

Final San Bruno Mountain LONG-TERM SITE MAINTENANCE PLAN



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TABLE OF CONTENTS

0.0 EXECUTIVE SUMMARY	3
1.0 INTRODUCTION	4
1.2 Purpose of the Long Term Maintenance Strategy	6
1.3 Long-Term Maintenance Needs	6
2.0 INVASIVE PLANT CONTROL PROGRAM ELEMENTS	9
2.1 Ongoing Gorse Detection and Removal	9
2.2 Ongoing Treatment of Secondary Invasive Species	10
3.0 RESTORATION PROGRAM ELEMENTS	12
3.1 Wetland Restoration Site	12
4.0 MONITORING PROGRAM ELEMENTS	16
4.1 Vegetation Composition Monitoring	16
4.2 Targeted Invasive Species Monitoring	16
5.0 VOLUNTEER STEWARDSHIP PROGRAM AND STAFFING	17
5.1 Continued County Parks Staff Involvement	17
5.2 Opportunities for Partnerships and Community Engagement	17
5.3 Priority Maintenance Actions for Volunteers	18
5.5 Priority Maintenance Actions for Staff or Contractors	19
Objective 1: Maintain all Current Gorse Treatment Areas	19
6.0 ANTICIPATED BUDGETS	21
7.0 REFERENCES	24

0.0 EXECUTIVE SUMMARY

The San Bruno Mountain Gorse Control and Revegetation Project is a 4-year grant funded project that includes following elements: initial removal of mature gorse (*Ulex europaeus*), an invasive non-native plant from approximately 49.5 acres of San Bruno Mountain; retreatment of gorse re-sprouts and seedlings in previously treated areas; treatment of secondary invasive species in treatment areas (funding permitting); and planning and implementation of a pilot wetland restoration project. Funding for this effort was provided from the Proposition 12 bond fund.

The objective of the grant funded program is the sustained control of 31 acres of gorse from selected areas of San Bruno Mountain (Figure 1), an objective that is expected to be reached by the close of the program in December 2008. Preliminary monitoring results collected from 2004 to 2007 indicate that the gorse removal effort to date has been successful, with the estimated total gorse cover along the sampling transects at 4% by the end of Year 3 (2007). Presumably, following completion of 2008 Year 4 control activities, gorse cover will be much less than the target goal of 4% by the end of the grant-funded program at the end of 2008.

Despite the successful control of gorse during the grant-funded project, gorse seedlings are expected to continue to establish in the treatment areas following completion of the grant funded program at the end of 2008. Seedlings may emerge from the existing seed bank for many years following project completion, and may also re-infest from untreated gorse stands that are adjacent to the treatment areas.

Ongoing maintenance will be required to help ensure that the treatment area does not become re-infested with gorse over time. Maintenance would include continued control of new gorse seedlings to ensure the successful transformation of the treatment areas to fully functioning native plant ecosystems.

This Long-Term Maintenance Plan presents actions considered necessary to ensure that the treatment areas do not revert back to gorse infested lands. Despite the need to treat gorse seedlings, we acknowledge that San Mateo County has limited funding and current staffing levels may not be sufficient to undertake all necessary maintenance actions described in this report. Components of the Long-Term Maintenance Strategy described in this document include the following:

- an assessment of the status of the project site anticipated by the end of the grant funded gorse removal program at the end of 2008;
- the purpose of the long-term maintenance plan;
- a summary of long-term maintenance needs;
- a description of long-term maintenance actions, including
 - ongoing invasive plant control,
 - maintenance of the pilot wetland restoration site,
 - vegetation monitoring, and
 - an assessment of volunteer and staff uses,
- recommended invasive non-native plant maintenance techniques; and
- post-project vegetation monitoring methods.

1.0 INTRODUCTION

1.1 Background

The San Bruno Mountain Gorse Control and Revegetation Project (Project) was initiated in fall 2004, with the objective of achieving sustained control of at least 31 acres of gorse (*Ulex europaeus*), an invasive non-native plant. Gorse infestations at San Bruno Mountain were evaluated and prioritized prior to control efforts, with the acres depicted in Figure 1 identified as the highest priority areas for controlling the spread of gorse. Within available funding and using cost efficient control techniques, the program actually treated and cleared gorse from a total of 49.5 acres under this grant.

This 4-year grant funded project included the following elements:

- initial removal of 49.5 acres of mature gorse;
- retreatment of gorse re-sprouts and seedlings in previously treated areas;
- control of secondary invasive non native plant species in selected treatment areas; and
- planning and implementing a pilot wetland restoration project.

Funding for the Project was provided by a grant from the State of California Proposition 12 bond fund.

The overall goal of the Project is to restore the priority gorse infestations to a healthy, functional ecosystem comprised of a mix of coastal terrace prairie, coastal scrub, and riparian habitat, while reducing the ongoing threat of gorse invasion. In addition, a pilot wetland revegetation project was undertaken to demonstrate the effectiveness of active restoration at the site. Both invasive non-native plant control and native plant species out-planting activities were undertaken as a part of the pilot project, with the adjacent intact native wetland community used as a reference for revegetation.

The specific objective of the Project was the sustained control of the species, such that all mature gorse was controlled and no more than 5% vegetative cover of emerging gorse seedlings colonized the treatment area by the end of the program. Complete eradication of gorse was not considered as a realistic goal for the Project for the following reasons:

- the project area is surrounded by gorse-infested areas that were not treated, therefore providing a potential source population that could re-infest the treated areas; and
- the existing gorse seed bank is suspected to be well established. Gorse seeds remain viable for many years, requiring more than 4 years of grant-funded treatment for complete eradication.

