INVASIVE WEED MANAGEMENT PLAN FOR PALO CORONA REGIONAL PARK

Prepared for

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EXECUTIVE SUMMARY

At the request of the Monterey Peninsula Regional Park District (MPRPD), Nomad Ecology prepared this Weed Management Plan for the approximately 4,540 acre Palo Corona Regional Park (PCRP) located in central coastal Monterey County. The purpose of the weed management plan is to strategically address the invasive weed problem in PCRP. This weed management plan uses an Adaptive Management Approach, which is based on setting goals, prioritizing species and sites for control, and following up control with monitoring.

Significant biological resources in PCRP include special-status plants and habitat, special-status wildlife and habitat, high priority vegetation types, and wetlands and aquatic features. Invasive weed populations threaten these resources and can result in the loss and degradation of habitats, conversion of native vegetation types, and ecosystems, as well as the reduction in size, range, and reproductive capacity of special-status plants and animals. Invasive species reduce biodiversity by displacing native organisms and bringing about changes in species composition, community structure, or ecosystem function (Randall and Hoshovsky 2000). Many invasive species form monocultures (dense stands of one plant) that push out native species and reduce food and shelter needed by native wildlife, including endangered species (Cal-IPC 2006).

Native Range Inc. was contracted by the Big Sur Land Trust in 2012 to survey for non-native plant species in PCRP. Nomad Ecology was contracted by MPRPD in 2013 to conduct additional invasive weed surveys and complete the weed management plan. Following the completion of field work, a draft invasive weed database and map was created by Nomad in a GIS platform (ESRI ArcGIS 9.2) by importing and manipulating field-collected GPS data.

A total of 28 target invasive weed plant species were mapped with a total of 825 occurrences comprising 572 gross acres. The 6 species with the highest number of occurrences in Palo Corona Regional Park were: French broom (*Genista monspessulana*), poison hemlock (*Conium maculatum*), bull thistle (*Cirsium vulgare*), milk thistle (*Silybum marianum*), Italian thistle (*Carduus pycnocephalus* subsp. *pycnocephalus*), and Harding grass (*Phalaris aquatica*). The 5 species with the highest total gross area were French broom, poison hemlock, Italian thistle, foxglove (*Digitalis purpurea*), and milk thistle.

The number of different invasive weeds at PCRP are too numerous to control. Ranking provides a methodology for treatment prioritization which allows for the highest ranked species or populations to be controlled first, limited resources to be used efficiently, and management decisions to be based on science. Weed species prioritization, site prioritization, and WHIPPET, a ranking tool, were all used to rank weed populations mapped in PCRP for control priority. Weed species prioritization ranks weeds based solely on their biology and ability to be treated. Weed species mapped in PCRP were ranked based on their impact to wildlands, invasibility, and feasibility of control. Site prioritization ranks populations for control based on their location. Sites that have been prioritized for control include: sites containing significant biological resources; dispersal corridors such as roads, trails, watercourses, and areas where cattle congregate; entry points for weeds including boundaries with private property that contain infestations; areas with low numbers of weeds, and small outlier populations. WHIPPET is a science-based, transparent, analytical ranking tool to prioritize weed populations for management instead of weed species. The results of the WHIPPET analysis were used to further direct prioritization of individual populations for treatment.

Based on the results of weed species prioritization, site prioritization, and the WHIPPET analysis specific weed populations and species were identified for control. These were divided into Priority 1, Priority 2, and Priority 3 for control. The decision of which high priority populations to treat will be based on

available funding, timing, and ability to make long term commitment. French broom is well established on PCRP and will never be eradicated; however it is a high priority for containment to prevent it from becoming well established throughout the entire park. There are several high priority species that have few populations and can likely be successfully eradicated from PCRP if the existing populations are treated before these species spread further. These include silverleaf cotoneaster, English ivy, Himalayan blackberry, Cape ivy, fennel, and tocalote. Yellow flag iris and jubata grass were also designated high priority for management to protect ponds and coastal scrub/chaparral which are high priority vegetation communities.

This plan includes details on how to treat weed species mapped in the park and prioritized for management. Management of target species will include mechanical and chemical methods and will be species specific. Timing of treatment is critical for efficient control. The most effective types of control are prevention and early detection. The plan includes Best Management Practices (BMPs) designed to prevent the accidental spread of invasive weeds at PCRP.

Monitoring is the systematic collection, recording, and analysis of observations over time with the goal of checking if the intended outcome of a management program is being achieved. Monitoring of invasive weeds within PCRP has been divided into: monitoring treatment projects; periodic weed mapping and monitoring of existing weed populations; and Early Detection Rapid Response. Protocols for each of these monitoring types are included in the plan. Weed management objectives, management actions, monitoring actions, and monitoring frequency for Priority 1 weed species and populations are clearly outlined.

The goal of Early Detection Rapid Response (EDRR) is to prevent the establishment of new weed species at PCRP by detecting new weed populations as they arise, treating them, and limiting spread of new infestations. The plan contains a list of target species for EDRR and a protocol for conducting EDRR surveys.

Section 1. INTRODUCTION

1.1. MONTEREY PENINSULA REGIONAL PARK DISTRICT

The Monterey Peninsula Regional Park District (MPRPD) was established in 1972 by a voter approved County Measure. The mission of MPRPD is "to acquire and maintain open space in the District for preservation and use, working with partners and the community, for public benefit, enjoyment and environmental protection (MPRPD 2014)." MPRPD's current boundaries cover over 500 square miles and include the seven incorporated cities on the Monterey Peninsula, Carmel Valley, Pebble Beach and the Big Sur Coast. The District is governed by an elected Board of Directors (MPRPD 2014).

1.2. PALO CORONA REGIONAL PARK

The approximately 4,540 acre Palo Corona Regional Park (PCRP) is located in central coastal Monterey County, immediately east of Highway 1 and south of the City of Carmel (Figure 1). The six-mile long property extends from the Carmel River floodplain in the north to the Joshua Creek Ecological Reserve of the California Department of Fish and Wildlife to the south. PCRP connects several separate wilderness areas and parks, including: Carmel River State Beach, Garrapata State Park, Joshua Creek Ecological Reserve, Mitteldorf Preserve, Glen Deven Ranch, Point Lobos State Reserve, Point Lobos Ranch State Park, Santa Lucia Conservancy lands, and the Ventana Wilderness.

Public access to PCRP is currently limited to pedestrians who receive a permit to access the northern portion of the park, with access prohibited south of Animas Pond. Further details about PCRP are included in Section 2.1 Setting.

1.3. PCRP WEED MANAGEMENT GOALS AND OBJECTIVES

Invasive species reduce biodiversity by displacing native organisms and bringing about changes in species composition, community structure, or ecosystem function (Randall and Hoshovsky 2000). Many invasive species form monocultures (dense stands of one plant) that push out native species and reduce food and shelter needed by native wildlife, including endangered species (Cal-IPC 2006). Not all non-native plants are invasive; only a small minority of the thousands of species introduced to California have escaped cultivation, and a minority of those that have escaped spread into wildlands.

The purpose of the weed management plan is to strategically address the invasive weed problem in PCRP. The goals and objectives were developed to be consistent with the *Invasive Weed Interim Management Plan* dated 2005 (MPRPD 2005).

Goal 1. Prevent the introduction and spread of new species of weeds in PCRP.

a. Develop and implement an Early Detection Rapid Response program to detect new species and new populations.

b. Eradicate all new infestations.

c. Train staff and/or volunteers in the identification of invasive weed species that are not known from the park but are expected targets for early detection.

Goal 2. Eradicate species with few populations before they become widespread.

a. Remove all populations of weeds species with few populations regardless of species rank.

Goal 3. Minimize the spread of existing priority weed species.

a. Rank weed species into high, medium, and low priority based on known impact to wildlands, invasiveness, and control effectiveness.

b. Control isolated individuals of high priority weed species.

c. Contain populations of widespread high priority weed species.

d. Target treatment of previously treated areas where control has been successful.

e. Control populations of weed species along dispersal routes.

f. Implement best management practices to reduce spread.

g. Train staff in the identification of invasive weed species known from PCRP.

Goal 4. Target select infestations of weed species to protect biological resources.

a. Exclude weed species from areas that are relatively free of invasive weeds.

b. Control specific populations of widespread weed species that threaten significant biological resources.

Goal 5. Implement an adaptive monitoring plan.

a. Develop a weed monitoring plan for PCRP

b. Conduct regular weed monitoring and mapping of PCRP.

c. Monitor existing weed populations to determine spread.

d. Measure changes in overall weed abundance.

e. Record new populations of existing weed species.

f. Evaluate the effectiveness of control methods.

g. Utilize an adaptive management approach.

1.4. ADAPTIVE MANAGEMENT OF INVASIVE WEEDS

The weed management program will use an Adaptive Management Approach which is based on setting goals, prioritizing species and sites for control, and following up control with monitoring[1]. Before beginning a weed management program, it is important to develop straightforward reasons for the actions that will be taken. Setting clear land use goals and realistic invasive plant species management objectives is the most important step in any invasive plant species management project. Invasive species control efforts often fail because unrealistic goals are set; there is a lack of planning, initial data collection and mapping, and follow through; and ineffective control methods are used. Successful control projects include working with partners across boundaries, consistent strategy over multiple years, and planning.

Weed management is best accomplished using an adaptive management approach as follows (Bossard et al. 2000; Jacquart 2008). Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.

[1] This section is excerpted from Bossard et al (2000).

1. **Establish management and conservation targets and goals.**

   Examples of land management goals include the protection of rare species, high quality natural communities, and productive grazing land. Goals should be as specific as possible.

2. **Identify and prioritize species/infestations that threaten targets and goals.**

   This is often a combination of site-based prioritization (where to control invasive plants) and species-based prioritization (which species to control first).

3. **Assess methods to control the weeds.**

   Control methods should be assessed for species/infestations that are prioritized in step 2. Control methods are often site specific. For example controlling scattered yellow starthistle plants in a high value habitat area would require a different control method than a dense one-acre stand in ruderal habitat.

4. **Develop and implement a weed management plan.**

   Weed management plans contain specific information including conservation targets, specific management goals, an inventory of weeds on site, prioritized list of weed species/infestation with prioritization determined as in step 2, weed management plan implementation schedule, and control plans for specific species of weeds which outline methods and timing.

5. **Monitor and assess the impacts of management actions in terms of effectiveness in moving towards goals and objectives.**

   Monitoring is necessary to show whether treatments are effective. Monitoring can be done at differing levels of effort.

6. **Use Adaptive Management to re-evaluate, modify, and start the cycle again at number 1.**

   This is an opportunity to change what is not working and recognize what is working. Priorities may change as new species emerge or goals for conservation change.

1.5. GLOSSARY OF TERMS

Adaptive Management - A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.

Annual Plants - Plants that complete their life cycle (germination through death) in one year or growing season. They are essentially non-woody above-ground (Hickman 1993).

Cal-IPC Rating – California Invasive Plant Council rates invasive weed species as listed in the California Invasive Plant Inventory Database (Cal-IPC 2014a).

- High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- Moderate – These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal,

though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

- Limited – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

CDFA Rating – California Department of Food and Agriculture rates noxious plant species (CDFA 2014).

- A Rating – State (or commissioner when acting as a state agent) enforced action involving: eradication, quarantine, containment, rejection, or other holding action.
- B Rating – Eradication, containment, control or other holding action at the discretion of the county agriculture commissioner.
- C Rating – State endorsed holding action and eradication only when found in a nursery; action to retard spread outside of nurseries at the discretion of the county agriculture commissioner; reject only when found in a cropseed for planting or at the discretion of the commissioner.

Containment – A management objective that entails limiting the spread from existing infestations and to restrict a species or population to a specific area.

Control – A management action to reduce the negative impacts of an invasive species, often by eliminating a significant portion of an invasive population in a given area. The most effective types of control are prevention and early detection (Randall and Hoshovsky 2000).

Cover – Cover is measured by estimating the aerial extent of the living plants, or the “bird’s-eye view” looking from above. For this project, cover will be assessed using the concept of "porosity" or foliar cover rather than "opaque" or crown cover. Cover estimates will exclude the openings plants may have in the interstitial spaces (e.g., between leaves or branches).

Distribution in the Park Rating – Each target invasive weed species was assigned a Distribution in the Park value of Limited, Moderate, or Widespread based on the number of data points and where they were located.

- Limited – Few data points (generally less than 10) or all data points are grouped together in one or a few locations in the park.
- Moderate – A moderate number of data points scattered in a few to several locations in the park.
- Widespread – A large number of data points scattered throughout many locations in the park.

Early Detection Rapid Response (EDRR) – A cost-effective approach to invasive plant management that aims to detect newly established invasive plant infestations early and to remove them before they spread.

Eradication – A management objective that entails complete removal of all infestations in the area.

Exclusion – A management objective that includes identifying areas that are relatively weed free or free of specific weed species. The goal is to maintain the absence of weeds or a specific weed species in these locations.

Herbicides – A category of pesticide that is used to kill plants, usually weeds.

Invasive Species – Species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Gates 2008). Invasive species reduce biodiversity by displacing native organisms, bringing about changes in species composition, community structure, or ecosystem function

(Randall and Hoshovsky 2000). Many invasive species form monocultures (dense stands of one plant) that push out native species and reduce food and shelter needed by native wildlife, including endangered species (Cal-IPC 2006). Not all non-native plants are invasive. Only a small minority of the thousands of species introduced to California have escaped cultivation, and a minority of those have escaped spread into wildlands.

Management – A management objective in which a plant species is the focus of some level of active management. Management may not address all populations of the plant. Management may result in stabilizing or reducing the overall abundance of the plant, or the plant may still be spreading overall.

Management Units – PCRP is divided into 22 Management Units (Figure 2). The Front Country refers to the 11 Management Units north of Animas Pond (Animas, West Animas, Barn, Bluff, Bull, East, Inspiration, Middle, River, South Front, North Front).

Native Species – Those species growing within their natural range and natural zone of dispersal potential. They are species or subspecies that are within the range they could occupy without direct or indirect introduction and/or care by humans (Randall and Hoshovsky 2000).

Non-Native Species – Those species growing beyond their natural range or natural zone of potential dispersal, including all domesticated and feral species and all hybrids involving at least one non-native parent species (Randall and Hoshovsky 2000). Other terms are often used a synonyms for non-native include alien, exotic, and introduced species. These plants have the capacity to alter native ecosystems, with potential detrimental implications for native plant communities, wildlife habitat, fire regimes, water flow, and nutrient cycling.

Occurrences – The basic unit of mapping and assessing a singular weed or weed population/infestation. Each occurrence defines the presence of a single species and is recorded at a specific location. The occurrence location is recorded as a point or polygon in space, although each occurrence may actually be a population of plants covering an extensive area.

Perennial Plants – Plants that live more than two years or growing seasons. The term is usually applied to plants that are essentially non-woody above-ground (Hickman 1993).

Pesticides – Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses. Though often misunderstood to only refer to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture or substances intended for use as a plant regulator, defoliant, or desiccant (U.S. EPA Office of Pesticide Programs 2014).

Shrubs – Woody plants of relatively short maximum height, as compared to trees and are usually much-branched from the base (Hickman 1993).

Surveillance – A management objective that entails regular surveys to detect new infestations of species not known to be present in an area.

Treatment – Any weed management activity that occurs at a specific time over a defined geographical area.

Section 2. SETTING

2.1. GENERAL SETTING

The approximately 4,540 acre Palo Corona Regional Park is located in central coastal Monterey County, at the northern tip of the Santa Lucia Mountains (Figure 1). The six-mile long property extends from the Carmel River floodplain in the north to the Joshua Creek Ecological Reserve of the California Department of Fish and Wildlife to the south. As recorded in the public land survey system, PCRP is depicted on the Monterey, Mt. Carmel and Soberanes Point 7.5-minute USGS topographic quadrangles. It is floristically situated near the boundary of the Central Coast and San Francisco Bay Area subregions of the California Floristic Province.

PCRP consists of low elevation coastal terraces at the northern end of the park, with steep mountainous terrain characterized by rounded ridges, steep slopes, and narrow canyons in the central and southern portions of the park. Within PCRP elevations range from 30 feet elevation at the northern end of the park near the Carmel River to 2,972 feet atop Palo Corona Peak located in the southern portion of the park. Annual average rainfall is approximately 17 to 41 inches (PRISM 2007). The climate is Mediterranean with the northern coastal portion of the park greatly influenced by maritime fog. PCRP contains land that is part of ten watersheds: San Jose, Animas, Seneca, Van Winkley, Carmel River, Malpaso, Soberanes, Williams, Doud, and Granite (McGraw 2007). Soils of PCRP are predominantly loams (USDA 1978). PCRP is divided into 22 Management Units (Figure 2).

PCRP has been grazed by cattle since 1927 and is currently grazed. Public access to PCRP is currently limited to pedestrians who receive a permit to access the northern portion of the park, with access prohibited south of Animas Pond. Surrounding land uses to the north are primarily residential and includes the City of Carmel. Lands to the west, east, and south of PCRP are mostly open space. PCRP connects several separate wilderness areas and parks, including: Carmel River State Beach, Garrapata State Park, Joshua Creek Ecological Reserve, Mitteldorf Preserve, Glen Deven Ranch, Point Lobos State Reserve, Point Lobos Ranch State Park, Santa Lucia Conservancy lands, and the Ventana Wilderness.

2.2. SIGNIFICANT BIOLOGICAL RESOURCES

Significant biological resources in PCRP include special-status plants and habitat, special-status wildlife and habitat, high priority vegetation types, and wetlands and aquatic features. Invasive weed populations threaten these resources and can result in the loss and degradation of habitats, conversion of native vegetation types, and ecosystems, as well as the reduction in size, range, and reproductive capacity of special-status plants and animals. The following section briefly summarizes the biological resources found in PCRP. A detailed discussion of significant biological resources in PCRP can be found in the *Grassland Management Plan for Palo Corona Regional Park* (McGraw 2007).

2.2.1 SPECIAL-STATUS PLANT SPECIES AND THEIR HABITAT

Special-status plant species are defined as species that are listed as endangered or threatened, are proposed or candidates for listing, or are designated as fully protected species under one or more of the following regulatory statutes: Federal Endangered Species Act (ESA), as amended (Code of Federal Regulations, Title 50, Section 17), California Endangered Species Act (CESA) (California Code of Regulations Title 14, Section 670.5), California Fish and Game Code (Sections 1901, 2062, and 2067), and the Native Plant Protection Act of 1977. Special-status species may also include locally rare species defined by CEQA guidelines Sections 15125(c) and 15380, which may include species that are designated

as sensitive, declining, rare, locally endemic, or as having limited or restricted distribution by various federal, state, and local agencies, organizations, and watch lists. CNPS has developed and maintains an inventory of rare, threatened, and endangered plants of California. This information is published in the Inventory of Rare and Endangered Vascular Plants of California (CNPS 2001; 2013).

Four special-status plant species are recorded in the California Natural Diversity Database (CNDDB) within PCRP (CDFW 2014). An additional nine special-status plant species have been recorded as occurring in PCRP (Overtree 2006 in McGraw 2007). These species, their habitat preference, occurrence in PCRP, and any invasive plant threats are discussed below in Table 1. The CNDDB occurrences and MPRPD occurrences are shown in Figure 3. The methodology and results of the field mapping effort are detailed in Section 3.

2.2.2 SPECIAL-STATUS WILDLIFE SPECIES AND HABITAT

Three special-status wildlife species (Smith's blue butterfly, California tiger salamander, and California red-legged frog) are known to occur within the park (Table 2) as recorded in the CNDDB, and mapped by MPRPD (CDFW 2014). These three species are included in the Safe Harbor Agreement for PCRP (MPRPD and USFWS 2011). These species, their habitat preference, occurrence in PCRP, and any invasive plant threats are discussed below in Table 2. The CNDDB occurrences and MPRPD occurrences are shown in Figure 4. An additional 11 special status wildlife species are known to occur in the park[2] (McGraw 2007).

[2] Steelhead trout, California horned lizard, California condor, golden eagle, white-tailed kite, northern harrier, merlin, burrowing owl, California horned lark, loggerhead shrike, and tricolored blackbird.

Table 1. Special Status Plant Species Known to Occur in PCRP

Species Name Common Name	Listing Status	General Habitat Preference	Occurrence within the PCRP[3]	Invasive Plant Threats[4]
Arctostaphylos hookeri subsp. *hookeri* Hooker's manzanita	Fed: None CA: None 1B.2	Occurs on sandy soils in closed-cone coniferous forest, chaparral, cismontane woodland and coastal scrub.	There are three CNDDB occurrences in the park and one occurrence immediately adjacent to the park. EONDX #66250 is in the South Front MU, east of the monastery on Monastery Ridge. It occurs on a west-facing ridgeline in maritime chaparral growing with Yadon's rein orchid. EONDX #66212 is just west of the western boundary of PCRP on Corona Road. EONDX #66233 is in the Panoche MU in maritime chaparral. EONDX #66234 is located near the border of the Panoche and Seneca MUs and is in a small pocket of maritime chaparral surrounded by coast live oak and redwood forest.	No invasive weeds were present in the vicinity of the populations of Hooker's manzanita within PCRP. The population along Corona Road was adjacent to grassland which contains infestation of Harding grass and French broom. Scattered individuals of French broom were observed in otherwise intact chaparral and scrub and could pose a threat to this population.
Ceanothus rigidus Monterey ceanothus	Fed: None CA: None 4.2	Occurs on sandy substrates in closed-cone coniferous forest, chaparral, and coastal scrub.	Occurs in chaparral communities at PCRP. Five occurrences are mapped at PCRP in the Panoche, Ridge, and West San Jose MUs.	Isolated French broom was growing on the edge of chaparral in the vicinity in the Panoche MU. Dense French broom was present in the vicinity in the West San Jose MU.
Chorizanthe douglasii Douglas's spineflower	Fed: None CA: None 4.3	Occurs in subshrub grasslands, chaparral, and coastal scrub.	Occurs in grasslands, chaparral, and coastal scrub at PCRP. Three occurrences are mapped at PCRP in the Panoche and West San Jose MUs. Also observed growing in Malpaso MU during weed mapping surveys.	French broom was observed growing in the immediate vicinity in the Panoche MU. No weeds were observed in Malpaso MU or in vicinity during weed mapping surveys.
Clarkia lewisii Lewis' clarkia	Fed: None CA: None 4.3	Occurs in broadleafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland and coastal scrub.	Occurs in grasslands, chaparral, and coastal scrub at PCRP. Three occurrences are mapped at PCRP in the Panoche and Corona MUs.	No invasive weeds were present in the vicinity of the mapped populations.

[3] It should be noted that local distribution references depicted in the California Natural Diversity Database (CDFW 2014) are referenced by the Element Occurrence Index (EONDX). The EONDX is a sequential number or integer primary key that is unique for each record in the CNDDB.

[4] Invasive plant threats were determined by looking at mapped occurrence and whether weeds were mapped in the vicinity. Special-status plant populations were not observed in the field. The methodology and results of the field mapping effort are detailed in Section 3.

Species Name Common Name	Listing Status	General Habitat Preference	Occurrence within the PCRP[3]	Invasive Plant Threats[4]
Delphinium hutchinsoniae Hutchinson's larkspur	Fed: None CA: None 1B.2	Occurs in broadleafed upland forest, chaparral, coastal prairie, and coastal scrub.	There are three CNDDB occurrences in the park. EONDX #60834 is in the Seneca MU near the northern boundary, growing on a granitic outcrop in coast redwood forest. EONDX #60835 is in the Panoche MU growing on an east facing slope in native grassland. EONDX #60847 is in the West San Jose MU, growing in scrub. Two additional locations were mapped by MPRPD in the Panoche MU in grassland habitat.	EONDX #60834 is located within a mapped stand of foxglove. No weeds were growing in the immediate vicinity of EONDX #60835 but scattered weeds including poison hemlock, French broom, foxglove, and crofton weed were in the vicinity. Foxglove and French broom were growing in the vicinity of EONDX #60847 in openings in chaparral and scrub. No weeds were observed in the vicinity of the two locations mapped by MPRPD in the Panoche MU in grassland habitat.
Eriogonum nortonii Pinnacles's buckwheat	Fed: None CA: None 1B.3	Occurs on sandy soils in chaparral, and valley and foothill grassland, often on recent burns.	There is one CNDDB occurrence in the park. EONDX #69154 is in the Panoche MU in maritime chaparral with Hooker's manzanita.	No invasive weeds were present in the vicinity of the population.
Leptosiphon grandiflorus large-flowered leptosiphon	Fed: None CA: None 4.2	Usually occurs in sandy soils in coastal bluff scrub, closed-cone coniferous forest, cismontane woodland, coastal dunes, coastal prairie, coastal scrub and valley and foothill grassland.	Occurs in subshrub grasslands at PCRP. Two locations were mapped by MPRPD in the Panoche MU in grassland habitat.	No invasive weeds were present in the vicinity of the population.
Lomatium parvifolium small-leaved lomatium	Fed: None CA: None 4.2	Occurs on and off serpentinite substrates in closed-cone coniferous forest, chaparral, coastal scrub and riparian woodland.	Occurs in Monterey pine forest at PCRP. One location was mapped in the South Front MU.	No invasive weeds were present in the vicinity of the population.
Microseris paludosa marsh microseris	Fed: None CA: None 1B.2	Occurs in closed-cone coniferous forest, cismontane woodland, coastal scrub and valley and foothill grassland.	This species was recorded as occurring in moist perennial grassland at PCRP but no location data was provided by MPRPD.	Unknown as no location data was provided by MPRPD.
Pinus radiata Monterey Pine	Fed: None CA: None 1B.1	Occurs in closed-cone coniferous forest, and cismontane woodland.	Approximately 43 acres of Monterey pine forest is present in the South Front MU.	Bermuda buttercup was present in scattered locations in the understory of Monterey pine forest.

Species Name Common Name	Listing Status	General Habitat Preference	Occurrence within the PCRP[3]	Invasive Plant Threats[4]
Piperia michaelii Michael's rein orchid	Fed: None CA: None 4.2	Occurs in coastal bluff scrub, closed-cone coniferous forest, chaparral, cismontane woodland, coastal scrub and lower montane coniferous forest.	One location mapped by MPRPD in the Panoche MU along Chamise Rd near the property boundary. In maritime chaparral habitat.	No invasive weeds were present in the vicinity of the population.
Piperia yadonii Yadon's rein orchid	Fed: FE CA: None 1B.1	Occurs in sandy soils in coastal bluff scrub, closed-cone coniferous forest, and maritime chaparral.	There is one CNDDB occurrence in the park. EONDX #63698 is in the South Front MU, east of the monastery. It occurs on a west-facing ridgeline in maritime chaparral growing with Hooker's manzanita, adjacent to Monterey pine forest. Yadon's piperia is included in the Safe Harbor Agreement for the park which requires removing any non-native invasive vegetation within the Yadon's piperia habitat.	No invasive weeds were present in the vicinity of the population.
Plagiobothrys diffusus San Francisco popcorn flower	Fed: None CA: CE 1B.1	Occurs in coastal prairie and valley and foothill grassland.	Occurs in moist perennial grassland at PCRP. One location is mapped in the South Front MU.	The mapped location of San Francisco popcorn flower is in a stand of French broom.

Explanation of State and Federal Listing Codes

Federal listing codes:

- FE Federally listed as Endangered
- FT Federally listed as Threatened
- FPE Federally proposed for listing as Endangered
- FPT Federally proposed for listing as Threatened
- FPD Federally proposed for delisting
- FC Federal candidate species (former Category 1 candidates)
- *SC Species of Concern – No longer maintained by USFWS*
- *SLC Species of local concern or conservation importance – No longer maintained by USFWS*

California listing codes:

- SE State listed as Endangered
- ST State listed as Threatened
- SR State listed as Rare
- SCE State candidate for listing as Endangered
- SCT State candidate for listing as Threatened

California Native Plant Society codes:

- 1A Presumed extinct in California
- 1B Rare/Endangered in California and elsewhere
- 2A Plants Presumed Extirpated in California, But More Common Elsewhere
- 2B Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
- 3 Plants for which we need more information - Review list
- 4 Plants of limited distribution - Watch list

California Native Plant Society Threat Codes:

- .1 Seriously Endangered in California (over 80% of occurrences Threatened / high degree and immediacy of threat)
- .2 Moderately Endangered in California (20-80% occurrences Threatened)
- .3 Not very Endangered in California (<20% of occurrences Threatened or no current threats known)
- *Notes: CNPS List 1A and some List 3 plant species lacking any threat information receive no threat code extension.*

Survey Recommendation Determinations Based On

- Observed phenology at the time of reconnaissance
- Seasonal weather patters
- Collection dates of herbarium specimens
- Blooming times given by the CNPS Inventory

Table 2. Special Status Wildlife Species Known to Occur in the PCRP based on CNDDB Occurrences

SPECIES NAME COMMON NAME	LISTING STATUS	GENERAL HABITAT PREFERENCE	OCCURRENCE WITHIN THE PARK	INVASIVE PLANT THREATS
Ambystoma californiense California tiger salamander Central California DPS	Fed: FT, CH CA: ST	A large terrestrial salamander that inhabits seasonal/semi-permanent water sources (3-4 months in duration) and adjacent upland habitat with small fossorial mammal activity in lowland grasslands, oak savannah and mixed woodlands.	There is one CNDDB occurrence in the park. EONDX #60766 is located at Roadrunner Pond in the South Animas MU. CTS have also been found in Salamander Pond in the West San Jose MU (MPRPD and USFWS 2011).	Roadrunner Pond contained infestations of poison hemlock, French broom, and Harding grass along the banks. Salamander Pond was surrounded by dense French broom on all sides which could impede travel by salamander. The pond itself was filled with bulrush and other emergent vegetation. Weed infestations at each pond are detailed in Table 4.
Euphilotes enoptes smithii Smith's blue butterfly	Fed: FE CA: none	Smith's blues are found in coastal sand dunes and cliff/chaparral areas along the central California coast in Monterey, Santa Cruz, and San Mateo Counties. Smith's blues spend their entire lives in association with two species of buckwheat, seacliff buckwheat (*Eriogonum parvifolium*) and seaside buckwheat (*Eriogonum latifolium*). These plants are obligate hostplants for the larvae and the principle nectar sources for adults. They also provide mating sites. The butterflies generally spend their lifetime within 200 feet of the hostplant on which they emerged.	There are ten CNDDB occurrences in the park located in the Inspiration, Animas, West San Jose, Seneca, Panoche, and Malpaiso MUs. All areas of suitable habitat for the species are mapped in the park and are considered as habitat in the Safe Harbor Agreement (MPRPD and USFWS 2011).	Invasive weed species that were mapped within Smith's blue butterfly habitat include crofton weed in Panoche MU, poison hemlock in South Front and Malpaiso MUs, French broom in West San Jose, South Front, and Panoche MUs, and common mullein in Panoche MU.

SPECIES NAME COMMON NAME	LISTING STATUS	GENERAL HABITAT PREFERENCE	OCCURRENCE WITHIN THE PARK	INVASIVE PLANT THREATS
Rana draytonii California red-legged frog	Fed: FT, CH CA: SSC	A medium-sized frog inhabiting lowlands & foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation up to 1,500 meters in elevation (Jennings and Hayes 1994, Bulger et al. 2003, Stebbins 2003). Breeding occurs between November and April in standing or slow moving water with emergent vegetation, such as cattails (*Typha* spp.), tules (*Scirpus* spp.) or overhanging willows (*Salix* spp.) (Hayes and Jennings 1988).	CRF is known to occur at Entrance Pond, River Pond, Boundary Pond, Animas Pond, Dead Pig Pond, Roadrunner Pond, and Salamander Pond. The CNDDB only contains two occurrences: EONDX #56918 at Animas Pond and EONDX #56949 at Dead Pig Pond.	Most of the ponds contained high concentrations of weeds in the immediate vicinity. Weed infestations at each pond are detailed in Table 4.

Explanation of State and Federal Listing Codes

Federal listing codes:

FE	Federally listed as Endangered
FT	Federally listed as Threatened
FPE	Federally proposed for listing as Endangered
FPT	Federally proposed for listing as Threatened
FPD	Federally proposed for delisting
FC	Federal candidate species (former Category 1 candidates)
SC	Species of Concern (NMFS regulated species only)
CH	Critical Habitat (Proposed or Final) is designated
SSC	Species of Special Concern designated by the Marine Mammal Commission
FSC	*Federal Species of Concern – No longer maintained by USFWS Sacramento Regional Office*
SLC	*Species of local concern or conservation importance – No longer maintained by USFWS*

California listing codes:

SE	State listed as Endangered
ST	State listed as Threatened
SCE	State candidate for listing as Endangered
SCT	State candidate for listing as Threatened
SCD	State candidate for delisting
SSC	California Species of Special Concern
FP	Fully Protected
WL	Watch List

2.2.3 HIGH PRIORITY VEGETATION TYPES

PCRP contains 13 vegetation communities (Table 3 and Figure 5). High priority vegetation communities in PCRP as identified by MPRPD staff and background documents include coastal terrace prairie, native grassland, coastal scrub in areas that contain seacliff buckwheat and coast buckwheat (*Eriogonum parvifolium* and *E. latifolium*), maritime chaparral, redwood forest, riparian, and wetland. Coastal scrub that contains seacliff buckwheat and coast buckwheat is suitable habitat for Smith's blue butterfly (*Euphilotes enoptes smithi*) which is federally-endangered and included in the Safe Harbor Agreement for the property (MPRPD and USFWS 2011). These vegetation communities are described in detail in McGraw 2007.

Table 3. Vegetation Communities in PCRP

VEGETATION COMMUNITY[5]	APPROXIMATE ACREAGE	HIGH PRIORITY VEGETATION [6] AS SPECIFIED BY MPRPD
GRASSLAND		
Annual Grassland	142.3	no
Coastal Terrace Prairie	16.7	yes
Native Grassland	1,333.1	yes
SHRUBLANDS		
Coastal Scrub	728.1	yes (areas that contain seacliff buckwheat and coast buckwheat)
Maritime Chaparral	380.0	yes
WOODLAND/FOREST		
Oak Woodland	116.7	no
Hardwood Forest	622.7	no
Pine Forest	64.9	no
Redwood Forest	902.5	yes
Riparian	24.5	yes
OTHER		
Bare Ground	3.9	no
Human Created	2.5	no
Wetland	0.8	yes

[5] Source: MPRPD. Vegetation was not mapped in the Lower San Jose MU.

[6] High priority vegetation may qualify as sensitive natural communities. Sensitive natural communities are characterized as plant assemblages that are unique in constituent components, restricted in distribution, supported by distinctive edaphic conditions, considered locally rare, potentially support special-status plant or wildlife species, and/or receive regulatory protection. The regulatory framework that protects sensitive natural communities is derived from local, state and federal laws and regulations including Section 10 of the federal Rivers and Harbors Act, sections 401 and 404 of the federal Clean Water Act, Section 1600 et seq. of the California Fish and Game Code, Section 15065 of the CEQA guidelines, and various other city or county codes. Implementation and enforcement of these regulations are conducted by their respective regulatory entities such as the U.S. Army Corps of Engineers, California Regional Water Quality Control Board, California Department of Fish and Game, lead agency and/or various cities or counties. The CNDDB treats a number of natural communities as rare, which are given the highest inventory priority (Holland 1986; CDFG 2010).

2.2.4 WETLANDS AND AQUATIC FEATURES

Streams

PCRP contains several streams including the Carmel River, Animas Creek, Barn Creek, Chavote Creek, Granite Creek, Malpaso Creek, Monastery Creek, Panoche Creek, San Jose Creek, Seneca Creek, Soberanes Creek, and Van Winkley Creek as well as numerous tributaries (Figure 6). Waterways are known vectors for spreading invasive weeds.

Ponds

PCRP contains 14 mapped ponds (Table 4 and Figure 6). Ten of these are included in the Safe Harbor Agreement for the property as habitat for California red-legged frog and California tiger salamander (MPRPD and USFWS 2011). The Safe Harbor Agreement outlines management activities that are beneficial to covered species including controlling non-native vegetation in covered species habitat (MPRPD and USFWS 2011). All but three of the ponds were surveyed by Nomad. Echo Ridge, Flint Ranch, and Van Winkley's ponds were not surveyed due to their remoteness and inaccessibility. Table 4 also contains a list of invasive weeds detected at each pond during field work.

Table 4. Ponds in PCRP and Invasive Weeds Present

POND	MANAGEMENT UNIT	TYPE	INCLUDED IN SAFE HARBOR AGREEMENT	SURVEYED BY NOMAD 2013	INVASIVE WEEDS PRESENT IN AND ADJACENT TO POND[7]
Animas Pond	Animas	perennial	X	X	Italian thistle poison hemlock yellow flag iris bull thistle
Barn Pond 1	Middle and North Front	seasonal	-	X	poison hemlock milk thistle
Barn Pond 2	Middle and North Front	seasonal	-	X	poison hemlock milk thistle
Boundary Pond (Barn Pond 3)	Middle and North Front	seasonal	X	X	bull thistle harding grass Italian thistle
Cabin Pond	Seneca	seasonal	-	X	none
Dead Pig Pond	West San Jose	perennial	X	X	poison hemlock
Echo Ridge Pond	Malpaso	perennial	X	-	not surveyed
Entrance Pond	North Front and South Front	perennial	X	X	Italian thistle milk thistle
Flint Ranch Pond	Ridge		-	-	not surveyed
River Pond	River	seasonal	X	X	Italian thistle bull thistle wild radish
Roadrunner Pond	South Animas	seasonal	X	X	poison hemlock French broom

[7] The methodology and results of the field mapping effort are detailed in Section 3.

Pond	Management Unit	Type	Included in Safe Harbor Agreement	Surveyed by Nomad 2013	Invasive Weeds Present In and Adjacent to Pond[7]
Salamander Pond	West San Jose	perennial	X	X	French broom
Van Winkleys Pond	Malpaso	perennial	X	-	not surveyed
Wire Corrals Pond	Malpaso	seasonal	X	X	poison hemlock

2.2.5 High Quality Habitat

High quality habitats are areas or sites that remain relatively undisturbed by human activity and that have low levels of non-native plant cover and are relatively uninvaded by any weed species. High quality habitats are important because maintaining them in good condition is a component of preserving biodiversity in PCRP. The southern portion of PCRP (including Panoche, Seneca, Corona, Ridge, Malpaso, and South MUs) was dominated by native vegetation, had low levels of weeds, and was relatively undisturbed by human activity. These MUs are considered high quality habitat (Figure 7).

Section 3. WEED INVENTORY AND RESULTS

3.1. INVASIVE WEED INVENTORY

3.1.1 NATIVE RANGE FIELD EFFORT 2012

Native Range Inc. was contracted by the Big Sur Land Trust in 2012 to survey for non-native plant species in PCRP. Details of the Native Range surveys are presented in the *Invasive Plant Survey Draft Report for the Palo Corona Ranch, April 2013* (Native Range 2013) and are summarized below.

Personnel and Field Surveys

The entire survey was conducted from a low-flying helicopter on April 16, 17, 18, and 19, 2012. A team of four individuals conducted the surveying, which included: helicopter pilot (Dean Graham), geographic information system and global positioning system support (Jason Casanova), and botanical surveyors (Steve Junak and John Knapp).

Native Range utilized its Schweizer-333 turbine-helicopter which has the lowest noise signature (85 db at 100 feet above the ground) in its class (small turbine helicopters). The helicopter was flown between 15 to 20 mph, and between 15 to 150 feet above the ground. The surveyors found that flying between 75 to 100 feet above the ground in most situations was ideal to detect the majority of the species surveyed.

Prior to the survey, a tablet PC equipped with a global positioning system (GPS) was preloaded with boundaries of each site to be surveyed. These data were used to guide the survey. Once the survey began, invasive plant populations were recorded as points and polygons. Polygons were recorded with the tablet PC only, while points were recorded with a Trimble Juno GPS. A second Trimble GPS was used by the second surveyor to record populations simultaneously with the other surveyor, and carried as a backup unit.

Project coordination occurred via cellular phone calls and in-person meetings between John Knapp and Cammy Chabre of Big Sur Land Trust daily to discuss project progression, notifications, and challenges. Close communications were crucial when the survey team realized that extent of Italian thistle (*Carduus pycnocephalus* subsp. *pycnocephalus*), poison hemlock (*Conium maculatum*), and milk thistle (*Silybum marianum*) were too abundant in the northern area near the corrals and main entrance to map in the same manner as all other species, and stay within budget. NRI and BSLT decided to record all other species in the same manner, but with respect to the three species listed above, assume that they are ubiquitous at this site.

Area infested and population density was visually estimated except for polygons. The area of each polygon was generated automatically once the polygons were digitized.

Data Collection and Definitions

The following is a description of each data attribute (column heading, bold) contained within the geographic information system shapefiles for invasive plant points and polygons (Native Range, Inc. 2013). All units of area measure are in square feet.

- **Species** – The scientific name of each target species.
- **Date** – The date auto-generated within the GPS.

- **Time** – The time auto-generated within the GPS.
- **Mapped_by** – The name of the surveyor recording the data. It is important to note that many populations were detected by other members of the survey team, but the data was primarily recorded by John Knapp.
- **Habitat_in** – The dominant vegetation type infested by the target population.
- **Age_class** – The most common age of plants within the population. Age was divided into seedlings, saplings, or mature.
- **Comment** – notable comments regarding the population.
- **Id_confidence** – The percent confidence the survey team had in identifying a species from the air.
- **Pop_density** – The vegetative cover of the target invasive plant species within the populations documented. The Daubenmire cover-classes were used to visually estimate cover within a range, i.e. 5-25% cover.
- **Ave_density** – The average density of each Pop_density range.
- **Gross_area** – The total area a population covers, which includes the inter-space between target plants within a population. Gross area (Shape_area) was calculated automatically within the GPS tablet when digitizing polygons. Gross area was calculated post-processing for points by multiplying Area_length x Area_width for points.
- **Net_area** – Net area is the area covered by the target species, not including inter-space between plants. Net area was calculated post-processing by multiplying Gross_area x Ave_density (average density). This is a synonym of Infested Ares.
- **Mustard_no** – The presence or absence of mustard species was noted when mapping all other species. These species were suspected of being too ubiquitous to map as points or polygons, and thus were noted to provide data for a presence/absence map.

3.1.2 NOMAD ECOLOGY FIELD EFFORT 2013

Nomad Ecology was contracted by MPRPD in 2013 to conduct additional invasive weed surveys and complete the weed management plan.

Personnel and Field Surveys

Nomad botanists Heath Bartosh and Erin McDermott conducted a reconnaissance site visit of PCRP with MPRPD Planning and Conservation Director, Tim Jensen on May 6, 2013. The site visit consisted of a driving tour to familiarize Nomad personnel with the study area, provide background information on PCRP, and discuss desired goals of the project. Based on the reconnaissance site visit, it was determined that the purpose of the additional surveys was to:

1) Field check a large portion of the Native Range data collected via helicopter in April 2012 to ascertain the data's accuracy and consistency.
2) Produce detailed maps of invasive weeds in the northern portion of the property (Front Country) as this area was not mapped completely by Native Range due to the large numbers of invasive weeds (John Knapp pers. comm.).

3) Survey native grasslands for invasive weed populations, particularly at the boundaries of scrub and maritime chaparral.

4) Survey redwood forests for invasive weed populations that would have not been easily detectable by Native Range from a helicopter, particularly in the lower reaches and in the vicinity of known concentrations of weeds.

5) Survey for later blooming species that would have not been easily detectable by Native Range in April 2012 including thistle species, foxglove, and poison hemlock.

Nomad botanists Erin McDermott, Katie Gallagher, Nick Jenson, and Brian Peterson conducted invasive plant surveys on June 5, 6, and 7, 2013. Surveys were a combination of driving and walking. Surveys focused on the northernmost and central Management Units. The "South" Management Unit was not surveyed due to time constraints.

Data was collected on field forms with the location of invasive weeds recorded using handheld GPS units. A data point or polygon was recorded for each occurrence of target weed species encountered and all attributes were recorded. The locations of invasive weeds on bordering properties were noted and described but not mapped in detail.

Widespread non-native grassland species such as Italian ryegrass (*Festuca perennis*), wild oats (*Avena fatua*), velvet grass (*Holcus lanatus*), and bristly ox-tongue (*Helminthotheca echioides*) were not mapped or inventoried.

Data Collection and Definitions

Nomad collected attribute data during the invasive weed species mapping. The methodology for this data collection is based on the California Weed Mapping Handbook (CDFA 2002) and the North American Invasive Plant Mapping Standards (NAWMA 2002). All weed data collected in the field and entered into GIS attribute tables is compatible with Calflora and the Cal-IPC's Cal Weed Mapper (Cal-IPC 2014b) for seamless integration with this online database. The attribute data provides additional information about the degree and spatial extent of infestation which is necessary for prioritizing and planning control efforts. The following attributes were collected for each occurrence that was mapped:

- **Observer Name** – Person collecting the data
- **Observation Date** – Date that the infestation information was recorded
- **Target Weed Species** – The target weed species corresponding to each data point or polygon. A point or polygon was taken for each species at a location.
- **Gross Area** – An estimate of the size of the general area where the target weed species occurred, including land and other plant species between target weed species individuals (by drawing an imaginary line around outside of infestation). Area was recorded in acres with <0.01 acre as the minimum unit. If more than 1 acre was observed, the Gross Area was rounded to the nearest acre. If less than 1 acre, one of the following fractions of an acre was assigned:
    - 0.01 acre
    - 0.05 acre
    - 0.1 acre
    - 0.25 acre
    - 0.5 acre
- **Infested Area** – An estimate of the area actually covered with target weed species if there were no spaces between the plants. Does not include land and other plant species.

This area is smaller than gross area. Area was recorded in acres with <0.01 acre as the minimum unit. If more than 1 acre, it was rounded to nearest acre. If less than 1 acre, one of the above fractions of an acre was assigned.

- **Cover Class** – Cover is the estimated percent of the gross area actually covered by the Target weed species. This attribute is separated into classes (Table 5).
- **Number of Individuals** – An estimate of the number of individual plants in the infested area. This attribute is separated into classes (Table 6).
- **Distribution Categories** – A description of how the target weed species were distributed across the landscape.
    - Single Plant – a single individual or 2 of the species
    - Single Patch – target weed species comprising one or a few individuals; otherwise devoid of that particular plant
    - Scattered Patches – target weed species occurring in groups
    - Scattered Plants – target weed species readily occurring throughout a specific area
    - Linear – target weed species occurring in linear patches such as along a road
    - Dense Monoculture – target weed species comprising a dominant stand of one particular species
- **Phenology –** life cycle stage of the majority of plants of infestation.
    - seedling/rosette
    - bolting
    - flowering
    - fruiting
    - dead/senescent
    - mature
- **Habitat** – The habitat or vegetation community where target weed species were observed
- **Habitat Value**
    - High – high quality or sensitive habitat such as native grassland or wetlands
    - Moderate – mostly native but common vegetation
    - Low – disturbed or weedy habitat such as roadsides and ruderal areas
- **Notes** – Notes on target weed species that pose a threat to sensitive resources, obvious signs of disturbance, location, and trends.

Table 5. Cover Classes for Target Weed Species.

Cover Class	Percent Cover	Description
Trace (T)	0-1%	Trace
1	1 – 5%	Low, occasional plants
2	5 – 25%	Moderate, scattered plants
3	25 – 50%	High, fairly dense
4	50 – 75%	Dense
5	75 – 95%	Very dense
6	95 – 100%	Solid stand

Table 6. Number Classes for Target Weed Species.

Number Class	Number of Individuals
Trace (T)	1
1	2 – 10
2	11 – 100
3	101 – 1,000
4	1,001 – 10,000
5	> 10,000

GIS Mapping

Following the completion of field work, a draft invasive weed map was created in a GIS platform (ESRI ArcGIS 9.2) by importing field-collected GPS data. The GIS data provided by Native Range was incorporated in the GIS platform and combined with Nomad Ecology data to result in a complete, consistent invasive weed data set for the property. Native Range polygon boundaries and point locations were refined to reflect observations made in the field by Nomad Ecology and to ensure that there was consistency between the data collected by Nomad Ecology and Native Range. Each weed occurrence mapped during the weed inventory and entered in the GIS was assigned a unique Population ID number for identification.

Invasive weeds polygons were drawn by interpreting digital color aerial photography and field notes to delineate polygon boundaries, through a “heads-up’ digitizing process (i.e. a photo interpreter manually drew polygons around each invasive weed population based on observations mapped in the field). Boundaries were heads-up digitized at a scale of 1:2,000 with a few exceptions. The base imagery used was a 2012 digital orthophoto for Monterey County provided by the National Agricultural Imagery Program (NAIP).

3.1.3 Limitations

Not all areas within PCRP were surveyed for weeds due to time and budget constraints. This inventory provides a temporal assessment of invasive plant species occurrence and was conducted in a large area with considerably less detail and precision than typically required for monitoring. Based on the timing of the surveys (April 2012 and June 2013) not all invasive weed plant species were identifiable.

The present study is not floristic in nature. A complete determination of the presence or absence of potentially occurring botanical resources would require focused surveys to be conducted during all appropriate blooming periods (CNPS 2001, CDFG 2000, and USFWS 2000). Additionally, certain plant species, especially annuals, may not be present in all years due to annual variations in temperature and rainfall, which influence plant phenology. Colonization of new populations within an area may also occur from year to year.

3.2. WEED INVENTORY RESULTS

The following results include the Native Range and Nomad Ecology data as one dataset. A total of 28 target invasive weed plant species were mapped with a total of 825 occurrences (Table 7). The Management Units that each target invasive weed species was mapped in is shown in Table 8. The "South" Management Unit was not surveyed by Nomad Ecology due to time constraints.

The 6 species with the highest number of occurrences in Palo Corona Regional Park were:

- French broom (*Genista monspessulana*; 288 data points)
- Poison hemlock (*Conium maculatum*; 113 data points)
- Bull thistle (*Cirsium vulgare*; 69 data points)
- Milk thistle (*Silybum marianum*; 53 data points)
- Italian thistle (*Carduus pycnocephalus* subsp. *pycnocephalus*; 48 data points)
- Harding grass (*Phalaris aquatica*; 47 data points)

Each data point also recorded the size of the area that contained the target weed.

The 5 species with the highest total gross area were:

- French broom (237.10 acres)
- Poison hemlock (119.66 acres)
- Italian thistle (89.23 acres)
- Foxglove (*Digitalis purpurea*; 52.81 acres)
- Milk thistle (41.81 acres)

Table 7. Target Invasive Weed Species Recorded in PCRP

Common Name Species Name	CAL-IPC Rating[8]	CDFA Rating[9]	Number of Data	Total Gross Area (acres)[10]	Total Infested Area (acres)	Distribution Rating[11]
crofton weed *Ageratina adenophora*	Moderate	-	24	5.31	2.22	Moderate
plume acacia *Albizia lophantha*	-	-	2	<0.01	<0.01	Limited
black mustard *Brassica nigra*	Moderate	-	3	4.72	3.85	Limited
Italian thistle *Carduus pycnocephalus* subsp. *pycnocephalus*	Moderate	C	48	89.23	9.26	Widespread
hottentot-fig *Carpobrotus edulis*	High	-	9	0.33	0.08	Limited
tocalote *Centaurea melitensis*	Moderate	C	7	0.02	0.01	Limited
bull thistle *Cirsium vulgare*	Moderate	C	69	5.76	0.66	Widespread
poison hemlock *Conium maculatum*	Moderate	-	113	119.66	38.84	Widespread
jubata grass *Cortaderia jubata*	High	B	37	0.55	0.21	Moderate
silverleaf cotoneaster *Cotoneaster pannosa*	Moderate	-	11	1.43	0.04	Limited
Cape ivy *Delairea odorata*	High	B	2	0.75	0.15	Limited
foxglove *Digitalis purpurea*	Limited	-	34	52.81	2.41	Moderate
pride of Madeira *Echium candicans*	Limited	-	5	0.11	0.01	Limited

[8] California Invasive Plant Council rating as listed in the California Invasive Plant Inventory Database (Cal-IPC 2014a).

[9] California Department of Food and Agriculture rating as listed in the online Encycloweedia Data Sheets (CDFA 2014).

[10] Data points that were assigned a value of <0.01 acre for Gross Area or Infested Area were given the value 0.002 for calculation purposes.

[11] Distribution Rating was assigned a value of Limited, Moderate, or Widespread based on the number of data points and where they were located in PCRP.

