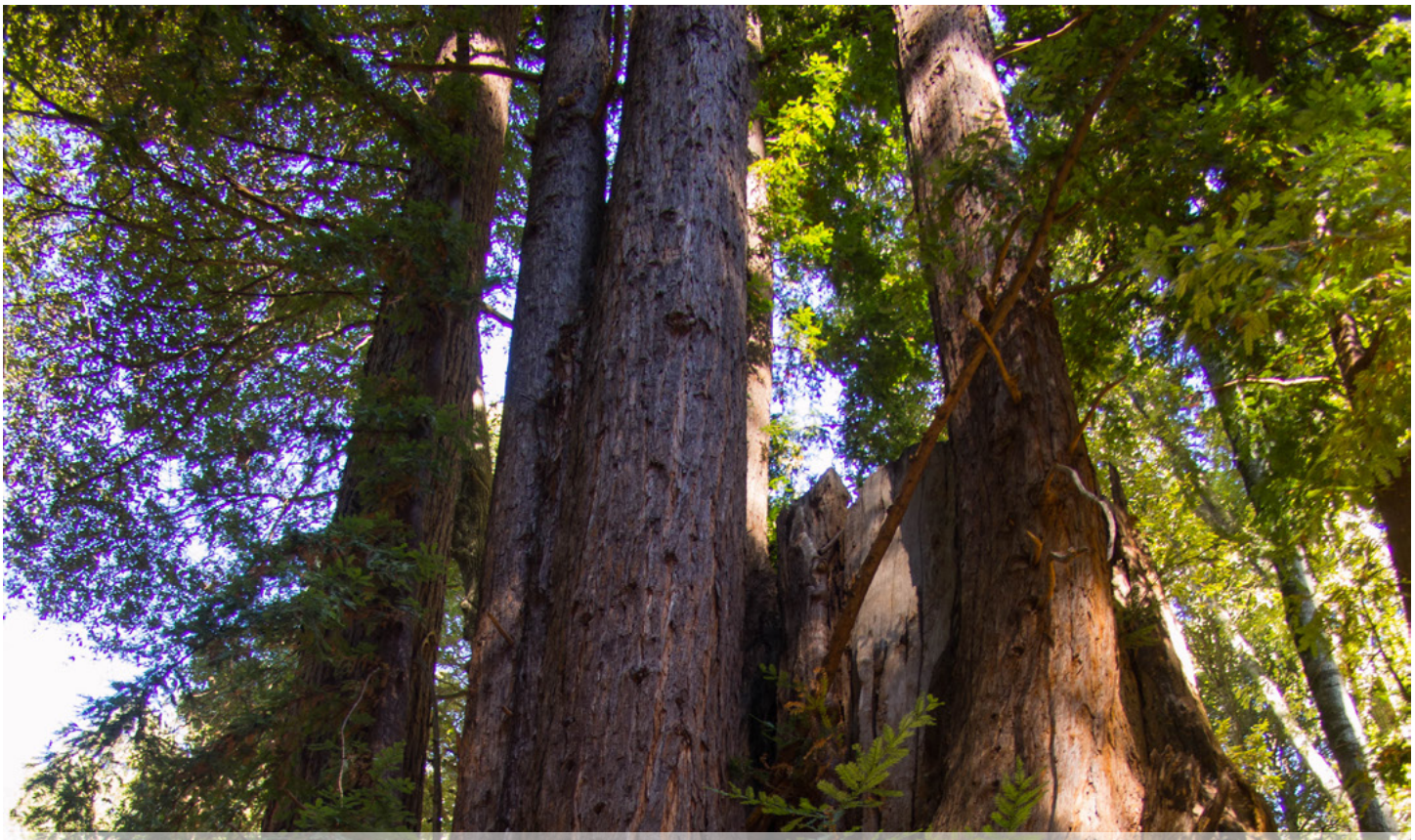

Bear Creek Redwoods Open Space Preserve

Invasive Plant Species Mapping and Integrated Pest Management Plan

MIDPENINSULA REGIONAL OPEN SPACE

January 2016

MIG | TRA Environmental Sciences

Shelterbelt Builders

INTEGRATED PEST MANAGEMENT PLAN FOR THE BEAR CREEK REDWOODS OPEN SPACE PRESERVE

Midpeninsula Regional Open Space District

Prepared by: Shelterbelt Builders Inc.
and MIG|TRA Environmental Sciences Inc.
January 2016

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1 INTRODUCTION

1.1 PLAN DESCRIPTION

The following is an Integrated Pest Plant Management Plan (Plan) for the prevention, detection, and control of priority invasive plant species impacting the Midpeninsula Regional Open Space District (District) Bear Creek Redwoods Open Space Preserve (Preserve). The Preserve is located in Santa Clara County along California Highway 17 near Los Gatos (Figure 1). This Plan provides guidelines for the control of invasive plants and the restoration of native plant communities in priority management areas of the Preserve.

The 1,432-acre Preserve (Figure 2) was purchased by the Peninsula Open Space Trust and the District in 1999, and is being prepared for public access in 2018. Part of the preparation includes managing invasive plant species so that pre-opening construction and future public use does not spread invasive plants and create a larger management problem, and so that the District has a strategy to proactively manage invasive plant species in the Preserve.

The Plan provides a long-term strategy to control invasive plant species in the Preserve within available budget and labor resources. Development of the Plan required mapping the current distribution of 12 different invasive plant types, and 17 species:

- Brooms: French broom (*Genista monspessulana*), Scotch broom (*Cytisus scoparius*), Spanish broom (*Spartium junceum*)
- Thistles: yellow star thistle (*Centaurea solstitialis*), bull thistle (*Cirsium vulgare*), Italian thistle (*Carduus pycnocephalus*)
- Ivy: Cape ivy (*Delairea odorata*) and English ivy (*Hedera helix*)
- Stinkwort (*Dittrichia graveolens*)
- Himalayan blackberry (*Rubus armeniacus*)
- Harding grass (*Phalaris aquatica*)
- Sweet pea (*Lathyrus latifolius*)
- Periwinkle (*Vinca major*)
- Teasel (*Dipsacus* sp.)
- Eggleaf spurge (*Euphorbia oblongata*)
- Poison hemlock (*Conium maculatum*)
- Klamath weed/ common St. John's wort (*Hypericum perforatum*)

The Plan was developed with guidance from the District's Programmatic Integrated Pest Management Plan and EIR (MROSD, 2014); Botanical Survey of the Bear Creek Open Space Preserve (EcoSystems West, 2008); and The Status and Management of Invasive Plants prepared for the District (Shelterbelt Builders Inc., 2004). This Plan is also supported by findings from invasive plant surveys conducted in 2003 by Shelterbelt Builders Inc., and in 2015 by MIG|TRA Environmental Sciences.

