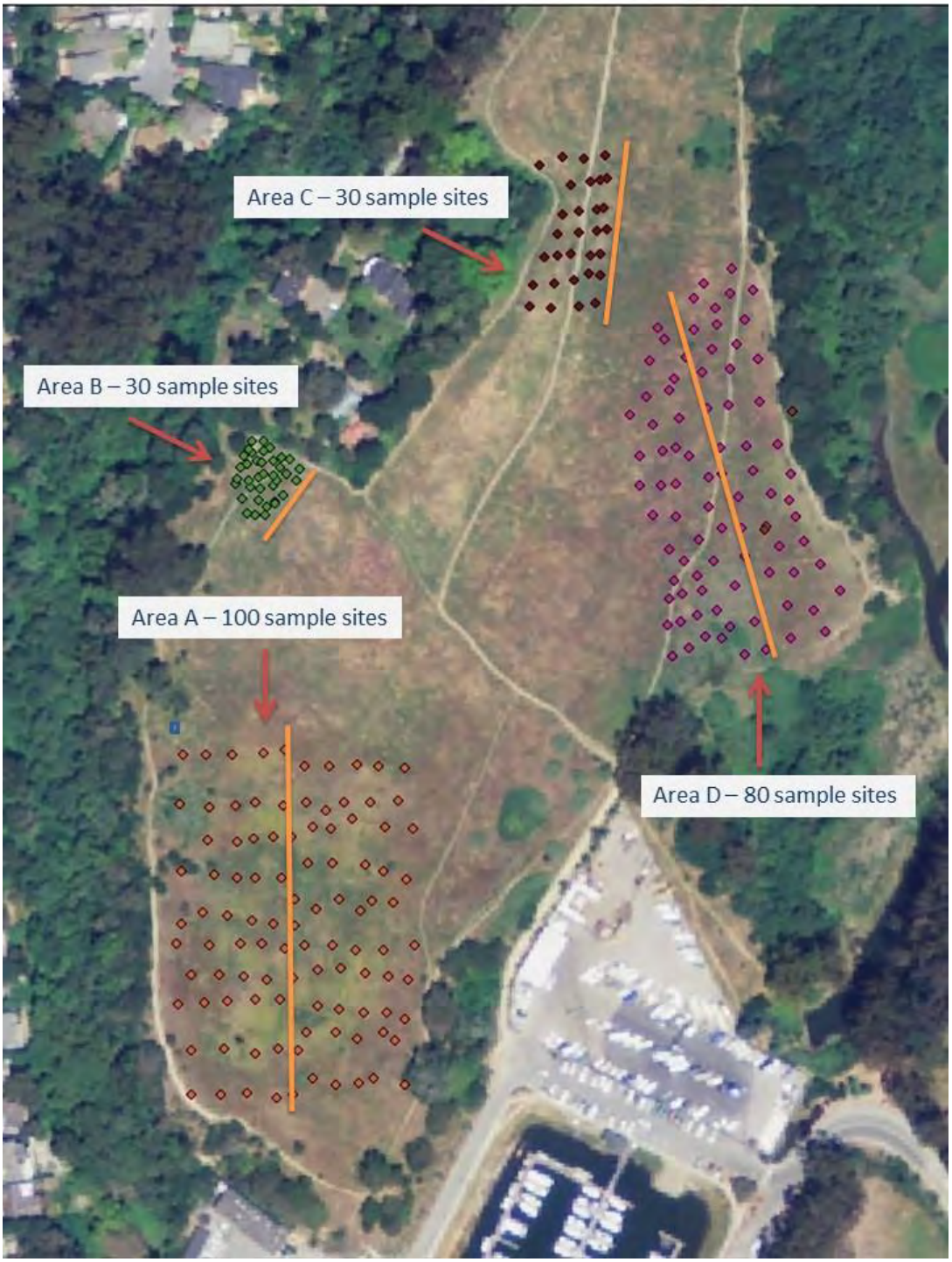
Approximate location of sample sites and baselines are shown in Figure 1. At each collection site, three soils cores were collected. Each core was 8 cm in diameter (50.26 $cm^2$ surface area) and soil samples were removed in two parts: 0-2.5 cm depth and 2.5-5 cm depth. Resulting sample sizes were 20 in areas A and D with sample densities of 2.6 to 3.1 soil cores per 100 square meters. Sample size in SCTP Area B and C was 6 with a sample density of 14.4 cores per 100 square meters. In SCTP Area C, the sample size was 6 with sample densities of 4 cores per 100 square meters.

**Table 1. Soil Seed Bank Sampling in SCTP Areas A-D.**

| | Approximate area sampled ($m^2$) | Number of transects (n) | Number of sample sites | Number of soil cores | Cores/100 $m^2$ sample area |
|---|---|---|---|---|---|
| Area A | 9,760 | 20 | 100 | 300 | 3.1 |
| Area B | 625 | 6 | 30 | 90 | 14.4 |
| Area C | 1,800 | 6 | 30 | 90 | 4 |
| Area D | 9,760 (~500) | 20 | 80 | 240 | 2.6 |

**Processing of soil samples.** All ray and disk cypselae are extracted from the soil samples by passively dissolving samples in water and rinsing through graduated white polyester sieves and visually checked for SCTP seeds in a sieve with 1mm size mesh. All large seeds and undissolved pieces of clay are put aside and the sample labeled for further inspection. Viability was tested by dissection of the seed coat under a microscope. If a white embryo or an off white embryo that started development if a petri dish was present, the cypselae was considered viable.

**Figure 1. Location of baselines and soil seed bank samples at Arana Gulch – 2013-14. Approximate location of baselines and soil seed bank samples based on coordinates recorded by GPS. Symbols represent sample sites comprised of three 50 cm$^2$ soil cores.**



**RESULTS:**

Thirty viable and 27 non-viable SCTP cypselae were located in the 52 samples (240 collection sites representing 720 soil cores) (Table 2). All viable and non-viable seeds were found in SCTP Areas A and D and all viable cypselae were in the samples collected in the first 2.5 cm of soil. Only ray cypselae were found - no disc cypselae were located in any of the samples. Location of collections sites where viable cypselae were found are shown in Figures 2 and 3. The non-viable cypselae located in the sample may or may not have been viable at some point because SCTP like other taxa can form a seed coat without a viable embryo.

**Table 2. Results of 2013-2014 Soil Seed Bank Resampling at Arana Gulch.**

| | Area A (n=20) | Area B (n=6) | Area C (n=6) | Area D (n=20) |
|---|---|---|---|---|
| Number of viable SCTP cypselae in samples*: | 28 | 0 | 0 | 2 |
| Average number of cypselae per sample (std. dev.): | 1.4 (2.03) | 0 | 0 | 0.2 (0.307) |
| Frequency of viable SCTP cypselae in samples (# samples w/viable cypselae/# samples): | 0.50 | 0 | 0 | 0.10 |
| Frequency of viable SCTP cypselae at collection sites (# viable cypselae/#collection sites): | 1.40 | 0 | 0 | 0.025 |
| Density of viable cypselae per square decimeters: | 0.187 | 0? | 0? | 0.033 |
| Number of non-viable SCT cypselae<br>Seed coat present but embryo not evident: | 23 | 0 | 0 | 2 |
| Embryo present – but not viable: | 2 | 0 | 0 | 0 |
| Fragments of SCT seed coat**: | 14 | 0 | 0 | 1 |
| Possible *Deinandra* or SCTP seed coat fragment: | 31 | 0 | 3 | 1 |

* All cypselae found in samples from the first 2.5 cm; no seeds or fragments found between 2.5 and 5.0 cm. ** Each of these fragments represents a different cypselae based on morphology.

**Figure 2. SCTP Area A: Approximate location of soil collection sites with viable SCTP seeds (orange dots) and collection sites (X).**

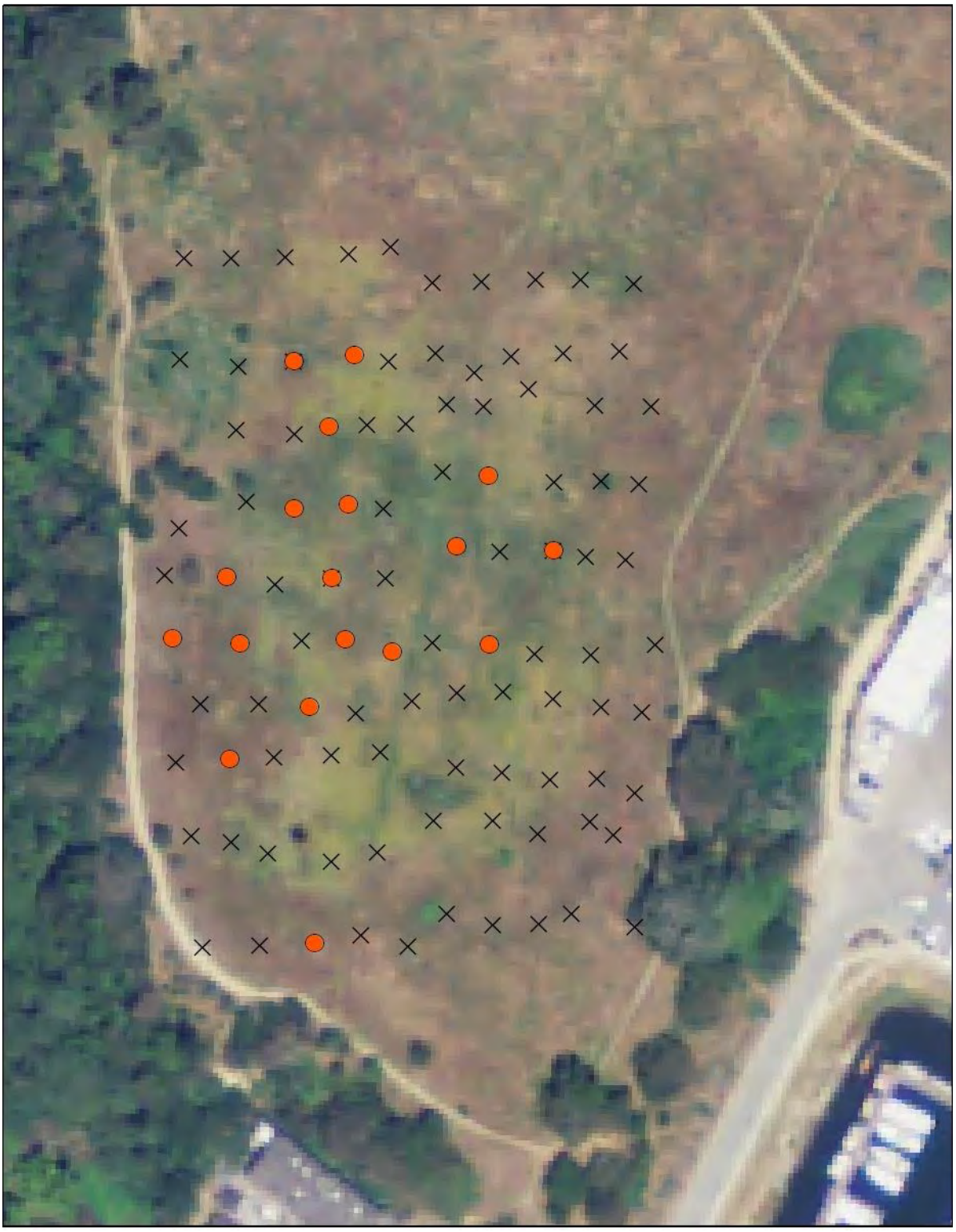
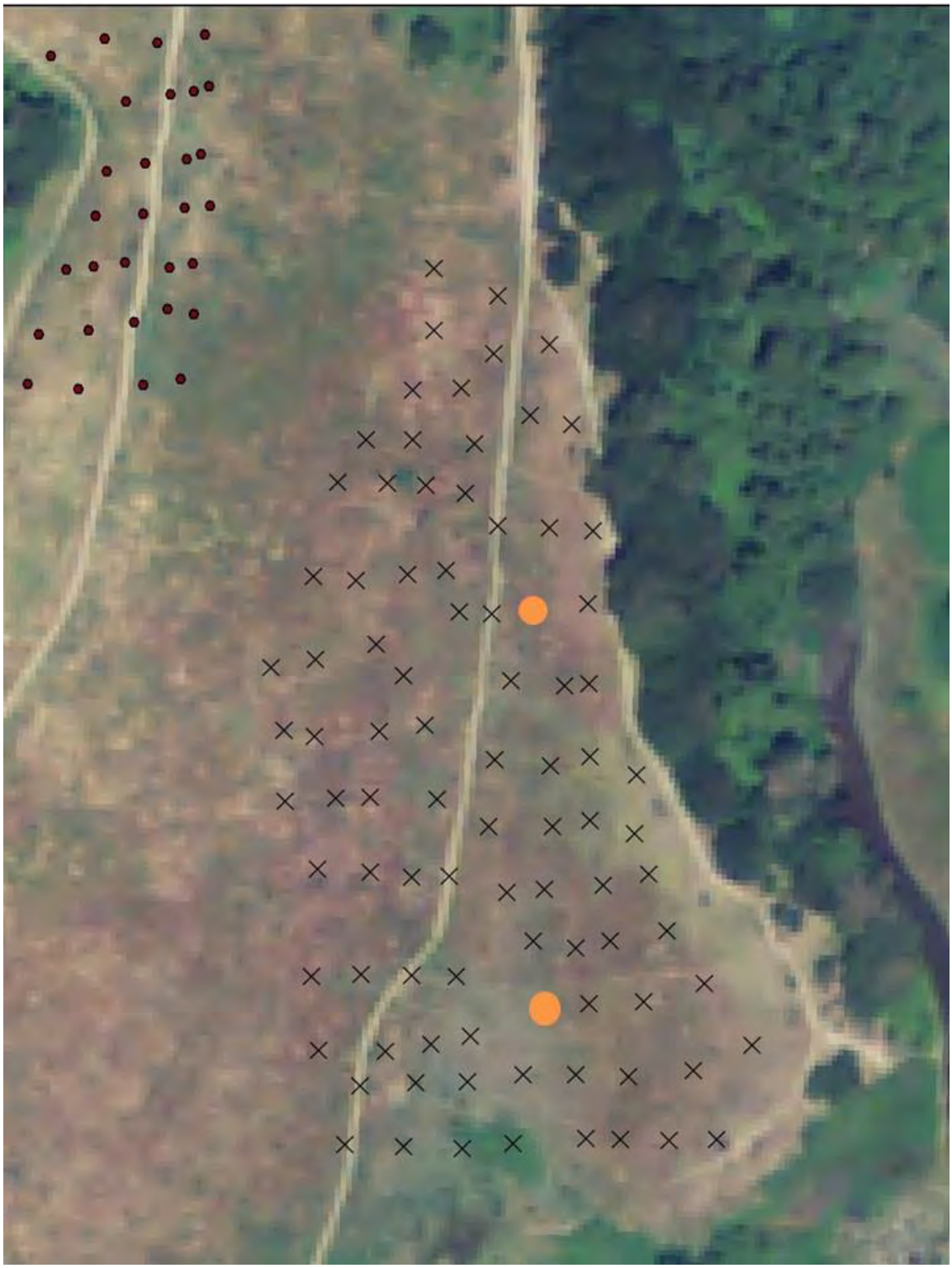


**Figure 3. SCTP Area D: Approximate location of soil collection sites with viable SCTP seeds (orange dots) and collection sites (X).**



**DISCUSSION AND RECOMMENDATIONS:**

Results from the 2013/2014 soil seed bank assessment indicate a significantly lower ($p=0.2 \times 10^{-8}$) soil seed bank density than was estimated in 1999 using the same method. A decline in seed bank density was expected given natural attrition from the soil seed bank without significant input since 2002-2003 but extent of the decline was hard to predict. Degraded habitat conditions and lack of appropriate disturbance in large portions of habitat to stimulate recruitment and seed aging since 1988 are probably the most important factors contributing to the decline.

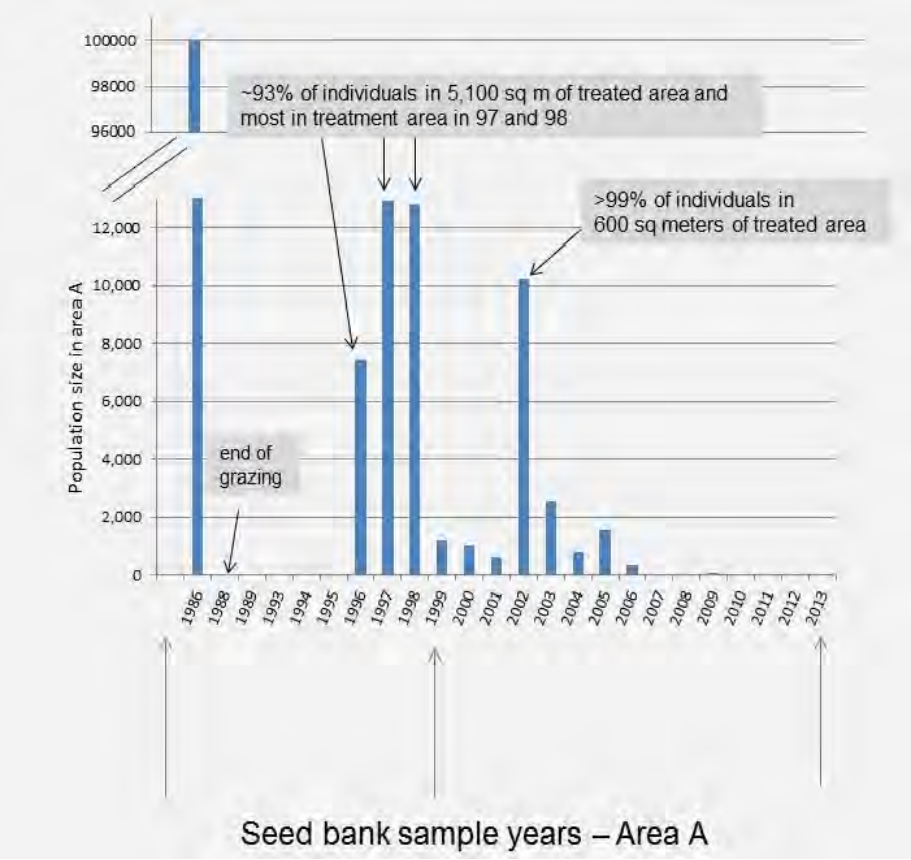
The decrease from 21.4 seeds per square decimeter in 1999 to 0.187 in Area A and from 2.0 to 0.333 in Area D represents a change of two orders of magnitude over the past 15 years. The seed bank density estimates for SCTP Areas A and D are now similar to estimates for small, introduced or demographically unrepresentative SCTP populations in 1999 (Twin Lakes SB, Wildcat Canyon, Watsonville Airport; Bainbridge, unpublished data).

Persistent soil seed banks buffer populations from bottlenecks and loss of genetic diversity otherwise experienced when above ground population sizes are low. However, a decline in the soil seed bank very likely resulted in loss of genetic diversity and/or allelic richness in the population.

In addition to the low density, the mean age of cypselae in the soil seed bank at Arana Gulch may now be much older than in 1999, and compared to other sites, due to lack of turnover in eth majority of the habitat and therefore much more vulnerable to attrition and/or poor recruitment due to seed age. Much of the soil seed bank found in 1999 probably dated back to the time of the discovery of the large population (1986) or later. The large population sizes recorded in 1986-1988 and 2002 are due to recruitment occurring in high density in small areas of habitat (Figure 4). In 1986 and 2002, 93% and >99% of the individuals recorded were in experimental scrape plots in approximately 5,100 square meters and 660 square meters of SCTP Area A respectively (refs). The majority of individuals from population estimates after the 1986 fire (1987 and 1988) were in the intersection of the scrape area and the fire (Hayes 1998). In other words, most of the SCTP soil seed bank has been dormant since 1986 and is about 30 years old. If so, future management should focus on distribution of recruitment throughout habitat as with livestock grazing, rather than total numbers of individuals at the site.

The lack of detected soil seed bank again in SCTP Areas B and C does not necessarily mean that a seed bank is not present, but that it might be in density too low for the methodology to detect. This low density may be due to lack of management in these areas. Alternatively, there may not be a persistent soil seed bank in those areas, but they are population sinks with SCTP Areas A and D and potentially other parts of the terrace as the population source from which seed may disperse and result in occasional recruitment. Either way, habitat in these areas should be managed for conditions that allow SCTP recruitment. Effect habitat management (low frequency scraping and reintroduction of grazing) would help determine if a persistent soil seed bank occurs in these areas and/or allow those areas to serve as population sinks.

**Figure 4. SCTP Area A: seed bank sampling events relative to large population sizes and area occupied by large populations.**



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# Arana Gulch
# Coastal Prairie Management Area
# City of Santa Cruz

## INVASIVE WEED WORK PLAN

July 20, 2015

Biotic Resources Group

Biotic Assessments • Resource Management • Permitting

# Arana Gulch
# Coastal Prairie Management Area
# City of Santa Cruz

# INVASIVE WEED WORK PLAN

Prepared for
City of Santa Cruz Parks and Recreation Department
Attn: Noah Downing

Prepared by

Kathleen Lyons
Biotic Resources Group

With

George McMenamin
Restoration Specialist

July 20, 2015

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# CHAPTER 1.0

## INTRODUCTION

This Invasive Weed Work Plan (IWWP) identifies methods for the removal and control of invasive weeds from the Coastal Prairie Management Area within the Arana Gulch greenbelt. The City of Santa Cruz will implement this program pursuant to the Arana Gulch Habitat Management Plan (HMP). Objective 3B of the HMP requires the reduction in the cover of non-native species in the coastal prairie from the baseline level to one more representative of a reference functioning coastal prairie by 2020 (please see the HMP, page 73) (Stanton, 2013). In 2015 the Arana Gulch Adaptive Management Working Group (AMWG) delineated the grassland areas that would be subject to prairie/grassland management activities.