Common Name Species Name	CAL-IPC Rating[8]	CDFA Rating[9]	Number of Data	Total Gross Area (acres)[10]	Total Infested Area (acres)	Distribution Rating[11]
erect veldtgrass *Ehrharta erecta*	Moderate	-	2	0.01	<0.01	Limited
blue gum *Eucalyptus globulus*	Moderate	-	1	0.50	0.50	Limited
fennel *Foeniculum vulgare*	High	-	5	0.03	0.01	Limited
French broom *Genista monspessulana*	High	C	288	237.10	81.45	Widespread
English ivy *Hedera helix*	High	-	1	<0.01	<0.01	Limited
yellowflag iris *Iris pseudacorus*	Limited	C	2	1.05	0.11	Limited
Bermuda buttercup *Oxalis pes-caprae*	Moderate	-	30	0.38	0.08	Moderate
kikuyu grass *Pennisetum clandestinum*	Limited	C	4	0.65	0.12	Limited
Harding grass *Phalaris aquatica*	Moderate	-	47	7.32	1.24	Widespread
wild radish *Raphanus sativus*	Limited	-	6	2.10	0.08	Limited
Himalayan blackberry *Rubus armeniacus*	High	-	1	<0.01	<0.01	Limited
cutleaf fireweed *Senecio glomeratus*	Moderate	-	19	0.05	0.04	Moderate
milk thistle *Silybum marianum*	Limited	-	53	41.81	3.93	Widespread
common mullein *Verbascum thapsus*	Limited	-	1	0.10	0.01	Limited
periwinkle *Vinca major*	Moderate	-	1	0.25	0.25	Limited
		Total:	**825**	**572.03**	**145.56**	

Table 8. Target Invasive Weed Species Recorded in Each Management Unit

Common Name Species Name	Animas	Barn	Bluff	Bull	Corona	East	East San Jose	Flint	Inspiration	Lower San Jose	Malpaso	Middle	North Front	Panoche	Ridge	River	Seneca	South	South Animas	South Front	West Animas	West San Jose	Off-Site
crofton weed *Ageratina adenophora*	X										X			X							X		X
plume acacia *Albizia lophantha*																							X
black mustard *Brassica nigra*																			X		X		
Italian thistle *Carduus pycnocephalus* subsp. *pycnocephalus*	X	x	X	X		X	X		X	x		X	X			X			X	X	X	X	
hottentot-fig *Carpobrotus edulis*																							X
tocalote *Centaurea melitensis*					X		X				X				X								
bull thistle *Cirsium vulgare*	X	x		X	X		X			x	X	X	X	X	X	X	X		X	X	X	X	X
poison hemlock *Conium maculatum*	X	x	X	X	X	X	X		X	x	X	X	X	X	X	X			X	X	X	X	X
jubata grass *Cortaderia jubata*	X							X		x	X			X					X	X	X	X	X
silverleaf cotoneaster *Cotoneaster pannosa*														X	X		X						
Cape ivy *Delairea odorata*																				X			X
foxglove *Digitalis purpurea*					X		X			x	X			X	X		X					X	X
pride of Madeira *Echium candicans*																							X
erect veldtgrass *Ehrharta erecta*		x																					X

Common Name Species Name	Animas	Barn	Bluff	Bull	Corona	East	East San Jose	Flint	Inspiration	Lower San Jose	Malpaso	Middle	North Front	Panoche	Ridge	River	Seneca	South	South Animas	South Front	West Animas	West San Jose	Off-Site
blue gum *Eucalyptus globulus*																				X			
fennel *Foeniculum vulgare*																				X			X
French broom *Genista monspessulana*	X		X		X	X	X	X	X	x	X	X	X	X	X		X		X	X	X	X	X
English ivy *Hedera helix*										x													
yellowflag iris *Iris pseudacorus*	X																		X			X	
Bermuda buttercup *Oxalis pes-caprae*		x	X						X			X	X							X			X
kikuyu grass *Pennisetum clandestinum*		x												X									
Harding grass *Phalaris aquatica*	X	x		X	X		X			x		X	X	X	X		X		X	X	X	X	
wild radish *Raphanus sativus*												X	X			X							
Himalayan blackberry *Rubus armeniacus*																	X						
cutleaf fireweed *Senecio glomeratus*	X								X	x										X	X		
milk thistle *Silybum marianum*	X	x	X	X	X	X	X			x	X	X	X	X	X	X	X		X	X	X	X	
common mullein *Verbascum thapsus*														X									
periwinkle *Vinca major*																						X	X

Section 4. INVASIVE WEED PRIORITIZATION

The number of different invasive weeds at PCRP are too numerous to control. Ranking provides a methodology for treatment prioritization which allows for the highest ranked species or populations to be controlled first, limited resources to be used efficiently, and management decisions to be based on science. Weed species prioritization, site prioritization, and WHIPPET[12] (a ranking tool) were all used to rank weed populations mapped in PCRP for control priority.

4.1. PRIORITIZATION METHODOLOGY

4.1.1 WEED SPECIES PRIORITIZATION

Prioritizing weed species is essential to understanding the threat to resources. Weed species prioritization ranks weeds based solely on their biology and ability to be treated. This prioritization is not specific to PCRP and does not take into account any site specific information such as their abundance or distribution in PCRP.

Weed species mapped in PCRP were ranked based on their impact to wildlands, invasibility, and feasibility of control. The California Invasive Plant Council's (Cal-IPC) ranking system was used to determine the threat posed by each species. Cal-IPC has assigned an Impact to Wildlands Score, Rate of Spread Score (invasibility), and Control Effectiveness Score with Herbicides (feasibility of control) for each species. For each species, these three values were summed and a category range applied to divide species into High, Medium, and Low Priority weeds (Table 9). A discussion of each weed species including general information, relevant life history traits, associated vegetation communities, and current distribution in PCRP are included in the detailed species accounts in the Attachment B.

Table 9. Weed Species Priority Rank

COMMON NAME	SPECIES NAME	IMPACT TO WILDLANDS SCORE[13]	RATE OF SPREAD SCORE[14]	CONTROL EFFECTIVENESS SCORE (WITH HERBICIDES)[15]	SUM OF SCORES[16]	PRIORITY RANK[17]
hottentot-fig	*Carpobrotus edulis*	10	6	6	22	High
tocalote	*Centaurea melitensis*	10	6	10	26	High

[12] WHIPPET stands for Weed Heuristics: Invasive Population Prioritization for Eradication Tool, which was developed as a population-level prioritization tool for land managers to identify areas for prioritizing weed eradication or management (Darin et al. 2010).
[13] For Impact to Wildlands Score a value of 10 means the species has a greater impact to wildlands and a score of 3 means the species has a lower impact to wildlands. Species with a higher score are considered higher priority for control. Source of Score: Cal-IPC.
[14] For Rate of Spread Score a value of 10 means the species has a greater rate of spread and a score of 3 means the species has a lower rate of spread. Species with a higher score are considered higher priority for control. Source of Score: Cal-IPC.
[15] For Control Effectiveness Score (with Herbicides), a value of 10 means the species can be effectively controlled with herbicides and a score of 3 means the species is less effectively controlled with herbicides. Species with a higher score are considered higher priority for control because control treatments are likely to be successful. Source of Score: Cal-IPC.
[16] The Impact to Wildlands Score, Rate of Spread Score, and Control Effectiveness Score (with Herbicides) were summed.
[17] Species were divided into Low, Medium, and High Priority based on Sum of Scores using the following intervals: Low=12-15, Medium= 16-19, High= >19.

Common Name	Species Name	Impact to Wildlands Score[13]	Rate of Spread Score[14]	Control Effectiveness Score (with Herbicides)[15]	Sum of Scores[16]	Priority Rank[17]
jubata grass	*Cortaderia jubata*	10	10	6	26	High
silverleaf cotoneaster	*Cotoneaster pannosa*	6	10	6	22	High
Cape ivy	*Delairea odorata*	10	10	6	26	High
fennel	*Foeniculum vulgare*	10	6	6	22	High
French broom	*Genista monspessulana*	10	10	3	23	High
English ivy	*Hedera helix*	10	10	6	26	High
Himalayan blackberry	*Rubus armeniacus*	10	10	6	26	High
crofton weed	*Ageratina adenophora*	6	6	6	18	Medium
black mustard	*Brassica nigra*	6	6	6	18	Medium
Italian thistle	*Carduus pycnocephalus*	6	6	6	18	Medium
bull thistle	*Cirsium vulgare*	6	6	6	18	Medium
poison hemlock	*Conium maculatum*	6	6	6	18	Medium
erect veldtgrass	*Ehrharta erecta*	6	6	6	18	Medium
blue gum	*Eucalyptus globulus*	6	6	6	18	Medium
common mullein	*Verbascum thapsus*	3	6	10	19	Medium
periwinkle	*Vinca major*	6	6	6	18	Medium
plume acacia	*Albizia lophantha*	3	1	10	14	Low
foxglove	*Digitalis purpurea*	3	6	3	12	Low
pride of Madeira	*Echium candicans*	3	6	6	15	Low
yellowflag iris	*Iris pseudacorus*	6	6	3	15	Low
Bermuda buttercup	*Oxalis pes-caprae*	6	6	3	15	Low
kikuyu grass	*Pennisetum clandestinum*	3	3	6	12	Low
Harding grass	*Phalaris aquatica*	6	6	3	15	Low
wild radish	*Raphanus sativus*	3	3	6	12	Low
cutleaf fireweed	*Senecio glomeratus*	3	6	6	15	Low
milk thistle	*Silybum marianum*	3	3	6	12	Low

4.1.2 Site Prioritization

Site prioritization ranks populations for control based on their location. Specific sites have been prioritized for control, even if the weed species in those locations have a low ranking or if the species is widespread on site. Weed species that have a low priority rank may be high priority for treatment if they are isolated occurrences or are in close proximity to resources of high conservation value.

Sites that have been prioritized for control include:

- Sites containing significant biological resources as detailed in Section 2.2 (special-status plant habitat, special-status wildlife habitat, high priority vegetation types, and wetlands and aquatic features).
- Dispersal corridors such as roads, trails, watercourses, and areas where cattle congregate.
- Entry points for weeds including boundaries with private property that contain infestations.
- Areas with low numbers of weeds including the Panoche, Seneca, Ridge, Corona, Malpaso, and South Management Units.
- Small outlier populations.

4.1.3 WEED POPULATION PRIORITIZATION

Overview

WHIPPET (Weed Heuristics: Invasive Population Prioritization for Eradication Tool) was developed as a population-level prioritization tool for land managers to identify areas for prioritizing weed eradication or management (Darin et al. 2010). WHIPPET is a science-based, transparent, analytical ranking tool to prioritize weed populations for management instead of weed species. WHIPPET uses a blended prioritization based on both species attributes and individual population and site parameters to rank populations. Targeting eradication for high-scoring populations thus directs efforts to populations with the greatest potential to cause negative impacts, spread rapidly, and with the highest feasibility of eradication.

The criteria used by WHIPPET to rank populations are divided into three major criteria with sub-criteria. The criteria and subcriteria were scored and weighted in Excel along with custom ArcGIS geoprocessing tools.

The three major criteria and sub-criteria are:

1) Impact
    a. Impact to Wildlands
    b. Regional Site Value
2) Invasiveness
    a. Distance to Conspecific Populations
    b. Rate of Spread
    c. Distance to Dispersal Vector
3) Feasibility of Eradication.
    a. Population Size
    b. Reproductive Ability
    c. Detectibility
    d. Accessibility
    e. Control Effectiveness

Methodology

Criteria and subcriteria values were entered into WHIPPET. The Impact to Wildlands, Rate of Spread, Reproductive Ability, Detectibility, and Control Effectiveness values were assigned using species specific scores as provided by Cal-IPC. The Regional Site Value score was assigned by dividing PCRP into a grid of 136 cells with each cell measuring approximately 1500 x 1500 square feet (with the exception of cells

on the PCRP boundary, which were smaller fragments). A value was assigned to each grid cell based on the number of biological resources present in the cell. Distance to Conspecific was generated in ArcGIS using the custom geoprocessing tools to measure the distance from a weed population to the nearest population of the same species. Distance to Dispersal Vector value was generated in ArcGIS using the custom geoprocessing tools to measure the distance to roads and streams which are dispersal vectors. Population Size values were assigned using the custom geoprocessing tools based on the gross area of the population as estimated during weed mapping field work and included in the ArcGIS attribute table. Accessibility values were assigned to each species based on knowledge of the site and whether in general populations of the species were accessible based on proximity to roads and steepness of slopes.

The results of the WHIPPET analysis were used to further direct prioritization of individual populations for treatment.

4.2. MANAGEMENT PRIORITY RECOMMENDATIONS

Below are recommendations for control of specific weed species and control of specific populations based on the results of weed species prioritization, site prioritization, and the WHIPPET analysis (Table 10). These recommendations were divided into Priority 1, 2, and 3:

- Priority 1 – populations that are highest priority for control.
- Priority 2 – second priority for control
- Priority 3 – third priority for control.
- Monitoring – populations that should be monitored but not controlled at this time.

Maps depicting these populations identified for control are included in Figures 8, 9, and 10. Monitoring protocols and timing are detailed in Section 6.

4.2.1 MANAGEMENT OBJECTIVES

Management objectives include containment, eradication, exclusion, management, and surveillance. These terms are defined below and in the Glossary in Section 1.5.

Containment – A management objective that entails limiting the spread from existing infestations and to restrict a species or population to a specific area.

Eradication – A management objective that entails complete removal of all infestations in the area.

Exclusion – A management objective that includes identifying areas that are relatively weed free or free of specific weed species. The goal is to maintain the absence of weeds or a specific weed species in these locations.

Management – A management objective in which a plant species is the focus of some level of active management. Management may not address all populations of the plant. Management may result in stabilizing or reducing the overall abundance of the plant, or the plant may still be spreading overall.

Surveillance – A management objective that entails regular surveys to detect new infestations of species not known to be present in an area.

Table 10. Priority Weed Populations for Management

Priority for Management	Common Name	Species Priority Rank	Weed Management Objective[1]	Notes
1	French broom *Genista monspessulana*	High	Containment. Treat isolated populations and any individuals that are crossing the containment line.	Remove isolated populations in Panoche, Seneca, Corona, Ridge, and Malpaso MUs. Remove isolated populations at Corona Rd entrance that are encroaching into scrub habitat occupied by Hooker's manzanita. Contain larger populations that are by road. Contain existing populations by treating any individuals that cross containment lines as shown on map.
1	silverleaf cotoneaster *Cotoneaster pannosa*	High	Eradication. Treat all individuals in PCRP.	Ten of the eleven occurrences occurred near each other in the Seneca MU. Species is spreading in woodland and scrub habitat. Smith's blue butterfly habitat is in the vicinity.
1	English ivy *Hedera helix*	High	Eradication. Treat the 1 detected individual. Survey immediate area for additional individuals.	Only 1 location detected in PCRP, in redwood forest in Campground MU. Small population.
1	Himalayan blackberry *Rubus armeniacus*	High	Eradication. Treat the 1 detected individual. Survey upstream and downstream for additional individuals.	Only 1 location detected in PCRP, detected near Seneca Creek in Seneca MU.
1	Cape ivy *Delairea odorata*	High	Eradication. Treat all individuals in PCRP.	All previously mapped occurrences were field checked and it was only present in 2 locations, both in the South Front Unit near the Monastery. The population along San Jose Creek Canyon Road has been controlled in the past. The other population is in a road side stand of willows along the side of Highway 1.
1	fennel *Foeniculum vulgare*	High	Eradication. Treat all individuals in PCRP.	2 occurrences in South Front MU. Several occurrences north of PCRP outside of the park.

Priority for Management	Common Name	Species Priority Rank	Weed Management Objective[1]	Notes
1	tocalote *Centaurea melitensis*	High	Eradication. Treat all individuals in PCRP.	7 locations detected in PCRP, scattered in the Corona, East San Jose, Malpaso, and Ridge MU's consisting of small populations. May be more widespread in Park due to difficulty in detection.
1	jubata grass *Cortaderia jubata*	High	Eradication or Management. Treat all individuals in PCRP as feasible. Some occurrences are very difficult to access.	37 locations mapped in PCRP, all consisting of just a few individuals. Control all accessible individuals in PCRP.
1	yellowflag iris *Iris pseudacorus*	Low	Management. Reduce cover in Animas Pond to protect habitat. Remove isolated population.	1 population at Animas Pond comprised of 4 discrete patches. 1 population of scatted plants was near San Jose Creek in West San Jose MU.
2	bull thistle *Cirsium vulgare* Italian thistle *Carduus pycnocephalus* milk thistle *Silybum marianum*	Medium Medium Low	Management and Containment. Reduce number of thistles in Front Country. Prevent spread along roads and cattle travel routes.	Continue treatment of thistles in Front Country with herbicide application. Control along roads and at cattle congregation areas including corral, water troughs, and at boundary of Corona and Malpaso MUs at fence line.
2	French broom *Genista monspessulana*	High	Management. Prevent from spreading and control at ponds for habitat.	Continue treatment of previously mowed areas. Treat previously mowed areas with herbicide. Control population at Salamander Pond and Roadrunner Pond inside fence to improve habitat for salamander. Control isolated populations in the Front Country in the South Front, North Front, Middle, Bluff, and Inspiration MUs. French broom is not widespread throughout these areas.
2	poison hemlock *Conium maculatum*	Medium	Containment and Management. Control isolated populations in back country. Prevent from spreading along roads.	Control populations in southwest portion of Malpaso MU. Control along roads to prevent spread and mow when spread is least likely (before seed sets).
2	Harding grass *Phalaris aquatica*	Low	Containment and Management. Prevent from spreading along roads.	Control isolated populations in southern portion of PCRP. Control along roads to prevent spread and mow when spread is least likely (before seed sets).

Priority for Management	Common Name	Species Priority Rank	Weed Management Objective[1]	Notes
2	cutleaf fireweed *Senecio glomeratus*	Low	Containment. Reduce size of infestations and prevent spread along roads.	Control all 19 populations which are in Front Country and all along roads to prevent spread along roads into interior of PCRP.
3	periwinkle *Vinca major*	Medium	Eradication. Control single population in PCRP.	1 population detected in PCRP, the West San Jose MU.
3	erect veldtgrass *Ehrharta erecta*	Medium	Eradication. Control all individuals in PCRP.	2 locations detected in PCRP. 1 occurrence was in Corrals MU right at entrance to PCRP. Control to prevent spread onto PCRP. Other location was on private property near Corona Rd entrance. Control to prevent spread onto PCRP
3	kikuyu grass *Pennisetum clandestinum*	Low	Eradication. Control all individuals in PCRP.	4 locations detected in PCRP. One population was in corral area in Front Country. Other occurrence were scattered along Highland Rd in Panoche MU.
3	croftonweed *Ageratina adenophora*	Medium	Containment. Prevent spread downstream and control isolated populations.	Control population along Malpaso Creek to prevent spread downstream. Control isolated individuals in southern portion of PCRP.
Monitoring	foxglove *Digitalis purpurea*	Low	Surveillance. Protect rare plant resources.	Monitor Hutchinson's larkspur (EONDX 60834) along Palo Corona Rd and remove any foxglove individuals in vicinity of population.
Monitoring	hottentot-fig *Carpobrotus edulis*	High	Surveillance. Prevent spread into PCRP.	All 9 occurrence were immediately north of PCRP outside of park boundaries. Monitor boundary to ascertain species does not spread into park.
Monitoring	blue gum *Eucalyptus globulus*	Medium	Surveillance. Prevent spread into PCRP.	In canyon near Monastery. Monitor to be certain population is not spreading up canyon.
Monitoring	plume acacia *Albizia lophantha*	Low	Surveillance. Prevent spread into PCRP.	Both occurrences were at the northern boundary of PCRP. Control as feasible. Monitor to be certain they are not spreading.
Monitoring	pride of Madeira *Echium candicans*	Low	Surveillance. Prevent spread into PCRP.	All 5 occurrence were immediately north of PCRP outside of park boundaries. Monitor boundary to ascertain species does not spread into park.
Monitoring	fennel *Foeniculum vulgare*	High	Surveillance. Prevent spread into PCRP.	3 occurrence were immediately north of PCRP outside of park boundaries. Monitor boundary to ascertain species does not spread into park.

4.2.2 PRIORITY 1 WEED POPULATIONS

French broom is well established on PCRP and will never be eradicated; however it is a high priority for containment to prevent it from becoming well established throughout the entire park. There are several high priority species that have few populations and can likely be successfully eradicated from PCRP if the existing populations are treated before these species spread further. These include silverleaf cotoneaster, English ivy, Himalayan blackberry, Cape ivy, fennel, and tocalote. Yellow flag iris and jubata grass are also high priority for treatment to protect ponds and coastal scrub/chaparral which are high priority vegetation communities.

French Broom (Containment)

The invasive weed of most concern at PCRP is French broom. French broom has a high species priority rank. French broom was the most abundant invasive weed in PCRP with 288 occurrences mapped totaling 237 gross acres. French broom was widespread through the northern and central portions of PCRP where it forms dense monocultures. Broom causes changes in plant community compositions by displacing existing vegetation and decreasing plant diversity (Leonard Charles and Associates 2012). Broom alters availability or quality of nutrients, and physical resources. Brooms grow and spread rapidly, forming tall, dense monospecific stands (Leonard Charles and Associates 2012). On lands owned by the Marin Municipal Water District, broom populations expanded an average rate of three feet per year (Hollander et al. 2009).

Broom plants are prolific seeders producing numerous seeds per plant (DiTomaso and Healy 2007). Seeds are long-lived under field conditions and can survive 30 years or more in the soil (DiTomaso and Healy 2007). Because of this, treatment of broom infestations require several years of follow up to control any seedlings, exhaust the seed bank, and prevent plants from going to seed.

Since 2008, mowing has been conducted as a primary means to control French broom (Petkus 2011). Portions of the Animas, South Animas, South Front, and West San Jose MUs have been mowed. Typically mowing has occurred in the late fall and sometimes late spring (Petkus 2011). As observed during field mapping in June 2013, French broom in these areas is resprouting from cut stumps. In addition, numerous seedlings were present. These mowed areas were still dominated by French broom, the French broom is shorter (approximately 1 foot in height) and flowering and seed set has been prevented.

Because French broom is well established in large portions of PCRP, and covers large acreage, eradication of this species is not feasible. Control should focus on containment, specifically not allowing existing French broom populations to expand in size and preventing the spread of French broom into uninfested areas of PCRP. “Containment lines” have been established for French broom, at the boundary of large existing populations (Figure 8). These boundaries should be monitored regularly and French broom should not be allowed to expand outside of these containment lines. To prevent the spread of French broom into uninfested areas of PCRP, isolated populations should be removed. Numerous isolated populations consisting of few individuals were mapped throughout the Panoche, Seneca, Corona, Ridge, and Malpaso MUs and these are designated Priority 1 for control (Figure 8). Scattered individuals of French broom were observed in otherwise intact chaparral and scrub near the Corona Road entrance and could pose a threat to a population of Hooker’s manzanita.

Silverleaf Cotoneaster (Eradication)

Cotoneaster is an evergreen to semi-evergreen shrub with orange to red, berrylike fruits that are cultivated as landscape ornamentals. Cotoneaster has a high species priority rank. Cotoneaster was limited in distribution with 11 data points recorded totaling 1.43 gross acre. Ten of the eleven occurrences were near each other in the Seneca MU (Figure 9). The other location was in the Panoche MU. Cotoneaster was

present along the margins of coast live oak woodland, scrub, and in grassland and was observed to be spreading into the adjacent woodland and scrub habitat. Mapped Smith's blue butterfly habitat is in the vicinity. Control of these populations has the potential to eradicate cotoneaster from PCRP.

English Ivy (Eradication)

English ivy is a vigorous woody perennial that is a common landscape ornamental. English ivy grows over the natural vegetation in an area, including the trees, and eventually kills most resident plants by shading them out with its dense canopy of foliage. English ivy has a high species priority rank. English ivy was very limited in distribution with only one occurrence in PCRP in the Lower San Jose MU in the understory of redwood forest, which is a high priority vegetation community (Figure 9). It was present along a tributary to San Jose Creek just upstream of the confluence and could spread downstream if it becomes established. The one occurrence is high priority for treatment to prevent it from becoming established and eradicate English ivy from PCRP.

Himalayan Blackberry (Eradication)

Himalayan blackberry is a mounded, climbing, and trailing shrub and inhabits disturbed moist open sites, roadsides, fencerows, fields, canal and ditch banks, and riparian areas. Himalayan blackberry has a high species priority rank. Himalayan blackberry was limited in distribution in PCRP with only one occurrence mapped in the Seneca MU (Figure 9). The occurrence was adjacent to Seneca Creek near the intersection of Palo Corona Road and Palo Corona Connector. The single occurrence was in the understory of redwood forest adjacent to a creek. Himalayan blackberry could spread downstream and become established along the creek in redwood forest. The single occurrence is considered a high priority for control to eradicate Himalayan blackberry from PCRP before it becomes well established.

Cape Ivy (Eradication)

Cape ivy is a vigorous perennial vine that can invade various plant communities but it is especially noxious in coastal riparian areas. Cape ivy has a high species priority rank. Cape ivy was identified as high priority for eradication in the PCRP Grassland Management Plan (McGraw 2007). Cape ivy was observed only in 2 locations, both in the South Front Unit near the Monastery (Figure 9). One population was along San Jose Creek Canyon Road in the willow riparian corridor along San Jose Creek. This population has been treated in the past and consists of remnant resprouting stems. The other population was in a stand of willows along with other weedy vegetation adjacent to Highway 1 near the entrance to the Carmelite Monastery. Cape ivy was previously recorded along the Carmel River and in Monastery Canyon but was not observed in these locations during surveys. According to the Palo Corona Ranch Management Plan, previous control efforts have focused on removal and spraying of the Carmel River and Highway 1 populations, but not in Monastery Canyon (Overtree 2001). Cape ivy has the potential to impact riparian vegetation along San Jose Creek. It could spread downstream. Both occurrences are high priority for treatment. Due to its limited distribution, Cape ivy has the potential to be eradicated from PCRP.

Fennel (Eradication)

Fennel is a perennial. Established plants are competitive and soil disturbance facilitates the development of dense stands, which can exclude native vegetation in some areas. Fennel has a high species priority rank. Fennel was limited in distribution with 5 occurrences totaling 0.03 gross acre, 3 of which were off site in the field north of PCRP and 2 in the South Front MU (Figure 9). Fennel was associated with grassland. The 2 occurrences in PCRP are high priority for treatment to eradicate this species from PCRP.

Tocalote (Eradication)

Tocalote is an annual and occasionally a biennial. Tocalote has a high species priority rank. There were 7 locations of tocalote detected in PCRP totaling 0.02 gross acre. It was scattered in the Corona, East San

Jose, Malpaso, and Ridge MU's (Figure 9). All populations were fairly small. However, this species may be more widespread in the park due to difficulty in detection. It was observed growing in grassland on the margin of coastal scrub habitat. Tocalote populations are high priority for control because they have only a few populations and can be successfully eradicated from PCRP.

Yellow Flag Iris (Eradication)
Yellowflag iris has a low species priority rank. Yellow flag iris was detected in only two locations at PCRP (Figure 9). One location was Animas Pond which is included in the Safe Harbor Agreement for PCRP as habitat for California Red-Legged Frog (MPRPD and USFWS 2011) (Figure 7). Yellowflag iris has been treated at Animal Pond by hand removal (McGraw 2007). The second population of scatted plants was present near San Jose Creek and could spread downstream. The two populations are high priority for treatment due to its threat to sensitive resources. Yellow flag iris was identified as high priority for eradication in the PCRP Grassland Management Plan (McGraw 2007).

Yellow flag iris is difficult to treat. On October 20, 2006, the U.S. District Court for the Northern District of California imposed a stipulated injunction and order which imposed no-use buffer zones around California red-legged frog upland and aquatic habitats for certain pesticides including glyphosate and triclopyr. Because Animas Pond is habitat for red-legged frog, pesticide cannot be used to control yellowflag iris. Mechanical removal is not considered effective since it may cause extensive disturbance that facilitates the establishment of other weedy plants. Nevertheless, physical and mechanical methods should be tried on an experimental scale prior to a large scale removal project. It is necessary to remove the entire plant and rhizome system.

Jubata Grass (Eradication)
Jubata grass invades coastal scrub and chaparral plant communities. Jubata grass is a very invasive species; mature plants are highly competitive with native vegetation. Any soil disturbance that creates bare ground, including natural disturbances such as landslides and human-caused disturbance, promotes invasion by jubata grass (DiTomaso et al. 2013). Jubata grass reproduces by seed. Seeds can disperse long distance with wind (to about 30 km) and human activities (DiTomaso and Healy 2007). Each seed bearing plume can produce up to 100,000 seeds (DiTomaso and Healy 2007). Jubata grass has a high species priority rank.
Jubata grass was mapped at 37 locations throughout PCRP, the majority of the populations consisted of just a few individuals (Figure 9). It was present in the Animas, Lower San Jose, Malpaso, Panoche, Risge, South Animas, South Front, West Animas, and West San Jose MUs. According to the Palo Corona Ranch Management Plan, previous management has included cutting and spraying jubata grass in a subset of known locations (Overtree 2001).

Jubata grass is high priority for control due to its invasiveness. Because jubata grass has the potential to invade large areas of PCRP, and this species is still fairly limited in distribution in the park, this species should be controlled to the extent feasible. Many of the occurrences are on extremely steep slopes that preclude access making treatment difficult. Jubata grass has been controlled on steep slopes in Point Reyes National Seashore using ropes and rappelling techniques, to rappel over cliffs wearing backpack sprayers (IWAC 2006).

4.2.3 PRIORITY 2 WEED POPULATIONS

Bull Thistle, Italian Thistle, and Milk Thistle (Management and Containment)
Bull thistle, Italian thistle, and milk thistle are widespread in PCRP. Bull thistle and Italian thistle have a medium species priority rank and milk thistle has a low species priority rank. They have been treated in the Front Country in prior years via application of preemergent herbicide in late winter (Greg Nowell pers. com. 2013). Control of these species should focus on the Front Country since these areas have been

treated previously with successful results. In addition, the Front Country is the area of the park that park users visit and has the most public exposure. Control of thistles in the Front Country will reduce the likelihood of them being spread to other areas of the park via cattle.

These thistle species were also observed in the back country in lower abundance along roads and at areas where cattle congregate including water troughs and fence lines. Control of these isolated locations will prevent these thistles from being spread throughout the park on vehicles and via cattle.

French Broom (Management)

In addition to the Priority 1 weed management objectives for French broom above, other populations are designated Priority 2 for control. If control of the Priority 1 French Broom populations is determined to be successful based on monitoring and follow-up, and budget is available, we recommend moving on to treatment of Priority 2 populations. The previously mowed areas in Animas, South Animas, South Front, and West San Jose MUs were resprouting and were still dominated by French broom. Control of French broom in these areas will require follow up with herbicide and follow up restoration since French broom is overwhelmingly dominant. Because these areas are located in the densest areas of French broom and new French broom populations are becoming established in more remote areas of the park, continued treatment of these areas is lower priority.

The populations at Salamander Pond and Roadrunner Pond should be treated inside the fences to improve habitat for California Tiger Salamander (Figure 10). These are dense monocultures of French broom and that are surrounded by large infestations of French broom, so maintaining these areas free of French broom will require continued long term follow-up to control new seedlings sprouting from the existing seed bank and from neighboring populations spreading seed.

There are several isolated populations in the Front Country in the South Front, North Front, Middle, Bluff, and Inspiration MUs (Figure 10). These areas are lower priority than treating those in the southern MUS of PCRP because these are considered High Quality Habitat. However, treating isolated populations in the Front Country will prevent French Broom from becoming more widespread in these areas as well.

Poison Hemlock and Harding Grass (Containment and Management)

There were several isolated populations in the southern portion of PCRP (Figure 10). Poison hemlock has a medium species priority rank and Harding grass has a low species priority rank Scattered individuals of poison hemlock were present in high quality coastal scrub habitat in the Malpaso MU. Isolated populations of Harding grass were present in the southern portion of PCRP. These should be treated to avoid these species from becoming more widespread in the back country.

Poison hemlock and Harding grass were observed along roadsides and are likely being spread by mowers, road equipment, and vehicles. These species should be treated along roadsides to prevent spread. Mowing of roadsides should occur before seed has set to prevent spread of viable seed.

Cutleaf Fireweed (Containment)

Cutleaf fireweed was present primarily along the main access road in the Front Country in the Inspiration and Animas MUs, with a few scattered populations in other locations in the Front Country. Cutleaf fireweed has a low species priority rank. The populations along the road should be controlled to prevent it from becoming spread throughout the park. These populations were slightly off the road in scrub habitat.

4.2.4 PRIORITY 3 WEED POPULATIONS

Periwinkle (Eradication)

Periwinkle is an herbaceous perennial. This species inhabits riparian sites, old homesteads, moist woodlands, and roadsides. Periwinkle has a medium species priority rank. Periwinkle reproduces vegetatively from trailing stems that root at the tips and stem fragments and rarely by seed. Periwinkle

was limited in distribution with only one occurrence present. It was in the West San Jose MU along Cypress Road near the boundary of PCRP at the margin of redwood forest adjacent to coastal scrub. Because this patch will likely grow larger but not spread, it can be controlled when feasible. Due to its large size, it will require mechanical removal and follow-up.

Erect Veltgrass (Eradication)

Erect veldtgrass is an erect to decumbent perennial grass that inhabits disturbed moist places, urban areas, turf, wetlands, and possibly other moist natural communities. Erect veldtgrass has a medium species priority rank. Erect veldtgrass reproduces primarily by seed. Erect veldtgrass was observed only in 2 locations. It was in the Corrals MU and just offsite at the Corona Rd entrance to the park. Controlling these two occurrences could prevent the species from becoming established in PCRP. The offsite populations should be monitored to ascertain they are not spreading onto PCRP.

Kikuyu Grass (Eradication)

Kikuyu grass is a tough low-growing perennial grass that reproduces primarily by creeping rhizomes and stolons. Kikuyu grass has a low species priority rank. There were 4 locations of kikuyu grass detected in PCRP. One population is in the corral area in the Front Country in the Corrals MU. The other occurrence are scattered along Highland Road in the Panoche MU. All locations were in grassland vegetation adjacent to a road. Because these have a low priority rank they are lower priority for control. It has shown to be most commonly spread by mowing, cultivation, and renovation equipment so implementing Best Managment Practices will control the spread.

Crofton Weed (Containment)

Crofton weed is an escaped perennial that is especially invasive in mild coastal regions where it inhabits disturbed places in canyons and riparian corridors. Crofton weed has a medium species priority rank Twenty-four occurrences of crofton weed were mapped totaling 5.31 gross acres. Crofton weed was present in the Animas, Malpaso, Panoche, and West Animas MUs and offsite at the Monastery.

Crofton weed was generally located in extremely steep ravines in grassland habitat. It was also present in redwood forest, in grassland adjacent to riparian habitat, and chaparral. Crofton weed was present in Malpaso Creek and could spread downstream. It should be controlled to prevent spread downstream.

4.2.5 OTHER POPULATIONS FOR CONTROL

In addition to the specific populations outlined in Table 10 and discussed above, new weed populations not present or detected at the time of the survey may be detected in the future. Numerous additional populations of a species designated for eradication may mean eradication is not feasible and will reduce the population priority. Any new species detected during future surveys may be prioritized for control. The protocol for Early Detection Rapid Assessment detailed in Section 6.3 is designed to detect and respond to new invaders.

Section 5. TREATMENT AND PREVENTION PLAN

This section includes details on how to treat weed species mapped in the park and prioritized for management in Section 4. The weed management plan uses an Adaptive Management Approach, whereby clear goals and rationale are established before any action is taken and any weed treatment is begun. The decision of which high priority populations to treat will be based on available funding, timing, and ability to make long term commitment. Once a weed control project is begun, the commitment must be made to conduct follow up monitoring and treatment to ensure success. Sporadic treatment or treatment that is not followed up by monitoring in subsequent years is a poor way to use limited resources. Weed management objectives and follow-up monitoring for each of the Priority 1 species and populations is detailed in Section 6.

The most effective types of control are prevention and early detection (Randall and Hoshovsky 2000). Best Management Practices (BMPs) are practices designed to prevent the accidental spread of invasive weeds. Section 5.4 contains BMPS that should be implemented at PCRP.

5.1. CONTROL METHODS

Management of target species will include mechanical and chemical methods and will be species specific. Each of these methods has advantages and disadvantages and often the best approach is to use a combination of methods. Table 11 summarizes control timing and survey timing for each species mapped in PCRP. Table 12 details control methods and timing for each species mapped in PCRP.

5.1.1 MECHANICAL CONTROL

Mechanical control techniques either remove the entire plant or physically damage shoots, roots, or root crowns of plants to the point where they can no longer survive. Mechanical methods include hand-pulling, hoeing, string trimming, tilling, mowing, cutting, lopping, grubbing, chainsawing, shredding, and removing plants with heavy equipment such as backhoes or bulldozers. These techniques can be disruptive to the soil and create disturbed sites prone to invasion by other species. Manual removing (handpulling, hoeing, cutting, string trimming etc.) is most suitable for small populations or for follow-up control where only a few plants remain after previous treatment.

5.1.2 CULTURAL CONTROL

Cultural control methods include fire, grazing, or revegetation efforts including mulching. The type of grazer, grazing intensity, and stocking rates all impact the effectiveness of grazing. Prescribed burns can be used to control invasive plants, specifically by depleting the soil seedbank or destroying reproductive structures. Reestablishment of desirable, competitive plant species can suppress weeds or inhibit invasive weeds from becoming established.

5.1.3 CHEMICAL CONTROL

Chemical control is the use of herbicides. Herbicides are the most widely used method for controlling weeds (DiTomaso et al. 2013). The potential risks associated with herbicide use are widely publicized in the scientific literature and public press. Risks include spray and vapor drift which can injure susceptible crops, ornamentals, or non-target native species. Surface water contamination can occur when herbicides are applied into ditches or other bodies of water.

Herbicides should be used only in situations where the benefits of controlling weeds outweigh overall risks of using herbicides and other methods are likely to not be effective. Herbicide use guidelines and safety practices should be followed (Appendix F).

It is critical to be familiar with the label before applying a pesticide. Labels are approved by the Environmental Protection Agency and contain critical information on application rates and requirements, pesticide handling and environmental safety information, protective clothing and equipment, cleaning instructions and other information. It is important to minimize exposure to pesticides during and after application.

Summary of Herbicides

Aminopyralid

Aminopyralid is a selective, pre- and postemergent herbicide registered under several trade names including Milestone and Milestone VM, Capstone, Forefront HL, PasturAll HL, Opensight, and Chaparral (DiTomaso et al. 2013). It provides control of broadleaf species, but particularly members of the Asteraceace (sunflower family) and Fabaceae (legume family). It can also control certain species in other families including the Apiaceae (carrot family), Solanaceae (nightshade family), and Poylygonaceae (knotweed family). It is a water soluble formulation and is used in rangelands, non-irrigation ditch banks, natural areas and wildlands, non-crop areas, rights-of-way, and grazed areas, among others. It is applied both pre- and postemergence to weeds. It has an average half-life of about 35 days and has limited potential for leaching into ground water. For annuals, it is best to apply in seedling stage as this will provide both postemergence and preemergence activity. For perennials, plants should be fully expanded to ensure movement to underground vegetative parts. In some perennials, fall application to dried material gives good control of new bud growth. Aminopyralid is readily translocated in the phloem and accumulates at below and above ground growing points or storage organs. It can be used up to water's edge and has no grazing restrictions. Treated plant residue should not be used as mulch, in compost, or as a fertilizer source since the herbicide degrades slowly in cut material (DiTomaso et al. 2013).

Chlorosulfuron

Chlorosulfuron is a broad spectrum, pre- and postemergence herbicide under several trade names including Telar, Landmark, Perspective, Cimarron X-tra and Cimarron Plus (DiTomaso et al. 2013). It provides control for many broadleaf and grass species, both annual and perennial, but is best on broadleaf species. It is a dry, flowable concentrate used in pasture, range, and non-crop industrial sites. It has an average soil half-life ranging between 28 to 42 days depending on soil characteristics, moisture, and temperature. Best results are achieved when weeds are treated in the bud to bloom or fall rosette stage. Chlorosulfuron is readily translocated in the xylem, as well as the phloem. Telar can be used near water, but cannot be applied to water (DiTomaso et al. 2013).

Clopyralid

Clopyralid is a selective, both pre- and postemergence herbicide under several trade names including Transline and Reclaim, Curtail, Confront, and WideMatch (DiTomaso et al. 2013). It provides control for broadleaf species, particularly members of the Asteraceae (sunflower family) and Fabaceae (legume family). It is a water soluble concentrate and is used in non-crop areas, industrial manufacturing and storage sites, rights-of-way, wildlands, rangelands, tree plantations, and grass pastures. It has an average soil half life of 40 days but ranges between 12 and 70 days, depending on soil characteristics, moisture, and temperature. Best results are achieved when treating annuals in the seedling stage as this will provide both postemergence and preemergence activity. In perennials, treat plants when they are fully expanded to ensure movement to underground vegetative parts. Clopyralid readily translocates in the phloem and accumulates at below and above ground growing points or storage organs. Clopyralid cannot be applied

near water but has no grazing restrictions. Treated plant residue should not be used as mulch for vegetable crops. Clippings from treated areas should not be used as compost; this herbicide degrades slowly in compost and can be a problem when treated plants are used as mulch or fertilize source in sensitive crops or landscapes (DiTomaso et al. 2013).

Glyphosate

Glyphosate is a broad spectrum, postemergent herbicide registered under several trade names including Roundup, Roundup ProMax, Rodeo, Accord XT, and Aquamaster, among others (DiTomaso et al. 2013). It provides broad spectrum control of annual and perennial grasses and broadleaf species, as well as many woody species. It is a water soluble formulation and is used in rights-of-way, non-crop areas, riparian areas, emerged aquatic vegetation, forests, rangelands, and other wildland areas. It is applied postemergence via spray, wick, cut stump, and stem injection. Although glyphosate has an average half – life of 47 days, it has no soil activity and is not biologically available to microbes or plants due to its high absorptive capacity on most soils. It has a very low risk of movement into water due to high adsorption to soil particles. Results are best when treating rapidly growing plants, particularly seedlings in annuals. In perennials, treat plants later in the season when sugars are translocating to underground reproductive structures. For woody species, late summer or fall applications are best when using cut stump or stem injection treatments. Glyphosate is translocated in the phloem and accumulates at above and below ground growing points and storage areas. Glyphosate can damage non-target species due to its non-selective nature. Both aquatic and terrestrial versions are available (DiTomaso et al. 2013).

Triclopyr

Triclopyr is a selective, postemergent herbicide registered under several trade names including Garlon 3A, Garlon 4 Ultra, RemedyUltra, and Pathfinder II, among others (DiTomaso et al. 2013). It provides control for woody and herbaceous broadleaf species. It is a water soluble or emulsifiable concentrate and is used in utility areas, rights-of-way, rangelands, forests, natural areas, aquatic, and riparian areas. It is applied postemergence via cut stump, stem injection, and basal bark. Aquatic formulations can be applied to emergent vegetation or directly to water. It has an average soil half-life of 30 days, but ranges between 10 and 46 days, depending on soil characteristics, moisture, and temperature. Best results are achieved when treating rapidly growing plants, particularly seedlings in annuals. Perennials plants should be treated later in the season when sugars are translocating to underground reproductive structures. For woody species, late summer or fall applications are best when using cut stump, stem injection, and basal bark treatments. Triclopyr is readily translocated in the phloem and accumulates at below and above ground growing points or storage organs (DiTomaso et al. 2013).

5.2. CONTROL TIMING

Timing of treatment is critical for efficient control. The timing of germination, flowering, and seed set dictates when treatments should be applied to result in effective control. For example, mowing too early can increase vigor of some plants that will resprout and produce more flower heads. Treating with herbicide at the wrong time will not result in control. Tables 11 and 12 shows the weed species mapped and the ideal time for control. Table 13 shows the annual phenology for each weed species.

Once a site is treated, the site should be revisited later in the season to verify that treatment was successful. Perennial species and woody trees and shrubs can resprout from roots. Annual species can germinate after treatment, depending on the treatment, and flower and produce seeds. For many species, depleting the seed bank in the soil is essential. Follow-up monitoring is detailed in Section 6.

Table 11. Summary of Control and Survey Timing

Scientific Name	Common Name	Life Form	Winter[18] (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sep-Nov)
Ageratina adenophora	crofton weed	perennial		M**S**	C**S**	C
Albizia lophantha	plume acacia	shrub or tree		MC**S**	MC**S**	MC
Brassica nigra	black mustard	annual herb	C	C**S**	**S**	M
Carduus pycnocephalus	Italian thistle	annual, sometimes biennial	MC	MC**S**	M**S**	
Carpobrotus edulis	hottentot-fig	a mat-forming or trailing shrub	**S**	MC**S**	MC**S**	M**S**
Centaurea melitensis	tocalote	annual, occasionally a biennial	C	C**S**	M**S**	M
Cirsium vulgare	bull thistle	biennial, sometimes annual or short-lived perennial	C	MC	C**S**	C**S**
Conium maculatum	poison hemlock	biennial, sometimes annual or short-lived perennial		MC**S**	C**S**	
Cortaderia jubata	jubata grass	tufted perennial grass	**S**	M	C	**S**C
Cotoneaster pannosa	silverleaf cotoneaster	evergreen to semi-evergreen shrub		M**S**	MC**S**	MC
Delairea odorata	cape ivy	perennial vine	M**S**	M**S**	MC	MC**S**
Digitalis purpurea	foxglove	biennial or short-lived perennial	M	M**S**	M**S**	
Echium candicans	pride of Madeira	shrub		MC**S**	MC	
Ehrharta erecta	erect veldtgrass	perennial grass		MC**S**	MC**S**	
Eucalyptus globulus	blue gum	tree	**S**	**S**	C**S**	C**S**
Foeniculum vulgare	fennel	perennial	MC	MC**S**	MC**S**	**S**
Genista monspessulana	French broom	evergreen shrub		MC**S**	MC**S**	M
Hedera helix	English ivy	shrub	**S**	MC	M**S**	M**S**

[18] M=Mechanical Control, C=Chemical Control, **S**=Survey

Scientific Name	Common Name	Life Form	Winter[18] (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sep-Nov)
Iris pseudacorus	yellowflag iris	perennial		C**S**	**S**	MC
Oxalis pes-caprae	Bermuda buttercup	perennial	M**S**	MC**S**	M	M
Pennisetum clandestinum	kikuyu grass	perennial	M	MC**S**	MC**S**	
Phalaris aquatica	Harding grass	perennial		C**S**	**S**	C**S**
Raphanus sativus	wild radish	biennial	M	C**S**	M**S**	
Rubus armeniacus	Himalayan blackberry	mounded, climbing, and trailing shrub		C**S**	MC**S**	MC
Senecio glomeratus	cutleaf fireweed	annual to short-live perennial		MC**S**	MC**S**	M
Silybum marianum	milk thistle	annual or biennial		MC**S**	MC**S**	C
Verbascum thapsus	common mullein	biennial	M	C	M**S**	M**S**
Vinca major	periwinkle	perennial	M**S**	C**S**	M**S**	C**S**

Table 12. Detailed Control Methods and Control Timing

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
Ageratina adenophora crofton weed perennial	Mechanical: Remove small infestations (spring) before flowering. When digging out plants, remove the crown and short rootstock to prevent the growth of new shoots. Cutting a plant may not control it, but over time it will reduce the seed bank and reduce the population. However, plants often grow on steep slopes making hand removal difficult. Cultural: Although generally unpalatable to cattle, goats are known to eat croftonweed. Because of its toxic nature, the same group of goats should be used for only one or two seasons to avoid risk of chronic health problems. Success depends on stocking rate, weed density, and availability of other feed at the site Chemical: Glyphosate (75 ml/15 L) for backpack sprayer, high volume foliar spray. 75 ml/15 L at rate of 0.5% *Roundup ProMax Concentrate* for spot treatment postemergence to fully developed leaves, generally in late summer or autumn when weed is growing actively. Spray to wet.		Manual removal of seedlings	Chemical application	Chemical application
Albizia lophantha plume acacia shrub or tree	Manual: Hand pull or dig small plants (all year round). Ensure minimum soil disturbance. Chemical: Cut and squirt method: Make 1 cut every 100 mm around the trunk and saturate each cut with 5 ml undiluted triclopyr 600 EC (5ml). Injection method: drill holes sloping into the sapwood at regular intervals around the tree. As each hole is drilled saturate with glyphosate (250ml/L) or triclopyr 600EC (10ml undiluted). Spray method (spring-summer): glyphosate (10ml/L) or triclopyr 600 EC (30ml/10L)".		Manual removal of seedlings Spray chemical	Manual removal of seedlings Spray chemical application	Manual removal of seedlings Inject/cut method chemical application
Brassica nigra black mustard annual herb	Mechanical: Plants can be hand pulled before they produce seed. Yearly removal of plants before seeds mature can eventually deplete the seedbank. Cultural: Plants are readily eaten by livestock. Prescribed Burning: Burning and other kinds of disturbance usually favor the increase of mustard species. Chemical: Chlorosulfuron preemergent or early postemergence when weeds are germinating or actively growing. Triclopyr postemergence when weeds are small and rapidly growing.	Chemical application preemergence	Chemical application applied seedlings to mid rosette stage plants		Manual removal
Carduus pycnocephalus subsp. *pycnocephalus* Italian thistle	Mechanical: Mechanical methods can be utilized when this species is small. To control by cutting, use a sharpened shovel at the top of the root crown. Grubbing hoes must cut the plants 2 to 4 inches below ground level to prevent resprouting	Manual removal	Manual removal	Mow	

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
winter annual sometimes biennial	from dormant axillary buds. Mowing plant during flowering can greatly reduce seed production, though a single mowing is seldom sufficient due to the wide differences in the maturity of plants in a natural population. For mowing, wait till plants bolt and are about to flower (May to July). This may require repeated visits at weekly intervals over the 4 to 7 week blooming period, because not all plants bloom simultaneously. Plants will regrow if mowed before they are fully bolted. Plants cut 4 days after the first flowers open can produce viable seed. Cultural: Large livestock tend to avoid grazing on thistles, although horse and cattle have been known to eat the flowerheads. Sheep will eat the rosettes. Goats like the flowerheads and are able to digest the seed. In general, thistles compete poorly with healthy established grasses and other vegetation. Establishment of selected, aggressive grasses can be effective cultural Chemical: Aminopyralid preemergence in winter to early spring and postemergence to seedling treatments up to flower bud stage. Clopyralid postemergence in spring, up to the flower bud stage. Triclopyr and glyphosate can be applied postemergence to rapidly growing plants in bud stage. An integrated, long-term plan with persistent follow-up and twice-yearly monitoring is needed to eliminate this thistle.	Chemical application premergence	Chemical application postemergence		
Carpobrotus edulis hottentot-fig mat forming or trailing shrub	Mechanical: Mechanical removal is effective at any time of year. Hottentot-fig and other ice plant species are easily removed by hand pulling. Tear the plants up by the roots. Because the plant can grow roots and shoots from any node, all live plants and stem fragments must be removed from contact with the soil to prevent resprouting. If removal is not possible, mulching with the removed plant material is adequate to prevent most resprouting, but requires at least one follow-up visit to remove resprouts. Prescribed Burning: Burning is not an effective strategy for control of ice plants. While the heat of the fire will kill the seeds, the succulent foliage will not entirely be killed by fire. Grazing is also not recommended. Chemical: Glyphosate applied at a time when the plant is actively growing. The addition of 1% surfactant can increase the effectiveness of the herbicide. Since glyphosate is nonselective, it may be more appropriate to use a shielded sprayer or even a wiper application technique at 50% concentrate of the herbicide.		Manual removal Chemical application	Manual removal Chemical application	Manual removal
Centaurea melitensis tocalote	Mechanical: Mechanical strategies used to control yellow starthistle are likely to control tocalote as well. There are several mechanical methods for dealing with	Chemical application	Chemical application	Manual removal	Manual removal