The District will weigh the recommendations in this report against other issues or constraints for the Preserve, and then a final IPM plan will be developed for the District's implementation.

1.2 INTEGRATED PEST MANAGEMENT PROGRAM

The District is implementing an Integrated Pest Management (IPM) program to be used for a wide variety of management needs on District lands. The District is responsible for managing many types of resources, including natural features, lands for agricultural production, and built facilities such as offices, outbuildings, and trails. The IPM program is a standardized system for decision-making for the management of populations or behavior of any native and non-native organisms that are incompatible with the District's resource management, public health, aesthetic, and regulatory goals.

IPM is an adaptive strategy to manage insect, weed, vertebrate and pathogen pest species in production agriculture and urban landscaping environments. Evolving definitions of IPM have been developed by organizations and management systems throughout the world since the 1960's. The traditional concept of IPM relies on the assumption that pests have natural enemies (predators and diseases) that will reduce and maintain their populations at some level. As a result, traditional goals for implementation of IPM programs generally do not focus on the eradication or elimination of the target pest species, but rather on actions that strengthen and stabilize landscapes to remain productive while resisting or tolerating low population levels of pest organisms.

IPM is a long-term, science-based decision-making system that assesses pest control alternatives and monitors site conditions to effectively control a target pest with minimum impact to human health, the environment, and non-target organisms. IPM can be used for many types of pests and situations, including invasive species control, control of structural and agricultural pests, and control of other nuisance species (e.g., rattlesnakes and stinging insects). IPM methodology includes the following elements:

1- Correctly identify the pest and understand its life cycle.
2- Determine and map the extent of the problem or infestation.
3- Establish the tolerance level for control actions.
4- Utilize the least toxic suite of treatment methods to control the pest at the most vulnerable stages of its life cycle.
5- Monitor populations and effectiveness of treatment methods.

IPM requires knowledge of the biology/ecology of each pest, the available techniques for controlling them, and understanding of the secondary effects of the control techniques (such as soil erosion, pesticide drift, bioaccumulation, fire hazard). Control of a pest is only undertaken once a "tolerance level" has been exceeded. Tolerance level, also referred to in IPM systems as a "tolerance threshold", is the level at which pests can be present without disturbance or disruption of natural processes, economic damage, degradation of intended uses or human enjoyment of facilities, or unacceptable human health risk.

The effectiveness, safety, and efficiency of control methods are important considerations as they apply to the specific site conditions and life history of the target pest. IPM requires monitoring site conditions before, during, and after treatment to determine if objectives are being met and if methods need to be revised. IPM requires that non-chemical methods be considered in addition to pesticides. If pesticides are necessary to meet a pest control objective, the potential for harm to workers and the public are carefully considered, as are effects on the environment, and then the least toxic and most effective, efficient, and target-specific pesticide is chosen.

IPM is:

- An adaptive process that takes into account new science, technology, and understanding of pests and their environment.
- A program to ensure more judicious use of pesticides. It is not necessarily intended to eliminate or reduce pesticide use; however, well-developed, science-based IPM programs have consistently resulted in reduced pesticide use because they employ a wider array of pest management techniques.
- A decision-making system that adapts to changing conditions. Control methods are determined based on the pest and site-specific conditions, and methods are not universally applied to all pest problems.

2 CURRENT SITE CONDITIONS

2.1 METHODS

The methodology described in this section includes the dates of survey, the survey methods, the areas that were surveyed, and the methods used to record and handle data.

Prior to the field survey, MIG|TRA staff reviewed 2003 invasive plant map data collected by Shelterbelt Builders Inc., determined an approach to the field survey, researched the California Natural Diversity Database for special-status species, and gathered equipment.

The survey was conducted the week of October 19, 2015. MIG|TRA personnel Taylor Peterson, Amy Parravano, and Robert Templar first met onsite with MROSD staff Coty Sifuentes-Winter and Ellen Gartside to discuss the project and safety procedures, and toured portions of the Preserve to discuss the general approach to the project. Additional personnel assisted on surveys during the course of the week.

Populations of invasive plant species mapped in 2003 were targeted for this survey, with the purpose of updating the physical extent of invasive plant species in these locations. Field teams of two persons walked or drove every trail/road in the Preserve except portions of the 9B and 9C trails which were impassable due to thick vegetation growth (Figure 3). The survey focused on trail/roads because invasive plant species are typically introduced along these disturbance corridors. In a few locations the survey went off-trail, because not all of the trails marked on the map are evident as trails in the field.

The field teams included a biologist and a surveyor equipped with a Trimble Geo-X 6000 (Series GNSS) unit and a mobile smart phone loaded with a map of the 2003 field results and the application called PDF Maps. Each team also had paper aerial photographs, and recorded field notes on paper. Data were downloaded or collected on a daily basis and reviewed to assure that all sites were visited and complete data were recorded. Multiple methods were made available in the event that tree canopy and/or topography interfered with the Trimble unit.

Invasive plant species were mapped in the field, and the following data were recorded for each site: the species, the percentage cover from each species, habitat, phenology, and relevant notes.

At the completion of the field survey MIG|TRA a geodatabase (ArcGIS v. 10.2) was created using the following percent cover categories:

Vegetation cover category	Percent cover range
Sparse	1-15%
Patchy	16-54%
Dense	55%+

The geodatabase was then used by Shelterbelt Builders to develop IPM strategies for the Preserve, taking into account information from the District regarding project phasing and priority areas for treatment.

2.2 LAND USE IMPACTS ON INVASIVE PLANT DISTRIBUTION

The Preserve contains extensive populations of invasive plants. This is primarily due to intense land use in recent decades. The Preserve contains many remnant structures from an old college (Alma College), vineyards, and old roads. The property boundaries are dissected by many small roads, private properties, and utility rights-of-way. Nearby land uses include major roads and suburban development. Many of the invasive plants species, especially French broom, English ivy, and periwinkle are concentrated around roads, trails, and structures.

Disturbance caused by human development and activity has allowed a host of invasive plants to establish and spread into native plant communities such as coastal scrub, oak woodlands, and even closed-canopy coniferous forest that often resists invasion from non-native plants. Most of the Preserve is accessible by a network of roads. Roads are dense around the developed northern portion of the Preserve. Invasive plants are found along every road in the Preserve, most notably French broom. The spatial distribution patterns of French broom mirror the road network in many areas of the preserve.

2.3 INVASIVE PLANTS OBSERVED

Figures 4a – 4d depict invasive plants mapped throughout the Preserve in 2003 and 2015. Species given priority for control are identified in the figures, though many additional species were mapped and are included in the geodatabase.