The IWWP identifies the location and treatment methods to be used by the City's maintenance personnel, contractors, and/or volunteers to remove and/or control the growth of invasive, non-native plant species (invasive weeds) with the delineated grassland management area. The IWWP identifies weed control strategies for areas within designated cattle grazing fields in addition to areas where grazing does not occur. The City will implement the IWWP over several years; each year's tasks and results will be reported upon in the City's annual HMP report.

## 1.1 STUDY METHODOLOGY

### 1.1.1 Existing Vegetation Types and Delineated Grassland Area

The existing vegetation types with Arana Gulch were mapped during the preparation of HMP (Alison Stanton, 2013). Additional field surveys were conducted by the AMWG in April 2015 wherein the grasslands subject to management were determined. Two plant community types occur within the IWWP project area: annual, non-native grassland and coastal prairie. The IWWP area also supports isolated oak trees/tree groves. Figure 1 shows the delineated grassland, as per direction from the AMWG; this delineated area is subject to this work program.

### 1.1.2 Existing Invasive Weeds, Infestation Areas, and Threat Rankings

The occurrence of invasive weeds within the central grassland of Arana Gulch was identified and mapped during field surveys conducted in April and October 2014. The infestations were identified by GPS and mapped as polygons or spot locations onto aerial photos. The 2014 survey documented 12 significant invasive weed species from the central grassland (Arana Gulch HMP, Year 1 Annual Report, City of Santa Cruz, 2015). Using the grassland delineation approved in April 2015 by the AMWG, a field survey was conducted in May 2015 to re-check the invasive weed species located within the IWWP area. As a result, one weed species was deleted (maidenhair vine). Maidenhair vine is located outside the delineated grassland. Three species were added: wild radish, pyracantha, and poison hemlock.

A species growth pattern, extent within the project area, effect on native vegetation, and ability to spread into uninfected areas were used to determine and prioritize the need for removal and control. Information on the invasive weed species and their ranking and threat is described in Chapter 2.0. Appendix A identifies, using photographs, the invasive weeds that are currently of management concern in the IWWP area.

### 1.1.3 Prioritize Vegetation Management and Weed Removal/Control Treatment Areas

Using information gathered in Tasks 1.1.1 and 1.1.2, above, areas within the IWWP area were identified for vegetation management action. Various management methods were evaluated as to their potential use in the IWWP project area, such as seasonal mowing, hand removal,

solarization, periodic thinning or pruning, and animal browsing (i.e., cattle). Threat rankings used by the USDA, Cal-IPC, and input from the AMWG were used to identify areas/species with a high priority for removal.

### 1.1.4 Development of Maintenance and Management Treatments

Vegetation management and/or maintenance treatments were identified for the IWWP area. Short-term weed treatments, as well as both long-term strategies to reduce weeds and long-term strategies to encourage native plant growth that can reduce long-term maintenance, were evaluated. Preferred maintenance operations were also identified, such as the time and intensity of mowing/weed whipping, hand removal, selective herbicide application and animal grazing/browsing. Chapter 3.0 of the IWWP outlines these recommended invasive weed control techniques. A general yearlong schedule outlining the optimum time for implementing treatment is also provided in this chapter.


**Figure 1.Delineated Grassland for IWWP Area**

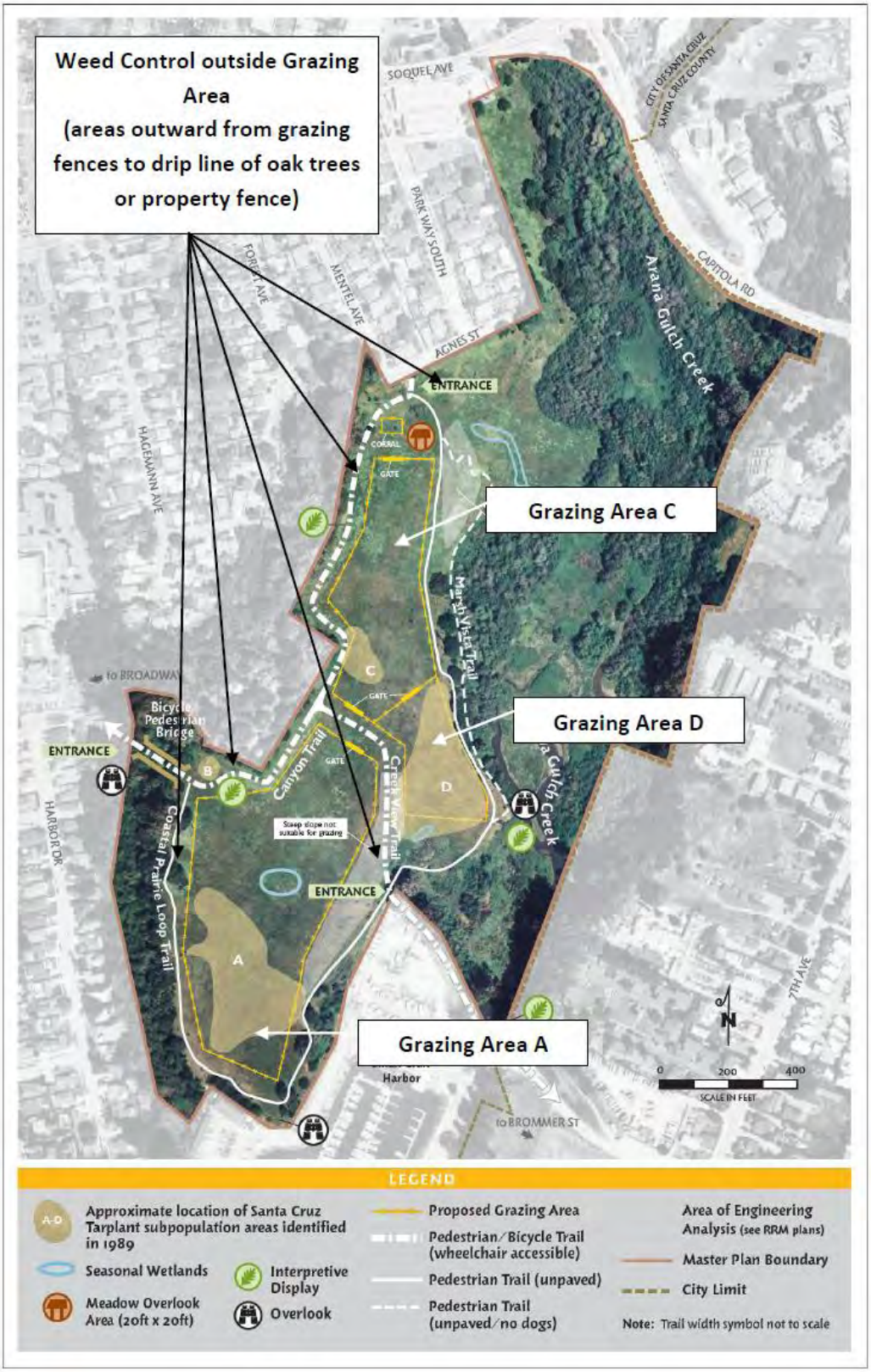


**Figure 2.Grazing Areas and Adjacent Weed Control Areas**

# CHAPTER 2.0

# INTRODUCTION TO WEEDS

Weeds, in general, are defined as plants growing in an area where they are not indigenous. In addition many plants are considered to be weeds when associated with agricultural/livestock operations. Some botanists and land managers also refer to these plants as ***non-native***. Many weeds are of European origin having entered the United States with early European explorers. In California, many weed species were also introduced during the Spanish and Mexican occupation periods, particularly at coastal sites and around settlements (Brossard, Randall and Hoshovsky 2000). Non-native plants came into California on grazing animals, in livestock feed, ship ballast, and through the transport of ornamental and crop plants. Non-native plants continue to enter California from the international transport of economic goods, the global plant trade, and tourism.

Currently, it is estimated that over 1,800 non-native plant species have become established in California, with a minority of these species (approximately 200) having escaped cultivation and invaded into natural areas (Cal-IPC 2006). In instances where a plant is found to be "troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate" the plant has been identified by the California Department of Food and Agriculture (CDFA) as a ***noxious weed*** (CDFA 2007). The CDFA rates each species based on its statewide importance, the likelihood of successful control/eradication, and the species distribution in the state.

In a similar manner, the California Invasive Plant Council (Cal-IPC) has identified plant species that displace native species and negatively affect natural systems as ***invasive species.*** Cal-IPC has developed it own ranking system that identifies a species invasive qualities as well as its negative effect on native ecosystems. These negative effects can include competition for light, soil moisture, growing space, and colonization of mineral soils.

## 2.1 STATE NOXIOUS WEEDS AND THREATS

The state's ***Noxious Weed List*** identifies plant species that are currently considered a pest according to laws/regulations in the California Food and Agriculture Code. Plants are rated as A, B, C, or Q, to give guidance on the most appropriate action to take against the weed species, as depicted on Table 1. Presently, there are 251 plant species considered noxious weeds in California.

**Table 1.Ratings of State's Noxious Weeds**

| Pest Rating | Appropriate Action |
|---|---|
| A | Eradication, containment, rejection or other holding action at the state-county level; quarantine possible. |
| B | Eradication, containment, control or other holding action at discretion of County Agricultural Commissioner. |
| C | State endorsed holding action and eradication if plant found in a nursery; action to retard spread of plant outside nursery at discretion of County Agricultural Commissioner. |
| Q | Quarantine of species from nurseries |
| D | No action |

Source: USDA 2015

## 2.2 Cal-IPC INVASIVE PLANTS AND THREATS

Cal-IPC has identified plant species that they consider to be invasive in natural areas, have an aggressive growth pattern that adversely competes with native species, and have potential to change plant community structure and reduce habitat values. In 2006 the California Invasive Plant Inventory was developed as a scientific and education report to provide information to those working on habitat restoration, land managers, and the public. The Cal-IPC inventory has no regulatory authority.

Table 2 identifies the inventory categories developed by Cal-IPC. These categories (high, moderate, or limited) reflect the level of a species negative ecological impact in California. This information can be useful to land managers in evaluating management actions. Presently, there are over 200 invasive plants listed in the Inventory. Many of these species are also listed as noxious weeds by the CDFA.

**Table 2.Cal-IPC Ratings of Invasive Weeds**

| Ranking | Meaning of Ranking |
|---|---|
| High | Plant species pose severe ecological impacts on physical processes, plant and animal communities and vegetation structure, plants have moderate to high rates of dispersal and establishment. |
| Moderate | Plant species have substantial ecological impacts; plants have moderate to high rates of dispersal yet establishment is generally dependent on ecological disturbance. |
| Limited | Plant species are invasive, but ecological impacts are minor on statewide level; reproductive biology result in low to moderate rates of spread, but species may be locally persistent and problematic. |

Source: Cal-IPC 2015

The Bay Area Early Detection Network (BAEDN) also tracks plant species that are the focus of early detection and eradication efforts throughout the nine-county San Francisco Bay Area. This organization periodically updates it list (www.baedn.org) that identifies species that are thought to only occur in limited locations, yet are of management concern.

## 2.3 PROBLEMS FOR MAINTENANCE AND LAND STEWARDSHIP

Both ***noxious weeds*** and ***invasive species*** can hinder natural habitats, degrade the aesthetic value of public spaces, and increase fire hazards on public lands. Typically, invasive weeds are successful in out competing native plants for growing space, soil moisture, and nutrients. These weeds may also contribute to a fire hazard, thus threatening adjacent lands.

## 2.4 INVASIVE WEEDS WITHIN THE VMP PROJECT AREA

The IWWP addresses plant species considered to be of significant management concern within the coastal prairie management area. Most of the plant species found within the project area are listed by the CDFA and Cal-IPC, as ***noxious weeds*** and ***invasive species.*** This plan provides field identification for the plant species considered to be of management concern. Table 3 lists these species. Table 3 also identifies the invasive threat ranking assigned to each species. This ranking is based on the CDFA ranking, Cal-IPC ranking, and field observations.

In general, ***noxious weeds*** and ***invasive plants*** are adapted to establish on previously disturbed conditions, such as loose soils exposed by grading or on sites that have experienced a substantial habitat change from previous agriculture, grazing or other activity.

The plants can be annual/biennial species, such as Italian thistle, that grow quickly and produce large amounts of seed. The seeds from annual plants are often easily dispersed by wind or by animals. Perennial herbaceous plants, such as cotoneaster, reproduce by seed but can also spread by spreading roots. The growth habitat of the IWWP invasive weed species is listed on Table 3.

Field identification features of each species are presented in Appendix A. This appendix provides the user with information on how to recognize the plant, where would one typically find it growing, and what problems it causes for habitat maintenance. Photographs are included, depicting the species in flower as well as in summer when the plants are commonly observed.

Figures 3 and 4 show the distribution of invasive weeds within the IWWP area that are currently of management concern. These weed occurrences, as well as others that may establish in the IWWP area in the future, are subject to removal and control as part of this IWWP. Note: The extent of wild radish is not depicted on the maps; this species is widespread within the three grazing areas.

**Table 3. Invasive Weeds of Management Concern, Coastal Prairie Management Area, May 2015**

| Common Name | *Scientific Name* | Cal-IPC Ranking | Growth Habit |
|---|---|---|---|
| Italian thistle | *Carduus pycnocephalus* | Moderate [1] | Annual |
| Bull thistle | *Cirsium vulgare* | Moderate [1] | Biennial |
| Poison hemlock | *Conium maculatum* | Moderate | Annual/Biennial |
| Cotoneaster | *Cotoneaster franchetii* | Moderate | Perennial |
| Bermuda grass | *Cynodon dactylon* | Moderate | Perennial |
| French broom | *Genista monspessulana* | High | Perennial |
| English ivy | *Hedera helix* | High | Perennial |
| Velvet grass | *Holcus lanatus* | Moderate | Perennial |
| Prunus | *Prunus sp.* | Limited | Perennial |
| Pyracantha | *Pyracantha sp.* | Limited | Perennial |
| Wild Radish | *Raphanus sativus* | Limited | Annual/Biennial |
| Himalaya blackberry | *Rubus armeniacus* | High | Perennial |
| Milk thistle | *Silybum marianum* | Limited | Annual/Biennial |

1 - species has a pest rating of "C" by CDFA

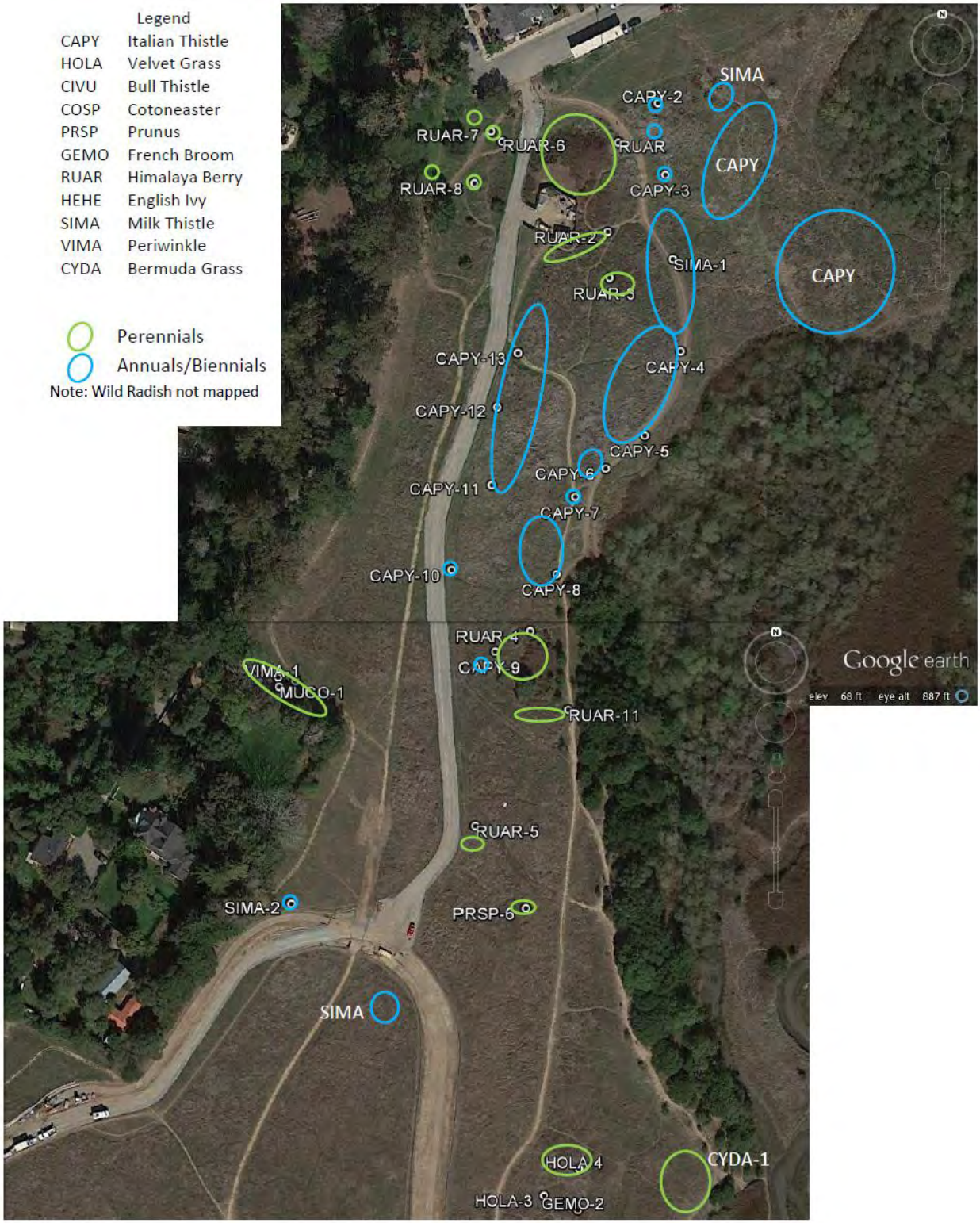


**Figure 3.Occurences of Invasive Weeds, Northern Area, April 2015**

Legend

| | | | |
|---|---|---|---|
| CAPY | Italian Thistle | HOLA | Velvet Grass |
| CIVU | Bull Thistle | COSP | Cotoneaster |
| PRSP | Prunus | GEMO | French Broom |
| RUAR | Himalayan Blackberry | HEHE | English Ivy |
| SIMA | Milk Thistle | COMA | Poison Hemlock |
| PYSP | Pyracantha | | |
| Note: Wild Radish not Mapped | | PHSP | Canary Grass |

Perennials

Annuals/Biennials

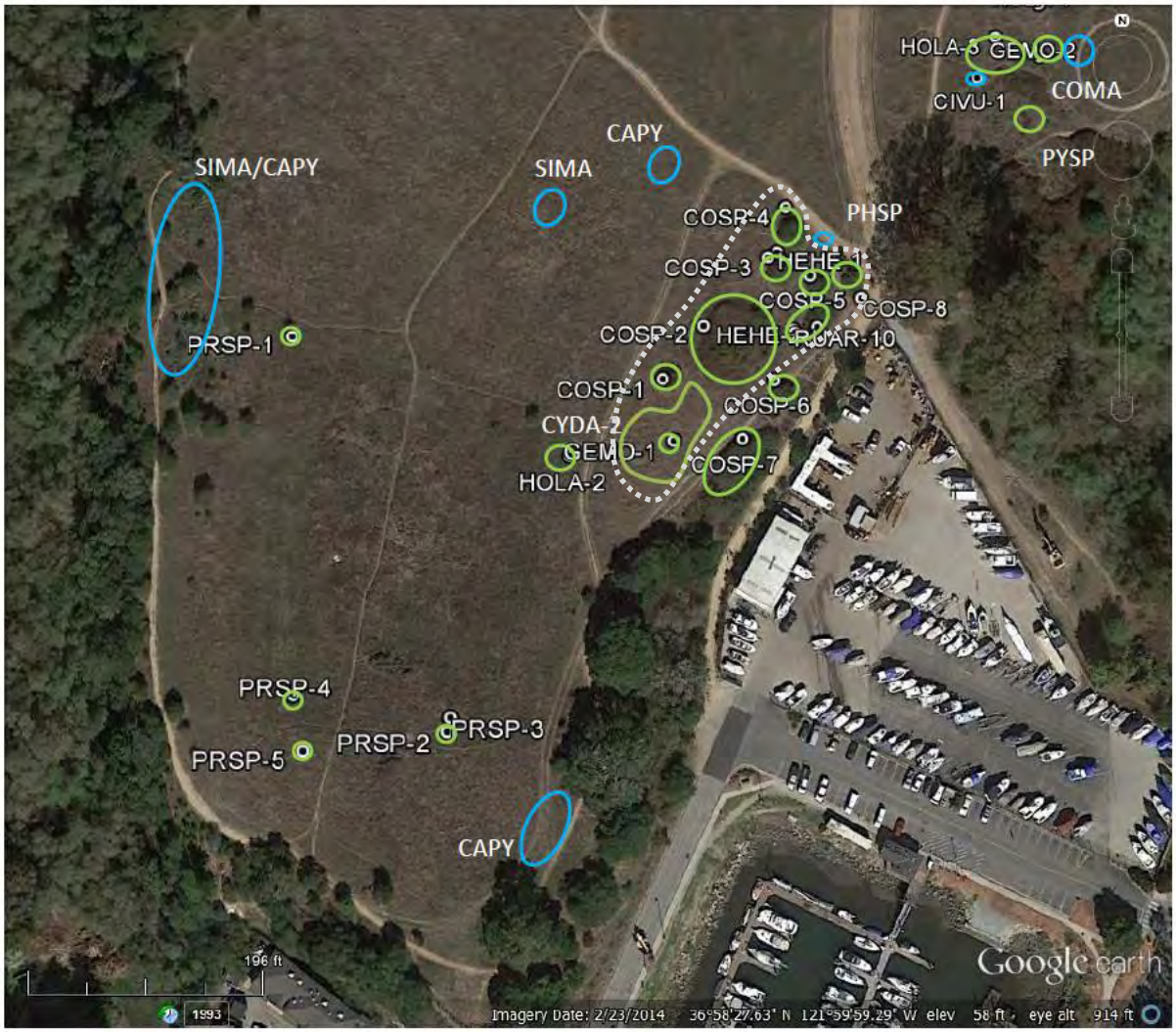


**Figure 4. Occurrences of Invasive Weeds, Southern Area, April 2015**

Note: This area of cotoneaster, Himalaya blackberry, ivy and French Broom treated in June 2015.

