

Habitat-Specific Interim BMPs

San Diego South County Grasslands Project:
Habitat Restoration BMP Development

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Cost/Time Matrix

- Efficiency is specific to the:
 - crew (experience and training), and
 - site (access and mobility considerations)
- Cost to an particular land manager depends greatly on any available existing staff, equipment, supplies and/or volunteer labor.
- A range of fully loaded costs are reflected, as might be expected from service provided by an independent restoration contractor.

Cost/Time Matrix

Initial Dethatching Event

Method	Example Standard Equipment	Cost (\$)/acre [Man-hours/acre]
Goat Dethatching	Goats Water Truck	\$350-\$700 [4-6]
Rotary Mow Large Areas	Batwing Attachment on a New Holland Tractor	\$50-\$100 [0.5-1]
Rotary Mow Around Native Shrubs (i.e. 6-ft rotary mower)	Rotary Mower on Bobcat	\$700-\$950 [10-14]
Rake Into Mulch Piles	Tractor with Hay Rake Attachment	\$700-\$1,000 [10-14]

Cost/Time Matrix

Weed Management / Site Preparation

Method	Example Standard Equipment	Cost (\$)/acre [Man-hours/acre]
Rotary Mow and leave cut material	Batwing Attachment on a New Holland Tractor	\$50-\$75 [0.5-1]
Flail Mow and leave cut material	Flail Mower Attachment on Bobcat	\$500-\$950 [10-14]
Line Trim and leave cut material	Weed eaters	\$1,100-\$1,400 [30-40]
Fusillade application with wand on truck mounted spray tank	Application with wand on 300-ft retractable hose, tank mounted on 4x4 pickup truck	\$500-\$700 [8-10]
Glyphosate (i.e. Roundup Pro) application with wand on truck mounted spray tank	Application with wand on 300-ft retractable hose, tank mounted on 4x4 pickup truck	\$450-\$600 [8-10]
Spot spray glyphosate (i.e. Roundup Pro) with backpack applicator	Truck Mounted Spray Tank Backpack Sprayers	\$700-\$1,200 [10-30]

Cost/Time Matrix

Seed Installation

Method	Example Standard Equipment	Cost (\$)/acre [Man-hours/acre]
Hand Broadcast Seed (i.e. Belly-Grinder) and Rake-in	Body Mounted Belly Grinder	\$950-1,200 [30-36]
Seed Balls	Already prepared by volunteers, installation only	\$500-600 [18-20]
Broadcast Spreader and follow with ATV pulling 6-ft cultipacker	Kubota with Culti-packer Attachment	\$180-\$250 [6-8]
Broadcast Spreader and follow with ATV pulling 6-ft cultipacker in Strips	Kubota with Culti-packer Attachment (6-ft seeded and 6-ft unseeded strips)	\$240-\$300 [8-10]
2-way drill seed (6-ft drill seeder)	Drill Seeder Attachment on a New Holland Tractor	\$300-\$750 [8-10]
1-way drill seed in strips (6-ft seeded and 6-ft unseeded strips)	Drill Seeder Attachment on a New Holland Tractor	\$200-\$650 [6-8]

Cost/Time Matrix

Hand Weeding

Method	Example Standard Equipment	Cost (\$)/acre [Man-hours/acre]
Handweeding 1/8 acres per day (Similar to QCB Habitat Intensity)	Misc.	\$7,000-\$15,000 [250-500]
Handweeding 1/3 acres per day (Similar to Forbland Intensity)	Misc.	\$2,800-\$7,000 [80-250]
Handweeding 1 acre per day (Selective hand weeding in grassland)	Misc.	\$2,600-\$3,400 [78-100]

Grassland Habitat

Target Diversity and PLS for Seed Mix

Functional Group Targets	Abundance	Target Ranges	
		PLS/sqft	PLS/sqft (incl. dormant and hard seed)
Native Annual Herbs (3+ sp)	occasional to common	30-50	30-75
Native Annual Herb, Nurse Plant (1-3+ sp) [e.g. <i>Amsinkia intermedia</i> , <i>Layia platyglossa</i> , <i>Lasthenia californica</i> , <i>Plagiobothrys canescens</i> , <i>Pseudognaphalium californicum</i> , and <i>Lupinus</i> spp.]	common in first year, occasional in future years	25-75	25-100
Native Perennial Grass (1-2+ sp) [e.g. <i>Stipa pulchra</i>]	common	10-25	10-40
TOTAL		70-150	70-200

Cost per acre for current study: \$6,000/acre
Wild local collection and commercial grow

**Amounts in final seed mix depend on availability of species, cost to collect, germ and dormancy of seed, existing site conditions (incl. existing native diversity) and forecasted germination conditions that will impact vigor of seed in the site. Low germ from poor conditions during the collection period can significantly increase costs.*

Otay Tarplant Habitat

Target Diversity and PLS for Seed Mix

Functional Group Targets	Abundance	Target Ranges	
		PLS/sqft	PLS/sqft (incl. dormant and hard seed)
Native Annual Herbs (3+ sp) [e.g. <i>Deinandra conjugens</i>]	occasional to common	25-50	25-75
Native Annual Herb, Nurse Plant (1-3+ sp) [e.g. <i>Layia platyglossa</i> , <i>Lasthenia coronaria</i> , <i>Lupinus biocolor</i> and <i>Lepidium nitidum</i>]	common in first year, occasional in future years	25-75	25-100
Native Perennial Grass (1-2+ sp) [e.g. <i>Stipa pulchra</i>]	common	10-25	10-40
TOTAL		70-150	70-200

Cost per acre for current study: \$2,400/acre
Wild local collection and commercial grow

**Amounts in final seed mix depend on availability of species, cost to collect, germ and dormancy of seed, existing site conditions (incl. existing native diversity) and forecasted germination conditions that will impact vigor of seed in the site. Low germ from poor conditions during the collection period can significantly increase costs.*

Forbland Habitat

Target Diversity and PLS for Seed Mix

Functional Group Targets	Abundance	PLS/sqft	Target Ranges
			PLS/sqft (incl. dormant and hard seed)
Butterfly Food Plants (1+ sp) [e.g. <i>Plantago erecta</i> and <i>Castilleja exserta</i>]	common to dominant	10-40	10-60
Native Annual Herbs (3+ sp)	occasional to common	15-40	15-60
Native Annual Herb, Nurse Plant (1-3 sp) [e.g. <i>Layia platyglossa</i> , <i>Lasthenia californica</i> and <i>Lepidium virginicum</i> sp. <i>menziesii</i>]	common in first year, occasional in future years	20-50	20-75
Native Perennial Grass (1-2 sp) [e.g. <i>Stipa pulchra</i> and <i>S. lepida</i>]	occasional	5-15	5-20
TOTAL		50-125	50-200

Cost per acre for current study: \$12,000/acre
 Wild local collection, seed bulk and commercial grow

**Amounts in final seed mix depend on availability of species, cost to collect, germ and dormancy of seed, existing site conditions (incl. existing native diversity) and forecasted germination conditions that will impact vigor of seed in the site. Low germ from poor conditions during the collection period can significantly increase costs.*

Quino Checkerspot Butterfly Habitat

Target Diversity and PLS for Seed Mix

Target Ranges			
Functional Group Targets	Abundance	PLS/sqft	PLS/sqft (incl. dormant and hard seed)
QCB Food Plants (1-2 sp) [e.g. <i>Plantago erecta</i> and <i>Castilleja exserta</i>]	common to dominant	15-40	15-100
Native Annual Herbs (3+ sp)	occasional to common	2-10	2-25
Native Annual Herb, Nurse Plant (1-3 sp) [e.g. <i>Lasthenia californica</i>]	common in first year, occasional in future years	25-50	25-75
TOTAL		50-100	100-200

Cost per acre for current study: \$11,000/acre
Wild local collection and commercial grow

**Amounts in final seed mix depend on availability of species, cost to collect, germ and dormancy of seed, existing site conditions (incl. existing native diversity) and forecasted germination conditions that will impact vigor of seed in the site. Low germ from poor conditions during the collection period can significantly increase costs.*

Grassland

Interim BMPs

- Working Hypothesis
 - For successful enhancement of native cover and diversity, the near surface non-native seed bank needs to be significantly depleted to either allow “passive restoration” from the existing native seed bank (and new additions), or “active restoration” from seed addition.
- Interim BMP Recommendations:
 - Select the most effective method that is feasible for your site and management objective*
 - Weed Management/Site Preparation
 - In general, (a) Herbicide 2x > (b) Mow 2x
 - But, a combination of the two would be effective: Winter Grass-Specific herbicide + Spring mowing or line trimming
 - Mechanized methods are significantly less expensive than hand work, and as effective
 - Therefore, where the site allows, mowing is preferable to line trimming; and, wand on truck mounted tank is preferable for herbicide application to back pack sprayer

Grassland

Interim BMPs

- Interim BMP Recommendations
 - Weed Management/Site Preparation
 - NNG is important to manage consistently and thoroughly as possible
 - Brachypodium distachyon is especially problematic, because of its character to grow in mats that flower close the soil surface, making mowing as a control method more challenging
 - Can use a flail mower, but rocks at the soil surface can slow the mowing operation.
 - Consider Phasing – For larger scale weed management, phasing implementation will leave some areas untreated for the existing wildlife using the annual grassland habitat.

Grassland

Interim BMPs

- Interim BMP Recommendations
 - Seeding
 - Seed at recommended rates when absolute non-native cover is <10% prior to the current year
 - Consider adding native shrubs to the seed mix; and, use site to screen seed
 - given likelihood that type-converted annual grasslands are suitable for a mosaic of vegetation types, including varying levels of shrub cover
 - Use adjacent native shrub communities as likely appropriate reference sites
 - For steep and highly erodible soils, consider weed management in strips parallel to the slope contour (e.g. Modified DeSimone method)

Grassland

Interim BMPs

- Interim BMP Recommendations
 - Maintenance Weeding
 - Avoid, if possible, by conducting sufficient site preparation prior to seeding; non-natives will remain a feature of the “restored grassland;” the goal is to reduce it to a level that will facilitate the establishment of new native grassland populations
 - When cut material is collected prior to seed set, leave in mulch piles on site to reduce disposal costs and provide cover for reptiles and other wildlife
 - Remember Timing is Critical
 - Monitoring
 - Qualitative monitoring is sufficient
 - More frequent and extensive qualitative observations are more useful than fewer more precise observations for weed management
 - Identify opportunities to use volunteer labor (e.g. citizen science) to engage and share monitoring effort

Grassland stuff

- Future Research Questions
 - Seed addition has added native cover and diversity to restoration plots, but is it sustainable, and will it increase over time?
 - How much future vegetation management will be necessary or warranted?
 - Is grazing a viable weed management strategy for grasslands? Likely comparable effectiveness to mowing.
 - What are appropriate targets for reduction in weed cover prior to seed addition?
 - Investigate seed addition without weed management as a treatment (longer time horizons?)

Otay Tarplant Habitat

Interim BMPs

- Working Hypothesis
 - Existing dormant Otay Tarplant seed banks (historic known extents and unknown adjacent populations) will germinate and contribute to the seed bank population with appropriate weather conditions and aided by weed management aimed at reducing litter cover from non-native annual grasses.
- Interim BMP Recommendations
 - **“Seed bulk in place”** Instead of seeding new populations of Otay Tarplant, conduct weed management for historic extents and a large buffer area surrounding it in suitable soils.
 - For restoration use weed management strategies for Grassland Habitat
 - For population management only, consider range of options from 1 winter management event to 2 per Year (Herbicide, mowing or line trimming)
 - Map population extents year-to-year to build geodatabase of local populations for management
 - Consider coupling grassland habitat restoration with targeted weed management for OTP populations, to enhance habitat value and focus resources

Forbland Habitat

Interim BMPs

- Working Hypothesis
 - *Erodium* spp. will not outcompete desirable natives in forbland habitat restoration
- Interim BMP Recommendations
 - Focus on suitable degraded habitat
 - Focus on control of annual grasses and highly invasive species with available method to land manager: Line trim 2x == Herbicide 2x (equally effective)
 - Seed addition method very effective:
 - Hand spread or with automated spreader (Choice depends on area to be seeded and efficiency in calibrating your seed application rate)
 - Use of Culitpacker was a great innovation for soil-seed contact
 - In smaller areas, can lightly rake it in, or where there are significant existing areas of soil crusts you want to avoid
- Future Research Questions
 - Will treatment plots, which have been weeded for 4 years, maintain and increase established native cover and diversity over the next several years?
 - Is seed addition without control of *Erodium* spp. as effective as weed management prior to seeding?
 - What will be the trajectory of soil crusts in treatment plots after management (source of disturbance) ceases?

Quino Checkerspot Butterfly Habitat

Interim BMPs

- Working Hypothesis
 - *Erodium* spp. will not outcompete desirable natives in QCB habitat restoration
- Interim BMP Recommendations
 - Focus on control of annual grasses and highly invasive species with hand weeding (ignoring *Erodium* spp.)
 - QCB habitat need bare ground for basking and add food plants
 - Seed addition for QCB food plants by hand seeding or seed balls, depending on available labor
 - Seed ball production well suited for volunteers and installation is simple
 - Hand seeding more labor intensive in the field, but more uniform establishment
- Future Research Questions
 - Will treatment plots, which have been weeded for 4 years, maintain and increase established native cover and diversity over the next several years?
 - Monitor sites in the future to see if *Erodium* spp. returns at QCB sites and if it interacts with the established native cover and diversity
 - Is seed addition without control of *Erodium* spp. as effective as weed management prior to seeding?
 - What will be the trajectory of soil crusts in treatment plots after management (source of disturbance) ceases?