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
annual, occasionally a biennial	yellow starthistle: hand pulling, hoeing, mowing and tilling. Hand pulling and hoeing are effective only on small infestations as they are labor intensive and time consuming making these two methods uneconomical for large infestations The mowing must be timed to coincide with the early flowering stage when 2 to 5 percent of the total population is in bloom. Mowing too early will increase the yellow starthistle problem by removing competing vegetation and promoting vigorous yellow starthistle growth. Mowing too late can spread seeds. Mowing is more successful if the plants are erect with a high branching growth form. Plants with a low branching growth form can not be controlled with mowing. The mowing must be repeated at least twice in a year Regardless of timing or branching form, mowing will result in some seed being produced. Cultural: Intensive grazing might be effective in reducing the amount of seed produced in an infestation. Timing of the grazing treatment for greatest effectiveness would be very difficult. Tocalote bolts in late spring when other plants are still green and appealing to livestock. The livestock would remove the competing plants while they grazed on the tocalote, possibly reducing the seed supply of the competing plants. Waiting until the associated plants are dry and have dropped their seed would miss the effective window for catching tocalote before seed set and drop. Compounding the problem is tocalote's tendency to produce an early flower head, where the plant would need to be eaten to ground level to prevent seed production. Generally, if plants are being eaten to ground level, the site is being heavily grazed, taking all of the plants to ground level including desirable competitors. If adequate soil moisture exists, the tocalote would likely resprout and need additional treatment. Prescribed Burning: Prescribed burning can be an effective method of tocalote control. Burning must be done in late spring or early summer when the plants have just begun flowering and before seed set. Since burning will actually create favorable growing conditions for tocalote seed in the soil seed bank, burning must be followed by other treatments or burning in the next two years to have an impact on the numbers or size of an infestation Chemical: Aminopyralid applied postemergence or pre-emergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rosette stage. Clopyralid applied postemergence or preemergence, most effective when applied to plants from the seedling to the late-rosette stage before bolting. Glyphosate postemergence from bolting to beginning of flowering. Triclopyr postemergence from seedling to bolting stage.	preemergence	applied seedlings to mid rosette stage plants		

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
Cirsium vulgare bull thistle coarse biennial, sometimes annual or short-lived perennial	Mechanical: Mowing or hand cutting at the soil surface, just before flowering can control bull thistle. However, if cut too soon, the plants can resprout and produce flowers and seed. Flower heads on cut plants can continue to produce viable seed. Cultural: Bull thistle is avoided by grazing animals, probably due to its spines. Overgrazing sites where bull thistle occurs can create bare spots, which are prime habitable sites for bull thistle. Goats and sheep will eat the seedlings, however, sheep may select the other more palatable plants, thereby reducing competition and promoting the bull thistle. Prescribed Burning: Response of bull thistle to prescribed fire hasn't been studied in depth and more research is needed. Chemical: Aminopyralid postemergence in spring to early summer when the target plants are in the rosette to bolting stage or in fall to seedlings. Clopyralid postemergence in spring up to the bud stage. Can also apply to fall regrowth. Results are best if applied to rapidly growing plants. Chlorsulfuron postemergence to young rapidly growing weeds. Triclopyr postemergence to rapidly growing weeds up to bud stage. Autumn or spring application is recommended to control rosettes.	Chemical application preemergence	Manual removal Chemical application	Chemical application	Chemical application
Conium maculatum poison hemlock erect biennial sometimes annual or short lived perennial	Mechanical: Hand removal is recommended for small infestations. When pulling the plants, dig down and remove the entire taproot. Wear gloves and wash hands after working with poison-hemlock. Manual control efforts can be successful, but can cause soil disturbance encouraging further germination of seeds. Solid carpets of hemlock seedlings are not uncommon following soil disturbance. Cutting is ineffective; the plants send up new seed stalk in the same season the cutting occurs. Establishment of populations can be prevented with repeated cultivation and plowing. Cultural: Due to the plant's toxicity, grazing is not recommended for control. Even dried plant parts are not safe as the toxins take several years to dissipate. Do not burn, as toxins can be released into the air through the smoke. Chemical: Triclopyr is best applied during the postemergence in seedling to rosette stage since it is most effective on smaller plants. In warm temperatures, spraying onto hard surfaces such as rocks or pavement can increase the risk of volatilization and off-target damage. Success has also been shown with Glyphosate. Glyphosate is best when applied to postemergence to rapidly growing plants before bolting. However, higher rates can control plants at the bud to full bloom stage. Chlorosulfuron postemergence to rapidly growing		Manual removal Chemical application	Chemical application early summer	

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
	plants but desirable grasses should be well established before application.				
Cortaderia jubata jubata grass tufted perennial grass	Mechanical: Hand-pulling seedlings can help prevent the spread of either species. For removing established clumps, pulaskis, or mattocks shovels are the safest and most effective tools. To prevent resprouting, it is important to remove the entire crown and top section of the roots. Detached plants left lying on the soil surface may take root and reestablish under moist soil conditions. Some land managers recommend turning the removed clumps upside down so the roots dry out in the air. A large chainsaw or weed eater can expose the base of the plant, allow better access for removal of the crown, and make disposal of the detached plant more manageable. Plumes can also be cut off to avoid seed dispersal. However plants that have had plumes removed may develop more plumes during the flowering season. Mechanical removal by heavy equipment, including excavators and backhoes, can be very effective and selective. However, the methods are labor and cost intensive, and feasibility depends upon site accessibility, size of the infestation, funding, and availability of volunteer support. Cultural: Heavily mulching bare sites or planting desirable vegetation may prevent or reduce seedling establishment. Burning or grazing are not typically considered effective control strategies. Any soil disturbance that creates bare ground, including natural disturbance and human caused disturbance, promotes invasion by jubata grass. Chemical: Best in late summer or fall, after flowering, when translocation of herbicide to base of tillers and rhizomes is at its peak. Glyphosate provides a consistent control. Low volume treatment at 8% and wiper application at 33% has shown to give the best and most consistent control.		Manual control	Chemical application late summer	Chemical application early fall
Cotoneaster pannosa silverleaf cotoneaster evergreen to semi-evergreen shrub	Mechanical: Seedlings and small plants can be hand pulled. Manually removing individual shrubs when discovered can help prevent the spread of cotoneaster species in natural areas. However, stumps and roots can resprout necessitating follow-up control. Roots need to be completely removed to prevent resprouting. Cultural: There are no known cultural control strategies developed for any species of cotoneaster Chemical: Triclopyr for treating cut stumps or basal stems in late summer or fall. Glyphosate postemergence later in the season when translocation of carbohydrates in downward towards the below-ground tissues.		Manual removal	Manual removal Apply chemical application late summer	Manual removal Apply chemical application late fall
Delairea odorata	Mechanical: Manual removal of plants, including roots and rhizomes, before	Manual	Manual	Manual	Manual

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
Cape ivy perennial vine	viable seed develops can help control infestations in areas where plants are accessible. Removing all plant material from the site will help prevent rerooting. Follow-up removal of resprouts is essential. In some large patches, all stems can be cut at ground level and Cape-ivy rolled up like a rug, this strategy makes it possible to detect and spot-treat new sprouts while avoiding contact with desirable vegetations. Because Cape-ivy can resprout and establish from stem fragments, mowing is not recommended. Cutting off Cape-ivy before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. All plant parts should be bagged and properly disposed of. Cultural: Grazing and burning are not considered effective control options. The leaves and stems can be toxic to livestock Chemical: Triclopyr spot treatment with a surfactant to thoroughly wet all leaves can be applied during postemergence when plants are growing rapidly. Glyphosate spot treatment can be used when plants are growing rapidly. Best results occur when plants are treated in late summer or early fall. Since glyphosate is a nonselective systemic herbicide, it may be more appropriate to use a wiper application to achieve selectivity. Glyphosate can be combined with triclopyr for more effective control. Use a surfactant when applying this combination. Triclopyr spot treatment postemergence when plants are growing rapidly.	removal	removal	removal Chemical application early fall	removal; Chemical application late summer
Digitalis purpurea foxglove erect biennial or short-lived perennial	Mechanical: Control efforts are required for at least five years. Hand pulling of stalks is effective. in spring, while soils are moist, and stalk and root masses are easily pulled from the ground. Pulled material must be removed from the site and destroyed (flower stalks left on site will continue to mature and release thousands of seeds). It is easy to strip flowers from the stalks, and little additional effort is needed to pull up the entire plant. If flower stalks are cut back before seeds ripen, the plant can bloom again in mid- to late summer. Therefore, above-ground treatments such as clipping and mowing may be counter-productive unless repeated before resprouts have time to produce seed. Workers must protect themselves from extended contact with the poisonous leaves. Prescribed Burning: Smoke from plants is toxic; populations are not conducive to burning.	Manual removal	Manual removal	Manual removal	

Species	Control Methods	Winter (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sep-Nov)
	Chemical: Herbicide has some effect on the plants but does not kill all of them. Herbicides may work, but hand pulling is more efficient and effective with fewer effects on non-target plants.				
Echium candicans pride of Madeira shrub	Mechanical: Hand pulling or mowing can control small patches. However, cut or pulled plants with immature flowers can continue to mature seed. Repeated cultivation can kill flushes of seedlings. Cultural: Grazing cattle on pastures and rangeland with species can increase populations. Prescribed Burning: Burning destroys some seeds but may stimulate others to germinate. Chemical: Glyphosate sprayed on leaves.		Manual removal Chemical treatment	Manual removal Chemical treatment	
Ehrharta erecta erect veldtgrass perennial grass	Nearly all documented attempts to control Ehrharta species have been limited to E. calycina, and the following discussion centers on this species. It is likely, however, that techniques used on E. calycina would be effective on the other two species Mechanical: Manually removing mature plants, including the buried crown, may reduce plant densities, but often stimulates seed germination. All the buried plants parts must be removed on the perennial species to prevent resprouting. Repeatedly removing seedlings as they appear for a period of 2 or more years can help to control populations. Prescribed Burning: Fire is inappropriate for *Ehrharta* species, as studies have shown that fire increases the invasiveness of this species Chemical: Glyphosate applied as a foliar spray at 2 percent concentration with added surfactant was shown to be effective against Ehrharta calycina under a wide variety of conditions. Spraying typically is carried out when the grass is actively growing and green. The use of glyphosate is belie ved by some to be most appropriate when E. calycina is growing as a near-monospecific stand, since it will cause damage to associated native plants. However, some managers have found that careful treatment of E. calycina bunches with a backpack sprayer can reduce or eliminate impacts to other native species. Under these circumstances it may be necessary to return and treat bunches of E. calycina that did not receive sufficient coverage with the first application.		Manual removal Chemical application	Manual removal Chemical application	
Eucalyptus globulus blue gum	Mechanical: Hand pulling can remove seedlings and small saplings. For larger saplings and small trees, a weed wrench or other woody weed extractor can be			Cut tree and herbicide	Cut tree and herbicide

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
tree	used. Care must be taken to extract the entire root or stump sprouting will occur. Best results are achieved when soil is moist. Cutting a tree at ground level before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting back regrowth when shoots reach 6 to 7 feet tall for 4 years or more can eventually kill the tree. Covering cut stumps with black plastic and sealing the edges with soil to exclude sunlight also gives good control. Plastic must be kept in place for at least one year. Cutting can also be combined with an herbicide treatment. Cultural: Grazing is not considered an effective control option as animals seldom browse on seedlings. Prescribed Burning: Burning alone is not an effective method for controlling eucalyptus. Although burning can remove debris, in many cases it can increase the population as it removes competitive vegetation, releases nutrients into the soil, and stimulates the germination of seeds left in the soil. Burning is more effective when followed by an herbicide application, subsequent burnings, and/or revegetation using desirable species. It is important to employ a control strategy following a burn; otherwise the eucalyptus population may increase in subsequent years. Chemical: Glyphosate is the most effective herbicide for control of eucalyptus. Best when used in late summer to early fall, use foliar spot treatment: 2% v/v solution (*Roundup ProMax)* Glyphosate and water plus 0.5% v/v non-ionic surfactant to thoroughly wet all leaves. Cut stump treatment: undiluted or 50% *Roundup* (or other trade name) in water. Stem injection treatment: one cut per every 3 inches of stem diameter, and 1 ml of undiluted herbicide added to each cut. Triclopyr is also a herbicide used to control eucalyptus. Foliar spot treatment: 2% v/v solution of *Garlon 4 Ultra* and water plus 0.5% v/v non-ionic surfactant to thoroughly wet all leaves. Basal cut stump treatment (treat the cut surface and the bark on the sides of the stump): 20 to 25% *Garlon 4 Ultra* in 75 to 80% oil carrier, or *Pathfinder II* (ready-to-use). Stem injection treatment: one cut per every 3 inches of stem diameter, and 1 ml of undiluted *Garlon 3A* added to each cut. Foliar treatments of Triclopyr are best applied when leaves are fully expanded, and should be made on small trees or seedlings. Stump and stem treatments can be used any time, but are best if not used when sap is rising in the early spring.			stump immediately after cut	stump immediately after cut
Foeniculum vulgare fennel	Mechanical: Hand chopping is recommended for small infestations (large fennel plants have a very substantial root, so it's labor intensive). Slashing just before flowering may kill the plants, repeat slashing of regrowth may be needed. Even	Manual removal	Manual removal	Manual removal	

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
perennial	if plants recover, slashing the stems at flowering will prevent seed set. The use of a mattock to remove the plant can be successful, but is very labor intensive. Digging out individual plants is also possible, but also labor intensive. Deep cultivation will also kill the plants but is not practical in most situations. Cultural: Grazing will not control fennel and often spreads the population. Prescribed Burning: Burning is not effective, as fennel will quickly recover following the fire. However, fall burns followed by herbicide treatment the following two springs reduced fennel cover. Burning can also stimulate the seed bank to germinate, which can reduce the number of years necessary for control. Chemical: Glyphosate gives very effective control and can also be used in combination with triclopyr at 1 lb a.e./acre each. Use broadcast foliar treatment: 5 pt. product (*Roundup ProMax)*/acre (2.8 lb a.e./acre). Spot treatment: 2 to 5% v/v solution during postemergence to fully developed leaves but before flowering. Control is less effective once plant has bolted. Triclopyr is most effective when applied during the wet season from late February to early March. For spot treatment, lower rates can be used early in the season. Triclopyr is a broadleaf herbicide that is standard for fennel control. For foliar treatment: 1 to 2 qt product/acre (1 to 2 ob. A.e./acre). For spot treatment: 0.5 to 1% v/v solution.	Chemical application	Chemical application	Chemical application	
Genista monspessulana French broom evergreen shrub	Mechanical: In general, when using hand removal or mechanical methods it is best to start in areas with small infestations and many desirable species that will reseed naturally. Desirable species should be given some assistance by hand weeding of French broom. Next work on areas with an intermediate degree of infestation. Tackle larger areas and dense concentrations of French broom using other techniques (fire, chemicals) to augment or replace hand pulling. Pulling with weed wrenches is effective for broom removal in small infestations or where an inexpensive, long-duration labor source is dedicated to broom removal. The weed wrench removes the entire mature shrub, eliminating resprouting. However, the resultant soil disturbance tends to increase depth of the seedbank and prolong the need for monitoring. Wrench removal is labor-intensive, but can be used on slopes. It also allows targeting of broom plants while minimizing impact on neighboring species. Cutting broom to the ground in spring before it flowers will reduce the number of seeds and will deplete the plant's energy reserves. Resprouts are common but		Mow early spring Manual removal Chemical application late spring	Manual removal Chemical application early summer	Mow fall

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
	can be reduced by cutting broom at the end of the dry season. Cutting should be combined with herbicide treatment or with multiple cuttings over a period of years. Cut shrubs at ground level. Cultural: A 10 cm deep wood bark mulch significantly decreased seedling emergence of French broom in experiments conducted by Cheng (in press) in the San Francisco Bay Area. This suggests that mulching could be used to suppress regrowth from the seedbank after removal of mature shrubs. Prescribed Burning: Using fire to remove uncut French broom in late spring or early summer has had some success at Mt. Tamalpais State Park in Marin County (Cal-IPC 2014). Reburning of the removal site is usually necessary two and four years after the initial burn. Ken Moore (pers. comm. 1999) reports that California State Parks has been very successful (100 percent mortality) using a propane torch to remove French broom seedlings up to 20 cm in height that emerge from the seedbank after removal of adult brooms. The torch is set so it is hot but not flaming and it is passed over the French broom seedlings. The heat does not cause the seedling to burn but within a day the seedling is wilted and dead. This is done at the end of the rainy season when seedlings are up but there is no fire danger. Chemical: Triclopyr or triclopyr and aminopyralid combined postemergence or cut stump. A solution of 3 percent glyphosate sprayed on foliage until wet has been used to treat mature French broom shrubs. Adding surfactant improved effectiveness (Cal-IPC 2014). However, the foliar spray impacts non-target species, and resprouting often occurs. Triclopyr ester (25 percent), in HastenÂ® or Penevator® oil (75 percent) in one spot, low-volume basal bark application with a wick has proved effective in killing French broom (Cal-IPC 2014a). Dye should be added to the herbicide solution to help avoid missing stems. It was necessary to spot only the main stem with 2 or 3 drops of herbicide, within 8 cm of the ground surface, to obtain a 99 percent kill of the eight-year-old French broom plants in this experiment conducted in Mendocino County. Soil analyses showed no contamination by the triclopyr, even in plots that were later burned. However, killing the mature shrubs was not sufficient to remove the infestation of French broom because of its well developed seedbank (Cal-IPC 2014a). This application technique does not impact non-target species, but it is time-consuming if the site is large. Both of these chemical methods should be used during periods of active growth after flower formation and seed set but before seed dehisces.				

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
Hedera helix English ivy woody shrub vine	Mechanical: The best method for controlling English ivy may be hand removal of vines. Use pruners to cut the vines and then pull the plants up from the forest floor and down from the trees. Removing and killing vines that spread up into trees is especially important because the fertile branches grow primarily on upright portions of the vine. If vines are cut at the base of the tree the upper portions will die quickly but may persist on the tree for some time; vines on the ground around the tree should also be removed to prevent regrowth up the tree. Care should be taken to minimize disturbance during removal. If the forest floor becomes disrupted, appropriate native species should be planted on the site to inhibit reinfestation by English ivy or another invader Chemical: English ivy is tolerant of preemergence herbicides. Its waxy leaves make effective application of postemergent herbicides difficult, even when a surfactant is added. Glyphosate postemergence when plants are growing rapidly. Foliar treatments in late summer or early fall. Cut stump treatment application in late summer, early fall or dormant season. Treatment should occur immediately after cutting. Plants should not be cut for at least 4 months after foliar treatment. Triclopyr postemergence when plants are growing rapidly. Cut stump and basal bark treatment, apply immediately after stem is cut, and control resprouts. Plants should not be cut for at least 1 month after basal bark treatment.		Chemical application early spring Manual removal	Manual removal	Manual removal
Iris pseudacorus yellowflag iris perennial	Mechanical: Not considered effective since it may cause extensive disturbance that facilitates the establishment of other weedy plants. Nevertheless, physical and mechanical methods may be tried. It is necessary to remove the entire plant and rhizome system. Repeated mowing may eventually weaken the plant. Plastic tarps have been used to control yellowflag iris in small patches. Woven plastic and landscape fabric proved to be the best materials. To avoid impacting California red-legged frog and California tiger salamander, treatment should be conducted between late August and the onset of fall rains which typically occur between mid-October and mid-November as feasible. During this time California tiger salamander is in its upland habitats, and California red-legged frog is less susceptible to mortality associated with trampling in and along the ponds (McGraw 2007) Chemical: Glyphosate can be applied at a rate of 4% v/v solution of *Rodeo* or *Aquamaster* (2% a.e.) for spot treatment. Application is most effective when plants are growing rapidly, but before flowering in late spring or early summer. It can also be applied in the fall. Use a non-ionic surfactant registered for use in aquatic areas. Glyphosate is nonselective. In some cases reapplication may be necessary. Application with a drizzle gun gives good results and is far easier to		Chemical application		Manual removal Chemical application

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
	treat compared to a conventional spray boom.				
Oxalis pes-caprae Bermuda buttercup perennial	The best control method for this pernicious weed is prevention. If new infestations are spotted and controlled early, it is possible to eradicate small populations. Large populations are difficult to control and will require multiple years of diligent control efforts. Mechanical: Removing the top of the plant by cultivating or cutting it off won't kill the bulb. Hand weeding is used extensively to reduce infestations, but because it is exceedingly difficult to remove all of the bulbs, new plants usually appear. Care must be taken to remove the entire plant, including underground rhizome and bulbs. Cultivation can provide control of new infestations. Repeated tillage is required to effectively control the bulbs. Cultural: Grazing is not considered an effective control option. Plants contain variable quantities of soluble oxalates and can be lethally toxic to livestock when ingested in quantity. Chemical: Glyphosate spot treatment application in early spring provides the best control. Use spot treatment: 2% v/v solution *Roundup ProMax* and water to thoroughly wet all leaves.	Manual removal	Chemical application early spring Manual removal	Manual removal	Manual removal
Pennisetum clandestinum kikuyu grass perennial	The best way to control kikuyugrass is to prevent its spread into new areas. Kikuyugrass can be spread both from seed and from stem sections. It has shown to be most commonly spread by mowing, cultivation, and renovation equipment. Clean equipment to remove any kikuyugrass seed or stem sections before moving it out of infested areas. Kikuyugrass also spreads in contaminated soil, sod, and planting stock. Make sure any incoming materials are free of contamination. Mechanical: Small patches can be pulled by hand. Avoid disking or cultivating, as this will spread stem fragments. Solarization may control infestations in areas that are to be replanted. For solarization to be effective, it must be used in full sun during the hottest part of the year (generally mid-July to mid-September for most of California), and the area must be kept covered with clear plastic mulch for 4 to 6 weeks. It is unlikely that solarization will be effective in coastal locations due to seasonal fog and overcast skies. Chemical: Apply glyphosate to rapidly growing, non-stressed plants after most seedlings have emerged at a rate 1.5 to 2 qt product (*Round up ProMax)*/acre (1.7 to 2.25 lb a.e./acre); 1.5% v/v solution as a spot treatment.	Manual removal	Chemical application Manual removal	Chemical application Manual removal	

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
Phalaris aquatica Harding Grass perennial	Mechanical: Cultivation is generally not an effective method of control because Harding grass produces an abundant seed bank and can also regenerate from short pieces of rhizome left in the ground. Repeated cultivation when plants are actively growing would be necessary. Active growth corresponds to the time of frequent rainfall, which limits the ability to cultivate. However, cultivation may be used to remove a flush of seedlings and reduce the seed bank. Cultural: Close mowing or clipping late in the growing season can greatly reduce the vigor of Harding grass. Mowing should be done when plants are still green but seasonal soil moisture is almost exhausted. Mowing and irrigation can be used to stimulate new growth of Harding grass. New growth can then be treated with glyphosate or fluazifop, resulting in high mortality. Grazing can be used in place of mowing, but in either case, at least ten to twelve inches (25-30 cm) of regrowth is needed before an herbicide application. Prescribed Burning: Burns made after mid-January have shown to be injurious to this species. Injury may have resulted from damage to young shoots. Recovery from fire was slow. Chemical: Postemergence control: Spot treatment with a 2 percent solution of glyphosate applied as a foliar spray to actively growing plants will kill Harding grass. A broadcast rate of 1.5 to 2.0 lb ai/acre is effective for large infestations. Ideal timing for this treatment is either at the early heading stage of development (mid- to late spring) or in early fall. With glyphosate, repeat applications should be made if regrowth occurs or to control plants not killed by the first treatment.		Chemical application mid to late spring		Chemical application early fall
Raphanus sativus wild radish biennial	Mechanical: Hand-pull, removing most of the root system, before plants produce seed (seeds germinate in spring and fall). Hand weeding may need to be repeated to control later developing plants. Mowing can help reduce seed production but does not harm the basal leaves, thus allowing plants to regrow. Repeated mowing is required to prevent seed set. This is not an effective means of control. Tillage is a common and effective method of control in agricultural areas and would also be effective, if practical, in natural areas and other non-crop sites. Cultural: Maintain competitive grasses and avoid overgrazing. Prescribed Burning: Burning is not practical for controlling wild radish. Chemical: Applications of 2,4-D at a rate of 1 to 2 pt. product/acre during postemergence before budding when plants are small and rapidly growing has	Manual removal (best after a heavy rain)	Chemical application	Manual removal	

Species	Control Methods	Winter (Dec-Feb)	Spring (Mar-May)	Summer (June-Aug)	Fall (Sep-Nov)
	shown to be effective. Also, Dicamba at a rate of .25 to 1 pt. product/acre applied during postemergence before budding when plants are small and rapidly growing has been reported to be effective on wild radish.				
Rubus armeniacus Himalayan blackberry mounded, climbing, and trailing shrub	Mechanical: Cutting and mowing effectively remove the canes, reducing the bramble. However, the plants will resprout from root crowns, sometimes coming back more densely than before cutting (Hoshovsky 2000). Hand pulling seedlings when the ground is damp or hand digging plants are also effective methods providing the roots, which can resprout, are removed (Hoshovsky and Martin 2001, Hoshovsky 2000. The canes from cutting, mowing and digging must be either removed from the site or piled and burned as they can take root and form new plants (Hoshovsky 2000). Cultural: Sheep, cattle, horse and goat grazing can be used to control the spread of blackberries (Hoshovsky 2000). Prescribed Burning: Prescribed burning is effective in removing the canes but will not kill the plants. The plants readily resprout from the root crowns (Hoshovsky and Martin 2001, Hoshovsky 2000). Chemical: Triclopyr is effective in controlling Himalayan blackberry. Glyphosate doesn't provide long-term control of Himalayan blackberry unless retreatment occurs (DiTomaso et al. 2013).		Chemical application	Chemical application Manual removal	Chemical application Manual removal
Senecio glomeratus cutleaf fireweed erect annual to short-lived perennial	Mechanical: Manual remove of cutleaf fireweed is suitable for small, isolated populations Chemical: postemergence glyphosate, triclopyr, and clopyralid		Chemical application Manual removal	Chemical application Manual removal	Manual removal
Silybum marianum milk thistle erect winter or summer annual or biennial	Mechanical: Cultivation can control seedlings. Mowing mature plants before flowers open can help control stands. Tillage can be an effective control option for younger plants. Cultural: Grazing is typically not an option for control, as plants are generally too spiny for animal to use as forage. Prescribed Burning: Because plants develop early in the season, burning is not an effective control and can encourage seed germination and establishment. Chemical: Glyphosate applied to plants in the rosette stage in spring. Broadcast foliar treatment: 1 to 2 pt. product/acre. Spot treatment: 1 to 2% v/v solution. Aminopyralid postemergence in spring or early summer to rosettes or bolting plants or in fall to seedlings and rosettes. Clopyralid postemergence from the		Chemical application Mow late spring	Chemical application Mow early summer	Chemical application

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
	seedling to the bud stage; best if applied to rapidly growing weeds.				
Verbascum thapsus common mullein biennial	Mechanical: Perhaps the most effective method of controlling common mullein is to cut plants with a weed hoe. Plants will not resprout if cut through the root crown below the lowest leaves. If plants have begun to set seed, cut off the flowering racemes with pruning shears just below the lowest seed pods and collect them in a bag to prevent seeds from being released during the hand removal operation. A second or third weeding may be necessary. Mowing appears to be ineffective, as plants cut above the root crown do not die. Prescribed Burning: Burning kills bolted plants and appears to kill rosettes, but creates open areas for reinfestation from seed germination. Individual bolted plants can be killed using a flame thrower, but its use is to be avoided during fire season. Chemical: Common mullein is difficult to control with herbicides because the thick hairs on the leaves prevent the herbicide from reaching and penetrating the leaf surface. A surfactant is recommended for all liquid herbicides used to control this plant. Glyphosate applied to late rosette and bolting plantings in late May has shown to kill species. Another control method, recently developed by a forest weed manager, is to spray each rosette with glyphosate by putting the spray nozzle into the center of the rosette (DiTomaso, pers. comm.). The applicator touches the plant with the spray nozzle and gives it one good squirt. The key is to ensure that the herbicide penetrates the region of the plant where the growing point is located. If the nozzle is off-center, this method does not work. Only seedlings and rosettes are susceptible using this method. In treating individual plants, it is recommended that a dye be used in the herbicide mixture to mark treated plants and prevent re-treatment. Aminopyralid postemergence from the rosette to young bolting stage. Surfactant needed for absorption into woolly leaves.	Manual removal	Chemical application	Manual removal	Manual removal

SPECIES	CONTROL METHODS	WINTER (DEC-FEB)	SPRING (MAR-MAY)	SUMMER (JUNE-AUG)	FALL (SEP-NOV)
Vinca major periwinkle perennial	Mechanical: Hand removal is labor-intensive, but yields good results if careful attention is paid to removing all root nodes and stolons. An effective method is to work inward from the perimeter of the patch and pull the periwinkle back in on itself to prevent further spread of the weed between removal sessions. Because periwinkle has the ability to resprout, mowing or cutting results in abundant regrowth and is not recommended. Chemical: Glyphosate (as *Roundup)* has been tested on large infestations of periwinkle. Greatest success is achieved if plants are cut first and then sprayed immediately afterward. Cutting with a weed whip or brush cutter breaks through the waxy cuticle and allows better foliar penetration of the herbicide. Using the cut and spray method, a 5 percent glyphosate solution gave nearly 100 percent control. To reduce native plant death in the area, a 3 percent solution provides 70-75 percent control and yields good results if followed by spot applications To aid chemical distribution throughout the plant, use surfactant and apply herbicide during an optimal growing period of good moisture and warm temperatures (70-80 degrees F) usually in late spring or early fall. Triclopyr postemergence when plants are growing rapidly. Applications in spring provide the best control. Monitoring is recommended. Follow-up on any removal actions is necessary, as any overlooked stem or plant fragments will quickly resprout. Following chemical removal, the population should be checked twice, in early fall and late spring. With manual removal, follow-up should be performed every three months to remove resprouts. After the patch is eradicated it should be checked twice a year in optimal growing seasons.	Manual removal	Chemical application late spring	Manual removal	Chemical application early fall

Table 13. Weed Species Phenology

Species	January	February	March	April	May	June	July	August	September	October	November	December
Annuals and Biennials												
Brassica nigra black mustard												
Carduus pycnocephalus Italian thistle												
Centaurea melitensis tocalote												
Cirsium vulgare bull thistle												
Conium maculatum poison hemlock												
Digitalis purpurea foxglove												
Raphanus sativus wild radish												
Senecio glomeratus cutleaf fireweed												
Silybum marianum milk thistle												
Verbascum thapsus common mullein												
Perennials												
Ageratina adenophora crofton weed												
Cortaderia jubata jubata grass												
Delairea odorata Cape ivy												
Ehrharta erecta erect veldtgrass												
Foeniculum vulgare fennel												
Hedera helix English ivy												

Species	January	February	March	April	May	June	July	August	September	October	November	December
Iris pseudacorus yellow flag iris												
Oxalis pes-caprae Bermuda buttercup												
Pennisetum clandestinum kikuyu grass												
Phalaris aquatica Harding grass												
Vinca major periwinkle												
Shrubs and Trees												
Albizia lophantha plume acacia												
Carpobrotus edulis hottentot fig												
Cotoneaster pannosus silverleaf cotoneaster												
Echium candicans pride of Madeira												
Eucalyptus globulus blue gum												
Genista monspessulana French broom												
Rubus armeniacus Himalayan blackberry												

Legend	
	Germination/seedling
	Flowering
	Seed-set/dispersal

5.3. ADDITIONAL RESOURCES FOR CONTROL INFORMATION

The resources below contain additional information about weed species control information.

- *Weeds of California and Other Western States* (DiTomaso and Healy 2007).
- *Weed Control in Natural Areas in the Western United States* (Ditomaso et al. 2013).
- *Invasive Plants of California's Wildlands* (Bossard et al.. 2000) available online http://www.cal-ipc.org/ip/management/ipcw/online.php
- Cal Weed Mapper (Cal-IPC 2014b) .available online http://calweedmapper.cal-ipc.org/plant-profiles/
- Invasipedia. Available online http://wiki.bugwood.org/Invasipedia
- San Francisco Estuary Institute's *Practical Guidebook to the Control of Invasive Aquatic and Wetland Plants of the San Francisco Bay-Delta Region* available online http://www.sfei.org/nis/index.html
- University of California Weed Research and Information Center available online http://wric.ucdavis.edu/
- CDFA's Noxious Weed Photographic Gallery: http://www.cdfa.ca.gov/plant/ipc/weedinfo/winfo_photogal-frameset.htmWeed Control in Natural States

5.4. BEST MANAGEMENT PRACTICES

The most effective and efficient weed control strategies are preventing invasions by new plant species (Randall and Hoshovsky 2000). Many invasive weeds in PCRP were on roadsides and likely spread on vehicles, equipment, or livestock. Implementing Best Management Practices (BMPs) may prevent the accidental spread of invasive weeds. Below are BMPs taken from *Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers* (Cal-IPC 2012) that are recommended for implementation at PCRP. Additional BMPS can be found in the document.

Planning

1. Include invasive plant risk evaluation as a component of initial project planning.
2. Integrate invasive plant prevention BMPs into design, construction, vegetation management and maintenance planning activities.
3. Coordinate invasive plant prevention efforts with adjacent property owners and local agencies.
4. Provided prevention training to staff, contractors and volunteers prior to starting work.
5. Conduct a site assessment for invasive plant infestations before carrying out field activities.
6. Schedule activities to minimize potential for introduction and spread of invasive plants.
7. Integrate cleaning BMPs into planning for land management activities.
8. Prepare worksite to limit the introduction and spread of invasive plants.
9. After land management activities, monitor worksites for invasive plants.

Travel

1. Plan travel to reduce the risk of invasive plant spread.
    a. Consider the scale of infestation at worksites and travel routes. Typically not all areas are infested to the same degree with the same plants; this may affect the type and degree of prevention measures implemented.
    b. Avoid driving off-road whenever possible.
    c. When driving off-road, avoid patches of invasive plants.
    d. Exclude areas infested with invasive plants from equipment travel corridors and staging area.
    e. Avoid parking on the side of the road in areas infested with invasive plants.
    f. Prevent animals (pack and grazing) from entering areas infested with invasive plants.
    g. When travel through infested areas cannot be avoided:
        - Consider the sequence of operations. Arrange travel routes from uninfested areas to infested areas. Work first in uninfested areas when vehicles and equipment are free from invasive plant material.
        - Control invasive plants at access roads and staging areas before using them.
        - Clean your vehicle before leaving the infested area.
        - Travel under dry conditions when feasible. Traveling under wet conditions, particularly along unpaved roads, greatly elevates the risk of picking up invasive plant seeds and transporting them.
        - Restrict travel to those periods when spread of seed is least likely, such as just prior to flowering or late in the season when seeds have already dropped.
    h. Limited the number of roads traveled to minimize soil disturbance and the risk of unintentionally transporting invasive plant parts and seeds on equipment into unifested areas.
    i. Close or reroute public roads or trails in areas infested with invasive plants. Where appropriate, ask user groups to become actively involved to help control an infestation so the trail can be reopened.
    j. Perform road maintenance such as road grading, brush clearing, and ditch cleaning from uninfested to infested areas. If possible, schedule such activities when seeds or propagules are least likely to be viable.
2. Integrate cleaning activities into travel planning
    a. Include cleaning when planning travel time.
    b. Set up cleaning operations to be efficient and effective to have minimal impact on travel time.
    c. Remove soil and plant materials from tools, vehicles, equipment, clothing, boots, and gear before entering and leaving a worksite.
    d. Refer to an inspection checklist to ensure comprehensive cleaning of vehicles, equipment, pack animals, clothing, and gear.

e. Avoid traveling through areas infested with invasive plants when collecting water for dust abatement or cleaning.

Tool, Equipment and Vehicle Cleaning

1. Designate cleaning areas for tools, equipment, and vehicles.
2. Inspect tools, equipment, and vehicles before entering and leaving the worksite. Clean soils and plant materials from tools, equipment, and vehicles before entering and leaving the worksite.
3. Clean pack, grazing and support animals.

Waste Disposal

1. Designate waste disposal areas for invasive plant material.
2. Render invasive plant material nonviable when keeping on-site.
3. When disposing of invasive plant material off-site, contain it during transport.

Soil Disturbance

1. Minimize soil disturbance.
2. Implement erosion control practices.

Vegetation Management

1. Schedule vegetation management activities to maximize the effectiveness of control efforts and minimize introduction and spread of invasive plants.
    a. Consider the timing of invasive plant control efforts based on the plant's life cycle.
        - Schedule land-disturbing activities to occur prior to seed set to minimize spreading seeds. Keep in mind that seeds may be present in the soil.
        - Consider invasive plant reproductive biology in response to fire when planning prescribed burns.
        - Coordinate the timing of maintenance activities and invasive plant control activities. For example, delay mowing until two weeks after herbicide application and delay spraying after mowing until vegetative regrowth has occurred.
        - Before excavating invasive plants from drainage ditches, treat the entire infestation to ensure that the plant parts will not spread to adjacent and downstream areas. Avoid side casting (piling excavated soil on either side of a trench when digging a drainage ditch) of accumulated road materials infested with invasive plants. Stock pile in one area that can be monitored.
2. Manage vegetation with methods favorable to desirable vegetation.
    a. Coordinate management of invasive plants and desirable plants.
        - Schedule mowing, clearing, trimming, or grazing of desirable plants for after seed maturation, ensuring desirable plants grow unrestricted and produce seed.
        - Schedule management of invasive plants at early flowering stage (or well before seed development) to avoid spreading viable invasive plant seeds.

b. Limit mowing and other mechanical control to the minimum needed to control invasive plants.

    - To reduce plant shock and root dieback of desirable plant species, mowing height should not be less than six inches. Mowing too low during the growing season will increase soil exposure to sun, soil temperatures, and erosion risks, and encourage invasive plant growth.

c. Identify conditions under which invasive plants should not be mowed to avoid spreading them. Some invasive plants have the ability to sprout from stem and root fragments. Mowing these plants should be avoided.

3. Retain existing desirable vegetation and canopy.

    a. Identify and protect desirable vegetation on site to increase competition with invasive plants. Desirable vegetation should be non-invasive and suitable for the conditions.

    b. Train personnel to identify invasive and non-invasive plants on-site. Provide identification guides to field staff.

    c. Minimize clearing large amounts of vegetation and creating canopy openings. Increased sunlight and bare ground creates suitable habitats for invasive plant germination.

    d. Consider the impacts of different types of equipment. Choose equipment that minimize vegetation disturbance.

Section 6. MONITORING PROGRAM

Monitoring is the systematic collection, recording, and analysis of observations over time with the goal of checking if the intended outcome of a management program is being achieved. If not then the conservation goals and objectives are reevaluated and the course of action is changed. As detailed in Section 1.1, monitoring is a crucial component of the adaptive management approach for managing weeds. The challenge of monitoring is to find a balance between time and money spent monitoring and the value of information obtained from monitoring.

Monitoring of invasive weeds within PCRP has been divided into:

1. Monitoring of Treatment Projects
2. Periodic Weed Mapping and Monitoring of Existing Weed Populations
3. Early Detection Rapid Response

These three monitoring categories contain similar elements (*i.e.* same data form). Each section below contains a complete discussion of the protocol and therefore there is some redundancy so that each section can stand alone as a protocol for dissemination to staff and volunteers.

6.1. MONITORING OF TREATMENT PROJECTS

The success of weed management actions are evaluated through monitoring. Prior to treatment, weed management objectives need to be clearly defined. The data collected will be based on the objectives and will clearly indicate if these objectives are being met. Table 14 outlines weed management objectives, management actions, monitoring actions, and monitoring frequency for Priority 1 Weed Species and Populations identified as high priority for control in Section 4.2.

6.1.1 PRE-TREATMENT BASELINE DATA COLLECTION

Prior to any weed treatment, the weed infestation to be treated should be accurately mapped. The mapped locations of weeds in this report are reconnaissance and not detailed enough for monitoring the success of a treatment project. The goal is to capture whether the treatment results in control of the species on site.

Survey Personnel

The baseline weed data collection should be performed by a consultant, staff, or the contractor who will be treating the weeds. Volunteers can be used if they have been trained in detailed data collection.

Survey Schedule

Collection of baseline data should occur immediately prior to treatment if plants are to be treated postemergence and are visible. If plants are to be treated with preemergence herbicides, data collection should occur the previous year, if feasible, when the target species is actively growing and visible.

Data Collected

Data Sheet

Data should be collected using the standardized data form provided in Appendix E. This data form conforms to the Calflora Weed Observation Entry template online for ease in sharing of data (Calflora 2014). The extent of the infestation should be mapped as a polygon (not a point) using a Global Positioning System (GPS) unit with the capability to collect polygon data. The polygon will be named with the name of the weed, population number, and date. If density or cover of the weed varies

significantly within the polygon, two or more polygons should be recorded and a data sheet completed for each polygon with different values for cover and number of individuals recorded for each polygon.

Any treatment should be noted on the data form and reported to ensure monitoring follow-up. Keep a record of what, where, when and how treatments are applied so the site can be monitored to determine if treatment was successful. For chemical treatment, record the volume of material, formulation, application method, and other details of application.

The following data will be collected (Appendix E).

- **Target Weed Species** – The target weed species corresponding to the polygon.
- **Observation Date** – Date that the infestation information was recorded
- **GPS Coordinates/Polygon Name** – The unique name of the polygon or the GPS coordinates if recording a point.
- **Observer Name** – Person collecting the data
- **Phenology –** Life cycle stage of the majority of plants of infestation.
    - seedling/rosette
    - bolting
    - leafing out
    - flowering
    - fruiting
    - mature
    - vegetative
    - dormant
    - dead/skeleton
- **Distribution Categories** – A description of how the target weed species is distributed across the landscape.
    - Single Plant – a single individual or 2 of the species
    - Single Patch – target weed species comprising one or a few individuals; otherwise devoid of that particular plant
    - Scattered Plants – target weed species readily occurring throughout a specific area
    - Dense Monoculture – target weed species comprising a dominant stand of one particular species
    - Scattered Dense Patches – target NIPS that are readily found throughout the specific area occurring in groups
- **Number of Individuals** – An estimate of the number of individual plants in the infested area.
- **Canopy Cover Class** – Cover is the estimated percent of the gross area actually covered by the target weed species.
- **Infested Area** – An estimate of the area actually covered with target weed species if there were no spaces between the plants. Does not include land and other plant species. This area is smaller than gross area.
- **Gross Area** – An estimate of the size of the general area where the target weed species occurs, including land and other plant species between target weed species individuals (by drawing an imaginary line around outside of infestation). For a polygon, this can be calculated in GIS.

- **Habitat** – The habitat or vegetation community where target weed species is observed and any notes on habitat quality.
- **Location Description** – A written description of the location of the weed occurrence.
- **Notes** – Notes on target weed species that pose a threat to sensitive resources. Details of treatment including herbicide, formulation, volume used, and application method.

Cover Measurements

Cover is measured by estimating the aerial extent of the living plants, or the "bird's-eye view" looking from above. Cover estimates exclude the openings plants may have in the interstitial spaces (e.g., between leaves or branches). If cover of the weed varies significantly within the polygon, two or more polygons should be recorded and cover estimates completed for each polygon. Generally, cover can generally be reliably estimated for a polygon. A diagram is included with the data sheet in Appendix E to aid in estimating cover.

Detailed cover estimates using plot or transect measurements are usually not necessary and the information obtained usually does not substantiate the time it takes to collect the data. Detailed cover measurements can be useful for small plants that are difficult to estimate cover or if additional information about the site (*i.e.* cover of native plants) is desired. Transects or plots can be used to collect more detailed cover information and are discussed below.

Transects – Transects are useful for larger woody vegetation such as French broom where sampling with a quad is not feasible. Transects should be placed randomly throughout the area where weeds occur. The length of the transects depends on the size of the infestation. Cover of the target weed species will be recorded using the point intercept method. The observer will stop at every two feet (0 ft, 2, feet, 4 feet etc; or or at a smaller or larger interval depending on the length of the transect). The observer will determine if the point intercepts the target species. The point will be recorded as a hit by species. Transects will not be permanent and will located randomly in new locations each year. Percent cover can be calculated by (Number of points with species)/(Total number of points)*100.

Plots – Plots are useful for smaller plants such as tocalote or Italian thistle. Generally plots measure 1 to 4 square meters in size. Absolute cover should be measured in the quadrats randomly located along transects. The number of plots and length of transects depends on the size of the target weed species. For example, a patch of Italian thistle patch could be will be measured in 24 1-meter-square quadrats, randomly located along four 20-meter long transects (six quadrats per transect). The four 20-meter long transects will be placed in the Italian thistle patch. The monitor will estimate the percentage of absolute cover of the weed species located in the quadrat.

Photo Points

Photopoints should be established so that all or nearly all of the infested area can be seen from the photo point. A permanent marker should be used to mark the photo point to enable it to be relocated. Good permanent markers include existing fence posts or 2 foot lengths of 5/8 inch rebar driven into the ground and covered with an aluminum cap to prevent injury to people and livestock. Take photographs when the target weed is most visible, usually during the period of peak flowering. Try to include obvious background features such as fences, trees, cliffs, and distant mountains to aid in repeating photograph location every year. Carry prints of last year's photographs to help frame the scene correctly.

6.1.2 POST-TREATMENT DATA COLLECTION

Survey Personnel

The post-treatment weed data collection should be performed by a consultant, staff, or the contractor who treated the weeds. Ideally, the same person who conducted the pre-treatment baseline monitoring will conduct the follow up monitoring.

Survey Schedule

The timing of collection of post-treatment data collection varies. For some weed species, a site visit should be made weeks to months later to determine if the treatment was effective and to see if any new plants have germinated. To determine if a treatment project is successful, the site should be visited the following year at the same time the baseline data was collected for comparison purposes or if feasible, prior to the ideal time for treatment. This way the results of monitoring can be used to plan for retreatment the same year if necessary. Table 14 details the monitoring frequency for Priority 1 species. Table 11 shows survey timing for each species.

Data Collected

The data collected should be the same that was collected during the pre-treatment baseline data collection. A data form should be completed and photos taken at the established photopoints.

Table 14. Weed Management Monitoring for Priority 1 Weed Species

COMMON NAME	WEED MANAGEMENT OBJECTIVE[1]	MANAGEMENT ACTION	MONITORING ACTION	MONITORING FREQUENCY
PRIORITY 1 WEED POPULATION				
French broom *Genista monspessulana*	Exclude French broom from Panoche, Seneca, Corona, Ridge, and Malpaso MUs.	Treat existing isolated populations in Panoche, Seneca, Corona, Ridge, and Malpaso MUs. Treat any new populations found during surveys. Can be combined with other French broom treatment.	After treatment of existing isolated populations in Panoche, Seneca, Corona, Ridge, and Malpaso MUs, monitor for seedlings and resprouts. Survey Panoche, Seneca, Corona, Ridge, and Malpaso MUs for new unknown populations of French broom.	Survey annually post treatment. Survey for new populations every 3 years.
French broom *Genista monspessulana*	Contain isolated populations at Corona Road and exclude them from encroaching into scrub.	Treat isolated populations at Corona Rd entrance that are encroaching into scrub habitat. Contain larger populations that are by road.	Monitor Corona Road population by surveying for plants in scrub habitat.	Survey annually post treatment. Survey for new populations every 3 years.
French broom *Genista monspessulana*	Contain existing French broom population within Containment lines as shown on map.	Treat any individuals that cross containment lines as shown on map.	Monitor Containment Lines as shown on the map in the field by walking along Containment Line.	Every 3 years
silverleaf cotoneaster *Cotoneaster pannosa*	Eradicate silverleaf cotoneaster from PCRP.	Treat all silverleaf cotoneaster in vicinity of known population. Treat resprouts and additional seedlings during follow up monitoring.	Survey vicinity of known silverleaf cotoneaster populations. Survey for seedlings and resprouts the first year and then every other year after.	Survey annually for seedlings and resprouts for 2 years and then every 3 years after if control is attained
English ivy *Hedera helix*	Eradicate English ivy from PCRP.	Treat all known English ivy in PCRP. Treat any additional plants found during monitoring.	Survey vicinity of single known English Ivy populations. After treatment, survey for seedlings and resprouts.	Survey annually for seedlings and resprouts for 1 year and then every 3 years after if control is attained
Himalayan blackberry *Rubus armeniacus*	Eradicate Himalayan blackberry from PCRP.	Treat all known Himalayan blackberry in PCRP. Treat any additional plants found during monitoring.	Survey vicinity of known Himalayan populations. After treatment, survey for resprouts and seedlings.	Survey annually for seedlings and resprouts for 2 years and then every 3 years after if control is attained

Common Name	Weed Management Objective[1]	Management Action	Monitoring Action	Monitoring Frequency
Cape ivy *Delairea odorata*	Eradicate Cape ivy from PCRP.	Continue treatment of previously treated population along San Jose Creek Canyon Road. Treat population in roadside stand of willows near monastery.	Monitor two known populations.	Survey two known populations every other year.
fennel *Foeniculum vulgare*	Eradicate fennel from PCRP.	Treat 2 occurrences in South Front MU.	Monitor PCRP northern boundary to ensure fennel does not spread onto property from areas north. After treatment, survey for seedlings and resprouts.	Survey annually for seedlings and resprouts for 1 year and then every 3 years after if control is attained
tocalote *Centaurea melitensis*	Eradicate tocalote from PCRP.	Treat all 7 known occurrences and treat any additional occurrences detected.	Monitor vicinity of existing populations. Monitor grasslands during periodic surveys.	Survey annually for seedlings.
jubata grass *Cortaderia jubata*	Eradication jubata grass from PCRP or suppress populations of jubata grass if eradication is infeasible.	Treat all individuals in PCRP as feasible. Some occurrences are inaccessible.	After treatment, survey treated areas by driving roads and surveying treated areas with binoculars since many areas will be difficult to access.	Survey annually for seedlings and resprouts for 2 years and then every 2 years after.
yellowflag iris *Iris pseudacorus*	Reduce cover in Animas Pond to protect habitat. Remove isolated population.	Treat yellowflag iris mechanically as feasible. Mechanical removal will likely require draining pond.	Monitor known populations to prevent spread. After treatment monitor for resprouts.	After mechanical removal, follow up annually to hand treat any resprouts.
Surveillance of Specific Weed Populations				
foxglove *Digitalis purpurea*	Prevent foxglove from impacting Hutchinson's larkspur population.	If found in PCRP, treat all populations.	Monitor Hutchinson's larkspur (EONDX 60834) along Palo Corona Rd and remove any foxglove individuals in vicinity of population.	Every 3 years
hottentot-fig *Carpobrotus edulis*	Prevent hottentot-fig from spreading into PCRP.	If found in PCRP, treat all populations.	All 9 occurrence are immediately north of PCRP outside of park boundaries. Monitor boundary to ascertain species does not spread into park.	Every 4 years
blue gum *Eucalyptus globulus*	Prevent blue gum from spreading further up the canyon or into adjacent grassland.	If determined to be spreading, treat sprouts on leading edge.	In canyon near Monastery. Monitor to be certain population is not spreading up canyon.	Every 4 years
plume acacia *Albizia lophantha*	Prevent plume acacia from spreading into PCRP.	If found in PCRP, treat all populations.	Both occurrences are at the northern boundary of PCRP. Monitor to be certain they are not spreading.	Every 4 years
pride of Madeira *Echium candicans*	Prevent pride of Madeira from spreading into PCRP.	If found in PCRP, treat all populations.	All 5 occurrence are immediately north of PCRP outside of park boundaries. Monitor boundary to ascertain species does not spread into park.	Every 4 years

6.2. PERIODIC WEED MAPPING AND MONITORING OF EXISTING WEED POPULATIONS

6.2.1 WEED MAPPING UPDATE

An update to the weed map should occur every 6 years or a budget allows. The update should be conducted by a contractor. Methodology should follow the methodology outlined in Section 3.1.2 and using the data sheet in Appendix E. Field maps will be created that show the existing weed data overlaid on an aerial with each weed occurrence having a unique id number. These maps will be carried in the field along with supplemental tables that contain the attribute information for each occurrence. The update will entail driving roads and hiking to visit or view the existing weed populations and remapping as necessary. We estimate it will take 12 person days (2 teams of 2 people, three days in the field) to update the map. This includes visiting all existing weed populations but does not include surveying large areas of the park where weeds were not observed.

6.2.2 MONITORING OF EXISTING WEED POPULATIONS

Existing weed populations will be monitored during periodic weed mapping updates as detailed above. Additional monitoring should occur for the specific weed populations as detailed in Table 14. Any additional monitoring of specific populations should have a clear monitoring objectives defined before beginning monitoring. However, monitoring of existing weed populations should be prioritized based on proximity to sensitive resources that may be negatively affected by persistent and expanding weed infestations. Depending on the type of resource that is threatened, a periodic monitoring schedule should be developed to ensure the long-term sustainability and survival of subject sensitive resources. When monitoring existing weed populations all data on the data form should be collected as detailed in Section 6.1.1. GIS data collected will be a combination of point and polygon data and will depend on the monitoring question.

6.3. EARLY DETECTION AND RAPID RESPONSE PROTOCOL

The goal of Early Detection Rapid Response (EDRR) is to prevent the establishment of new weed species at PCRP by detecting new weed populations as they arise, treating them, and limiting spread of new infestations. Early detection allows the control of invasive plant populations at the most cost-effective stage.