# CHAPTER 3.0

# INVASIVE WEED MANAGEMENT

The management of invasive weeds within the IWWP area refers to the removal/control of invasive, non-native plant species that have been considered an immediate and/or significant threat to the adjacent coastal prairie, including habitat areas for the Santa Cruz tarplant (*Holocarpha macradenia)*. The desired manner for the control of these species is for City maintenance personnel (or City contractors or volunteers) to remove the occurrences such that weeds are reduced from the project area. Removal of these plants will also reduce weed seeds that can re-infest the project area and surrounding areas. This chapter describes the various weed management techniques that can be used and identifies the most effective techniques for each species.

## 3.1 INVASIVE WEED CONTROL TECHNIQUES

Invasive weeds within the IWWP area can be controlled through hand removal/cutting, mechanical weed whipping/mowing, solarization, grazing/browsing, and herbicide application. Passive revegetation is also a viable control technique for some species and locations and for long-term weed abatement.

The most effective control techniques must take into account a species growth pattern, its reproductive characteristics, and its occurrence or level of infestation with the project area. Control and eradication techniques must also take into account a species growing cycle, particularly the flowering period and seed production/release periods. Table 4 identifies the growth patterns and the potential control techniques for each invasive weed species currently found within the IWWP area. The invasive ranking of each species within the project area is also identified. This ranking is based on the species CDFA ranking, Cal-IPC ranking, and observations of its occurrence/infestation within the project area.

### 3.1.1 Field Training

Although supervision as to timing, technique and general location for invasive plant management can be provided for personnel performing invasive plant fieldwork, the personnel performing the work will need to be capable of operating independently. Untrained personnel will cause negative impacts on plant management results. Therefore, a certain level of field training is required for success. Such training should also be provided so that the methods and skills are readily transferable to future workers.

Training should include, but not be limited to, the follow skills and abilities:

- The ability to identify the key invasive plant species likely to be encountered within the IWWP area. This could be achieved by disseminating a booklet of major invasive plants (see Appendix A) and field training sessions.
- The ability to identify the key native plants species likely to be encountered within the IWWP area. This could be achieved by disseminating information on native plants in the project area and field training sessions (see Appendix B).
- Although field personnel often have a high degree of skill with various types of equipment, details of proper techniques and timing should be provided to achieve maximum efficiency and success.
- Instructions if field personnel encounter plants, animals or situations outside of their scope of training, including the proper course of action when these situations occur. General guidance should be provided to workers to limit harm to sensitive or protected

habitats (such as Santa Cruz tarplant areas) including guidelines to employ that would limit the disruption of work.

- Use adaptive management strategies. Field personnel may have useful and efficient ideas and methods for doing a given task. Field supervisors should be encouraged to consider new ideas and potential improvements based on monitoring the effectiveness and effects of actions implemented on both the targeted species and the habitat, short and long-term.

### 3.1.2 Grubbing

Within the IWWP area, grubbing, *both with tools and by hand,* is often a suitable and efficient treatment for infestations of thistles, French broom, English ivy and most other invasive weeds found in isolated small to moderate patches. Grubbing is often used during the Bradley Method. The Bradley Method is a technique where invasive plants are completely removed around the perimeter of desirable, existing native plants to create noncompetitive growth patches for the native plants.

Additionally, hand grubbing may be used to create controllable perimeters around large patches of weeds or to provide buffers around patches of desirable native species. Depending on the species targeted and the timing of the treatment, biomass created by grubbing may need to be bagged and removed for proper disposal. Plants that should be carefully bagged and removed for disposal include species that re-sprout from spreading rhizomes or stems, such as Harding/canary grass and Bermuda grass. Table 4 provides specific details for grubbing individual plant species.

**General Rules for *Grubbing*** (there are exceptions to these general rules)

- If the plant has gone to flower, the floral heads should be bagged and removed for proper disposal.
- If the plant has runners (rhizomes or stolons) all parts of the plant should be bagged and removed for disposal.
- If plants are to be root cut, they should be cut below the root crown (greater than 2" below the surface) and prior to flowering.
- Small to moderate woody stem plants may be girdled, if it is safe to do so and it is not efficient to dig them up or remove them by hand.
- If you are not sure if a plant is an invasive species, do not remove it until it has been identified.

There are a number of hand tools that are widely used for ***grubbing*** specific types of invasive plants. Commonly used tools include:

- Rakes - Rakes may be used to remove lose biomass, establish clear perimeters or remove dense non-woody spreading plants or vines.
- McLeod/fire rake - These tools are used to clear areas to bare earth for controllable perimeters or when utilizing the Bradley Method.
- Pulaski/hand pick - These tools can be used like an axe, hoe, small shovel, or pick to cut large or woody plants, clear earth, dig holes, or girdle trees.
- Round-pointed shovel - Depending on type, shovels are efficient for cutting roots, exposing rhizomes and establishing perimeters.
- Soil knife- A soil knife is useful for exposing and cutting the roots of individual plants or small patches of plants. This tool can be easily carried in a pouch.
- Scythe/hand scythe - The scythe is not commonly used, as it requires proper training in both use and sharpening. However, the scythe is increasingly being used to cut grasses, as it is proving to be faster, quieter, and more effective than weed whipping when the proper technique is developed. It can be useful when disturbance to wildlife is a concern. The

hand scythe is useful for small areas of grass, in sensitive areas. Use of the hand scythe does not require any training.

- Axes, saws, loppers and pruners - These tools are used to remove woody-stemmed plants or large/tough stemmed herbaceous plants, such as late season thistles.
- Serrated knife- Knives can be carried at all times and used to cut, saw, or girdle small woody-stemmed plants or tough stemmed herbaceous plants.
- Strapping or chains- These can be used with vehicles, come-alongs, or winches to pull plants such as jubata pampas or cotoneaster out of the ground.
- Hoes- Discussed below.

### 3.1.3 Hoeing

Hoeing invasive weeds is an effective technique to remove small groups of plants and/or individual occurrences, particularly in areas with loose soil.

Typically, hoeing should occur prior to flowering, with the plant cut 2-4" below the ground surface (or below the root crown in hard soils). If flowers are on the plant, the cut/removed material should be bagged and removed from the site. If no flower heads have formed, the cut material can be left on site. Hoeing can be used at all times of the year, although plant removal before the flowering season (typically spring) is usually the most effective as a means of reducing weed seeds in the project area.

Within the IWWP area, hoeing is a suitable treatment for all species where they occur as small, densely concentrated infestations. Plants that can re-sprout from spreading rhizomes or stems, such as Bermuda grass should be removed in a controlled, careful manner such that hoeing does not encourage the species growth. Table 4 identifies species suitable for hoeing. Table 5 displays the typical flowering period for the invasive weeds currently found within the IWWP area; this table should be consulted such that hoeing is conducted prior to flowering.

### 3.1.4 Mowing and Weed-Whipping

As depicted on Table 4, many invasive weed species can be controlled with a properly timed mowing and/or weed whipping program.

To be an effective invasive weed control technique, a mowing or weed -whipping program needs to be timed to mow in the spring (prior to flowering and seed set – see Table 5), then possibly again in summer and/or early fall, depending upon the rainfall year and the species targeted. This type of mowing or weed-whipping program will adequately control most invasive weed species.

Within the IWWP area, mowing and weed-whipping is a suitable treatment for thistles (Italian thistle, bull thistle, and milk thistle) as well as many of the other targeted species. Specifications for each of these species are listed in Table 4.

**Flail Mowers.** By definition, a flail mower uses banks of flails (or "knives") instead of blades. A flail is a short piece of metal that operates by beating the grass (flailing it) and breaking it off. The stems are cut into small pieces, which can shorten the drying time and speed decomposition. Flail mowers have a tendency to minimize the bunching and the lumping of cut material. The cut from a flail mower is very distinctive; the flails are often Y-shaped, or sometimes a half-Y, giving the mowed grass a combed or ridged appearance.

**Rotary Mowers.** Rotary mowers cut larger pieces of grass and weeds. This type of mower is useful if the material is to be raked and baled.

**Walk Behind Mowers.** Walk behind mowers of commercial quality, such as the large DR mowers, provide an effective tool between large scale tractor mowing and weed whipping. These mowers can cut a path of 24-30" and are capable of cutting almost any weed that is less than 1.5-2", including wood stemmed plants. These mowers are self propelled with multiple forward speeds and reverse. They have fat rubber tires and can work banks up to 15-20 degrees. They should be effective for wild radish, Harding grass and similar tough weeds. They are useful in areas where tractor mowers cannot or should not go due to habitat constraints. They allow more careful control of potential negative effects on wildlife or desirable plant species, particularly with regard to flail mowers. However, like many rotary mowers, they cut at a set height of 4". This maybe too high for effective control of some species, such as Italian or slender flowered thistle.

**String Trimmers/Weed Whips (includes Tri blades and metal blades).** If possible, the use of both types of string trimmers/weed whips is recommended. There are significant benefits and roles for each type, if they are utilized for the correct purposes. A walk behind string trimmer can have distinct advantages and disadvantages with regard to a hand held unit. Often this leads to greatly reduce time required to treat a given area.

Advantages include:

- Use of much thicker string and greater power allows the user to cut much heavier and thicker vegetation consistently.
- Units cut a wider path, so they cover a larger area on each pass.
- These machines require less physical exertion for some applications.
- These types of units are more efficient when cutting straight lines or levels areas

Disadvantages include;

- These units have adjustable heights for the string, but do not cut lower than 1.5 inches, which can be significant for effectiveness on some species, such as Italian thistle.
- When cutting on uneven ground with many narrow depressions, achieving even cutting height can become difficult. Additionally, the narrow wheels can get caught in narrow ruts or depressions.

**General notes for string trimmers or weed whipping:**

- The City typically uses metal-bladed weed whips. During dry summer months or after vegetation has dried appreciably, the use of metal blades is discouraged as they may strike rocks or metal, thereby producing sparks that can start fires. Additionally, metal blades can create a wind effect that limits their effectiveness, on some plant species. If metal blades must be used during the late spring, summer or fall prior to the rainy season, City crews must provide and practice fire prevention controls during weed-whipping, such as a hand-held water sprayer or truck-mounted water tank. As plastic tri-blades will not start fires and can provide a high level of control in areas with desirable native plants or grasses, their use should be considered, as a viable alternative to metal blades for many applications where string will not work.
- Whenever it is possible, the timing for weed-whipping should be based on the biology and life cycles of the targeted species. Incorrect timing leads to reduced control effectiveness, requires additional treatments, allows greater seed spread and creates a general increase in resource expenditures.
- Both hand held and walk behind string trimmers/weed whips are useful. For a specific application one will hold an advantage in effectiveness, for example a hand held is most effective for Italian thistle, highly uneven ground, smaller mixed patches of plants. A walk behind is most effective along pathways, large level areas, thick, woody or fibrous plants (such as wild radish).

**General notes for hand held *weed-whipping:***

- Invasive weeds should be cut as close to the ground as possible without causing significant increases in erosion potential or damaging desirable plant species.
- Table 5 provides a general guideline on the correct timing for the initial weed-whipping. The timing presented in this table will often need to be adjusted for conditions found during physical site inspections or seasonal monitoring
- Weed-whipping should be timed to deplete the root reserves of invasive plants, to the maximum extent possible. Correct timing can also greatly reduce the number of re-treatments and the effort required during re-treatments.
- All flower heads that have gone to or are likely to go to seed should be bagged and removed from the site. If noted for specific species (Table 4), all biomass should also be bagged and removed from the site.

Weed Whipping Thistles (Italian thistle, slender-flowered thistle, bull thistle, milk thistle) - The general concept for weed whipping these four species of thistles are similar, although bull thistle is a biennial and milk thistle can be biennial. However, there are distinct differences in practical treatment effectiveness between some species. The idea is to whip the thistles when their root reserves are depleted to the maximum extent. This limits re-growth of individual plants and reduces the number of repeat treatments required and the effort needed for the treatment.

The timing of the initial weed-whipping is critical. The optimum period for treatment varies for each species, although there may be an overlap for milk thistle with the other 3 species. This should not present a significant problem in many cases, although it may cause a reduction in the effectiveness in treatment of for one species, if they both have high density within a joint patch. Local conditions require site inspections to determine the exact timing. The initial weed-whipping should occur soon after the thistle has bolted (the main stem has risen from the basal leaf grouping) and during the period when the flower buds are forming or have formed, but have not yet opened.

With the correct timing this method can be highly effective on Italian or slender flowered thistle and may only require a quick hand pull session as a secondary treatment. As bull thistle and milk thistle are often biennial, have significantly larger roots, energy storage, and flower later in the season than Italian and slender thistle, the initial weed whipping for both bull and milk thistle likely will occur at a different time. Additionally, weed whipping bull thistle is not as effective a technique, as it is for Italian or slender thistle. Bull and milk thistle may require the use of Tri-blades instead of string and require additional weed whipping. However, the initial bull thistle treatment may correspond with a secondary treatment for the Italian and slender thistle species. Finally, as all thistles in an area do not bolt at the exact same time, several sessions over a period of a couple weeks may be required. If funding or labor availability is limited, the initial weed whipping should occur when the majority of thistles have bolted, creating buds and possibly when a few have gone to flower. If the timing is correct, only one shorter re-treatment may be necessary, particularly for Italian and slender flowered thistle. A periodic inspection of the thistle sites should be scheduled to determine the number and timing of re-treatments. Any thistle flowers that have opened or about to open should be bagged and removed from the site

### 3.1.5 Solarization

Within the IWWP area, solarization is a suitable treatment for the small patches of Harding/canary grass and Bermuda grass (Table 4). For these two species, a minimum thickness 10mm black plastic needs to be in place for one or more years (Harding grass) or six months (Bermuda grass) to effectively kill the plant/plant roots and the successional weed seeds. Additionally, treatment by solarization may be suitable for isolated large patches of other invasive

weeds (such as the roots of cotoneaster or pyracantha), depending on location, slope and proximity to desirable native plants. Potential concerns/problems with the solarization method are the long time the site needs to be covered to fully kill the weed species, the plastic waste created and if human or animal activities are likely to consistently damage or remove the plastic. Solarization may not be a good treatment for depressions or sloped areas where soil may deposit onto the plastic, where insufficient temperature and hours of sunlight prevent proper results, or where aggressive woody species are common.

### 3.1.6 Spot Application of Herbicide and Organic Sprays

The use of herbicides and organic sprays may also be suitable for some of the invasive species. All herbicide use should be used in a manner that will not negatively impact the adjacent native vegetation. Although herbicide use can prove economically attractive, the IWWP recommends the use of herbicides only where other management techniques would prove impractical or are not economically viable.

Within the IWWP area, spot application of herbicide may be a suitable treatment for biennial thistles, cotoneaster, French broom, English ivy, pyracantha, *Prunus,* and Himalaya blackberry. Herbicide use is typically effective when combined with mechanical cutting/removal techniques and/or applied to coincide with plant growth/uptake. This allows for the use of the least amount of herbicide and often eliminates the need to surfactants. Methods of application should be limited to those with the lowest probability of damage to surrounding habitat, such as cut and paint and selective, targeted foliar spray. In some cases, multiple applications will be required. Strict adherence to manufacturing and agency guidelines should be observed, as the minimum standard. Often stricter guidelines than labels or agencies require can achieve the same result. A licensed herbicide applicator with restoration experience should be consulted regarding herbicide use within the IWWP area.

In recent years, several organic, contact-type herbicide products have appeared on the market. These organic sprays include the soap-based product, Scythe™, (produced by Mycogen), clove oil products, Matran II (produced by EcoSmart), and acetic acid/citric acid products, AllDown (produced by Summerset) (UC Davis, 2007). These products damage any green vegetation contacted, though they are safe as directed sprays against woody stems and trunks. Because these herbicides only kill contacted tissue, good coverage is essential. Adding an organically acceptable surfactant is also recommended. Because these materials lack residual activity, repeat applications will be needed to control new flushes of weeds. Recent work has also examined essential oils as potential herbicides. It was found that clove oil or cinnamon oil at concentrations of 1 to 5% controlled most small weeds. The use of organic sprays could be evaluated for use within the IWWP area as part of a pilot project if so desired by the City.

## 3.17 Grazing/Browsing

Within the IWWP area, cattle-grazing is available in three fenced areas. As of July 2015, grazing occurred in Areas A, C, and D in 2015 from the end of February through June (see Figure 2). Grazing is a suitable treatment for velvet grass, and Harding/ canary grass; however, it is less effective on thistles and wild radish, due to the unpalatable nature of these plants and potential toxic effects of wild radish when consumed in quantity.

Grazing by cows may prove helpful in reducing the amount of velvet grass and Harding/canary grass. Cattle will graze these grasses when they are young and short but as they get taller/older cattle will begin to avoid them; therefore, timing is important if grazing is used to control these species (Devii Rao, pers. comm.., 2015). Cattle can remove biomass, thereby lowering green waste removal costs; however, they do not kill many invasive plant species and re-infestations

occur unless secondary control methods are utilized in conjunction with the cattle grazing. Currently grazing within Areas A, C and D is being used as a management tool for Santa Cruz tarplant recovery and not as a primary means of invasive weed control. Once Santa Cruz tarplant recovery is achieved the City could re-evaluate the timing, intensity and duration of grazing for invasive weed control purposes.

### 3.1.8 Mulching

Within the IWWP area, mulching may be a suitable weed control treatment in some areas. In suitable areas, wood chip mulch, placed three-four inches deep can be used to suppress some species re-growth. Mulch use would be most suitable for areas where initial control methods were implemented (i.e., hoeing, weed-whipped, herbicide application) and where the wood mulch would not migrate into intact prairie or areas suitable for the growth of Santa Cruz tarplant or other prairie-dependent plant species. However, mulch may also limit the spread of desirable plant species or lead to growth of specific weeds that flourish in the loose organic matter.

### 3.1.9 Passive Revegetation

Within the IWWP area, passive revegetation is a suitable treatment for expanding stands of desirable native plants (e.g., purple needlegrass, California oatgrass, and creeping wild rye) that are vigorous and have the potential to spread into areas infested by invasive weeds. The IWWP area supports areas of thistles and wild radish that are growing adjacent to native vegetation (i.e., areas supporting purple needlegrass and California oatgrass). In these areas, selective removal/control of the invasive weeds (while retaining the surrounding or adjoining native vegetation) will allow the native plants to spread and, over time, out-compete the invasive weeds.

Where invasive weeds abut stands of native plants, selective removal of the weeds should be done using hand labor such that there is minimal impact to the native plants to be retained.

## 3.2 IMPLEMENTATION SCHEDULE AND ADAPTIVE MANAGEMENT

Weed control should be timed to coincide with specific weather and plant growth conditions. As much as is possible, let the biology guide the timing of the treatment. Most invasive weed infestations can be effectively controlled when treatments are implemented prior to plant flowering, which reduces seed formation. Some biennial and perennial species are best treated after flowering, when plant nutrients are being expended and treatment actions can stress the plant, reduce its vigor, and inhibit its ability to reproduce. Other species may be best treated when they are focusing on drawing nutrients into the roots or stems for storage (i.e., English ivy, Himalaya blackberry).

Table 6 presents a generalized schedule of invasive weed control and maintenance. This schedule should only be used as a guide, as plant growth, including timing of flowering and seed set, are greatly influenced by rainfall and temperature patterns. Also, various techniques may require changing patterns to maximize effects. Management actions should be updated and refined in response to weather patterns, plant responses, and as new information on weed control/treatment is gathered.

All management actions should be monitored as to their effectiveness. Adaptive management techniques should be used to update, revise, amend, and improve the IWWP.

The actions identified on Table 6 are most suitable for the ungrazed areas where management actions (such as seasonal mowing or weed-whipping) will not affect the amount of forage

available for the cattle. Spot weed control methods, such as hand removal or hoeing thistle occurrences, may be the most suitable control methods within the grazing areas.

## 3.3 PRECAUTIONS TO PROTECT SENSITIVE BIOTIC RESOURCES

Implementation of some weed management activities has the potential to harm native plant and animal species, if such resources are present in the work area. For example, ground nesting birds can be harmed if they have nests within areas subject to mowing during the bird nesting season. Native plants, including the endangered Santa Cruz tarplant, can be harmed if weed control activities inadvertently weed-whip these plants. Measures are described in this section on actions to be implemented to avoid impacts to non-target plants and animals.

### 3.3.1 Pre-Construction Bird Nest Survey

When invasive weed removal work is to occur within the bird-breeding season (i.e., March 1 through August 15) measures are needed to ensure work does not affect nesting birds, as all migratory bird nests are protected under the Federal Migratory Bird Treaty Act.

Prior to weed-whipping or mowing the work area should be walked and inspected to determine presence/absence of nesting migratory birds. This survey should be conducted by a qualified biologist or trained City personnel. Meandering walking transects should be conducted through the work area up to 7 days prior to work. If birds are found nesting within or immediately adjacent to the proposed work area, reschedule work until young have fledged, as determined by a qualified biologist, or the biologist shall establish an appropriate sized buffer zone around the nest(s) where no work shall take place until all young have fledged.

### 3.3.2 Pre-Construction Native Plant Survey

When invasive weed removal work is to occur within any of the historic Santa Cruz tarplant areas (Areas A, B, C, or D, as depicted on Figure 2) measures are needed to ensure work does not affect any above or below ground tarplants (plants or seedbank), pursuant to the City's permit with California Department of Fish and Wildlife (Scientific, Education, or Management Permit No 2081(a)-13-013-RP). Prior to work, all workers shall receive on-site training on the Santa Cruz tarplant, identification information, and information on work actions to avoid take of the species. A worker training brochure shall be provided to workers (see Year 1 HMP Annual Report for copy of worker training brochure).

Invasive weed control work shall avoid/minimize adverse impacts to native plants on site.