1.1.1 Targeted Treatment Areas

The targeted treatment areas illustrated in Figure 1 were selected using the following criteria:

- areas with high natural resource values (such as endangered species habitats);
- areas adjacent to intact native ecosystems;
- sparse outlier weed population (that could become problem infestation sites in the future); and
- the leading edges of an expanding/dense weed infestation(s);

Of the 49.5 acres of mature gorse that were treated, approximately 2.86 acres were considered “outlier” infestations, 23.73 acres were defined as “scattered individuals,” and 22.94 acres were considered to be “dense” mature stands with 80-100% cover of gorse at the beginning of the project (Figure 1).

1.1.2 Treatment Methods

Treatment methods consisted of the following:

Outlier infestations - The stands consisted of dense gorse stands (80-100% cover), which were either situated in topographical areas which made it difficult or impossible to access with heavy equipment, or were situated adjacent to sensitive ecological resources and required minimal disturbance during removal activities. Removal methods focused on mostly hand removal, with limited herbicide treatment in inaccessible areas (i.e. limited localized cutting and treating of cut stumps with herbicide, and/or foliar application of herbicide to entire plants).

Scattered individuals - Removal was conducted by traversing the area for gorse individuals and either applying foliar application of herbicide, or cutting and treating cut stumps of individual plants with herbicide.

Dense stands – Treatment was conducted using mechanical methods (i.e. mulching tractor, and a converted excavator with a mulching head). In areas within dense patches of gorse where topography or rock outcrops prevented effective use of mechanical methods, hand crews conducted manual removal using chainsaws, and applied herbicide to the cut stumps. Throughout the majority of the area, all mature gorse was mulched in place. Mulch varied in depth from 12 – 24” and it was allowed to “hot compost” on site. The thick mulch helped suppress seedlings and prevented any overwhelming seedling flush during the initial treatment period. We also anticipate that the hot composting mulch is helping to reduce the viability of the long-lived seed bank through increased microbial activity (Chee-Sanford et al, 2006). Soil microbe – seedbank interactions are currently poorly understood but there is some evidence that seedbanks can be reduced through soil management.

1.1.3 Initial Monitoring Results

Preliminary monitoring results indicate that, by the end of Year 3 of the program in 2007, the gorse control effort has been successful in meeting the stated goals and objectives. The total gorse cover along the sampling transects was estimated at 4% by the end of Year 3 (2007). Of the gorse that was present at the site in 2007, 98% were seedlings and less than 2% were re-sprouting mature plants, indicating that treatments to date had been successful in controlling mature plants. Presumably, following successful completion of Year 4 control activities in 2008, gorse cover will less than 4% by the end of the grant-funded program

The site however, will still require ongoing maintenance to control germinating gorse seedlings, limit the establishment of secondary weeds and to ensure the successful transformation of the treatment areas to a functioning coastal ecosystem.

1.1.4 Secondary Invasive Plant Infestations

The primary objective of the grant funding was control of gorse. Control efforts for secondary invasive species such as purple velvet grass and sheep sorrel was limited to treatments that could be accomplished within the revegetation area given the limited resources that were available under the grant. A number of secondary invasive non-native plants have colonized the project site following the removal of the mature gorse in 2004. The most problematic species that were encountered from 2004-2007 include:

- Purple velvet grass (*Holcus lanatus*)
- Himalayan blackberry (*Rubus discolor*)
- Sheep sorrel (*Rumex acetosella*)
- Curly dock (*R. crispus*)
- Fiddle dock (*R. pulchra*)

Control of Himalayan blackberry and purple velvet grass was initiated in 2006, with control of sheep sorrel initiated in 2007. Preliminary cut-stem and spot treatments of the blackberry has reduced the infestation considerably, and continued treatment in 2008 will likely reduce the vigor and growth of this species to a maintenance level. Preliminary control of these species has been somewhat successful, with the species responding well to spot-treatment of herbicide (Mark Heath, pers. comm. 2008). However more extensive long term treatment will be required to achieve full control, an outcome that is outside the scope of the grant-funded program.

Purple velvet grass in particular continues to be a problem. The species is well established in the wetland habitat and has also colonized scrub canopy openings in the coastal scrub habitat as well as deeper-soiled moist grassland areas. Control treatments for all of these secondary invasive species will continue to the end of the program in 2008.

1.1.5 Pilot Wetland Revegetation

Active revegetation in the pilot wetland restoration area has also yielded favorable results. The wetland restoration site was planted in 2006, with additional plants installed in 2007. By 2007, the wetland restoration site had achieved an increased native plant cover of approximately 24 percent over baseline conditions. Secondary invasive plants continue to be problematic at the wetland restoration area, and additional plantings may be required following the completion of the grant-funded program to maintain the wetland and help suppress the colonizing non-native invasive velvet grass.

1.1.6 Need for Ongoing Site Maintenance

Based upon the above, the overall project site will require ongoing maintenance to fully control the germinating gorse seedlings in the treatment areas, prevent the spread of gorse from the other mature infestations within the watershed, reduce the successful colonization of secondary invasive weeds, and ensure the successful conversion of the treatment areas to a functioning coastal ecosystem.

The following sections outline and present the proposed maintenance strategy.

1.2 Purpose of the Long Term Maintenance Plan

The purpose of this Long-Term Maintenance Plan is to identify critical vegetation management actions that are considered essential to maintain the gorse treatment areas following completion of the grant funded program in 2008. This plan presents recommended actions, and associated timelines and invasive control strategies considered necessary for successful long-term site management. Additionally, the Plan outlines suggested performance measures for evaluating the success of continued vegetation management actions implemented during the maintenance period.

The anticipated lifespan of this Maintenance Plan is 5-7 years. Therefore it is recommended that the Plan be adaptively refined in the future based upon the changing site conditions, the implementation of future projects within proximity to the project site, changing resources and budgets and the possible creation of a non-profit San Bruno Mountain Conservancy that could significantly increase community engagement within the area.

1.3 Long-Term Maintenance Needs

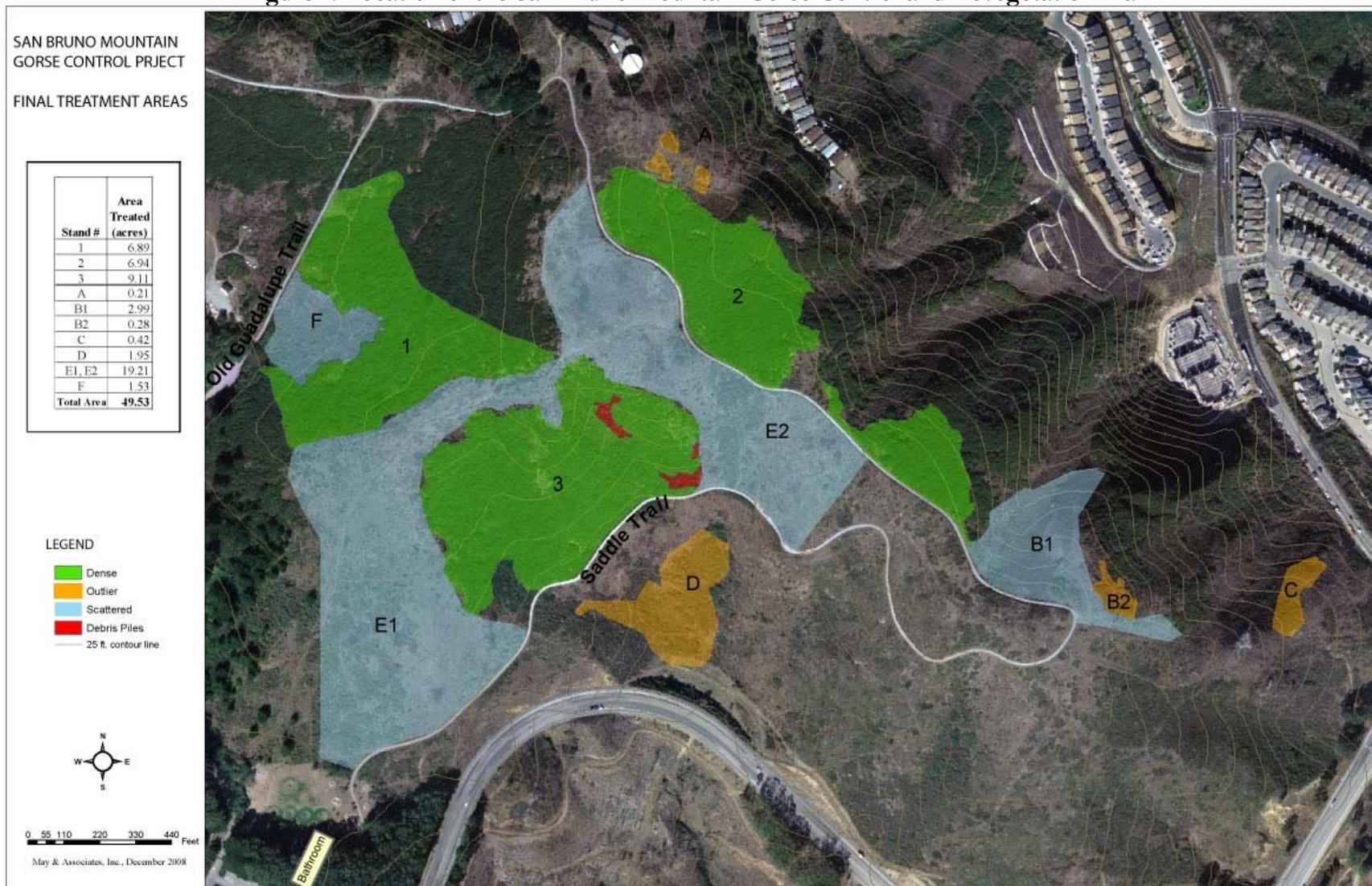
Following the initial removal of the mature gorse in 2004, vegetation treatment activities focused on controlling gorse re-sprouts and seedlings in the project area. Control efforts were implemented several times per year, and included spot treatment of gorse with herbicides, mechanical removal, and hand removal. In 2006, an increased focus was placed on the control of secondary invasive non-native weeds. While control of

secondary weeds was not the primary focus of the grant, and therefore control of these species was not fully achieved during the program, the successful colonization of these species will adversely impact the overall health of the recovering natural system if left untreated during the maintenance phase.

Continued control actions, funding, and resources are needed to sustain the significant financial and ecological investment undertaken within the past 4 years. While more than 96 percent of the gorse cover has been controlled within the project area by the end of 2007, the remaining 4 percent, if left untreated will quickly re-establish.

The following two sections provide detailed treatment options for the continued control of both the gorse seedlings and the targeted secondary weeds. The strategy also includes treatment timelines, and proposed costs. Adherence to the maintenance actions identified within this strategy should provide the County with a template for future contracting and volunteer work plan development.

Figure 1. Location of the San Bruno Mountain Gorse Control and Revegetation Plan



2.0 INVASIVE PLANT CONTROL PLAN ELEMENTS

The following section outlines the invasive non-native plant control elements of the Maintenance Plan. Sections 5.5 and 6.0 respectively summarize these program elements, the anticipated frequency of each element as well as the projected cost.

2.1 Ongoing Gorse Detection and Removal

Ongoing detection and treatment of gorse is considered an important aspect of the success of the program. While the grant-funded gorse removal program is successful, it is likely that there will still be an estimated 2-4% of gorse seedlings present in the treatment area by the end of the program. As a point of comparison, there was an estimated 97% decrease from baseline conditions in the dense stand areas since 2004 (i.e. from average of 95% cover of gorse down to 2.4% average cover of gorse seedlings in 2008). Despite the dramatic improvement, the seed bank in gorse treatment areas is well established, and seedlings are expected to germinate for many years following completion of the grant-funded program. To achieve full elimination of gorse will require additional treatments following completion of the program.

We recommend at least 3 more years of site assessment, gorse detection, and spot-treatment with herbicides at a rate of 2 times per year to more fully control the species. Following completion of the 3 additional years of treatment, the treatment areas should be re-assessed to determine if full control has been achieved. If there are still remaining seedlings after the 3 years of maintenance, additional years of annual site monitoring may be required to identify and, if necessary, spot-treatment any new gorse infestations.

Anticipated Treatment Frequency: 2 times annually for 3 years, then an assessment of site conditions to determine if additional years of maintenance are required.

Proposed Treatment: Herbicide application Shelterbelt Builders Inc. (M. Heath pers. comm.) has successfully treated this species using a spot-application of a two percent (2%) solution of Garlon 4™ (triclopyr) and Roundup Pro™ (glyphosate), an herbicide formulated for use on brush and other woody species.

Anticipated Timing: Preferably twice a year, once in late spring/early summer, and again in late fall/early winter. At the completion of the 3 years on maintenance, a site assessment should be conducted in fall to determine if additional years of maintenance will be required. If so, timing would be similar to the initial 3 years of maintenance, twice a year, once in late spring/early summer, and again in late fall/early winter.

Level of Expertise Required: Herbicides should be approved by the County of San Mateo prior to implementation. Herbicides should be applied by a qualified herbicide applicator familiar with controlling wildland weeds (County Staff or Paid Contractor) and under the direction of the written pest control recommendation from a licensed Pest Control Advisor. Oversight of this activity should be undertaken by the San Bruno Mountain Habitat Conservation Plan (HCP's) designated Biologist. Small seedlings can also be pulled by hand and with weed wrenches by trained and/or supervised volunteers. However large-scale seedling pulling by volunteers is not recommended because it is inefficient. It can take a work crew approximately one day to remove seedlings by hand on 100 square feet (M. Heath, pers. comm.). On a small scale, volunteers could work independently if fully trained as land stewards or under the leadership of a program manager as a part of a restoration workday. All volunteer and contractor activities should be documented, so that the number of controlled seedlings can be tracked over time to evaluate the effectiveness of site maintenance actions.

2.2 Optional Treatment of Secondary Invasive Species

As staffing and funding allow, treatment of secondary invasives that have been problematic in the treatment areas is recommended. The following species were previously treated during the course of the grant-funded program, but if left untreated, may colonize and/or continue to spread in the treatment areas.

Velvet grass (*Holcus lanatus*)

Velvet grass continues to be problematic in the central portion of the Gorse treatment area known as the “saddle area”, particularly in areas where soils were disturbed in the past.

Velvet grass spreads from seed or sprouts from roots in late autumn. Unlike other grass species, velvet grass actively grows in the cool moist winter months, with flowering between May and July. It can produce up to 240,000 seeds per plant, most of which are wind distributed. Its seeds are short-lived (i.e. are reported to only be viable for 48 weeks or less), but can germinate shortly after landing on moist soils. Seeds reportedly do not germinate well under shaded conditions: when soils were stored under shaded conditions for a year (such as solarizing or mulching), seed germination rates were less than 3% (Source: TNC weed abstract available online at <http://tncweeds.ucdavis.edu/esadocs/documnts/holclan.pdf>). There is also evidence that velvet grass suppresses native detritivores where it has invaded grasslands (Bastow, Preisser, and Strong, 2008). The net result is increased duff and litter accumulates at twice the rate of native grasslands, reducing competition from native species.

Shelterbelt (M. Heath pers. comm.) has had successful results in treating this species using a spot-application of a one percent (1%) solution of Envoy™ (Clethodim) or 2% solution of Roundup Pro™ (glyphosate). Envoy™ is a post-emergent, grass specific herbicide that is intended for use on perennial and annual grasses. It will not adversely affect sedges or broadleaf weeds, therefore reducing the potential for impact to surrounding native plant species. Envoy™ works best on actively growing grasses, but should not be applied near standing water. Roundup Pro™ is effective for effective control later in the growing season (summer and fall). Mark Heath recommends treating the site 2 times per year, preferably in February and April when velvet grass is actively growing, and before seed set. Mowing, in combination with herbicide treatment may also be effective. Velvet grass can be controlled with mowing followed by herbicide application, as long as the mowing occurs before the plants set seed.

An alternative treatment would be to shade out the species by covering with plastic or heavy mulch (seed free straw, at least 6 inches thick). This alternative treatment is considered appropriate for small and/or especially difficult areas where herbicides are failing to control the species. This treatment is most appropriate in areas that were previously dominated by mostly non-native annual grasses. Following 1-2 years of mulching or solarizing, the site should be uncovered and actively planted with native grasses or native coastal scrub species. Native grasses should be planted in areas with low risk of re-infestation by velvet grass, as the velvet grass is known to out-compete native grasses during site establishment. In these areas, densely planted native shrubs are recommended as more appropriate to out-compete (i.e. shade-out) velvet grass, thereby suppressing the velvet grass seed bank and increasing the potential for successful site restoration.

Himalayan blackberry (*Rubus discolor*)

Himalayan blackberry persists in patches at the site mostly in the wetland planting area. The species is also common throughout the site, forming large thickets along access roads. Unlike velvet grass, Himalayan blackberry is reportedly responding well to the existing treatment regime, and is expected to be fully controlled by the end of the program. Following completion of the program, maintenance workers and volunteers should be trained to identify the invasive Himalayan blackberry, and mark the plants for treatment.

Maintenance worker and volunteers should also be trained to differentiate Himalayan blackberry from the native California blackberry (*Rubus ursinus*) to prevent inadvertent treatment of this valuable native species.

Shelterbelt (M. Heath pers. comm.) has observed positive results treating this species using a spot-application of two percent (2%) Garlon™ (Triclopyr), an herbicide formulated for use on brush and other woody species. Mark Heath recommends treating the remaining (and any emerging) infestations once a year, preferably in August or September.

Curly Dock (*Rumex crispus*), Fiddle dock, (*R. pulcher*), Sheep Sorrel (*R. acetosella*)

Like Himalayan blackberry, curly dock, sheep sorrel and fiddle dock are most common in the wetland planting area, but all of these plants also occur in other areas of the site. These species prefer moist soils conditions, so are most common on the edges of wetlands. Effective treatment is similar to that described for Himalayan blackberry, and treatment can occur for all of these species concurrently.

Shelterbelt (M. Heath pers. comm.) has observed positive results treating this species using a spot-application of two percent (2%) Garlon™ (Triclopyr), an herbicide formulated for use on brush and other woody species. Mark Heath recommends treating once a year, preferably in August or September.

3.0 RESTORATION PROGRAM ELEMENTS

3.1 Wetland Restoration Site

A pilot wetland restoration project was also undertaken as part of the gorse removal grant-funded project. Prior to the restoration effort, the site supported approximately 48% non-native plant species, and 52% native species. Plants present included wetland grasses and forbs, upland grasses, forbs, and scattered native shrubs, and some invasive plants, including gorse.

In 2005 and 2006, a pilot restoration site was identified and some initial non-native invasive plant treatments were implemented. Following initial invasive plant control, the site was planted in 2006 and 2007 with a mixture of wetland and upland native species. Refer to the Table 1 below for a list of plants, planting numbers, and planting years.

Planted natives continued to grow and spread, increasing overall coverage of native species from 52% at the start of the project, to approximately 75% in 2007. 2007 results represented an increase of 4.5% native vegetative cover over 2006 levels, and a similar incremental increase is expected to be observed in the 2008 monitoring results. By the end of the grant-funded project in December 2008, we anticipate that native vegetation cover will increase to approximately 78-80% of the treatment site. During 2006 and 2007, the site was also repeatedly spot treated for targeted invasive non-native plant species (mostly purple velvet grass, dock, and Himalayan blackberry).

In general, the cover and extent of invasive purple velvet grass, dock species, and Himalayan blackberry within the wetland restoration site have been reduced from their original extent. Despite reductions in invasive plant cover, velvet grass and dock are likely to be present at the end of the grant funded program, and may require ongoing maintenance. Gorse and Himalayan blackberry are expected to be significantly controlled (it is expected that some seedlings will still emerge) in the wetland area by 2008, but may re-infest the wetland restoration site from adjacent lands, and should be monitored and spot treated following completion of the grant-funded program.

Table 1. Plants Installed at the Pilot Wetland Restoration Site

2006		
Species	Amount	Size
Carex hardfordii	10	SC10
Juncus balticus	98	SC10
Juncus effuses	2,156	SC10
Juncus patens	1,894	SC10
Juncus phaeocephalus	170	SC10
Leymus triticoides	196	SC10
Subtotal 2006	4,524	
2007		
Species	Amount	Size
Achillea millifolium	58	D16
Aster chilensis	77	D16
Carex barbarae	41	SC10
Festuca rubra	96	SC10
Grindelia hirsutula	45	D16
Heracleum lanatum	50	D16
Hordeum brachyantherum	98	SC10
Juncus balticus	28	SC10
Juncus effuses	254	SC10
Juncus patens	1	1 gal
Mimulus guttatus	94	SC10
Nassella pulchra	30	D16
Ranunculus californica	6	D16
Sambucus racemosa	10	D16
Subtotal 2007	888	

Table 1. Continued

2008		
Species	Amount	Size
Achillea millifolium	20	2"
Eriophyllum stachaedifolium	10	D16
Hordeum brachyantherum	44	D16
Juncus balticus	100	SC10
Juncus effuses	34	D16
Juncus phaeocephalus	98	SC10
Juncus phaeocephalus	25	D16
Nassella pulchra	60	SC10
Rhamnus californica	10	D16
Sambucus racemosa	15	D16
Schrophularia californica	50	D16
Schrophularia californica	16	4"
Sidalcea malvaflora	29	D16
Total	511	
TOTAL PLANTS INSTALLED		5,923

3.2 Wetland Restoration Site Maintenance

Following completion of the grant funded program in 2008, long-term maintenance of the wetland restoration site should include the following elements, as staffing, volunteer opportunities and funding allow.

This plan recognizes that San Mateo County has limited staffing and funding to accomplish site maintenance, and suggest a combination of staff and volunteer labor could accomplish the following:

- Ongoing invasive non-native plant monitoring, especially for purple velvet grass, dock, Himalayan blackberry, and gorse. Spot-treatment with herbicides, where detected (Site monitoring should be conducted in February and April for velvet grass, and August or September for Himalayan blackberry, gorse, dock, and other invasive species);
- Additional mulching of the edges of the site with rice straw (4-8 inches thick) to provide a buffer between the restoration site and surrounding areas that are still infested with invasive species (Note: although some invasive plants are wind distributed, heavy mulch typically prevents seed germination by preventing soils-seed contact, and by shading out the existing seed bank);
- As funding allows, consider additional plantings. Plant survivorship at the restoration site indicates that the native plants established along a moisture gradient, with upland grasses such as yarrow (*Achillea millefolium*), purple needlegrass (*Nasella pulchra*), and California oatgrass (*Danthonia californica*) establishing at the highest and driest end of the planting zone, aster in the middle zone, and rushes (*Juncus* sp.) at the lowest and wettest end of the planting zone. Two species that were planted at the site, carex (*Carex barbarae*) and mugwort (*Artemisia douglasiana*), did not do well, and should be replaced with species such as aster and rushes that established well at the site. Additional plantings will help increase in plant diversity of the wetland site.

Volunteers can be integrated into this wetland restoration project by performing activities such as planting, small-scale weed control, mulching and monitoring.

4.0 MONITORING PROGRAM ELEMENTS

4.1 Vegetation Composition Monitoring

Vegetation composition monitoring should be performed as funding and staffing allow, preferably once a year for 3 additional years following completion of the grant-funded program, and every 2-3 years thereafter. Vegetation composition data would be used to assess the following:

- Use vegetation composition data to determine following year's revegetation goals and/or restoration objectives;
- Use vegetation data to assess restoration success/performance; and
- Use conditions at reference sites to calibrate data collected at treatment sites to assess performance and measure success.

Vegetation composition can be measured using a variety of methods. The most common methods include belt transects, quadrats, line transects and ocular estimates. These can be performed randomly throughout the site, be demarcated by permanent markers or be laid out in a stratified random manner (e.g. strata could be a certain type of vegetation community, slope aspect or other defining characteristic).

Monitoring methods can be found in a number of references (e.g., *Measuring and Mapping Plant Populations* Elzinga, Salzer and Willoughby, 2001), and in the San Mateo County's Decision-Making Guidelines for Vegetation Management document (May & Associates, Inc. 2006). For this project, we recommend continuing the vegetation monitoring that was established under the grant funded program. The project monitoring included a combination of permanent transects, permanent quadrats, and control plots. Refer to the vegetation Monitoring Reports for the project for more details on monitoring methods and locations (May & Associates, Inc 2005, 2006, 2007, and 2008).

4.2 Targeted Invasive Species Monitoring

Integral management elements for effectively directing invasive non-native plant control actions include:

- Fully understanding the spatial and temporal distribution of invasive plants within the management area, and how their distribution changes over time;
- Prioritizing which invasive species have the potential to have the most significant impact on the management areas highest priority ecological resources;
- Identifying a range of control treatments that can be successfully implemented and adapted to a range of habitat conditions; and
- Adaptively anticipating and managing which invasive species have the potential to colonize habitats where control actions are initiated.

This section addresses the first and second bullets listed above. Invasive non-native plant species mapping data collected under the HCP and through the gorse control and revegetation project provides some baseline data. However, it is recommended that the County expand these efforts and undertake a comprehensive inventory and mapping program. It is recommended that the outcome of this mapping effort would be a GIS database that would include but not limited to attributes such as distribution, cover class, patch size, feasibility for control, and adjacency to high priority ecological resources.

5.0 VOLUNTEER STEWARDSHIP PROGRAM AND STAFFING

As described earlier in this Plan, an active volunteer program is considered an important tool for maintaining cost-effective weed control and helping to gain community support and engagement. Building a successful and sustainable program however, requires an initial investment of resources and staff time, the benefits of which we believe can be reaped ten-fold over time if strategically allocated. This plan encourages development of volunteer activities, while recognizing that, at present, San Mateo County has limited resources to undertake volunteer program capacity building.

Natural area stewardship programs are growing in popularity in urban jurisdictions as both communities and municipalities recognize the value of remnant historic ecosystems and undeveloped parkland. Some programs have developed organically through community interest and advocacy, while others have responded to regulatory requirements. Many have followed many different pathways in establishing overall program goals, system-wide practices, and park-specific work plans. This is important to consider when determining the optimal overall stewardship program structure for San Bruno Mountain.

The following section outlines volunteer activities that could be undertaken within the gorse removal project area.

5.1 Continued County Parks Staff Involvement

As with all community stewardship programs that are administered on public lands, it is important that the program's goals and work plan are overseen by County staff who work in partnership with local stakeholder groups and community volunteers. Staff support is critical at both the planning and field level, to ensure that community-based activities are shaped by priority planning goals and are guided, facilitated and monitored by key field staff.

5.2 Opportunities for Partnerships and Community Engagement

The San Mateo County Parks Department offers a variety of volunteer opportunities to people of all ages, backgrounds and abilities. The focus of volunteer projects is to assist Park Ranger staff with the preservation and protection of park facilities, parklands, and native plant and wildlife habitats. Currently volunteers work at a diversity of sites throughout the County, including San Bruno Mountain. Below are two programs that specifically focus on building community awareness and engagement on San Bruno Mountain. Both programs offer the potential to increase volunteer engagement necessary to sustain the gorse and other weed control and habitat restoration efforts on the mountain.

San Mateo County Parks and Recreation Foundation. The San Mateo County Parks and Recreation Foundation (Foundation) is directly affiliated with San Mateo County and provides financial support to the County's volunteer programs and a number of priority initiatives and projects. The Foundation was established in 1998 to provide additional financial support for the recreational, environmental and educational programs and projects of the San Mateo County Department of Parks. The Foundation seeks grants and contributions from individuals, foundations and businesses, however does not manage the projects directly. The San Mateo County Department of Parks is responsible for the design, permitting, contracting and maintenance of the projects.

The Foundation works closely with the County to provide funding for special projects and programs that enhance the County Park experience for visitors or that preserve its many native ecosystems. Currently the Foundation has raised resources and assisted with the following:

- Stewardship of the County Parks.
- Preserving and Restoring Native Habitats
- Environment Education
- Volunteer Opportunities
- Bike Sunday
- Trail Improvements

The continued (and potential future expansion) of the gorse control program on San Bruno Mountain could be a compelling fundraising opportunity provided the case-making is linked directly to the unique ecological and community engagement opportunities that the project and other resource management actions provide.

Creation of San Bruno Mountain Conservancy. While the Foundation certainly offers an important organizational vehicle to solicit funding for the continued gorse control and other priority non-native plants through increased volunteer engagement, the creation of a Conservancy specific to supporting the County's and stakeholders resource management and stewardship goals for the Mountain provides another viable opportunity.

If successful, the Conservancy, working in partnership with the County, could provide an umbrella for developing and maintaining volunteer activities at San Bruno Mountain.

5.3 Priority Maintenance Actions for Volunteers

Volunteers can however perform a diversity of tasks that are critical to the long-term stewardship of natural areas. Below is a list of suggested criteria for determining whether or not tasks in the project area are appropriate for volunteers.

Suggested criteria include (but are not limited to):

- Can the activities be performed using tools that are appropriate for volunteers?
- Can the activities be performed safely by volunteers?
- Can volunteer work leverage the work of paid contractors by helping to follow-up or pre-treat weed management areas?
- How many volunteers are needed to perform the activity and is there County staff or non-profit organizational leadership and capacity to train and oversee the volunteers?
- Can the volunteer clearly visualize the impact s/he has made through his/her volunteer contribution?

Using these criteria, a suggested volunteer work plan for this long-term gorse removal project is presented below in Table 2.

**Table 2. Suggested Volunteer Work Plan for Long-term Gorse Control Project
(Year 1 to be assessed prior to development of Year 2 Goals and Objectives)**

Work Plan Task	Proposed Timeline-Annual Basis				Notes
	Winter	Spring	Summer	Fall	
Perform early detection weed monitoring throughout Project area	X	X	X		Suggest 1-2 well trained volunteers who provide communication to Volunteer Coordinator, r County staff.
Conduct monthly (or bi-monthly) volunteer work day to remove gorse seedlings, immature gorse spreading from leading edges of un-controlled infestations adjacent to project area and incipient infestations of other secondary weeds. Additional work may also include mulching and monitoring.	X	X	X		Volunteer group size should be based upon size of infestations. Groups could be led by Volunteer Coordinator or County staff
Augment plantings/divisions in wetland area	X				See above re: coordination responsibilities

This efficacy of this work plan should be evaluated each year, and depending upon the results modified accordingly.

5.5 Priority Maintenance Actions for Staff or Contractors

Action 1.1 Update Maps and Treatment Monitoring Information (January – March)

As time and funding allow, gorse distribution maps should be updated to reflect the actual effort required to treat each patch (person hours per patch/treatment). Summarizing the information from the last 3 years of maintenance will lead to better time management, budgeting and efficiency for future treatments. Any additional patches discovered during the initial treatment phases should be added to existing distribution maps.

Additional Notes:

Paper maps produced for field navigation and treatment should clearly outline, but not cover and hide the treatment areas so crews can actually use the imagery to assist in search and navigation.

Action 1.2 Implementation - First Treatment (May – July)

Herbicide carried in backpacks is the optimum tool for this task. GPS track logs or daily updating paper maps each day is critical to insuring each and every patch is treated.

Additional Notes:

Trained specialty restoration crews that can thoroughly search, clearly identify and treat gorse in complex native vegetation environments will be critical to accomplishing this task. Crews must be able to identify all life stages and variations of this plant and be able to predict where it is likely to occur within patches.

Although fewer large plants occur each year, seedling recruitment will continue until the seed bank is exhausted. Treating these areas each year will take similar amounts of time during the time when the

seed bank is still present, and for a few years after the seed bank is exhausted. The majority of effort for this task is largely based on hiking and searching time, not actual treatment time. Prematurely reducing the amount of time allocated to treating these areas because plants are not obviously apparent can reduce the effectiveness of the overall treatment.

GPS track logs, paper map work logs and/or crew briefing/debriefing each day are critical to insure that each and every patch is thoroughly addressed. GPS track logs have worked well in past projects as a digital record of treating each patch. Paper maps or other equivalent protocol would be acceptable as long as daily records are maintained and reviewed on a daily basis and shared with all project partners.

Action 1.3 Implementation - Second Treatment (September – November)

A second treatment pass is critical for every patch each year of active treatment. It is inevitable that some plants escape treatment during the first pass. This occurs when plants are missed or incompletely treated during the first pass and the mild coastal environment yields year round seedling recruitment.

Additional Notes:

Though a single treatment pass seems adequate for a trained crew, environments are very complex, challenging and variable which ultimately lead to some missed targets. The challenge of treating every single individual necessitates multiple treatments each season. The utilization of quick action herbicides such as glyphosate and triclopyr helps with intra-season follow-up attempts. Failure to implement secondary treatments will allow some escapement which will ultimately lengthen the control period.

Action 1.4 Performance Review (August – October)

Gorse management team members should review treatment maps and herbicide use record following each full treatment season. Maps should be adjusted as necessary if any additional individuals or patches are found.

Additional Notes:

If areas are discovered with unusual seedling abundance, additional methods should be considered to treat seedlings or the seed bank directly.

5.5.1 Priority Maintenance Activities Related to Wildfire Events

San Bruno Mountain has experienced wildfires that have greatly affected vegetation patterns (both positively and negatively). If another future wildfire occurs within gorse treatment areas, it is likely that a large gorse seedling flush will occur in the spring after the fire event. The seedling flush associated with a wildfire could easily exceed staff capabilities allocated for ongoing maintenance. In this instance, we recommend prioritizing maintenance actions within the fire burned gorse treatment areas as follows:

- During spring following a wildfire, assess the magnitude and distribution of gorse seedlings;
- Set maintenance priorities as follows
 1. Control seedlings near sensitive habitat areas (i.e. butterfly habitat, wetlands etc) first.
 2. Control dense seedling area using localized herbicide foliar spray techniques while seedlings are less than 6 inches tall
 3. Control sparse seedling and individual seedlings as the last priority.
- Conduct necessary maintenance using prioritizations (described above) and gorse control techniques described in this document.
- Continue to monitoring seedling flushes in burned areas for 3-5 years, and treat as possible given available staff resources.

6.0 ANTICIPATED BUDGETS

Four cost estimates are included in this section. These budgets represent anticipated costs for actions outlined in the Maintenance Strategy.

Table 3 presents Anticipated Annual Volunteer Program-Based Costs associated with the invasive non-native plant control and monitoring activities for the gorse control project.

Table 4 presents the Anticipated Annual Maintenance Costs for the Gorse Control Areas assuming contractor-based control associated with the invasive non-native plant control and monitoring activities for the gorse control project for a 3-year planning window. Note: control activities may be required for 10 years or more to fully eradicate the species.

Table 3. Cost Estimate - Annual Volunteer Work Plan Support for Long-term Gorse Control Project Management.

Task Name	Proposed Personnel and Consulting Hours			Pers. & Consult. Costs	Direct Expenses*	Subtotal
	County Staff	Vol. Coord.	Consultant			
Task 1. Coordinate and implement volunteer work days	8	90	4	\$4,908.00	\$560.00	\$5,468.00
Task 2. Conduct Photo Monitoring	0	8	0	\$400.00	\$25.00	\$425.00
Task 3. Augment pilot wetland revegetation by in-planting and weeding	0	24	4	\$1,600.00	\$750.00	\$2,350.00
Task 6. Coordination btwn. Vol. Coordinator and Weed Contractor	2	10	10	\$1,502.00	\$ -	\$1,502.00
Subtotal	10	132	18	\$8,410.00		
TOTAL COST ESTIMATE:						\$9,745.00
COSTING ASSUMPTIONS:						
*Includes travel, mulch, volunteer recognition and program material support						
Assume average County hourly rate is \$50/hr (including benefits)						
Assume Vol. Coordinator wage is \$50/hr (contracted)						
Assume average Consulting rate is \$100/hour						

**Table 4. Cost Estimate –
Continue Contractor Weed Treatments of Gorse Treatment Area (3 Years)**

Task Name	Proposed Personnel and Consulting Hours			Staff and Consultant Costs*	Direct Expenses**	Subtotal
	County Staff	Volunteer Coordinator	Consultant (Weed Mgt)			
Task 1. Annual Gorse Seedling treatments (2X per year for 3 years)	30		675	\$35,000 .00	\$1,920 .00	\$36,920.00
Task 2. Vegetation Monitoring /Adaptive Management	4		16	\$1,240.00	\$ -	\$1,280.00
Task 3. Coordination with Volunteer Program	12	12	24	\$2,820.00	\$ -	\$1,920.00
Subtotal	46	12	715	\$49,435.00	\$1,920.00	
TOTAL COST ESTIMATE						\$50,495.00
COSTING ASSUMPTIONS:						
<p>*Assume average County hourly rate is \$50/hr (including benefits) Assume Volunteer Coordinator wage is \$50/hr (contracted) Assume Weed Mgt. Contractor labor rates average \$65/hr for crew/project management Assume Contractor project management rate of \$80/hr Assume average Consulting rate is \$100/hour</p> <p>**Direct expenses includes travel, mulch, volunteer recognition and program material support ** Contractor's direct expenses include herbicides, adjuvanents and fuel costs.</p> <p>NOTE: Costs provided in this report are for a 3 year planning window, however, invasive plant control may be required for 10 years or longer to fully eradicate gorse.</p>						

7.0 REFERENCES

7.1 Printed References

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7.2 Personal Communications

- Heath, Mark. Restoration Ecologist, Shelterbelt Builders. Various meetings and telephone conversations from 2005 to 2008. Work: (510) 841-0911 Email: mark@shelterbeltbuilders.com