Developed Areas

The northern Preserve entrance, parking, and pond areas near Alma College Road have the highest diversity of invasive plants. A comparison of 2003 and 2015 mapping data indicates that invasive plant population extents in these areas are relatively stable, although some stands of French broom have expanded since 2003.

Annual grassland, coastal scrub, and oak woodland are the dominant vegetation types in the Alma College/stable area. Many invasive plant species including periwinkle, English ivy, and acacia trees (*Acacia* spp.), were likely planted as part of the landscaping of the college and have since naturalized in the areas surrounding the structures. Periwinkle radiates out from the college structures and almost completely covers the woodland understory of an adjacent small creek channel. Acacia trees are common around Front and Moss Lakes. Several giant reed (*Arundo donax*) patches were mapped during the 2003 surveys but were removed by volunteers in 2013-2014, so no giant reed was observed in 2015. Patches of Italian thistle, Harding grass, and Himalayan blackberry are all present as well.

East of Moss Lake, periwinkle continues to be the dominant invasive plant in the forest understory. It is especially abundant around a wetland seep area just uphill from Briggs Creek. French broom is common along the roads where there is available light. Poison hemlock, fennel (*Foeniculum vulgare*), and Himalayan blackberry also occur in the area.

The northeast corner of the Preserve, north of Alma College, is dominated by annual grassland and patches of coastal scrub and oak woodland. French broom is very common in this area, mostly found along roads, disked fuel breaks, and along the power line right-of-way paralleling State Highway 17. French broom also occurs in

patches of coastal scrub and at the boundaries between annual grassland and oak woodland. Harding grass is patchily abundant near the grasslands along Bear Creek Road. Cotoneaster and Italian thistle also occur in the area.

Scrub, Woodlands, and Grasslands

The upper and central regions of the Preserve are dominated by oak woodland, coastal scrub, old vineyards, annual grasslands, and redwood/Douglas-fir forest. Redwood/Douglas-fir forests are restricted to the major creek drainages of the Preserve and are discussed in the following section. French broom is consistently present along roads and trails throughout the Preserve. Vegetation types most impacted by French broom include grassland, coastal scrub, and open oak woodlands where there is enough light to penetrate the canopy. Older, closed-canopy oak woodlands have less French broom except along roads. Broom occasionally occurs in redwood forest, but only in small patches along roads or other disturbances where light is available. French broom coverage was mapped in the 5-25% cover class to the 50-75% cover class in both the 2003 and 2015 surveys.

Other invasive plants are common in scrub and grassland habitats in addition to French broom. Sweet pea is present in very large patches. Sweet pea appears to have the greatest impact in grasslands, where it can spread to 100% cover, though only during late spring and early summer during its growing season. In coastal scrub, it was not observed covering the canopy layer; it is only present as a thick layer in the understory. Spanish broom, Himalayan blackberry, fennel, acacia, and Italian thistle are also present in the disturbed grassland and scrub areas.

Klamath weed/St. John's Wort remains present in the southern portion of the Preserve in two small patches along Summit Road. This perennial species has not spread much beyond where it was originally found in 2003.

Redwood/Douglas-fir Forest

Redwood/Douglas-fir forest is common throughout the main and sub drainages of the preserve. Periwinkle and English ivy are the most problematic invasive plants in this forest habitat and are some of the few invasive plants that will tolerate deep shade. Between the two, English ivy is much more widespread. Periwinkle is limited to patches where understory light is available, usually along road edges. Large patches of English ivy are common in upper Dyer Creek and Webb Creek. In these infestations, the understory consists of nearly 100% cover of English ivy, in addition to ivy climbing tree trunks and flowering. The population extends well beyond road corridors. The Dyer Creek infestation was traced during the 2003 survey to a nearby private home property that appeared to have planted ivy as a ground cover. English ivy is the most significant invasive plant found at the Preserve that seems to spread independently from road dispersal corridors, and results in a significant impact because the density of its cover eliminates the native plant understory.

3 INVASIVE PLANT MANAGEMENT

3.1 PRIORITIES FOR CONTROL

The Preserve is currently open to limited public use, and broader public use is planned when areas of the Preserve are anticipated to open in 2018. Invasive plant control projects will begin immediately, and scheduling may be adjusted to prevent conflict with infrastructure work or new visitor use areas.

Table 1 summarizes recommendations for site-specific treatment priorities with estimated costs for control for the first three years of management beginning in 2016. All invasive plant populations mapped were reviewed, and a subset was selected as a priority for treatment as listed in Table 1. The following factors were considered in determining priorities: 1) the invasive species' potential to impact natural systems; 2) ability for the District to provide meaningful control in a 3-year period; 3) the capacity for the site to be restored to natural conditions; 4) budget availability; 5) reasonable access; and 6) the feasibility of the use of volunteer labor. The availability of funding and volunteer labor was determined by Preserve staff.

Annual monitoring of invasive plant dispersal corridors (roads, trails, and any other human activity) in less-disturbed portions of the Preserve using staff and/or volunteer labor is recommended to check for new invasive plant species or significant changes in populations.

3.1.1 Priority 1

English ivy, periwinkle, and French broom are the dominant invasive species mapped in the Preserve. Populations of these species are far too extensive to be fully controlled in three years, so several key populations are recommended to be managed to prevent spread into less disturbed areas (Figure 4a).

Perennial Vines (English ivy, cape ivy, and periwinkle)

English ivy and periwinkle are the species of greatest ecological concern as they are most often found in sensitive riparian and wetland areas, they often form large mats that exclude native vegetation, and they can impact the deep shade of coniferous forests. English ivy and periwinkle are the highest priority for management as they both have limited extents of invasion (compared to French broom) and they are the most exclusionary species in the Preserve. Both species form large single-species patches, so they can be controlled with minimal damage to neighboring native species. English ivy does not have a long-lived seed bank and periwinkle is sterile, allowing revegetation and restoration to follow relatively quickly after removal. Care should be taken on steep slopes and in riparian areas to reduce the potential for bank and hillside erosion, as control of ground covers often result in temporary, large areas of bare ground.

A single population of Cape ivy near Moss Lake is the only occurrence of Cape ivy currently known in the Preserve. The patch is a high priority to prevent Cape ivy from spreading in the Preserve while it is still present in a manageable quantity. Trained volunteer laborers will be utilized to manually control this population. A portion of the budget is allocated for additional chemical or manual control in Year 3 in case volunteer laborers are not able to achieve eradication of the Cape ivy.