Early detection includes both newly detected species and newly discovered infestations. Limited distribution invasive plant species (Table 7) will be prioritized for early detection. Different levels of effort have been included to allow flexibility due to budget and personnel limitations. This protocol conforms to already established Early Detection Rapid Response protocols including Bay Area Early Detection network (BAEDN) and the National Park Service in the San Francisco Bay Area (Williams et al. 2009)

6.3.1 EARLY DETECTION SPECIES

A list of 22 target species for early detection that are likely to occur at PCRP was created (Table 15). The list was generated in CalWeed Mapper (Cal-IPC 2014b) by searching for all invasive weed species known from Monterey and then refining the list to include species that are known from the immediate vicinity, that invade habitats present on site, and have elevated Cal-IPC and CDFA ranks. These 22 species are included in the weed identification booklet created for PCRP which contains photographs of each species, and information about identification, habitat, and blooming time.

During surveys, species that are known from PCRP but have limited distribution (Table 7)should also be surveyed for during EDRR surveys for new occurrences.

Table 15. Early Detection Priority Plant List

COMMON NAME	SCIENTIFIC NAME	CAL-IPC RATING	CDFA RATING
Russian knapweed	*Acroptilon repens*	Moderate	B
barb goatgrass	*Aegilops triuncialis*	High	B
fertile capeweed	*Arctotheca calendula*	Mod-Alert	-
sterile capeweed	*Arctotheca prostrata*	Mod-Alert	A
giant reed	*Arundo donax*	High	B
perennial false-brome	*Brachypodium sylvaticum*	Mod-Alert	A
woolly distaff thistle	*Carthamus lanatus*	Mod-Alert	B
purple starthistle	*Centaurea calcitrapa*	Moderate	B
diffuse knapweed	*Centaurea diffusa*	Moderate	A
yellow starthistle	*Centaurea solstitialis*	High	C
spotted knapweed	*Centaurea stoebe* subsp. *micranthos*	High	A
rush skeletonweed	*Chondrilla juncea*	Moderate	A
artichoke thistle	*Cynara cardunculus*	Moderate	B

COMMON NAME	SCIENTIFIC NAME	CAL-IPC RATING	CDFA RATING
Scotch broom	*Cytisus scoparius*	High	C
common and Fuller's teasel	*Dipsacus fullonum and D. sativus*	Moderate	-
stinkwort	*Dittrichia graveolens*	Mod-Alert	-
purple veldtgrass	*Ehrharta calycina*	High	-
medusahead	*Elymus caput-medusae*	High	C
common St. John's wort, klamathweed	*Hypericum perforatum*	Moderate	C
perennial pepperweed	*Lepidium latifolium*	High	B
Spanish broom	*Spartium junceum*	High	C
gorse	*Ulex europaeus*	High	B

6.3.2 SURVEY METHODOLOGY

The sampling methodology is based on protocols established in other parks including the National Park Service in the San Francisco Bay Area (Williams et al. 2009) and the Bay Area Early Detection Network. This methodology focuses on low-intensity, qualitative techniques, such as presence data, which are easiest to collect and to respond to for treatment. Large scale sweeps of roads and trails will ensure coverage and since roads and trails are major vectors for invasive plants, will target likely locations for new invaders. The methodology can be scaled based on resources available from an opportunistic strategy using minimal staff to a full volunteer/staff program with systematic survey efforts.

Survey Personnel

Survey personnel include staff, grazers, consultants and volunteers. Opportunistic samplings can occur by staff that regularly work on PCRP including rangers that are patrolling the site or conducting maintenance activities, grazers in the backcountry, and consultants. Every person that enters PCRP has the potential to detect invasive weeds. Giving them quality information and asking them to look for invasive weeds can result in valuable data collection. In general, surveyors should work in pairs.

Regular monitoring will be conducted, as resources allow, by consultants, staff or through a volunteer program. Trainings are required for volunteers and staff in which they are educated about the importance of invasive weeds, trained to identify invasive weeds, and trained how to collect data.

Survey Schedule

Each survey area has been assigned a survey frequency (Table 16). Areas where weeds are likely to be introduced or become established (roads, trails, grazing infrastructure) will be surveyed more frequently. Surveys should ideally be conducted between April and June when most species are in flower. However, surveys at different times of year are also beneficial to maximize detectability of different species. The below schedule is suggested; due to budget and personnel constraints, surveys may be conducted less frequently.

Table 16. EDRR Survey Frequency and Location

SURVEY SCHEDULE AND SURVEY LOCATION	RATIONAL
EVERY 2 YEARS	
Survey roads, trail edges, and parking lots in Front Country (all MUs north of and including Animas and Lower San Jose).	These are highly trafficked areas that could be a source of weeds and where weeds may be spread from.
Survey at the Corona Road entrance, and along the eastern border of West San Jose and East San Jose MUs especially along Rancho San Carlos Road.	Adjacent private land may serve as a source for invasive weed propagules.
Survey grazing infrastructure including water troughs, corrals, and known areas where cattle congregate	Cattle can move weeds within PCRP. Disturbance by cattle can create conditions favorable for weed infestations.
EVERY 3 YEARS	
Survey 14 mapped ponds.	Ponds on site are identified as sensitive biological resources.
Survey roads and trail edges in the backcountry including West San Jose, East San Jose, Panoche, Seneca, Ridge, Corona, Flint, Malpaiso, and South MUs.	These areas are high quality habitat with low numbers of weeds and considered a sensitive biological. Surveys are only scheduled every 3 years since there were low numbers of weeds and low traffic volume. If new weed invaders are detected then the frequency of surveys can be increased as needed.
Survey known locations of rare plant species. Survey CRPR List 1 species: Yadon's rein orchid, San Francisco popcorn flower, Pinnacles's buckwheat, Hutchinson's larkspur, and Hooker's Manzanita. Survey List 4 species as feasible.	Rare plant species are identified as sensitive biological resources.
EVERY 6 YEARS	
Survey high priority vegetation communities: native grassland, coastal terrace prairie, and coastal scrub in areas that contain seacliff buckwheat and coast buckwheat (*Eriogonum parvifolium* and *E. latifolium*).	These areas are high quality habitat with low numbers of weeds and considered a sensitive biological resources. Surveys are only scheduled every 5 years since these areas are off-road and need to be accessed by walking.

Field Equipment

Field surveyors should carry the following equipment for recording weed occurrences and to control small infestations when encountered as feasible.

- GPS unit
- digital camera
- clipboard and pens
- data sheets
- map
- field notebook or blank paper
- Weed ID booklet
- binoculars
- large and small ziplock bags (for collecting specimens)
- gloves
- shovel or pickaxe
- flagging
- plastic trash bags

Survey Data Collection

Surveys consist of walking and driving surveys, where road and trail sides are scanned for target species. Some surveys may require walking (for example known locations of rare plant species).

Data Sheet

Data should be collected using the standardized data form provided in Appendix E. This data form conforms to the Calflora Weed Observation Entry template online for ease in sharing of data. Paper forms and maps were chosen based on ease of use. Data forms can be easily photographed or scanned and emailed. The extent of the infestation should be mapped as a point or polygon using a GPS unit. If density or cover of the weed varies significantly within the polygon, two or more polygons should be recorded and a data sheet completed for each polygon with different values for cover and number of individuals recorded.

The following data will be collected (Appendix E).

- **Target Weed Species** – The target weed species corresponding to the polygon.
- **Observation Date** – Date that the infestation information was recorded
- **GPS Coordinates/Polygon Name** – The unique name of the polygon or the GPS coordinates if recording a point.
- **Observer Name** – Person collecting the data
- **Phenology –** life cycle stage of the majority of plants of infestation.
    - seedling/rosette
    - bolting
    - leafing out
    - flowering
    - fruiting

  - mature
  - vegetative
  - dormant
  - dead/skeleton
- **Distribution Categories** – A description of how the target weed species is distributed across the landscape.
  - Single Plant – a single individual or 2 of the species
  - Single Patch – target weed species comprising one or a few individuals; otherwise devoid of that particular plant
  - Scattered Plants – target weed species readily occurring throughout a specific area
  - Dense Monoculture – target weed species comprising a dominant stand of one particular species
  - Scattered Dense Patches – target NIPS that are readily found throughout the specific area occurring in groups
- **Number of Individuals** – An estimate of the number of individual plants in the infested area.
- **Canopy Cover Class** – Cover is the estimated percent of the gross area actually covered by the target weed species.
- **Infested Area** – An estimate of the area actually covered with target weed species if there were no spaces between the plants. Does not include land and other plant species. This area is smaller than gross area.
- **Gross Area** – An estimate of the size of the general area where the target weed species occurs, including land and other plant species between target weed species individuals (by drawing an imaginary line around outside of infestation). For a polygon, this can be calculated in GIS.
- **Habitat** – The habitat or vegetation community where target weed species is observed and any notes on habitat quality.
- **Location Description** – A written description of the location of the weed occurrence.
- **Notes** – Notes on target weed species that pose a threat to sensitive resources. Details of treatment including herbicide, formulation, volume used, and application method.

Gathering negative data is important because it records where weeds do not occur. Surveyors also record where they surveyed and did not find weeds. Surveyors can email a GPS unit tracklog which records where the surveyor surveyed or the surveyor can mark on a hard copy of a map.

If infestation is small, the infestation can be treated when detected, provided the surveyor is experienced and identification is certain. Any treatment should be noted on the data form and reported to ensure monitoring follow-up. Keep a record of what, where, when and how treatments are applied so it can be monitored to determine if treatment was successful. Photos should be taken of the weed species and the infestation.

Specimen Collection

A physical voucher of a plant is the best method of reporting an observation in addition to photographing it in its habitat to capture details that are lost during pressing. Collections should only be taken by staff or experienced volunteers. Volunteers and inexperienced observers should take a photo. Specimen collection methodology is included in Appendix G and is taken from the Bay Area Early Detection Network.

6.4. DATA MANAGEMENT AND REPORTING

Reporting Collected Data

A specific MPRPD staff person needs to be identified as the contact person responsible for receiving collected invasive weed data to ensure consistency and that data is reported. A GIS database should be set up to enter information on weed reporting, control methods, treatment activities, and monitoring. The MPRPD contact is responsible for communicating data to the GIS person. Completed data forms and maps should be sent to the MPRPD contact person within one month after data is collected. Photographs and GPS data should also be included. This person will enter the info into a GIS, as feasible. Early Detection field data is time sensitive. Acting upon new infestations in a timely manner is critical, therefore reporting new weed populations is high priority. Even if new infestations are controlled at the time of detection, they should be reported for continued monitoring of site and to track success of the program.

Data Review

Data should be reviewed when it is reported. Annually at the end of the year, the date collected will be reviewed. Detections are then prioritized for eradication based on assessments of threat and eradication feasibility. Any detected occurrences will be analyzed for invasiveness using the species priority ranking and site priority ranking as detailed in Section 4. Clear objectives will be identified for any new populations before any treatment is begun. Objectives will include monitoring, eradication, or containment among others. An annual report shall be prepared that summarizes the monitoring effort, reports any data detected, and summarizes management objectives and actions taken for specific populations. Annual reports will include a summary of staff hours worked on invasive weed control projects and any contracts for control in order to evaluate success relative to stated targets and expenditures.

Every 5 years the data will be reviewed and a summary report will be produced. The summary report will clearly outline all control projects undertaken, clear management objectives, results of monitoring, and recommendations. It will include a summary of all EDRR surveys and results.

Adaptive Monitoring

As part of the 5 year monitoring review invasive plant monitoring and mapping data will be evaluated to determine the primary pathways leading to new invasions in PCRP. The data will be reviewed to refine when to search and how frequently to search. For example if a site that is surveyed only every 3 years has many new species or populations detected, then this site should be surveyed more frequently. Possible management actions to prevent new infestations should be identified.

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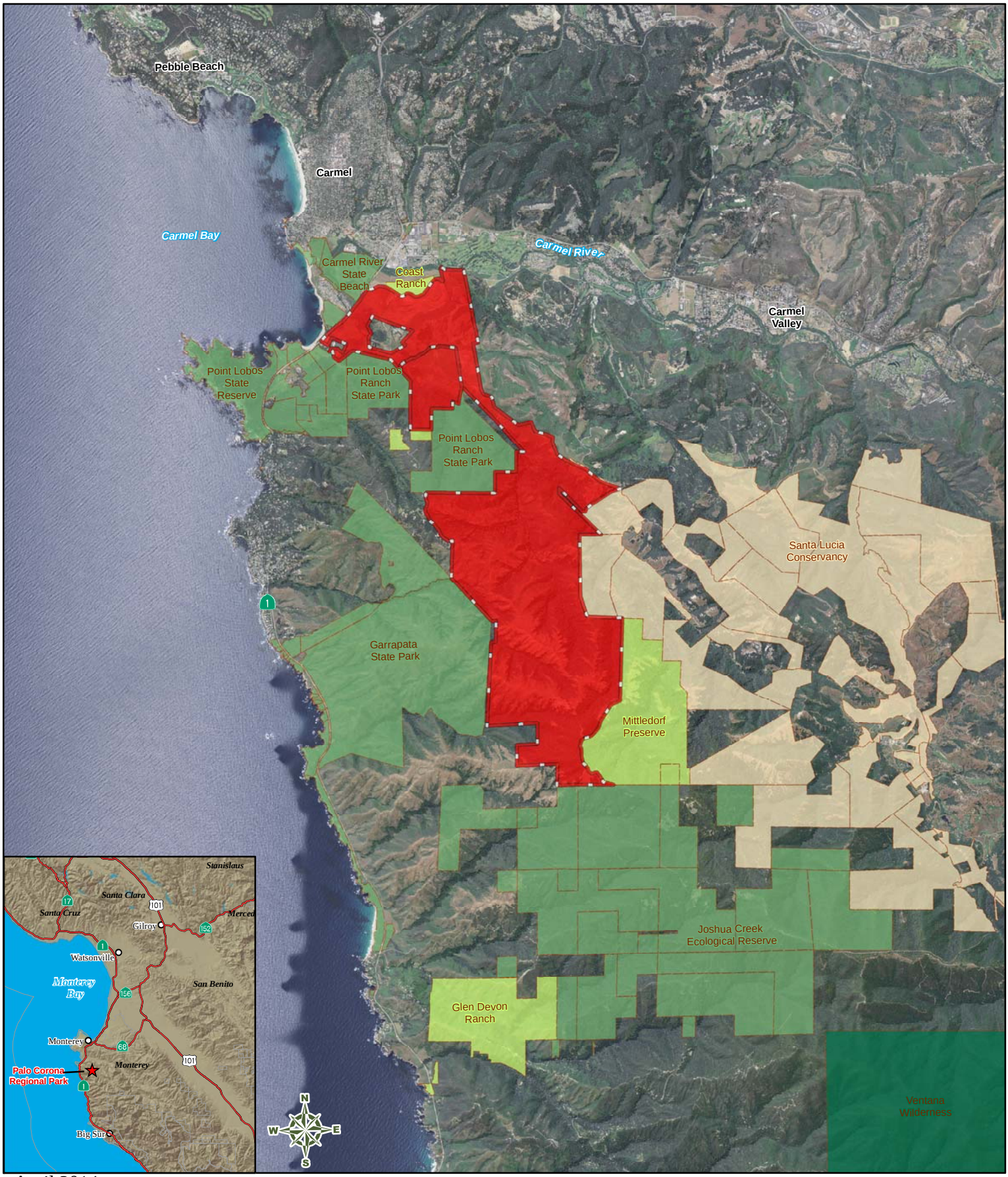
APPENDIX A FIGURES



April 2014

Legend

- Palo Corona Regional Park Boundary
- State Parks
- Santa Lucia Conservancy
- U.S. Forest Service
- Big Sur Land Trust

Figure 1

Location of Palo Corona Regional Park

Palo Corona Regional Park

Monterey Peninsula Regional Park District

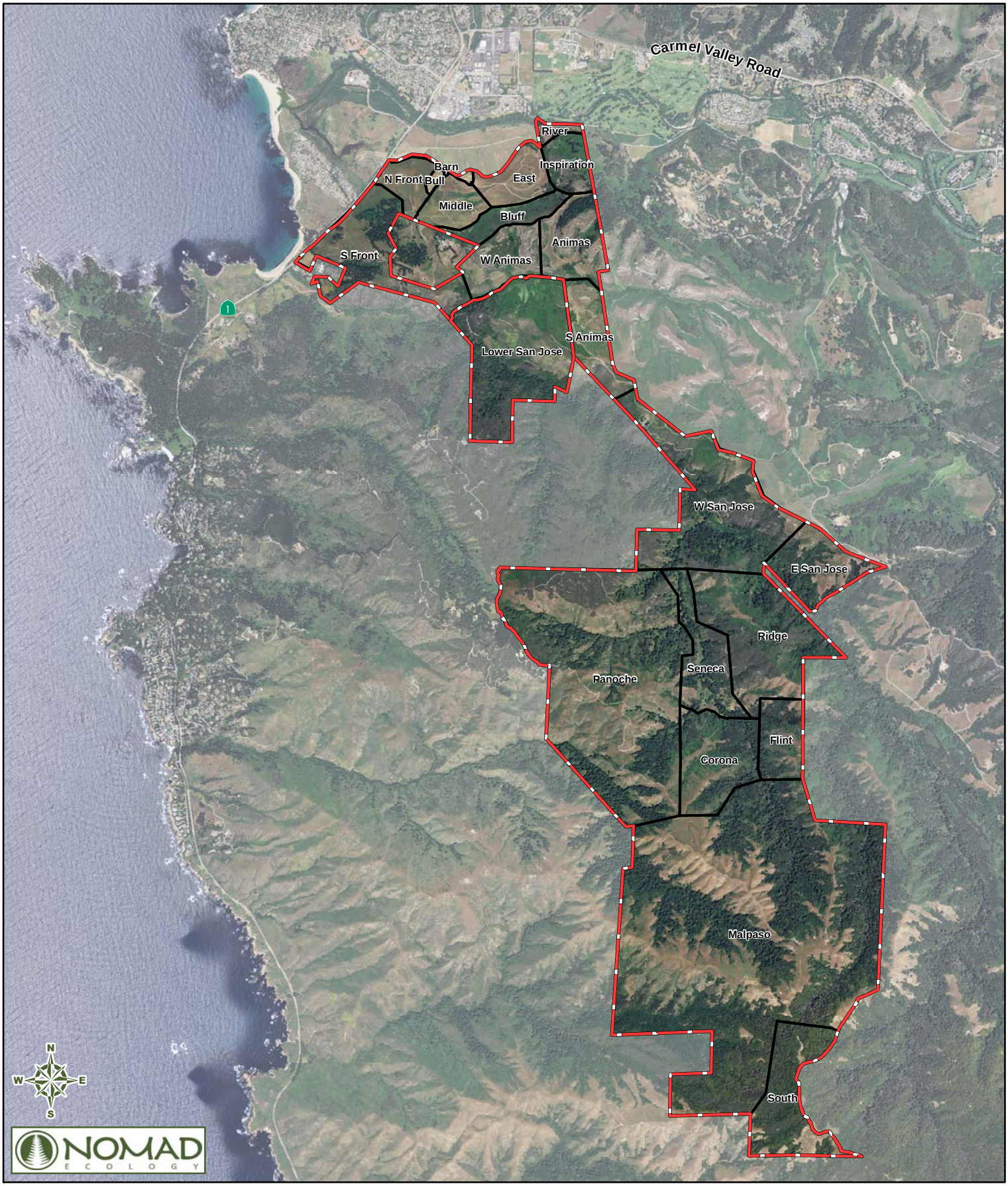
1:95,040

0 0.75 1.5 Miles

NOMAD ECOLOGY

Sources: California Spatial Information Library, NAIP aerial imagery dated 2012. MPRPD. Turfimage.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Figure 2

Management Units

Palo Corona Regional Park

Monterey Peninsula Regional Park District

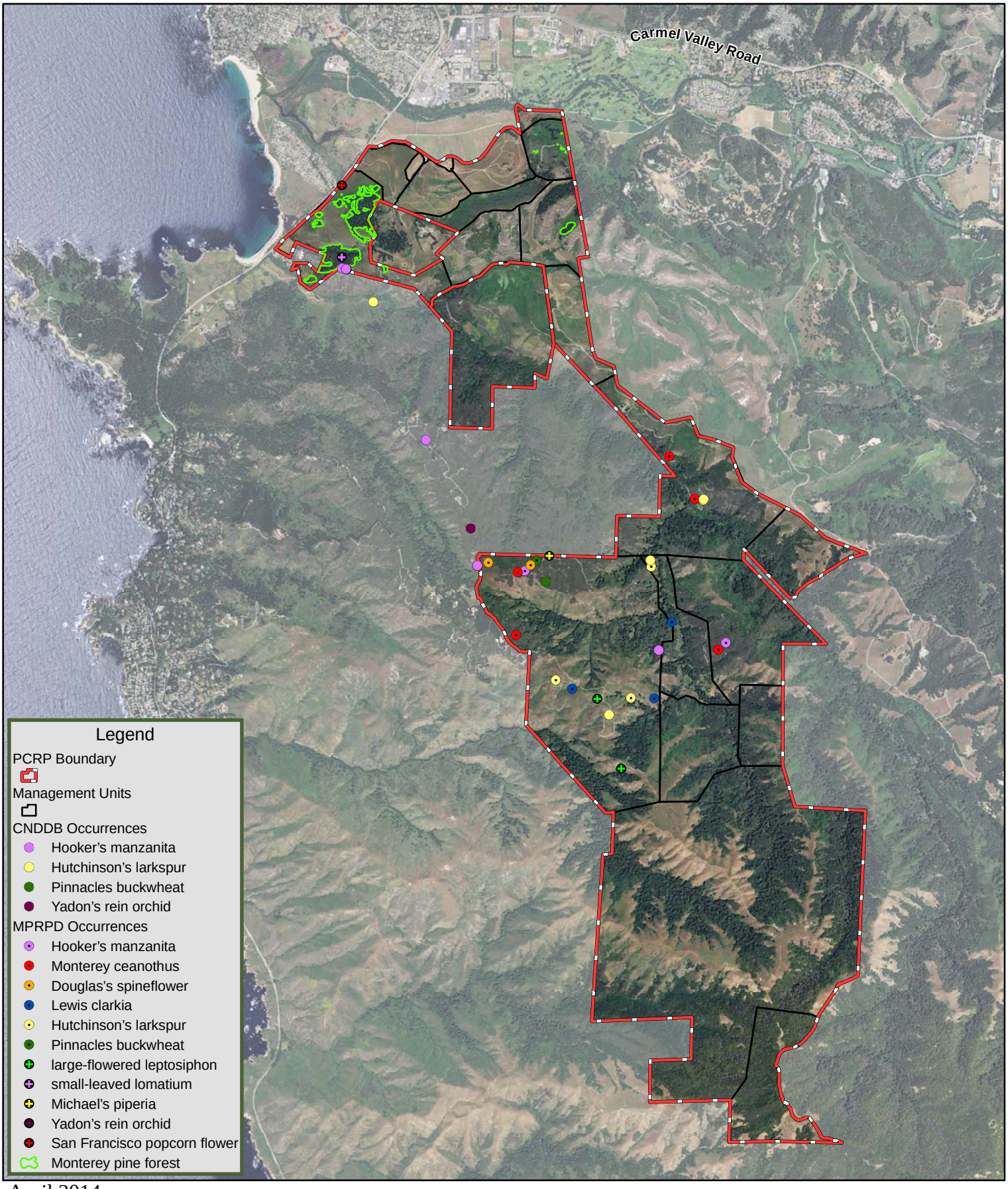
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California



April 2014

Figure 3

Special-Status Plant Species Occurrences in PCRP

Palo Corona Regional Park

Monterey Peninsula Regional Park District

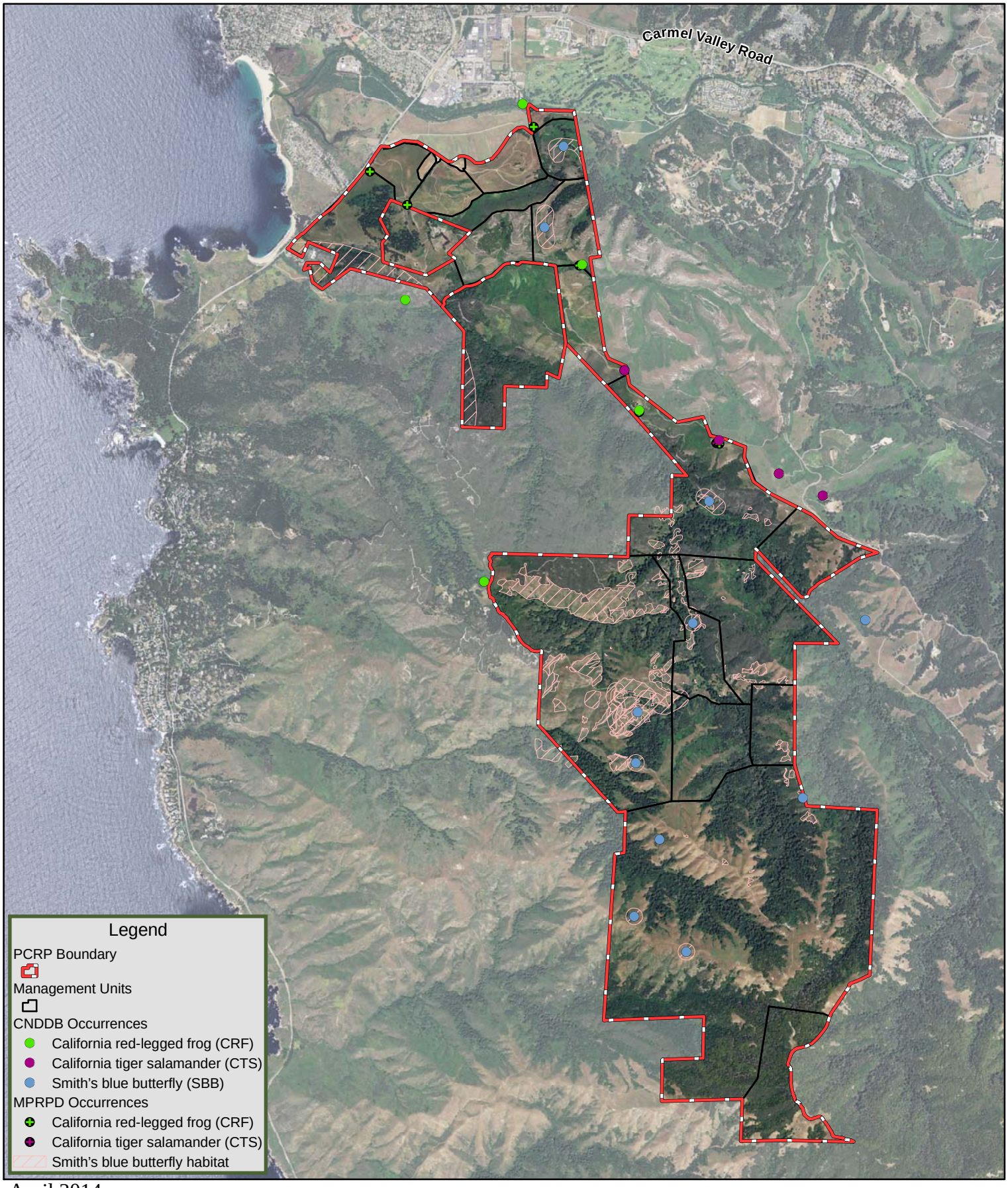
1:48,000

0 2,000 4,000 Feet

NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. CNDDB. MPRPD. TurfImage.

Monterey County, California



April 2014

Figure 4

CRF, CTS, and SBB Occurrences in PCRP

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

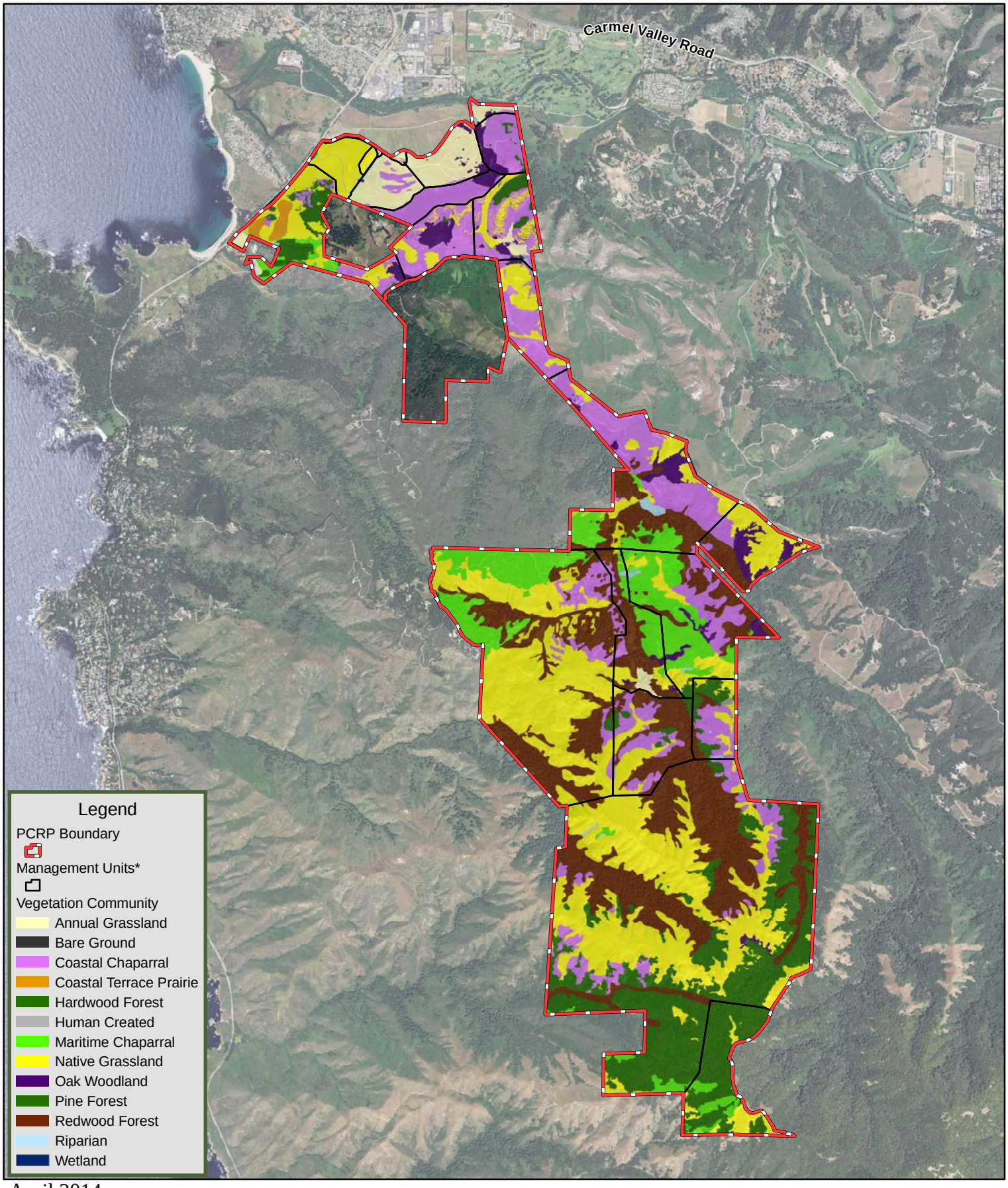
0 2,000 4,000

Feet

NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. CNDDB. MPRPD. TurfImage.

Monterey County, California



April 2014

*Vegetation has not been mapped in the Lower San Jose MU.

Figure 5

Vegetation Communities

Palo Corona Regional Park

Monterey Peninsula Regional Park District

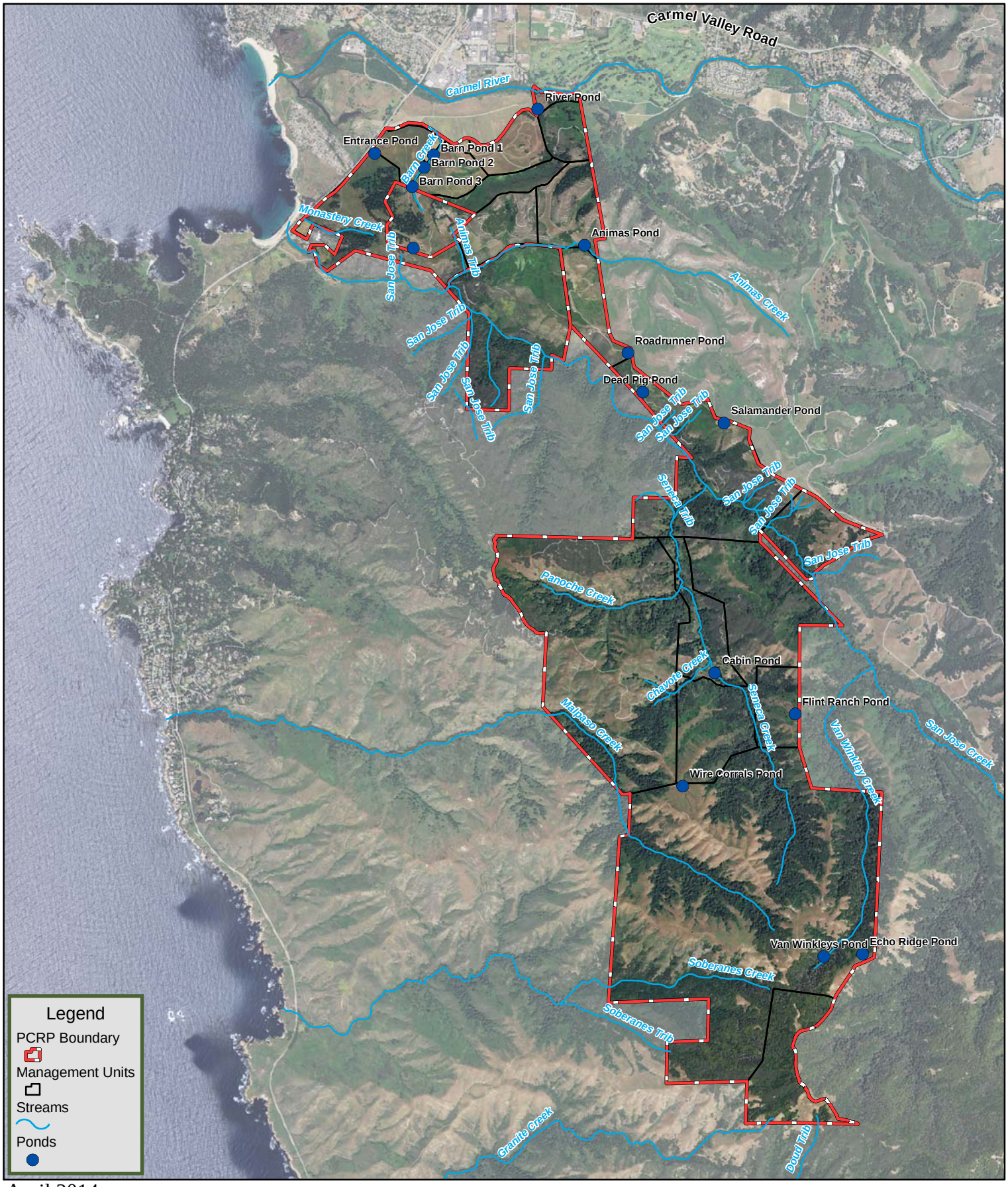
1:48,000

0 2,000 4,000 Feet

NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California



April 2014

Figure 6

Ponds and Streams

Palo Corona Regional Park

Monterey Peninsula Regional Park District

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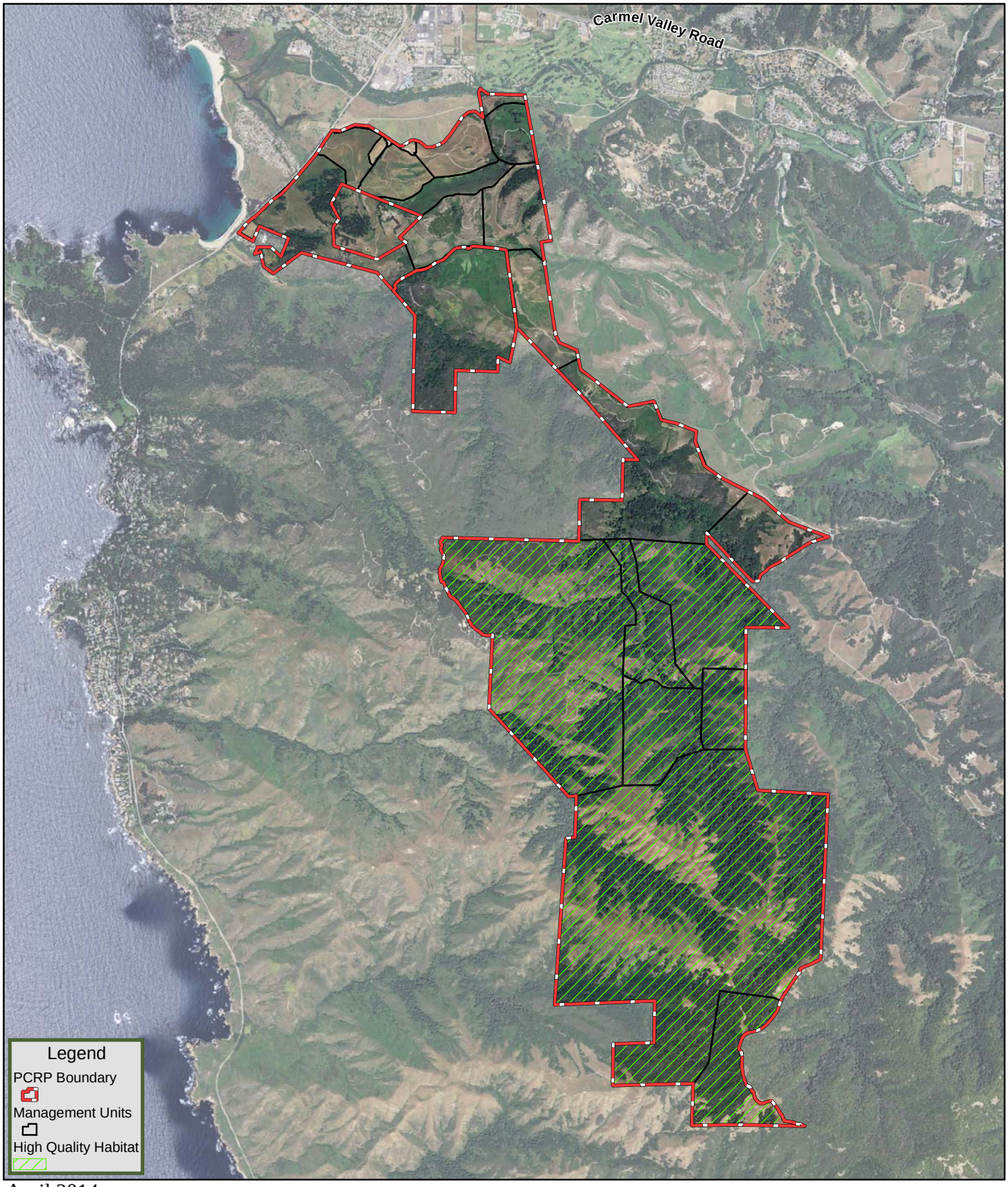
NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California



April 2014

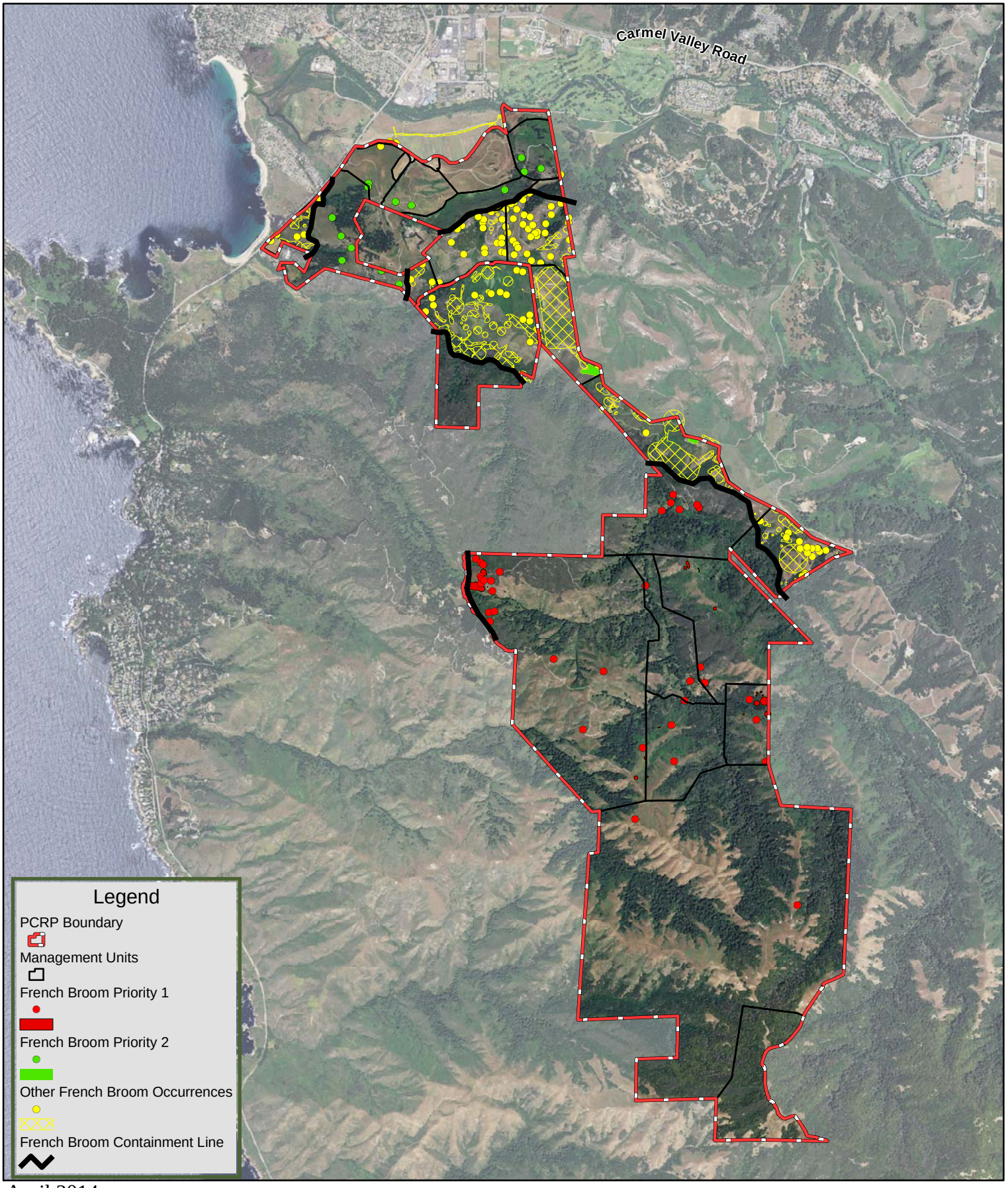
Figure 7
High Quality Habitat
Palo Corona Regional Park
Monterey Peninsula Regional Park District

1:48,000
0 2,000 4,000
Feet

NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California



April 2014

Figure 8

French Broom Priority Populations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

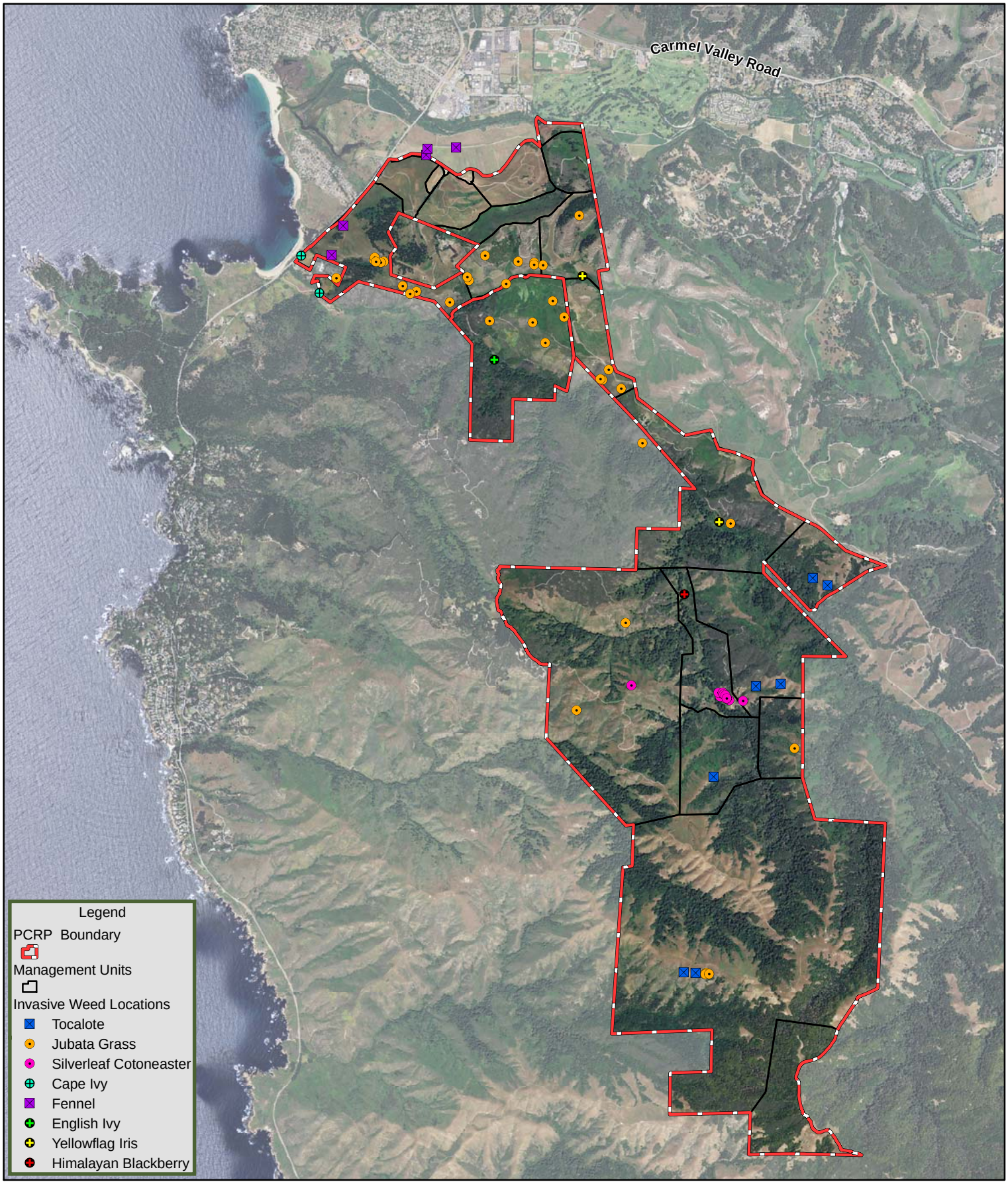
1:48,000

0 2,000 4,000 Feet

NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California



April 2014

Figure 9

Priority 1 Weed Populations
(excluding French Broom)

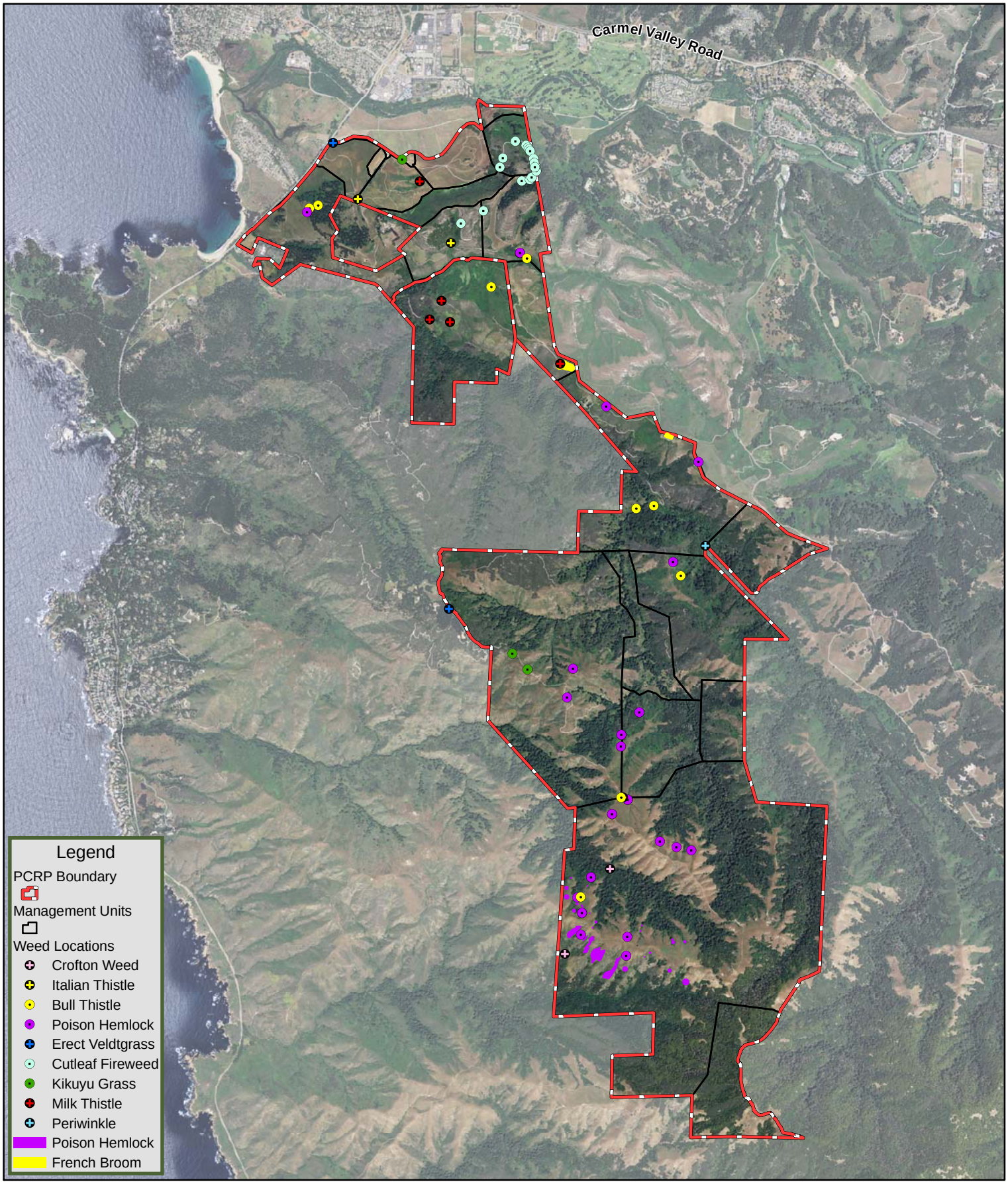
Palo Corona Regional Park
Monterey Peninsula Regional Park District

1:48,000
0 2,000 4,000
Feet

NOMAD ECOLOGY

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California



April 2014

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W E
S

NOMAD ECOLOGY

Figure 10

Priority 2 and 3 Weed Populations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

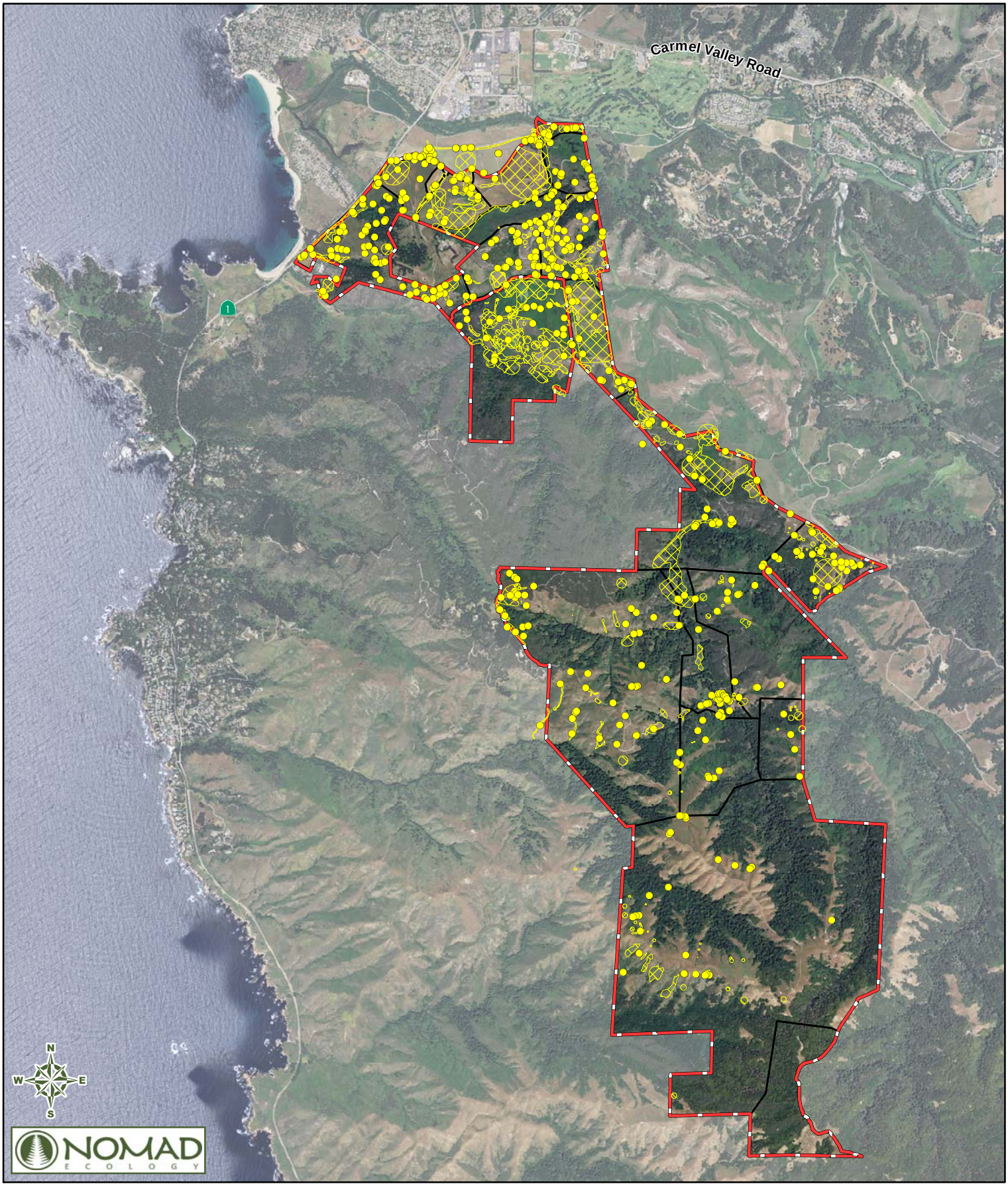
0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. MPRPD. TurfImage.