The native plant species to be avoided are those currently on site or previously documented:

- Santa Cruz tarplant (*Holocarpha macradenia)*
- California oatgrass (*Danthonia californica*)
- purple needlegrass (*Stipa pulchra)*
- coast tarweed (*Deinandra corymbosa)*
- pretty face (*Triteleia ixioides)*
- dwarf brodiaea (*Brodiaea terrestris)*
- Choris's popcorn flower (*Plagiobothrys chorisianus)*
- Indian thistle (*Cirsium brevistylum)*
- yellow mariposa lily (*Calochortus luteus)*
- California aster (*Corethrogyne filaginifolia*)

Appendix B contains photos of each of these plant species; this information should be provided to workers.

## 3.4 IMPLEMENTATION SCHEDULE

Table 5 displays the typical flowering period of the targeted invasive weeds currently found with the IWWP area. This table, together with Table 6, can be used as a guideline for determining the optimum timing for invasive weed control. Table 6 presents a calendar year schedule with optimum periods of weed control for each species.

### 3.4.1 Invasive Weed Control Implemented in 2014 and Spring 2015

Invasive weed control with the Coastal Prairie Management Area was initiated in 2014 wherein the City cut several *Prunus.* In addition, The City initiated control of Himalaya blackberry thickets in 2014 by brush-cutting several dense stands that were growing in Grazing Area C. The entire management area was flail mowed in spring 2014.

Management actions in 2015 (to date) have included mowing of Tarplant Area B (April 2015) and mowing the northern portion of the management area (May 2015). Due to periodic episodes of wet weather through May 21, mowing of other areas did not occur until late May. Cattle-grazing occurred in all grazing areas from late February through June. Also in June a large patch of cotoneaster, with Himalaya blackberry, English ivy, and French broom, was removed from the management area (see Figure 4). Cattle grazing also provided some weed control within this grazing area as they grazed on wild radish patches.

Invasive weed control actions are identified for the remainder of 2015. Despite many invasive weeds having already flowered and many with seed set (i.e., wild radish, Italian thistle, and milk thistle); the following actions are recommended for the remainder of 2015:

<u>Recommended Invasive Weed Actions (July 2015 – December 2015)</u>

**Italian and Slender-flowered Thistle**

- Spot occurrences: pull plants up or cut flowering stalks, bag plants or seed heads and remove from site; will reduce seed release for 2015.
- Large infestation: Weed whip or mow for aesthetic/trail clearance purposes or to improve grazing areas and to lower the profile of potential seed spread; will not affect seed release for 2015. Potential for seed spread does exist from equipment; protocols for equipment movement with the habitat and on access paths should be established.

**Milk Thistle**

- Spot occurrences: cut flowering stalks. Cut and bag flower/seed heads and remove them from site; will reduce seed release for 2015, if flower/seed heads are cut and bagged.
- Large infestation: Mow for aesthetic/trail clearance purposes, fire control and to improve grazing areas; will not affect seed release for 2015. Potential for seed spread does exist from equipment. Protocols for equipment movements within the habitat should be established and followed.

**Bull Thistle**

- Spot occurrences: Shovel cut/dig up roots prior to flowering, or cut flowering stalks, bag the flower/seed heads and remove them from the site; will reduce seed release for 2015.
- No large infestation have been noted within the area, as of 2015.

**Poison Hemlock**

- Spot occurrence: Hand pull/shovel cut the roots. Bag all plant parts and remove them from site

**Wild Radish**

- Mow all infestations except small patches or isolated plants in desirable habitat patches. Isolated plants may be dug up and removed from site.

**Cotoneaster and Pyracantha**

- Cut and paint these with herbicide. No surfactant is required. Woody mass with no berries or seeds may be chipped on site. All woody mass with flowers, berries or seeds should be removed from the site

**Himalayan Blackberry**

- Individual or small patches may be dug up, including the roots. Larger patches should be sprayed with herbicide in the late summer or early fall.

***Prunus***

- Cut and paint these with herbicide. No surfactant is required. Hand pull or weed-wrench small seedlings.

### 3.4.2 Invasive Weed Control for 2016

Table 6 presents a calendar year schedule with optimum periods of weed control for each species. Actions in 2016 are scheduled to be implemented according to this schedule.

**Table 4. Levels of Invasive Weed Infestations and Potential Control Techniques, Coastal Prairie Management Area**

| Common Name | Scientific Name | Invasive Weed Ranking | Infestation Threshold | Growth Pattern | Potential Control Techniques |
|---|---|---|---|---|---|
| Italian thistle | *Carduus pycnocephalus* | Moderate | Greater than 25 plants or patch greater than 25 sq. ft.<br>Site documented to support over 15 patches (2015) or varying size and density | Annual (sometimes biennial)<br>Spread by seeds on wind, vehicles and animals; most seeds germinate in fall and spring; basal rosettes can over winter and crowd out native plants. | a. Hand pull plants prior to flowering.<br>b. Weed whip after the plant bolts, but before most of the flowers opens. Requires a brief revisit to treat missed plants Shovel cut basal rosettes, cutting taproot below crown (2-4") in early spring prior to bolting.<br>c. After plant bolts, yet before flowers open, shovel cut or hoe plants, cutting taproot below ground 4-6", remove seed head, bag and dispose; or prior to flowers opening, cut off seed head, bag and dispose.<br>d. Hand pull plant and bag flower heads if they have flowered.<br>e. Multiple mowing from late spring to early summer, after bolting, yet before seeds form.<br>f. Spot spray with herbicide in late fall on rosettes or in spring before flowering stalks form. Spot spray with herbicide when plants are >10" tall. |
| | ***Management Goal:*** Reduce number of patches to <5 in 5 years | | | | |
| Bull thistle | *Cirsium vulgare* | Moderate | Greater than 25 plants or patch greater than 25 sq. ft.<br>Site documented to support one patch (2014) | Annual or biennial<br>Spread by seeds on wind, vehicles and animals; seeds germinate in fall after first rains or in spring; first year basal rosettes persist through summer and can over winter and crowd out native plants. | a. Shovel cut the plant, dig up the root as completely as practical shortly before flowering; bag and remove any open flowers.<br>b. Mow after bolting, prior to flowering.<br>c. Spot spray with herbicide in late fall on rosettes or in spring before flowering stalks form. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |

**Table 4. Levels of Invasive Weed Infestations and Potential Control Techniques, Coastal Prairie Management Area**

| Common Name | Scientific Name | Invasive Weed Ranking | Infestation Threshold | Growth Pattern | Potential Control Techniques |
|---|---|---|---|---|---|
| Poison Hemlock | *Conium maculatum* | High | Greater than 5 plants or patch greater than 25 sq. ft.<br>Site documented to support one patch (2015) | Annual or biennial<br>Spread by seeds on vehicles and animals; basal rosettes over winter and crowd out native plants, yet individual plants die after setting seed. | a. Hand pull small to moderate patches before the ground dries completely.<br>b. Shovel cut or hoe plant, cutting taproot below crown (2-4") shortly before flowering. If the plant has flowered, remove seed head, bag and dispose. If possible, bag and remove the entire plant under any circumstances.<br>c. Spot spray with herbicide in late spring before flowering stalks form. No surfactant may be needed. |
| | ***Management Goal**:* Reduce number of patches to 0 in 5 years | | | | |
| Cotoneaster | *Cotoneaster spp.* | Moderate | Greater than 25 plants or patch greater than 25 sq. ft.<br>Site documented to support eight patches (2014) | Perennial<br>Spread by seeds on wind, vehicles and animals; plants can re-sprout from cut stumps and roots. | a. Manually remove small plants; cut stems of larger plants, leaving roots in place; apply cut-stem application of systemic herbicide to reduce stump and root re-sprouting. No surfactant is needed.<br>b. Re-check area for sprouting seeds, hand pull seedlings in spring when soil is moist. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |
| Bermuda grass | *Cynodon dactylon* | Moderate | Patch greater than 50 sq. ft.<br>Site documented to support two patches in 2014 | Perennial<br>Spread by vegetative growth from creeping rhizomes and stolons and by seed. | a. Manual removal of rhizomes and stolons removing all root pieces and seed heads, bag and dispose.<br>b. Avoid mechanical cutting of rhizomes and stolons and transport of cut pieces to new locations.<br>c. Summer solarization for minimum of 6 weeks with 10mm black plastic or 30 mil landfill liner (if available).<br>d. Spot spray with systemic herbicide, after flowering in summer to mid-fall. |
| | ***Management Goal:*** Reduce size of existing patch to <25 sq. ft. in 5 years | | | | |

**Table 4. Levels of Invasive Weed Infestations and Potential Control Techniques, Coastal Prairie Management Area**

| Common Name | Scientific Name | Invasive Weed Ranking | Infestation Threshold | Growth Pattern | Potential Control Techniques |
|---|---|---|---|---|---|
| French broom | *Genista monspessulana* | High | Greater than 5 plants or patch greater than 15 sq. ft.<br>Site documented to support two patches in 2014 | Perennial<br>Spread by seeds; seeds viable 5-30 years; plants can re-sprout from cut stumps. Can flower twice a year at some locations. | a. Hand pull and pull with weed wrenches, removing entire mature plant; repeat yearly for 5years. If practical, apply multiple treatments each year to speed up depletion of the seed bank. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |
| English ivy | *Hedera helix* | High | Greater than 15 plants or patch greater than 25 sq. ft.<br>Site documented to support two patches in 2014 | Perennial<br>Spread by seeds and sprouts from stem pieces; vigorous vine growth. | a. Hand-pull small to moderate/large patches.<br>b. Cut ivy and apply herbicide directly to the cut stem, within 5 minutes.<br>c. Apply a foliar spray application of herbicide in the later summer/early fall. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |
| Velvet grass | *Holcus lanatus* | Moderate | Patch greater than 100 sq. ft.<br>Site documented to support four patches in 2014 | Perennial<br>Spreads by seed; seeds disperse short distances yet germinate readily. | a. Manual removal of plants removing all root pieces and seed heads, bag and dispose.<br>b. Intensively mow or weed-whip to reduce vigor, repeat several years.<br>c. Graze low and repeatedly during the growing season to control.<br>d. Spray with herbicide (no surfactant) prior to flowering. |
| | ***Management Goal:*** Reduce size of existing patches to <100 sq. ft. in 5 years | | | | |

**Table 4. Levels of Invasive Weed Infestations and Potential Control Techniques, Coastal Prairie Management Area**

| Common Name | Scientific Name | Invasive Weed Ranking | Infestation Threshold | Growth Pattern | Potential Control Techniques |
|---|---|---|---|---|---|
| Harding grass | *Phalaris aquatica* | High | Patch greater than 100 sq. ft.<br>Site documented to support one patch (2015) | Perennial<br>Spreads by seed and spreading underground stems (rhizomes). | a. Avoid mechanical cutting of rhizomes and transport of cut pieces to new locations.<br>b. Remove small patches, removing all root pieces and seed heads, bag and dispose.<br>c. Mow close late in season to reduce vigor, repeat several years. Apply herbicide.<br>d. Solarization for ≥1 year with 10mm black plastic.<br>e. Spot remove young Harding/canary grass seedlings. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |
| Prunus | *Prunus sp.* | Limited | Greater than 5 plants or patch greater than 25 sq. ft.<br>Site documented to support six patches (2014) | Perennial<br>Spread by seeds on wind, vehicles and animals; plants can re-sprout from cut stumps and roots. | a. Manually remove small plants; cut stems of larger plants, leaving roots in place; apply cut-stem application of systemic herbicide to reduce stump and root re-sprouting. No surfactant is needed. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |
| Pyracantha | *Pyracantha sp.* | Limited | Greater than 1 plant or patch greater than 25 sq. ft.<br>Site documented to support one patch (2015) | Perennial<br>Spread by seeds on wind, vehicles and animals; plants can re-sprout from cut stumps and roots. | a. Manually remove small plants; cut stems of larger plants, leaving roots in place; apply cut-stem application of systemic herbicide to reduce stump and root re-sprouting. No surfactant is needed.<br>c. Re-check area for sprouting seeds, hand pull seedlings in spring when soil is moist. |
| | ***Management Goal:*** Reduce number of patches to 0 in 5 years | | | | |

**Table 4. Levels of Invasive Weed Infestations and Potential Control Techniques, Coastal Prairie Management Area**

| Common Name | Scientific Name | Invasive Weed Ranking | Infestation Threshold | Growth Pattern | Potential Control Techniques |
|---|---|---|---|---|---|
| Wild Radish | *Raphanus sativa* | Limited | Greater than 200 plants or patch greater than 200 sq. ft.<br>Species widespread in grazing areas in 2015. | Annual, sometimes biennial<br>Slender taproot that can reach 3 feet deep.<br>Spread by seeds by, animals and human activities; dried seed pods can persist into winter; seed germination usually occurs in fall after significant rains. | a. Manually remove plants before seed production; mowing may be the most effective control for large areas, but should be done prior to seed formation.<br>b. Goats may browse and eat radish plants, in limited quantities as this plant can be toxic. |
| | ***Management Goal:*** Reduce number of patches to <20 in 5 years | | | | |
| Himalaya blackberry | *Rubus armeniacus* | High | Greater than 50 plants or patch greater than 100 sq. ft.<br>Site documented to support 11 patches in 2014 | Perennial<br>Spread by seeds, spreading vines | a. Hand cut, remove rootstock.<br>b. Establish a controllable perimeter around the edge of each large patch.<br>c. Apply foliar spray of herbicide in late summer/ early fall.<br>d. Cut and paint individual plants with herbicide (no surfactant). |
| | ***Management Goal:*** Reduce patch size to <100 square feet in 5 years. | | | | |
| Milk thistle | *Silybum marianum* | Limited | Greater than 5 plants or patch greater than 100 sq. ft. | Annual or biennial<br>Spread by seeds on wind, vehicles and animals; basal rosettes over winter and crowd out native plants. | a. Hand pull plant and bag if they have flower heads.<br>b. Shovel cut plants, cutting taproot below crown 4-6”), after bolting and prior to flowers opening, or remove seed head, bag and dispose.<br>c. Multiple mowing or weed whip with Tri-blades from late spring to late summer, after bolting, yet before seeds form. |
| | ***Management Goal:*** Reduce number of patches to <5 in 5 years | | | | |

**Table 5. Typical Flowering Period of Invasive Weeds, Coastal Prairie Management Area,**

| Common Name | *Scientific Name* | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Italian thistle<br>Slender-flowered thistle | *Carduus pycnocephalus*<br>*Carduus tenuiflorus* | | | | | | | | | | | | |
| Bull thistle | *Cirsium vulgare* | | | | | | | | | | | | |
| Poison hemlock | *Conium maculatum* | | | | | | | | | | | | |
| Cotoneaster | *Cotoneaster spp.* | | | | | | | | | | | | |
| Bermuda grass | *Cynodon dactylon* | | | | | | | | | | | | |
| French broom | *Genista monspessulana* | | | | | | | | | | | | |
| English ivy | *Hedera helix* | | | | | | | | | | | | |
| Velvet grass | *Holcus lanatus* | | | | | | | | | | | | |
| Harding grass/ canary grass | *Phalaris aquatica, P. arundinacea* | | | | | | | | | | | | |
| Prunus | *Prunus sp.* | | | | | | | | | | | | |
| Pyracantha | *Pyracantha sp.* | | | | | | | | | | | | |
| Wild radish | *Raphanus sativus* | | | | | | | | | | | | |
| Himalaya blackberry | *Rubus armeniacus* | | | | | | | | | | | | |
| Milk thistle | *Silybum marianum* | | | | | | | | | | | | |

**Table 6. Invasive Weed Treatment – Yearly Implementation Schedule, Coastal Prairie Management Area, Years 1-5 (2015-2020)**

| Task | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly Tasks (Years 1-5)** | | | | | | | | | | | | |
| Conduct field inspection to monitor plant growth and progress of flowering stalks on invasive weed species. Monitor project area for changes in distribution of existing invasive weeds. Update distribution maps as needed. | | | ■ | ■ | | ■ | ■ | | | | | |
| Conduct field inspections to document any new invasive weed species within project area. Update maps as needed. | | | ■ | ■ | | ■ | ■ | | | | | |
| Prior to the spring flowering season conduct first-season mowing and/or weed whipping (see below).<br>In summer, re-mow/weed-whip as needed (see below). | | | ■ | ■ | | | ■ | ■ | | | | |
| Compile results on management actions and removal efforts; develop treatment plan for next year; insert results into HMP annual report. | | | | | | | | | | | ■ | |
| **Treatment Areas (Years 1-5)** | | | | | | | | | | | | |
| Remove annual/biennial weed species prior to flowering; shovel-cut, hand pull, hoe, weed whip or mow (depending upon species): | | | | | | | | | | | | |
| Italian thistle/ slender flowered thistle | | | ■ | ■ | | | | | | | | |
| Bull thistle | | | | | ■ | ■ | | | | | | |
| Poison hemlock | | | ■ | ■ | | | | | | | | |
| Wild radish | | | ■ | ■ | ■ | | | | | | | |
| Milk thistle | | | ■ | ■ | ■ | | | | | | | |
| Remove perennial weed species before flowering or seed set; mow, cut, hand-pull or hoe the following weeds. | | | | | | | | | | | | |
| Cotoneaster | | | ■ | ■ | ■ | ■ | | | | | | |
| Bermuda grass | | | ■ | ■ | | | | | | | | |
| French broom | ■ | ■ | ■ | | | | | | | | | |
| English ivy | | ■ | ■ | ■ | ■ | | | | | | | |
| Velvet grass | | ■ | ■ | ■ | | | | | | | | |
| Harding grass | | | | | ■ | | | | ■ | ■ | | |
| Prunus | | | ■ | ■ | ■ | ■ | | | | | | |
| Pyracantha | | | ■ | ■ | ■ | ■ | | | | | | |
| Himalaya blackberry | | | ■ | ■ | ■ | ■ | | | ■ | ■ | | |
| Establish solarization plot within Bermuda grass patches. | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | |

## 4.0 MONITORING AND REPORTING

Annual reports prepared for the HMP will present data on the invasive weed control and the attainment of target success criteria, as presented in Table 4, progress toward final success criteria, and any remedial actions required.

### 4.1 Annual Reports

The following activities and results of the IWWP will be included in the HMP Annual Report:

1. Purpose and goals of the invasive weed work
2. Dates of weed abatement activities
3. Results of field data and analysis of success criteria
4. Monitoring photographs
5. Maps identifying treated and monitored areas, as appropriate.
6. Identification of any remedial actions necessary to meet performance standards.
7. List of actions for the next year's maintenance.

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# APPENDIX A

## Invasive Weeds within the IWWP Area

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## ITALIAN THISTLE

*C. pycnocephalus*

## SLENDER-FLOWERED THISTLE

*C. tenuiflorus*

**DISTINCTIVE FEATURES** These thistles have winged stems, are very spiny, and have many-branched stems. They grow as annual or biennial herbs from a basal rosette of spiny leaves. The leaves are deeply lobed; the undersides are slightly to very woolly. Plants typically grow 1- 4 feet tall (Italian thistles can reach 6.5 feet). Rosette is evident in fall and spring, distinguished by thorny patch with leaves that have a white midrib (center rib).

**BLOOMS** Pink to purple in cylindrical heads, with either single or multiple flowers, **May - August.**

**PREFERRED HABITAT** Bare ground, road/trail edges and previously disturbed areas. Often spreads rapidly and forms dense stands by chemically inhibiting the growth of other plants (allelopathy).

## BULL THISTLE

*Cirsium vulgare*

**DISTINCTIVE FEATURES** This thistle grows as a biennial herb. The species has erect, highly branched, stems, arising from a basal rosette. The leaves are alternate and deeply lobed, with a rough, sandpaper-like texture and attach to the stem in awing-like pattern. The leaf tips have spines. The flower heads are 1-2" wide and 1-1.5" tall. Plants typically grow to 2-6 feet tall.

**BLOOMS** Purple-pink, **July - October**.

**PREFERRED HABITAT** Bull thistle is common in coastal grasslands and edges of mesic areas elsewhere in the state. Forms infestations in disturbed pastures, cleared areas and along roads and ditches. It spreads by seed, forming a rosette in year 1, with flowering and seed set in the 2nd year.

## POISON HEMLOCK

*Conium maculatum*

**DISTINCTIVE FEATURES** This member of the carrot family typically grows as a biennial herb from a deep taproot. The species has finely divided leaves arising from an erect, yet hollow, ribbed stem. The stem has characteristic purple spots. The small flowers form a terminal flat-topped cluster on stalks that reach above the leaves. Plants range between 2-10 feet tall.

**BLOOMS** White, **April - July**.

**PREFERRED HABITAT** Poison hemlock occurs throughout California below 5,000 feet elevation. It is commonly found in meadows, along roadsides and riparian area, where there is moist soil during most of the growing season. Poison hemlock spreads by seed and can spread quickly in open areas. The plant is toxic to livestock, wildlife and humans. The plant forms flowering stalks in spring it is 2nd year, with seed set by early summer. Seeds can be dispersed for several months and are viable for up to 5 years.

## COTONEASTER

*(Cotoneaster spp.)*

**DISTINCTIVE FEATURES.** This perennial shrub is common to previously disturbed areas, often becoming established by birds carrying seed from residential area. The numerous red seeds are characteristic of the shrubs. Shrubs can reach over 6 feet tall and can form thickets in favorable growing conditions. It spread from seeds.

**BLOOMS** New plants establish from seed in spring with flowering in late spring (April – July).

**PREFERRED HABITAT** In California, the largest patches are found in previously disturbed areas that are moist in the spring.

## BERMUDA GRASS
*(Cynodon dactylon.)*

**DISTINCTIVE FEATURES.** This perennial grass is common to turf and residential settings. It also invades natural lands and established in moist areas. It spreads by creeping rhizomes and stolons, as well as from seed.

**BLOOMS** Flowering stalks are usually present in the summer months (June - September).

**PREFERRED HABITAT** In California, the largest patches are found in previously disturbed areas that are moist in the spring.

## FRENCH BROOM
*Genista monspessulana*

**DISTINCTIVE FEATURES** A perennial shrub (6-10 ft.). Stem 5-angled in Scotch broom and round in French broom; leaves with 3 leaflets. Bright yellow pea flowers, forming dark brown or black pods.

