

**INVASIVE BROOMS AND ACACIA MANAGEMENT PLAN  
FOR THE OLYMPIA WELLFIELD**

**SAN LORENZO VALLEY WATER DISTRICT**

JULY 2016

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**PLAN TO CONTROL INVASIVE BROOMS AND ACACIA  
AT THE OLYMPIA WELLFIELD**

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# **PLAN TO CONTROL INVASIVE BROOMS AND ACACIA AT THE OLYMPIA WELLFIELD SAN LORENZO VALLEY WATER DISTRICT**

## **1. INTRODUCTION AND BACKGROUND**

The Olympia Wellfield comprises 180 acres, much of which was mined for gravel and fine quality sand for about 30 years starting in 1937. The quarry operation closed before the Surface Mining and Reclamation Act took effect in 1976. No reclamation was required or performed, although several species of non-native conifers were planted to improve the appearance of denuded areas. For another three decades, there was no vegetation management of the site and during this time invasive non-native species colonized large portions of the property.

Although it was much degraded and fragmented by mining and the spread of invasive woody plants, the site still retained a unique assemblage of plant species – ranging from common species to rare/endangered species, as well as local endemic forms of relatively widespread plants. This unique assemblage has been termed Sand Specialty plants (R. Morgan 1983). Of the 83 Sand Specialty plants identified by Morgan, 56 occur on the Wellfield property as mapped in 2011 (S. Schettler 2011).

The San Lorenzo Valley Water District (District) began to remove Silver Wattle (*Acacia dealbata*) trees in 2000 in an effort to restore habitat for the Sand Specialty plants. Most of the Sand Specialty plants are relatively small herbaceous plants that require full sun and are easily shaded out by invasive trees and shrubs. Tens of thousands of Silver Wattle, French Broom (*Genista monspessulana*), and Portuguese Broom (*Cytisus striatus*) plants were removed during the decade that followed. A hiatus in control resulted in stands of the two Broom species becoming re-established, as well as scattered young Acacia plants.

The current status of the Brooms is that the large majority are mature and are producing seed; perhaps two-thirds of them are now too large to be eliminated by uprooting them. French Broom is widespread at the Wellfield; Portuguese Broom is less so. Young Acacias are sparsely but widely scattered.

The site also supports two federally Endangered animals, Mount Hermon June Beetle (*Polyphylla barbata*) and Zayante Band-Winged Grasshopper (*Trimerotropis infantilis*). Animals receive stronger protection under the federal Endangered Species Act than plants. “Take” of a listed species is prohibited unless a Habitat Conservation Plan (HCP) has been approved and an Incidental Take permit has been issued consistent with Section 10(a)(1)(B) of the Endangered Species Act. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The permit also must prevent harm to breeding, feeding, or sheltering by the covered species. This plan describes vegetation control methods that will avoid take of the listed insects and thus avoid the need for a federal permit.



FIGURE 1. *Polyphylla* larvae are large, as grubs go. This one is Mt. Hermon June Beetle or a sibling species. Photo by S. Schettler.



FIGURE 2. The Zayante Band-winged Grasshopper is well camouflaged against the Zayante sand. It is small – males are about 1/2" long, females closer to an inch. The lower hind legs (not visible here) are blue-gray. Photo by S. Schettler.

## 2. CONTROL METHODS

Four vegetation treatments will be used to control Brooms and Acacias at the Wellfield : uprooting, cutting below ground, cut stump treatment, and thermal weeding. These methods are customized to avoid harming ground-dwelling insects.

### 2.1. PULLING SMALL PLANTS

The simplest way to eliminate unwanted plants up to a certain size is to uproot them, either pulling them by hand or using a specialized tool. Uprooting is particularly suitable for French Broom, which is typically shallow-rooted. Because of the high temperature of the Sandhills substrate, larvae of the June Beetle are presumed to occur only at depths greater than 6" (C. Mitcham [USFWS] pers. comm. 2016), where the sand is cool compared to the surface. In order to avoid harming larvae of the June Beetle, uprooting will be limited to plants with roots less than 6" deep.

Small seedlings of the Brooms or Acacia are easily pulled by hand. Tools such as the Weed Wrench or the Extractigator® are unlikely to come into play at the Wellfield because they are designed for plants with roots deeper than 6".

### 2.2. CUTTING BELOW GROUND

Broom plants up to 1" in diameter at the base can be cut below the ground surface. A small bowl 2-3" deep is excavated around the base of the plant, exposing the root. Then the upper part of the root system is cut off with carpenter's pincers or nippers that are designed to cut nails and wire. The cutting tool must be kept away from the sand surface to prevent dulling it. To complete the process, loose sand is filled back in over the remainder of the root system.



Deprived of light and their photosynthetic green stems, brooms do not resprout as they do when cut above the ground surface.

### 2.3. CUT AND APPLY SYSTEMIC HERBICIDE – CUT STUMP METHOD

This technique is applicable for plants of the invasive woody species addressed in this plan whose roots are deeper than 6 inches, and is highly effective. First the duff is removed around the base of the plant. The plant is cut a short distance above the exposed base of the stem or trunk, so that the cutting tool is not dulled by working in sand. Immediately – within one minute – a 50% solution of either Roundup PRO® or Triclopyr 4e and water is applied to the cambium. Triclopyr 4e is an emulsion, so the container must be shaken frequently. Although the label recommends using Triclopyr 4e full strength, a 50% solution is equally effective at half the cost (K. Moore, pers. comm. 2016).

Persons who apply herbicides must hold a Qualified Applicator License and use appropriate Personal Protective Equipment (PPE). The licensee can work side by side with non-licensed personnel who cut and stack the vegetation. The California Department of Pesticide Regulation maintains a list of Qualified Applicator Licensees.