Monterey County, California

APPENDIX B MAPS OF WEED SPECIES IN PCRP



April 2014

Legend

Park Boundary

Management Units

All Mapped Invasive Weed Locations

All Mapped Invasive Weed Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

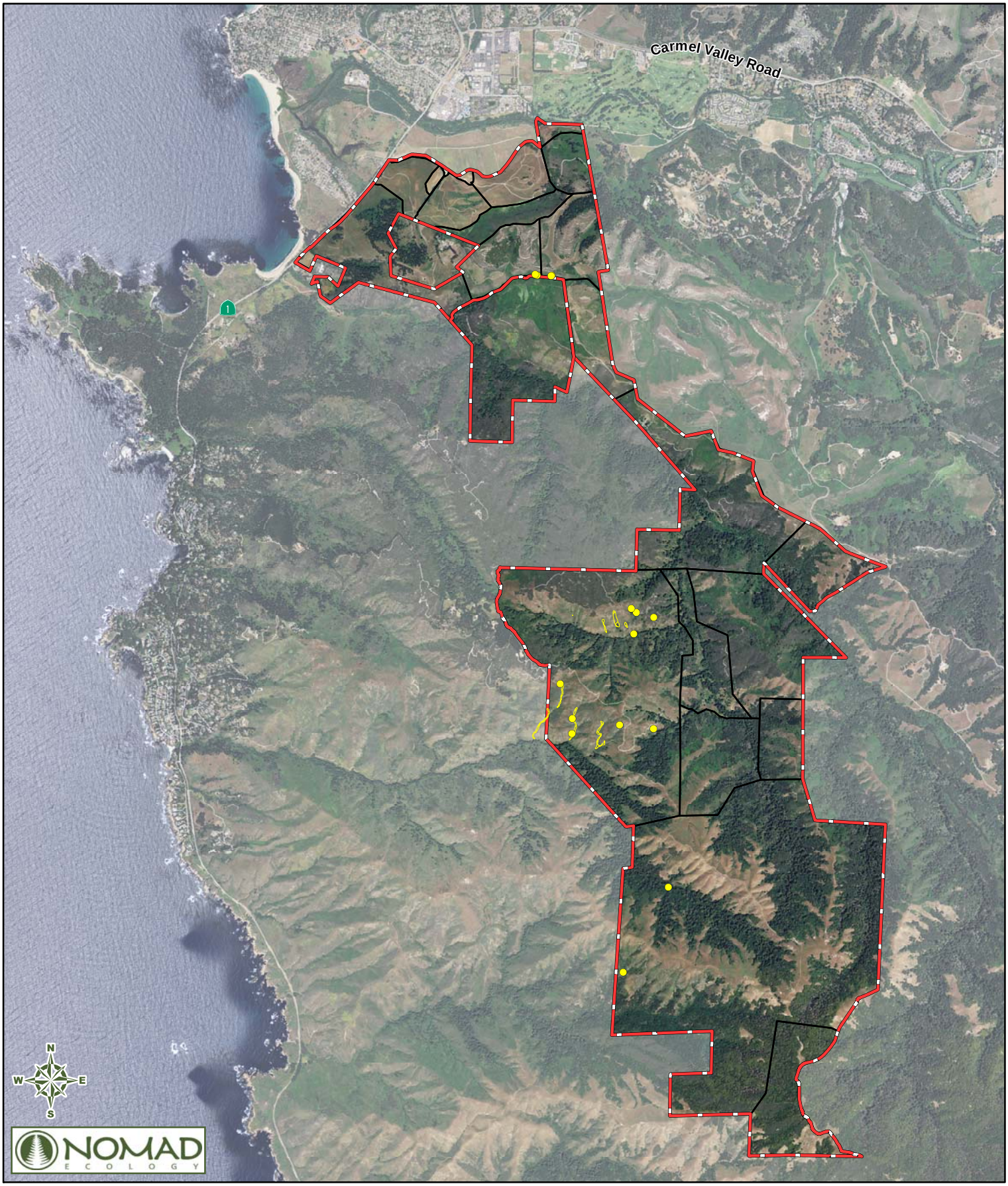
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Crofton Weed (Ageratina adenophora)

Management Units

Crofton Weed Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

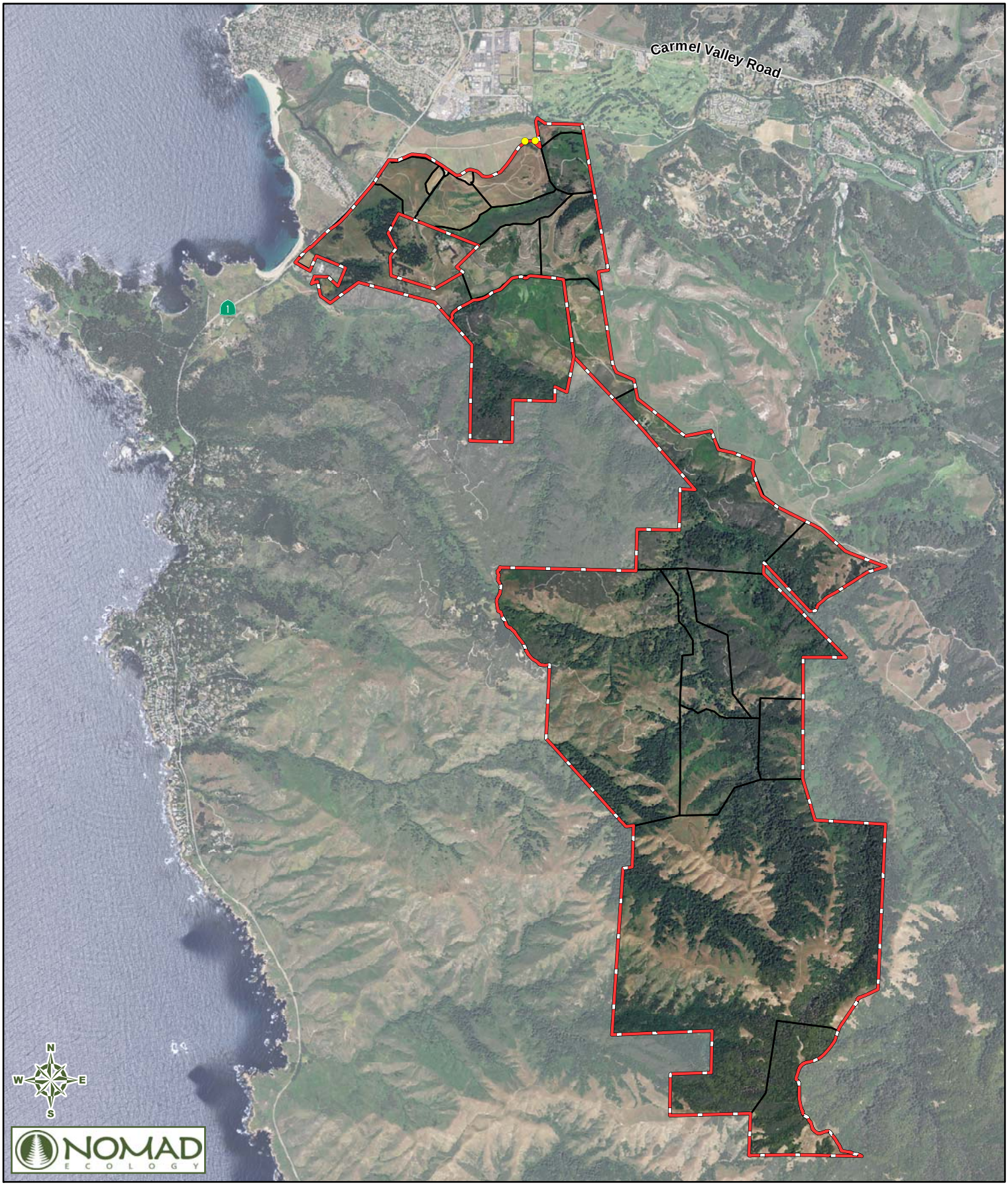
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Plume Acacia (Albizia lophantha)

Management Units

Plume Acacia Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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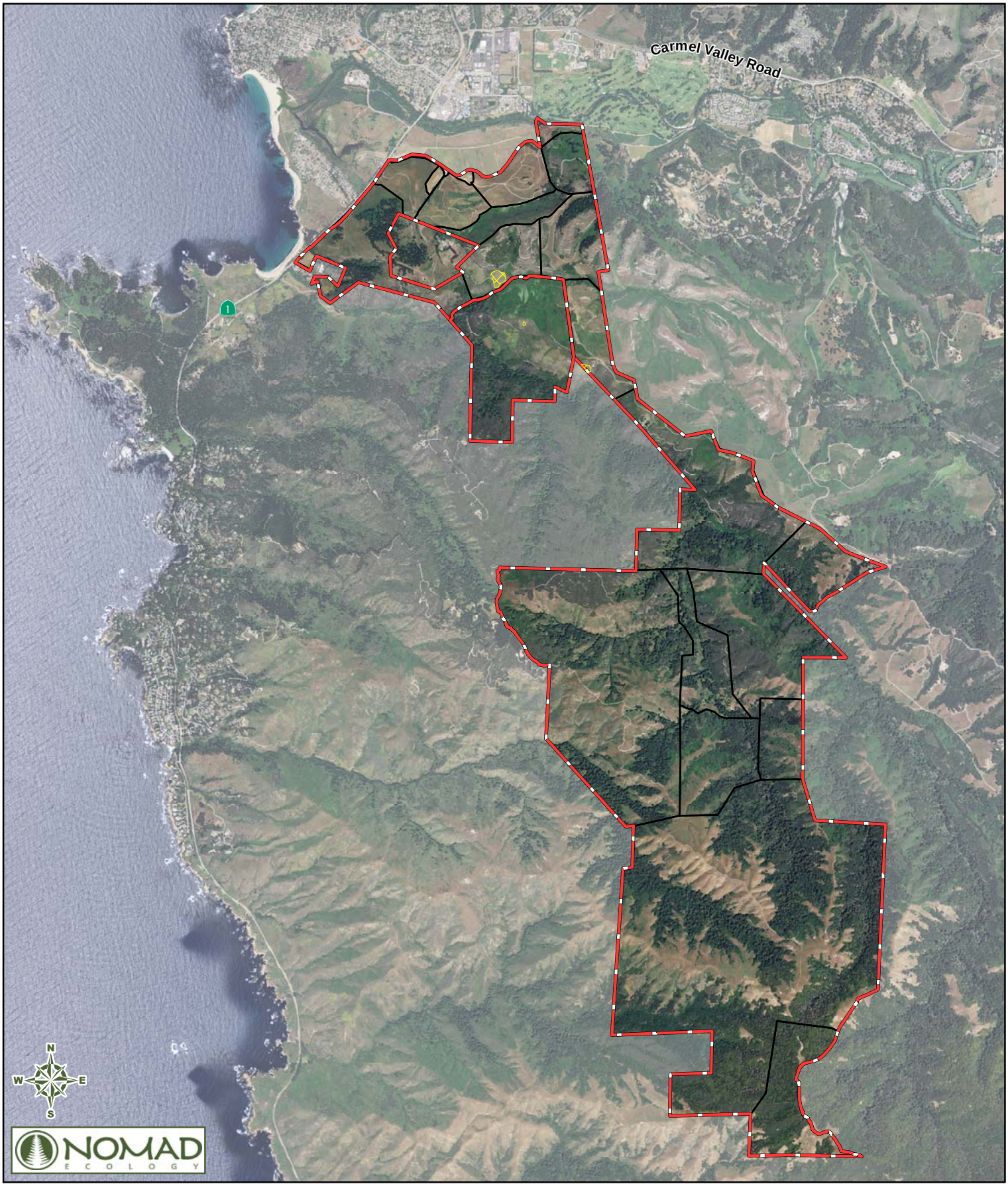
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Black Mustard (Brassica nigra)

Black Mustard Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

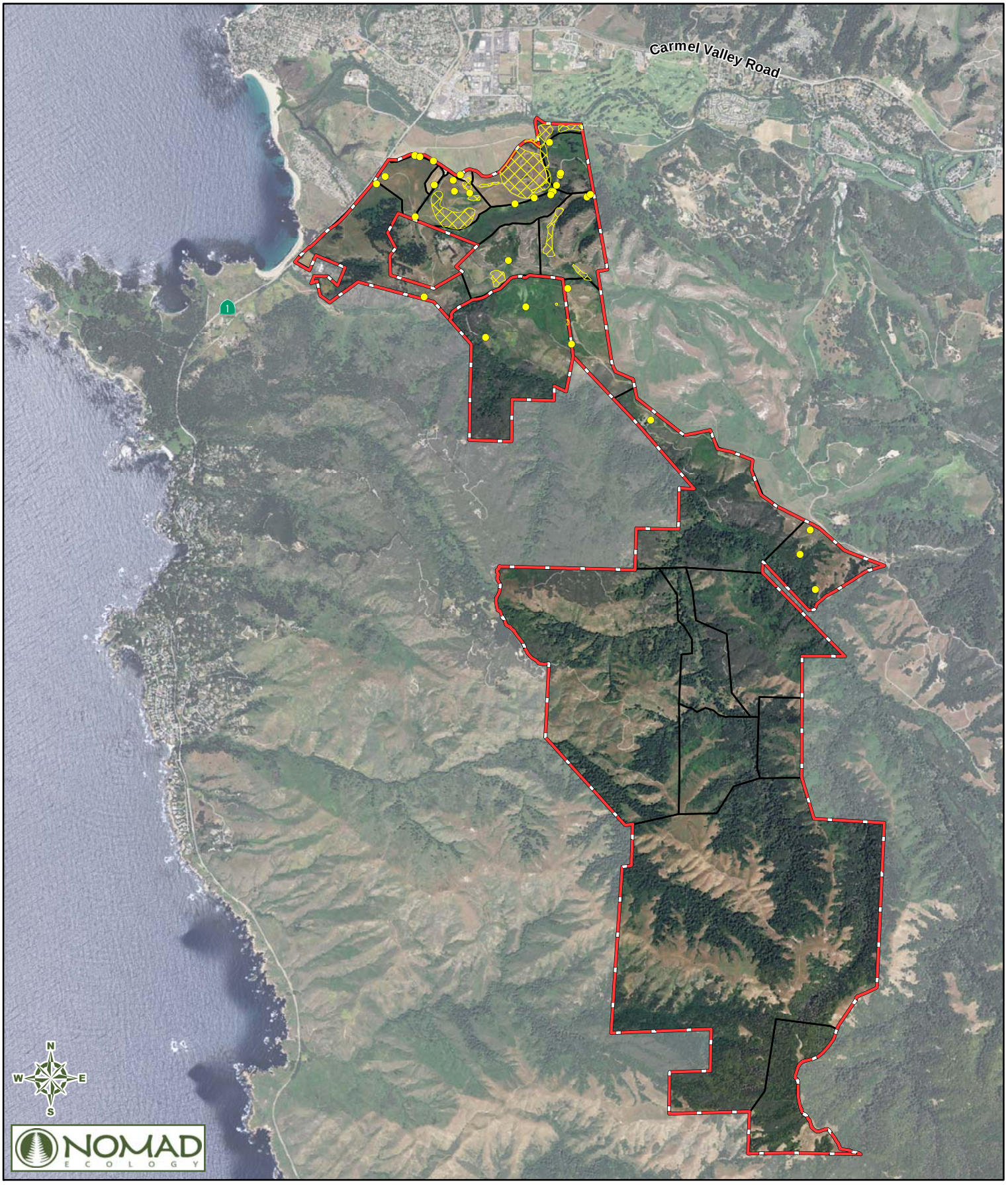
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Italian thistle (Carduus pycnocephalus)

Italian Thistle Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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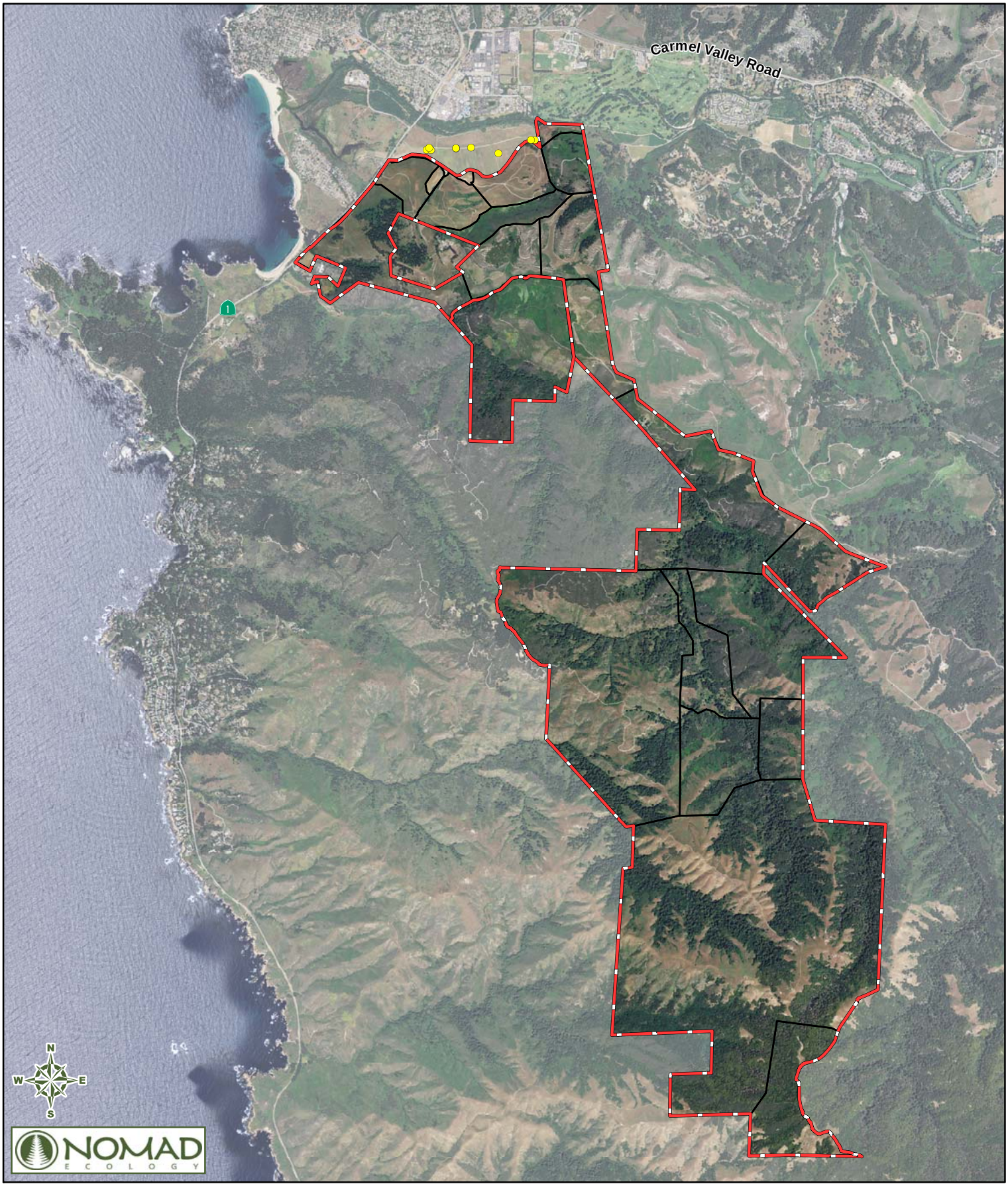
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Hottentot-Fig (Carpobrotus edulis)

Management Units

Hottentot-Fig Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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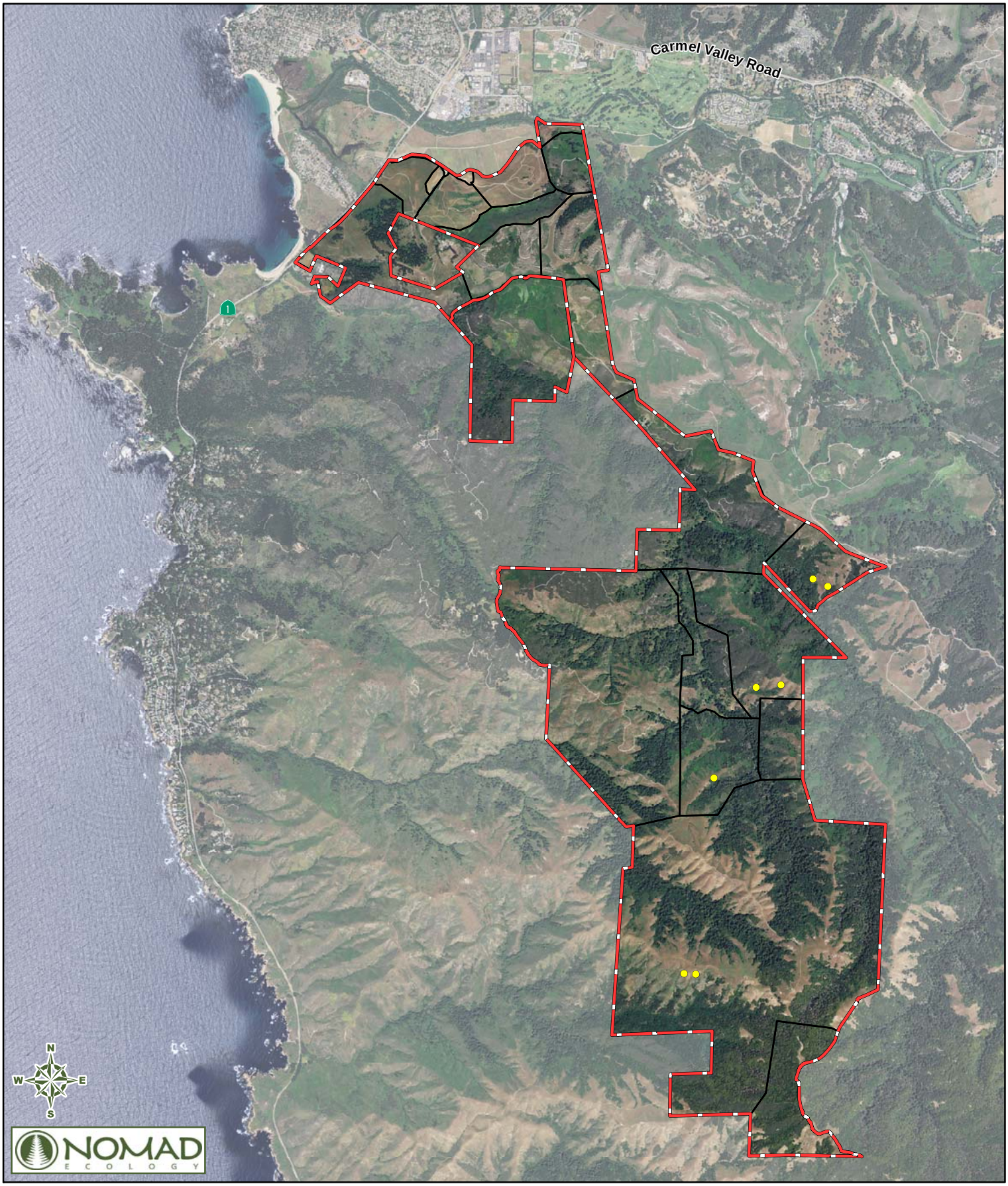
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Tocalote (Centaurea melitensis)

Tocalote Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

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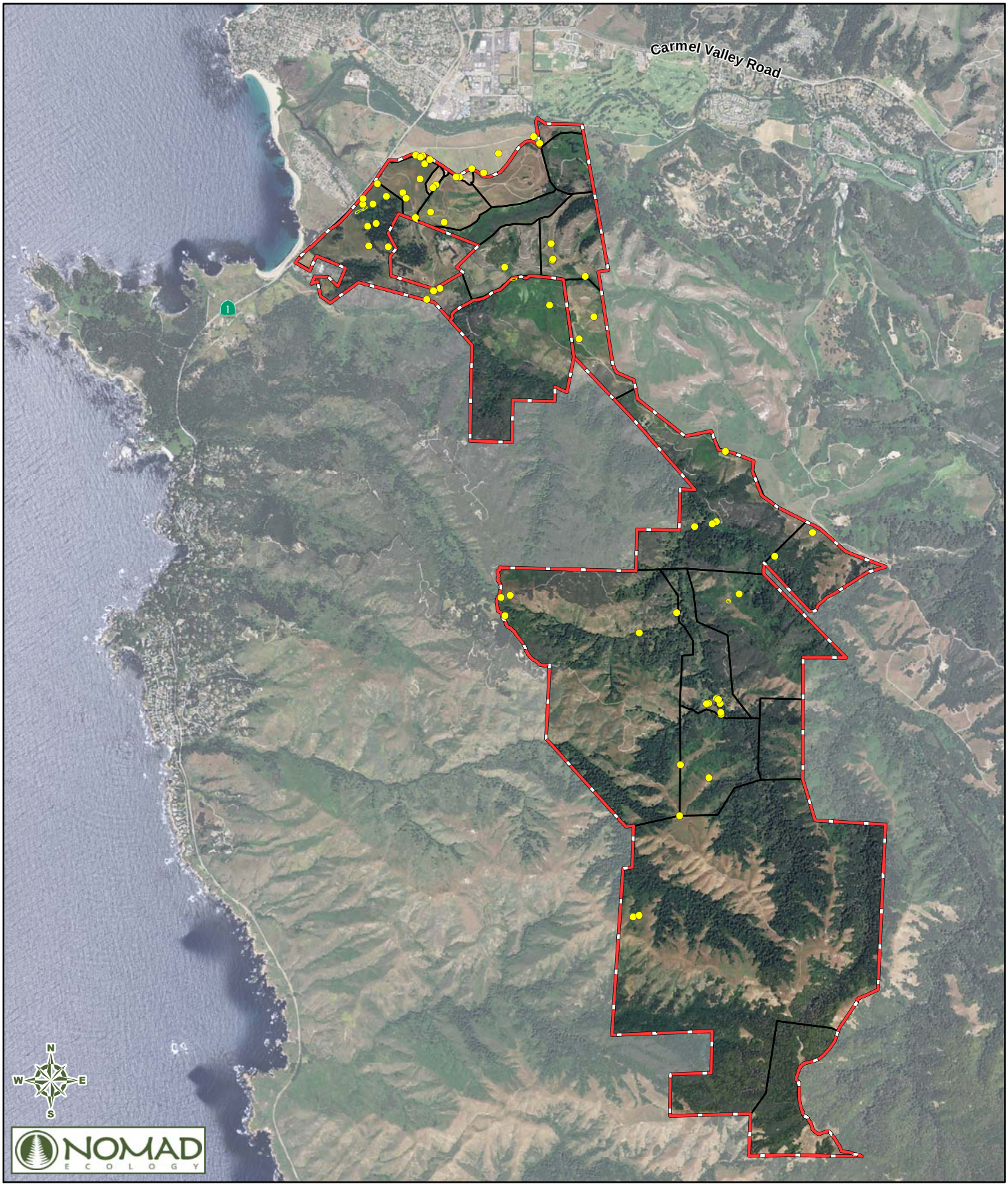
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Bull Thistle (Cirsium vulgare)

Bull Thistle Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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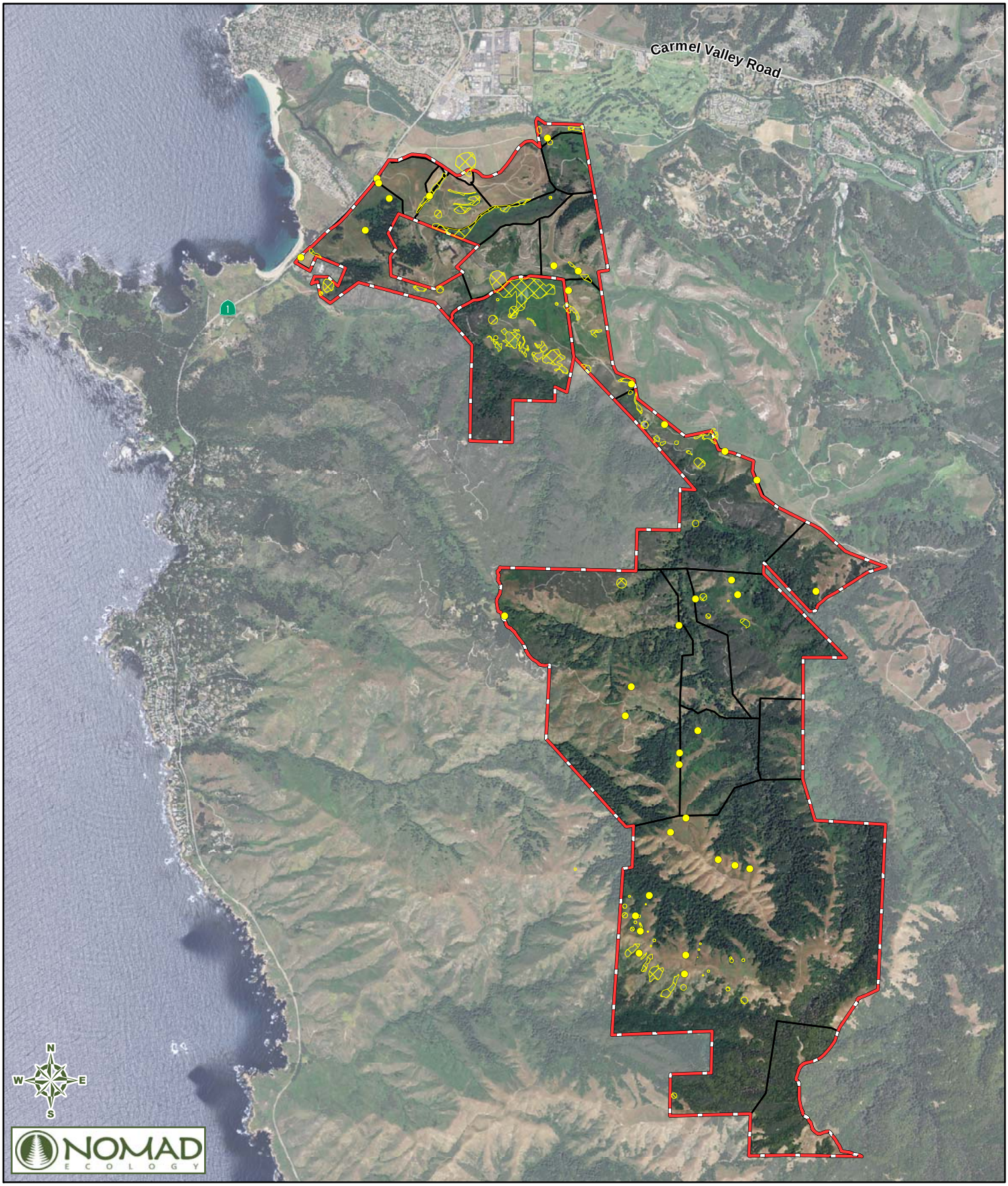
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Poison Hemlock (Conium maculatum)

Poison Hemlock Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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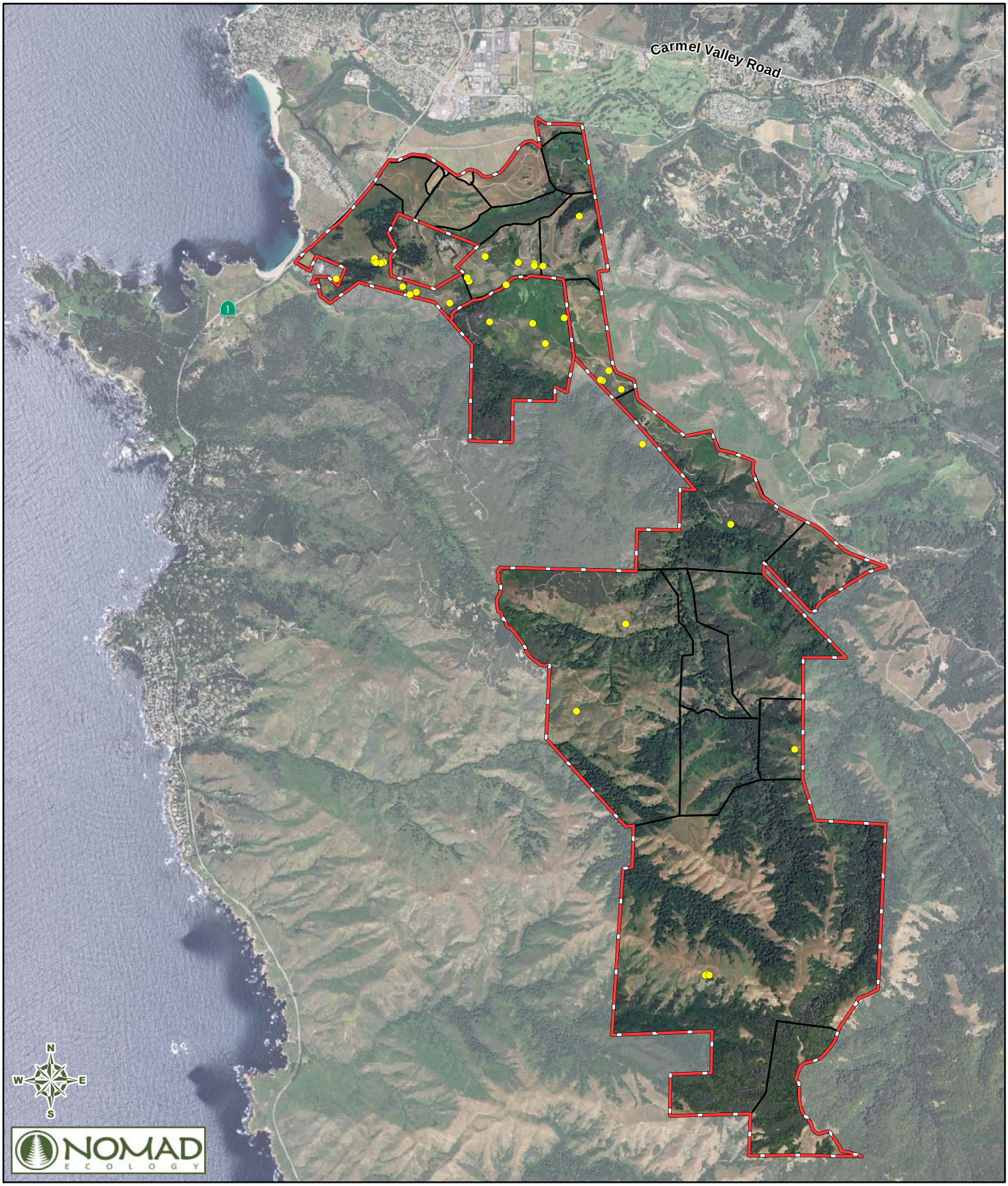
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Jubata Grass (Cortaderia jubata)

Management Units

Jubata Grass Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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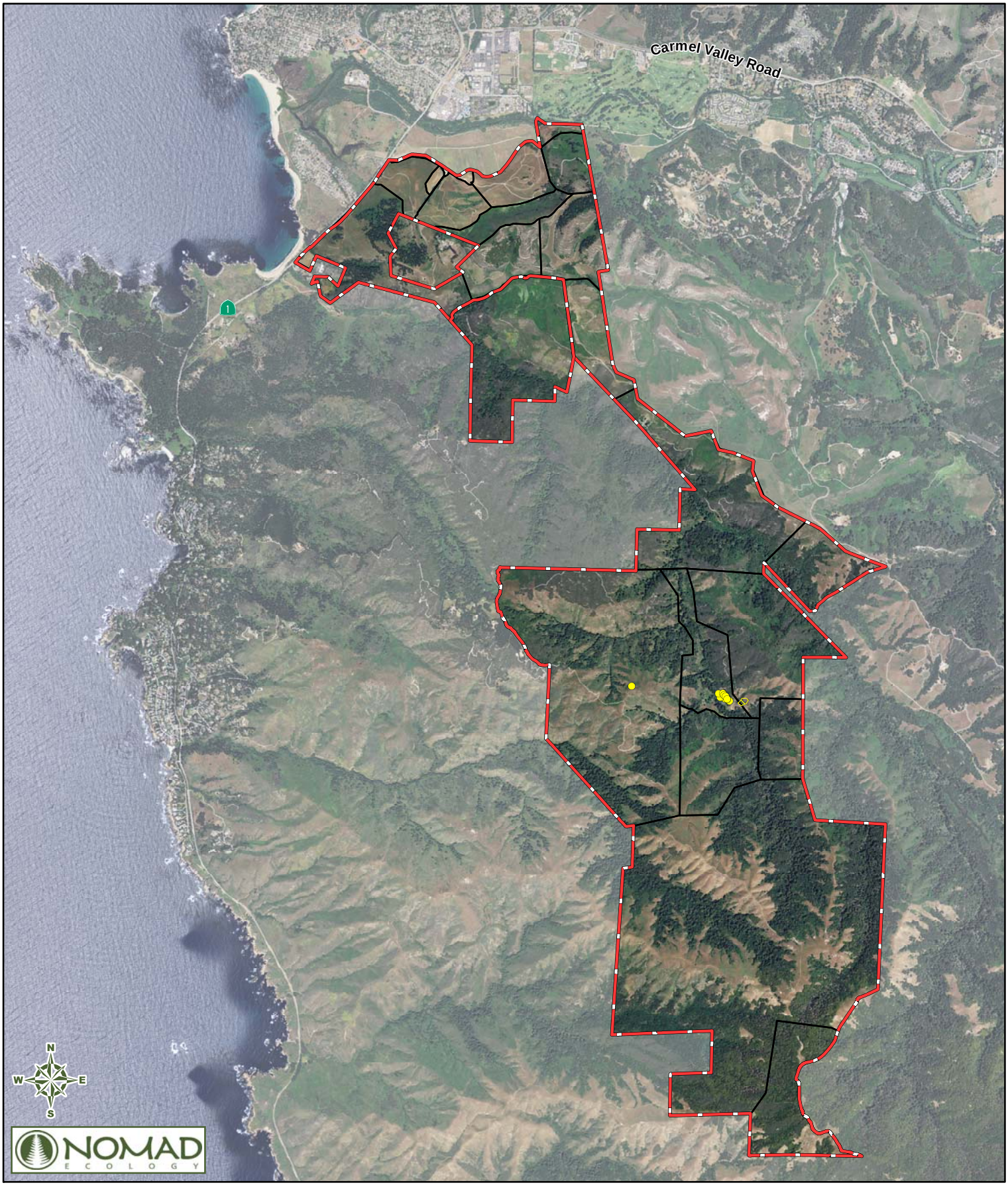
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Silverleaf Cotoneaster (Cotoneaster pannosa)

Management Units

Silverleaf Cotoneaster Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

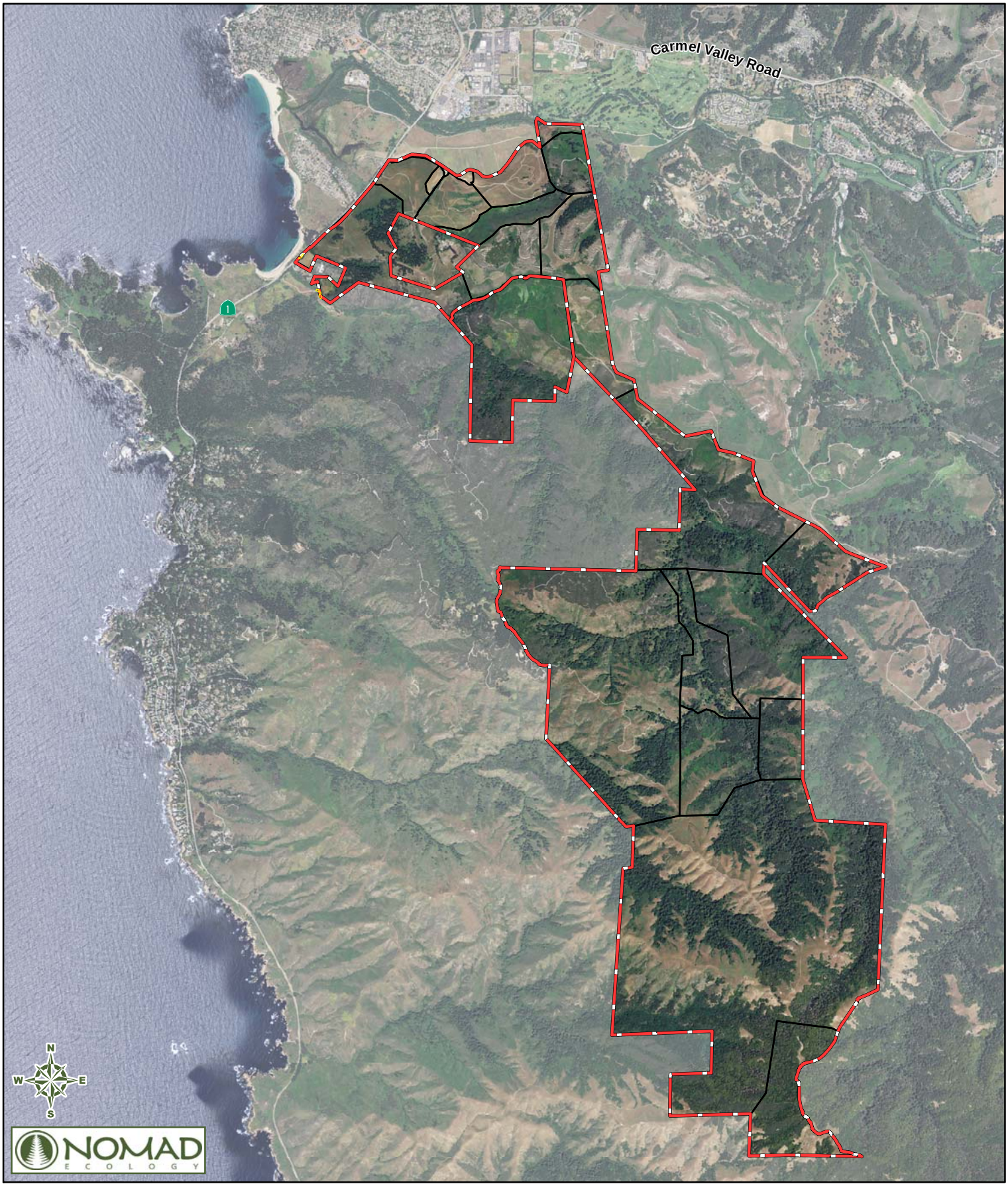
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Cape Ivy (Delairea odorata)

Management Units

Cape Ivy Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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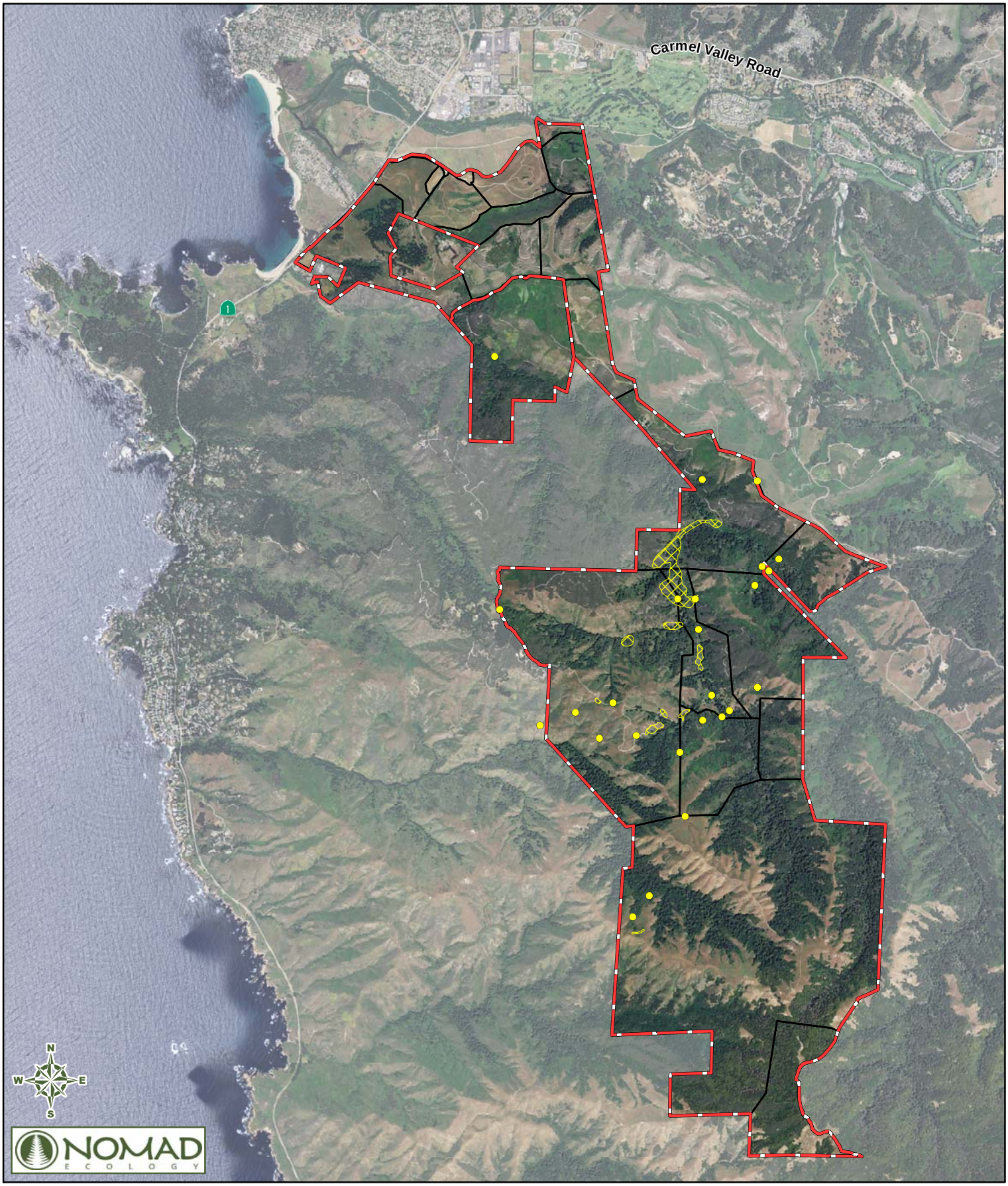
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Foxglove (Digitalis purpurea)

Management Units

Foxglove Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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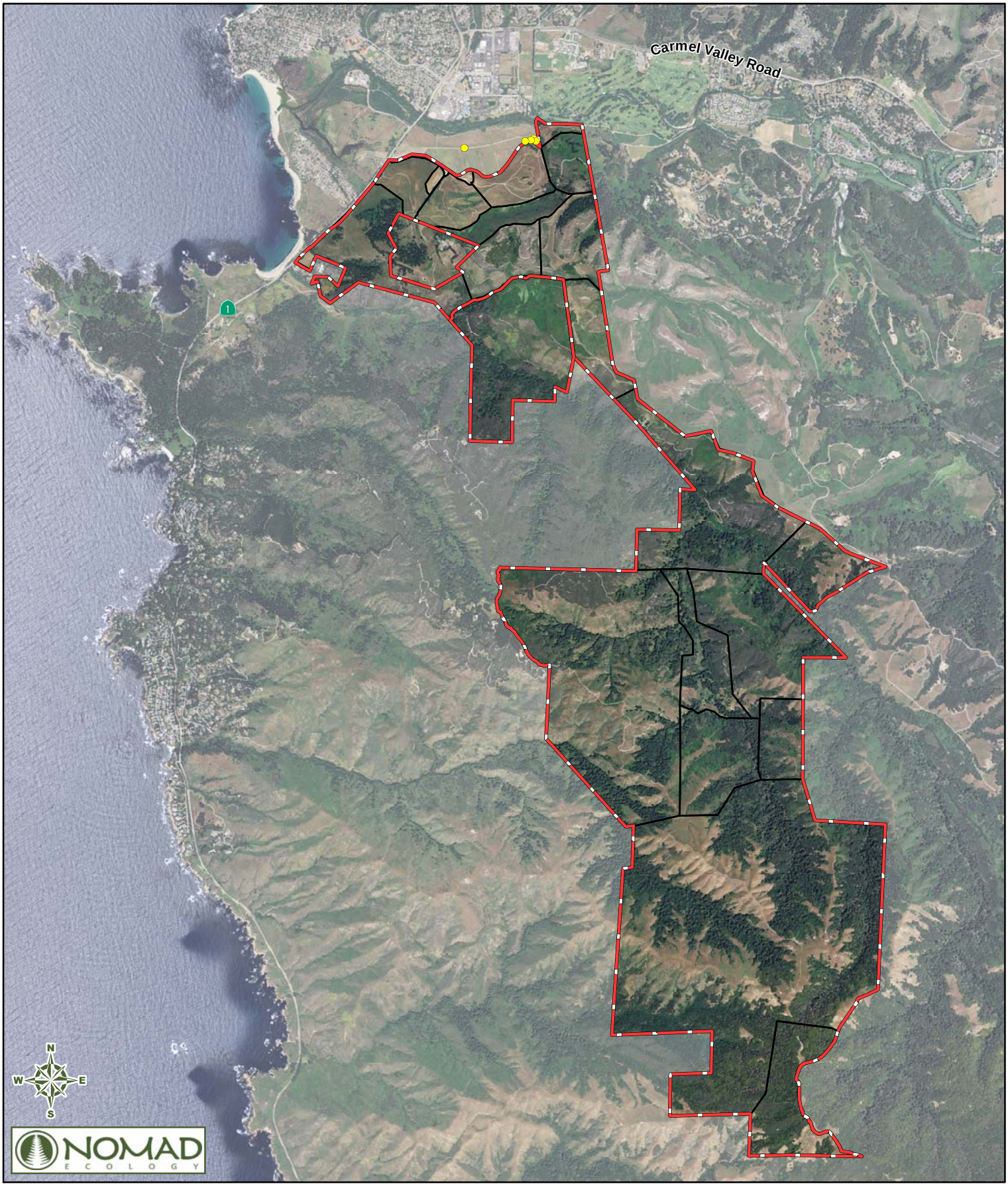
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Pride of Madeira (Echium candicans)

Management Units

Pride of Madeira Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

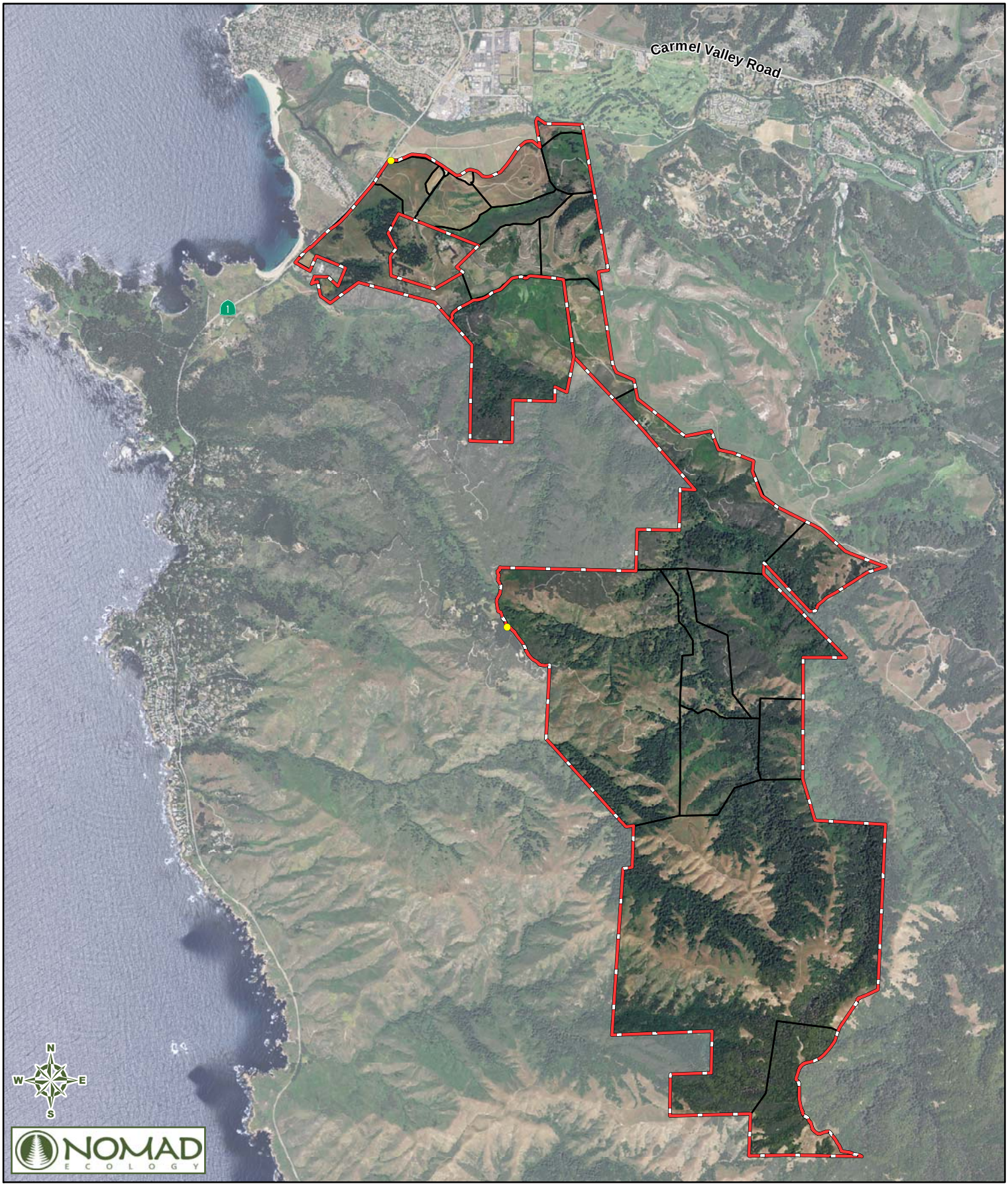
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Erect Veldtgrass (Ehrharta erecta)

Management Units

Erect Veldtgrass Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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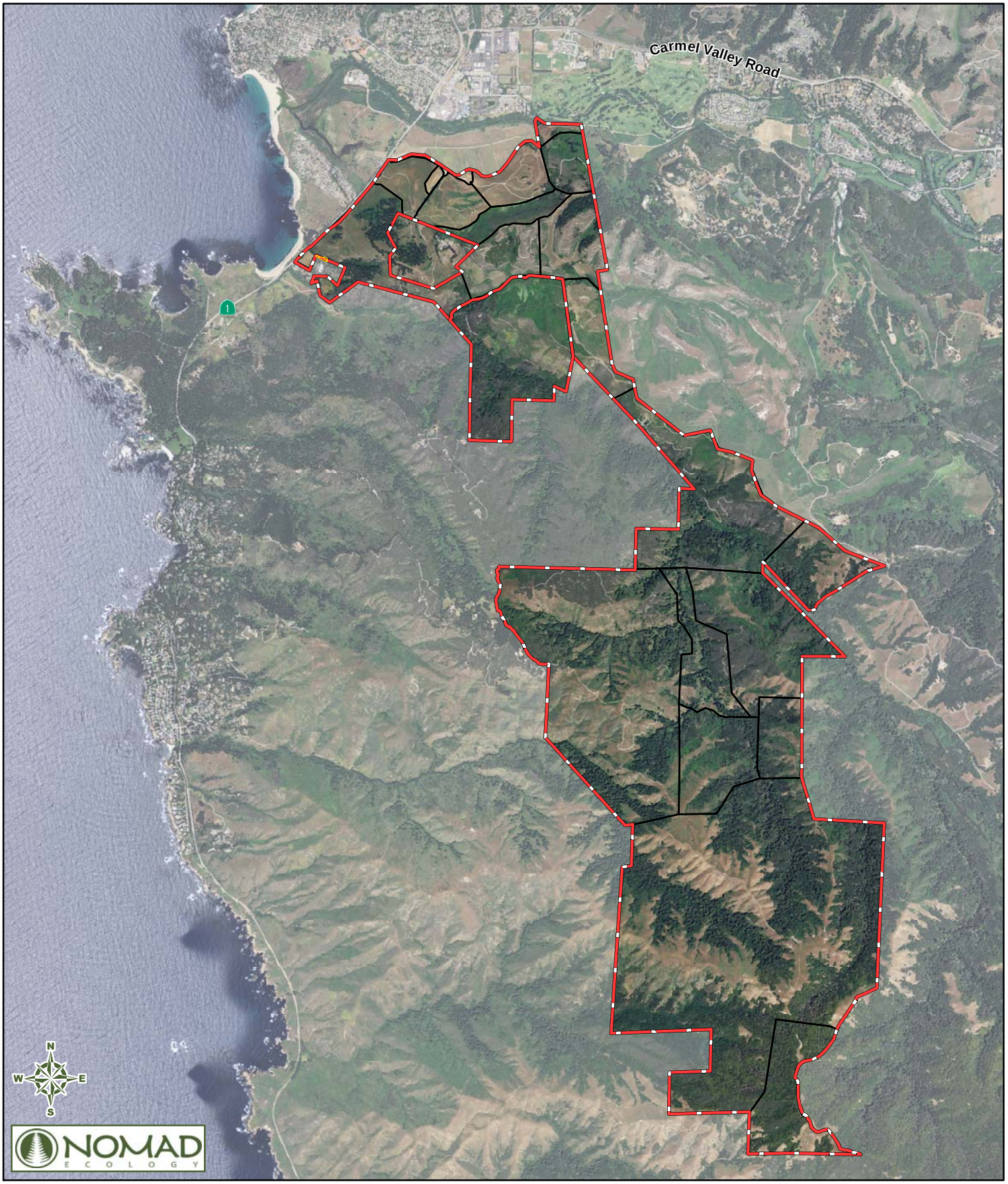
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Blue Gum (Eucalyptus globulus)

Management Units

Blue Gum Locations

Palo Corona Regional Park

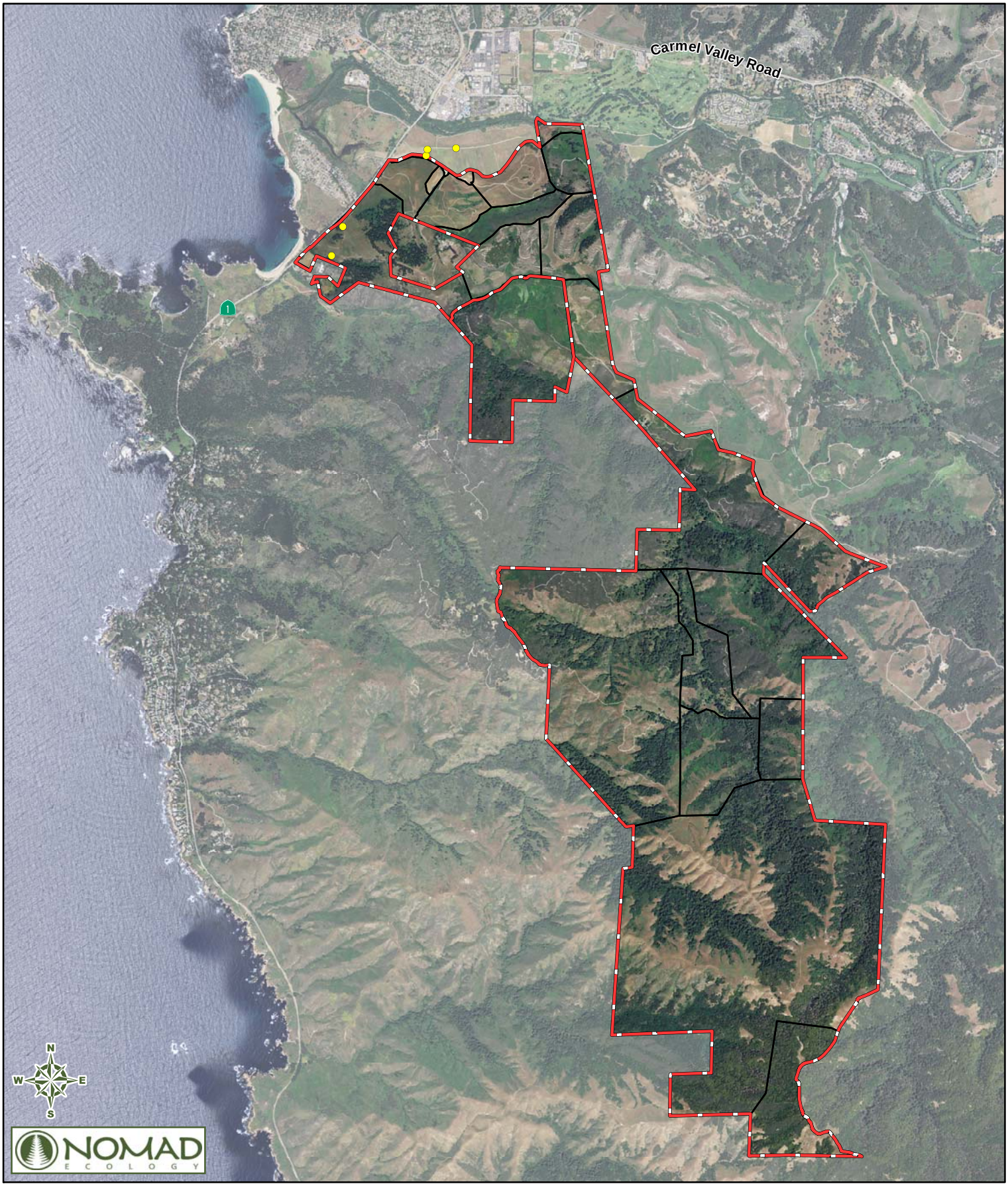
Monterey Peninsula Regional Park District

1:48,000

0 2,000 4,000 Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Fennel (Foeniculum vulgare)

Management Units

Fennel Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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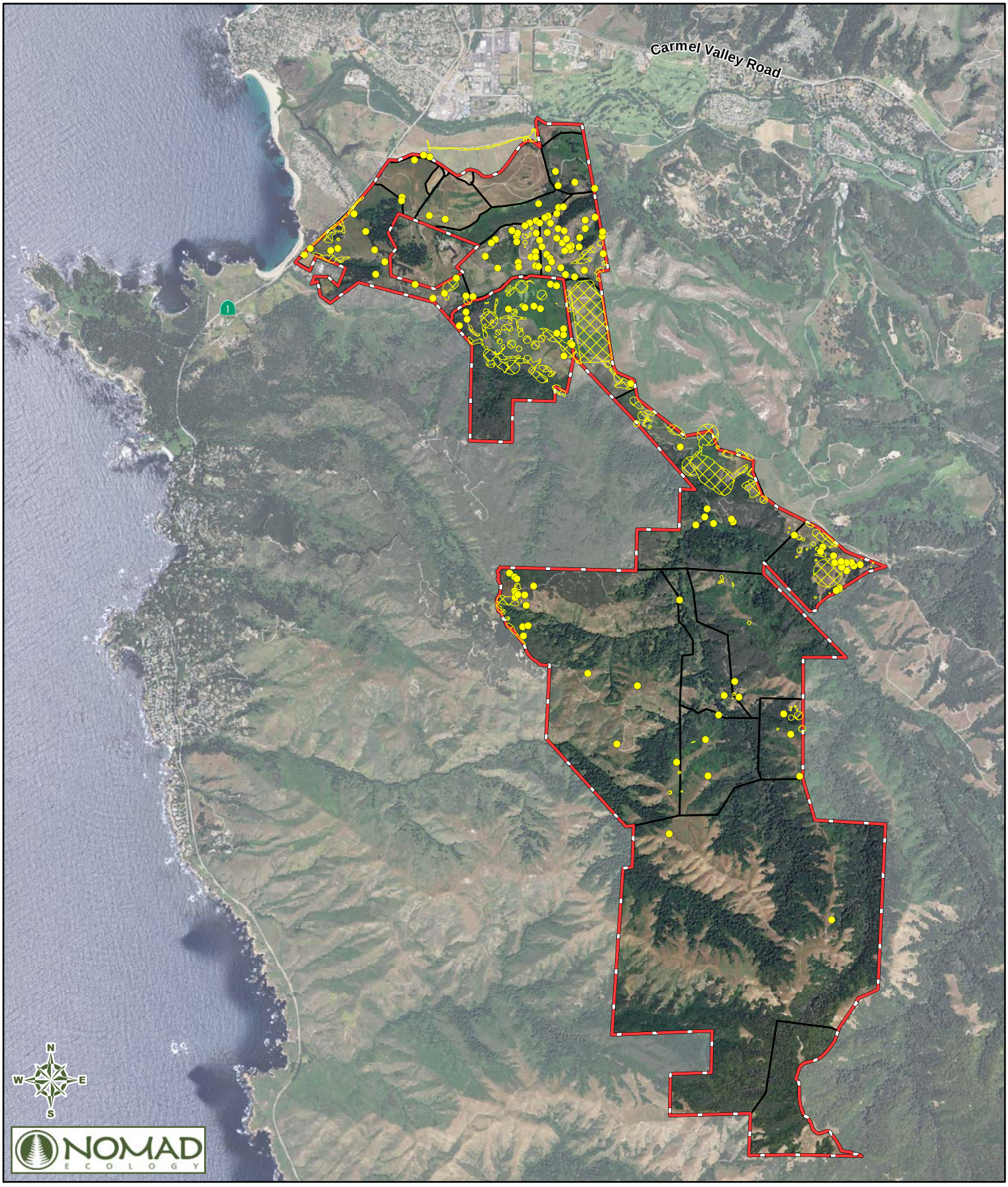
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

French Broom (Genista monspessulana)

French Broom Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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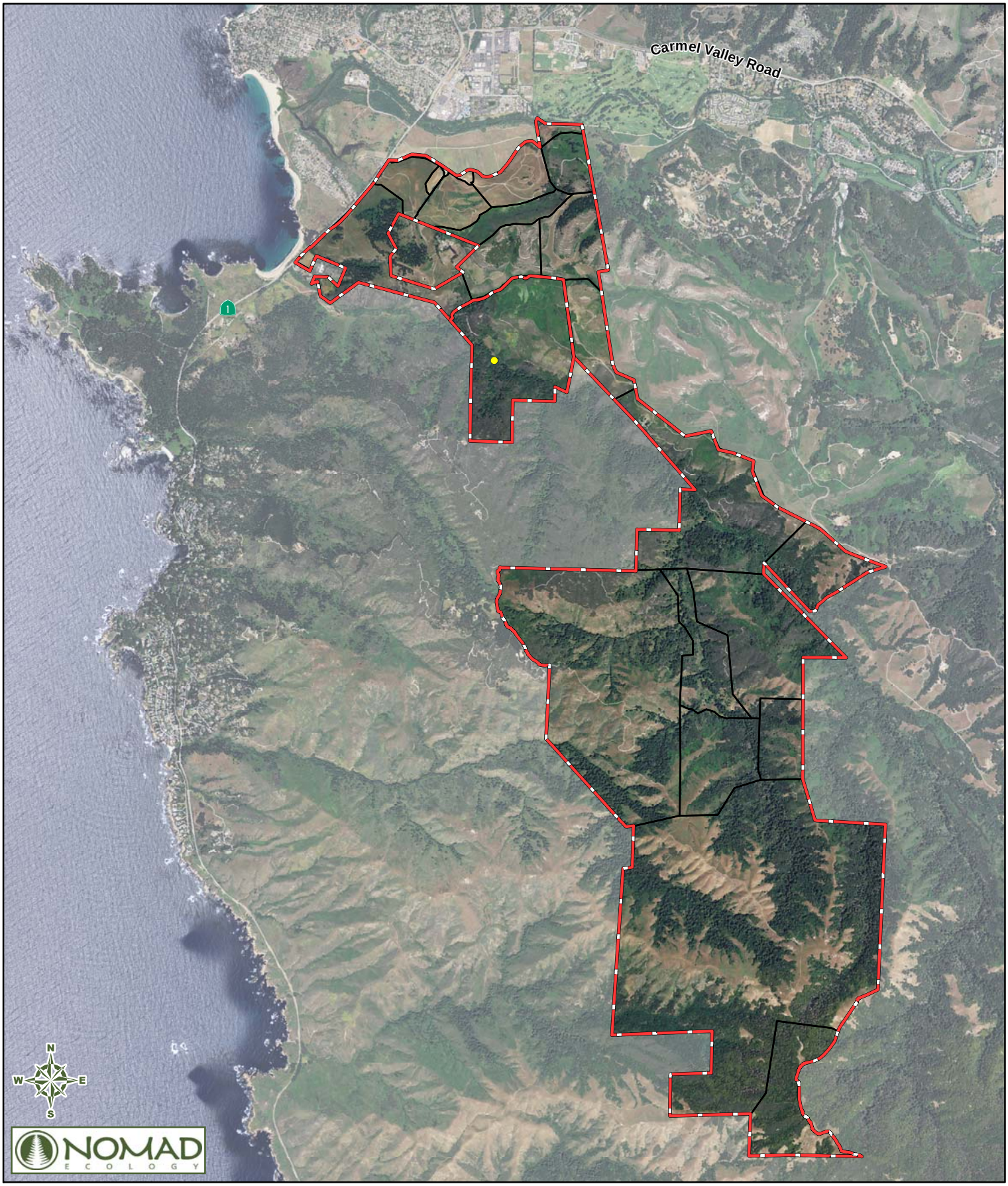
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

English Ivy (Hedera helix)

Management Units

English Ivy Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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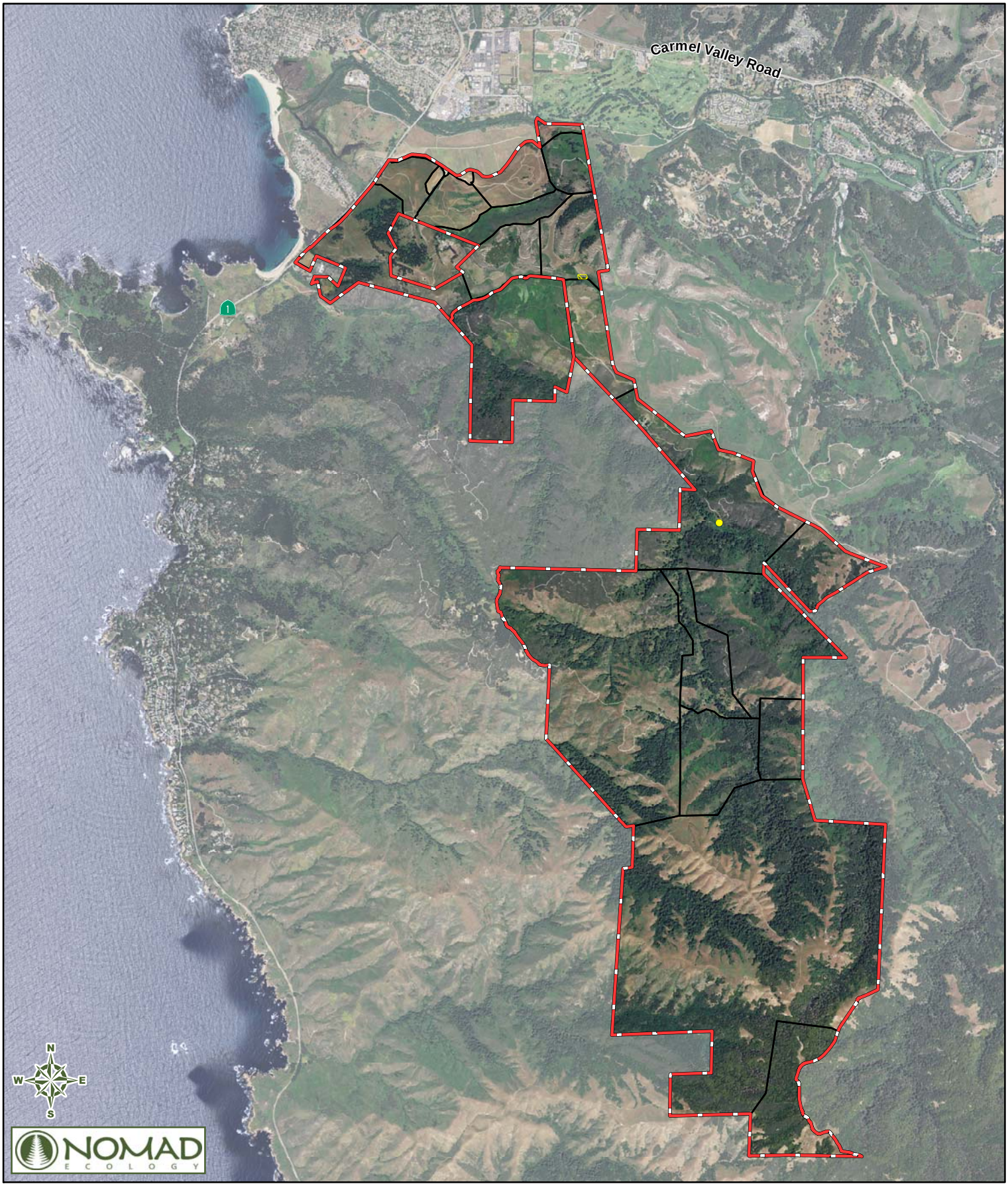
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Yellow Flag Iris (Iris pseudacorus)

Yellow Flag Iris Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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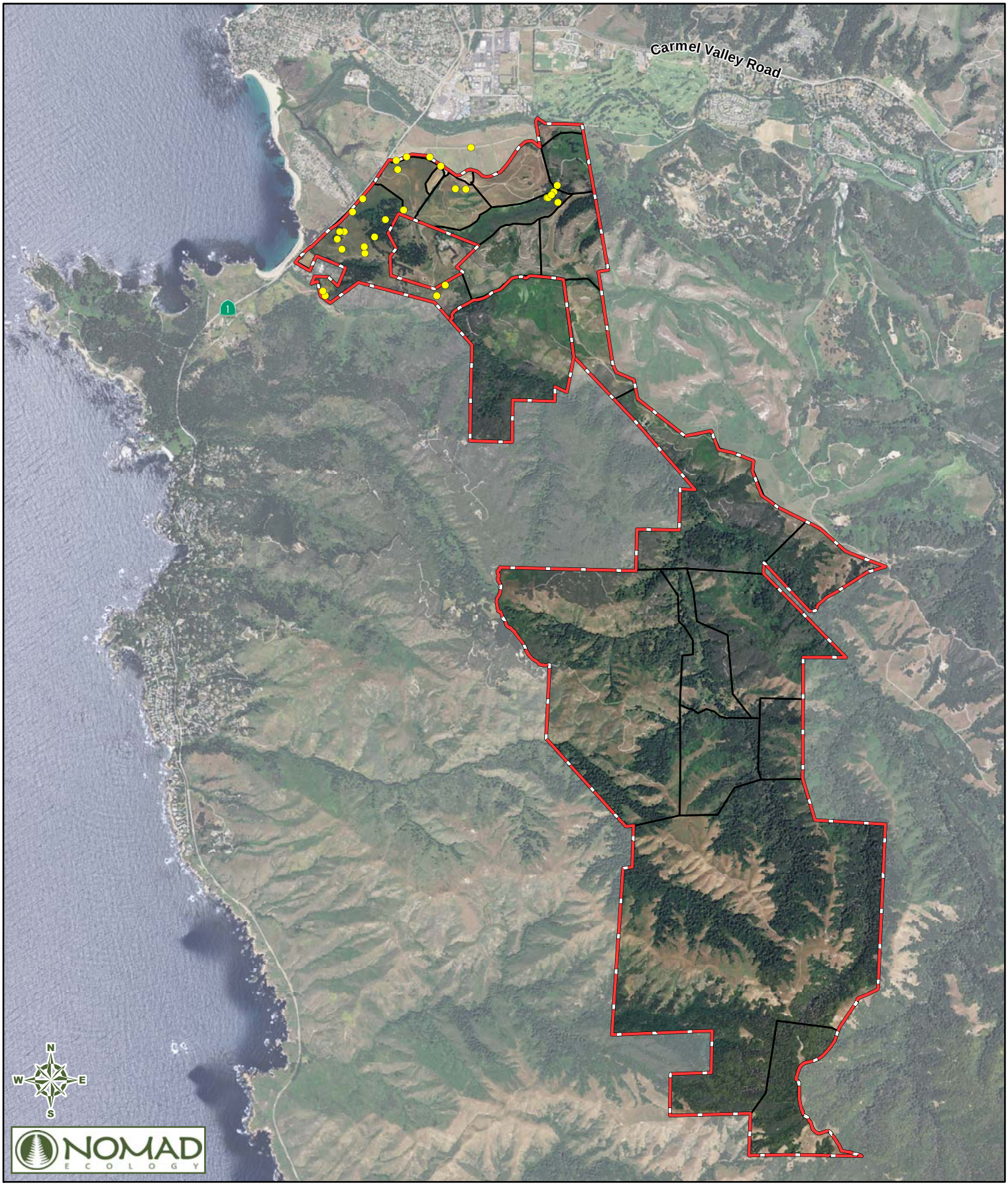
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Bermuda Buttercup (Oxalis pes-caprae)

Bermuda Buttercup Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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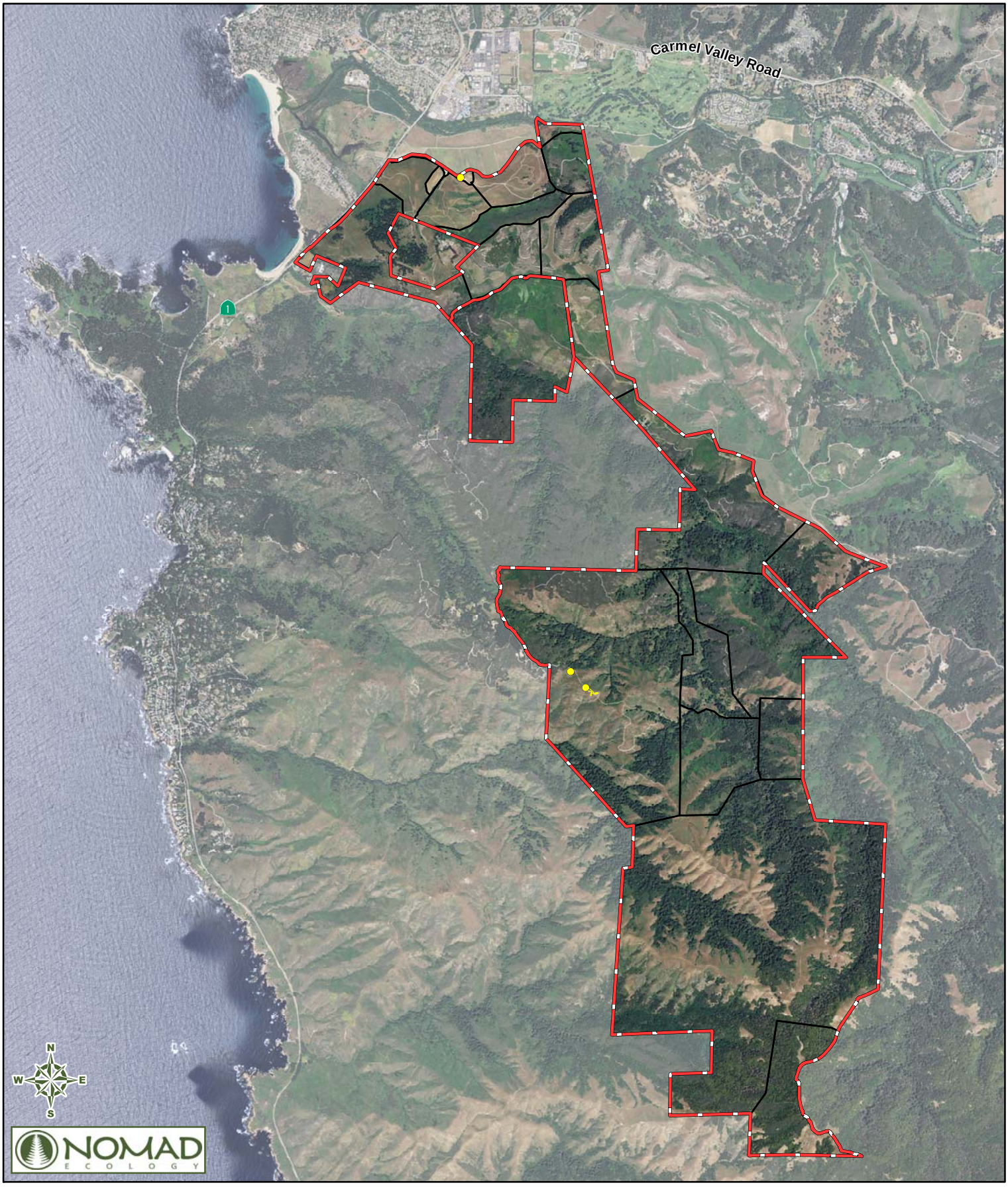
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Kikuyu Grass (Pennisetum clandestinum)

Kikuyu Grass Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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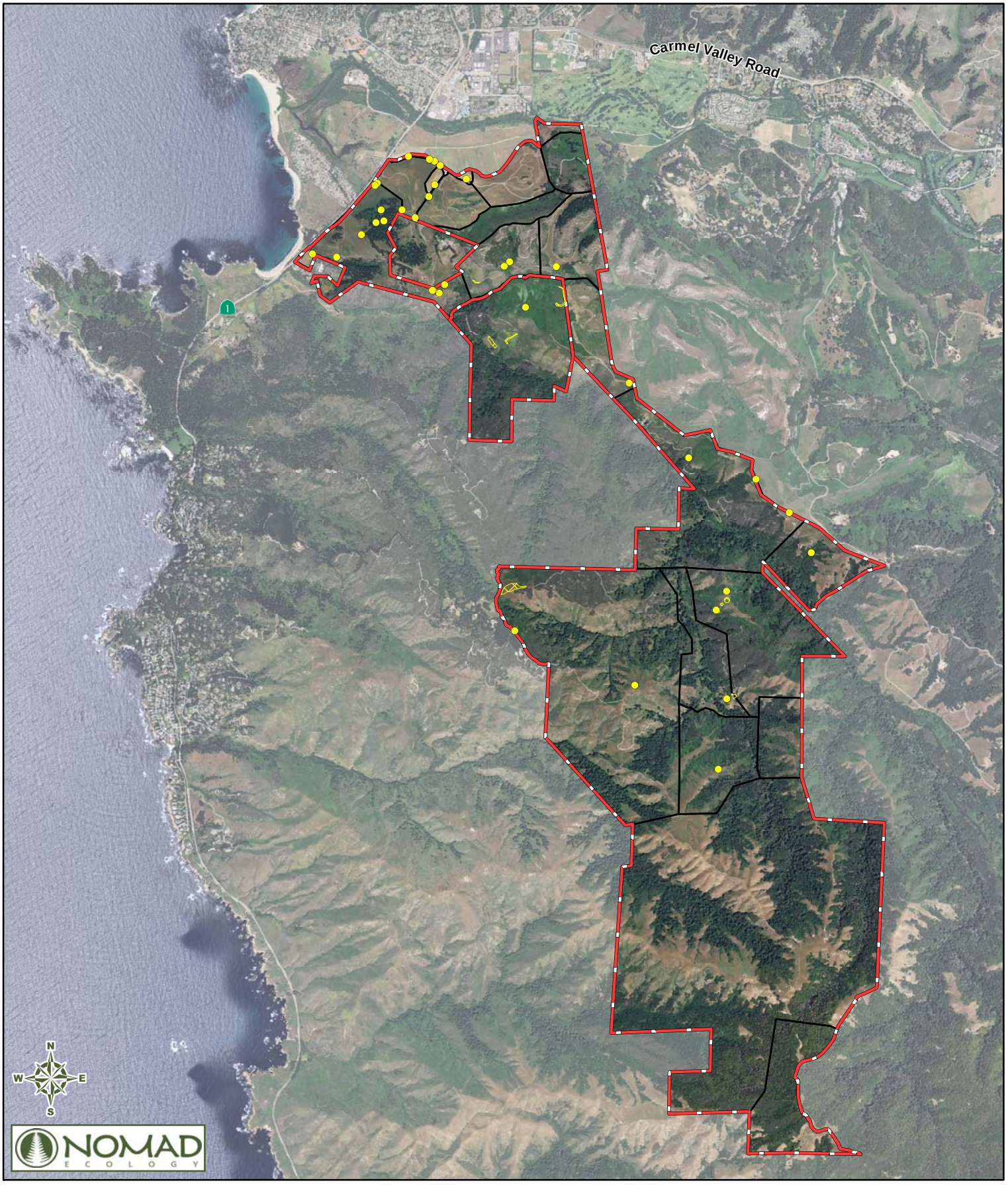
Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Harding Grass (Phalaris aquatica)

Harding Grass Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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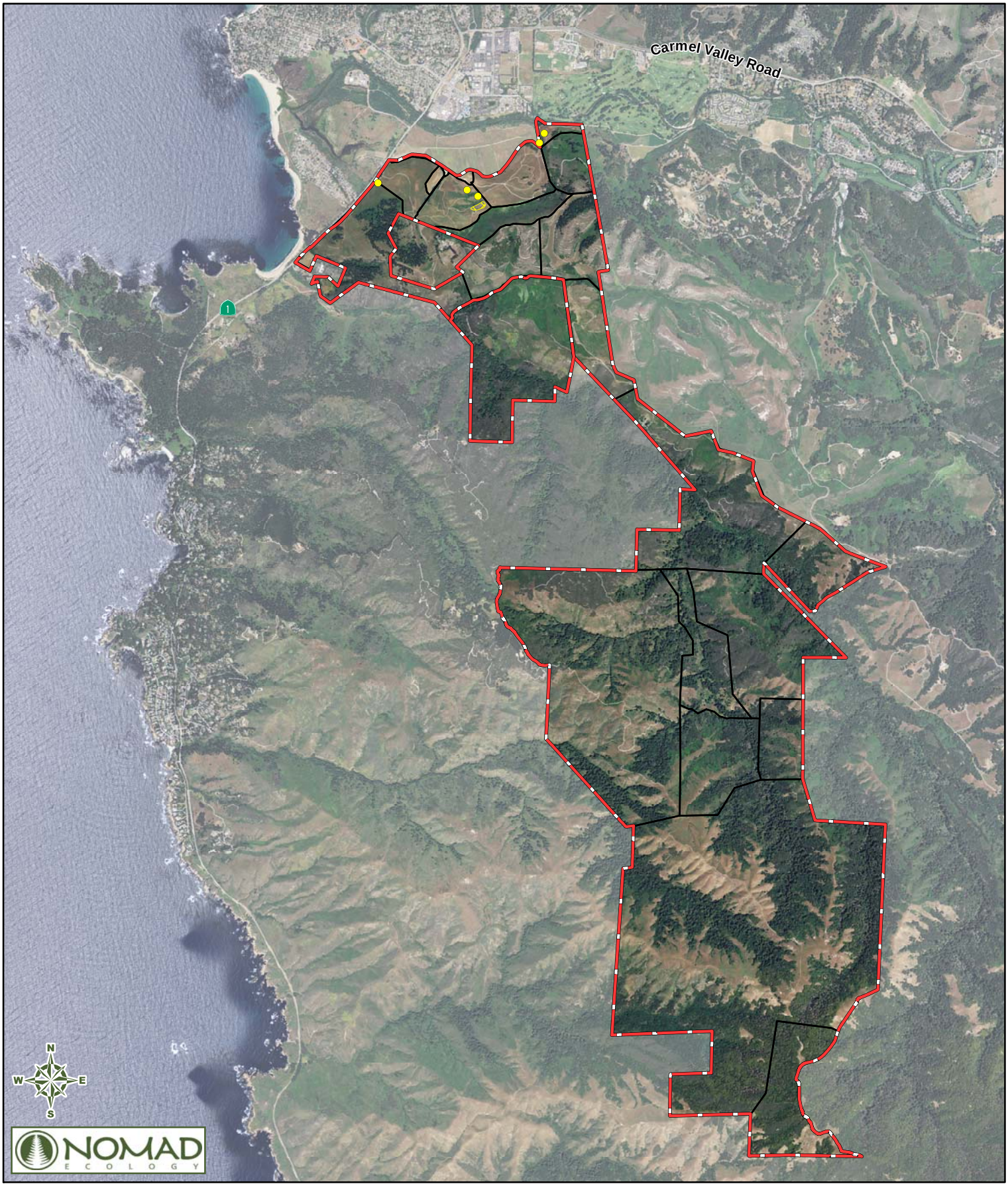
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Wild Radish (Raphanus sativus)

Wild Radish Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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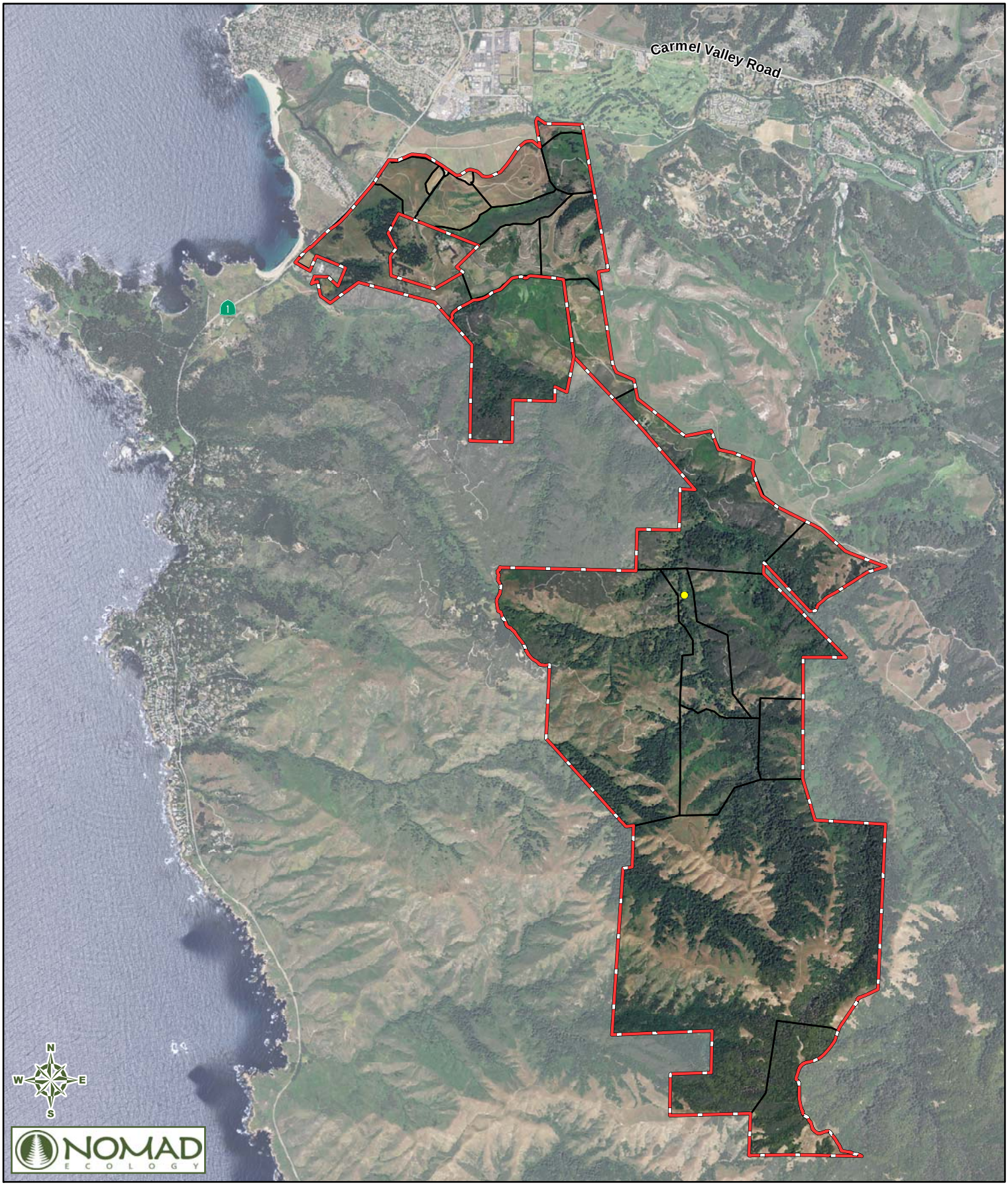
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Himalayan Blackberry (Rubus armeniacus)

Management Units

Himalayan Blackberry Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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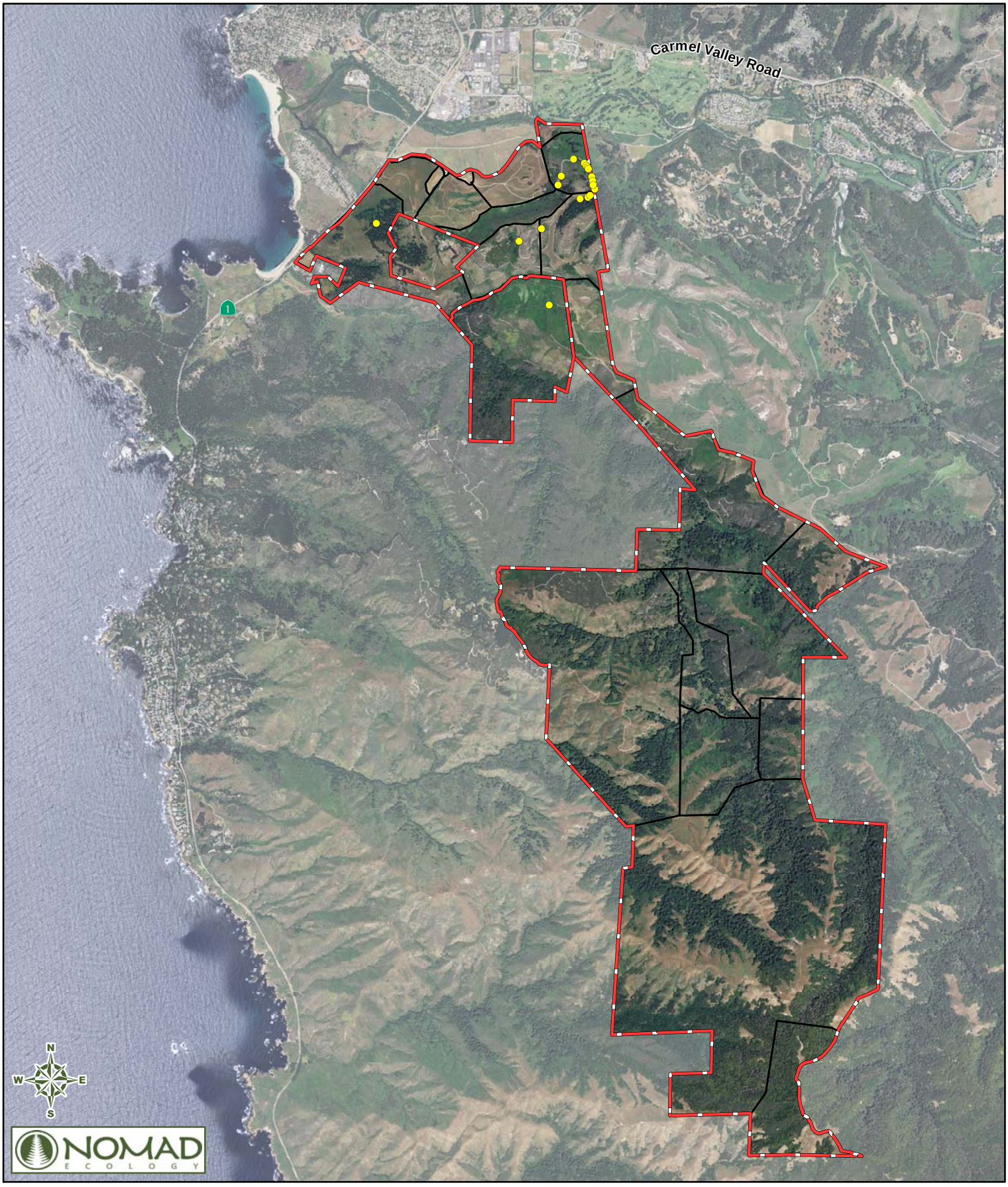
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Cutleaf Fireweed (Senecio glomeratus)

Cutleaf Fireweed Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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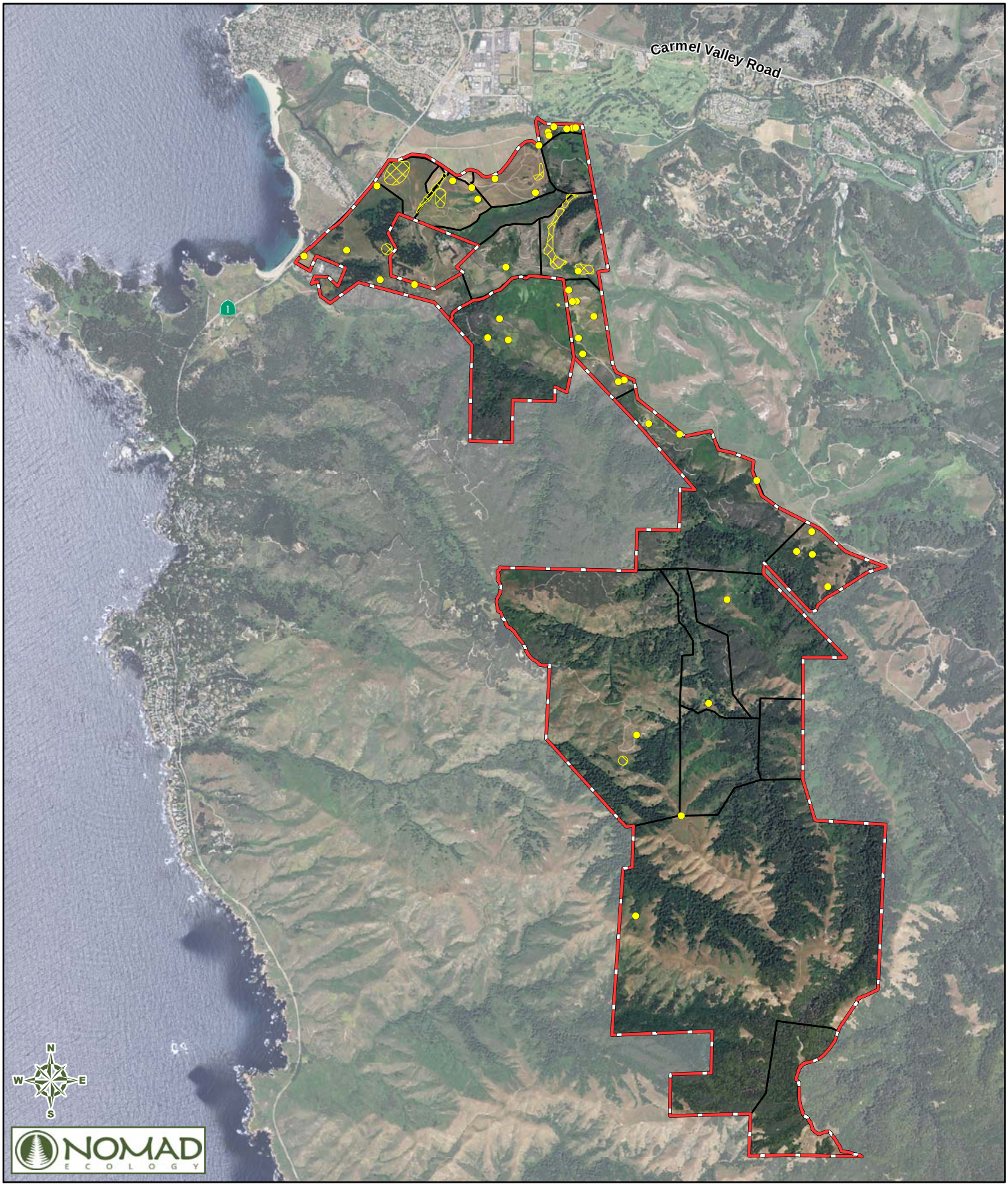
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Management Units

Milk Thistle (Silybum marianum)

Milk Thistle Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

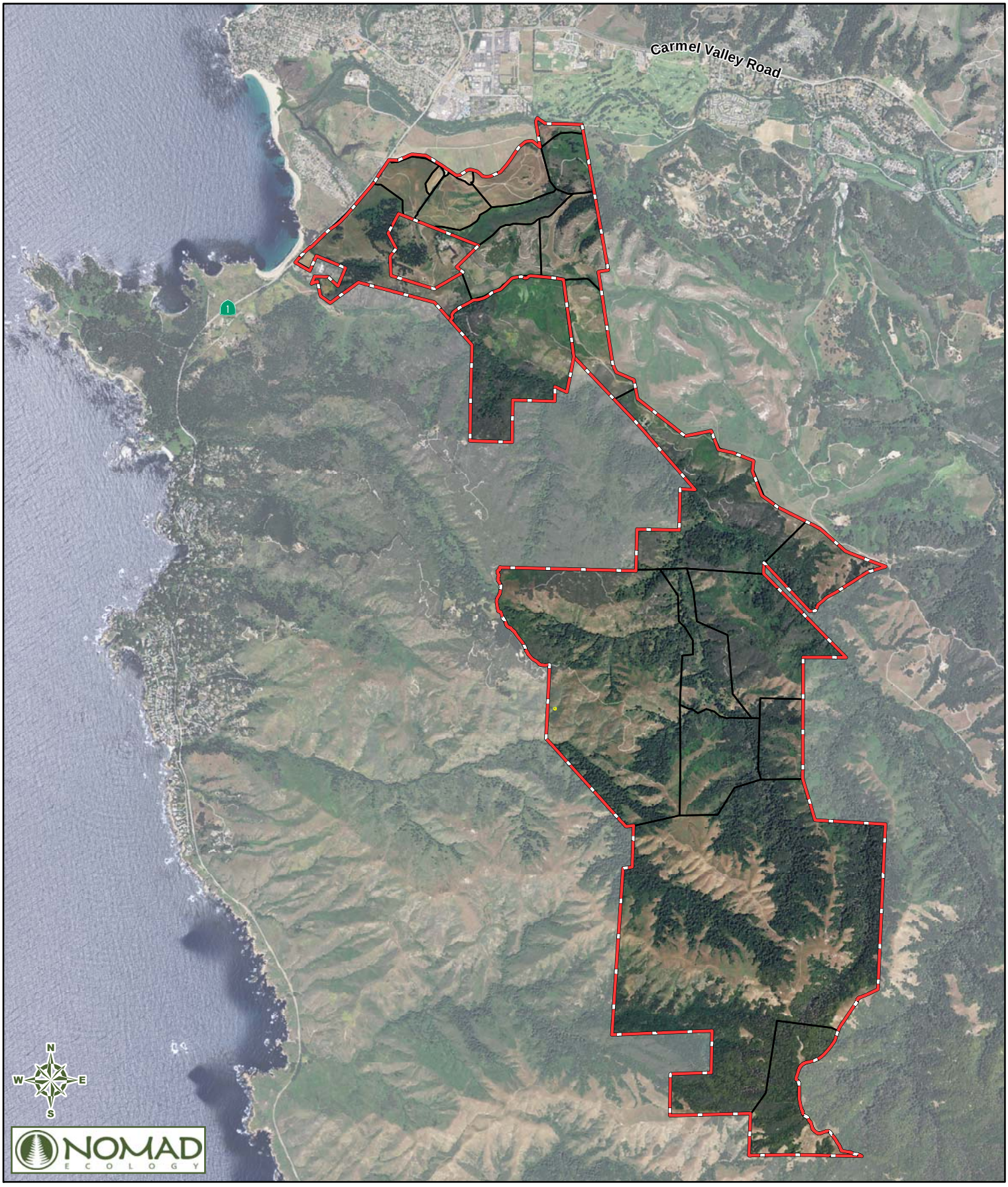
1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Common Mullein (Verbascum thapsus)

Management Units

Common Mullein Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

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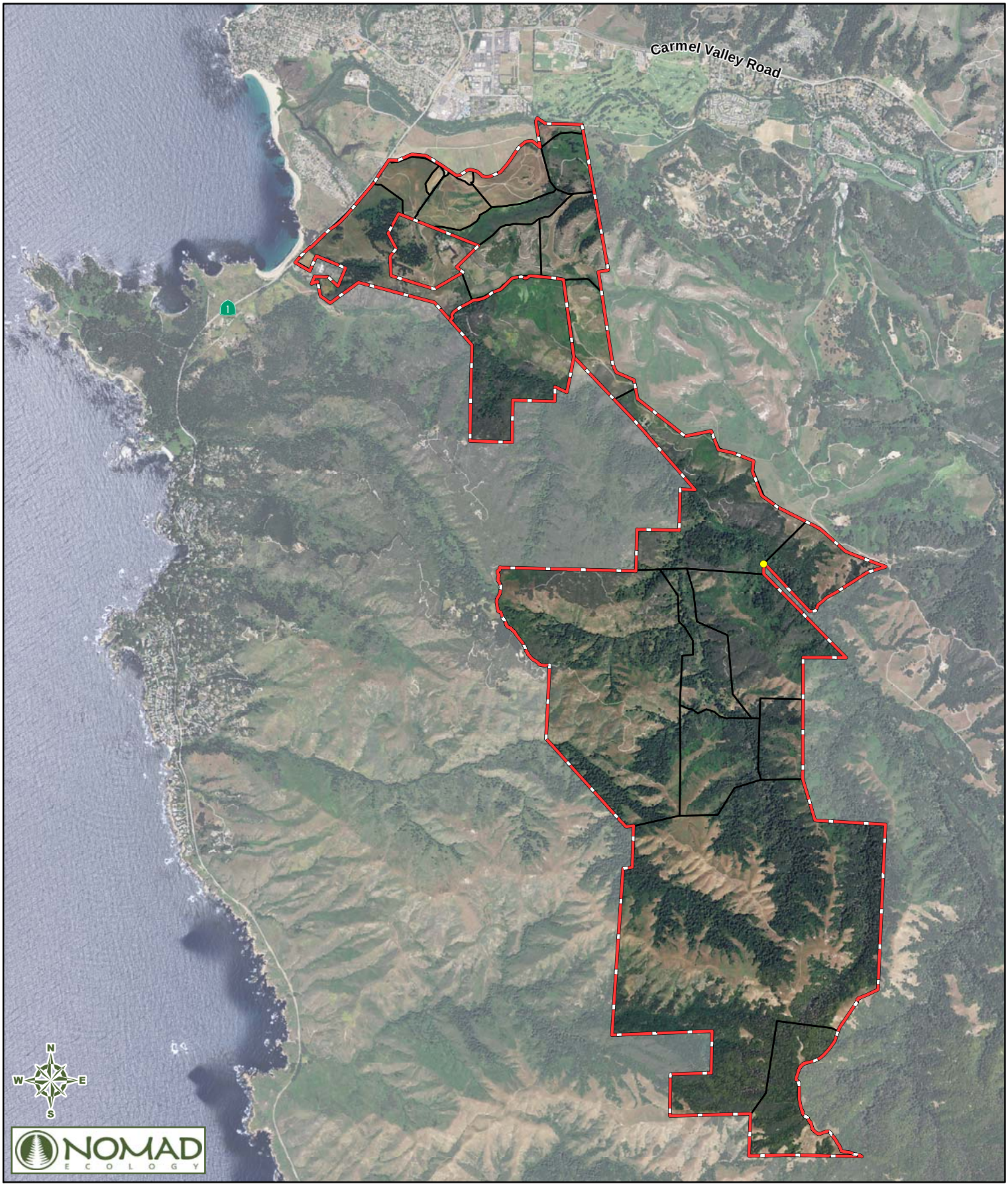
Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California



April 2014

Legend

Park Boundary

Periwinkle (Vinca major)

Management Units

Periwinkle Locations

Palo Corona Regional Park

Monterey Peninsula Regional Park District

1:48,000

0 2,000 4,000

Feet

Sources: California Spatial Information Libray, NAIP aerial imagery dated 2012. Native Range 2012 data. Nomad Ecology 2013 data. MPRPD.

Monterey County, California

APPENDIX C TARGET INVASIVE WEED SPECIES FOR MAPPING EFFORT

This list was compiled by Big Sur Land Trust, The Nature Conservancy, and Monterey Peninsula Regional Park District in order to direct field mapping efforts.

GENUS	SPECIES	COMMON NAME	CAL-IPC RANK	HELICOPTER	FAMILY
Ageratina	*adenophora*	crofton weed	Moderate	Unknown	Asteraceae
Anthemis	*cotula*	mayweed	Not Evaluated	Moderate	Asteraceae
Brassica	*rapa*	field mustard	Limited	High	Brassicaceae
Brassica	*nigra*	black mustard	Moderate	High	Brassicaceae
Bromus	*diandrus*	ripgut brome	Moderate	Difficult	Poaceae
Carduus	*pycnocephalus*	Italian thistle	Not Evaluated	High	Asteraceae
Carpobrotus	*chilensis*	ice plant, sea fig	Moderate	High	Aizoaceae
Centaurea	*melitensis*	tocolate	Moderate	Moderate	Asteraceae
Centaurea	*solstitialis*	yellow starthistle	High	Moderate	Asteraceae
Cirsium	*vulgare*	bull thistle	Moderate	Moderate	Asteraceae
Conium	*maculatum*	poison hemlock	Moderate	High	Apiaceae
Cortaderia	*jubata*	jubatagrass	High	High	Poaceae
Cotoneaster	*pannosa*	silverleaf contoneaster	Moderate	High	Rosaceae
Cotula	*australis*	Australian cotula	Not Evaluated	Unknown	Asteraceae
Dactylis	*glomerata*	orchard grass	Limited	High	Poaceae
Delairea	*odorata*	cape ivy	High	High	Asteraceae
Ehrharta	*calycina*	perennial veldtgrass	High	Moderate	Poaceae
Ehrharta	*erecta*	veldt grass	Moderate	Difficult	Poaceae
Eucalyptus	*globulus*	blue gum	Moderate	High	Myrtaceae
Foeniculum	*vulgare*	sweet fennel	High	High	Apiaceae
Genista	*monspessulana*	French broom	High	High	Fabaceae
Hedera	*helix*	English ivy	High	High	Araliaceae
Ilex	*aquifolium*	English holly	Moderate	High	Aquifoliaceae
Iris	*pseudacorus*	yellow flag iris	Limited	Unknown	Iridaceae
Marrubium	*vulgare*	white horehound	Limited	High	Lamiaceae
Nicotiana	*glauca*	tree tobacco	Moderate	High	Solanaceae
Oxalis	*pes-caprae*	Bermuda buttercup	Moderate	Moderate	Oxalidaceae
Pennisetum	*clandestinum*	kikuyu grass	Limited	High	Poaceae
Phalaris	*aquatica*	Harding grass	Moderate	High	Poaceae

GENUS	SPECIES	COMMON NAME	CAL-IPC RANK	HELICOPTER	FAMILY
Raphanus	*sativus*	wild radish	Limited	High	Brassicaceae
Rubus	*armeniacus*	Himalayan blackberry	High	High	Rosaceae
Senecio	*glomerata*	cutleaf fireweed	Moderate	High	Asteraceae
Senecio	*minima*	New Zealand fireweed	Moderate	Moderate	Asteraceae
Silybum	*marianum*	milk thistle	Limited	High	Asteraceae
Vinca	*major*	periwinkle	Moderate	Moderate	Apocynaceae
Xanthium	*spinosum*	spiny cocklebur	Not Evaluated	High	Asteraceae

APPENDIX D INVASIVE WEED SPECIES ACCOUNTS

Information appearing under the headings General Information, Relevant Life History Traits and Management Strategies for each species was primarily excerpted from DiTomaso, J.M. and E.A. Healy. 2007. *Weeds of California and Other Western States*. University of California Agriculture and Natural Resources Publication 3488.

CROFTON WEED
Ageratina adenophora

General Information

Crofton weed is an escaped perennial with ovate-triangular leaves in the sunflower family (Asteraceae). It is especially invasive in mild coastal regions where it inhabits disturbed places in canyons and riparian corridors. Crofton weed is most successful where moisture is available year-round, and it can tolerate various levels of shade. It is native to southern and central Mexico (DiTomaso and Healy 2007). Cattle generally avoid eating it, but it can cause a fatal respiratory illness in horses when ingested frequently.

Relevant Life History Traits

Lower stems and stem fragments that contact moist soil can develop adventitious roots. Crofton weed reproduces primarily by seed. Seeds can disperse with water, soil movement, human activities, and animals. Seeds can germinate nearly year-round (DiTomaso and Healy 2007).

Current Distribution in PCRP

Twenty-four occurrences of crofton weed were mapped totaling 5.31 gross acres. Crofton weed was present in the Animas, Malpaso, Panoche, and West Animas MUs and offsite at the Monastery.

Associated Vegetation Communities

Crofton weed was generally located in steep ravines in grassland habitat. It was also present in redwood forest, in grassland adjacent to riparian habitat, and chaparral.

Threats to Sensitive Biological Resources

Crofton weed was present in Malpaso Creek and could spread downstream. It was scattered in maritime chaparral.

Priority for Treatment

Crofton weed has a medium species priority rank. The occurrence that is along Malpaso Creek is Priority 2 for control to prevent spread downstream. Other populations are lower priority for treatment. Steep slopes will make control of this species difficult.

Management Strategies

Prevention is strongly recommended as large infestations, are difficult to control.

Mechanical: Remove small infestations (spring) before species begins flowering. When digging out plants, remove the crown and short rootstock to prevent the growth of new shoots. Cutting a plant may not control it, but over time it will reduce the seed bank and reduce the population. However, plants often grow on steep slopes making hand removal difficult.

Cultural: Although generally unpalatable to cattle, goats are known to eat crofton weed. Because of its toxic nature, the same group of goats should be used for only one or two seasons to avoid risk of chronic health problems. Grazing success depends on stocking rate, weed density, and availability of other feed at the site.

Chemical: Use glyphosate (75 ml/15 L) for backpack sprayer with a high volume foliar spray. Apply 75 ml/15 L at a rate of 0.5% *Roundup ProMax Concentrate* for spot treatment postemergence to fully developed leaves, generally in late summer or autumn when weed is growing actively. Make sure to spray to wet leaves.

PLUME ACACIA
Albizia lophantha

General Information

Plume acacia is a shrub or tree in the legume family (Fabaceae) with compound leaves and bottlebrush-like clusters of flowers. It infests disturbed coastal urban areas where it tolerates poor soils well. Plume acacia is native to western Australia.

Relevant Life History Traits

Seeds can be dispersed by invertebrates, particularly ants, and transported soil. The seeds germinate well after fire and can grow very quickly.

Current Distribution in PCRP

There were 2 occurrences totaling less than 0.01 gross acre. Both occurrences were at the northern boundary of PCRP, just off site. Monitor population to be certain they are not spreading onto PCRP.

Associated Vegetation Communities

These populations were growing in ruderal grassland.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Plume acacia has a low species priority rank and these populations are low priority for treatment. Populations should be monitored to be certain they are not spreading onto PCRP.

Management Strategies

Manual: Hand pull or dig up small plants (all year round). Be careful to ensure minimum soil disturbance.

Chemical: Make use of the cut and squirt method: Make 1 cut every 100 mm around the trunk and saturate each cut with 5 ml undiluted triclopyr 600 EC (5ml). There is also an injection method where you drill holes sloping into the sapwood at regular intervals around the tree. As each hole is drilled saturate with glyphosate (250ml/L) or triclopyr 600EC (10ml undiluted). Finally, the spray method (spring-summer) apply glyphosate (10ml/L) or triclopyr 600 EC (30ml/10L).

BLACK MUSTARD
Brassica nigra

General Information

Black mustard is an erect winter annual that exists as a basal rosette until flowering stems develop at maturity. This species is in the mustard family (Brassicaceae). This species is native to Europe. The foliage, roots, and seeds of black mustard are toxic to livestock when consumed in large quantities over time. Black mustard grows along roadsides, fields, disturbed waste places, and grasslands, especially in coastal areas. In coastal grasslands, dense stands of black mustard outcompete native vegetation. Newly burned sites are subject to invasion (DiTomaso and Healy 2007).

Relevant Life History Traits

Black mustard reproduces by seeds. Most seeds fall near parent plants but disperse to greater distances with water, soil movement, human activities, and animals. Black mustard usually develops a large, persistent seed bank (DiTomaso and Healy 2007).

Current Distribution in PCRP

There were 3 polygons mapped totaling 4.6 acres. These polygons were dense monocultures of the species. During field data collection, Native Range noted the presence or absence of mustard when mapping other species as point data during their fieldwork. Native Range recorded 38 locations of mustard with the majority recorded in the Front Country. Eighteen of these 38 locations were off site in the field north of PCRP. The species of mustard was not noted.

Associated Vegetation Communities

Black mustard was associated primarily with annual grassland vegetation.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Black mustard has a medium species priority rank. No occurrences are high priority for treatment.

Management Strategies

Mechanical: Plants can be hand pulled before they produce seed. Yearly removal of plants before seeds mature can eventually deplete the seedbank.

Cultural: Plants are readily eaten by livestock.

Prescribed Burning: Burning and other kinds of disturbance usually favor the increase of mustard species.

Chemical: Use Chlorosulfuron on preemergent or early post emergent plants when weeds are germinating or actively growing. Triclopyr can be used during postemergence when weeds are small and rapidly growing.

ITALIAN THISTLE
Carduus pycnocephalus subsp. *pycnocephalus*

General Information
Italian thistle is a winter annual, sometimes biennial, in the sunflower family (Asteraceae). Italian thistle is native to the Mediterranean region. It colonizes disturbed open sites, roadsides, pastures, annual grasslands, and waste areas and inhabit sandy to clay soils (DiTomaso and Healy 2007). In general, thistles compete poorly with healthy, established grasses and other vegetation. It can carry grass fires into tree canopies (Bossard and Lichti 2000). Disturbances such as fires, overgrazing, or trampling can create prime sites for thistle colonization (DiTomaso and Healy 2007).

Relevant Life History Traits
Italian thistle reproduces only by seed. Most disk seeds are wind-dispersed and can travel several hundred feet. Disk seeds also have a thin gummy coating, which allows them to attach to animals and machinery. The germination rate is high, and germination typically takes place in the fall. Ray seeds generally remain in the flower head until it drops. These seeds can persist in the soil for up to 10 years. Italian thistle overwinters as a rosette. Flowering can be continuous until soil moisture is depleted (The Watershed Project and Cal-IPC 2004).

Current Distribution in PCRP
Italian thistle was widespread in the park with 48 occurrences mapped totaling 89.23 gross acres. It was present primarily in the Front Country and was recorded in the Animas, Bluff, Bull, Lower San Jose, Corona, Corrals, East, East San Jose, Inspiration, Middle, North Front, River, South Animas, South Front and West Animas MUs.

Associated Vegetation Communities
Italian thistle was observed in a range of vegetation communities including ruderal areas along roadsides, grassland, coastal scrub, oak woodland, and on the margin of ponds.

Threats to Sensitive Biological Resources
Italian thistle was observed growing near ponds.

Priority for Treatment
Italian thistle has a medium species priority rank. Italian thistle is widespread and considered a low priority for treatment. However, Italian thistle has been treated, along with other thistles, in the Front Country with herbicide spray application (pers. comm. Nowel 2013). Treatment of Italian thistle with herbicides should be continued. In addition, it should be treated along with other thistles at cattle congregation areas including corrals and water troughs, at the boundary of Corona and Malpaso MUs, and at the fence line.

Management Strategies
Mechanical: Mechanical methods can be utilized when this species is small. To control by cutting, use a sharpened shovel at the top of the root crown. Grubbing hoes must cut the plants 2 to 4 inches below ground level to prevent resprouting from dormant axillary buds.

Mowing plant during flowering can greatly reduce seed production, though a single mowing is seldom sufficient due to the wide differences in the maturity of plants in a natural population. For mowing, wait till plants bolt and are about to flower (May to July). This may require repeated visits at weekly intervals over the 4 to 7 week blooming period, because not all plants bloom simultaneously. Plants will regrow if mowed before they are fully bolted. Plants cut 4 days after the first flowers open can produce viable seed.

Cultural: Large livestock tend to avoid grazing on thistles, although horse and cattle have been known to eat the flowerheads. Sheep will eat the rosettes. Goats like the flowerheads and are able to digest the seed. In general, thistles compete poorly with healthy established grasses and other vegetation. Establishment of selected, aggressive grasses can be effective cultural

Chemical: Apply aminopyralid during preemergence in winter to early spring and during postemergence to seedling up to flower bud stage. Apply clopyralid during postemergence in spring, up to the flower bud stage. Triclopyr and glyphosate can be applied postemergence to rapidly growing plants in bud stage. An integrated, long-term plan with persistent follow-up and twice-yearly monitoring is needed to eliminate this thistle.

HOTTENTOT-FIG
Carpobrotus edulis

General Information

Hottentot-fig is a mat-forming or trailing shrub in the iceplant family (Aizoaceae). Hottentot-fig inhabits coastal scrub, grassland, chaparral, bluffs, dunes, and other sandy coastal sites where it can change the ecology of the community by increasing soil organic matter. This encourages other non-native species to invade the richer soils. It is native to South Africa (DiTomaso and Healy 2007).

Relevant Life History Traits

Hottentot-fig reproduces vegetatively by stem fragments and by seed. Fruits are consumed and primarily dispersed by animals such as deer, rabbits, and rodents. In grassland, seedlings compete poorly with grasses, but individuals that do establish can spread rapidly by vegetative means. Plants appear to grow actively year round (DiTomaso and Healy 2007).

Current Distribution in PCRP

Hottentot-fig was recorded at 9 locations totaling 0.33 gross acre. All 9 occurrence were immediately north of PCRP outside of park boundaries.

Associated Vegetation Communities

All locations were observed in ruderal grassland areas.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Hottentot-fig has a medium species priority rank. Populations should be monitored to ascertain species does not spread into park. If hottentot-fig is found in PCRP it should be treated immediately.

Management Strategies

Mechanical: Mechanical removal is effective at any time of year. Hottentot-fig and other ice plant species are easily removed by hand pulling. Tear the plants up by the roots. Because the plant can grow roots and shoots from any node, all live plants and stem fragments must be removed from contact with the soil to prevent resprouting. If removal is not possible, mulching with the removed plant material is adequate to prevent most resprouting, but requires at least one follow-up visit to remove resprouts.

Prescribed Burning: Burning is not an effective strategy for control of ice plants. While the heat of the fire will kill the seeds, the succulent foliage will not entirely be killed by fire. Grazing is also not recommended.

Chemical: Glyphosate can be applied at a time when the plant is actively growing. The addition of 1% surfactant can increase the effectiveness of the herbicide. Since glyphosate is nonselective, it may be more appropriate to use a shielded sprayer or even a wiper application technique at 50% concentrate of the herbicide.

TOCALOTE
Centaurea melitensis

General Information

Tocalote is an annual and occasionally a biennial in the sunflower family (Asteraceae). This species is called Malta starthistle outside of California. It is native to southern Europe. It is generally less prevalent than yellow starthistle statewide. Tocalote inhabits open disturbed sites, open hillsides, grassland, rangeland, open woodlands, fields, pastures, roadsides, wasteplaces, and cultivated fields (DiTomaso and Healy 2007).

Relevant Life History Traits

Tocalote reproduces by seed. Seed production is highly variable. Seeds fall near the parent plant and are dispersed short distances with wind and to greater distances with human activities, animals, water, mud, and soil movement. Most seeds germinate after the first fall rains. Plants exist as basal rosettes through winter and early spring until flower stems develop in late spring or early summer (DiTomaso and Healy 2007).

Current Distribution in PCRP

There were 7 locations of tocalote detected in PCRP totaling 0.02 gross acre. It was scattered in the Corona, East San Jose, Malpaso, and Ridge MU's. All populations were fairly small. However, this species may be more widespread in the park due to difficulty in detection.

Associated Vegetation Communities

Tocalote was observed growing in grassland on the margin of coastal scrub habitat.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Tocalote has a high species priority rank. Tocalote populations are high priority for control because they have only a few populations and can be successfully eradicated from PCRP.

Management Strategies

Mechanical: Mechanical strategies used to control yellow starthistle will also control tocalote. There are several mechanical methods for dealing with yellow starthistle including hand pulling, hoeing, mowing and tilling. Hand pulling and hoeing are effective only on small infestations as they are labor intensive and time consuming making these two methods uneconomical for large infestations

The mowing must be timed to coincide with the early flowering stage when 2 to 5 percent of the total population is in bloom. Mowing too early will increase the yellow starthistle problem by removing competing vegetation and promoting vigorous yellow starthistle growth. Mowing too late can spread seeds. Mowing is more successful if the plants are erect with a high branching growth form. Plants with a low branching growth form can not be controlled with mowing. The mowing must be repeated at least twice in a year Regardless of timing or branching form, mowing will result in some seed being produced.

Cultural: Intensive grazing might be effective in reducing the amount of seed produced in an infestation. Timing of the grazing treatment for greatest effectiveness would be very difficult. Tocalote bolts in late spring when other plants are still green and appealing to livestock. The livestock would remove the competing plants while they grazed on the tocalote, possibly reducing the seed supply of the competing plants. Waiting until the associated plants are dry and have dropped their seed would miss the effective window for catching tocalote before seed set and drop. Compounding the problem is tocalote's tendency

to produce an early flower head, where the plant would need to be eaten to ground level to prevent seed production. Generally, if plants are being eaten to ground level, the site is being heavily grazed, taking all of the plants to ground level including desirable competitors. If adequate soil moisture exists, the tocalote would likely resprout and need additional treatment.

Prescribed Burning: Prescribed burning can be an effective method of tocalote control. Burning must be done in late spring or early summer when the plants have just begun flowering and before seed set. Since burning will actually create favorable growing conditions for tocalote seed in the soil seed bank, burning must be followed by other treatments or burning in the next two years to have an impact on the numbers or size of an infestation.

Chemical: A number of herbicide applications have proven effective for controlling tocalote. Aminopyralid can be applied during postemergence or preemergence. Postemergence applications of Aminopyralid are most effective when applied to plants from the seedling to the mid-rosette stage. Clopyralid can be applied during postemergence or preemergence, but is most effective when applied to plants from the seedling to the late-rosette stage, before bolting. Glyphosate can be applied postemergence from bolting to the beginning of flowering. Finally, triclopyr can be applied during postemergence from seedling to bolting stage.

BULL THISTLE
Cirsium vulgare

General Information

Bull thistle is a coarse biennial, sometimes annual or short-lived perennial in the sunflower family (Asteraceae). The thistle is native to Eurasia. Bull thistle inhabits open disturbed sites, hillsides, rangeland, forest openings, fields, pastures, roadsides, orchards, and crop fields. Bull thistle typically does not tolerate deep shade or constantly wet soils. It grows best on heavy fertile soils (DiTomaso and Healy 2007).

Relevant Life History Traits

Bull thistle reproduces by seed. Plants exist as rosettes until flowering stems develop at maturity. Seeds fall near the parent plant or are dispersed short distances with wind and to greater distances with human activities, water, soil movement, and as seed or hay contaminants. Most seeds germinate after the first fall rains or in spring. Soil disturbance facilitates seed germination and seedling establishment. Plants on very poor soils or in shade can take more than two seasons to mature. Plants in grazed pastures often produce more seed than plants in adjacent ungrazed areas due to reduced competition from grazed plants. Most seeds germinate within the first year (DiTomaso and Healy 2007).

Current Distribution in PCRP

Bull thistle was widely distributed in PCRP. A total of 69 data points were recorded totaling 5.76 gross acres. It was scattered throughout PCRP and was present in all MUs except Bluff, East, Inspiration, and South. Many populations consisted of just a few individuals and others were as large as 0.5 acre.

Associated Vegetation Communities

Bull thistle was present in almost every vegetation type including grassland, riparian, woodland, scrub, on the edge of woodland and chaparral, and on the margin of ponds.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Bull thistle has a medium species priority rank. Bull thistle is widespread and considered a low priority for treatment. However, bull thistle has been treated, along with other thistles, in the Front Country with herbicide spray application (pers. comm. Nowel 2013). Treatment of bull thistle with herbicides should be continued. In addition, it should be treated along with other thistles at cattle congregation areas including corrals and water troughs, at boundary of Corona and Malpaso MUs, and at the fence line.

Management Strategies

Mechanical: Mowing or hand cutting at the soil surface, just before flowering can control bull thistle. However, if plants are cut too soon, the plants can resprout and produce flowers and seed. Flower heads on cut plants can continue to produce viable seed.

Cultural: Bull thistle is avoided by grazing animals, probably due to its spines. Overgrazing of sites where bull thistle occurs can create bare spots, which are prime habitable sites for bull thistle. Goats and sheep will eat the seedlings, however, sheep may select the other more palatable plants, thereby reducing competition and promoting the bull thistle.

Prescribed Burning: Response of bull thistle to prescribed fire hasn't been studied in depth and more research is needed.

Chemical: Apply aminopyralid during postemergence in spring to early summer when the target plants are in the rosette to bolting stage or in fall to seedlings. Clopyralid works when applied during postemergence in spring up to the bud stage. It can also be applied to fall regrowth. Results are best if applied to rapidly growing plants. Chlorsulfuron application during postemergence to young, rapidly growing weeds works. Triclopyr can be applied during postemergence to rapidly growing weeds up to the bud stage. Autumn or spring application is recommended to control rosettes.

POISON HEMLOCK

Conium maculatum

General Information

Poison hemlock is an erect biennial (sometimes annual or short-lived perennial) in the carrot family (Apiaceae). Plants exist as large basal rosettes of leaves during the first year. All plant parts are highly toxic to humans and animals when ingested. Most animals avoid eating poison hemlock when suitable forage is available. It is native to Europe. Poison hemlock inhabits fields, pastures, roadsides, ditches, riparian areas, cultivated fields, and other disturbed often moist sites (DiTomaso and Healy 2007).

Relevant Life History Traits

Poison hemlock reproduces by seed. Seeds fall near the parent plant but some may disperse to greater distances with human activities, water, soil movement, and animals. After dispersal most seeds can germinate almost immediately if conditions are favorable, but a small proportion remains dormant. Germination occurs with the first fall rains through early spring. Seeds can survive up to about 3 years under field conditions (DiTomaso and Healy 2007).

Current Distribution in PCRP

Poison hemlock was widely distributed in PCRP. A total of 113 data points were recorded totaling 119.60 gross acres. It was scattered throughout PCRP and was present in all MUs except East San Jose, Seneca, and South. It formed large stands in the Front Country. Many populations consisted of just a few individuals and the largest was 27 acre in size.

Associated Vegetation Communities

Poison hemlock was present primarily in grassland growing on the margin of scrub. It was also present in riparian areas, along the margins of ponds, and along roadsides.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Poison hemlock is extremely widespread. The poison hemlock populations in the southwest portion of Malpaso MU are a Priority 2 treatment because they are isolated populations and are in areas with relatively few weeds.

Management Strategies

Mechanical: Hand removal is recommended for small infestations. When pulling the plants, dig down and remove the entire taproot. Wear gloves and wash hands after working with poison hemlock. Manual control efforts can be successful, but can cause soil disturbance encouraging further germination of seeds. Solid carpets of hemlock seedlings are not uncommon following soil disturbance. Cutting is ineffective; the plants send up new seed stalk in the same season the cutting occurs. Establishment of populations can be prevented with repeated cultivation and plowing.

Cultural: Due to the plant's toxicity, grazing is not recommended for control. Even dried plant parts are not safe as the toxins take several years to dissipate. Do not burn, as toxins can be released into the air through the smoke.

Chemical: Triclopyr is best applied during postemergence in seedling to rosette stage since it is most effective on smaller plants. In warm temperatures, spraying onto hard surfaces such as rocks or pavement can increase the risk of volatilization and off-target damage. Success has also been shown with glyphosate. Glyphosate is best when applied to postemergence to rapidly growing plants before bolting.

However, higher rates can control plants at the bud to full bloom stage. Chlorosulfuron can be applied postemergence to rapidly growing plants but desirable grasses should be well established before application.

JUBATA GRASS (PAMPAS GRASS)

Cortaderia jubata

General Information

Jubata grass is a large densely tufted perennial grass in the grass family (Poaceae). Jubata grass was introduced as a landscape ornamental and for erosion control but has since escaped cultivation. Mature plants are highly competitive with native vegetation. Jubata grass inhabits disturbed areas, dunes, bluffs, roadsides, roadcuts, logged forests, coastal scrub, grasslands, and adjacent inland areas moderated by fog or other maritime influences (DiTomaso and Healy 2007).

Relevant Life History Traits

Jubata grass reproduces by seed. Viable seed develops without fertilization, so seedlings are genetic clones of parent plants. Seeds are nearly mature when plumes emerge from their sheaths. Seeds can disperse long distance with wind (to about 30 km) and human activities. Each seed bearing plum can produce up to 100,000 seeds. Sites with bare, sandy soil are most favorable for seedling establishment. Germination occurs in the fall after the first rains and continues through spring. Seeds generally survive for less than 6 months under field conditions and a persistent seed bank does not accumulate. Individual plants are capable of surviving up to 15-20 years (DiTomaso and Healy 2007).

Current Distribution in PCRP

Jubata grass was mapped at 37 locations totaling 0.55 gross acre. Most populations consisted of just a few individuals. It was present in the Animas, Lower San Jose, Malpaso, Panoche, Risge, South Animas, South Front, West Animas, and West San Jose MUs. According to the Palo Corona Ranch Management Plan, previous management has included cutting and spraying jubata grass in a subset of known locations (Overtree 2001).

Associated Vegetation Communities

The majority of the occurrences were in coastal scrub vegetation with a few in riparian, chaparral, and oak woodland.

Threats to Sensitive Biological Resources

Jubata grass occurred in coastal scrub vegetation which is considered a high priority vegetation type when it contains seacliff or coast buckwheat. Jubata grass was present in the southern portion of PCRP which has relatively few invasive weed species.

Priority for Treatment

Jubata grass has a high species priority rank. Jubata grass is high priority for control due to its invasiveness. Because there are only 37 occurrences, with control jubata grass may be successfully eradicated from PCRP. Many of the occurrences are on extremely steep slopes that preclude access making treatment difficult.

Management Strategies

Mechanical: Hand-pulling seedlings can help prevent the spread of either species. For removing established clumps, pulaskis, or mattocks shovels are the safest and most effective tools. To prevent resprouting, it is important to remove the entire crown and top section of the roots. Detached plants left lying on the soil surface may take root and reestablish under moist soil conditions. Some land managers recommend turning the removed clumps upside down so the roots dry out in the air. A large chainsaw or weed eater can expose the base of the plant, allow better access for removal of the crown, and make disposal of the detached plant more manageable. Plumes can also be cut off to avoid seed dispersal. However plants that have had plumes removed may develop more plumes during the flowering season. Mechanical removal by heavy equipment, including excavators and backhoes, can be very effective and

selective. However, the methods are labor and cost intensive, and feasibility depends upon site accessibility, size of the infestation, funding, and availability of volunteer support.

Cultural: Heavily mulching bare sites or planting desirable vegetation may prevent or reduce seedling establishment. Burning or grazing are not typically considered effective control strategies. Any soil disturbance that creates bare ground, including natural disturbance and human caused disturbance, promotes invasion by jubata grass.

Chemical: Chemical application is best in late summer or fall, after flowering, when translocation of herbicide to base of tillers and rhizomes is at its peak. Glyphosate provides a consistent control. Low volume treatment at 8% and wiper application at 33% has shown to give the best and most consistent control.

SILVERLEAF COTONEASTER
Cotoneaster pannosus

General Information

Cotoneaster is an evergreen to semi-evergreen shrub with orange to red, berrylike fruits that are cultivated as landscape ornamentals. Cotoneaster is in the rose family (Rosaceae). Cotoneaster inhabits disturbed places, mixed evergreen forest, coastal scrub, and grassland, often near residential areas. It is native to China (DiTomaso and Healy 2007)

Relevant Life History Traits

Cotoneaster reproduces by seed. Fruits and seeds disperse by animals, water, soil movement, and human activities. Seeds are enclosed in a hard endocarp. Scarification followed by a few months of cold, moist stratification stimulates germination. The ingestion of fruits by animals may enhance seed germination (DiTomaso and Healy 2007).

Current Distribution in PCRP

Cotoneaster was limited in distribution with 11 data points recorded totaling 1.43 gross acre. 10 of the 11 occurrences were near each other in the Seneca MU. The other location was in the Panoche MU. Cotoneaster was spreading into the adjacent woodland and scrub habitat. Mapped Smith's blue butterfly habitat is in the vicinity.

Associated Vegetation Communities

Cotoneaster was present in along the margins of coast live oak woodland, scrub, and in grassland.

Threats to Sensitive Biological Resources

Cotoneaster was observed to be spreading into the adjacent woodland and scrub habitat. There is mapped Smith's blue butterfly habitat is in the vicinity.

Priority for Treatment

Cotoneaster has a high species priority rank. All occurrences are considered high priority for treatment as it was observed to be actively spreading and currently its distribution is limited. Control of these populations has the potential to eradicate cotoneaster from PCRP.

Management Strategies

Mechanical: Seedlings and small plants can be hand pulled. Manually removing individual shrubs when discovered can help prevent the spread of cotoneaster species in natural areas. However, stumps and roots can resprout necessitating follow-up control. Roots need to be completely removed to prevent resprouting.

Cultural: There are no known cultural control strategies developed for any species of cotoneaster

Chemical: Triclopyr can be applied for treating cut stumps or basal stems in late summer or fall. Glyphosate can be applied postemergence later in the season when translocation of carbohydrates is downward towards the below-ground tissues.

CAPE IVY
Delairea odorata

General Information

Cape ivy is a vigorous perennial vine in the sunflower family (Asteraceae). Cape ivy can invade various plant communities but it is especially noxious in coastal riparian areas. Vines grow over trees and shrubs and can form dense mats that smother underlying vegetation. Plant material in contact with water may cause fish kill. Cape ivy was introduced to the United States in the late 1800s as a house plant. It is native to the moist mountain forest of South Africa. It inhabits disturbed riparian sites, seasonal wetlands, coastal bluffs and scrub, moist canyons, oak woodlands, and coastal grasslands, as well as Monterey or Bishop pine, eucalyptus, and redwood forests. Most infestations are associated with urban areas or former human habitations. Grows in deep shade or under cloudy conditions but does not tolerate full sunlight. This species tolerates serpentine soils. Established plants can tolerate drought (DiTomaso and Healy 2007).

Relevant Life History Traits

Cape ivy reproduces vegetatively from rhizomes, stolons, and fragments of rhizomes and stems, and in some locations, by seed. Stem fragments as small as 2.5 cm that include a node can generate a new plant. Stem fragments can dry and then resprout when moistened. Seeds disperse with water, wind, soil movement, and probably human activities (DiTomaso and Healy 2007).

Current Distribution in PCRP

Cape ivy was observed only in 2 locations, both in the South Front Unit near the Monastery. One population was along San Jose Creek Canyon Road in the willow riparian corridor along San Jose Creek. This population has been treated in the past and consists of remnant resprouting stems. The other population was in a stand of willows along with other weedy vegetation adjacent to Highway 1 near the entrance to the Carmelite Monastery. Cape ivy was previously recorded along the Carmel River and in Monastery Canyon but was not observed in these locations during surveys. According to the Palo Corona Ranch Management Plan, previous control efforts have focused on removal and spraying of the Carmel River and Highway 1 populations, but not in Monastery Canyon (Overtree 2001).

Associated Vegetation Communities

Cape ivy was associated with willow riparian growing in the shaded understory.

Threats to Sensitive Biological Resources

Cape ivy has the potential to impact riparian vegetation along San Jose Creek. It could spread downstream.

Priority for Treatment

Cape ivy has a high species priority rank. Both occurrences are high priority for treatment. Due to its limited distribution, Cape ivy has the potential to be eradicated from PCRP.

Management Strategies

Mechanical: Manual removal of plants, including roots and rhizomes, before viable seed develops can help control infestations in areas where plants are accessible. Removing all plant material from the site will help prevent rerooting. Follow-up removal of resprouts is essential. In some large patches, all stems can be cut at ground level and Cape-ivy rolled up like a rug, this strategy makes it possible to detect and spot-treat new sprouts while avoiding contact with desirable vegetations.

Because Cape-ivy can resprout and establish from stem fragments, mowing is not recommended. Cutting off Cape-ivy before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. All plant parts should be bagged and properly disposed of.

Cultural: Grazing and burning are not considered effective control options. The leaves and stems can be toxic to livestock

Chemical: Use triclopyr spot treatment with a surfactant to thoroughly wet all leaves. This is best applied during postemergence when plants are growing rapidly. Glyphosate spot treatment can be used when plants are growing rapidly. Best results occur when plants are treated in late summer or early fall. Since glyphosate is a nonselective systemic herbicide, it may be more appropriate to use a wiper application to achieve selectivity. Glyphosate can be combined with triclopyr for more effective control. Use a surfactant when applying this combination. Triclopyr spot treatment can be applied during postemergence when plants are growing rapidly.

FOXGLOVE
Digitalis purpurea

General Information

Foxglove is an erect biennial or short-lived perennial with racemes of large tubular pink or white flowers. The plants exist as rosettes until flowering stems develop in the second year. All plants produce cardiac glycosides and are toxic to humans and livestock. Foxglove usually inhabits roadsides, logged areas, other open to partly shaded sites in coniferous forests and mixed woodlands, and meadows. It grows best on fertile acidic soil (DiTomaso and Healy 2007).

Relevant Life History Traits

Foxglove reproduces by seed, which fall near the parent plant and can be dispersed by wind, water, soil movement, mud, and human activities. Seeds germinate in fall and spring and have been reported to survive in the seed bank for up to 68 years (DiTomaso and Healy 2007).

Current Distribution in PCRP

Foxglove was mapped at 34 locations totaling 52.81 acres. Foxglove was not present in the Front Country. It was present in the Lower San Jose, Corona, East San Jose, Malpaso, Panoche, Ridge, Seneca, and West San Jose MUs. It was present as scattered plants that formed large stands.

Associated Vegetation Communities

Foxglove was present in openings in coastal scrub, in the understory of riparian corridors and redwood forest, and in grassland.

Threats to Sensitive Biological Resources

A location of Hutchinson's larkspur (EONDX 60834) along Palo Corona Rd is within a mapped population of foxglove. Foxglove was present in redwood forest and riparian areas which are considered high priority vegetation communities.

Priority for Treatment

Foxglove has a low species priority rank. Foxglove is considered low priority for treatment. The population within the Hutchinson's larkspur population should be monitored and controlled if it threatens rare plant population.

Management Strategies

Mechanical: Control efforts are required for at least five years. Hand pulling of stalks is effective in spring, while soils are moist, and stalk and root masses are easily pulled from the ground. Pulled material must be removed from the site and destroyed (flower stalks left on site will continue to mature and release thousands of seeds). It is easy to strip flowers from the stalks, and little additional effort is needed to pull up the entire plant. If flower stalks are cut back before seeds ripen, the plant can bloom again in mid- to late summer. Therefore, above-ground treatments such as clipping and mowing may be counter-productive unless repeated before resprouts have time to produce seed. Workers must protect themselves from extended contact with the poisonous leaves.

Prescribed Burning: Smoke from plants is toxic; therefore populations are not conducive to burning.

Chemical: Herbicide has some effect on the plants but does not kill all of them. Herbicides may work, but hand pulling is more efficient and effective with fewer effects on non-target plants.

PRIDE OF MADEIRA
Echium candicans

General Information

Pride of Madeira is a branched shrub with dense, conical panicles of blue to purple flowers in the borage family (Boraginaceae). It has escaped cultivation in some coastal areas. Pride of Madeira is native to Madeira and the Canary Islands. It usually inhabits open coastal hillsides and bluffs on many soil types. It requires a source of summer moisture in inland areas (DiTomaso and Healy 2007).

Relevant Life History Traits

Pride of Madeira reproduces by seed, but seedlings are seldom encountered. The seeds of a close relative to pride of Madeira, Vipers bugloss (*Echium plantagineum*), are spread primarily by water, soil movement, and human activities. The seeds are hard coated and survive ingestion by livestock (DiTomaso and Healy 2007).

Current Distribution in PCRP

Five locations were mapped totaling 0.11 gross acre. All 5 occurrence are immediately north of PCRP outside of park boundaries.

Associated Vegetation Communities

Pride of Madeira was present in grassland.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Pride of Madeira has a low species priority rank. The PCRP boundary should be monitored to ascertain species does not spread into park.

Management Strategies

Mechanical: Hand pulling or mowing can control small patches. However, cut or pulled plants with immature flowers can continue to mature seed. Repeated cultivation can kill flushes of seedlings.

Cultural: Grazing cattle on pastures and rangeland with species can increase populations.

Prescribed Burning: Burning destroys some seeds but may stimulate others to germinate.

Chemical: Glyphosate can be sprayed on leaves.

ERECT VELDTGRASS
Ehrharta erecta

General Information
Erect veldtgrass is an erect to decumbent perennial grass in the grass family (Poaceae). Erect veldtgrass inhabits disturbed moist places, urban areas, turf, wetlands, and possibly other moist natural communities. Erect veldtgrass grows in many soil types, thrives in shade, and is expanding its range in California. Erect veldtgrass is native to South Africa and is a naturalized weed in Europe and Australia (DiTomaso and Healy 2007).

Relevant Life History Traits
Erect veldtgrass reproduces primarily by seed and sometimes vegetatively from short rhizomes. Florets fall near parent plants and disperse short distances with wind and longer distances with human activities, water, soil movement, and possibly animals.

Current Distribution in PCRP
Erect veldtgrass was observed only in 2 locations totaling 0.01 gross acre. It was in the Corrals MU and just offsite at the Corona Rd entrance to the park.

Associated Vegetation Communities
Ono occurrence was in the understory of Monterey cypress forest and the other was in the understory of pine forest.

Threats to Sensitive Biological Resources
None.

Priority for Treatment
Erect veldtgrass has a medium species priority rank. These populations are Priority 3 for control. Controlling these two occurrences could prevent the species from becoming established in PCRP. The populations should be monitored to ascertain they are not spreading onto PCRP.

Management Strategies
Nearly all documented attempts to control *Ehrharta* species have been limited to *E. calycina,* and the following discussion centers on this species. It is likely, however, that techniques used on *E. calycina* would be effective on the other two species

Mechanical: Manually removing mature plants, including the buried crown, may reduce plant densities, but often stimulates seed germination. All the buried plants parts must be removed on the perennial species to prevent resprouting. Repeatedly removing seedlings as they appear for a period of 2 or more years can help to control populations.

Prescribed Burning: Fire is inappropriate for *Ehrharta* species, as studies have shown that fire increases the invasiveness of this species

Chemical: Glyphosate applied as a foliar spray at 2 percent concentration with added surfactant has shown to be effective against *Ehrharta calycina* under a wide variety of conditions. Spraying typically is carried out when the grass is actively growing and green. The use of glyphosate is believed by some to be most appropriate when *E. calycina* is growing as a near-monospecific stand, since it will cause damage to associated native plants. However, some managers have found that careful treatment of E. calycina bunches with a backpack sprayer can reduce or eliminate impacts to other native species. Under these circumstances it may be necessary to return and treat bunches of *E. calycina* that did not receive sufficient coverage with the first application.

BLUE GUM
Eucalyptus globulus

General Information

Blue gum is a fast growing tree and is the most common Eucalyptus species in California. It is in the myrtle family (Myrtaceae). It is widely planted as a landscape and windbreak tree, but it has escaped cultivation and is invasive in some coastal areas. Blue gum litter, fog and rain drip, and shading appear to create conditions that inhibit the growth of seedlings and most other plants in the understory. Mature blue gum trees can create a safety hazard in public places because they tend to drop limbs continually. Leaves and branches decompose very slowly. Blue gum inhabits disturbed places, especially in riparian areas and coastal grasslands and forests. Groves expand from perimeters into relatively intact adjacent areas of scrub, woodlands, or grasslands (DiTomaso and Healy 2007).

Relevant Life History Traits

Blue gum reproduces by seed. Most seeds are released from capsules while still attached to the tree. Seeds typically fall within 100 meters from the parent plant, although some may disperse to greater distances with water, soil movement, animals, and human activities. Under favorable conditions, seeds germinate a few weeks after release from capsules, usually late fall through spring, but if conditions are dry seeds may remain dormant for several years. Blue gum grows best on deep, well-drained soils where roots can tap deep soil moisture. Seedlings and juveniles are more sensitive to frost and drought than mature trees.

Current Distribution in PCRP

Blue gum was present in one location totaling 0.50 gross acre. It was located in the South Front MU adjacent to the Monastery and consists of a stand of mature trees in a canyon. Half of the stand was within the PCRP boundary.

Associated Vegetation Communities

Blue gum is the dominant vegetation and is adjacent to pine forest and riparian vegetation.

Threats to Sensitive Biological Resources

Blue gum could spread into adjacent riparian vegetation.

Priority for Treatment

Blue gum has a medium species priority rank. The blue gum stand should be monitored to ascertain seedlings are not spreading into adjacent habitats.

Management Strategies

Mechanical Hand pulling can remove seedlings and small saplings. For larger saplings and small trees, a weed wrench or other woody weed extractor can be used. Care must be taken to extract the entire root or stump sprouting will occur. Best results are achieved when soil is moist. Cutting a tree at ground level before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting back regrowth when shoots reach 6 to 7 feet tall for 4 years or more can eventually kill the tree. Covering cut stumps with black plastic and sealing the edges with soil to exclude sunlight also gives good control. Plastic must be kept in place for at least one year. Cutting can also be combined with an herbicide treatment.

Cultural: Grazing is not considered an effective control option as animals seldom browse on seedlings.

Prescribed Burning: Burning alone is not an effective method for controlling eucalyptus. Although burning can remove debris, in many cases it can increase the population as it removes competitive vegetation, releases nutrients into the soil, and stimulates the germination of seeds left in the soil. Burning is more effective when followed by an herbicide application, subsequent burnings, and/or revegetation using desirable species. It is important to employ a control strategy following a burn; otherwise the eucalyptus population may increase in subsequent years.

Chemical: Glyphosate is the most effective herbicide for control of eucalyptus. It is best when used in late summer to early fall, use foliar spot treatment: 2% v/v solution (*Roundup ProMax)* Glyphosate and water plus 0.5% v/v non-ionic surfactant to thoroughly wet all leaves. If using cut stump treatment, use undiluted or 50% *Roundup* (or other trade name) in water. If using stem injection treatment, make one cut per every 3 inches of stem diameter, and 1 ml of undiluted herbicide added to each cut. Triclopyr is also a useful herbicide for controlling eucalyptus. For foliar spot treatment use 2% v/v solution of *Garlon 4 Ultra* and water plus 0.5% v/v non-ionic surfactant to thoroughly wet all leaves. For basal cut stump treatment, (treat the cut surface and the bark on the sides of the stump) use 20 to 25% *Garlon 4 Ultra* in 75 to 80% oil carrier, or *Pathfinder II* (ready-to-use). Stem injection treatment involves one cut per every 3 inches of stem diameter, and 1 ml of undiluted *Garlon 3A* added to each cut. Note that foliar treatments of Triclopyr are best applied when leaves are fully expanded, and should be made on small trees or seedlings. Stump and stem treatments can be used any time, but are best if not used when sap is rising in the early spring.

FENNEL
Foeniculum vulgare

General Information

Fennel is a perennial in the carrot family (Apiaceae). Fennel invades open disturbed sites, roadsides, slopes, fields, grasslands, coastal scrub, riparian and wetland areas, and agronomic crops, particularly in coastal regions of central and southern California. Established plants are competitive and soil disturbance facilitates the development of dense stands, which can exclude native vegetation in some areas. It is native to southern Europe. It tolerates drought and frost and grows in many soil types (DiTomaso and Healy 2007).

Relevant Life History Traits

Fennel reproduces by seed and sometimes vegetatively from root or crown fragments. Seed production is usually prolific. Seeds disperse with human activities, water, soil movement, animals, and as a seed contaminant. Most seeds germinate in the fall during the wet season but germination can occur year round when conditions are favorable. Seeds appear to survive several years under field conditions. Fragmentation of roots and crowns may occur during flood events, mudslides, or agricultural operations. New shoots grow from the crown or lower portion of overwintering stems in mid-winter to early spring (DiTomaso and Healy 2007).

Current Distribution in PCRP

Fennel was limited in distribution with 5 occurrences totaling 0.03 gross acre, 3 of which were off site in the field north of PCRP and 2 were in the South Front MU.

Associated Vegetation Communities

Fennel was associated with grassland.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Fennel has a high species priority rank. The 2 occurrences in PCRP are high priority for treatment to prevent this species from becoming more widespread in PCRP.

Management Strategies

Mechanical: Hand chopping is recommended for small infestations (large fennel plants have a very substantial root, so it's labor intensive). Slashing just before flowering may kill the plants, repeat slashing of regrowth may be needed. Even if plants recover, slashing the stems at flowering will prevent seed set. The use of a mattock to remove the plant can be successful, but is very labor intensive. Digging out individual plants is also possible, but also labor intensive. Deep cultivation will also kill the plants but is not practical in most situations.

Cultural: Grazing will not control fennel and often spreads the population.

Prescribed Burning: Burning is not effective, as fennel will quickly recover following the fire. However, fall burns followed by herbicide treatment the following two springs reduces fennel cover. Burning can also stimulate the seed bank to germinate, which can reduce the number of years necessary for control.

Chemical: Glyphosate gives very effective control and can also be used in combination with triclopyr at 1 lb a.e./acre each. If using broadcast foliar treatment, apply 5 pt. product (*Roundup ProMax)*/acre (2.8 lb a.e./acre). For spot treatment, apply 2 to 5% v/v solution during postemergence to fully developed leaves but before flowering. Control is less effective once plant has bolted. Triclopyr is most effective when applied during the wet season from late February to early March. For spot treatment, lower rates can be used early in the season. Triclopyr is a broadleaf herbicide that is standard for fennel control. For foliar treatment, use 1 to 2 qt product/acre (1 to 2 ob. A.e./acre). For spot treatment, use 0.5 to 1% v/v solution.

FRENCH BROOM
Genista monspessulana

General Information

French broom is an evergreen shrub in the pea family (Fabaceae) that was originally introduced as a landscape ornamental. French broom is widespread and aggressive in California. It forms dense stands that displace native vegetation and wildlife. French broom inhabits open disturbed sites, such as logged or burned sites, roadsides, and pastures, and also relatively undisturbed grasslands, coastal scrub, oak woodlands, riparian corridors, and open forests. It is native to Mediterranean region and Azores Islands (DiTomaso and Healy 2007).

Relevant Life History Traits

French broom flowers March to May and reproduces by seed. Pods typically burst apart into spiral halves, ejecting seeds a short distance from the parent plant. Seeds disperse to greater distances with water, soil movement, vehicle tires, human activities, and animals. Seeds are hard-coated and long-lived under field conditions and can survive 30 years or more. Brooms can resprout from the crown when cut above. Fire appears to stimulate germination. Where seeds are present in the soil, a large flush of seedlings may emerge on newly burned sites. French broom is a prolific seeder and pods are often copiously produced (DiTomaso and Healy 2007).

Current Distribution in PCRP

French broom was the most abundant invasive weed in PCRP with 288 occurrences mapped totaling 237 gross acres. It was present in all MUs except Bull, Corrals, River and South. French broom was widespread through the northern and central portions of PCRP where it forms dense monocultures. In the southern portion of PCRP it occurred as scattered, isolated infestations.

Associated Vegetation Communities

French broom was most often associated with grassland and coastal scrub. It also occurred in redwood forest, on the margins of chaparral, and in riparian communities.

Threats to Sensitive Biological Resources

French broom occurred at Salamander Pond and Roadrunner Pond which are habitat for California Tiger Salamander and Red-Legged Frog.

Priority for Treatment

The following populations are high priority for treatment: the isolated populations in Panoche, Seneca, Corona, Ridge, and Malpaso MUs; the isolated populations at Corona Rd entrance that are encroaching into scrub habitat; and isolated populations in the Front Country in the South Front, North Front, Middle, Bluff, and Inspiration MUs. The populations at Salamander Pond and Roadrunner Pond inside fence are high priority for treatment to improve habitat for salamander.

Management Strategies

Mechanical: In general, when using hand removal or mechanical methods it is best to start in areas with small infestations and many desirable species that will reseed naturally. Desirable species should be given some assistance by hand weeding of French broom. After, work on areas with an intermediate degree of infestation. Tackle larger areas and dense concentrations of French broom using other techniques (fire, chemicals) to augment or replace hand pulling.