**BLOOMS** Yellow, **March - June.**

**PREFERRED HABITAT** Previously disturbed areas, recently seeded areas, eroded slopes, riverbanks and road cuts. French broom is limited to the Coast Range.

## ENGLISH IVY

*Hedera helix*

## ALGERIAN IVY

*H. canariensis*

**DISTINCTIVE FEATURES** These aggressive perennial vines are evergreen, becoming woody as it ages. English ivy leaves are 3-5 lobed, leathery and are alternately arranged along the stem. Algerian ivy leaves are generally 3-lobed. Young shoots and leaves often have hairs. The vine produces inconspicuous white flowers, followed by dark blue to black fruit. Some forms have variegated leaves.

**BLOOMS** White, **December - February.**

**PREFERRED HABITAT** Forms spreading patches in coastal forests of California. Prefers shady, disturbed sites with year-round moisture, such as riparian woodlands, moist oak woodlands, and redwood forests. English ivy is native to England, Ireland and northern Europe; it is very frost-hardy. Algerian ivy is native to Tunisia and Algeria and can be frost-damaged.

English ivy

Algerian ivy

## VELVET GRASS

*(Holcus lanatus)*

**DISTINCTIVE FEATURES.** This perennial grass is common in moist areas. It is characterized by its soft, velvety leaves. The leaf blades are covered with long grayish hairs. It spreads by seed.

**BLOOMS** Flowering stalks are usually present in the late spring and summer (May - August).

**PREFERRED HABITAT** In California, the largest patches are found in previously disturbed areas that are moist in the spring.

## HARDING GRASS
*Phalaris aquatica*

## REED CANARY GRASS
*P. arundinaceae*

**DISTINCTIVE FEATURES** These two perennial grasses are distinguished by their gray-blue leaves and dense, spike-like flowering heads. The plant grows from deep, spreading rhizomes, forming a dense, waist-high thicket.

**BLOOMS** Grass heads, **March - September.**

**PREFERRED HABITAT** Forms spreading patches in wet soil conditions. Spreads by seed and underground stems. Native to the Mediterranean region, it is widespread in California since it is used for forage and withstands heavy grazing.

## PRUNUS
*(Prunus spp.)*

**DISTINCTIVE FEATURES.** This perennial tree is common to previously disturbed areas, often becoming established by birds carrying seed from residential areas. Commonly observed *Prunus* specimens can be flowering cherries, plums, or crabapples. The small cherry or plum-like fruit are characteristic of the trees. The foliage can range from green or red-purple. The trees spread from seeds and can re-sprout from cut stumps or roots..

**BLOOMS** These trees typically flower in early spring.

**PREFERRED HABITAT** These tree species can colonize many habitats in California, yet often prefer previously disturbed areas that are moist in the spring.

## PYRACANTHA
*(Pyracantha spp.)*

**DISTINCTIVE FEATURES.** This perennial shrub is common to previously disturbed areas, often becoming established by birds carrying seed from residential area. The numerous red seeds are characteristic of the shrubs. Shrubs can reach over 6 feet tall and can form thickets in favorable growing conditions. It spread from seeds.

**BLOOMS** New plants establish from seed in spring with flowering in late spring (April – July).

**PREFERRED HABITAT** In California, the largest patches are found in previously disturbed areas that are moist in the spring.

## WILD RADISH
*Raphanus sativa*

**DISTINCTIVE FEATURES** Wild radish grows as an annual herb. The lower leaves are deeply lobed; the upper leaves are toothed, often on short stalks. Plants typically grow 2-5 feet tall.

**BLOOMS** White to pink, in terminal clusters; flowers are 4-petaled, **February - June.**

**PREFERRED HABITAT** Bare ground, road/trail edges and previously disturbed areas. Spreads rapidly from seed. Native to Europe.

## HIMALAYA BERRY

*Rubus discolor*

**DISTINCTIVE FEATURES** Himalaya berry is a fast-growing perennial vine, often forming dense thickets or mounds. The leaves are 5-parted, which hooked prickles on the leaf stems. Flowers form at the end of the branches, black berries form when ripe.

**BLOOMS** White, 5-petaled, **April - June.**

**PREFERRED HABITAT** Bare ground, road/trail edges and previously disturbed areas, especially riparian areas. Spreads rapidly from seed and rooting cane tips. Native to Western Europe.

## MILK THISTLE

*(Silybum marianum)*

**DISTINCTIVE FEATURES.** This biennial plant is common to previously disturbed area. The prickly leaves are tinged with white. It grows 1-3 feet tall, forming dense stands in favorable growing conditions. It spread from seeds.

**BLOOMS** New plants establish from seed in spring with flowering in late spring (April – May).

**PREFERRED HABITAT** In California, the largest patches are found in previously disturbed areas that are moist in the spring.

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# APPENDIX B

## Native Plants within the IWWP Area

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## CALIFORNIA OATGRASS
*(Danthonia californica)*

## PURPLE NEEDLEGRASS
*(Stipa pulchra)*

## SANTA CRUZ TARPLANT
*(Holocarpha macradenia)*

## COAST TARWEED
*(Deinandra corymbosa)*

**PRETTY FACE**
*(Triteleia ixioides)*

**DWARF BRODIAEA**
*(Brodiaea terrestris)*

## CHORIS'S POPCORN FLOWER

*(Plagiobothrys chorisianus)*

## INDIAN THISTLE

*(Cirsium brevistylum)*

## YELLOW MARIPOSA LILY
*(Calochortus luteus)*

## CALIFORNIA ASTER
*(Corethrogyne filaginifolia)*

# Cattle Grazing Area

- Dogs must remain on leash and under control. Cattle perceive dogs as predators.
- Do not allow your dog to chase or harass the cattle.
- Never enter the fenced grazing area.
- Do not feed, pet, or startle the cattle.
- If you see cattle outside of the fences, keep your distance and call 911. The rancher will be notified immediately.
- Report any incidents or aggressive, injured, or sick cattle to the Parks and Recreation Department at 831-420-5270.

## In an emergency, call 911.

City of Santa Cruz Parks and Recreation Department
www.cityofsantacruz.com/habitatmanagementataranagulch

# Appendix C 2015 Vegetation Monitoring Report

C-1. Coastal Prairie Assessment Report, 2015 (Stanton, 2015)

# Arana Gulch Habitat Management Plan
# 2015 Coastal Prairie Vegetation Assessment

Prepared for the City of Santa Cruz Planning Department,
Department of Parks and Recreation,
and the Arana Gulch Adaptive Management Working Group

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

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December 2015

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## Introduction

The Coastal Development Permit issued to the City of Santa Cruz by the California Coastal Commission for the implementation of the Arana Gulch Master Plan (CDP No. 3-11-074 Arana Gulch) requires a baseline assessment of the vegetation conditions in the Santa Cruz tarplant (SCT)/Coastal Prairie Management Area in areas that will be grazed under guidance of the Grazing Program. The goal of the Grazing Program is to restore a disturbance regime in the coastal prairie in order to improve habitat function and reverse the decline in the SCT population.

The first baseline vegetation assessment was conducted in June, 2013 with the installation of permanent point intercept vegetation transects. The Arana Gulch Adaptive Management Working Group (AMWG) approved the field sample design and data analysis methods prior to the installation. Trail construction at Arana Gulch began in early November, 2013 and a second year of data was collected in April, 2014. Construction was completed in November, 2014. The entry sign posted at the Frederick Street entrance on the west side of the Hagemann Gulch bridge shows the trail system, the grazing fences, the SCT historic areas A,B,C, and D, and the location of seven interpretive signs (Figure 1).

The AMWG wanted grazing to begin as soon as the construction was completed, but there was insufficient grass growth in November due to the extraordinarily low precipitation received that year. However, over 11 inches of rain fell in December (see Table 1). When the rancher determined that there was sufficient grass growth to support the animals the cattle were finally brought to the site on February 26, 2015. The late arrival of the cattle made it possible to collect a third year of baseline vegetation data on April 16-17 because only small patches of the grassland had been impacted by grazing at that point.

The three years of baseline vegetation and ground cover data presented in this report will be used by the AMWG to evaluate progress towards meeting the goals and interim success criteria for the SCT and Coastal Prairie Management Area specified in the Arana Gulch Habitat Management Plan (HMP) (Stanton 2013). The goals are:

Goal 1: Maintain a viable Santa Cruz tarplant (SCT) population at Arana Gulch.

Goal 2: Reintroduce grazing to restore a disturbance regime that maintains functioning coastal prairie.

Goal 3: Minimize the detrimental effects of high non-native plant cover and restore coastal prairie species diversity and habitat function.

Goal 4: Maintain a genetically and demographically viable soil seed bank in perpetuity.


Figure 1. The entry sign posted at the Frederick Street entrance to Arana Gulch.

This baseline assessment study was specifically designed to evaluate whether grazing can meet the following objectives under Goals 2 and 3:

Objective 2B: Reduce the Residual Dry Matter (RDM) from the baseline level to the minimum acceptable level for coastal prairie grasslands of 500-650 lbs per acre (plus 20% error).

Objective 3A: Reduce canopy height during the basal rosette stage for SCT (November-April) from the baseline level to a level that enables SCT plants to complete their lifecycle (2-3 in., 5-8 cm).

Objective 3B: Reduce the cover of non-native species in the coastal prairie from the baseline level to one more representative of a reference functioning coastal prairie system by 2020.

Objective 3C: Increase cover of native species from baseline levels to one more representative of a reference functioning coastal prairie system by 2020.

Objective 3D: Increase native species richness from baseline levels to one more representative of a reference functioning coastal prairie system by 2020.

Objective 3E: Increase the cover of bare ground in the coastal prairie from the baseline level to a level that enables SCT plants to complete their lifecycle by 2015.

## Methods

### Vegetation transects

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.

The coastal prairie occupies about 30 acres at Arana Gulch. The total area within the grazing enclosures is about 18.75 acres (8.4 hectares) divided as follows:

Area A = 651,763 $ft^2$ or 15 acres (6 ha)
Area C = 177,340 $ft^2$ or 4.1 acres (1.6 ha)
Area D = 92,269 $ft^2$ or 2.1 acres (0.9 ha)

The vegetation transects were first installed on June 10-12, 2013. We used satellite imagery on Google Earth to select starting points for 25m point intercept vegetation transects in each of the grazing enclosures. We selected a total of 8 points in A, 6 in C, and 4 in D using a stratified approach to get good coverage within each unit. To determine the number of transects for each enclosure, we utilized field sampling and power analysis. In the field, we used GPS 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 insure that there was at least a 5m buffer with infrastructure, existing dirt trails, or other features that needed to be avoided.

We first sampled 5 of the 6 pre-selected transects in Area C. On that first set of data we conducted a power analysis using a statistical power calculator provided by DSS Research (http://www.dssresearch.com/toolkit/sscalc/size_a1.asp). This enabled us to test how much change we can detect by comparing the average cover and standard deviation values recorded for the 5 transects to a fixed value that is 2.5 or 5% greater than that value. We accepted an 80% power level ($\beta = 0.2$) and $\alpha = 0.1$ based on standard practice. For Area C, a sample size of 5 transects provided sufficient power, so we did not install the additional transect. In Area A, after sampling all 8 transects we determined that we needed an additional 3 transects for a sample size of 11. In Area D, the 4 transects were sufficient.

In 2013 and 2014, sampling was conducted every 0.5 m along the 25m transect for a total of 50 points. The number of hits was multiplied by 2 to get percent cover. In 2015, the number of sample points was reduced to 25 points per transect (collected every one meter) so the number of hits was multiplied by 4 to get percent cover. A power analysis revealed that the lower sampling intensity had sufficient statistical power.

The average height of the canopy layer was also measured at the 6, 12, 18, and 24 m points. In 2013 and 2014, the average low canopy height and high canopy height were recorded with a meter stick. In 2015, the method was modified to utilize a plastic dinner plate threaded on a wire pin. The canopy height measurement was taken at the height where the plate comes to rest. 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. We then took a photo from 0m looking along the length of transect with a whiteboard held up at the 5m point labeled with the transect number and date. All transect photos are included in Appendix A. On the data sheet we recorded the 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.

Several transects first installed in 2013 were destroyed by the construction access road and these were re-positioned in the second monitoring on April 21-22, 2014. However, all of the rebar and caps were subsequently destroyed in the mowing that was conducted 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". Figure 2 shows the locations of the 11 transects in A, 5 in C, and 4 in D.

Figure 2. Permanent transect placement on the coastal prairie at Arana Gulch in 2015.

The transect is the sample unit and for each we calculated the percent cover by species, the total number of species encountered, and the % ground cover of litter, bare, gopher, basal vegetation, and rock or cow flop. Average cover values were grouped by guilds: 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). We present mean cover values for all three sample years by species and by guild with error bars constructed using one standard deviation from the mean. No statistical tests were performed because differences are likely due to the sample timing (June in 2013 and April in 2014 and 2015) and a large difference in precipitation as described in Table 1. Statistical tests will be performed once the vegetation has had a chance to respond to grazing.

## Photo points

Photo points for long-term monitoring were established during the monitoring in April, 2015. A total of 15 points are distributed throughout the coastal prairie with two additional points on the Arana Creek causeway and two on Hagemann Bridge (Figure 3). All points are located at either an interpretative sign or a fence corner. Four photos were taken per point in a clockwise order; 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 B.


Figure 3. Location of photo points for long- term monitoring established at Arana Gulch in April, 2015.

## 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. At the January 28, 2015 meeting, the AMWG members agreed that an RDM zone map, portraying the following RDM levels, provides a sufficient level of detail for aiding management and cattle grazing decisions:

- BLUE = RDM exceeds the objective
- GREEN = RDM meets the objective (500-650 lbs per acre (plus 20% error, up to 780lbs)
- RED = RDM is below the objective

The monitoring was conducted on October 13, 2015. Clipping and weighing of RDM plots was used to help calibrate visual estimates of RDM. The City purchased a clip and weigh RDM kit from Wildland Solutions that included a 13.25" diameter circular hoop plot, a Pesola gram scale, and the monitoring guide. In the field, all dry plant matter clipped from the plot was placed in plastic bag and weighed with the clip scale and the weight was converted to pounds per acre (grams clipped x 100 = lbs/acre RDM). The photo point reference kit, including the robel pole, was not available from Wildland Solutions.

## Results

### Precipitation

Precipitation conditions at the NOAA Santa Cruz COOP weather station over the last three growing seasons were all below the long term average of 30 inches (Table 1).

Table 1. Monthly rainfall (inches) at the NOAA Santa Cruz COOP weather station for the 2013-2015 water years.

| Water year | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014-2015 | 0.03 | 0 | 0.92 | 0.84 | 3.83 | 11.49 | 0 | 2.85 | 0.51 | 1.98 | 0.1 | 0.01 | 22.56 |
| 2013-2014 | 0.01 | 0.02 | 0.11 | 0.06 | 0.31 | 0.11 | 0.01 | 2.85 | 1.36 | 0.42 | 0.03 | 0.05 | 5.34 |
| 2012-2013 | 0 | 0 | 0 | 0.11 | 5.97 | 8.96 | 0.92 | 0.32 | 1.7 | 0.88 | 0.02 | 0.03 | 18.91 |
| 111 yr avg | 0.06 | 0.07 | 0.42 | 1.39 | 3.31 | 5.24 | 6.14 | 5.42 | 4.33 | 1.92 | 0.8 | 0.22 | 30.04 |

The 2013/2014 water year was the driest year on record. At the beginning of the 2014-2015 water year, there was almost one inch of rainfall in September, but there was still insufficient grass growth on the coastal prairie in November to bring on cattle. There was twice as much rain as normal in December 2014, which helped the grasses recover to some degree, but total precipitation in January through March, 2015(3.36") remained far below the long-term average (15.89").

### Species richness

Across all years a total of 38 species were recorded as hits along each transect or within the 5m belt transects (125m$^2$) (Table 2).) 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).

The only native species detected were California brome (*Bromus carinatus*), California oatgrass (*Danthonia californica*), California poppy (*Eschscholozia californica*), California rose (*Rosa californica),* Great Basin wildrye *(Elymus triticoides),* purple needle grass (*Stipa pulchra),* and spreading rush *(Juncus patens).* Coyote bush (*Baccharis pilularis*) and coast live oak (*Quercus agrifolia*) were also present within the 5m belts in Area A. All other species were non-native. Common vetch (*Vicia sativa spp. sativa*) and narrow-leaved vetch (*Vicia sativa spp. nigra)* were both present but distinguishing them would have been unnecessarily time consuming, so they are combined.

Of the non-native species, several are ranked by Cal-IPC (Invasive Plant Council). French broom (*Genista monspessulana*) was found in Area D in one 5m belt transect in 2014 and it is ranked High. Himalyan blackberry (*Rubus armeniacus*) is the other High ranked species that was found in area A in 2015. A total of three forb species are ranked Moderate including Italian thistle (*Carduus pycnocephalus*), bull thistle (*Cirsium vulgare*), and sheep sorrel (*Rumex acetosella*). The perennial velvet grass (*Holcus lanatus*) and three annuals grasses, wild oat (*Avena fatua*), ripgut brome (*Bromus diandrus*) and rattail six weeks grass (Festuca myuros), are considered Moderate because of the intense effect these grasses can have on fire regime and their ability to exclude natives.

Table 2. Species recorded during the 2013-2015 vegetation baseline assessment.

| Scientific name, TJM 2 | Area(s) found | Common name | Life form | Family |
|---|---|---|---|---|
| Anagallis arvensis | A,C,D | Scarlet pimpernel | EAF | PRIMULACEAE |
| Avena fatua | A,C,D | Wild oat | EAG | POACEAE |
| Baccharis pilularis | A | Coyote brush | Shrub | ASTERACEAE |
| Briza maxima | A,D | Rattlesnake grass | EAG | POACEAE |
| Briza minor | A,D | Quaking grass | EAG | POACEAE |
| Bromus carinatus | A | California brome | NPG | POACEAE |
| Bromus diandrus | A,C | Ripgut brome | EAG | POACEAE |
| Bromus hordeaceus | A,D | Soft chess | EAG | POACEAE |
| Carduus pycnocephalus | C | Italian thistle | EPF | ASTERACEAE |
| Cerastium glomeratum | C | Mouse-ear chickweed | EAF | CARYOPHYLLACEAE |
| Cirsium vulgare | A | Bull thistle | EPF | ASTERACEAE |
| Convolvulus arvensis | A,C,D | Bindweed | EPF | CONVOLVULACEAE |
| Danthonia californica | A | California oatgrass | NPG | POACEAE |
| Elymus triticoides | D | wild rye | NPG | POACEAE |
| Erodium botyrs | A,C | long bill stork's beak | EAF | GERANIACEAE |
| Erodium cicutarium | A,D | red stem filaree | EAF | GERANIACEAE |
| Eschscholzia californica | A | California poppy | NPF | PAPAVERACEAE |
| Festuca myuros | A,C,D | Rattail six weeks grass | EAG | POACEAE |
| Festuca perennis | A,C,D | Italian ryegrass | EAG | POACEAE |
| Genista monspessulana | D | French Broom | Shrub | FABACEAE |
| Geranium dissectum | D | Cutleaf geranium | EAF | GERANIACEAE |
| Holcus lanatus | A,CD | velvet grass | EPG | POACEAE |
| Hypochaeris glabra | A,C,D | Smooth cat's-ear | EAF | ASTERACEAE |
| Juncus patens | A,C,D | Spreading rush | NPG | JUNCACEAE |
| Lactuca serriola | C,D | Prickly lettuce | EPF | ASTERACEAE |
| Nassella pulchra | A | Purple needle grass | NPG | POACEAE |
| Plantago lanceolata | A,C,D | English plantain | EPF | PLANTAGINACEAE |
| Quercus agrifolia | A | Coast live oak | Tree | FAGACEAE |
| Raphanus sativus | A,C,D | wild radish | EAF | BRASSICACEAE |
| Rosa californica | A | California rose | Shrub | ROSACEAE |
| Rubus armeniacus | A | Himalayan blackberry | Shrub | ROSACEAE |
| Rumex acetosella | A,D | Sheep sorrel | EPF | POLYGONACEAE |
| Rumex crispus | A,C | Curly dock | EPF | POLYGONACEAE |
| Senecio jacobaea | A,C,D | Tansy ragwort | EPF | ASTERACEAE |
| Stipa pulchra | A | Purple needlegrass | NPG | POACEAE |
| Tragopogon pratensis | A,C,D | Salsify | EPF | ASTERACEAE |
| Trifolium subterraneum | A | Subterranean clover | EAF | FABACEAE |

| | | | | |
|---|---|---|---|---|
| Vicia sativa subsp. sativa/nigra | A,C,D | common/narrow leaved vetch | EPF | FABACEAE |

The percent cover of each species is presented separately below for areas A, C, and D for 2015 along with percent cover by plant guild and ground cover. Species richness is presented in tables with all three monitoring years. Canopy height and summed cover are presented last. The photos from each transect line are included separately as Appendix A.

### *Area A*

Area A is the only unit where SCT have been observed in recent years, but no plants were detected in other surveys in July, 2015. Plant cover data was calculated for 22 species (Figure 4).