Cut stump treatments will not be conducted when rain is forecast within the next 24 hours.

### 2.4. THERMAL WEEDING

After a stand of French Broom is removed, abundant small seedlings typically appear from the seed bank, too dense and numerous to be managed by controlling individual plants. These young seedlings respond well to thermal weeding, sometimes referred to as “flaming”. This technique has long been used for weed control in agriculture.

A propane torch is passed over young French broom seedlings up to 20 cm in height. The heat does not cause the seedling to ignite but within a day the seedling is wilted and dead. This treatment is effective on a wide variety of unwanted plant species. There is an informative short video describing thermal weeding at [https://youtu.be/\\_2BLHhCWgOE](https://youtu.be/_2BLHhCWgOE) (Flame Cultivation for Weed Control). Additional materials concerning thermal weeding are at <https://ag.umass.edu/fact-sheets/flame-cultivation-for-weed-control>.

A common misconception is that flame equipment should “burn” or consume the weeds with fire during treatment. Thermal weed control is based on flash heating to rupture cell membranes within the weed, thus shutting down the plant’s capacity for photosynthesis. When applied correctly to young, vigorous green weeds with minimal dead material there should be very little, if any, smoke from the treated area (Smith, K. Western Farm Press. <http://westernfarmpress.com/another-look-thermal-technology-weed-control>).

As of early 2016, there are currently no carpets of young Broom seedlings at the Wellfield. Thermal weeding may not be applicable but will be a backup control method if large numbers of Broom seedlings appear in the future after stands of adult Brooms have been removed. Modest numbers of seedlings may be controlled by hoeing.



Because of the obvious hazard of working with fire, the timing of flaming is critical. It is performed only when vegetation at the site is too wet to carry a fire; during a light rain is ideal. The aim is not to actually burn the seedlings, but to heat them enough to break their cell walls. The torch passes briefly over any given point, limiting impact to ground-dwelling organisms. No chemicals contaminate the site.

The Zayante Fire Department is adjacent to the Wellfield. As a courtesy and a safety measure, fire personnel should be contacted in person or by phone (831-335-5100) when flaming is to be carried out.

### 3. SPECIAL CASES

#### 3.1 NO SOIL DISTURBANCE DEEPER THAN 6"

In order not to harm larvae of Mt. Hermon June Beetle (Figure 1), all soil disturbance will be limited to a maximum depth of 6 inches.

#### 3.2 ZAYANTE BAND-WINGED GRASSHOPPER

Adult grasshoppers are mobile, although the Zayante Band-winged Grasshopper (ZBWG) also relies on camouflage (Figure 2). It visually blends in with the sand, and does not have particularly colorful flight wings as some grasshoppers do. Besides its small size compared to other grasshoppers, its most distinguishing trait is the crepitating sound when it flies, resembling the sound of a bug-zapper. The USFWS recommends that a) informal surveys for ZBWG be conducted concurrent with vegetation treatment and b) if a ZBWG is observed, work that may disturb the species would not take place (C. Mitcham [USFWS] pers. comm. 2016).

#### 3.3 PORTUGUESE BROOM

Portuguese Broom plants produce prolific branches right at the soil level, which limits access for cutting tools. The lower branches need to be individually cut away in order to get at the main plant. Its roots also splay out in all directions immediately belowground. While the cut stump treatment is effective, it is sometimes simpler to remove modest-sized Portuguese Broom by cutting apart the root system one root at a time. A hand mattock is employed to expose roots to a maximum depth of 6" (so as not to harm June Beetle larvae) and then the individual roots are cut to release the upper portion of the plant for removal from the site.

#### 3.4 ACACIA

The lateral roots of *Acacia dealbata* often produce new sprouts, even after the main trunk has been killed by a cut-stump treatment. The new shoots may be immediately adjacent to the stump or some distance away. A young plant may be either a seedling or a root sprout. To test, give the plant a few short sharp tugs. If it starts to come out, continue pulling to uproot it. If it

doesn't start to come out, clear the duff and soil away from the base of the plant. Then cut the plant 1/4" above the soil, maintaining a sharp edge on the cutting tool by keeping it free of ground contact, and apply 50% RoundupPRO® or Triclopyr 4e to the cut surface.

### 3.5 NO HERBICIDE TREATMENT BEFORE RAIN

Cut stump treatments will not be conducted when rain is forecast within the next 24 hours.

## 4. TIMING OF WEED CONTROL

With the exception of thermal weeding, control methods may be implemented at any season. The best time of year to uproot Broom plants is March and April, when they are flowering and easy to spot but for the most part have not yet produced seed for the current year. RoundupPRO® or Triclopyr 4e can be applied in any season but may be most effective in the fall when the plant's reserves are depleted by the dry summer.

During late spring and summer it can become dangerously hot for personnel to work in the Sandhills, risking heat exhaustion or heat stroke. Radiant heat from the sun is reflected up from the white sand, and the heat of the sand itself can de-laminate boot soles (S. Schettler, pers. obs.).

There is a mildly effective natural ally in the campaign to eliminate French Broom. The larvae of Genista Broom Moth (*Uresiphita reversalis*) defoliate random plants, sometimes causing death.



FIGURE 3. Caterpillar (larva) of Genista Broom Moth with chewed foliage. Photo by Chuck Baughman.



FIGURE 4. French Broom plants killed by Genista Broom Moth caterpillars and/or gophers at the Wellfield

## 5. PRIORITY AREAS FOR CONTROLLING ACACIAS AND BROOMS

The Sand Specialty Species were mapped in 2011 under an Educational Grant from the San Lorenzo Valley Water District to fill a data gap in developing the management plan for the Olympia Wellfield. That mapping forms the basis for prioritizing the locations to control Acacias and Brooms. The priority ratings are based on several factors:

- Sites with greatest species richness of Sand Specialty plants
- Highest quality degraded sites, including locations of unique species occurrences
- Moderate quality degraded sites
- Remainder of areas mapped as Sand Parkland or Sand Parkland (Degraded)
- Areas along service roads
- Expansion areas outside the areas mapped as Sand Parkland or Sand Parkland (Degraded)

### 5.1. PRIORITY ZONE 1. SOUTHERN EDGE OF PROPERTY

The areas containing the highest species richness of Sand Specialty plant species (as many as 33 species per site, median 19 species) are located where there has been least disturbance of the ground in the past. These areas also have the lightest populations of invasive species. These are the areas where it is ecologically most important, and least costly, to control Acacia and Brooms. The Mayer easement and a mitigation site for replacement of the Probation Tank are included in the Priority 1 zone.

Because there have been various interpretations of where the southern property line actually lies and it has never been surveyed to an engineering standard, Priority Zone 1 includes all locations north of the old Cemex/Lonestar access road parallel to the District's southern property line. This alignment does not match the existing fence lines but is readily identified in the field. The old road itself can function as a buffer between Cemex vegetation management and District management. Permission has been requested from Cemex to work on this far northern edge of their property and the request will be followed up.

### 5.2. PRIORITY ZONE 2. HIGHEST QUALITY DEGRADED SITES

These are areas containing 12 or more Sand Specialty plant species. These also include unique locations of species that are not found elsewhere on the Wellfield property.

### 5.3. PRIORITY ZONE 3. MODERATE QUALITY DEGRADED SITES

Areas containing 11 or fewer Sand Specialty plant species occurring in dense clusters.

### 5.4. PRIORITY ZONE 4. OTHER SAND PARKLAND SITES

Priority Zone 4 comprises the rest of the areas mapped as Sand Parkland or Sand Parkland (Degraded).

### 5.5. PRIORITY ZONE 5. ROADSIDES

This zone comprises all areas within 30 feet of service roads and other vehicle access routes. It includes gated routes that formerly provided vehicle access and could potentially be used again in the future. There are two rationales for including roadsides as a priority: seeds of Brooms and Acacias are readily transported by tires of vehicles that routinely use the service roads; and the routes that are currently closed and gated will provide access for control work and for disposition of the plants removed. Re-opening these former access routes may require light blading, which will be limited to maximum 6" depth in order not to harm larvae of the Mt. Hermon June Beetle.

NOTES: Where a vehicle route passes through an area designated Priority Zone 1, 2, 3, or 4, that segment of the vehicle route will be cleared of Brooms and Acacias at the same time as the rest of the Priority Zone. Also, the mapping of the roadsides is schematic rather than detailed; Brooms and Acacias are not consistently present in some portions of the locations shown.

#### 5.6. PRIORITY ZONE 6. EXPANSION AREAS

Over time, control of invasive Brooms and Acacias will be gradually expanded outward beyond Priority Zones 1 - 5. The increments will be planned in such a way that each increment can regularly receive follow-up treatment on an annual basis. Regular follow-up control is at least as

\*\*\*\*INSERT FIGURE 5. 11" x 17" MAP OF PRIORITY ZONES\*\*\*\*

important as initial removal, but on a per-acre basis is far less expensive than the initial removal or re-starting after a hiatus in control work. As with Priority Zone 5 (Roadsides) the mapping of the Expansion Areas is schematic rather than detailed; some areas may be inaccessible or contain no Brooms or Acacia.

The detailed map of Sand Specialty Plants that was developed in 2011 contains sensitive information. The map that will be available to the public is the generalized map included in this plan (Figure 5) minus the concentrations of Sand Specialty Plants. The map that will be used in the field is a detailed 24" x 36" version of that map including the polygons of Sand Specialty species.

Regrettably, the District's GIS specialist passed away unexpectedly during the preparation of this plan. Given his passing, Figure 5 was drawn by hand. **The current map needs one deletion on the 11 x 17 version -- the layer showing Dense Sand Specialty Plants. The map also needs several additions:**

- **Contour lines to assist with identifying sites in the field**
- **A labeled grid to identify the "addresses" of individual areas where Brooms and Acacia will be controlled**
- **A scale bar**

#### 5.7. COMMENTS ON PRIORITIES

In addition to the ecological importance of managing invasive species at the relatively intact southern end of the District property, the Priority Zone 1 is also administratively important. It has been identified as Option 1 for off-site mitigation for the impacts of replacing the Probation Tank (J. McGraw 2015), since not all the impacts created by replacing the Probation Tank can be mitigated at that site.

The priority zones are not mutually exclusive when it comes to the timing of treatment. Because Zones 1 through 3 have the lightest population of Acacia and Brooms, they can all be treated simultaneously during the initial control work. Depending on the available budget, additional priority zones may be manageable in the first year.

There could be a "Priority 1A" designation: any single isolated Broom or Acacia plant that is observed far from others should be removed to forestall it founding a new population.

Two areas that would qualify as Priority 2 or 3 are *not* targeted for control of invasive Acacias and Brooms. One is at the remote north end of the SLVWD property, and is mostly on a neighboring parcel. The other is the large slope of drifted sand below the eastern highwall that supports Sand Specialty plants along with a widespread population of Childing Pink (*Petrorhagia prolifera*, formerly called *Tunica prolifera*). This is a non-native annual that is difficult to eradicate. During the course of mobilizing and demobilizing to work below the highwall, its seed would likely be spread to sites where it currently does not occur. A high number of the Sand Specialty plants are native annuals and could be vulnerable to competition from a non-native annual if this species spreads to other locations.