Table 1. Invasive Plant Control Prioritization and Recommended Budget for Bear Creek Redwoods OSP

Pri-ority	Plant Name	Site Name	Point and Polygon Numbers	Gross area (or #)	% cover in polygons	Habitat Type	Projected Budget Allocation		
							Year 1	Year 2	Year 3
1	Cape ivy	Moss Lake	Polygon: **DeOd**001	0.1 acres	30%	Urban/ Developed	60 hrs volunteers	60 hrs volunteers	$5,000 50 hrs volunteers
1	English ivy	Webb Creek	Polygons: **HeHe**001, 002, 004, 007, 011, 018, 019	7.6 acres	70% - 90%	Redwood/ Douglas-fir	$25,000 80 hrs volunteers	$10,000 80 hrs volunteers	$5,000 50 hrs volunteers
1	English ivy; periwinkle	Dyer Canyon (west)	Polygons: **HeHe**012, 014, 015, 016; **ViMa**018 Points: **HeHe**002*	6.6 acres	60% - 80%	Redwood/ Douglas-fir	$25,000 80 hrs volunteers	$10,000 80 hrs volunteers	$5,000 50 hrs volunteers
1	English ivy; periwinkle	Dyer Canyon (east)	Polygons: **HeHe**008, 010, 017; **ViMa**013	1.9 acres	ivy 5-50%; periwinkle 90%	Redwood/ Douglas-fir	$5,000 80 hrs volunteers	$5,000 80 hrs volunteers	$5,000 50 hrs volunteers
1	French broom	Summit Road	Polygons: **GeMo**016, 017, 018, 019 Points: **GeMo**010*	1.0 acre	5 - 40%	Roadside	$2,500	$2,500	$2,500
1	French, Scotch, & Spanish broom	Central Preserve - south of Bear Creek Rd.	Polygons**: GeMo**012, 014, 028, 029, 034, 095, 096, 098, 099, 100, 104, 105, 109, 125, 126; **SpJu**005, 006, 013, 014 Points: **GeMo**005*, 013*, 014*, 024*; **CySc**001*, 002*	4.4 acres	5 - 60%	Roadside	$15,000	$10,000	$8,500
1	French & Scotch broom	Central Preserve - north of Bear Creek Rd.	Polygons: **GeMo**022, 041, 049, 050, 051, 052, 053, 054, 055, 056, 058, 061, 062, 063, 065, 067, 069, 112, 117, 120 Points: **GeMo**009*, 015*, 018*; **CySc**004*, 005*	14.8 acres	2 - 60%	Roadside	$12,500	$11,500	$10,000
2	Himalayan blackberry	Dyer Canyon (west)	Points: **RuAr**009*, 010*	21 plants	-	Redwood/ Douglas-fir	-	$6,000	$4,000
2	Egg-leaf spurge	Collins Creek	Polygon: **EuOb**001	0.3 acres	20%	Scrub	60 hrs volunteers	40 hrs volunteers	40 hrs volunteers
2	French & Spanish broom	Alma College	Polygons: **GeMo**042, 043, 070, 071, 075, 078, 086 Points: **GeMo**001*, 006*, 007*, 008*, 021*, 022*, 023*, 026*, 027*, 029*; **SpJu**002*	1.2 acres	10 - 40%	Roadside	-	$10,000	$5,000
3	Poison hemlock	Preserve-wide	Polygons: **CoMa**002, 004, 005, 010	5.7 acres	10%	Various	-	staff	staff
3	Tree of Heaven	Summit Road	Point: **AiAt**001*	1 tree	-	Redwood/ Douglas-fir	staff	-	-
						Total Budgeted	$85,000 + 360 hours volunteer	$65,000 + 340 hours volunteer	$50,000 + 240 hours volunteer

French, Scotch, and Spanish Broom

French broom is found throughout the Preserve but it occurs predominantly in disturbed areas and along roads, trails, and other rights-of-way. There are also several large stands of Spanish broom and small patches of Scotch broom. Most of the French broom patches are mixed with native vegetation. The highest concentrations are in the northeastern corner of the Preserve where the most historic disturbance has occurred. Many of the broom stands are linear and follow road corridors. Initial control of broom should be limited to the smallest patches in less-disturbed habitats, along with patches that occur on roads, trails, and right-of-ways that will be decommissioned or that will be improved or expanded (causing new disturbance that will spread weed seeds). The prioritization of these patches will reduce and control the spread of broom throughout the rest of the Preserve on road and trail networks. These actions are intended to protect the Preserve from new invasion rather than to eradicate species. In addition to weed management, the control of roadside broom patches also helps to reduce fire hazards along the future permanent trail network of the Preserve. Broom's long-lived seedbank requires diligent control over long timelines for any meaningful reduction of populations. Managing the larger patches of broom should be deferred until sufficient funding is available for larger restoration projects.

Volunteer labor has already been used to manage several French broom sites for the last 3 to 7 years, and these sites will continue to be maintained by volunteers. Volunteer labor is also designated to assist in follow-up control of roadside priority sites, particularly to pull outliers of small populations that were previously mowed or sprayed.

3.1.2 Priority 2

Himalayan blackberry

Himalayan blackberry is found in limited quantities in the Preserve, and has the potential to spread into much larger populations. This species is a good candidate for control since it can significantly impact the Preserve, particularly the sensitive wetlands and creek habitats, but is currently limited in distribution. This species has a deep root system that makes it difficult to control. Patches should be prioritized based on their predicted ability to spread into sensitive habitats, as even small patches will require significant amounts of time and energy to control.

French, Scotch, and Spanish Broom – Alma College area

Control of broom in the northeastern developed portion of the Preserve is a lower priority than in less disturbed areas. However, road clearing and maintenance and other Preserve management activities have the potential to spread seeds and clear new areas. Therefore smaller manageable roadside populations can be controlled as a first step in reducing the spread of broom along roads and trails.

Eggleaf spurge

Eggleaf spurge is an invasive species with limited impact to wildlands, but a single roadside patch present can be controlled relatively easy before it spreads further in the Preserve. Due to the location along a trail, trail maintenance has the potential to both provide initial control and to spread seeds. Therefore, this species can be targeted for follow-up removal after any trail clearance occurs, to prevent further spread. Some people are

allergic to the sap of eggleaf spurge, so care must be taken to avoid contact with the skin during removal efforts.

3.1.3 Priority 3

Poison hemlock and tree of heaven are listed as lower priorities for control. While tree of heaven has high potential for invasion in both disturbed and undisturbed habitats, only one tree is currently known to occur on the Preserve so local conditions are possibly not very suitable for the species.

Poison hemlock generally grows in disturbed areas and creek flood zones, but will also occur in intact shrublands. Large stands of poison hemlock are present in the Preserve, but are primarily in disturbed habitats with many other annual and biennial weeds. A portion of the poison hemlock stands are recommended for spray treatment where along roads or where adjacent to less-disturbed habitats that could be further invaded.

3.2 TREATMENT STRATEGIES

Table 2 summarizes invasive plant treatment methods for invasive plants mapped at the Preserve, and indicates the time of year that each treatment method should be performed to be most effective, based on the life cycle of each plant.

Budget for follow-up treatments is included in Table 2, though most sites will require more than two years of follow-up by volunteers or staff to manage resprouts and the extended seed bank of some species (such as French broom). Continued weed control (mowing or chemical control) will be necessary in large bare areas, particularly in disturbed sunny areas likely to be invaded by disturbance-following invasive species such as Italian thistle and mustard (*Brassica* spp.). Replanting of native shrubs in areas exposed after removal of English ivy and periwinkle is recommended in Year 3 or later, once several rounds of follow-up treatment have been completed. Reseeding of native grasses and shrubs may also be feasible in more exposed cleared areas, but planting containers of native understory shrubs will generally be more successful in shaded forest habitats.

A composting site should be established on the Preserve in an existing disturbed zone, which will be monitored and maintained to prevent spread of weed species in adjacent areas. When plants are controlled manually, the debris can often be composted within the removal area to avoid spread of propagules. However, if the plants are in seed at the time of removal and seeds are likely to spread from the compost pile, flowering/seeding plants should be bagged and disposed of at the main Preserve compost site.

Table 2. Treatment Strategies and Calendar

Treatment Strategies for Invasive Plants at Bear Creek Redwoods Open Space Preserve

Midpeninsula Regional Open Space District

Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
SHRUBS															
BROOMS:	**Shrub -- Life cycle:**			Active Growth				Flower			Fruit			Reduced Growth	
Scotch broom ***(Cytisus scoparius)***	Manual			Hand pull small plants; weed wrench large plants											
French broom ***(Genista monspessulana)***	Mechanical + Chemical	Flat areas				**0.5-1% Roundup Pro** Foliar spray; once stand has browned, cut and mulch in place with tractor/chainsaws						Drought stress reduces effectiveness			
Spanish broom (Spartium junceum)	Chemical					**50% Roundup Pro** Cut and immediately treat									
	Shrub -- Life cycle:			Active Growth					Flower			Fruit			
Himalayan blackberry ***(Rubus armeniacus)***	Manual			Hand pull/dig out full root											
	Chemical									**7 oz/ac Milestone + 1.2% Roundup Custom + 0.5% Liberate NIS** Foliar broadcast/spot spray					

Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
VINES															
Cape ivy ***(Delairea odorata)***	**Perennial Vine -- Life cycle:**			Flower			Vegetative								Flower
	Manual									Hand pull/dig out full root					
	Chemical	Aquatic		**1.5% Roundup Custom + 0.5% Liberate NIS** Foliar broadcast spray											
	Chemical	Upland		**7 oz/ac Milestone + 0.5% Liberate NIS** Foliar broadcast spray											
English ivy ***(Hedera helix)***	**Woody Vine -- Life cycle:**			Fruit			Vegetative						Flower		Fruit
	Manual		2 years	Dig or pull up roots of accessible plants; cut off vines where they are climbing trees (chemical treatment of stumps cut from climbing vines may also be attempted but is not always effective)											
	Chemical			**1.5% Roundup Custom + 1% Competitor MSO** Foliar broadcast spray									**1.5% Roundup Custom + 1% Competitor MSO**		
	Chemical	Conifer forest											**1% Polaris + 1% Competitor MSO** Foliar broadcast spray		
Periwinkle ***(Vinca major)***	**Perennial Vine -- Life cycle:**			Vegetative											
	Manual/ Mechanical		1-3 years	Hand remove and dispose off-site OR Brushcut and cover with weed fabric, pull or grub escaping vines every 3 mo. for 4-8 yrs											
	Chemical			**1.5% Roundup Custom + 1% Competitor MSO** Foliar broadcast spray											
	Chemical	Conifer forest											**1% Polaris + 1% Competitor MSO** Foliar broadcast spray		

Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PERENNIALS & BIENNIALS															
Eggleaf spurge ***(Euphorbia oblongata)***	**Perennial Herb -- Life cycle:**			Active Growth					Flower			Fruit			
	Manual			Hand pull/dig out full root (some people are senstitive to the sap, so ensure skin is well-covered)											
Harding grass ***(Phalaris aquatica)***	**Perennial Grass -- Life cycle:**			Active growth					Flower	Fruit		Reduced growth			
	Manual		5+ years				Dig out and compost onsite (bag flowering stalks to dispose at Preserve compost site)								
	Mechanical + Chemical	flat areas	1-2 years						Mow before seeds mature			**1.5% Roundup Pro** Foliar spray			
	Chemical		1+ years, depends on patch size			**32 oz/ac Envoy Plus + 0.25% Liberate NIS** Foliar broadcast/ spot spray			**1.5% Roundup Pro** Foliar broadcast/ spot spray before dormancy						
Klamath weed/ St. John's wort ***(Hypericum perforatum)***	**Perennial Herb -- Life cycle:**			Active growth					Flower						
	Manual							Hand pull							
	Chemical							**7 oz/ac Milestone + 1.5% Roundup Custom + 0.5% Liberate NIS** Foliar spot spray							
Poison hemlock ***(Conium maculatum)***	**Biennial Herb -- Life cycle:**			Germinate			Rosettes		Bolt	Flower		Fruit	Germinate		
	Manual								Hand pull						
	Chemical							**1.5% Roundup Custom + 1% Competitor MSO** Foliar broadcast/spot spray							
Teasel ***(Dipsacus spp.)***	**Biennial Herb -- Life cycle:**					Emergent - Basal Rosette				Flower		Fruit			
	Manual						Hand pull and compost onsite								
	Chemical				**3-7 oz/ac Milestone + 0.5% Liberate NIS** Foliar broadcast/spot spray										

Species Name	Treatment Method(s)	Specific Conditions	Minimum Treatment Duration	WINTER			SPRING			SUMMER			FALL		
				Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
ANNUAL HERBS															
Stinkwort ***(Dittrichia graveolens)***	**Annual Herb -- Life cycle:**						Emergent - Basal Rosette			Flower		Fruit			
	Manual									Hand pull and compost onsite (bag flowering plants to dispose of at Preserve compost site)					
	Chemical					**3-7 oz/ac Milestone + 0.5% Liberate NIS** Foliar broadcast/ spot spray									
	Chemical	where greater selectivity is desired					**8-16 oz/ac Transline + 0.5% Liberate NIS** Foliar broadcast/ spot spray								
Sweet pea ***(Lathyrus latifolius)***	**Annual Herb -- Life cycle:**			Dormant			Emergent -Active Growth			Flower		Fruit		Dormant	
	Chemical	sensitive areas						**10% Milestone + 0.5% Liberate NIS** Cut and paint immediately							
	Chemical							**3-7 oz/ac Milestone + 0.5% Liberate NIS** Foliar broadcast/ spot spray							
THISTLES: **Bull thistle** ***(Cirsium vulgare)*** **Italian thistle** ***(Carduus pycnocephalus)*** ***Yellow star thistle (Centaurea solstitalis)***	**Annual Herb -- Life cycle:**							Emergent - Basal Rosette		Flower		Fruit			
	Manual						Hand pull and compost onsite (bag flowering stalks to dispose at Preserve compost site)								
	Mechanical								Mow when flowering as first fruit develops						
	Chemical					**3-7 oz/ac Milestone + 0.5% Liberate NIS** Foliar broadcast/ spot spray									
	Chemical	where greater selectivity is desired					**8-16 oz/ac Transline + 0.5% Liberate NIS** Foliar broadcast/ spot spray								
	Chemical								**0.5-1.5% Roundup Pro** Foliar spray						
	Cultural	yellow star thistle only	2-3 years							Prescribed burn when flowers first appear					

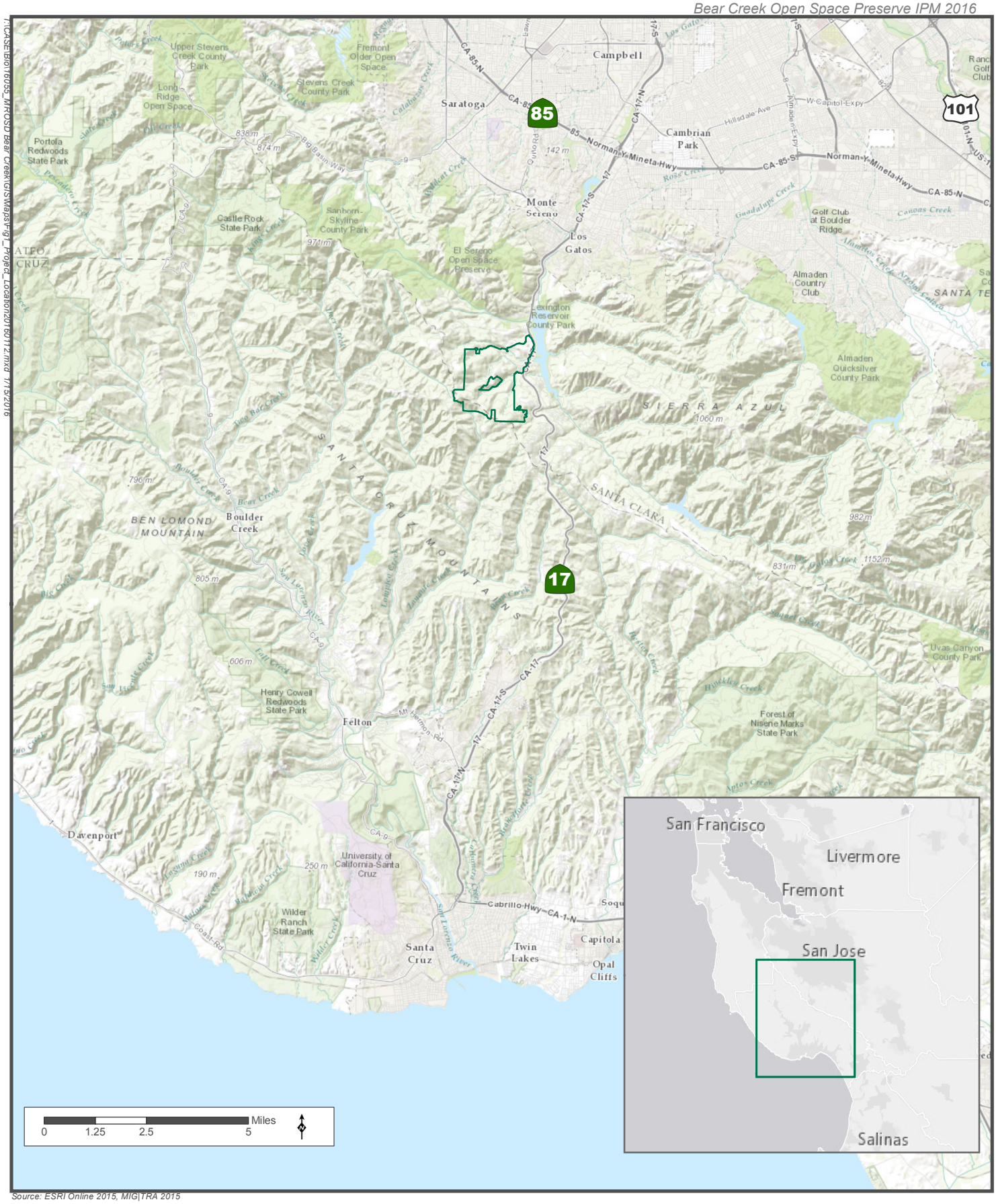
4 REFERENCES

Ecosystems West. 2008. *Botanical Survey of the Bear Creek Open Space Preserve.*

Midpeninsula Regional Open Space District. 2014. *Programmatic Integrated Pest Management Plan and EIR.*

Shelterbelt Builders Inc. (2004). T*he Status and Management of Invasive Plants for the Midpeninsula Regional Open Space District*.

APPENDIX A: FIGURES

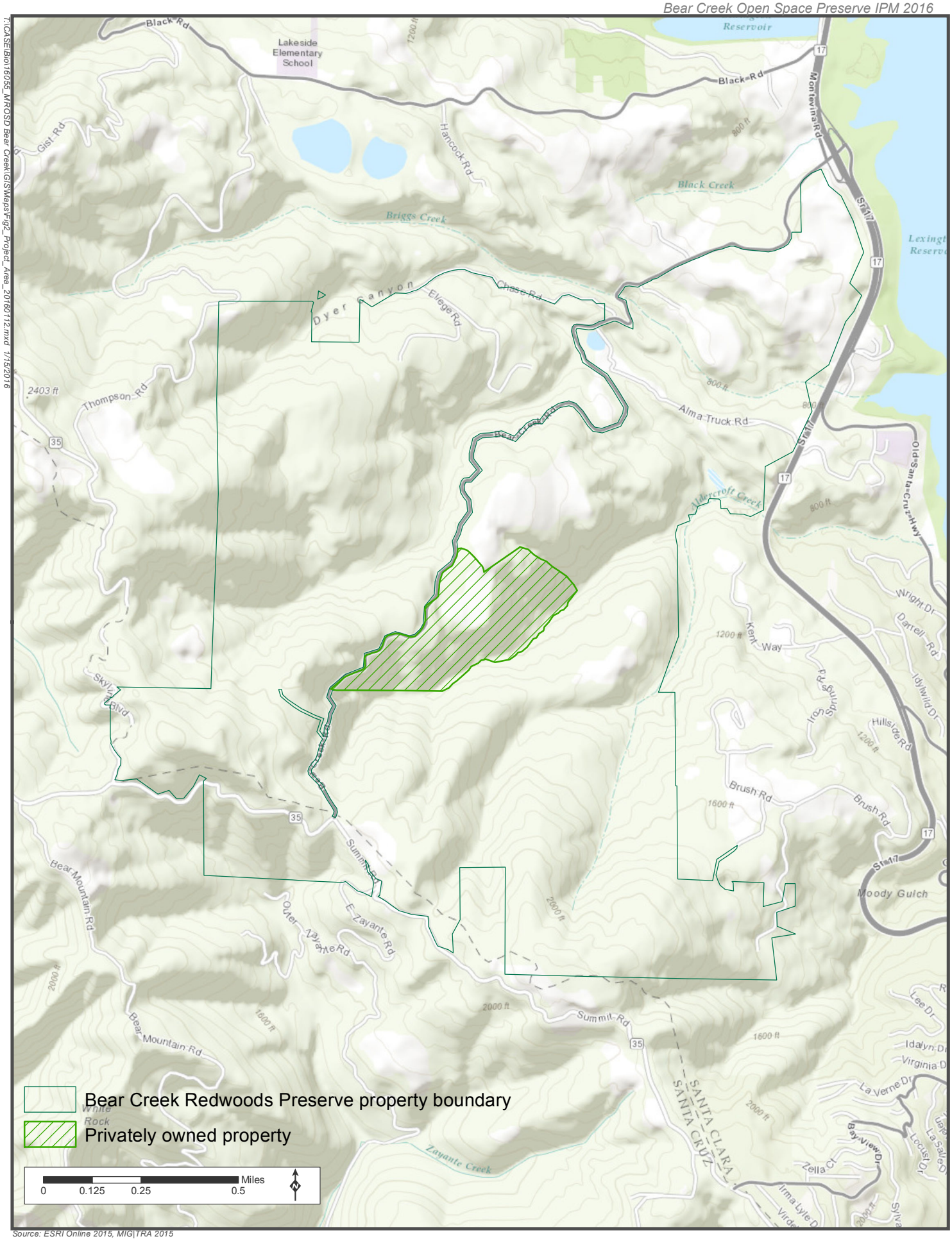


Source: ESRI Online 2015, MIG|TRA 2015

Bear Creek Redwoods Open Space Preserve

Figure 1 Project Location

Bear Creek Redwoods Open Space Preserve



Source: ESRI Online 2015, MIG|TRA 2015

Figure 2 Project Area

Bear Creek Redwoods Open Space Preserve

T:\CASE\Bio\16055_MROSD Bear Creek\GIS\Maps\Fig3_Area_Surveyed_20160116.mxd 1/15/2016

Bear Creek Road
Briggs Creek
Front Lake
Moss Lake
Dyer Creek
Webb Creek
Alma Lake
Collins Creek
Aldercroft Creek
Zayante Creek
Summit Road

Bear Creek Redwoods Open Space Preserve property boundary
Privately owned property
Roads and trails
Invasive vegetation expansion survey (2015)
Invasive vegetation initial survey (2003)
Unsurveyed areas (2015)

0 0.125 0.25 0.5 Miles

Source: Esri Online 2015, MIG|TRA 2015

Figure 3 Area Surveyed and Vegetation Extent

Bear Creek Redwoods Open Space Preserve

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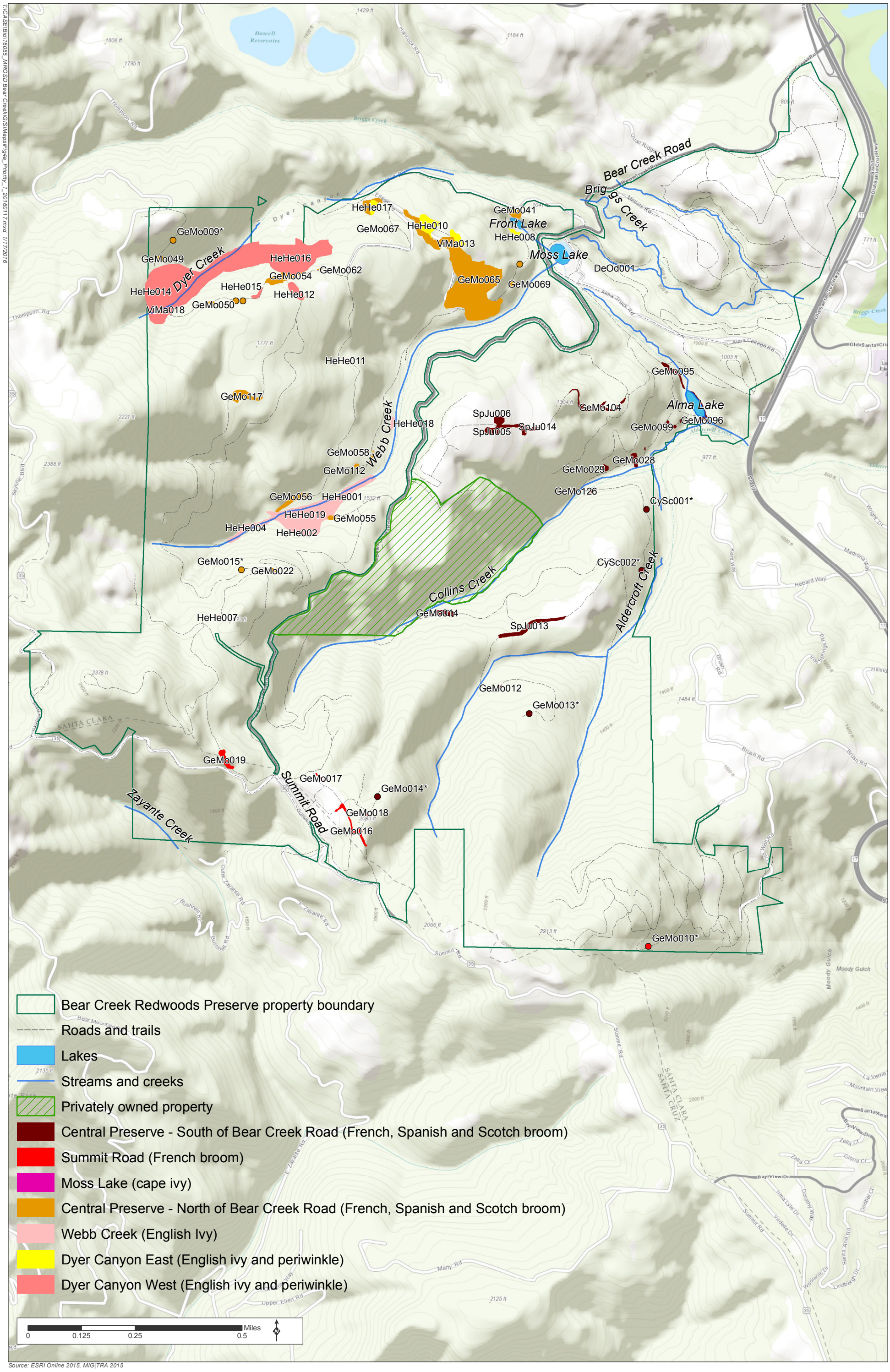
T:\CASE\Bio\16055_MROSD Bear Creek\GIS\Maps\Fig4a_Priority_1_20160117.mxd 1/17/2016