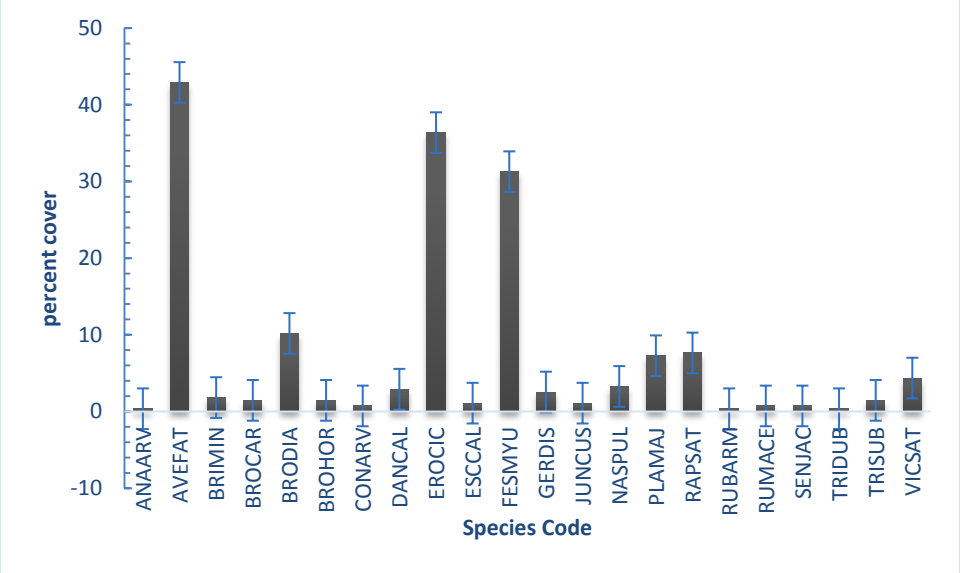


Figure 4. Mean percent cover of species sampled in Area A in 2015. Each error bar is constructed using 1 standard error from the mean.

*Avena fatua* was the most dominate species with 43% cover, followed by *Erodium cicutarium* (36%) and *Festuca myurous* (31%). *Bromus diandrus* cover was 10% and all other species had 7% cover or less. Native species detected include *Bromus carinatus*, *Danthonia californica, Eschscholzia californica*, *Juncus patens*, and *Nasella pulchra*.

Exotic annual grasses (EAG) had the greatest cover followed by exotic annual forbs (EAF) and exotic perennial forbs (EPF) (Figure 5). *Eschscholzia californica* was the only native perennial forb (NPF) encountered on the transects. *N*ative perennial grass (NPG) cover included *Juncus patens*. Shrub cover was present as the Himalayan blackberry found near the clump of *Rosa californica* that is found on the southern end of Area A. Average bare ground was 8% (Figure 6).

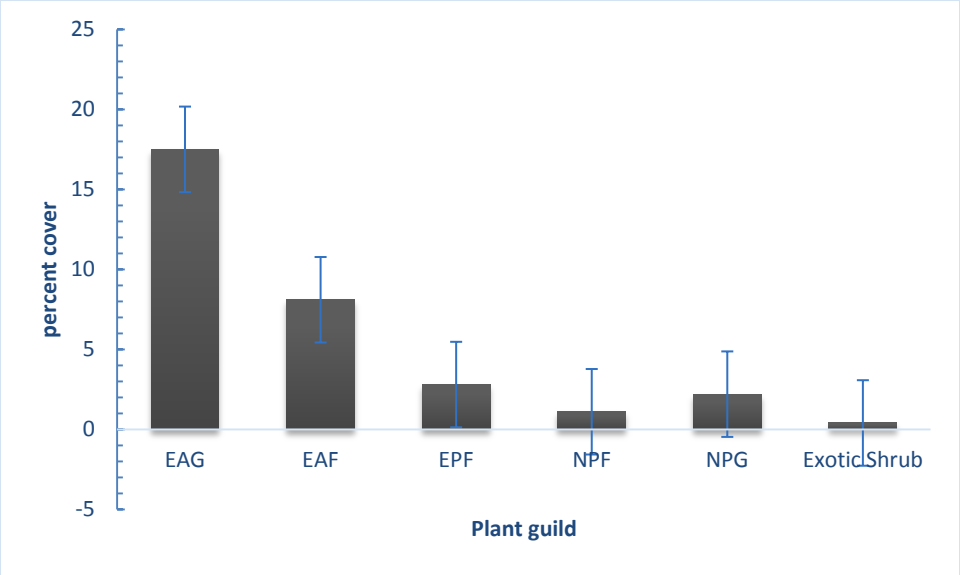


Figure 5. Mean percent cover of 6 plant guilds in Area A in 2015. Each error bar is constructed using 1 standard error from the mean.

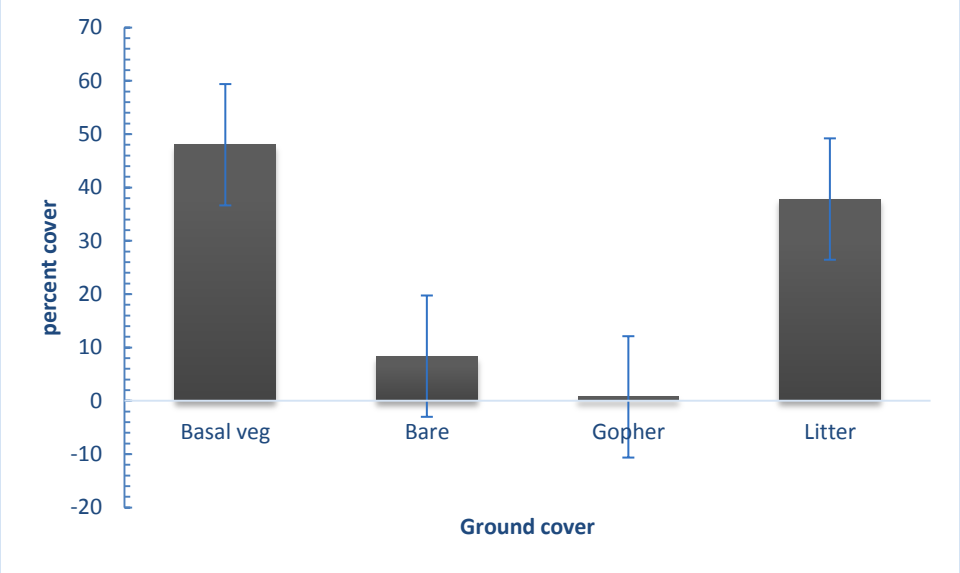


Figure 6. Mean percent ground cover in Area A in 2015. Each error bar is constructed using 1 standard error from the mean.

Fewer species were recorded on each transect and within the 125 $m^2$ plot in 2014 and 2015 than in 2013 (Table 3). Native species richness was less than 1% in all years.

Table 3. 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 | 2013 | 2014 | 2015 |
|---|---|---|---|
| # Species per transect | 9.5 (2.7) | 7.3 (2.1) | 7.6 (2.5) |
| # Additional species in plot | 3.9 (2.5) | 3 (2.7) | 3.6 (2.3) |
| Total # species/125 $m^2$ | 13.4 (3.8) | 10.3 (4.1) | 11.2 (3.8) |
| | | | |
| # Native species per transect | 0.4 (0.5) | 0.5 (0.5) | 0.7 (0.8) |
| # Additional native sp. in plot | 0.3 (2.5) | 0.5(0.8) | 0.3 (0.5) |

### *Area C*

Plant cover data was calculated for 11 species in Area C (Figure 7). The northern most transect in Area C (CT7 see Figure 2) contained Italian thistle (*Carduus pycnocephalus*). *Raphanus sativa* had the greatest cover, and *Avena fatua*, *Bromus diandrus, Erodium cicutarium,* and *Festuca myurous,* all had similar cover.

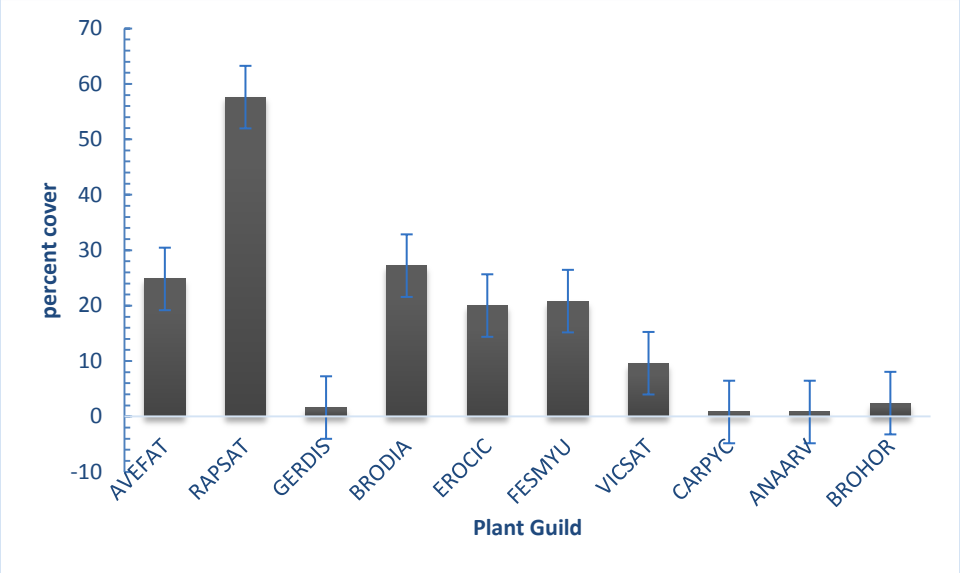


Figure 7. Mean percent cover of species sampled in Area C in 2015. Each error bar is constructed using 1 standard error from the mean.

Cover of EAG was somewhat greater than EAF (Figure 8). Cover of EPF was primarily from common vetch (*Vicia sativa spp. sativa*). Average bare ground was 21% and one cow flop was encountered on a transect (Figure 9).

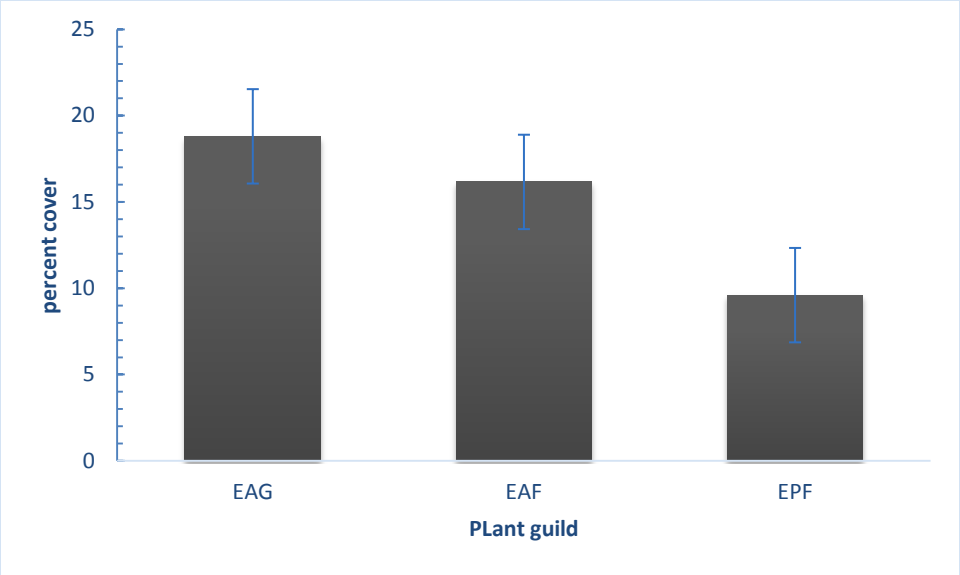


Figure 8. Mean percent cover of 3 plant guilds in Area C in 2015. Each error bar is constructed using 1 standard error from the mean.

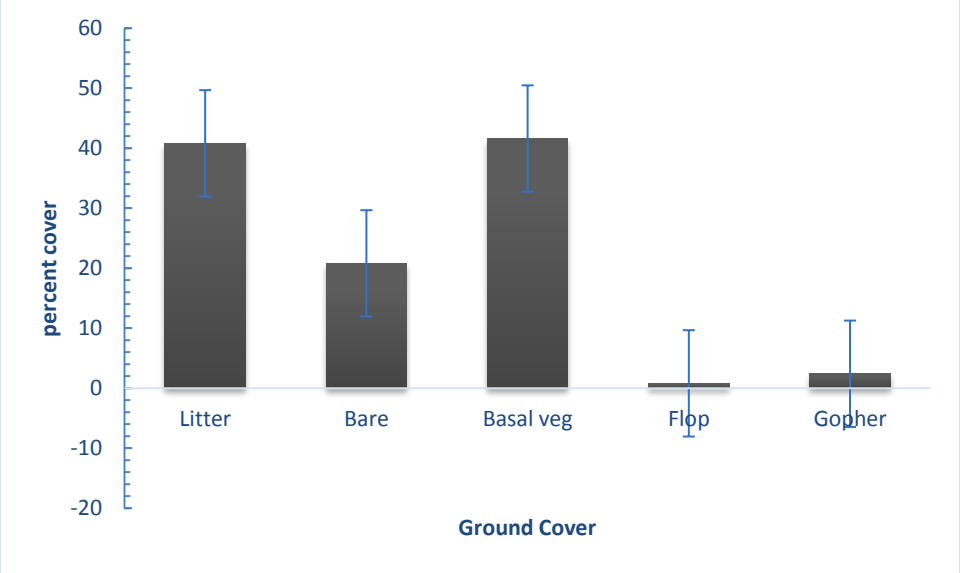


Figure 9. Mean percent ground cover sampled across Area C in 2015. Each error bar is constructed using 1 standard error from the mean.

No native species were captured by the transect sampling or in the 5m belt transects in Area C. On average, 6 species were recorded on each transect, two fewer then were detected in 2013 or 2014 (Table 4). The transects captured only 10 total species in 2015 compared to 14 in 2014 and 12 in 2013.

Table 4. 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 | 2013 | 2014 | 2015 |
|---|---|---|---|
| # Species per transect | 8 (1.0) | 8.3 (1.7) | 6.0 (1.0) |
| # Additional species in plot | 4.6 | 2 (1.4) | 1.4 (0.9) |
| Total # species/125 $m^2$ | 12.6 (2.7) | 10.3 (3.0) | 7.4 (0.9) |
| # Native species per plot | 0 | 0 | 0 |

### *Area D*

Plant cover data was calculated for 13 species in Area D (Figure 10). *Erodium cicutarium* had the greatest cover with 62%. *Avena fatua* had 48% cover and cover of *Festuca myurous* was 31%. Area D has an infestation of the invasive perennial velvet grass (*Holcus lanatus)* that was captured on only one transect. French broom (*Genista monspessulana*) is beginning to emerge from the wet area but it was not captured in the 125$m^2$ plot in 2015.

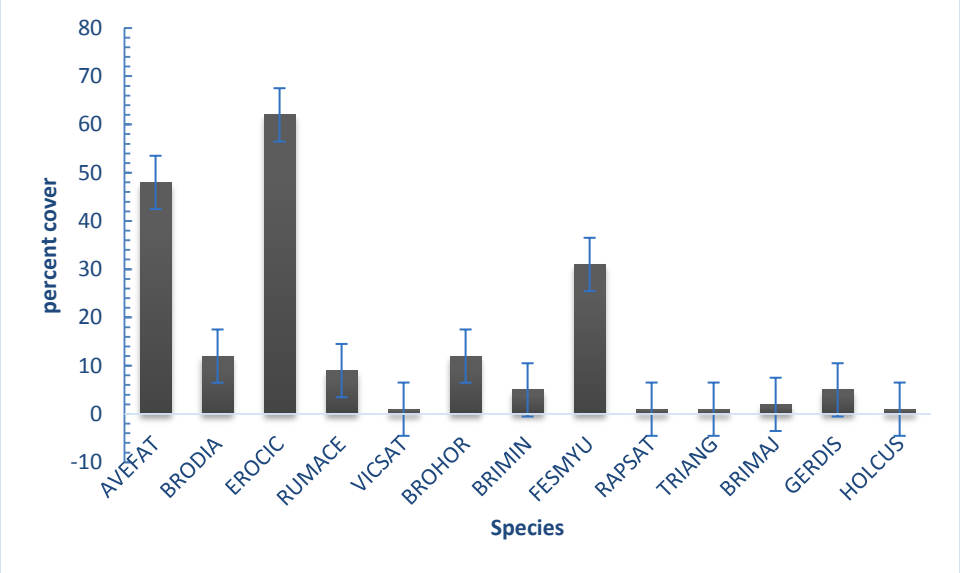


Figure 10. Mean percent cover of species sampled in Area D in 2015. Each error bar is constructed using 1 standard error from the mean.

In Area D in 2015, EAG and EAF had similar average cover (Figure 11). *Holcus lanatus* comprised the entire EPG guild. *Rumex acetosella* and *Vicia sativa* were the only exotic perennial forbs (EPF). Average bare ground was 10% (Figure 12).

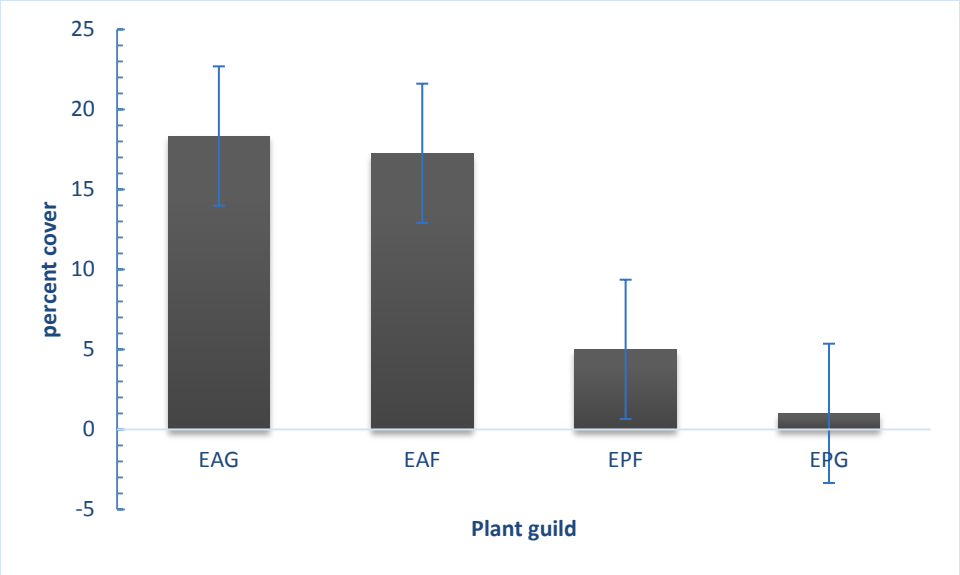


Figure 11. Mean percent cover of 5 plant guilds sampled across Area D in 2015. Each error bar is constructed using 1 standard error from the mean.

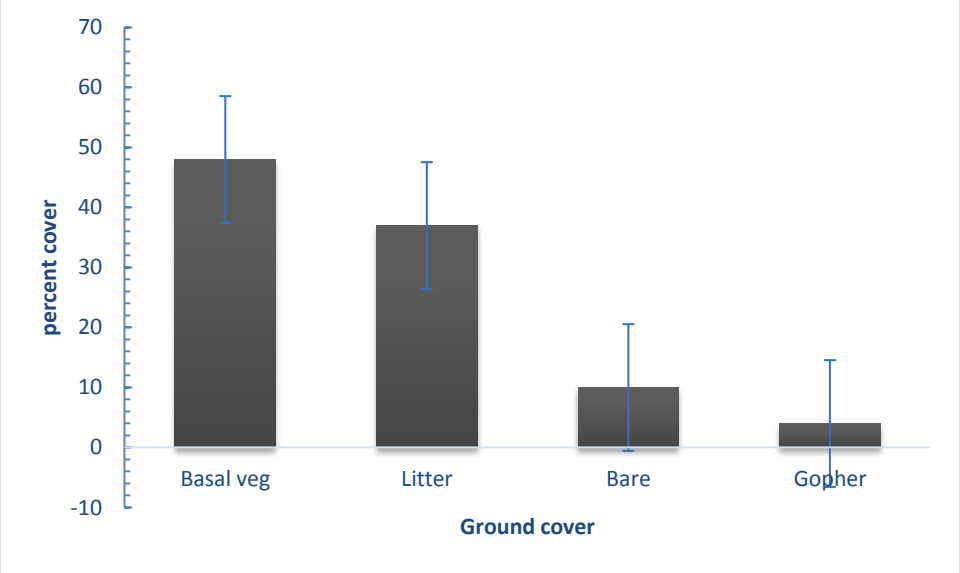


Figure 12. Mean ground cover sampled across Area D in 2015.. Each error bar is constructed using 1 standard error from the mean

A similar number of species were recorded on average in Area D compared to 2014 (Table 5). Native species richness was zero because the patches of the native perennial grass *Leymus triticoides* were not captured in sampling in 2015.

Table 5. 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 | 2013 | 2014 | 2015 |
|---|---|---|---|
| # Species per transect | 10.3 (1.5) | 8.8 (1.5) | 8.5 (2.1) |
| # Additional species in plot | 4.5 (2.6) | 3.3 (3.3) | 3.8 (1.0) |
| Total # species/125 $m^2$ | 14.8 (1.3) | 12 (4.8) | 12.3 (1.7) |
| | | | |
| # Native species per transect | 0.5 (1.0) | 0.5 (0.6) | 0 |
| # Additional native sp. in plot | 0.3 (0.5) | 0.5(0.6) | 0 |

## Canopy height

Canopy heights have been far above the objective of 5-8 cm in 2013 and 2014 (Table 6). In 2013, the high canopy exceeded 1 meter in Areas A and C. In 2014, the lower measured heights in 2014 were due to the extreme drought with only 5 inches of precipitation for the entire water year.

Table 6. Mean height measured to the nearest 5 cm of the low and high canopy height in 2013 and 2014 (with one standard deviation in parentheses).

| Area | 2013 | | 2014 | |
|---|---|---|---|---|
| | Low canopy | High Canopy | Low canopy | High Canopy |
| A | 39 (13) | 122 (42) | 28 (9) | 44 (12) |
| C | 59 (12) | 126 (48) | 29 (8) | 55 (17) |
| D | 38 (7) | 86 (5) | 33 (5) | 44 (4) |

In 2015, the measuring method was modified to use a plastic dinner plate threaded on a wire pin flag that comes to rest at the average vegetation height where ground shading becomes a concern. The average canopy heights measured in April were still well above the objective and ranged from 38 cm in Area A to 54 in Area D (Figure 13) and were similar to the low canopy heights measured in 2013 (38 to 59 cm). Although it was not measured in 2015, the high canopy layer in April was also over 1 meter high in Areas A and C, like it was in 2013. By September, grazing reduced the average canopy heights of all three Areas to about 8 cm (Figure 13).