## 6. DISPOSAL OF THE CUT/PULLED PLANTS

The cut or pulled plants will be piled for future burning or removal by District personnel. As much as feasible, the piles will be located outside the Priority zones – and preferably near a vehicle route where they can either be removed from the site or burned while a truck stands by with a tank of water and a pump.

Different species handled by different methods will be stacked separately so approximate numbers may be tallied at the end of each segment of work and recorded on the Daily Work Log (Appendices A-B). This is important information for budgeting the work in subsequent years.

The smallest or sparsest plants need not be stacked and may be left on the ground where they were growing.

## 7. STEEP SLOPES

Some of the steep slopes included in the zones prioritized for control of Brooms and Acacia can be accessed on foot. Others will be accessed on ropes – but only by personnel with climbing experience. The cliff just north of the main east-west service road should not be accessed at all because it is crumbly; working on it would create damage to the slope and possibly to the service road, and it would be unduly hazardous and costly to work on.

There is a cliff on the northwest edge of the southwest pit that *should* be included in the removal of Acacia and Brooms. After a thick stand of Acacias was removed at the top of the hill, the single small remnant population of Pussy Paws (*Calyptridium monospermum*) expanded dramatically and has moved down into the southwest pit. Refer to the aerial photo at Figure 6 for orientation. Other steep slopes will be evaluated on an individual basis for the feasibility of initial removal and ongoing follow-up. In some cases, cleaning up the steep slopes will provide sufficient benefit to the flatter areas below to justify working on them. In others, the weed control may have to be limited to continuing control on the flatter areas below unmanageable steep slopes.



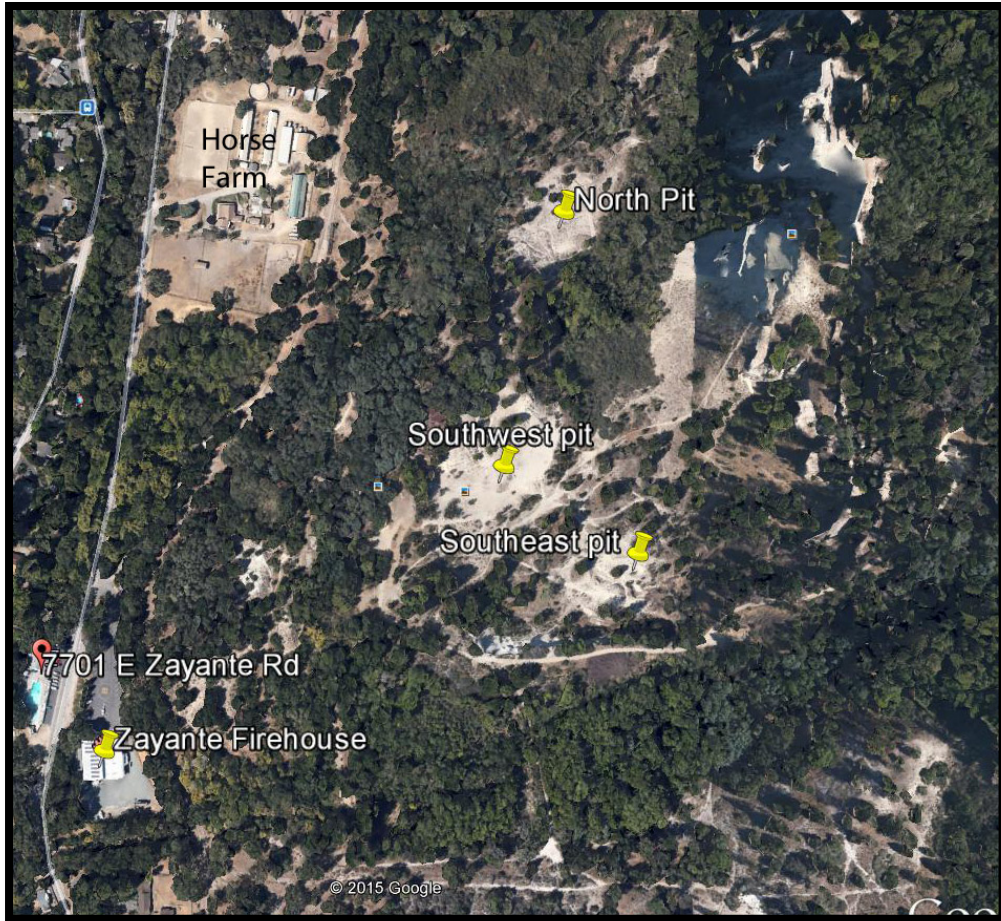


FIGURE 6. Overview of the quarried pits at the Olympia Wellfield.

## 8. RECORD-KEEPING

A key component of this plan is a procedure to quantify, on an ongoing basis, the level of control effort and the results. The Management Plan for the Olympia Wellfield acknowledges that eradication of invasive exotic vegetation is not feasible without a continued and dedicated effort over decades. Seed of French Broom is known to remain viable in the soil for 40 years or more (K. Moore, pers. comm. 2016). It will be necessary to record daily reports of the invasive species work while onsite in order for the District to plan for, and budget for, continuing invasive species control. The California Department of Parks uses a daily work log which has been modified for the Olympia Wellfield site. Examples are shown at Appendices A - C.

A grid will be superimposed on the field map, with the X and Y axis numbered and lettered such that each block will have an identification code. The identification code for the treatment block will be recorded, with a tag indicating the year of initial treatment. The latitude and longitude at or near the center of each block will be recorded so that every block can be relocated and progress of the given block can be tracked over time; this central location will be photographed before work begins and used for future reference in the field. These records will facilitate planning and budgeting for each subsequent round of control work, and will be essential for monitoring progress over time.



The treatment methods for the three target invasive species differ, and the amount of labor required for each treatment varies. Therefore, separate records will be kept for French Broom, Portuguese Broom, and Silver Wattle Acacia. The exact number of plants need not be counted each day, rather they can be recorded in categories (1 to 10, 11 to 100, 101 to 1,000).

## 9. PERSONNEL

There are a number of potential work crews available to carry out the control of invasive Acacia and Brooms at the Olympia Wellfield. Current crew availability and hourly fees should be investigated so that field work can begin in a timely manner.

### **American Conservation Experience**

333 Soquel Avenue, Santa Cruz, CA 95062  
Vasiliki Vassil, Director of ACE California  
Phone: 831/427-1091  
[v.vassil@usaconservation.org](mailto:v.vassil@usaconservation.org)

### **AmeriCorps National Civilian Community Corps**

1400 10<sup>th</sup> Street  
Sacramento, CA 95814  
Karen Baker, Chief Service Officer  
Phone: 888/567-SERV  
[reception@CaliforniaVolunteers.ca.gov](mailto:reception@CaliforniaVolunteers.ca.gov)  
[californiavolunteers.org](http://californiavolunteers.org)

### **Ben Lomond Conservation Camp 45**

13575 Empire Grade  
Santa Cruz, CA 95060  
Phone: 831/426-1610

### **C12 Restoration**

Qualified Applicator licensee  
Chris Spohrer, owner  
1610 El Dorado Avenue  
Santa Cruz, CA 95062  
Phone: 831/359-7420

### **California Conservation Corps**

757 Green Valley Road, Watsonville, CA 95076  
Janet Wohlgem  
Phone: 831/768-0150  
[jwohlgem@ccc.ca.gov](mailto:jwohlgem@ccc.ca.gov)

**Shelterbelt Builders Inc.**

401 Terry A. Francois Blvd., Suite 220

San Francisco, CA 94158

Mark Heath, CEO

Phone: 415/357-1500

[www.shelterbeltbuilders.com](http://www.shelterbeltbuilders.com)

In addition to these resources, high school and college students are often interested in internships. They are typically available during the summer between school terms and some will accept unpaid positions in exchange for valuable experience.

In addition to receiving safety training prior to the beginning of field work, each worker will be provided with a copy of the Handbook of Sandhills Plants that was prepared in 2012 under an Educational Grant from the District. The Handbook was developed to acquaint District personnel with the more conspicuous Sand Specialty plants at the Wellfield. Photos of the other Sand Specialty plants, especially the smaller or more uncommon ones, will also be provided to each worker for reference in the field.

## 10. SUCCESS CRITERIA

After a given treatment plot has received the full array of appropriate control methods (uprooting, cutting below ground, cut stump, and thermal weeding), success criteria will apply. The initial success criterion after the first – and most extensive – treatment will be zero percent cover by the three target invasive species immediately following treatment. Subsequent treatments will also result in zero cover by the Brooms and Acacia at the completion of annual treatment.

The most significant measurement of cover will be made at the *beginning* of each annual treatment after the initial clearing, for comparison with the previous year. Each treatment plot is expected to decrease in percent cover of Brooms and Acacias by 3% per year, and the cost of control will decrease by 5% per year.

If at any time a given treatment block appears to be clear of Acacias and Brooms of all sizes, it will continue to be monitored annually on at least a reconnaissance basis. After 15 years of a clean slate it may be deemed to be free of these invasive woody plants. It will still be patrolled annually, because deer are known to widely disperse seed of Portuguese Broom in particular, which is present on nearby properties. However, at that point, minimal control work will be sufficient to keep the treated areas clean of invasive woody species.

## 11. MONITORING AND REPORTING

The detailed field map will be overlaid with a grid, much like metropolitan street maps, so that every treatment area will have a permanent address where progress can be tracked over time.

### 11.1. MONITORING

Monitoring will be performed twice a year, both before and after the control work.

In January - February, all the grid blocks that have been controlled in the past will be monitored and either the number or percent cover (Appendix D) of Brooms and Acacia present will be estimated. The population of plants present at the beginning of each year's work is expected to decline over time. This pre-treatment monitoring will provide a measurement of progress.

Every two weeks during the season of the removal work, there will be an inspection of each grid unit that has recently been treated. The purpose of this inspection will be to assess the effectiveness of the work. Immediately after treatment, a given area should contain zero Broom or Acacia plants. If there are any, the work crew will be called back to finish the work. New seedlings that may germinate after 100% effective treatment will be addressed the following year.

Each treated grid unit will be inspected at a reconnaissance level and at least one estimate of cover will be made for every 10,000 square feet of treatment area, or approximately 100 feet by 100 feet. \*\*\*Verify with scale bar added to the map\*\*\* Illustrations for estimating proportions of cover are shown at Appendix E. The identification code for each treatment block will be recorded, with a tag indicating the year of initial treatment.

All of the areas mapped as Sand Parkland or Sand Parkland (Degraded) will be walked annually to find any other invasive species that may appear over time. If they do appear, control methods will be developed for the additional species and they will be incorporated into the vegetation management program.

### 11.2. REPORTING

A written annual report will be submitted before Thanksgiving each year to the San Lorenzo Valley Water District's Environmental Programs Manager and to the U. S. Fish and Wildlife Service. A narrative will describe the work done, observations, and problems encountered. The Daily Work Log will be summarized on the Monitoring and Reporting Form (Appendix C). The data presented on the Monitoring and Reporting Form will provide cumulative records of the progress of controlling Brooms and Acacia. The total hours worked in each grid unit are expected to decrease each year.

Photographs will be included to illustrate the most successful sites, average sites, and particularly troublesome spots. The report will include recommendations for changes in invasive species management that may become appropriate over time.

## 12. REMEDIAL MEASURES

If the success criteria are not met in any year, that will be an indication that either the budget appears to be inadequate or the work has been sloppy. In the former case, the work plan and budget for the subsequent year will be adjusted to pull back from the lower priority treatment

zones and temporarily concentrate the work effort on the higher priority areas. In the latter case, a staffing and/or supervision change will be made in order to achieve more effective control of Brooms and Acacia.

### 13. TIMELINE OF WORK UNDER THIS PLAN

Seed of French Broom is known to remain viable in the soil and then germinate after more than 40 years (K. Moore, pers. comm. 2016). Therefore, this plan will be in effect for half a century after it is approved – or longer if Brooms or Acacia are still showing up from the seed bank.

### 14. ADAPTIVE MANAGEMENT

Given the long timeline of this plan, new weed control methods may be developed over time. Ways to reduce costs while retaining the effectiveness of the field work may also evolve. Appropriate revisions to this plan will be made upon agreement between the field contractor, District personnel, and the U.S. Fish and Wildlife Service.

Adjustments may also be recommended for specific field conditions; for instance, the 30-foot clearance along vehicle routes may need to be widened in some places. Because seed of the Brooms is partially dispersed by gravity, some far-flung downslope locations may be less important for control than upslope areas.

### 15. COST

Cost estimates were attached to an earlier plan to manage and monitor French Broom at the Wellfield (Ecological Concerns, Inc., undated). However, that plan addressed only French Broom, which is the simplest to manage of the three species addressed in this plan. It also did not address the constraints imposed by the Endangered Species Act, which limits control work because of potential impacts on the listed ground-dwelling insects.

A comparison of the cost of control methods follows at Table 1. It is based on the key cost of the work: an estimate of person-hours needed to implement each technique for each target species. The amount of labor translates directly to the price of the control work and will vary according to the hourly cost of the labor involved. Each labor pool (Section 8.1) will charge different hourly fees for crew members, crew supervisor, chainsaw operator, and pesticide licensee. If, for example, the average pay per crew member is \$20 per hour, the initial cost for Priority Zones 1 – 5 will be \$48,680.00 excluding time to mobilize and demobilize.

The person-hours required for the work will be updated based on records of the initial work on each species at each work site (see Section 8 above), and then updated annually. With consistent follow-up, the cost of control will drop steadily and may eventually approach zero.

Estimated costs for the effective control methods can be translated from the person-hours in Table 1 based on conservative estimates of the current populations:

- Approximately 20,000 French Broom plants are currently present in the Sandhills areas of the Wellfield and along vehicle routes. Most of these are rooted more than 6” deep or larger than 1” diameter at the base and will require the cut stump treatment rather than uprooting.
- There are approximately 2,000 plants of Portuguese Broom, most of them rooted more than 6” deep and thus requiring the cut stump treatment rather than uprooting.
- Full-sized Acacia trees were removed in the past but there are approximately 1,000 young seedlings and root-sprouts in widely scattered locations.

It should be noted for planning purposes that a work day is functionally 6.5 hours, when a half hour each is subtracted for mobilizing, demobilizing, and a lunch break.

Table 1 follows on the next page.

**TABLE 1. COMPARISON OF CONTROL METHODS**

ASSUMES A LARGE ENOUGH LABOR POOL  
TO ADDRESS PRIORITY ZONES 1-5 IN THE FIRST YEAR

SPECIES	CONTROL METHOD	ESTIMATED NUMBER OF PLANTS*	APPROX. PERSON- HOURS PER PLANT excludes mobilize/demobilize	TOTAL PERSON- HRS
French Broom seedlings <20 cm	thermal weeding	tbd after large plants are removed	0.0015	
French Broom small plants w/ roots <6" deep	uproot and stack	1,000	<b>0.07</b> (4 minutes)	70
French Broom all sizes	cut, apply 50% RoundupPRO® or Triclopyr 4e to cambium, stack	18,000	<b>0.10</b> (6 minutes)	1,800
Portuguese Broom small plants	pull	400	<b>0.07</b> (4 minutes)	28
Portuguese Broom medium plants	dismantle roots & stack plant	800	0.20 (12 minutes)	160
Portuguese Broom large plants	remove lower branches for access; then cut, apply 50% RoundupPRO® or Triclopyr 4e to cambium, stack plant	800	0.17 (10 minutes)	136
Acacia  test: seedling or root sprout?	if seedling: pull by hand	500	0.14 (8 minutes); includes locating widely scattered small plants	70
	if root sprout: cut, apply 50% RoundupPRO® or Triclopyr 4e to cut surface	500	0.17 (10 minutes); includes locating widely scattered small plants	70
All 3 species: plants up to 1" diameter at base	Excavate a small bowl around the plant, cut stem below ground, cover with sand	1,000	<b>0.10</b> (6 minutes)	100
TOTAL PERSON-HOURS				2,434
*The estimated number of plants excludes Priority Zone 6, the Expansion Areas, where the number of French Broom plants may be higher than anywhere else on the Wellfield.				
<b>Bold</b> print in Table 2 indicates the lowest cost treatments. Treatments for Acacias and for Portuguese Broom are more costly than for French Broom because of their re- sprouting growth habit and their structural form, respectively.				

There is some overlap and choice among treatments. When there is a choice, the lower cost treatment will be selected.

The draft HCP for the Probation Tank replacement identifies a cost of \$5,000 per year to manage and monitor habitat within the 5.5-acre habitat set-aside located in the Olympia Wellfield, or \$909 per acre. This set-aside area contains by far the lightest populations of Broom and Acacia plants at the Wellfield. **The acreage occupied by Priority Zones 1 through 5 will be calculated from the GIS data in the District files.** Extrapolating from the maintenance cost of the 5.5-acre habitat set-aside, the acreage of Priority Zones 1 through 5 will be multiplied by \$3,600 per acre to budget for the annual cost of controlling invasive Broom and Acacia species at most of the Wellfield, where their populations are higher and the seed bank is heavy.

Grant funding may be available for initial removal of Brooms and Acacia under such programs as the federal Partners for Wildlife program. However, funders are unlikely to support ongoing maintenance. The decades of follow-up maintenance work must be funded by annual District budgets or by an endowment.

## 16. RECOMMENDATION

It is recommended that, as soon as possible the District should

- Investigate potential grant funding, and
- Resume the control of invasive woody species at the Olympia Wellfield.

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## **APPENDICES**

DAILY WORK LOG: SMALL PLANTS PULLED									
Date	Recorder	Site hrs.	No. crew	Crew hrs.	Supvsr hrs.	Grid location	Species	No. plants	Notes
1/2/2017	CM	2	4	8	2	H-30-2016			training
1/2/2017	CM	6	4	24	6	H-30-2016	Fr. Broom	11-100	
							Port. Broom	1 -10	
							Acacia	1-10	
1/3/2017	CM	8	4	32	8	H-31-2016	Fr. Broom	1-10	
							Port. Broom	1-10	
							Acacia	1-10	
1/4/2017	KR	8	4	32	8	H-28-2016	Fr. Broom	11-100	
							Port. Broom	1-10	
							Acacia	1-10	
continue									
E X A M P L E									
2/26/2017	CM	8	4	32	8	K-14-2016	Fr. Broom	100-1,000	
							Port. Broom	11-100	
							Acacia	1-10	
continue									

**APPENDIX A  
SMALL PLANTS PULLED**

[illegible]

[illegible]

## APPENDIX C

### CUT STUMP

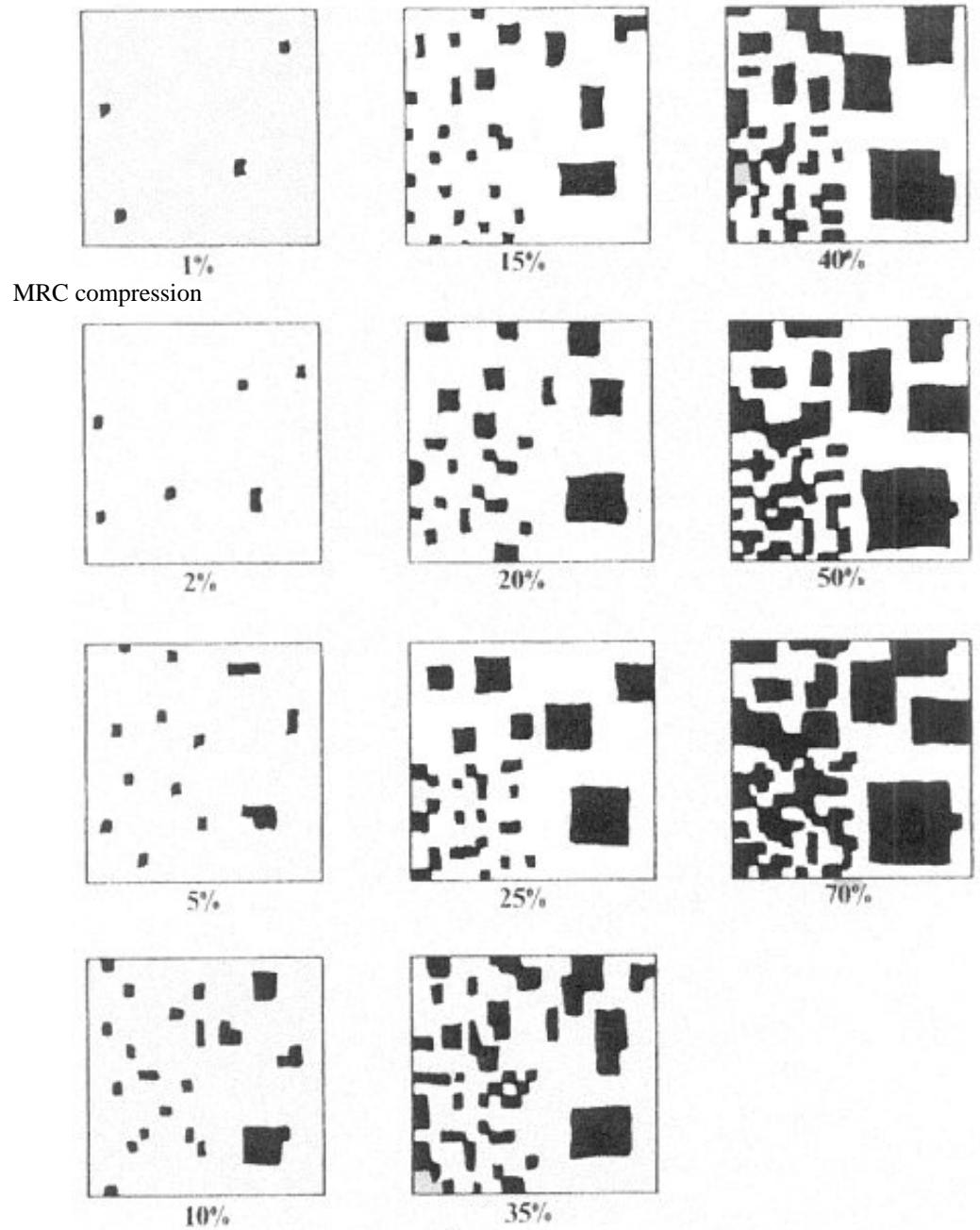
# **MONITORING AND REPORTING FORM**

YEAR \_\_\_\_\_

TREATMENT AREA grid unit ID & year	LAT/LONG AT OR NEAR CENTER	APPROX. BEGINNING PLANT NUMBERS			PERSON-HOURS WORKED			TOTAL HOURS
		Fr. Broom	Port. Broom	Acacia	Fr. Broom	Port. Broom	Acacia	
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							
	N37° 4' W122° 3'							

## **APPENDIX D** **MONITORING AND REPORTING FORM**

## ILLUSTRATIONS FOR ESTIMATING PERCENTAGE OF CO



Each fourth of any one square has the same amount of black.

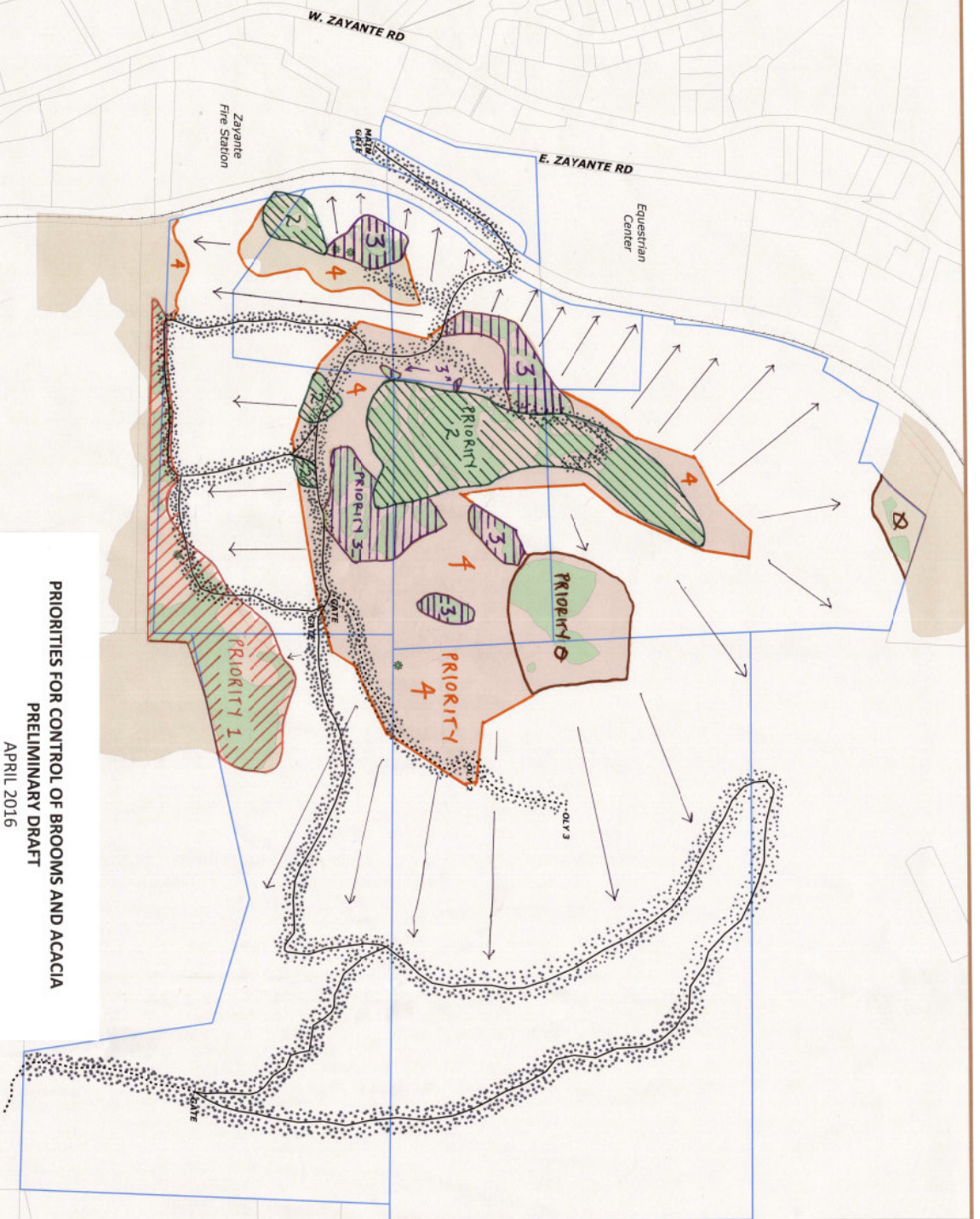
APPEND





**San Lorenzo Valley Water District**  
**Olympia Watershed Property**  
**~~NATIVE PLANT SPECIES MAPPING 2011~~**

**PRIORITIES FOR CONTROL OF BROOMS AND ACACIA**  
**PRELIMINARY DRAFT**  
**APRIL 2016**



SCALES 1:2,041

**Legend**

—	Service Road - Public Use
.....	Service Road - Closed To Public
—+—+—	Railroad Tracks
□	SILVUD Parcels
□	S.C. County Assessors Parcels
□	Sand Parkland (degraded)
□	Sand Parkland
□	Dense Sand Specialty Plants
★	Silverleaf Manzanita

**PRIORITY ZONES FOR CONTROL OF BROOMS AND ACACIA**

1	HIGHEST DENSITY OF SAND SPECIALTY PLANTS
2	SECOND HIGHEST DENSITY OF SAND SPECIALTY PLANTS
3	THIRD HIGHEST DENSITY OF SAND SPECIALTY PLANTS
4	OTHER SAND PARKLAND SITES
5	ROADSIDES
6	EXPANSION AREAS
7	NO PRIORITY

NOTE: Contour lines will be added, as well as a labeled grid to identify "addresses" of treatment areas.