Source: ESRI Online 2015, MIG|TRA 2015

Figure 4a IPM Targeted Locations: Priority 1

Bear Creek Redwoods Open Space Preserve

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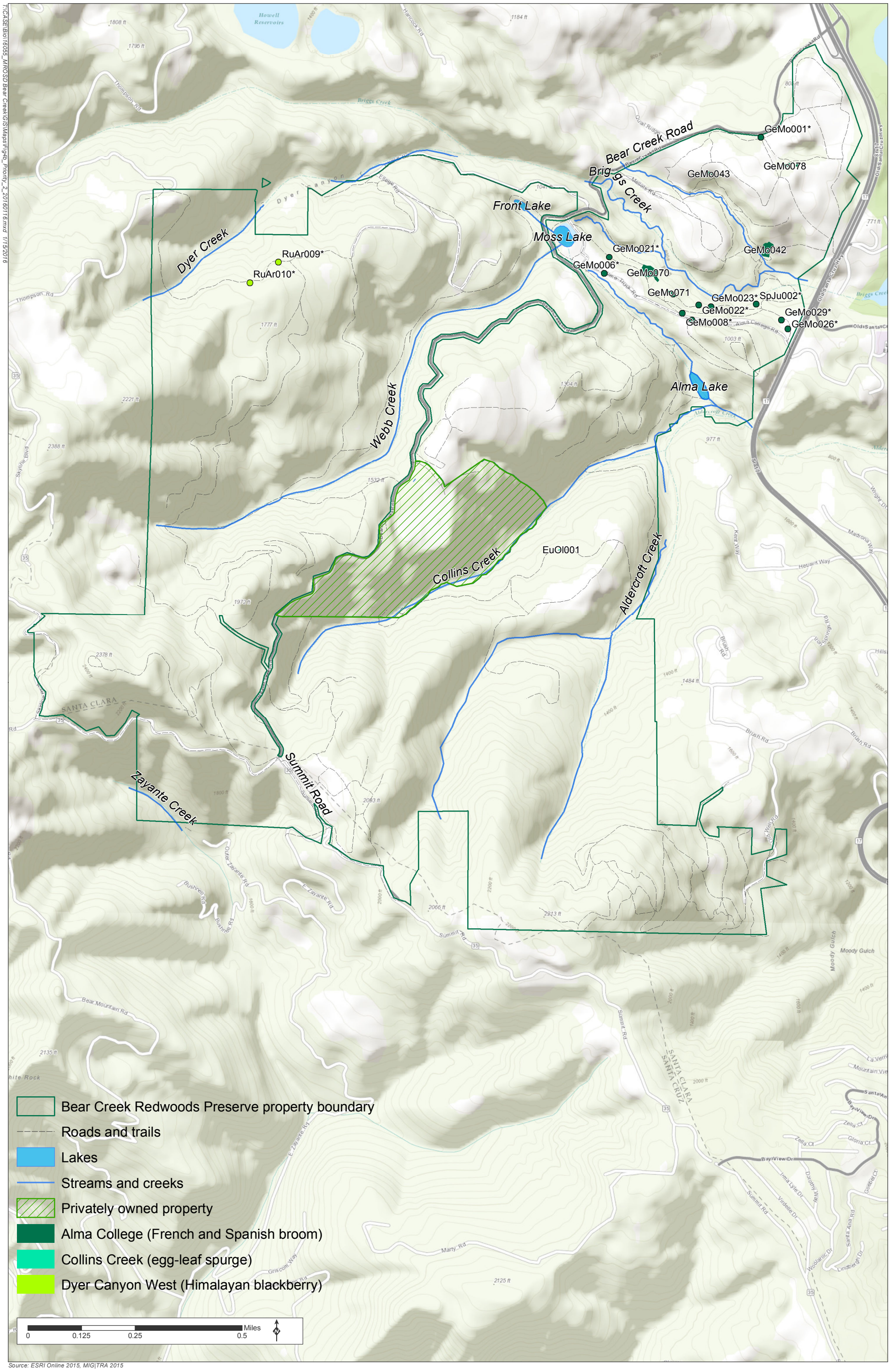

Source: ESRI Online 2015, MIG|TRA 2015

Figure 4b IPM Targeted Locations: Priority 2

Bear Creek Redwoods Open Space Preserve

T:\CASE\Bio\16055_MROSD Bear Creek\GIS\Maps\Fig4c_Priority_3_20160116.mxd 1/15/2016

Howell Reservoirs
Bear Creek Road
Briggs Creek
Front Lake
Moss Lake
Dyer Creek
CoMa002
CoMa004
Alma Lake
CoMa010
Webb Creek
Collins Creek
Aldercroft Creek
CoMa005
Summit Road
AiAt001*
Zayante Creek

Bear Creek Redwoods Preserve property boundary
Roads and trails
Lakes
Streams and creeks
Privately owned property
Preserve-wide (poison hemlock)
Summit Road (tree of heaven)

Miles
0 0.1 0.2 0.4

Source: ESRI Online 2015, MIG|TRA 2015

Figure 4c IPM Targeted Locations: Priority 3

Bear Creek Redwoods Open Space Preserve

T:\CASE\Bio\16055_MROSD Bear Creek\GIS\Maps\Fig4d_Priority_phases_20160116.mxd 1/15/2016

Bear Creek Road
Briggs Creek
Front Lake
Moss Lake
Dyer Creek
Alma Lake
Webb Creek
Collins Creek
Aldercroft Creek
Summit Road
Zayante Creek
Howell Reservoirs
Thompson Rd
Hancock Rd
Bear Mountain Rd
Marty Rd
Griscom Way
Upper Ellen Rd
Bear Creek Redwoods Preserve property boundary
Roads and trails
Lakes
Streams and creeks
Privately owned property
Priority 1
Priority 2
Priority 3
Unprioritized
0 0.125 0.25 0.5 Miles

Source: ESRI Online 2015, MIG|TRA 2015

Figure 4d IPM Targeted Locations by Priority

Bear Creek Redwoods Open Space Preserve