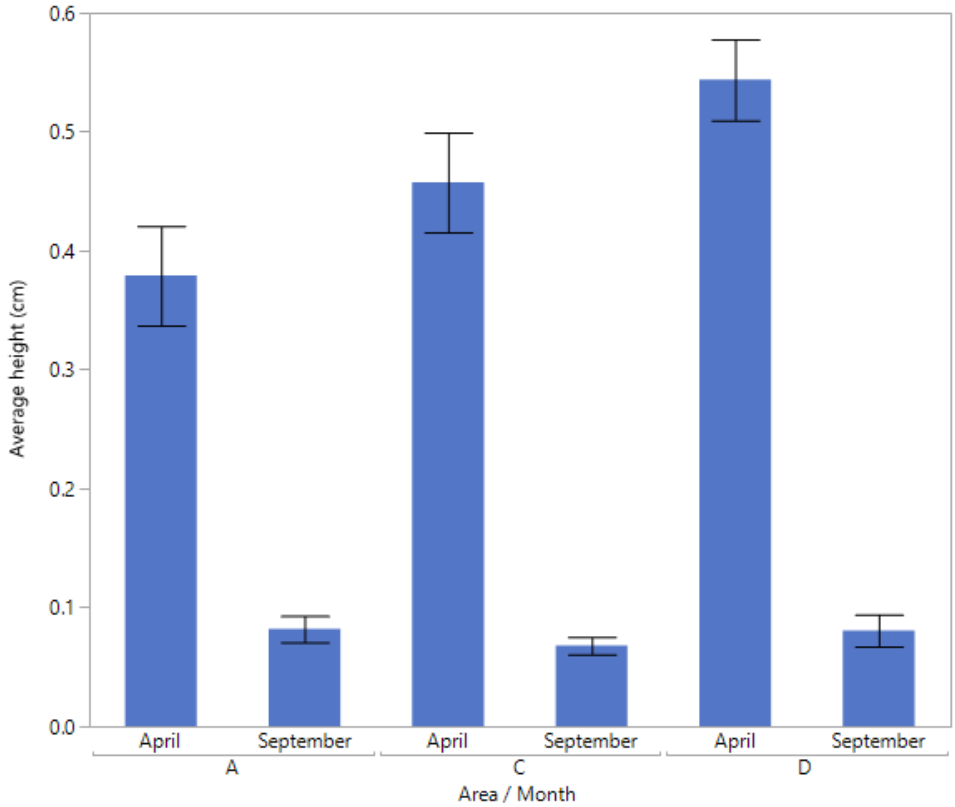


Figure 13. Mean canopy height in Area A, C, and D measured in April and September, 2015.
Each error bar is constructed using 1 standard error from the mean

## Residual dry matter

After less than 8 weeks of grazing, cattle utilization in Area A was very patchy in April 2015. After walking through and around Area A to get an idea of the variability in vegetation and ground cover conditions, several clip plots were taken to assess the RDM level. As in earlier monitoring events, it was difficult to distinguish between the current year's dry plant material and older thatch. Therefore, thatch was included and so the mapping represents RDM/Thatch distribution. The boundaries of the 3 RDM/ mulch categories of Above Target (blue), At Target (green) and Below Target were delineated in the field on print outs of the most recent Google Earth imagery available (Imagery Date: 3/28/2015). GPS tracks did not result in satisfactory polygons, but waypoints from clip plots and at perceived boundaries zones allowed rectification of the field map with Google Earth. Polygons drawn in Google Earth can only utilize straight lines, so the imagery was exported to Powerpoint where polygons of the RDM zones were hand-drawn.

In Area A, about 30% of the pasture was At Target, 10% or less was Below Target, and about 60% was Above Target (Figure 14). The RDM of the Above Target zones was very high, with a heavy thatch load and was measured at over 5,000 lbs/acre in multiple clip

plots (Figure 15). The heavy thatch was comprised of tall annual grasses left over from the 2013 growing season.


Figure 14. RDM map of Area A in October, 2015. Blue= Above target, Green= At target, and Red= below target. The black line is the estimated fence lines.


Figure 15. Clip plot of RDM Above Target (4,400 lbs/acre) in Area A in October, 2015.

Within Area A in an At Target clip plot with 600 lbs/acre, bare ground was visible (Figure 16) and poppies were already growing in some parts of the zone (Figure 17).

Figure 16. Clip plot of RDM At Target (600 lbs/acre) in Area A in October, 2015.

Figure 17. Poppies and bare ground in At Target (600 lbs/acre) RDM zone Area A in October, 2015.

Although poppies were already in flower, tansy ragwort (*Senecio jacobaea*) was also in flower in some areas where the RDM was At Target (Figure 18).

Figure 18. Tansy ragwort in flower and bare ground in At Target (600 lbs/acre) RDM zone Area A in October, 2015.

The Below Target areas had mostly bare ground and were located where the cows congregated under shade trees and near water troughs (Figure 19).


Figure 19. RDM clip plot Below Target in Area A in October, 2015.

The RDM in Area C was Above Target, with areas around the former construction access road Below Target (Figure 20). Two areas of concrete remain and several blackberry infestations are also shown on the map. All of Area D except the perimeter adjacent to Area C was Above Target (Figure 21).


Figure 20. RDM map in Area C. Blue= Above target, Red= below target, Purple= blackberry infestation, and Grey = concrete. The black line is the estimated fence lines.


Figure 21. RDM map in Area D. Blue= Above target, Red= below target. The black line is the estimated fence lines.

## Discussion

Across three years, the sampled coastal prairie vegetation at Arana Gulch was comprised almost exclusively of non-native species with high cover, tall canopy height, a large thatch accumulation, and almost no bare ground. The three sampling Areas have inherent differences and in general Area A has the best quality habitat for SCT. SCT has been found only in Area A in recent years and the three years of sampling showed greater species richness in Area A (19-22 species total) including the presence of 4-5 native species. In contrast, no-native species have been detected in Area C during the period, total species richness has remained lowest (10-14 species), and there are many invasive weed infestations including Italian thistle, Himalayan blackberry, and velvet grass. Area D has more moist conditions due to its proximity to Arana Creek with moderate species richness (13-16 total species), few natives (2 species), and an infestation of velvet grass.

Drought appears to be the primary driver of the vegetation conditions observed during 2013-2015. The 5 inches of rain received in the 2013-2014 water year is the lowest on record and canopy height was dramatically reduced that year. The vegetation recovered to some degree and canopy heights were taller at the beginning of 2015 than they had been in 2014. Grazing began at Arana Gulch on February 26th, and by time of the permanent vegetation transect monitoring in April, cattle had been grazing for only 6 weeks. Grazing impacts were restricted to localized areas and measured canopy heights in all three Areas was around one half meter, far higher than the objective of 5-8cm. The cattle were on the site at various stocking levels for almost 16 weeks until June 17th. When canopy heights were re-measured in September, the average was around 8cm in all Areas.

The cattle were not on site soon enough to influence germination of SCT, and so the lack of SCT plants and recruitment at the site in 2015 does not indicate that the grazing failed and is instead a result of the drought. In October, the RDM levels were Above Target across a majority of the grazed Areas. A heavy thatch layer of tall grasses and wild radish was intact on large swaths of the ground and had not been broken up by hoof action. As a result, the amount of bare ground available that could facilitate germination of SCT during the coming winter and spring is less than desired. The return of cows to Arana in 2016 could increase the amount of bare ground. If SCT does not appear in 2016, it would not necessarily mean that grazing had failed because it could take more than one year for SCT to respond to grazing and changes in vegetation.

In 2015, the AMWG identified a need to establish more specific achievable objectives for the vegetation at Arana Gulch. During the development of the HMP there was not yet any baseline data to quantify existing conditions and so the interim restoration criterion was established as a return to an ideal of a functional reference coastal prairie. An AMWG task for 2016 is to better define what it means to be a functioning coastal prairie. However,

limited data is available on vegetation conditions at reference coastal prairies because there are so few left. In addition, vegetation conditions depends on many factors including the position of the coastal terrace, soil type, hydrology, dominant species, and past land-use history (Stromberg et al 2001) and few or none of the remaining coastal prairie remnants match Arana Gulch in these important characters. Arana Gulch experienced intensive cultivation in the past and cultivation has been identified as a factor that most strongly negatively affects native cover and species richness (Stromberg and Griffin 1996). 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.

## Literature cited


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Stromberg, M. R., Kephart, P., and Yadon, V. 2001. Composition, invasibility, and diversity in coastal California grasslands. Madroño **48**, 236-52.

Wildland Solutions. 2008. Monitoring Annual Grassland Residual Dry Matter: A Mulch Manager's Guide for Monitoring Success. (2nd ed.)[Brochure 34 pp.]. Brewster, WA: Guenther, K. and Hayes, G.

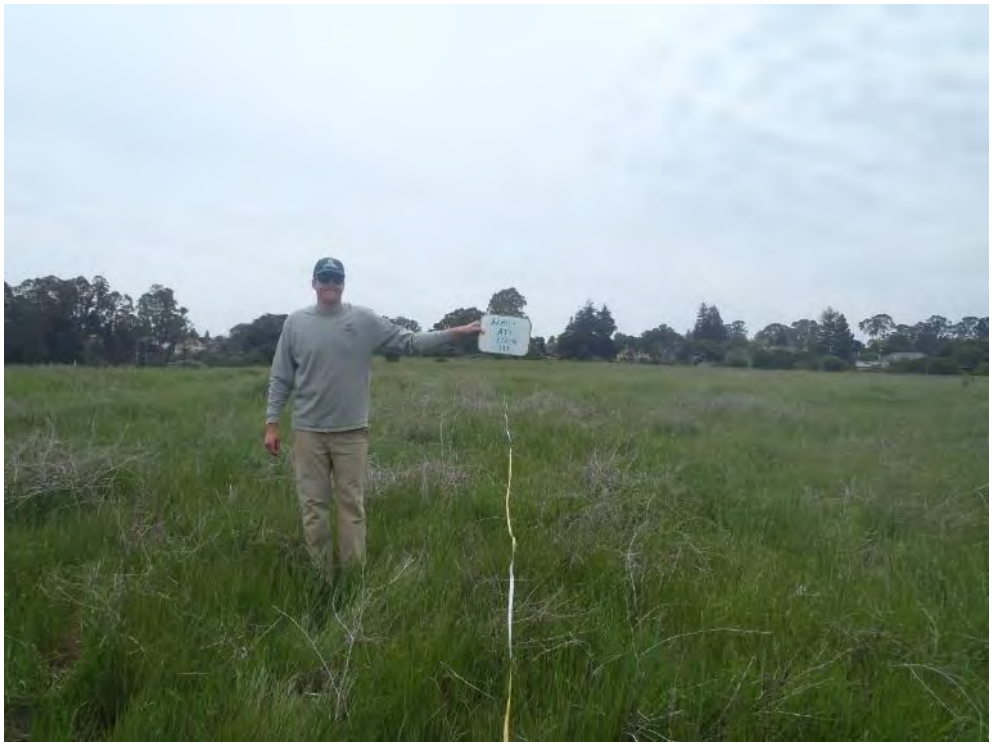
Appendix A Transect monitoring photos 2013-2015

Appendix B Photo monitoring 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT1 2013

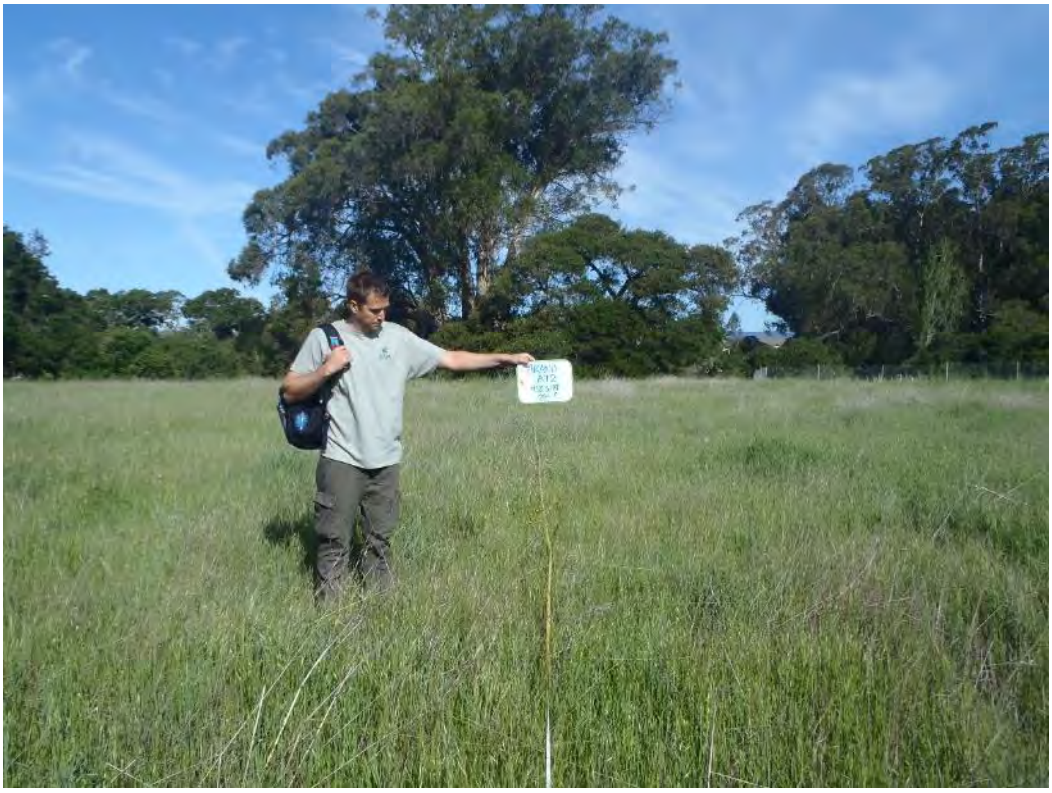

AT 1 2014



Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT1 2015

AT2 2014 (AT 2 from 2013 was destroyed by construction)



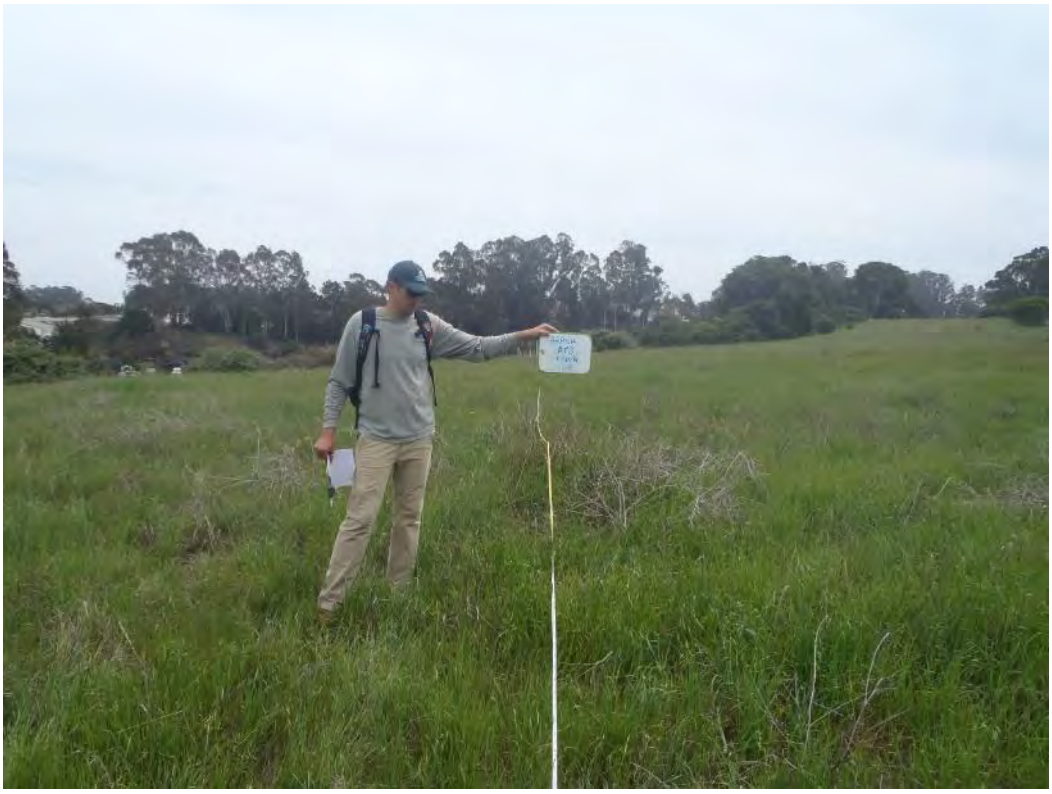
Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT2 2015

AT3 2013

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT3 2014



AT3 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT4 2013

AT4 2014: a new 25m mark was installed because it had been destroyed by a user trail.

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT4 2015

AT5 2013

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

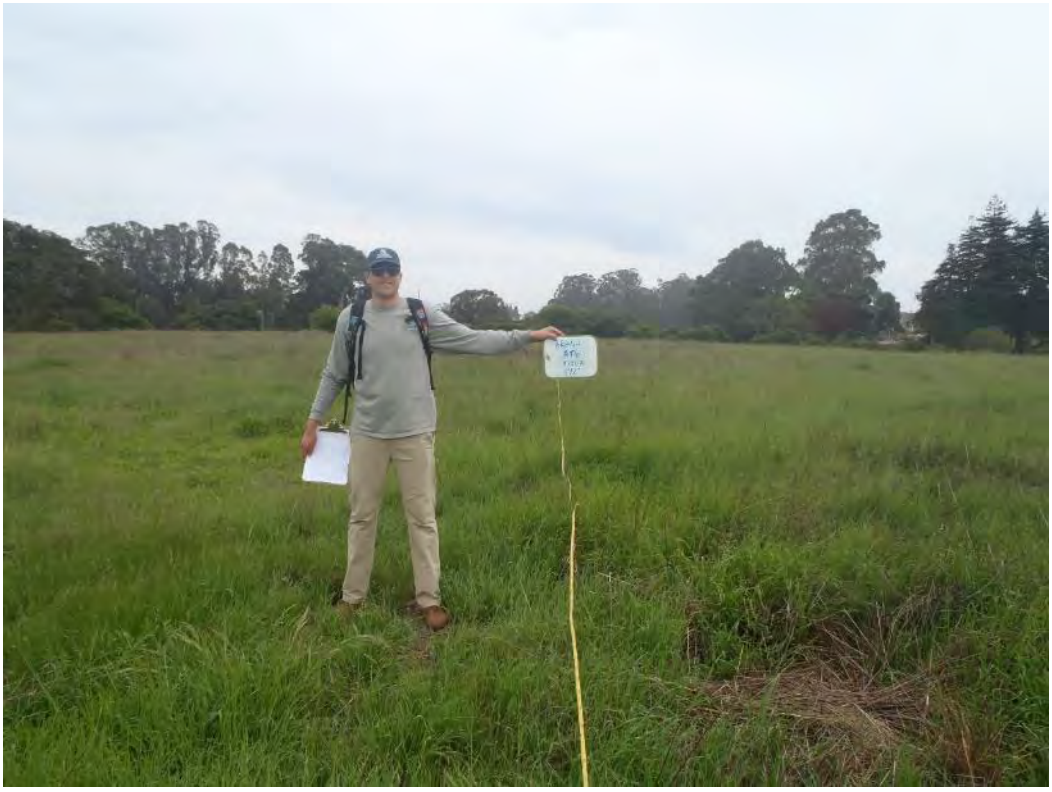
AT5 2014

AT5 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT6 2013

AT6 2014



Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT6 2015

AT7 2013

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

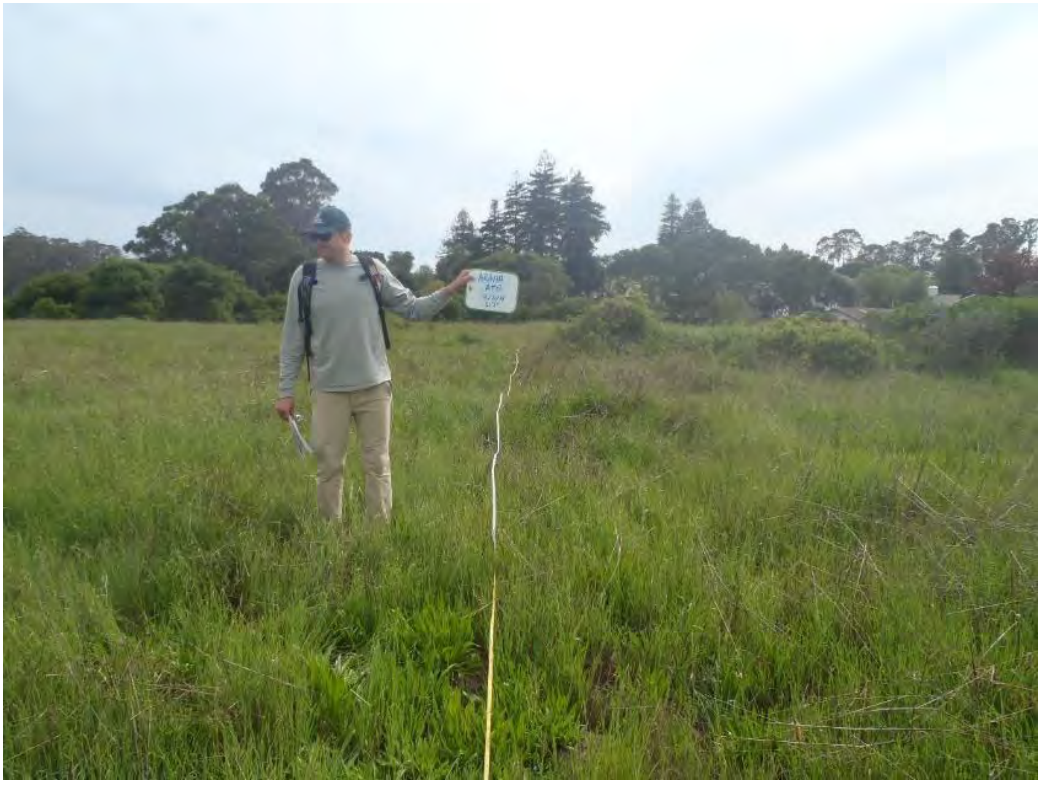
AT7 2014

AT7 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT8 2013

AT8 2014



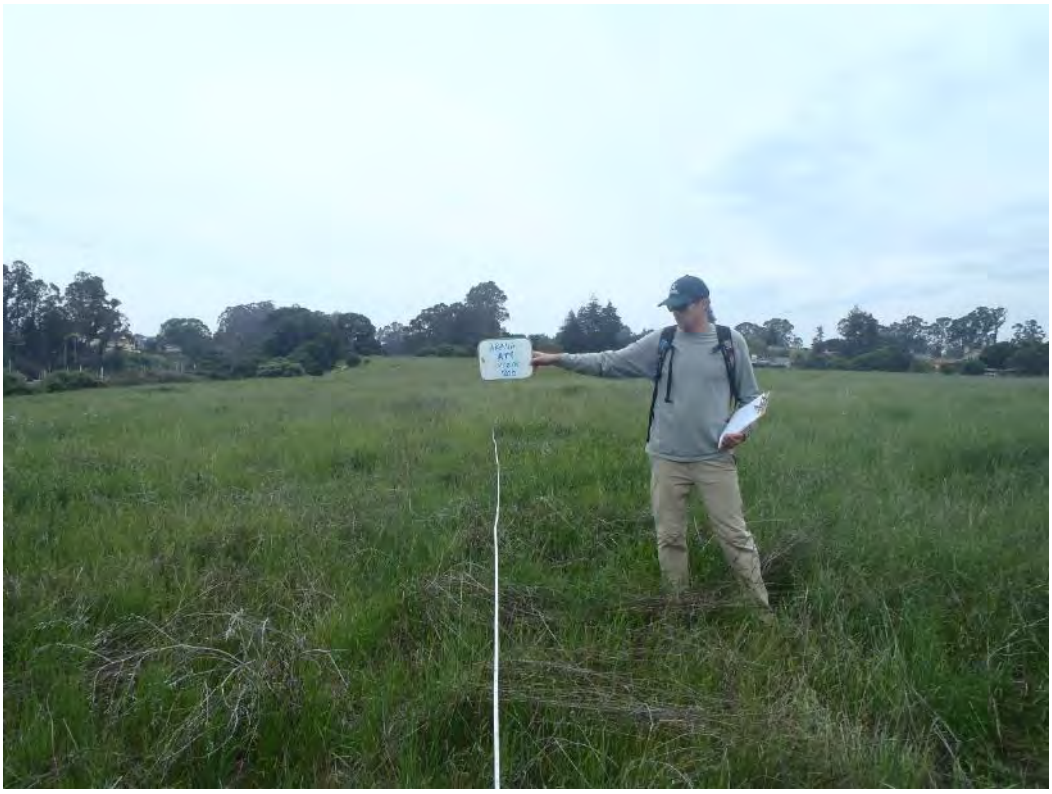
Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT8 2015