Pulling with weed wrenches is effective for broom removal in small infestations or where an inexpensive, long-duration labor source is dedicated to broom removal. The weed wrench removes the entire mature shrub, eliminating resprouting. However, the resultant soil disturbance tends to increase depth of the

seedbank and prolong the need for monitoring. Wrench removal is labor-intensive, but can be used on slopes. It also allows targeting of broom plants while minimizing impact on neighboring species.

Cutting broom to the ground in spring before it flowers will reduce the number of seeds and will deplete the plant's energy reserves. Resprouts are common but can be reduced by cutting broom at the end of the dry season. Cutting should be combined with herbicide treatment or with multiple cuttings over a period of years. Cut shrubs at ground level.

Cultural: A 10 cm deep wood bark mulch significantly decreased seedling emergence of French broom in experiments conducted by Cheng (in press) in the San Francisco Bay Area. This suggests that mulching could be used to suppress regrowth from the seedbank after removal of mature shrubs.

Prescribed Burning: Using fire to remove uncut French broom in late spring or early summer has had some success at Mt. Tamalpais State Park in Marin County (Cal-IPC 2014a). Reburning of the removal site is usually necessary two and four years after the initial burn.

Ken Moore (pers. comm. 1999) reports that California State Parks has been very successful (100 percent mortality) using a propane torch to remove French broom seedlings up to 20 cm in height that emerge from the seedbank after removal of adult brooms. The torch is set so it is hot but not flaming and it is passed over the French broom seedlings. The heat does not cause the seedling to burn but within a day the seedling is wilted and dead. This is done at the end of the rainy season when seedlings are up but there is no fire danger.

Chemical: Triclopyr or triclopyr and aminopyralid can be combined and applied during postemergence or to cut stump. A solution of 3 percent glyphosate sprayed on foliage until wet has been used to treat mature French broom shrubs. Adding surfactant improved effectiveness (Cal-IPC 2014a). However, the foliar spray impacts non-target species, and resprouting often occurs. Triclopyr ester (25 percent), in HastenÂ® or Penevator® oil (75 percent) in one spot, low-volume basal bark application with a wick has proved effective in killing French broom (Cal-IPC 2014a). Dye should be added to the herbicide solution to help avoid missing stems. It was necessary to spot only the main stem with 2 or 3 drops of herbicide, within 8 cm of the ground surface, to obtain a 99 percent kill of the eight-year-old French broom plants in this experiment conducted in Mendocino County. Soil analyses showed no contamination by the triclopyr, even in plots that were later burned. However, killing the mature shrubs was not sufficient to remove the infestation of French broom because of its well developed seedbank (Cal-IPC 2014a). This application technique does not impact non-target species, but it is time-consuming if the site is large. Both of these chemical methods should be used during periods of active growth after flower formation and seed set but before seed dehisces.

ENGLISH IVY
Hedera helix

General Information
English ivy is a vigorous woody perennial that is a common landscape ornamental in the aralia family (Araliaceae). English ivy grows over the natural vegetation in an area, including the trees, and eventually kills most resident plants by shading them out with its dense canopy of foliage. Trees covered with ivy are more susceptible to wind damage. It is native to Europe. English ivy grows in disturbed forests and woodlands, and riparian areas. It requires some moisture year round. It tolerates deep shade but thrives in places where plants receive some summer shade and direct winter sun (DiTomaso and Healy 2007).

Relevant Life History Traits
English ivy reproduces vegetatively from juvenile stems and by seed. Stem fragments of juvenile and adult plants left in contact with moist soil can generate a new plant. Fruit production in adult plants is high. Fruits are consumed and dispersed primarily by birds. Birds can carry seeds from gardens into nearby natural areas (DiTomaso and Healy 2007).

Current Distribution in PCRP
English ivy was very limited in distribution in PCRP with only 1 occurrence in the Lower San Jose MU in the understory of redwood forest.

Associated Vegetation Communities
English ivy was in the understory of redwood forest.

Threats to Sensitive Biological Resources
English ivy was present in redwood forest which is a high priority vegetation community. It was present along a tributary to San Jose Creek just upstream of the confluence and could spread downstream if it becomes established.

Priority for Treatment
English ivy has a high species priority rank. The one occurrence is high priority for treatment to prevent it from becoming established.

Management Strategies
Mechanical: The best method for controlling English ivy may be hand removal of vines. Use pruners to cut the vines and then pull the plants up from the forest floor and down from the trees. Removing and killing vines that spread up into trees is especially important because the fertile branches grow primarily on upright portions of the vine. If vines are cut at the base of the tree the upper portions will die quickly but may persist on the tree for some time; vines on the ground around the tree should also be removed to prevent regrowth up the tree. Care should be taken to minimize disturbance during removal. If the forest floor becomes disrupted, appropriate native species should be planted on the site to inhibit reinfestation by English ivy or another invader

Chemical: English ivy is tolerant of preemergent herbicides. Its waxy leaves make effective application of postemergent herbicides difficult, even when a surfactant is added. Glyphosate can be applied during postemergence when plants are growing rapidly. Foliar treatments can be used in late summer or early fall. Cut stump treatment application is best in late summer, early fall or during the dormant season. Treatment should occur immediately after cutting. Plants should not be cut for at least 4 months after foliar treatment. Triclopyr can be applied during postemergence when plants are growing rapidly. Cut stump and basal bark treatment applied immediately after stem is cut can control resprouts. Plants should not be cut for at least 1 month after basal bark treatment.

YELLOWFLAG IRIS
Iris pseudacorus

General Information

Yellowflag iris is a perennial, with swordlike leaves and yellow to cream-colored flowers. It is in the iris family (*Iridaceae*). Yellowflag iris was introduced as a pond ornamental and has since escaped. It usually inhabits moist soils near pond margins, irrigation ditches, and wetland sites. It is toxic to humans and animals when ingested. Native to Europe (Cal IPC 2013a).

Relevant Life History Traits

Yellowflag iris plants can take three years to mature before flowering. They can reproduce by seed, which is usually dispersed by water, and by its thick rhizomes (Cal IPC 2013a).

Current Distribution in PCRP

There are 2 locations mapped totaling 1.05 acre. It is present in the Animas, South Animas, and West San Jose MUs. One population at Animas Pond is comprised of 4 discrete patches. One population of scatted plants is present near San Jose Creek. Yellowflag iris was treated at Animal Pond by hand removal (McGraw 2007).

Associated Vegetation Communities

Yellowflag iris is associated with pond and riparian communities.

Threats to Sensitive Biological Resources

Yellowflag iris formed an extensive stand in Animas Pond which is included in the Safe Harbor Agreement for PCRP as habitat for California Red-Legged Frog (MPRPD and USFWS 2011). It was also present near San Jose Creek and could spread downstream.

Priority for Treatment

Yellowflag iris has a low species priority rank. The two populations are high priority for treatment due to its threat to sensitive resources.

Management Strategies

Mechanical: Not considered effective since it may cause extensive disturbance that facilitates the establishment of other weedy plants. Nevertheless, physical and mechanical methods may be tried. It is necessary to remove the entire plant and rhizome system. Repeated mowing may eventually weaken the plant. Plastic tarps have been used to control yellowflag iris in small patches. Woven plastic and landscape fabric proved to be the best materials.

To avoid impacting California red-legged frog and California tiger salamander, treatment should be conducted between late August and the onset of fall rains which typically occur between mid-October and mid-November as feasible. During this time California tiger salamander is in its upland habitats, and California red-legged frog is less susceptible to mortality associated with trampling in and along the ponds (McGraw 2007).

Chemical: Glyphosate can be applied at a rate of 4% v/v solution of *Rodeo* or *Aquamaster* (2% a.e.) for spot treatment. Application is most effective when plants are growing rapidly, but before flowering in late spring or early summer. It can also be applied in the fall. Use a non-ionic surfactant registered for use in aquatic areas. Note that glyphosate is nonselective. In some cases reapplication may be necessary. Application with a drizzle gun gives good results and is far easier to treat compared to a conventional spray boom.

BERMUDA BUTTERCUP
Oxalis pes-caprae

General Information
Bermuda buttercup is a low-growing perennial with shamrock-like leaves and yellow flowers. It contains soluble oxalates and can be lethally toxic to livestock when ingested in quantity. Bermuda buttercup usually inhabits coastal dunes, scrub, grasslands, oak woodlands, gardens, turf, urban areas, and agricultural fields (UC Press 2013). It can grow in most environments and can tolerate many soil types, but inland it grows primarily in semi-shaded sites. It was introduced from South Africa as a garden ornamental (DiTomaso and Healy 2007).

Relevant Life History Traits
Bermuda buttercup reproduces vegetatively by bulbs. These can be spread along roadsides with vehicular movement, and by transportation of soil. Bulbs typically germinate in fall, typically after the first rain, but in dry years, some bulbs can germinate before it rains (UC Press 2013).

Current Distribution in PCRP
Bermuda buttercup was mapped at 30 locations totaling 0.38 gross acre. It was limited to the Front Country and was present in the Bluff, Corrals, Inspiration, Middle, North Front, and South Front MUs.

Associated Vegetation Communities
Bermuda buttercup was present primarily in grassland and along roads with a few locations in oak woodland and riparian vegetation.

Threats to Sensitive Biological Resources
None.

Priority for Treatment
Bermuda buttercup has a low species priority rank. No occurrences are priority for treatment.

Management Strategies
The best control method for this pernicious weed is prevention. If new infestations are spotted and controlled early, it is possible to eradicate small populations. Large populations are difficult to control and will require multiple years of diligent control efforts.

Mechanical: Removing the top of the plant by cultivating or cutting it off won't kill the bulb. Hand weeding is used extensively to reduce infestations, but because it is exceedingly difficult to remove all of the bulbs, new plants usually appear. Care must be taken to remove the entire plant, including underground rhizome and bulbs. Cultivation can provide control of new infestations. Repeated tillage is required to effectively control the bulbs.

Cultural: Grazing is not considered an effective control option. Plants contain variable quantities of soluble oxalates and can be lethally toxic to livestock when ingested in quantity.

Chemical: Glyphosate spot treatment application in early spring provides the best control. When using spot treatment, apply 2% v/v solution *Roundup ProMax* and water to thoroughly wet all leaves.

KIKUYU GRASS
Pennisetum clandestinum

General Information

Kikuyu grass is a tough low-growing perennial in the grass family (Poaceae). It has an extensive network of coarse, creeping stolons and rhizomes within the top 10 cm of soil. Kikuyu grass can accumulate high levels of nitrates and soluble oxalates that are toxic to livestock when ingested in quantity. It usually inhabits disturbed sites, roadsides, agricultural fields, and occasionally wetland areas. It is native to tropical Africa and introduced to California as an erosion-controlling ground cover (DiTomaso and Healy 2007).

Relevant Life History Traits

Kikuyu grass reproduces primarily by creeping rhizomes and stolons. Rhizomes and stolon fragments disperse with landscape maintenance and other human activities, agricultural machinery, hand tools, soil movement, and water. Seedlings typically emerge from soil depths up to about 6 cm (DiTomaso and Healy 2007).

Current Distribution in PCRP

There were 4 locations of kikuyu grass detected in PCRP totaling 0.65 gross acre. One population was in the corral area in the Front Country in the Corrals MU. Other occurrence were scattered along Highland Road in the Panoche MU.

Associated Vegetation Communities

All locations are in grassland vegetation adjacent to a road.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

The best way to control kikuyu grass is to prevent its spread into new areas. Kikuyugrass can be spread both from seed and from stem sections. It has shown to be most commonly spread by mowing, cultivation, and renovation equipment. Clean equipment to remove any kikuyugrass seed or stem sections before moving it out of infested areas. Kikuyugrass also spreads in contaminated soil, sod, and planting stock. Make sure any incoming materials are free of contamination.

Mechanical: Small patches can be pulled by hand. Avoid disking or cultivating, as this will spread stem fragments. Solarization may control infestations in areas that are to be replanted. For solarization to be effective, it must be used in full sun during the hottest part of the year (generally mid-July to mid-September for most of California), and the area must be kept covered with clear plastic mulch for 4 to 6 weeks. It is unlikely that solarization will be effective in coastal locations due to seasonal fog and overcast skies.

Chemical: Apply glyphosate to rapidly growing, non-stressed plants after most seedlings have emerged at a rate 1.5 to 2 qt product (*Round up ProMax)*/acre (1.7 to 2.25 lb a.e./acre). For spot treatment, use 1.5% v/v solution.

HARDING GRASS
Phalaris aquatica

General Information

Harding grass is a coarse, tufted perennial in the grass family (Poaceae). Occasionally Harding grass is toxic to livestock when consumed in quantity. Harding grass was introduced to provide extra-seasonal forage on pastures and rangeland, but it has escaped cultivation in riparian areas and other moist places in California. Harding grass is generally more invasive in coastal regions. It is native to Mediterranean Europe and introduces as a cultivar from Australia. Harding grass inhabits riparian areas, ditch banks, and fields. It tolerates frost and drought (DiTomaso and Healy 2007).

Relevant Life History Traits

Harding grass flowers from May to September and reproduces by seed. Seeds typically fall near the parent plant or disperse to greater distances with agricultural and other human activities, soil movement, water, and animals. Seeds germinate when moisture is available and temperatures are favorable. Seedlings compete poorly with established vegetation, but larger plants can displace native vegetation. Most active growth occurs fall through spring when moisture is plentiful. Under suitable conditions, rhizome fragments can develop into a new plant (DiTomaso and Healy 2007).

Current Distribution in PCRP

Harding grass was widespread throughout PCRP with 47 data points totaling 7.32 acres. It was present in the Animas, Bull, Lower San Jose, Corona, Corrals, East San Jose, Middle, North Front, Panoche, Ridge, Seneca, South Animas, South Front, West Animas, and West San Jose MUs. It was not present in the Malpaso or South MUs.

Associated Vegetation Communities

Harding grass was commonly present in grassland. It was often adjacent to roadsides. It was also present along the margins of coastal scrub and oak woodland.

Threats to Sensitive Biological Resources

Harding grass is likely being spread along roads as it was present adjacent to roadways in many locations. Harding grass could spread into high quality grasslands.

Priority for Treatment

Harding grass has a medium species priority rank. Harding grass has not been identified as high priority for treatment.

Management Strategies

Mechanical: Cultivation is generally not an effective method of control because Harding grass produces an abundant seed bank and can also regenerate from short pieces of rhizome left in the ground. Repeated cultivation when plants are actively growing would be necessary. Active growth corresponds to the time of frequent rainfall, which limits the ability to cultivate. However, cultivation may be used to remove a flush of seedlings and reduce the seed bank.

Cultural: Close mowing or clipping late in the growing season can greatly reduce the vigor of Harding grass. Mowing should be done when plants are still green but seasonal soil moisture is almost exhausted. Mowing and irrigation can be used to stimulate new growth of Harding grass. New growth can then be treated with glyphosate or fluazifop, resulting in high mortality. Grazing can be used in place of mowing, but in either case, at least ten to twelve inches (25-30 cm) of regrowth is needed before an herbicide application.

Prescribed Burning: Burns made after mid-January has shown to be injurious to this species. Injury may have resulted from damage to young shoots. Recovery from fire was slow.

Chemical: For postemergence control, use spot treatment with a 2 percent solution of glyphosate applied as a foliar spray to actively growing plants. A broadcast rate of 1.5 to 2.0 lb ai/acre is effective for large infestations. Ideal timing for this treatment is either at the early heading stage of development (mid- to late spring) or in early fall. With glyphosate, repeat applications should be made if regrowth occurs or to control plants not killed by the first treatment.

WILD RADISH
Raphanus sativus

General Information

Wild radish is an erect biennial with white, yellow, or pale purplish pink flowers in the mustard family (Brassicaceae). The plants exist as rosettes until flowering stems develop at maturity. Wild radish usually inhabits roadsides, pastures, agricultural fields, and other disturbed places. In non-crop areas it can be toxic to livestock if consumed in large amounts. Wild radish is native to the eastern Mediterranean region and Asia (DiTomaso and Healy 2007).

Relevant Life History Traits

Wild radish flowers February through July. Wild radish reproduces primarily by seed which can disperse with the fruit by water, soil movement, animals, human activities, and agricultural operations. Its pods do not open to release seeds. Most germination occurs in fall after the first significant rain, but some seeds continue to germinate throughout spring or at other times when conditions are favorable. Buried seeds can survive up to 30 years or more (DiTomaso and Healy 2007).

Current Distribution in PCRP

Wild radish has a limited distribution in PCRP with 6 occurrences totaling 2.10 acres. It was present in the Front Country in the Middle, North Front, and River MUs.

Associated Vegetation Communities

Wild radish was present in grassland and riparian vegetation communities.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Wild radish has a low species priority rank. None of the populations are considered a priority for treatment.

Management Strategies

Mechanical: Hand-pull, removing most of the root system, before plants produce seed (seeds germinate in spring and fall). Hand weeding may need to be repeated to control later developing plants. Mowing can help reduce seed production but does not harm the basal leaves, thus allowing plants to regrow. Repeated mowing is required to prevent seed set. This is not an effective means of control. Tillage is a common and effective method of control in agricultural areas and would also be effective, if practical, in natural areas and other non-crop sites.

Cultural: Maintain competitive grasses and avoid overgrazing.

Prescribed Burning: Burning is not practical for controlling wild radish.

Chemical: Applications of 2, 4-D at a rate of 1 to 2 pt. product/acre during postemergence before budding when plants are small and rapidly growing has shown to be effective. Also, Dicamba at a rate of .25 to 1 pt. product/acre applied during postemergence, before budding, when plants are small and rapidly growing, has been used to successfully kill wild radish.

HIMALAYAN BLACKBERRY
Rubus armeniacus

General Information

Himalayan blackberry is a mounded, climbing, and trailing shrub in the rose family (Rosaceae). Himalayan blackberry is a vigorous cultivar introduced from Eurasia and is the most common non-native bramble invading natural areas in California. It originated in Armenia. Himalayan blackberry inhabits disturbed moist open sites, roadsides, fencerows, fields, canal and ditch banks, and riparian areas in many plant communities. It tolerates periodic flooding with brackish water (DiTomaso and Healy 2007).

Relevant Life History Traits

Himalayan blackberry reproduces by seed, root sprouts, and stem tip rooting. New shoots can grow from buds on the roots. Under favorable conditions, root fragments of root-sprouting species may develop into new plants. Fruits typically disperse to greater distances with animals, especially birds. Seeds without the flesh may also disperse with water and soil movement. Seed germination occurs mainly in spring (DiTomaso and Healy 2007).

Current Distribution in PCRP

Himalayan blackberry was limited in distribution in PCRP with only one occurrence mapped in the Seneca MU. The occurrence was adjacent to Seneca Creek near the intersection of Palo Corona Road and Palo Corona Connector.

Associated Vegetation Communities

The single occurrence was in the understory of redwood forest adjacent to a creek.

Threats to Sensitive Biological Resources

Himalayan blackberry could spread downstream and become established along the creek in redwood forest.

Priority for Treatment

California blackberry has a high species priority rank. The single occurrence is considered a high priority for control to eradicate Himalayan blackberry from PCRP before it becomes well established.

Management Strategies

Mechanical: Cutting and mowing effectively remove the canes, reducing the bramble. However, the plants will resprout from root crowns, sometimes coming back more densely than before cutting (Hoshovsky 2000). Hand pulling seedlings when the ground is damp or hand digging plants are also effective methods providing the roots, which can resprout, are removed (Hoshovsky and Martin 2001, Hoshovsky 2000. The canes from cutting, mowing and digging must be either removed from the site or piled and burned as they can take root and form new plants (Hoshovsky 2000).

Cultural: Sheep, cattle, horse and goat grazing can be used to control the spread of blackberries (Hoshovsky 2000).

Prescribed Burning: Prescribed burning is effective in removing the canes but will not kill the plants. The plants readily resprout from the root crowns (Hoshovsky and Martin 2001, Hoshovsky 2000).

Chemical: Triclopyr is effective for controlling Himalayan blackberry. Glyphosate does not provide long-term control of Himalayan blackberry unless retreatment occurs (DiTomaso et al. 2013).

CUTLEAF FIREWEED
Senecio glomeratus

General Information

Cutleaf fireweed is an erect annual to short-live perennial in the sunflower family (Asteraceae). Fireweed can become locally dominant on disturbed sites, especially those in coastal regions that are newly burned or logged. However, dense populations typically do not persist beyond 10 years. These species are native to Australasia. This species inhabits disturbed places, burned sites, roadside, fields, coastal forest and woodland, grassland, and coastal scrub (DiTomaso and Healy 2007).

Relevant Life History Traits

Cutleaf fireweed flowers from April to October. This species reproduces by seed. The biology of this species is poorly understood. Seeds disperse primarily with wind. Soil disturbance, including fire, appears to enhance germination. Cutleaf fireweed appears to have fairly long-lived seeds and develops persistent seedbanks (DiTomaso and Healy 2007).

Current Distribution in PCRP

Cutleaf fireweed was recorded at 19 locations totaling 0.05 gross acre. It was limited to the Front Country and was recorded in the Animas, Lower San Jose, Inspiration, South Front, and West Animas MUs. At all locations it was adjacent to roads, which suggests that it is being spread along roads by vehicles or cattle.

Associated Vegetation Communities

Cutleaf fireweed was adjacent to the road in oak woodland, pine forest, and maritime chaparral.

Threats to Sensitive Biological Resources

Cutleaf fireweed was present in area mapped as Smith blue butterfly habitat.

Priority for Treatment

Cutleaf fireweed has a low species priority rank. Populations of cutleaf fireweed are medium priority for control. Because they occur only along roadsides, it is likely cutleaf fireweed is being spread along the road by vehicles or cattle. Control will prevent cutleaf fireweed from being dispersed throughout PCRP roads. Control will also protect the adjacent mapped Smith blue butterfly habitat form further invasion.

Management Strategies

Mechanical: Manual remove of cutleaf fireweed is suitable for small, isolated populations.

Chemical: Postemergencence applications of glyphosate, triclopyr, and clopyralid are recommended.

MILK THISTLE
Silybum marianum

General Information

Milk thistle is an erect winter or summer annual or biennial in the sunflower family (Asteraceae). Milk thistle often occurs in dense, competitive stands. Depending on the amount of soil moisture plants can range from very small to very tall. It inhabits disturbed sites, roadsides, pastures, fields, agronomic crops, waste places, orchards, and trail margins in chaparral and woodlands. Mild thistle grows best on fertile soils. It is native to the Mediterranean region. (DiTomaso and Healy 2007).

Relevant Life History Traits

Milk thistle flowers from April to July. Milk thistle reproduces by seed. Seeds probably disperse only short distances with wind but they can disperse to greater distances with human activities, water, soil movement, animals and as a crop seed or feed contaminant. Most seeds germinate after the first fall rain, but some can germinate throughout winter and early spring. Seeds can survive at least nine years under field conditions (DiTomaso and Healy 2007).

Current Distribution in PCRP

Milk thistle was widespread in PCRP with 53 occurrences totaling 41.81 gross acres. It was scattered throughout PCRP with occurrences in all MUs except Corona, Inspiration, and South.

Associated Vegetation Communities

Milk thistle was present primarily in grassland often along roadsides. It was also present in riparian areas, oak woodland, and on the margin of ponds and coastal scrub.

Threats to Sensitive Biological Resources

None.

Priority for Treatment

Milk thistle has a low species priority rank. No occurrences are considered priority for control. However, milk thistle has been treated, along with other thistles, in the Front Country with herbicide spray application (pers. comm. Nowel 2013). Treatment of milk thistle with herbicides should be continued. In addition, it should be treated along with other thistles at cattle congregation areas including corrals, water troughs, and at boundary of Corona and Malpaso MUs at fence line.

Management Strategies

Mechanical: Cultivation can control seedlings. Also, mowing mature plants before flowers open can help control stands. Tillage can be an effective control option for younger plants.

Cultural: Grazing is typically not an option for control, as plants are generally too spiny for animal to use as forage.

Prescribed Burning: Because plants develop early in the season, burning is not an effective control and can encourage seed germination and establishment.

Chemical: Glyphosate can be applied to plants in the rosette stage in spring. If using the broadcast foliar treatment, use 1 to 2 pt. product/acre. For spot treatment, use 1 to 2% v/v solution. Aminopyralid can be applied during postemergence in spring or early summer to rosettes or bolting plants or in fall to seedlings and rosettes. Clopyralid applied during postemergence from the seedling to the bud stage can be useful, but works best if applied to rapidly growing weeds.

COMMON MULLEIN
Verbascum thapsus

General Information
Common mullein is a biennial in the figwort family (Scrophulariaceae) that develops a single tall flowering stem at maturity. Juvenile plants exist as basal rosettes until they mature, usually in spring and summer of the second season. Common mullein is native to Eurasia. It commonly inhabits roadsides, fields, pastures, forest clearings, agricultural fields, and other disturbed places (DiTomaso and Healy 2007).

Relevant Life History Traits
Common mullein reproduces by seed. Most seeds fall near the parent plant. Seeds do not require an after-ripening period, but germination generally occurs in spring. Soil disturbance facilitates germination and seedling establishment. Under field conditions, some common mullein seeds can survive up to 35 years or more (DiTomaso and Healy 2007).

Current Distribution in PCRP
Common mullein had limited distribution in PCRP with only one occurrence mapped totaling 0.10 acre. It was present in the Panoche MU near a steep drainage.

Associated Vegetation Communities
The occurrence was in grassland habitat.

Threats to Sensitive Biological Resources
The occurrence was adjacent to Smith's blue butterfly habitat.

Priority for Treatment
Common mullein has a medium species priority rank. Treatment of common mullein would prevent this species from becoming further established in PCRP.

Management Strategies
Mechanical: Perhaps the most effective method of controlling common mullein is to cut plants with a weed hoe. Plants will not resprout if cut through the root crown below the lowest leaves. If plants have begun to set seed, cut off the flowering racemes with pruning shears just below the lowest seed pods and collect them in a bag to prevent seeds from being released during the hand removal operation. A second or third weeding may be necessary. Mowing appears to be ineffective, as plants cut above the root crown do not die.
Prescribed Burning: Burning kills bolted plants and appears to kill rosettes, but creates open areas for reinfestation from seed germination. Individual bolted plants can be killed using a flame thrower, but its use is to be avoided during fire season.
Chemical: Common mullein is difficult to control with herbicides because the thick hairs on the leaves prevent the herbicide from reaching and penetrating the leaf surface. A surfactant is recommended for all liquid herbicides used to control this plant. Glyphosate applied to late rosette and bolting plantings in late May has shown to kill common mullein. Another control method is to spray each rosette with glyphosate by putting the spray nozzle into the center of the rosette (DiTomaso, pers. comm.). The applicator touches the plant with the spray nozzle and gives it one good squirt. The key is to ensure that the herbicide penetrates the region of the plant where the growing point is located. If the nozzle is off-center, this method does not work. Only seedlings and rosettes are susceptible to this method. In treating individual plants, it is recommended that a dye be used in the herbicide mixture to mark treated plants and prevent re-treatment. Aminopyralid can be applied during postemergence from the rosette to young bolting stage. A surfactant is necessary for absorption into plants woolly leaves.

PERIWINKLE
Vinca major

General Information

Periwinkle is an herbaceous perennial with trailing sterile stems and erect flower-bearing stems in the dogbane family (Apocynaceae). Periwinkle is commonly cultivated as an ornamental groundcover, but it has escaped cultivation in many places. Under favorable conditions, plants spread invasively and can develop a dense ground cover that out-competes other vegetation in natural areas. Some infestations around old homesteads have been present for many years. It is native to central Europe. This species inhabits riparian sites, old homesteads, moist woodlands, and roadsides. It is more abundant along the coast and grows best under moist shady conditions and tolerates deep shade and poor soil (DiTomaso and Healy 2007).

Relevant Life History Traits

Periwinkle reproduces vegetatively from trailing stems that root at the tips and stem fragments and rarely by seed. Plants and stem fragments disperse with human activities. Under favorable conditions, stem cuttings left on the ground can take root. In riparian areas, water currents can fragment stems and carry them downstream where they can root if lodged in a suitable place. Fruits with viable seeds rarely develop on cultivated and naturalized plants in California (DiTomaso and Healy 2007).

Current Distribution in PCRP

Periwinkle had limited distribution with only one occurrence present. It was in the West San Jose MU along Cypress Road near the boundary of PCRP.

Associated Vegetation Communities

Periwinkle was present at the margin of redwood forest adjacent to coastal scrub.

Threats to Sensitive Biological Resources

Periwinkle was adjacent to redwood forest which is a high priority vegetation community.

Priority for Treatment

Periwinkle has a medium species priority rank. The population is medium priority for control. Control would prevent periwinkle from spreading.

Management Strategies

Mechanical: Hand removal is labor-intensive, but yields good results if careful attention is paid to removing all root nodes and stolons. An effective method is to work inward from the perimeter of the patch and pull the periwinkle back in on itself to prevent further spread of the weed between removal sessions. Because periwinkle has the ability to resprout, mowing or cutting results in abundant regrowth and therefore is not recommended.

Chemical: Glyphosate (as *Roundup)* has been tested on large infestations of periwinkle. Greatest success is achieved if plants are cut first and then sprayed immediately afterward. Cutting with a weed whip or brush cutter breaks through the waxy cuticle and allows better foliar penetration of the herbicide. Using the cut and spray method, a 5 percent glyphosate solution gave nearly 100 percent control. To reduce native plant death in the area, a 3 percent solution provides 70-75 percent control and yields good results if followed by spot applications To aid chemical distribution throughout the plant, use surfactant and apply herbicide during an optimal growing period of good moisture and warm temperatures (70-80 degrees F) usually in late spring or early fall. Triclopyr postemergence when plants are growing rapidly. Applications in spring provide the best control.

Monitoring is recommended. Follow-up on any removal actions is necessary, as any overlooked stem or plant fragments will quickly resprout. Following chemical removal, the population should be checked twice, in early fall and late spring. With manual removal, follow-up should be performed every three months to remove resprouts. After the patch is eradicated, it should be checked twice a year in optimal growing seasons.

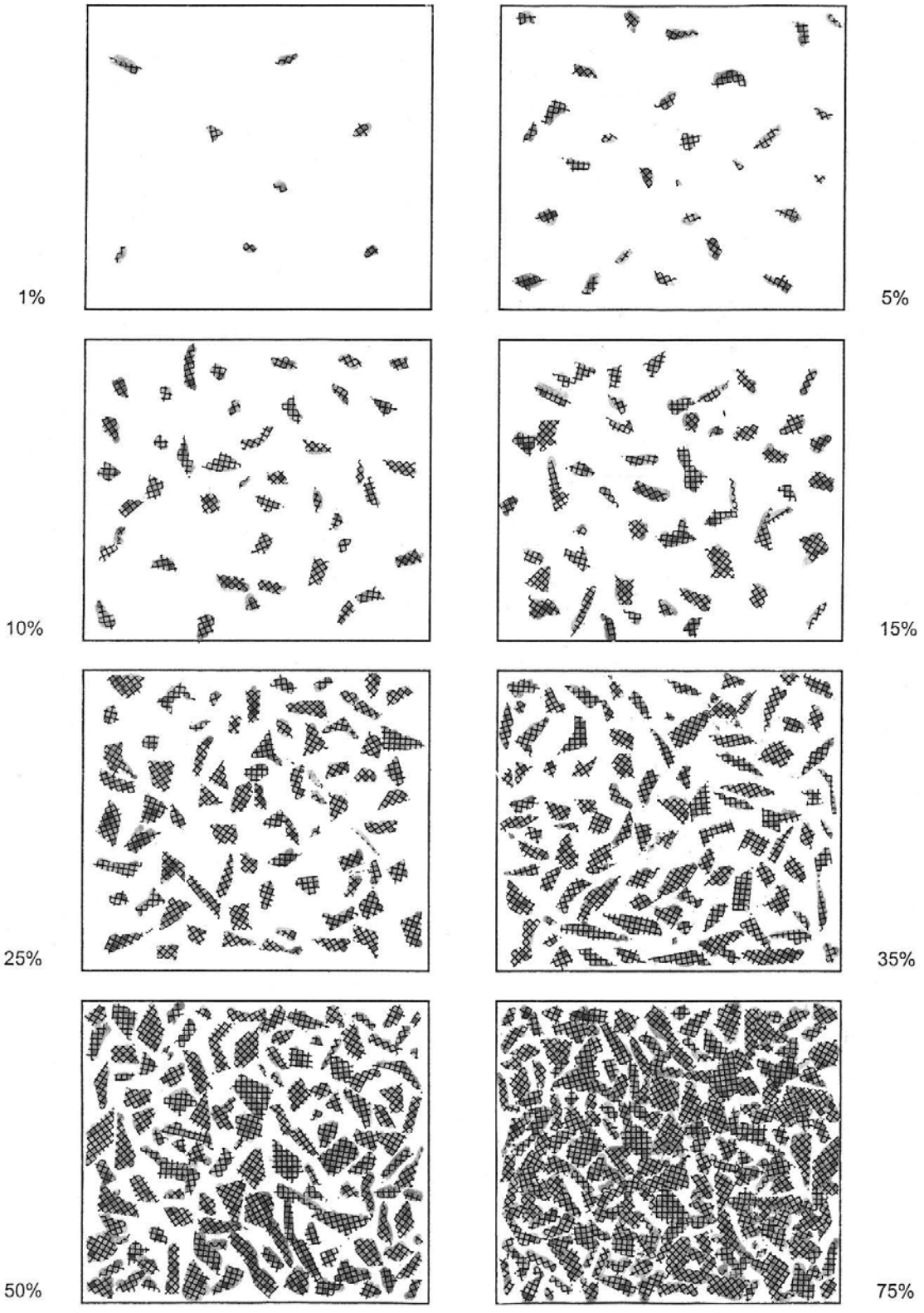
APPENDIX E DATA FORMS AND INSTRUCTIONS

WEED SPECIES DATA FORM INSTRUCTIONS

Use your GPS Unit to record a point or polygon at the location of the weed occurrence. Take a separate point (or polygon) and fill out a data form for each weed species.

- **Target Weed Species** – The target weed species corresponding to the polygon.
- **Observation Date** – Date that the infestation information was recorded
- **GPS Coordinates/Polygon Name** – The unique name of the polygon or the GPS coordinates if recording a point.
- **Observer Name** – Person collecting the data
- **Phenology –** life cycle stage of the majority of plants of infestation.
    - seedling/rosette
    - bolting
    - leafing out
    - flowering
    - fruiting
    - mature
    - vegetative
    - dormant
    - dead/skeleton
- **Distribution Categories** – A description of how the target weed species is distributed across the landscape.
    - Single Plant – a single individual or 2 of the species
    - Single Patch – target weed species comprising one or a few individuals; otherwise devoid of that particular plant
    - Scattered Plants – target weed species readily occurring throughout a specific area
    - Dense Monoculture – target weed species comprising a dominant stand of one particular species
    - Scattered Dense Patches – target NIPS that are readily found throughout the specific area occurring in groups
- **Number of Individuals** – An estimate of the number of individual plants in the infested area.
- **Canopy Cover Class** – Cover is the estimated percent of the gross area actually covered by the target weed species. Use the attached cover diagram to help you estimate.
- **Infested Area** – An estimate of the area actually covered with target weed species if there were no spaces between the plants. Does not include land and other plant species. This area is smaller than gross area.
- **Gross Area** – An estimate of the size of the general area where the target weed species occurs, including land and other plant species between target weed species individuals (by drawing an imaginary line around outside of infestation). For a polygon, this can be calculated in GIS.
- **Habitat** – The habitat or vegetation community where target weed species is observed and any notes on habitat quality.
- **Location Description** – A written description of the location of the weed occurrence.
- **Notes** – Notes on target weed species that pose a threat to sensitive resources. Details of treatment including herbicide, formulation, volume used, and application method.

CNPS COVER DIAGRAMS



WEED SPECIES DATA FORM

Fill out one box for each weed species encountered. Definitions of attribute fields are attached.

Weed Species	Observation Date	GPS Coordinates/Polygon Name
Observer	Phenology	Canopy Closure (Cover)
Observer Email and phone number	Distribution/Abundance	Infested Area (acre or sq. ft.)
	No. of Plants	Gross Area (acre or sq. ft.)
Habitat		
Location Description		
Notes including Treatment (Herbicide/Formulation/volume used)		

Weed Species	Observation Date	GPS Coordinates/Polygon Name
Observer	Phenology	Canopy Closure (Cover)
Observer Email and phone number	Distribution/Abundance	Infested Area (acre)
	No. of Plants	Gross Area (acres)
Habitat		
Location Description		
Notes including Treatment (Herbicide/Formulation/volume used)		

APPENDIX F HERBICIDE USE GUIDELINES AND SAFETY PRACTICES

This Standard Operating Procedure was adapted from the Nature Conservancy's Santa Cruz Island Weed Management Strategy (Knapp et al *2007).*

The Standard Operating Procedure developed by The Nature Conservancy's Disney Wilderness Preserve is known to be comprehensive and applicable to wildlands situations, and thus adapted for Palo Corona Regional Park. To ensure the appropriate and effective application of herbicides as a management tool, to minimize detrimental effects to the environment, to ensure the safety of all individuals at risk of exposure, and to minimize PCRP, and their contractor's exposure to liability, the following safety protocols have been adopted for the PCRP weed program.

1. Herbicides shall be used only in situations where benefits of controlling targeted weeds outweigh overall risks of using herbicides and other methods are prohibitively expensive, not effective, or more likely to cause unintended damage than the herbicide.
2. All herbicide and service containers (spray bottles/backpack sprayer, spray rig, etc.) should be labeled properly as required by law, and should include the following minimum information:
    a. Product name, e.g. Roundup Pro
    b. Signal word, e.g. Caution
    c. Applicator contact information: Name, address, telephone number, e.g. John E. Nozzlehead, American Weed Company, 1234 Infestation Way, Somewhere Ville, CA 90000. (555) 555-5555.
3. An herbicide may be used only in a manner consistent with its labeling.
4. An herbicide may be used only in compliance with all federal, state, and local regulations, including those related to licensing and/or certification of applicators, use of protective and safety gear, and posting requirements.
5. Standard safety practices, as specified by Federal, state, and county agencies, for storage, mixing, transportation, container and unused herbicide disposal, and spill containment will be followed.
6. Herbicide containers and related equipment will be stored in a locked location, away from people, animals, feed, and food.
7. Herbicide containers will be stored closed and inspected periodically for leakage.
8. All contractor certified applicators will maintain their certification when working on PCRP property, and will notify the appropriate land owner when applications are planned.
9. Receipt of employee, contractor, or volunteer suggestions or complaints relating to safety and health issues involving herbicides will be used to improve program safety.
10. All herbicide applicators shall wear the following protective gear when mixing or applying herbicides:
    a. Closed-toe footwear (preferably water repellant)
    b. Protective clothing (long-sleeve shirts [worn down], long pants, underwear, and socks not used for other activities). Coveralls can be worn in place of long shirt and pants.
    c. Tyvek or nitrile gloves
    d. Safety glasses or goggles (which ever is specified in the label)
    e. It is recommended to always wear an appropriate apron when mixing and loading herbicide.

11. Volunteers are required to fill out emergency contact information and sign consent and release forms.
12. Decontamination kits must be readily available in storage and mixing areas, and must include at least two one-gallon containers filled with potable water, eyewash bottles filled with eyewash or water, soap and single use paper towels.
13. A binder containing all herbicide labels, Material Safety Data Sheets (MSDS), a map of roads, and directions to obtain medical attention, i.e. how to secure medical evacuation from the park, will be available in all project vehicles and in herbicide storage areas.
14. Treated areas should be closed to public access (via signs, flagging, or applicator presence) until they are safe for re-entry (until the herbicide dries or for the minimum period required by the product label-whichever is longer)\
15. All herbicide applications occurring must report all herbicide applications in accordance with State and County rules and regulations.
16. Weather and site conditions should be taken into account prior to utilizing herbicide. Typically, spray applications should not be made when wind speeds are 10 mph or greater. The herbicide label should be check 1) for specific conditions to avoid and 2) when a temperature inversion exists to avoid drift to off-target plants.
17. The site should be inspected for standing water, as some herbicide can not be applied near open water such as streams, vernal pools, or the sea. Inspect soil texture, since some herbicides do not absorb (bind) to clay colloids, and thus may leach readily through sandy soil. This is especially important when working around drinking water wells.

APPENDIX G VOUCHER COLLECTION GUIDE

Bay Area Early Detection Network: Voucher Collection Guide

Collecting Voucher Specimens

Having a physical voucher of a plant, especially a potentially new record for a county or a park, is still the preferred method of proving an observation. Vouchering adds third-party expert certification as well as a physical record that can be later re-examined. The Bay Area Early Detection Network (BAEDN) encourages vouchering high-priority early detection plant species as a means of bolstering the certainty of photographs and reports associated with early detections.

If you do not know what a plant is, and there are fewer than 20 in an area, do not collect it but take good location information and photographs and send them to unknown@baedn.org. Volunteers and inexperienced observers should take only photographic vouchers of any unknown species. More experienced botanists may field-key or choose to voucher.

Collection restrictions and safety considerations should always be weighed prior to collecting voucher specimens. Some land management agencies such as the National Park Service require permits for collecting. Collections along roadsides should be made only when it is safe and legal to do so. It is not safe or legal to stop on along highways to collect plant samples.

Vouchers should be collected in the following situations:

- for expert identification of an unknown;
- to record a new species for a site's plant list;
- to record a significant range expansion for a species (*e.g.*, first county record);
- to document species that will be treated by BAEDN;
- to support and verify your study, monitoring, or treatment of the species.

A collection should also be accompanied by photographs of the plant *in situ* to capture characteristics that may be lost during pressing.

An example of a mounted herbarium specimen is provided here (click on the image to see it enlarged) http://ucjeps.berkeley.edu/cgi-bin/new_detail.pl?JEPS104252.

Collecting Tips

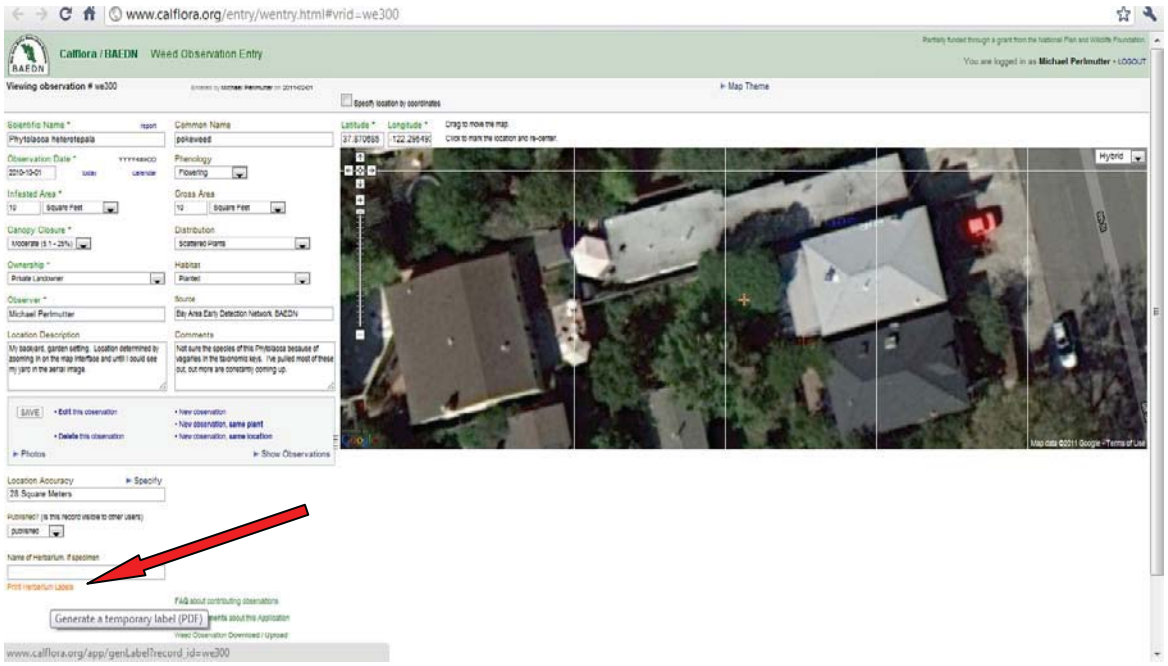
Plants are best keyed fresh, so field-key when possible. Tiny-flowered plants are especially difficult to key when wilted or pressed. If field-keying is unsuccessful, press some and bag some in a plastic baggie. Blow it up with air and keep it moist (a small piece of wet paper in the bag helps); refrigeration will help keep your specimen fresh. Remember to label both the bagged and the pressed plants! A plastic sandwich container will also work well for delicate structures. Key or submit fresh samples immediately!

If you are collecting with the intent of creating a pressed and mounted specimen:

- Collect a representative example of the species, not the largest or smallest. Try to include many phenological stages (flowering and fruiting), since many keys use characteristics of fruit and flower. If possible, collect at least two specimens allowing for accessioning by both the CDFA and Jepson herbaria. Additional material collected for ID/keying should be labeled as such. Collect as much of the individual plant as possible, *including roots* (or a portion if rhizomatous), bulbs, vegetative and flowering/fruiting matter. If the plants are tiny, collect enough to fill about half an herbarium sheet.
- Wash as much dirt as possible from the roots and pat dry before pressing.
- If flowers are large enough, cut one or two open and press flat so the interior/cross-section can be seen. Do the same for fruits. Turn over at least one leaf so the underside will be visible in the final mounting.

- Press carefully. Typically specimens are pressed in folds of newspaper, with the label slipped in with the plant material. The standard plant press is the same size as a standard herbarium sheet (11”x17”). You can make your own plant press or purchase one, see http://sdplantatlas.org/pdffiles/equipment.pdf for ideas. How you place the plant in the press will generally be how it will look mounted. If a plant is large, fold it or cut it to fit, keeping branching and general form intact. Note original dimensions and photograph if possible. Plants requiring more than one sheet for proper representation should be noted by labeling the sheets “[1] of [total number of sheets],” “[2] of [total number of sheets],” etc. The herbarium will typically mount the specimen on herbarium sheets
- All records should be entered into the Calflora database to ensure digital preservation of the data. A best guess genus and species label should be assigned for uncertain identifications, along with a note regarding the uncertainty. If you are only confident of the genus, enter this preceded by an asterisk (ex: **Petasites*), and if even the genus is not known, report it as “*Unknown*.” In all cases, the record should be edited once the species name is determined by experts. Additional Calflora reporting instructions for non-native plants are posted at the reporting tab at www.BAEDN.org.

Figure 1. Calflora interface



- Take copious **notes**, including the following information: **date**; **collector** and **collection number** (the collector’s name and the number of specimens the collector has collected to date—*e.g.*,, Andrea Williams’1000th specimen would be coded as “A. Williams 1000.”); exact **location** in Lat/Long or UTM (from GPS–if GPS is used, specify datum such as NAD83); elevation; descriptive location (*e.g.* about 1 mile up Coastal Trail from Rodeo Lagoon parking lot, Wolf Ridge, Marin Headlands; do not use “local” nicknames not on any map!); county; **habitat** description (dominant species); **associated species**; characteristics that may be lost in pressing (smells, flower color, habit, stature, bark, branching patterns, etc.); study name and number/plot number if applicable. Some information (elevation, sensitivity, county) may be filled in at the office. **Many specimens are eventually discarded due to a lack of collection information—don’t let this happen to yours!**

- Herbarium labels can be created directly from Calflora. After completing and saving the online occurrence record, click the "Print herbarium label" button in the left hand bottom corner of the page to generate the label. Print enough copies for each specimen. All duplicates (parts of the same plant) and individual specimens with multiple sheets should bear the label information.

Figure 2. Sample collection label printed from Calflora

Date: 2010-10-01	**Collector:** Michael Perlmutter	**Calflora ID#:** we300	**Determination:**
Phytolacca heterotepala	H. Walter		
Phytolaccaceae	pokeweed		
Coordinates: 37.870685, -122.295493 NAD83			
Location Description: My backyard, garden setting. Location determined by zooming in on the map interface and until I could see my yard in the aerial image.			**Det. by:**
Comments: Not sure the species of this Phytolacca because of vagaries in the taxonomic keys. I've pulled most of these out, but more are constantly coming up.			**Det. date:**

Remember to specify units and give any useful details!

- Notes and labels should be printed on acid free cotton bond paper and also provided electronically (a spreadsheet can be used to document multiple labels).

Early detection vouchers, as well as unknown non-native plant species, should be mailed or brought to:

Fred Hrusa, Ph.D.
Senior Plant Taxonomist
California Dept. of Food & Agriculture
3294 Meadowview Rd.
Sacramento, CA 95832-1448
fhrusa@cdfa.ca.gov
Herbarium: 916-262-1143; 916-262-0951

Please include your name, email address, and phone number so that Fred can contact you with the identification determination.

Alternatively samples can be brought to the local County Agriculture Commissioner's Office (see following pages for locations and hours), where the biologist will assist in identification and/or filling out a Pest Damage Record. Regionally important specimens, or those that cannot be identified by county biologists, will be sent to the California Department of Food and Agriculture's (CDFA) taxonomists for identification and accessioning to the herbaria.

Bay Area Early Detection Network: Voucher Collection Guide

County Agricultural Commissioner Contacts

County	Address	Phone	Email	Notes
Alameda	3575 Greenville Road, Livermore, CA 94550	925-245-0849		Every weekday from 8:30AM - 12PM a biologist is "On Duty." You can call us or bring a sample to our office for help. For general identification, bring in a sample of flowers, fruit or seeds (if present) and a stem portion with leaves attached, approximately 12 inches long.
Contra Costa	2366 A Stanwell Circle, Concord CA 94520-4807	925-646-5250		Office Hours 8AM - 5PM. For general identification, bring in a sample of flowers, fruit or seeds (if present) and a stem portion with leaves attached, approximately 12 inches long.
Contra Costa	Branch office: 3020 Second St., Knightsen, CA 94548	925.427.8610		Office Hours 8AM-8:30AM and 1PM-2PM
Marin	1682 Novato Blvd. Suite 150-A , Novato, CA 94947	415-499-6700		
Napa	1710 Soscol Ave # 3, Napa, CA 94559-1311	707-253-4357	agcommissioner@countyofnapa.org	You can bring in a specimen to the UC Cooperative Extension's Master Gardeners for identification. The Agricultural Commissioner's staff can also help identify landscape plants or unwanted weeds. Napa County Master Gardeners are available: Monday, Wednesday and Friday 9:00 am - 12 noon. 1710 Soscol Avenue, Suite 4 , Napa, CA 94559. (707) 253-4221.
San Francisco	501 Cesar Chavez St., Suite 109-A, San Francisco, CA 94124-1209	415-252-3830		
San Mateo	728 Heller Street, P.O. Box 999, Redwood City, CA 94064-0999	650-363-4700	smateoag@co.sanmateo.ca.us	A Biologist is available Monday through Friday in the afternoon at the main office (728 Heller Street, Redwood City) to assist homeowners and pest control businesses with the identification of landscape, home and structural insect pests, weeds and plant diseases.

Bay Area Early Detection Network: Voucher Collection Guide

County	Address	Phone	Email	Notes
San Mateo	Half Moon Bay Field Office	650-726-2514	smateoag@co.sanmateo.ca.us	
San Mateo	San Bruno Field Office	650-877-5763	smateoag@co.sanmateo.ca.us	
Santa Clara	1553 Berger Drive, San Jose, CA 95112	Main: 408-918-4600; Agricultural Biologist Office Duty line: 408-918-4610	scc.agriculture@aem.sccgov.org	(Biologist office hours are from 1PM - 5PM)
Santa Clara	605 Tennant Avenue, Suite G, Morgan Hill, CA 95037	Main: 408-465-2900; Agricultural Biologist Office Duty line: 408-465-2908	scc.agriculture@aem.sccgov.org	(Biologist office hours are from 8AM- 12PM)
Solano	501 Texas Street, Fairfield, CA 94533	707-784-1310	AgComm48@solanocounty.com	Samples can be dropped off Monday – Friday: 8AM to noon and 1PM to 5PM. Every weekday from 2PM to 4PM, a Biologist is on duty to answer questions, i.e., identify insects and assist with regulatory requirements. An 'Identification Slip' should be filled out for all samples.
Sonoma	133 Aviation Boulevard, Suite 110, Santa Rosa, CA 95403	707-565-2371		Bring in a sample of the plant for possible identification by the UC Cooperative Extension's Master Gardeners, 133 Aviation Blv., Ste 109, Santa Rosa | Sonoma: 19722 8th St E. The sample should be freshly acquired and just packaged in clear freezer bag--not put in a bag, left to mold for a week, and then brought in. A good size sample is required, showing leaves, bark, stem and flower, if applicable.