AT9 2013

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT9 2014

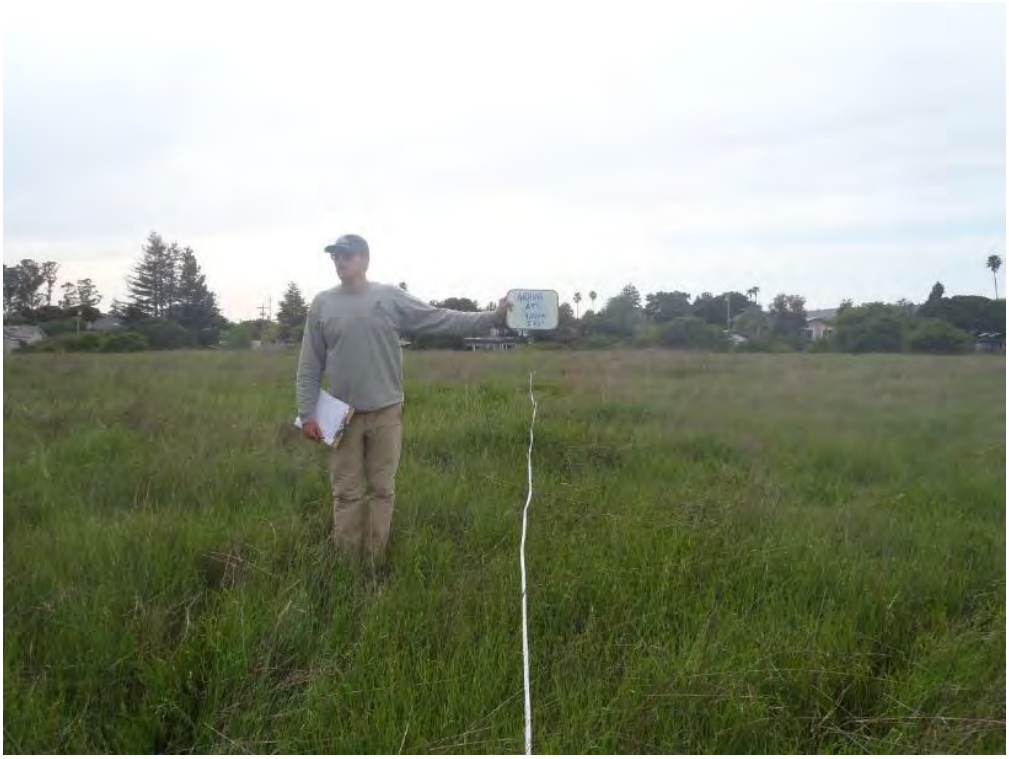


AT9 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT10 2013


AT10 2014



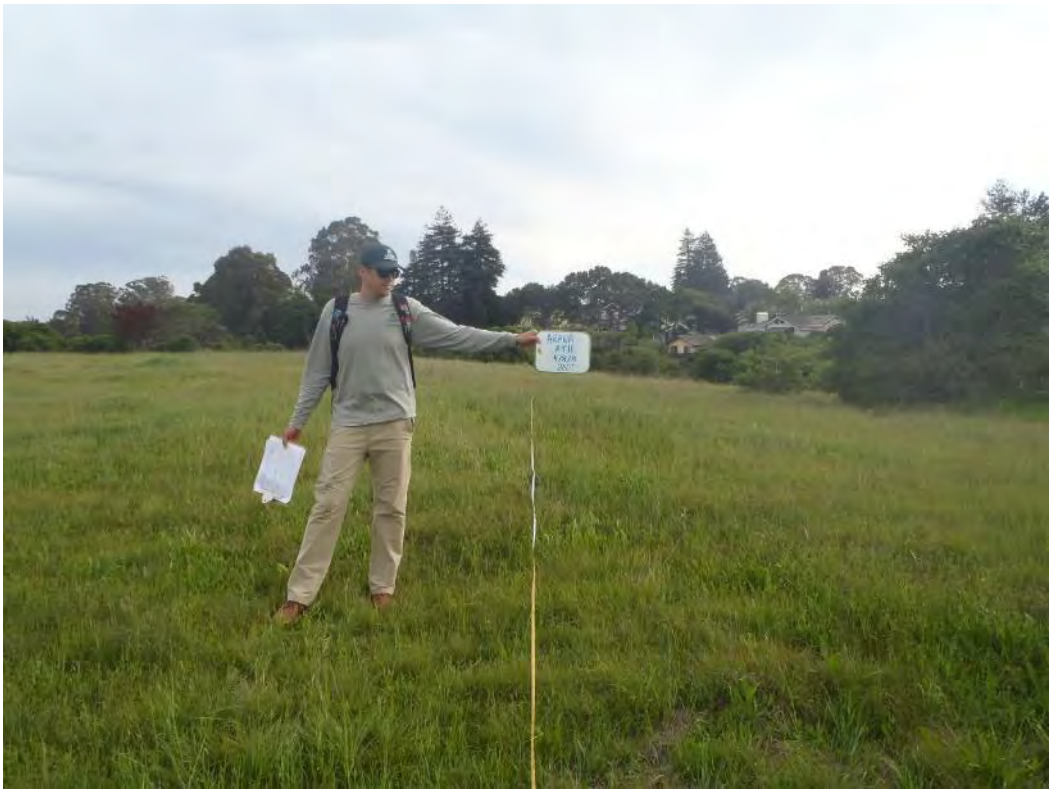
Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

AT10 2015

AT11 2013

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

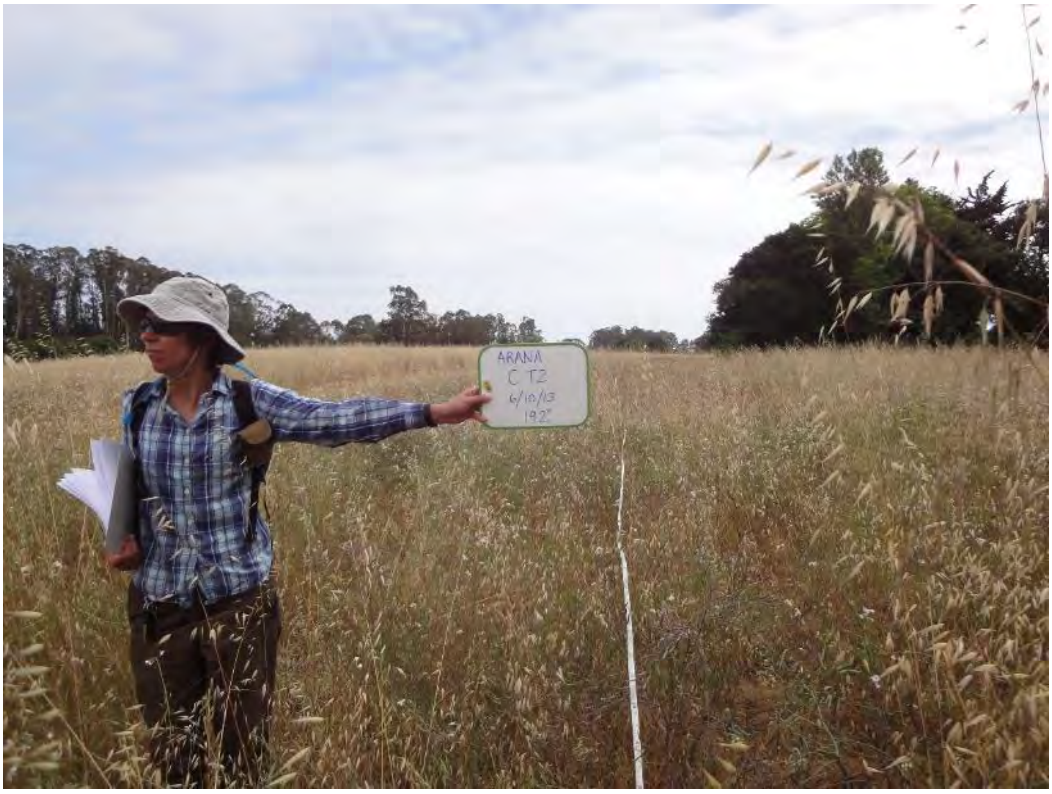
AT 11 2014



AT11 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

CT2 2013




CT2 2014

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

CT2 2015

CT3 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

CT5 2013

CT5 2104: access road destroyed 25m end and it was shifted west

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

CT5 2015

CT6 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

CT7 2014

CT7  2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

DT1 2015


DT2 2015

Appendix A Arana Gulch Vegetation Assessment – Permanent Transect Photos

DT3 2015


DT4 2015

# Appendix B Arana Gulch 2015 Photo Points


Arana Gulch 2015 Photo points

PP1 1

PP1 2

PP1 3

PP1 4

PP2 1

PP2 2

PP2 3

PP2 4

PP3 1

PP3 2

PP3 3

PP3 4

PP4 1

PP4 2

PP4 3

PP4 4

PP5 1

PP5 2

PP5 3

PP5 4

PP6 1

PP6 2

PP6 3

PP6 4

PP7 1


PP7 2


PP7 3

PP7 4

PP8 1

PP8 2

PP8 3


PP8 4

PP9 1

PP9 2

PP9 3

PP9 4

PP10 1

PP10 2

PP10 3

PP10 4

PP11 1

PP11 2

PP11 3

PP11 4

PP12 1

PP12 2

PP12 3

PP12 4

PP13 1

PP13 2

PP13 3

PP13 4

PP14 1

PP14 2

PP14 3

PP14 4

PP15 1

PP15 2

PP15 3

PP15 4

PP16 1

PP16 2

PP16 3

PP16 4

PP17 1

PP17 2

PP17 3

PP17 4

HG South down

HG South out

HG South east

HG South west

**HG North down**

**HG North out**

**P23**

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

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

# CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or Rapid Assessment (Circle One) (Revised Sept 10, 2009)

| For Office Use: | Final database #: | Final vegetation type name: | Alliance / Association: Year 1 Mainstem |
|---|---|---|---|

## I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

| Polygon/Stand #: | Air photo: | Date: | Name(s) of surveyors (circle recorder): |
|---|---|---|---|
| Arana A | — | 11/3/15 | K. Lyons |

GPS wypt #: ____ GPS name: ____ Datum: ____ or NAD83. Bearing, left axis at SW pt____ (degrees) of Long / Short side

UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ Zone: 10 / 11 (circle one) Error: ±____ ft / m / pdop

GPS within stand? Yes / No If No, cite from waypoint to stand, distance ____(meters) & bearing ____(degrees)

Elevation: ft / m Camera Name/Photograph #'s:

Stand Size (acres): (<1,) 1-5, >5 | Plot Size ($m^2$): 10 / 100 / 400 / 1000 | Plot Shape ___ x___ ft / m or Circle Radius____ft / m

Exposure, Actual °: W NE NW SE SW Flat Variable /All | Steepness, Actual °: ____ 0° 1-5° (5-25°) > 25°

Topography: Macro: top ~~upper~~ ~~mid~~ (lower) bottom | Micro: convex flat concave undulating

Geology code: _____ Soil Texture code: _____ | Upland or (Wetland/Riparian) (circle one)

% Surface cover

H20:____ BA Stems:____ Litter: ____ Bedrock:____ (Incl. outcrops) Boulder:____ (>60cm diam) Stone:____ (25-60cm) Cobble: ____ (7.5-25cm) Gravel:____ (2mm-7.5cm) Fines:____ (Incl sand, mud) =100%

% Current year bioturbation _____ Past bioturbation present? Y / N | % Hoof punch _____

Site history, stand age, comments:

Slope adjacent to trail & toe of slope along Arana Creek, seeded slope & willow plantings @ toe (12/14)

Type/ Level of disturbance codes: ____/___ ____/___ ____/___ ____/___ ____/___ "Other"

## II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH (T1) (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), (S3) mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) % Non-Vasc cover: 0 Total % Vasc Veg cover: 95

% Cover -Overstory Tree Conifer/Hardwood: — / 10 Low-Medium Tree: 10 Shrub: 25 Herbaceous: 50

Height Class - Overstory Conifer/Hardwood: — / 05 Low-Medium Tree: 04 Shrub: 02 Herbaceous: 01

*Height classes:* 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

**Species, Stratum, and % cover. Stratum categories:** T= Overstory tree, U= Understory Tree, S = Shrub, H= Herb, N= Non-vascular.
*% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

| Strata | Species | % cover | C | Strata | Species | % cover | C |
|---|---|---|---|---|---|---|---|
| T | Salix lasiolepis | 10 | | | | | |
| U | Salix lasiolepis | 10 | | | | | |
| S | Rubus armeniacus | 25 | | | | | |
| H | Hordeum sp | 45 | | | | | |
| H | Frankenia salina | 2 | | | | | |
| H | Salicornia sp. | 2 | | | | | |
| H | Misc. grasses | 1 | | | | | |
| | | | | | | | |
| | | | | | | | |

Unusual species: _____

## III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Willow - blackberry / scrub

Field-assessed association name (optional): _____

Adjacent alliances: _____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L): Herb____ Shrub____ Tree____ Other identification or mapping information:

# CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or ~~Rapid~~ Assessment (Circle One) (Revised Sept 10, 2009)

| For Office Use: | Final database #: | Final vegetation type name: | Alliance / Association Year 1 Monitoring |
|---|---|---|---|

## I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

| Polygon/Stand #: | Air photo: | Date: | Name(s) of surveyors (circle recorder): |
|---|---|---|---|
| Arana B | — | 11/3/15 | K Lyons |

GPS wypt #: ____ GPS name: ____ Datum: ____ or NAD83. Bearing, left axis at SW pt____ (degrees) of Long / Short side

UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ Zone: 10 / 11 (circle one) Error: ±____ ft / m / pdop

GPS within stand? Yes / No If No, cite from waypoint to stand, distance ____(meters) & bearing ____(degrees)

Elevation: ft / m Camera Name/Photograph #'s:

Stand Size (acres): (<1,) 1-5, >5 | Plot Size ($m^2$): 10 / 100 / 400 / 1000 | Plot Shape ___ x___ ft / m or Circle Radius____ft / m

Exposure, Actual °: ____ NE (NW) SE SW Flat Variable /All | Steepness, Actual °: ____ (0°) 1-5° 5-25° > 25°

Topography: Macro: top upper (mid) lower bottom | Micro: convex flat concave undulating

Geology code: _____ Soil Texture code: _____ | (Upland) or Wetland/Riparian (circle one)

% Surface cover

H20:____ BA Stems:____ Litter: ____ Bedrock:____ Boulder:____ Stone:____ Cobble: ____ Gravel:____ Fines:____ =100%
(Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)

% Current year bioturbation _____ Past bioturbation present? Y / N | % Hoof punch _____

Site history, stand age, comments:

Revegetation area northwest of causeway abutment - Elymus planting area (3/15)

Type/ Level of disturbance codes: ____/___ ____/___ ____/___ ____/___ ____/___ "Other"

## II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH : T1 (<1" dbh), (T2) (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: S1 seedling (<3 yr. old), (S2) young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: (H1) (<12" plant ht.), H2 (>12" ht.) % Non-Vasc cover: 0 Total % Vasc Veg cover: 80

% Cover -Overstory Tree Conifer/Hardwood: —/10 Low-Medium Tree: — Shrub: 5 Herbaceous: 65

Height Class - Overstory Conifer/Hardwood: ____/05 Low-Medium Tree: — Shrub: 04 Herbaceous: 01

*Height classes:* 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species, Stratum, and % cover. Stratum categories: T= Overstory tree, U= Understory Tree, S = Shrub, H= Herb, N= Non-vascular.
*% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

| Strata | Species | % cover | C | Strata | Species | % cover | C |
|---|---|---|---|---|---|---|---|
| T | Salix lasiolepis | 10 | | | | | |
| S | Rubus armeniacus | 5 | | | | | |
| H | Elymus ~~spp~~ trachycaulus | 70 | | | | | |
| H | Lolium multiflorum | 15 | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Unusual species: _____

## III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Willow - creeping ryegrass thicket

Field-assessed association name (optional): _____

Adjacent alliances: _____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L): Herb___ Shrub___ Tree___ Other identification or mapping information: _____

# CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or Rapid Assessment (Circle One) (Revised Sept 10, 2009)

| For Office Use: | Final database #: | Final vegetation type name: | Alliance / Association: Year 1 Monitoring |
|---|---|---|---|
| | | | |

## I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

| Polygon/Stand #: | Air photo: | Date: | Name(s) of surveyors (circle recorder): |
|---|---|---|---|
| Arana C | — | 11/3/15 | K. Lyons |

GPS wypt #: _____ GPS name: _____ Datum: _____ or NAD83. Bearing, left axis at SW pt_____ (degrees) of Long / Short side

UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ Zone: 10 / 11 (circle one) Error: ±_____ ft / m / pdop

GPS within stand? Yes / No If No, cite from waypoint to stand, distance _____(meters) & bearing _____(degrees)

Elevation: ft / m Camera Name/Photograph #'s:

Stand Size (acres): (<1,) 1-5, >5 | Plot Size ($m^2$): 10 / 100 / 400 / 1000 | Plot Shape ___ x___ ft / m or Circle Radius ___ft / m

Exposure, Actual °: W NE NW SE SW (Flat) Variable /All | Steepness, Actual °: _____ (0°) 1-5° (5-25°) > 25°

Topography: Macro: top (upper) (mid) (lower) bottom | Micro: convex (flat) concave undulating

Geology code: _____ Soil Texture code: _____ | (Upland) or Wetland/Riparian (circle one)

% Surface cover

H20:___ BA Stems:___ Litter: ___ Bedrock:___ Boulder:___ Stone:___ Cobble: ____ Gravel:___ Fines:____ =100%

(Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)

% Current year bioturbation _____ Past bioturbation present? Y / N | % Hoof punch _____

Site history, stand age, comments:

Revegetation area north of trail / causeway; planting area of grasses and shrubs (3/15)

Type/ Level of disturbance codes: ____/___ ____/___ ____/___ ____/___ ____/___ "Other"

## II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH : T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: (S1) seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: (H1) (<12" plant ht.), H2 (>12" ht.) % Non-Vasc cover: 0 Total % Vasc Veg cover: 90

% Cover -Overstory Tree Conifer/Hardwood: — / — Low-Medium Tree: — Shrub: 5 Herbaceous: 75

Height Class - Overstory Conifer/Hardwood: — / — Low-Medium Tree: — Shrub: 02 Herbaceous: 01

*Height classes:* 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

**Species, Stratum, and % cover. Stratum categories:** T= Overstory tree, U= Understory Tree, S = Shrub, H= Herb, N= Non-vascular.
*% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

| Strata | Species | % cover | C | Strata | Species | % cover | C |
|---|---|---|---|---|---|---|---|
| S | Rosa californica | 3 | | | | | |
| S | Artemesia douglasiana | 2 | | | | | |
| H | Elymus triticoides | 20 | | | | | |
| H | Plantago coronopus | 20 | | | | | |
| H | Lactuca sp. | 20 | | | | | |
| H | Lolium multiflorum | 20 | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Unusual species: _____

## III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: _____

Field-assessed association name (optional): _____

Adjacent alliances: _____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L): Herb ___ Shrub ___ Tree ___ Other identification or mapping information: