BIOLOGICAL RESOURCES
OF THE DEL MONTE FOREST

MONTEREY PINE AND MONTEREY PINE FOREST HABITAT

DEL MONTE FOREST
PRESERVATION AND DEVELOPMENT PLAN

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Executive Summary

Monterey pine and its associated forest habitat in the Del Monte Forest have long been recognized as unique and important environmental resources. Because of its limited natural range and its biological, aesthetic and commercial value, the long-term preservation of native Monterey pine forest on the Monterey Peninsula is a high priority, not only in Monterey County, but on a worldwide scale.

Land use planning and development in the Del Monte Forest cannot proceed without consideration of the conservation and management of the Monterey pine forest resource. The Del Monte Forest Land Use Plan (LUP) sets standards by which development may occur in the forest and establishes key forest protection measures, including designation of environmentally sensitive habitat areas (ESHAs) and preservation of the 372-acre Huckleberry Hill Natural Area (HHNA) to mitigate forest build out. Successive plans and proposals for forest development over the years have included additional mitigating measures to offset impacts to Monterey pine.

On November 7, 2000, Monterey County voters overwhelmingly approved the Del Monte Forest Plan: Development Limitations and Forest Preservation Initiative (Measure A) to change land use plan designations and zoning within the Del Monte Forest. Measure A effectively downzoned lands in the Del Monte Forest to clearly limit future potential development in currently undeveloped Monterey pine forest areas. In conformance with Measure A, Pebble Beach Company (PBC) drafted the Del Monte Forest Preservation and Development Plan (DMF/PDP), a plan for the preservation and build out of PBC-owned lands within the Del Monte Forest.

The DMF/PDP proposes to preserve large tracts of forested open space within the Del Monte Forest previously designated by the LUP for medium density residential development, to convert some land previously planned for residential use to recreation, and to renovate existing and provide new visitor serving accommodations and uses. Over 423 acres of forest habitat would be designated as permanent open space forest and approximately 105 acres of forested lands would be developed. When combined with the 200-acre portion of the HHNA, dedicated by the LUP to mitigate remaining forest buildout, the total DMF/PDP dedicated open space forest acreage (over 623 acres) compensates for forest losses at a ratio of almost 6:1.

The DMF/PDP fully responds to public and agency comments on previous development proposals for the Del Monte Forest by substantially reducing impacts to Monterey pine forest acreage (approximately 105 acres instead of the 278 acres removed by the most recent proposal) and Monterey pine trees (approximately 6,371 instead of 12,000 Monterey pines removed), coupled with a commitment to extensive forest preservation and management. Implementation of the DMF/PDP will increase the existing inventory of formally preserved habitat within the Del Monte Forest to a total of over 1,100 acres or about 80% of the remaining undeveloped forested lands in the forest.

Environmental review of previous development proposals has created a substantial record of information on biological resources in the Del Monte Forest, including the Monterey pine forest

resource. Broad-ranging Monterey pine resource assessments (Huffman and Associates 1994, Jones & Stokes Associates 1994 and 1996) have also been conducted to assemble and summarize current scientific knowledge on the species and its habitat. In addition, information compiled as a result of the California Native Plant Society (CNPS) petition to list the species as threatened provides a body of background material. A portrait of ecological and other biological attributes, current and historical distribution, and conservation principles and strategies regarding Monterey pine forest can be drawn from all of these sources.

However, a supplemental forest assessment was conducted in 2001 to update the record and to determine whether measurable parameters could be used to establish areas of particular environmental sensitivity within the Del Monte Forest. The assessment evaluated forest characteristics relative to tree density, canopy cover, understory associations and other factors. The assessment concluded that forest structure is relatively consistent in the Del Monte Forest, and the natural processes of regeneration, growth, maturity and senescence continue to occur, albeit in a static rather than dynamic state. While fire or an equivalent stand-replacing disturbance may expand and accelerate the cycle of forest renewal, that cycle appears to be working at a sustainable pace without such disturbance. The 2001 data also indicate that discernable trends in understory vegetation composition and cover allow general characterization by soil type, elevational gradient and other factors (e.g. presence of moisture), but depict a mosaic of species associations with no real definable boundaries distinguishing particular areas. The data do not point to additional unique or environmentally sensitive habitat areas or high priority locations for conservation. Rather, the data validate previous conclusions that a sound conservation strategy would include preservation of all differentiated vegetation types in large enough and connected blocks of natural habitat to maintain a self-sustaining forest and provide opportunity for enhancement through appropriate ecological management.

There is general consensus that the priority areas for conservation in the Del Monte Forest are the remaining unfragmented, larger-sized native Monterey pine stands with relatively undisturbed understory along with adequate area supporting representative populations of special-status-species and unique habitats. Sufficient area to allow natural ecological processes is important for long-term genetic and habitat sustainability of Monterey pine and its associated species.

The preservation component of the DMF/PDP is intended to balance reasonable and appropriate use of PBC-owned land with assurances for the long-term sustainability of the Monterey pine forest and its associated species and habitats in the Del Monte Forest. The DMF/PDP limits and consolidates its development components to existing disturbed areas or already fragmented forest areas and preserves large, intact, functioning ecosystems. It conserves diverse areas of the forest and conserves species or groups of species of special interest. It establishes habitat linkages and connectivity between and among remaining undeveloped areas of the forest. Finally, the DMF/PDP is accompanied by a commitment to manage the preserve and other open space areas of the forest in an ecologically sound manner.

1.0 INTRODUCTION

1.1 Purpose

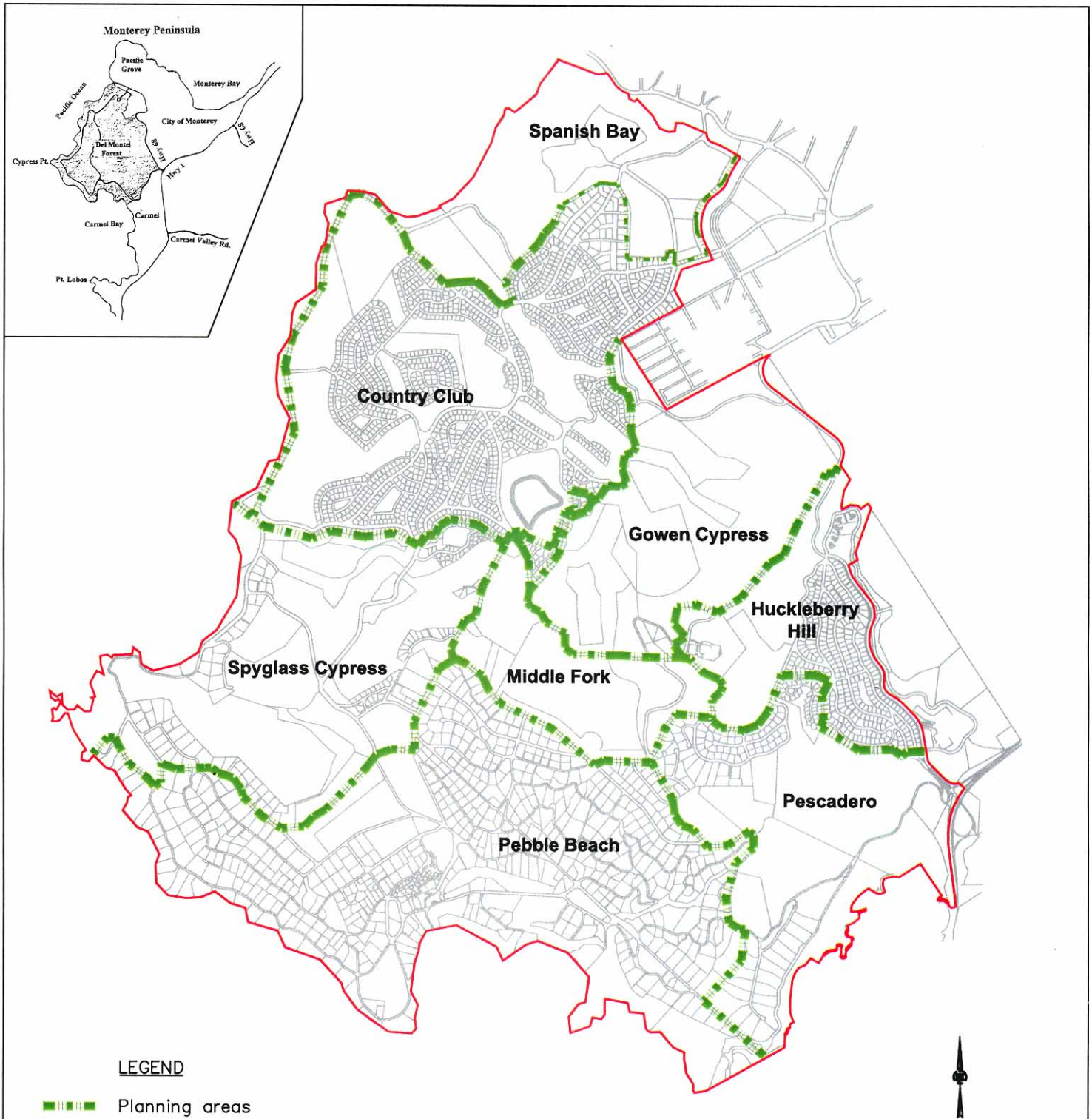
This report was prepared by Zander Associates to address Monterey pine and Monterey pine forest habitat in relation to the proposed Del Monte Forest Preservation and Development Plan (DMF/PDP). The DMF/PDP was conceived by Pebble Beach Company (PBC) in conformance with the voter-approved initiative, Measure "A" that revised land use and zoning designations and policies in the Del Monte Forest. The initiative replaced nearly 80% of remaining undeveloped land within the Del Monte Forest formerly designated for residential development with open space uses, of which 70% is reserved for open space forest resource conservation uses and 30% for open space recreation. Other changes will increase the amount, and enhance the quality, of existing visitor serving commercial uses. A key component of the Pebble Beach Company plan is to preserve, through amendments to the Monterey County Local Coastal Program (LCP), a majority of forested lands in the Del Monte Forest to permanently protect the Monterey pine forest resource.

This report is one of several separate but related documents prepared to provide information on biological resources within the Del Monte Forest, to evaluate the effects of the DMF/PDP on those resources, and to identify appropriate management strategies for the long-term sustainability of those resources within the DMF/PDP area. The report relies on the extensive history of study and documentation of Monterey pine forest resources on the Monterey Peninsula, supplemented by site-specific assessment in the DMF/PDP area to:

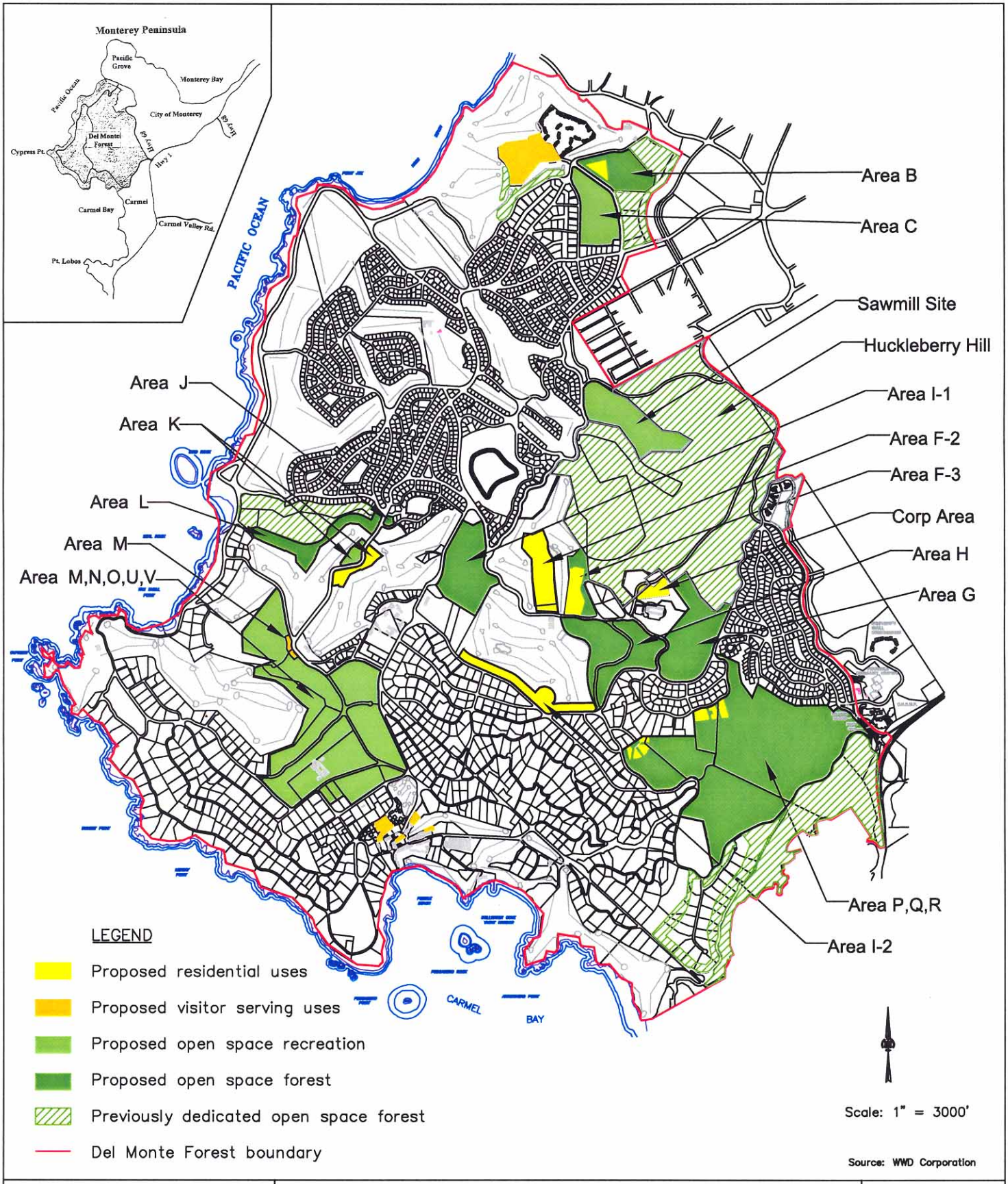
- Review the planning context and background of the DMF/PDP relative to the Monterey pine forest resource;
- Summarize existing general and Del Monte Forest-specific characteristics of Monterey pine and Monterey pine forest habitat;
- Provide supplemental information to address the question of environmentally sensitive Monterey pine forest habitat in the Del Monte Forest;
- Evaluate the effects of the DMF/PDP on Monterey pine trees and forest habitat and;
- Assess the conservation and management benefits of the DMF/PDP for Monterey pine and forest habitat in the Del Monte Forest

1.2 Project Description

The DMF/PDP is a plan for the preservation and buildout of PBC-owned lands within the Del Monte Forest, a designated planning area within the Monterey County Local Coastal Program (LCP) consisting of eight sub areas and comprising approximately 5,300 acres of land on the Monterey Peninsula (Figure 1). The DMF/PDP proposes to preserve large tracts of forested open space within the Del Monte Forest previously designated by the Del Monte Forest Land Use Plan (DMF LUP) for medium density residential development, to convert some land previously planned for residential use to recreation, and to renovate existing and provide new visitor serving accommodations and uses (Figure 2).



Zander Associates Environmental Consultants 150 Ford Way, Suite 101 Novato, CA 94945 (415) 897-8781	Del Monte Forest with Land Use Planning Areas Monterey County, California	Figure 1



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Del Monte Forest
Preservation and Development Plan
Monterey County, California

Figure 2

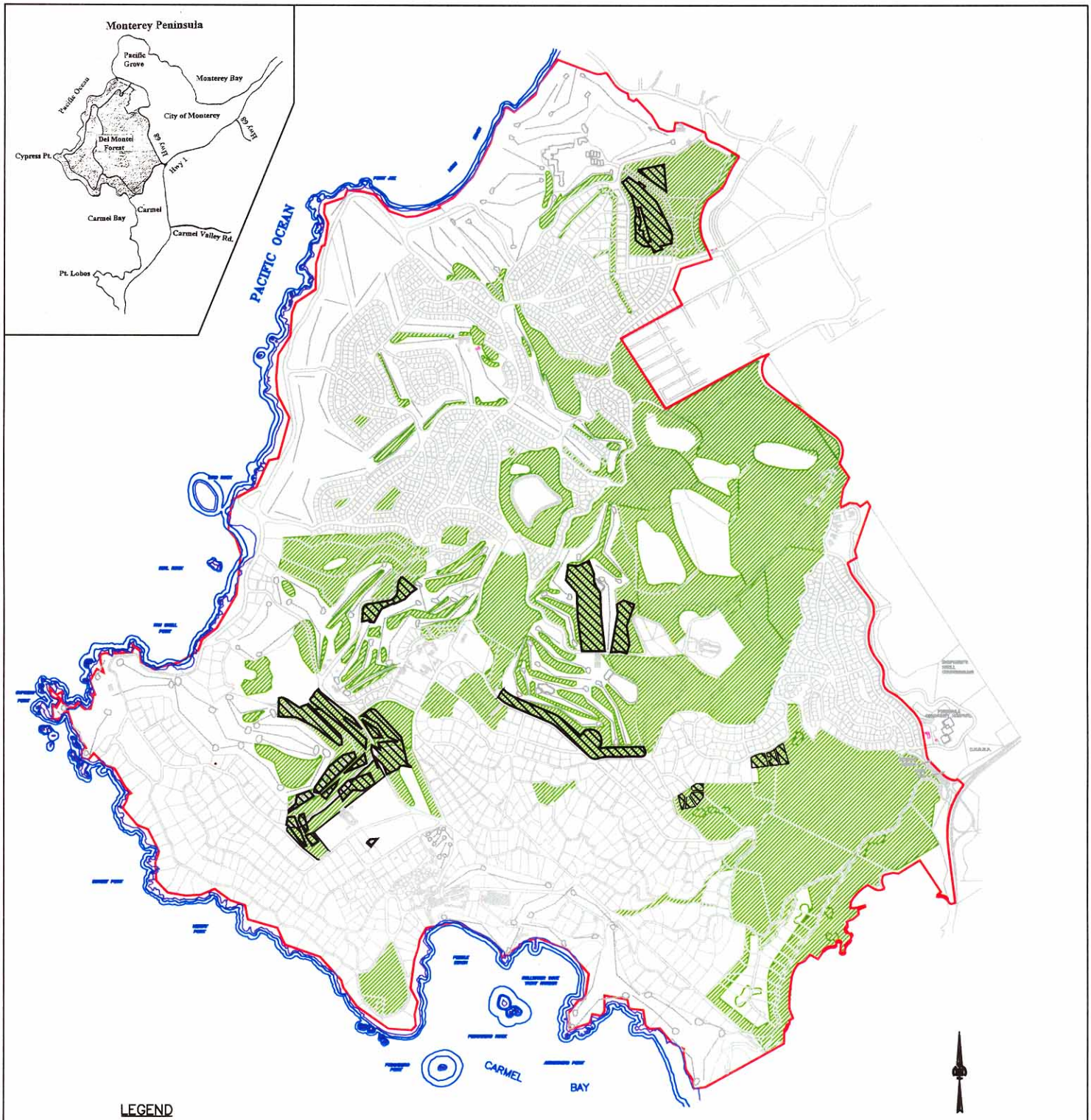
The DMF/PDP will result in permanent open space forest designation of over 423 acres of forest habitat and conversion of approximately 105 acres of forested lands to visitor-serving commercial and open space recreation uses. Approximately 80 acres of forested lands associated with those developed uses will also be retained and managed under appropriate forest maintenance standards. When combined with the 200-acre portion of the Huckleberry Hill Natural Area (HHNA), dedicated by the LUP to mitigate remaining forest buildout, the total DMF/PDP dedicated open space forest acreage (over 623 acres) compensates for forest losses at a ratio of almost 6:1. Implementation of the DMF/PDP will increase the existing inventory of formally preserved habitat within the Del Monte Forest to a total of over 1,100 acres or about 80% of the remaining undeveloped forested lands in the forest (Figure 3).

The DMF/PDP consists of the following elements:

- Designation as open space forest and ecological management of over 273 acres that are currently zoned for residential development by the DMF LUP. These lands, in addition to the existing LUP-designated open space within the DMF/PDP area (an addition of approximately 150 acres for a total of 423 acres), and previously dedicated open space throughout the Del Monte Forest, contribute to the establishment of permanent, large, contiguous tracts of forest habitat and add to the acreage of existing preserve areas (Figure 3). The DMF/PDP establishes a significantly larger native Monterey pine forest preserve area than anticipated by the LCP certified by the Coastal Commission or any of the subsequent proposals for buildout in the Del Monte Forest. DMF/PDP open space forest preserve areas include over 233 acres in Area PQR, approximately 48 acres in Area G, 53 acres in Area H, 18 acres in Area L, 40 acres in Area I-1, 21 acres in Area B, and over eight acres in a portion of residential area F-3.

- Construction of a new 18-hole golf course in former subdivision areas M, N, O, U & V. The course has been designed with sensitivity for the surrounding natural environment. Nearly half of the course (Holes 3, 4, 5, 6, 7, 8, 9, & 10) would be constructed on lands with limited forest resources, having been used for the Pebble Beach Equestrian Center. Three other golf holes (Holes 15, 16 & 17) would be constructed on previously mined and disturbed areas associated with the Spyglass Quarry, designated as a Rehabilitation Area by the DMF LUP. Approximately 61 acres of Monterey pine forest, fragmented by roads and equestrian trails, would be removed to allow golf course improvements, but another 55 acres of forested lands around the new golf course would remain undeveloped. Construction of the golf course would also involve the removal of over five acres of paved roadways within the interior of the site including Bristol Curve, Stevenson Road, Drake Road and Portola Road. Bristol Curve would be eliminated, and Stevenson Road would be realigned. A total of about 15 acres of formerly paved or disturbed areas would be replanted with Monterey pines and other native species. The golf course has been designed to avoid all wetlands and significant occurrences of special-status plant species in this area and to maintain setbacks from these resources consistent with the DMF LUP.

- Relocation of the existing Equestrian Center to the Sawmill Quarry. A new equestrian facility would be constructed on an approximately 45.5-acre area known as the Sawmill



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Monterey Pine Forest Removed and Remaining following DMF/PDP
Del Monte Forest
Monterey County, California

Figure 3

- Quarry that consists of two formerly mined terraces adjacent to the Huckleberry Hill Natural Area. Buildings, stables and other permanent structures (e.g. covered arena for event functions) would occupy the upper 18.13-acre portion of the site. Overflow parking and other temporary activities would be located on the lower 27.35-acre portion of the site. The quarry area was mined continuously until the early 1980's; attempts at restoration have been only marginally successful. Development of the Equestrian Center at this location would require the removal of about 13.5 acres that support planted trees and about three acres of native forest on the edges of the former quarry. These improvements have been sited and designed to avoid all designated wetlands on the site with setbacks consistent with the DMF LUP.

- Construction of a new driving range and teaching facility at The Spanish Bay Resort. A new driving range and a ±3,000 sq. ft. golf teaching facility are proposed for a 29.05-acre parcel (LUP Development Area C) directly across 17 Mile Drive from The Inn at Spanish Bay. The driving range site would also provide 301 parking spaces for employees, guests and driving range users. An open space buffer would surround the range. Identified wetlands on the site would be avoided with setbacks consistent with the DMF LUP. Approximately 17 acres of Monterey pine forest habitat would be removed by construction of these facilities and approximately 12 acres would remain.

- Additions to the existing Inn at Spanish Bay and Lodge at Pebble Beach. Construction of new buildings, remodeling of existing buildings, construction of additional parking areas (both above and below ground) and other improvements are proposed to add visitor accommodations and meeting space, improve interior resort operations, increase parking and improve circulation, and generally enhance the recreational resort experience at these two facilities. Less than 0.5 acre supporting Monterey pine will be affected by the Spanish Bay improvements, and no natural areas will be disturbed at The Lodge.

- Relocation of existing residential lots and construction of employee housing units. The total number of lots proposed for residential development by the DMF/PDP is substantially less than any prior proposals for build out in the Del Monte Forest. Tentative Maps or lot line adjustments for LUP Development Areas F-2 (10 residential lots), F-3 (4 residential lots), I-2 (11 residential lots), K (lot line adjustment for 1 residential lot) and PQR (7 lots) to accomplish this relocation would result in the designation of 33 lots for residential use. In addition, 12 employee housing units in four new buildings are proposed for an approximately three acre portion of LUP Development Area B and 48 employee units in eight clustered buildings are proposed for the existing Corporation Yard area. Several of the Tentative Maps include designated open space parcels to avoid impacts to important forest resources. The lot areas are generally of sufficient size to allow sensitive placement of building sites so that impacts to those resources will be further reduced through site-specific forest maintenance standards and management plans for each lot. The employee housing in Area B would remove about two acres of forest area while the Corporation Yard housing would be constructed on previously disturbed ground.

1.3 Report Organization

The background on development planning in the Del Monte Forest relative to the Monterey pine resource is presented in the following chapter of this report (Chapter 2). Chapter 2 summarizes the planning policies in the DMF LUP that pertain to protection of Monterey pine forest and pine trees, and discusses the relevant polices that pertain to pine forest elements considered environmentally sensitive habitat areas. The assessment work done in support of the original Lot Program proposal, including the assessment completed for the revised alternative proposal (known as Refined Alternative 2 or RA2), is also discussed. Finally, Chapter 2 presents an overview of the DMF/PDP as a response to the planning and review process relative to preservation and protection of the Monterey pine resource.

Chapter 3 summarizes two important background documents regarding the Monterey pine forest resource along with the history of the petition to list the species as threatened under the California Endangered Species Act (CESA). Broad-ranging Monterey pine resource assessments were completed by both Huffman and Associates (1994) and Jones & Stokes Associates (1994a & b; 1996b) to compile and summarize current scientific knowledge on the species during review of the Lot Program. In addition, the California Native Plant Society (CNPS) submitted a petition to the California Fish and Game Commission in 1999 to list the species as threatened, and Pebble Beach Company and others compiled a body of information on the species to document comments in response to the petition. Together, these studies, articles and reports provide a compendium of information on ecological and other biological issues, current and historical extent of Monterey pine forest, and pertinent conservation principles and strategies.

Chapter 4 provides a characterization of Monterey pine and Monterey pine forest habitat, both in a general sense and as it occurs in the Del Monte Forest Plan area. The information in this section is drawn largely from the record established by the evaluation conducted for the Lot Program proposal and also incorporates information from the studies referenced above. Specific issues that arose through environmental review of the Lot Program related to the distribution and environmental sensitivity of the Monterey pine forest resource in the Del Monte Forest are also addressed.

Chapter 5 presents the methodology and results of a supplemental forest assessment conducted by Pacific Southwest Biological Services, Zander Associates and Webster & Associates during 2001 to evaluate forest characteristics relative to tree density, canopy cover, understory associations and other factors. The assessment was conducted to supplement and update the record and to determine whether measurable parameters could be used to establish areas of particular environmental sensitivity within the Del Monte Forest. The results are evaluated and compared with previous studies of Monterey pine forest characteristics.

Chapter 6 evaluates each of the various elements of the DMF/PDP in relation to tree and forest habitat acreage losses. This chapter also discusses appropriate conservation measures (in addition to the establishment of substantial new forest open space preserve areas) that further compensate for these losses, in conformance with the requirements of the DMF LUP. This

chapter provides the quantitative basis for impact and mitigation assessment pursuant to California Environmental Quality Act (CEQA) standards.

Chapter 7.0 reviews the conservation planning context of the DMF/PDP and assesses its conservation and habitat management benefits against a set of accepted conservation standards. It also reviews the implementation commitment inherent in the DMF/PDP.

2.0 DEVELOPMENT PLANNING CONTEXT RELATIVE TO MONTEREY PINE

Over the past several decades, land use and planning within the Del Monte Forest could not have proceeded without consideration of the conservation and management of the Monterey pine resource. With passage and implementation of the California Environmental Quality Act (CEQA), California Coastal Act and state and federal endangered species laws in the early 1970s came a heightened awareness of the importance of resource conservation and planning in the context of development. As planning and development or proposals for development have occurred in the Del Monte Forest, successive assessments of the values and environmental sensitivities associated with the Monterey pine resource and policies and restrictions relative to that resource have accompanied them. This chapter summarizes the planning history in the Del Monte Forest, beginning with the DMF LUP, as it pertains to the Monterey pine forest resource.

2.1 Del Monte Forest Land Use Plan

The County of Monterey has adopted policies and regulations for the preservation and protection of the Monterey pine and its habitat. These provisions are found in the Monterey County LCP certified by the California Coastal Commission. The LCP consists of four land use and implementation plans, zoning and subdivision ordinances, and a set of administrative provisions applied by Monterey County throughout the Coastal Zone. The Del Monte Forest segment of the LCP includes the DMF LUP and addresses a large (approximately 5,300 acre) planning area (Figure 1), much of which supports urban, landscape and natural stands of Monterey pine.[1] Protection and preservation of Monterey pine forest habitat, as build out proceeds within the forest, plays a central role in the DMF LUP. Accordingly, the LUP policy guidance statement for Forestry and Soil Resources (LUP page 9) states:

> *The natural beauty of the Del Monte Forest is one of its chief assets. The forest resource, in addition to its role in the area's natural environment, is a principal constituent of the scenic attractiveness of the area, which should be preserved for the benefit of both residents and visitors. The forest is more than an aggregate of trees. It is home to the area's wildlife and serves to moderate climatic extremes. Therefore, long-term preservation of the forest resource is a paramount concern.*

2.1.1 Policies to Protect Monterey Pine Forest Resource

The DMF LUP identifies forestry resources as one of its primary elements and establishes various policies related to the Monterey pine and its habitat in the context of forest build out. The LUP calls for the preservation of the natural forested character of the Del Monte Forest to the maximum degree feasible (Policy 31) and sets forest-wide specific criteria for the removal of native trees species (Policy 32). For Monterey pine, the LUP specifies that (non-emergency) removal of any significant (greater than or equal to 12" diameter at breast height (dbh)) trees shall be done in conformance with an approved forest management plan or forest maintenance

[1] Over 1,400 acres of natural and urban stands of Monterey pine forest remain undeveloped within the Del Monte Forest today (see Figure 3 and Huffman and Associates 1994).

standard. Preservation of the scenic resource value of Monterey pine (Policy 33), minimization of vegetation removal (Policy 34) erosion control (Policy 35) and numerous other policies are articulated in the LUP with the clear intent of preserving and protecting the Monterey pine forest resource as build out occurs in conformance with the DMF LUP. Perhaps most importantly, the LUP states that "where LUP objectives conflict, preference should be given to the long term protection of the resource" (Policy 32).

2.1.2 Policies Regarding Environmentally Sensitive Habitat Areas

Another important element of the DMF LUP relative to the Monterey pine forest resource is the designation of Environmentally Sensitive Habitat Areas (ESHAs). Consistent with the Coastal Act, the Monterey County LCP and the Zoning Code, the DMF LUP defines ESHAs as follows:

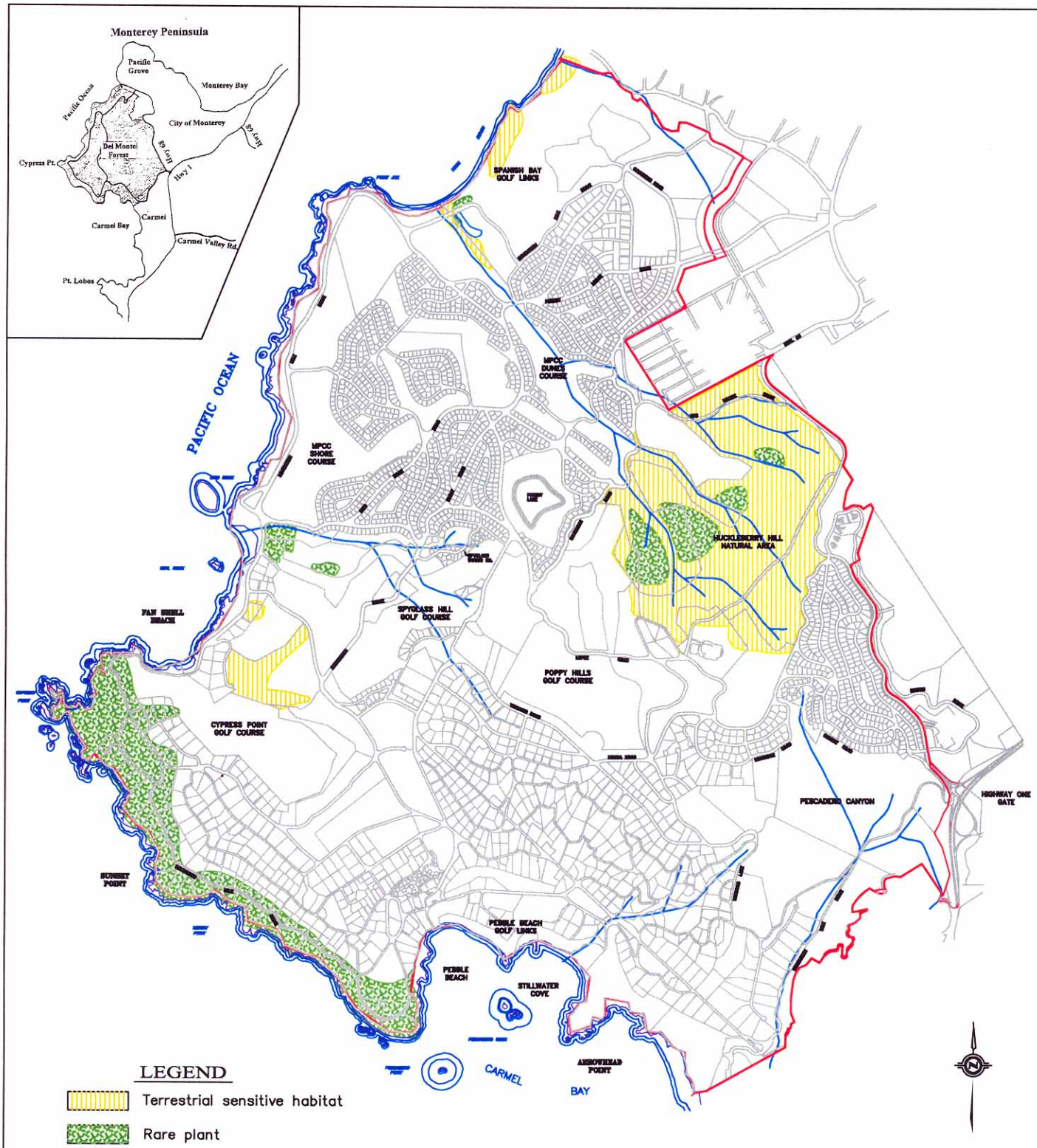
> *Environmentally sensitive habitat areas are those in which plant or animal life or their habitats are rare or especially valuable due to their special role in an ecosystem.*

The LUP recognizes ESHAs as unique, limited and fragile resources and calls for their protection, maintenance and, where possible, enhancement and restoration in accordance with specific LUP policies. The LUP goes on to describe examples of ESHAs in the Del Monte Forest and states that a complete list of the species and sensitive areas that qualify as ESHA is provided in LUP Appendix A. ESHA locations were also mapped and that mapping is reproduced here as Figure 4.

Certain specific forest associations or Monterey pine locations within the Del Monte Forest such as the stands of pine on the remnant Signal Hill Dune, the Monterey pine/Bishop pine association and Gowen cypress community at Huckleberry Hill are afforded the protections associated with the ESHA designation. Those protections are codified in policies pertaining to ESHAs that prohibit significant disruption of habitat values by prioritizing or restricting the nature and type of land uses within and adjacent to designated ESHAs and by requiring conformance with Open Space Advisory Committee (OSAC) Plan maintenance standards (Policies 8, 9 & 10). Policy 11, in particular, promotes the preservation and maintenance of contiguous areas of undisturbed land, as follows:

> *Contiguous areas of undisturbed land in open space uses shall be maintained wherever possible to protect environmentally sensitive habitat areas and associated wildlife values. To this end, development parcels immediately adjacent to designated environmentally sensitive habitat areas shall be planned to keep development intensity immediately adjacent to the sensitive habitats as low as possible, consistent with other planning criteria (e.g. drainage design, roadway design, and public safety). Conformance to applicable OSAC maintenance standards shall be the test of consistency with this policy.*

Other policies require site-specific field evaluation to determine precise locations of ESHAs and recommend mitigating measures (Policy 12), require deed restrictions or conservation easements to provide protections of ESHAs (Policy 13), limit clearing and



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LUP Environmentally Sensitive Habitat Areas
Del Monte Forest
Monterey County, California

Figure 4

grading in the vicinity of ESHAs to the minimum amount necessary to accommodate development (Policy 14), and require the use of appropriate (i.e. non-invasive and native plants) landscape materials, especially in developments adjoining ESHAs (Policy 15). The LUP contains other policies that pertain to specific to terrestrial plants and habitats (Policies 16–23), riparian corridors and other terrestrial habitats (Policies 24-26), and wetlands and marine habitats (Policies 27-30).

2.2 Lot Program

2.2.1 Original Proposed Project

In 1992, PBC submitted applications to build out the remaining vacant land under PBC ownership in the Del Monte Forest in conformance with the DMF LUP, which had zoning designations to allow 1067 residential units. Those applications anticipated 403 residential units on 686 acres. The proposal also included an 18-hole golf course, clubhouse and related facilities, and a 53 unit Planned Use Development (PUD) for affordable housing. Through the County's environmental review process, significant impacts to a number of biological resources were identified, including removal of approximately 17,500 Monterey pines ($\geq$ 12"dbh) and loss of approximately 412 acres (or nearly 30%) of the remaining native Monterey pine and associated forest habitat in the Del Monte Forest. A mitigation formula for loss of trees and increased preservation of remaining forest areas to compensate for habitat loss was developed. The formula estimated a need for dedication and active ecological management of almost 700 acres, including a minimum of two large ($\geq$200-acre) blocks of Monterey pine forest habitat to compensate for the losses associated with the Lot Program proposal.[2] However, even with this mitigation, the County's Draft Environmental Impact Report (DEIR) concluded that the impact of the project on Monterey pine forest habitat remained significant and unavoidable (i.e. could not be mitigated to a level of insignificance), primarily because of golf course development on the large, unfragmented forested area in Area PQR combined with loss of forest habitat in Areas G, H, I-1, and L. In response to that determination and other issues raised through the environmental review, Pebble Beach Company produced an alternative development proposal known as Refined Alternative 2 (RA2).

2.2.2 Refined Alternative 2

Refined Alternative 2 incorporated design changes to the original proposal and was the basis of further County environmental review through the Final EIR (FEIR) on the Lot Program. RA2 reduced the proposed number of subdivision lots from 403 to 364, relocated some proposed lots to different areas, and moved the proposed golf course location to a fragmented, disturbed, and partially developed part of the forest between and including the Spyglass Quarry Rehabilitation Area on the north and the existing Pebble Beach Equestrian Center and Collins Field on the south. The new location of the golf course required relocation of the Equestrian Center to an abandoned quarry (Sawmill Quarry) adjacent to Huckleberry Hill. The FEIR concluded that fewer trees (12,000 instead of 17,500 Monterey pines out of an estimated total of more than 100,000 trees $\geq$12"dbh in naturally forested areas of the Del Monte Forest) would be removed

[2] The 372-acre Huckleberry Hill Natural Area (HHNA) was established by the DMF LUP to mitigate for build out of the LUP; mitigation for the Lot Program included 200 acres of Monterey pine forest on Huckleberry Hill.

with development of RA2 and also that fewer acres of forest habitat (278 acres instead of 412 acres) would be disturbed. Nonetheless, the FEIR concluded that significant impacts from removal of Monterey pine and other trees and from loss and alteration of Monterey pine forest habitat would still result from implementation of the modified project. However, the FEIR also concluded that sufficient (≥700 acres consisting of two ≥200 acre areas) habitat preservation and active management according the guidelines presented in the FEIR's Ecological Management Plan (EMP) and Ecological Management Implementation Plan (EMIP) was now feasible (largely because of the preservation of Area PQR) and would mitigate those impacts to less than significant levels.

In early 1999 PBC, the County and the California Department of Fish and Game (CDFG), the trustee agency for natural resources affected by the project, met to discuss the mitigation concepts for RA2. CDFG agreed that phasing development and setting aside and actively managing three acres of high quality pine forest, in large tracts, for each acre of pine forest impacted (3:1 ratio) would mitigate the losses of Monterey pine forest associated with RA2 (Hunter 1999a). Suitable mitigation areas, acceptable to CDFG, included Area PQR, a 200-acre portion of the Huckleberry Hill Natural Area and a portion of the PBC-owned Aquajito property offsite, adjacent to Jack's Peak Park. CDFG stated that such mitigation, based on total acreage impacted, would also address the tree replacement requirements of the LUP. Although CDFG had originally requested a forest habitat replacement ratio of 4:1, a reduction of that ratio was considered acceptable if all of the set aside acres were in large parcels of high quality habitat and able to be managed ecologically (Hunter 1999b).

Based on that and other agreements, recommended conditions of approval, and responses to additional public comments, the RA2 project was presented before the County's Minor Subdivision/Standard Subdivision Committee and tentatively scheduled for public hearings before the Monterey County Planning Commission, with a staff recommendation to approve both the FEIR and the project. However, prior to those hearings, staff of the California Coastal Commission submitted comments to Monterey County expressing concerns over the County's conclusions regarding sensitive environmental resources, including wetlands, other forest resources and designated ESHAs. In response, the County directed PBC to conduct additional field assessment to address Coastal Commission concerns prior to proceeding with further public review of the RA2 project.

2.3 Del Monte Forest Preservation and Development Plan

In the summer of 1999, PBC was sold and the new owners substantially modified the previously proposed plan for build out of the forest, consistent with their commitment to protect the natural resources of the Del Monte Forest, enhance priority visitor serving uses, and maintain the current residential community. The owners eliminated planned and proposed residential development from the most sensitive lands including those contiguous with existing forest reserves (Areas G, H, L, & I-1) and most of Area PQR, and substituted Open Space Forest and Resource Conservation LUP land use designations and zoning. The proposed golf course and relocated Equestrian Center remained in the same locations identified in RA2 and a new driving range was proposed for Area C instead of the previously proposed residential subdivision. The Del Monte Forest Plan: Development Limitations and Forest Preservation Initiative (Measure A) was

proposed by PBC to change land use plan designations and zoning to accomplish the DMF/PDP. On November 7, 2000, Monterey County voters, and Del Monte Forest residents and property owners in particular, overwhelmingly approved the land use plan/zoning designations compatible with the new plan.

Coastal Commission staff acknowledged that this "downzoning (was) meant to clearly limit future potential development in currently undeveloped forest areas…(and) correspondingly decrease the amount of traffic, water use and other public service requirements associated with such development" (Grove 2000). While development of a new 18-hole golf course and clubhouse in Areas MNOUV and a new driving range and golf teaching center in Area C would result in potential impacts to Monterey pine and forest habitat, these areas were previously proposed for development (golf course in Areas MNOUV and residential development in Area C) and evaluated as such by Monterey County through environmental review of the Lot Program and its alternatives (notably RA2) as described above.

The Lot Program EIR process evaluated much larger proposals than the DMF/PDP (Table 2-1) and the County's FEIR concluded that, with mitigation, the effects of the RA2 project on Monterey pine and Monterey pine forest habitat could be reduced below a significant level. CDFG also concurred that a 3:1 mitigation ratio, with large, contiguous blocks of forest set aside as open space, both within and outside of the Del Monte Forest, to compensate for forest habitat impacts, was acceptable for that project. With a substantial reduction in impact to Monterey pine forest acreage (approximately 105 acres instead of 278 proposed by RA2) and Monterey pine trees (approximately 6,371 instead of 12,000 Monterey pines >12"dbh), coupled with application of appropriate forest conservation planning measures and forest maintenance standards, the DMF/PDP responds fully to public and agency comments on the previous development proposals for Pebble Beach Company property within the Del Monte Forest.

The DMF/PDP significantly modifies the RA2 golf course previously under consideration by Monterey County in response to the existence of sensitive resources on the site. The DMF/PDP:

1) locates the golf club house, fairways, tees, and greens to avoid wetland areas and to provide for appropriate setbacks to protect wetland habitat resources;

2) locates the proposed on-site golf course maintenance facility away from high density Yadon's piperia habitat and within an area adjacent to the existing developed driving range;

3) eliminates Stevenson Road within the golf course site to provide greater design flexibility in avoiding sensitive resources;

4) realigns Stevenson Road to eliminate Bristol Curve in order to provide a larger effective habitat for Yadon's piperia on-site, and;

5) revises the golf course layout to reduce the amount of disturbed area and the number of trees removed.

Table 2-1 provides a summary of the forest acreage and Monterey pine impacts and forest set aside proposals for the originally proposed Lot Program, RA2 and the DMF/PDP.

Table 2-1
Comparison of Forest and Pine Tree Impacts and Forest Set Aside

	Lot Program	RA 2	DMF/PDP
Impacts			
Forest Acres Removed	412 acres	278 acres	105.5 acres
Monterey Pine Removed (≥ 12")	17,500 trees	12,000 trees	6,371 trees
Forest Set Aside			
Onsite Large Blocks: HHNA	200 acres	200 acres	200 acres
PQR	--	230 acres	233 acres
Other Onsite	95 acres	84 acres	190 acres[3]
Total Onsite	295 acres	514 acres	623 acres
Offsite Required	>400 acres[1]	430 acres[2]	n/a

[1] Over 400 acres of suitable forest habitat were necessary to meet the acreage requirements of the mitigation established for the Lot Program. Since no suitable areas were identified, forest impacts remained significant.
[2] CDFG agreed that 430 offsite forest acres at Aquajito, along with two large blocks on site would compensate (3:1) for forest impacts from RA2 (which CDFG estimated at 285 acres).
[3] Approximately 110 of the "other onsite" forest set aside acres for the DMF/PDP (Areas G, H, and F3) are contiguous with the HHNA

3.0 BACKGROUND MONTEREY PINE RESOURCE ASSESSMENTS

The Draft and Final EIRs for the Lot Program discussed above provide a substantial record of information on biological resources in the Del Monte Forest, including the Monterey pine forest resource. That record was established through thorough compilation and review of background materials, directed independent field assessment, and peer review of field assessment conducted by PBC biologists and others. Other important reports on the Monterey pine forest resource (Huffman and Associates 1994; Jones & Stokes Associates 1994a & b, 1996b) were completed to compile and summarize current scientific knowledge on the species during review of the Lot Program. In addition, the California Native Plant Society (CNPS) submitted a petition to the California Fish and Game Commission in 1999 to list the species as threatened, and Pebble Beach Company and others compiled a body of information on the species to document comments in response to the petition. Together, these background documents provide a compendium of information on ecological and other biological issues, current and historical extent of Monterey pine forest, and pertinent conservation principles and strategies. The Huffman and Associates and Jones & Stokes Associates reports along with a brief overview of the petition to list the species as threatened under the California Endangered Species Act are summarized below.

3.1 Huffman Report

In 1993, PBC retained Huffman and Associates to evaluate the current conditions and characteristics of the Monterey pine in its natural range. The primary objectives of the evaluation were to 1) develop an information base about native Monterey pine; 2) determine current ecological conditions and the potential for sustainability of each of the three separate mainland populations and; 3) recommend, based on the resulting technical findings, management policies and criteria that would ensure, maintain and/or enhance continued genetic sustainability of the native Monterey pine. Huffman and Associates reviewed literature regarding species ecology, resource management and threats to native populations, conducted field surveys to ascertain the health of native populations and analyzed the data using geographic information system (GIS)-based mapping techniques. The resulting report (Huffman and Associates 1994) provided information on the distribution and extent of forest stands, an analysis of the sustainability for each of the three populations, and management recommendations to ensure future or enhance existing sustainability.

The report provided a comparison of historic acreage of Monterey pine with the current inventory and it characterized the remaining forest stands based on the size, degree of fragmentation, proximity to development, and other factors. Section 4.2 of this report discusses the results of that comparison and characterization in the context of the Monterey Peninsula population. Huffman and Associates concluded that the native Monterey pine forest on the Monterey Peninsula was sustainable because of the protected status of many existing geographically and environmentally varied stands. They also concluded that the Cambria and Año Nuevo populations could achieve long-term sustainability through directed management and conservation efforts.

Sustainability was defined as "a reasonable assurance that sufficient native Monterey pine forest in its natural habitat will be preserved so as to perpetuate the species' natural dynamic genetic process through both inter and inbreeding of populations in their natural habitat under natural conditions." Key factors in determining sustainability included the distribution and diversity of Monterey pine over its natural range within each of the three populations found in California; the ability of the stand to survive a catastrophic event such that it would not result in the elimination of the entire gene pool, and; demonstrated fecundity and active regeneration within the stand. Huffman and Associates concluded that larger stands have a greater ability than smaller stands to contribute to sustainability because there are lesser degrees of fragmentation, they have less area subject to landscaping or invasive and unwanted species, and they are more likely to allow fire as a forest management tool. Data collected for the evaluation indicated that negative forest edge characteristics diminished at measured distances within stands such that a stand of less than 20 acres was more affected by edge effects. Therefore, a stand size of 20 acres was selected as the minimum needed to contribute significantly to sustainability.

In evaluating the sustainability of the Monterey Peninsula population of Monterey pine, Huffman and Associates found that there were protected stands well distributed throughout the historic range of the species, over thirty-six percent ($\pm$ 2500 acres) of the total protected acreage was in stands greater than twenty acres in size, the stands spanned all soil types on the Peninsula, and over half were natural forest stands of the highest genetic and habitat value.

The report provided recommendations to ensure future sustainability in Año Nuevo and Cambria, and to enhance sustainability on the Monterey Peninsula. Key among those recommendations were the requirements to prepare forest conservation programs for each geographically distinct population and individual forest management plans for all significant protected stands and for future development within each population. Huffman and Associates concluded that these forest management planning requirements were already the current practice in the Monterey County Coastal Zone (because of the policies in the DMF LUP discussed previously) but should be expanded to include all Monterey pine stands within all three California populations to achieve the recommended sustainability goals.

3.2 California Department of Fish and Game (Jones & Stokes Associates) Studies

In 1994, Jones & Stokes Associates (JSA) produced three reports for CDFG and The Nature Conservancy (TNC) to: provide a compilation of information on the distribution, ecology, and current status of Monterey pine (Jones & Stokes Associates 1994a); describe findings concerning relationships between Monterey pine forest and geomorphic features of the Monterey Peninsula (Jones & Stokes Associates 1994b) and; provide a list of published and unpublished references on the ecology of Monterey pine (Jones & Stokes Associates 1994c). Literature review, field studies, and GIS-based map analyses were conducted to gain a better understanding of Monterey pine as a species, the Monterey pine forest ecological community, the extent and character of the historical and contemporary Monterey pine forest, and the nature and extent of alterations to the native Monterey pine forest. Data and findings from these reports were used to develop a conservation plan for Monterey pine and Monterey pine forest which was prepared as a subsequent report for CDFG and the California Native Plant Society (CNPS) in 1996 (Jones & Stokes Associates 1996b).

The first of the studies compiled existing data on Monterey pine and largely paralleled the Huffman report in form and content. However, there were differences in some of the conclusions reached. For instance, JSA found more extant and historical forest than Huffman and Associates (see discussion in Section 4.2 of this report) and JSA concluded that most remaining stands of Monterey pine were overstocked, aged and in unhealthy condition while Huffman reported most stands in fair to good health except for the Cambria population. Both Huffman and JSA acknowledge the importance of conserving the genetic health of the forest but suggest different strategies for that conservation. Where Huffman emphasized the importance of preserving larger stands that are diverse and well-distributed over the species' natural range, JSA concluded that it was vital to conserve representative examples of Monterey pine forest from each geomorphic surface.

The geomorphic surface classification concept for Monterey pine forest subtypes was described in more detail in the second JSA study (Jones & Stokes Associates 1994b). In that study, JSA characterized variation within Del Monte Forest natural stands of Monterey pine forest based upon the "ecological staircase" model originally described for the Mendocino area (Jenny et al. 1969). Using that model and geomorphic surface mapping for the Monterey Peninsula by Dupré (1990), JSA theorized that a series of six marine terraces of different ages may support differing habitat types and possibly genetic variation. JSA developed a classification concept for Monterey pine forest subtypes based on reported observations of variation in canopy character and understory vegetation associated with soils found on different geomorphic surfaces. The study concluded that strong and subtle differences are found between the Monterey pine forests growing on different geomorphic surfaces and soils and suggested that a goal of preserving representative stands of functional forest on each geomorphic surface would best protect the full range of Monterey pine forest diversity. The Marine Terrace Ecological Staircase concept is further discussed in Section 4.2.4 of this report.

The Monterey Pine Forest Conservation Strategy Report (Jones & Stokes Associates 1996b) was prepared for CDFG and CNPS to identify conservation priorities and conservation tools that could be used in achieving the long-term conservation of the indigenous Monterey pine forest ecosystem. The strategy uses the findings of the previous JSA studies as well as Huffman and others in identifying conservation area priorities. Conservation priorities were only assigned to stands of indigenous Monterey pine forest with natural understory in the Monterey area and outside of existing protected properties. The following criteria were applied by JSA in assigning a conservation priority:

- conservation priority of geomorphic surfaces
- degree of fragmentation
- management potential, and
- presence of priority species

High priority was given to conservation of representative and sustainable stands of Monterey pine forest on each of the geomorphic surfaces. The assumption was that preservation of the greatest diversity of Monterey pine forest across geomorphic surfaces would ensure the greatest diversity of forest subtypes, species, and genetic variation within species.

3.3 California Native Plant Society's Petition to list Monterey Pine as Threatened

In August 1999, the Monterey Bay Chapter of CNPS submitted a petition to the California Fish and Game Commission to list the Monterey pine as a threatened species under the California Endangered Species Act (CESA). The reasons cited by CNPS for listing the species were that only three indigenous populations of Monterey pine remain in the State and these were suffering dramatic decline due to habitat loss, habitat fragmentation, infestation from introduced disease, probable genetic contamination, and lack of adaptive management and conservation strategies. The petition maintained that the long-term survival of the three mainland populations of Monterey pine was threatened by the loss or fragmentation of forest habitat caused by recreational, residential and agricultural development and by mortality of stands resulting from the infestation of pitch canker. Listing of Monterey pine as a threatened species would, according to CNPS, allow CDFG to participate in land use planning decisions and to encourage local agencies to provide the level of protection warranted for the species.

The Fish and Game Commission determined that the petition met the necessary requirements and referred it to CDFG for a mandatory three month review. During that period, several interested parties compiled and submitted extensive information refuting the claims of CNPS and opposing the listing of Monterey pine (Nossaman et al. 1999). Challenged were the statements that the native Monterey Pine forest was suffering dramatic decline due to habitat loss, habitat fragmentation, infestation from introduced disease and lack of adaptive management and conservation strategies. The interested parties, including several noted forestry experts, represented that the petition should be denied for the following reasons:

- Monterey pine as a species, is not in serious danger of foreseeable extinction because it exists on millions of hectares throughout the world;
- Substantial regulatory protections are in place for all three of the remaining intact populations of Monterey pine in California; Nearly 40% of Monterey pine in the Monterey population are in protected reserves and the Año Nuevo population is growing;
- Existing management programs are in place in Cambria, Año Nuevo and Monterey to insure long-term survival of the species;
- A sufficient percentage of Monterey pine are exhibiting natural resistance to pitch canker to insure the survival of these populations;
- There is significant regeneration of Monterey pine – even in areas of long-standing fire suppression.

On December 14 1999, CNPS withdrew its petition without prejudice citing the time it would take to review the extensive scientific information submitted and maintained it would resubmit in early 2000. According to the Monterey Bay Chapter of CNPS, so much information was submitted by so many interested parties, that there simply was not enough time for a thorough scientific review of all the material (CNPS 2000). Therefore, CNPS withdrew its petition to allow for a complete evaluation of the facts by CDFG.

To date, CNPS has not resubmitted its petition to list the Monterey pine. In March 2002, the Monterey Bay Chapter of CNPS issued a "Monterey Pine Update" stating that the chapter had delayed resubmitting the petition for a number of reasons (CNPS 2002). Among the reasons

cited were a potential reduction in impacts on the pine from the DMF/PDP, increased efforts to set aside other important areas of Monterey pine[3], and information from ongoing studies that provides a better understanding of the pine's recovery from and resistance to pitch canker. CNPS acknowledged that these and other factors indicate that Monterey pine is receiving more attention by decision-makers and therefore may be less threatened by disease and development. CNPS believes that its efforts have contributed to this potentially improved situation relative to Monterey pine.

[3] Several properties supporting native stands of Monterey pine, including Hatton Canyon and Palo Corona Ranch have been dedicated as permanent open space since the CNPS petition was filed.

4.0 CHARACTERIZATION OF MONTEREY PINE AND FOREST HABITAT

Following is a selective summary of key points and issues associated with Monterey pine and Monterey pine forest, both at a general level and as they pertain to the Del Monte Forest and the DMF/PDP. Information in this section is drawn largely from the record established by the studies conducted for the Lot Program, the Huffman Report and the JSA reports described in the previous chapter.

4.1 General Overview

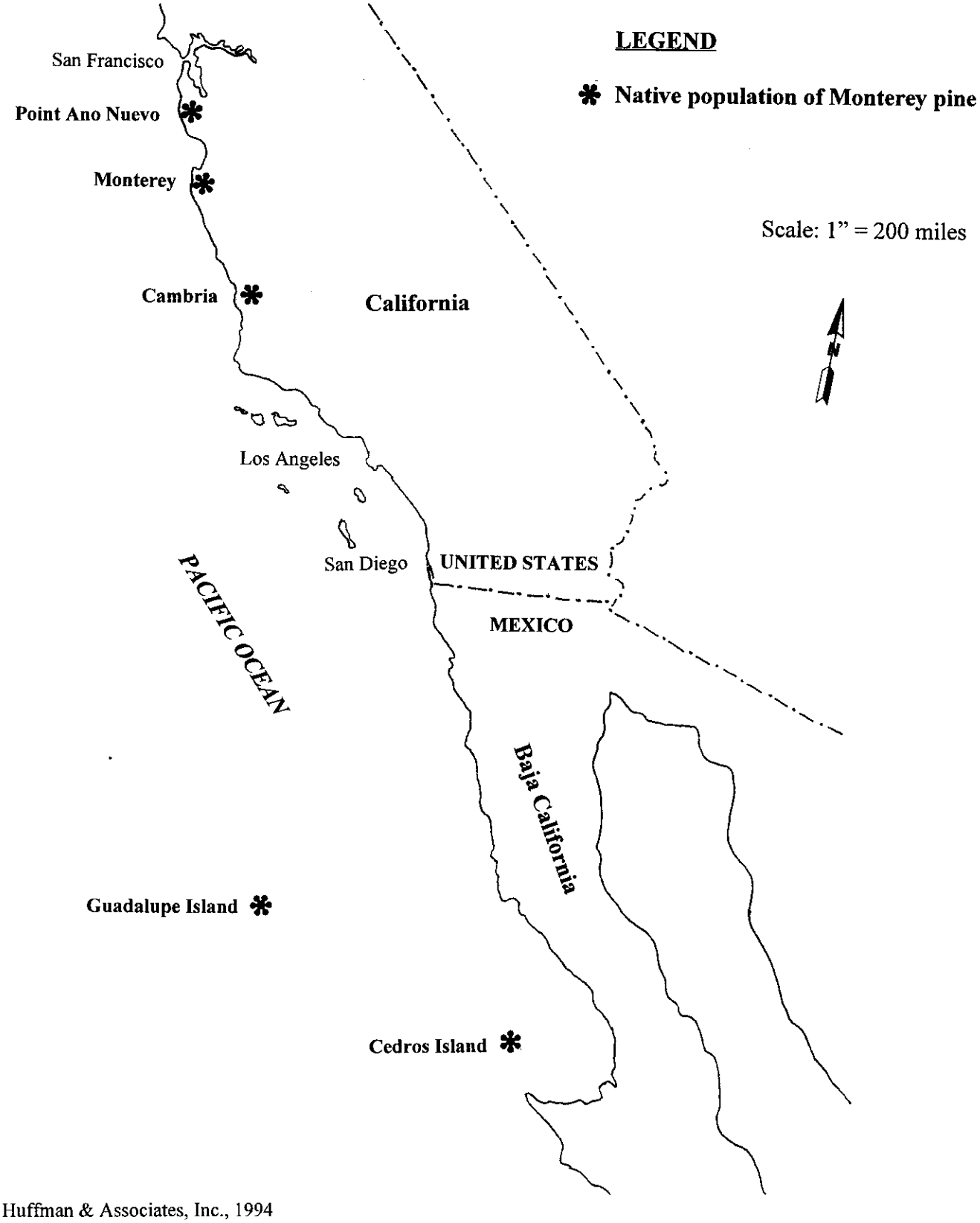
4.1.1 Distribution and Range

Monterey pine (*Pinus radiata*) is an endemic, closed-cone pine of California and Baja California. Today the species occurs naturally in five disjunct native populations in California and Baja California: near Año Nuevo on the Santa Cruz/San Mateo County coastline, on the Monterey Peninsula, near Cambria just south of the Big Sur Coast, and on the two Mexican islands of Guadalupe and Cedros (Figure 5). The contemporary limited range of Monterey pine has been attributed to several factors including the inland reach of summer fog, soil type, annual rainfall, availability of soil nutrients, root diseases and other factors (Vogl et al 1988). However, over the past two million years the natural distribution of Monterey pine has fluctuated regularly, primarily in response to large-scale climate change. The species is considered an aggressive colonizer that has always expanded and contracted from fragmented populations during favorable climatic conditions and is thus adapted to small population sizes, fluctuations in size, colonization's of new locations and even local extirpations (Millar 1998). Adaptation to fire and the topographic and edaphic variability of the California coast have allowed Monterey pine to persist during regularly adverse climate periods (i.e. ice ages) and expand during favorable periods (i.e. interglacial periods).

Over the past 200 years, Monterey pine has also become the most widely planted pine tree in the world. It has been introduced to many coastal and near coastal areas in California where it has survived and thrived following direct planting and aerial seeding. It has also become an important commercial and landscape tree and is of great economic importance for lumber production in many countries throughout the world including New Zealand, Australia, Chile, Spain, Argentina, Uruguay, South Africa, and Kenya (Jones and Stokes 1996b).

4.1.2 Fire Adaptability

The species is one of a group of several closed-cone pines including Bishop pine (*Pinus muricata*) and knobcone pine (*Pinus attenuata*) in which fire plays an important role in the reproductive cycle. In the more widespread closed-cone pines, reproduction is fire-dependent with cones only opening and releasing seeds in response to fire-generated heat. This closed cone character is not as pronounced in Monterey pine; while the cones remain attached to the tree for years, they open and close several times during warm or extremely dry weather, providing a constant, though relatively modest seed rain. However, even though the cones open without fire, optimum conditions for reestablishment occur with fire whereby maximum numbers of cones are opened and a receptive seedbed is prepared.



Source: Huffman & Associates, Inc., 1994

Zander Associates
Environmental Consultants
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Native Monterey Pine Forest Populations
California and Mexico

Figure 5

4.1.3 Species Associations

Monterey pine occurs as a dominant member of several associations of plants and animals within its native range, collectively referred to as Monterey pine forest. Co-dominant canopy species found in California populations of Monterey pine range from redwoods (*Sequoia sempervirens*), Douglas fir (*Pseudotsuga menziesii*) and knobcone pine (*Pinus attenuata*) near Año Nuevo at the northernmost extent of its current native range to coast live oaks (*Quercus agrifolia*), Bishop pine, Monterey cypress (*Cupressus macrocarpa*) and Gowen cypress (*Cupressus goveniana* ssp. *goveniana*) on the Monterey Peninsula. In Cambria, the Monterey pine is found largely in pure stands, but occasionally occurs with coast live oak (Hillyard 1997).

According to Axelrod (1982), the Monterey area is rich in endemics as a result of influences from floras to the north and south, edaphic (soil/substrate) conditions, summer fog patterns and other factors. About 150 species reach their northern limits and about 160 species reach their southern limits in Monterey County (Howitt and Howell 1963, 1973). Consequently, the Monterey pine forest associates in the Monterey population exhibit greater species richness than in other populations. Shrubby species such as manzanitas (*Arctostaphylos* spp.), huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shalon*) ceanothus (*Ceanothus* spp.), mock heather (*Ericameria* spp.) and coyote brush (*Baccharis pilularis*) share the understory with native grasses, sedges, rushes and several special status species of plants in the Monterey population, resulting in a diverse and important ecological resource.

4.1.4 Pests and Diseases

Monterey pine is susceptible to a wide range of pests and diseases. Approximately 72 insect and fungal diseases, of which 17 are common or can cause significant damage, have been recorded in natural stands (EIP Associates 1995). Surveys completed in the Monterey population have found more than 10% of the trees and 20% of the seedlings and saplings to be diseased (Ciesla 1995).[4] In areas where Monterey pine is not native but has been planted as an ornamental or forestry tree, pests and diseases indigenous to those areas have found the tree to be an excellent host (Ibid). Some of the more important disease causing agents in natural stands include: western dwarf mistletoe (*Arceuthobium littorum*), a parasitic plant that penetrates the stems, weakens the trees and increases susceptibility to insect attack; western gall rust (*Peridermium harknessii*), a fungus that produces branch and stem galls which can girdle branches or stems resulting in mortality in small trees and declining health in young trees; several root disease fungi, most notably the fungus causing white pocket rot (*Phellinus pini*) whose lifecycle is poorly understood, but whose spores apparently infect branch stubs and grow into the heartwood where the gradual process of decay occurs. Insect pests include a variety of defoliators, sucking insects, wood borers and bark beetles. The red turpentine beetle (*Dendroctonus valens*) and various other bark beetles (*Ips* spp.) are the most common insect pests in the Monterey pine forest. Some pathogens, and beetles, primarily attack older trees, while other fungal pathogens tend to attack saplings or vigorous new growth (Offord 1964; Storer et al. 1994).

[4] These surveys were presumably conducted prior to the wider spread of pitch canker which had infected well over 80% of Monterey pines in some areas.

Most of these pests and diseases have evolved with the native stands of Monterey pine and do not pose serious threats to the overall health and integrity of Monterey pine forest. These native insects and diseases are important in the maintenance of ecological functions in Monterey pine forests due to their roles in processes such as nutrient cycling and provision of coarse woody debris. However, a relatively recently introduced pathogen, the pitch canker fungus *(Fusarium circinatum* aka *F. subglutinans* ssp. *pini*), has heightened concern for the species. The pitch canker fungus, a native of the southeastern U.S., was first identified on the west coast in 1986 in Santa Cruz County. By the beginning of 1992, it was known from sites north to San Francisco County and south to San Diego County. Pitch canker has also been noted in bishop and ponderosa pines, among others, and more recently in other conifers such as Douglas fir. The disease is characterized by exudation of resin from shoots, branches, boles and exposed roots. Needles on the tips of infected branches eventually fall from the tree and a die-back of the tree crown becomes apparent. Cankers on the main stem of the tree usually appear following significant crown dieback and are the result of separate inoculation events. Tree mortality often results in association with infestation by native bark beetles. The fungus has been isolated from a number of species of twig beetles (*Pityophthorus* spp.) and engraver beetles as well as cone beetles *(Conophthorus radiatae)* and dry twig and cone beetles (*Ernobius punctulatus*), all of which have been demonstrated to be capable of vectoring the pitch canker pathogen (Fox et al. 1991; Hoover et al. 1996; Storer et al. 1999 unpublished). Many of these beetles are active throughout the year in coastal areas of California. In addition, the spittlebug, *Aphrophora canadensis* has been demonstrated to produce infection areas that can become colonized by the pitch canker fungus (Storer et al. 1998).

The pitch canker fungus was cultured from two trees at the Pebble Beach fire station site in April 1992, and another 20 trees in the vicinity were symptomatic for pitch canker in December 1992 (Storer et al. 1994). Pitch canker has since spread and been identified at numerous locations on the Monterey Peninsula and throughout the Del Monte Forest. The rapid spread of the disease had increased concern for the future of the Monterey pine forest.

PBC, in collaboration with the University of California at Berkeley and Davis, the Del Monte Forest Foundation, the Pitch Canker Task Force and other concerned parties has taken an active role in developing study and action plans to respond to this threat. Through this process, natural resistance has been documented and resistant strains have been identified. Trees can vary from resistant to very susceptible, with all intermediate levels of susceptibility evident in populations (Gordon et al. 1998; Storer et al. 1999). In native stands, perhaps up to 30 percent of Monterey pines are resistant, while a much smaller percentage of resistance has been observed in landscape plantings (Storer et al., 2002). In addition, a systemic induced resistance effect has been documented in lab studies (Bonello et al. 2001) such that once a tree is exposed to the pathogen, it is less susceptible to subsequent exposure to the pathogen. This may in part explain the observed remission recently documented in urban stands (Gordon et al. 2001). Urban plots established in 1992 and revisited in 1999 contained trees that had high levels of infection in 1992 were free of disease symptoms in 1999 (Storer et al. 1999 unpublished). Old branch tip infections had broken from many of these trees, and subtending lateral branches continued to grow. Thus branch stubs with growth of laterals around them were characteristic of an infection that had become inactive. The highest levels of apparent disease remission were recorded at New Brighton State Beach (Santa Cruz Co.), where pitch canker was discovered in 1986; 30% of the

trees remaining in the monitoring plot had indications of disease remission, and this represented 17% of the original population in this plot. In areas where pitch canker became established more recently, smaller percentages of trees showed signs of remission (Storer et al. 1999 unpublished).

Since Monterey pine is an aggressive colonizer and can respond to both large-scale (e.g. fire) and small-scale (e.g. native diseases) disturbances by beginning new local cycles, and since natural resistance can be expressed through genetic recombination (i.e. seed production and seedling establishment), natural restocking of the forest offers some hope for a forest less affected by the pitch canker pathogen. Management of pitch canker and therefore the ultimate survival of the Monterey pine forest now seems likely with ecologically-oriented management of the forest and other directed forestry practices (e.g. ongoing resistance screening, appropriate green waste handling and hauling procedures, limitations on transport of wood products from infected areas). Active forest management could serve to accelerate the process that results in a native forest that is more resistant to pitch canker than the forest of today. A similar outcome in terms of resistance to pitch canker could also result in the absence of active management, though the process would take longer.

4.1.5 Genetics

Studies into the genetic diversity of Monterey pine have assessed a range of parameters in order to detect differences between the populations (Año Nuevo, Monterey and Cambria), subpopulations or stands (ecological units within populations) and families (individuals arising from a single parent tree). These parameters include chromosome and DNA comparisons, oleoresin composition, morphological characters such as cone size, growth parameters under varying environmental conditions, and susceptibility to various diseases. A summary of these studies is presented on Table 4-1. Most of these studies utilized one of two sources of plant material: a 1968 outplanting at Russell Reservation maintained by the University of California, and a 1978 collection of seed made by Eldridge that included seed from six locations within the Monterey population, described as coastal sand dunes, Monterey City, Huckleberry Hill, Jack's Peak Park, Point Lobos, and Carmel Highlands (Eldridge 1978).

Guinon and Libby (1982) found that the genetic differences between different stands of the Monterey population were not statistically significant for any of the characteristics studied. However, significant differences were found between different individuals, between stands in other California populations, and between the three populations. Plessas and Strauss (1986) studied the genetics of all three California populations of Monterey pine, using trees from nine or ten stands per population from the Russell Reservation collection, "stands chosen to sample the range of environments present within each population." They found that, on average, 94.9 percent of observed genetic diversity of the species was found within stands, 3.5 percent between populations (that is, between Monterey, Año Nuevo, and Cambria), and only 1.6 percent between stands within populations. Further, they state that "genetic and geographic distances between stands within populations were uncorrelated at Monterey, Cambria, and in the species as a whole." This relatively low variation among stands and relatively high variation within stands is indicative of widespread gene flow, primarily through wind-dispersed pollen, within the

Table 4-1: Review of Information Relating to the Genetic Diversity of Monterey Pine (*Pinus radiata*)

Citation	Parameter	Finding	Comments
Guinon, Libby et al. 1982	Growth and form	Differences between different stands of Monterey population not statistically significant but significant differences found between different individuals, between stands in other California populations, and between the three populations.	Evaluated common-garden grown clones from 1968 outplantings at Russell Reservation over nine growing seasons.
Cromer et al. 1982	Salinity tolerance	Stands in coastal areas at Monterey appear to have lower salt tolerance compared to inland stands in same population.	Physiological study using Eldridge's 1978 collection.
Plessas and Strauss, 1986	Allozymes	Low to moderate genetic variation compared with most conifers. Approx. 95% of genetic variation resides within stands, 1.6% between stand within populations, and 3.5% between populations.	Used 1968 outplantings at Russell Reservation.
Moran et al. 1988	Allozymes	Low genetic diversity (as with other closed cone pines). 2% of variation apportioned to ecological stands within populations (lower in Monterey populations).	Used Eldridge's 1978 collection. In dendrogram, dunes population separated first from other Monterey populations.
Hong et al. 1993	RFLP of chloroplast DNA	Monterey pine showed almost no variation within or among populations.	Sampled 12 trees from Monterey population from Libby collections. Organelle genomes have different genetic diversity than nuclear genes due to low mutation rates, lower effective population sizes. Cites Millar et al 1988 Gene diversity within populations ranges from 12-14% for MP, BP and KP.
Johnson et al. 1997	Height and basal area	Significant differences among some subpopulations within the three mainland populations. Jacks Peak population superior for growth among Monterey stands, but no significant differences reported among other subpopulations.	Provenance trials at eight sites using Eldridge's collections including six subpopulations from Monterey.
Eldridge, 1997	Cone size	Cone size varies between populations and also between trees within populations	Cites Cromer et al, 1982, Hood and Libby, 1980 and Guinon and Libby, 1982 as stating that variation between subpopulations (distinct ecological units within populations) has proved to be of small magnitude and rarely of statistical significance.
Garnier-Gere et al 1997	Various growth parameters	Height, dbh, volume not different between the Monterey subpopulations. Differences in variance between families were evident.	Used Eldridge's 1978 collections.
Burdon et al. 1997	Cortical oleoresin monoterpenes	Little if any local differentiation within Monterey populations. Variation within the subpopulations was large, variation between subpopulations was not.	Used Eldridge's 1978 collection and planting
Boardman and McGuire, 1997	Growth parameters in Mediterranean-type climate	Jacks Peak grew best after 9 years, indistinguishable from 4 other Monterey groups after 16 (Huckleberry Hill remained lower basal area)	Used Eldridge 1978 collection.

Table 4-1 Continued

Citation	Parameter	Finding	Comments
Butcher and Stukely, 1997	Resistance to *Phytophthora cinnamomi*	Variation large between & within populations. Tested seedlings. Considered two populations (coastal dunes, Jacks Peak), found similar responses. W/in populations, family variation considerable & significant.	Used Eldridge 1978 seed collection.
Kinloch and Libby, 1997	Susceptibility to western gall rust	Monitored natural infections in 1977 and 1985. Found considerable variation among trees within populations	Used 1968 plantings outplanted at Russell. Only presented differences between populations, not stands w/in populations.
Ades and Garnier-Gere, 1997	Impact of *Dothiostroma* needle blight	Suggests differences between the Monterey subpopulations.	Used Eldridge's 1978 collection.
Richardson et al 1997	Various DNA markers	State that probably a very small fraction of the *P. radiata* genome determines the observed differences in phenotype. i.e. Genome is large.	Only published as an abstract of ongoing work.
Wu et al 1999	Nuclear gene diversity using RAPD DNA loci	RAPD phenotypes represent more underlying diversity than do allozyme phenotypes.	Only a single Monterey population used.
Beales, 2001	Common garden plots	Growth differences are evident between garden sites and between sites of origin. Sand dune populations have higher growth rates based on common gardens and when estimated from microcalorimetry results.	Study looks specifically for differences between trees originating from seed on various marine terraces. This is from Pitch Canker Task Force minutes.

Some Definitions

Population: Año Nuevo, Monterey, Cambria, Cedros and Guadalupe
Sub-populations: Populations of trees within a population
Stand: similar to subpopulation
Family: progeny of seed from one tree

Seed origins from the Monterey peninsula were (Eldridge 1978 collection):

a. Coastal sand dunes
b. City of Monterey
c. Huckleberry Hill
d. Jack Peak Park
e. Point Lobos
f. Carmel Highlands

population (Jones & Stokes 1994a). Interestingly, Plessas and Strauss found "substantial genotypic differentiation among cohorts" (groups of trees of different age classes). While finding genetic differentiation among cohorts could be the result of various factors (e.g. a sampling of different families), this information suggests that genetic conservation efforts could benefit by further research into variation in tree age in addition to variation due to ecological community in which trees are found.

Genetic studies of Monterey pine using the seed collection of Eldridge were reported by Moran et al. (1988). These authors were particularly interested in genetic diversity that might be correlated with stands within populations that were separated on either geographic grounds (physical distance) or ecological grounds. They too found that "when the mainland populations of *P. radiata* are divided into stands, either on an ecological or geographic basis, the proportion of the variation between stands within each population is low (2 and 1.3 percent, respectively)." They concluded, "it appears that by applying genetic criteria based on isozyme data alone, a large portion of the genetic diversity for each population could be conserved by maintaining one or two stands per population." Most other studies that used the 1978 seed collection (Garnier-Gere et al. 1997; Burdon et al. 1997; Boardman and McGuire 1997; Butcher and Stukely 1997) found very few differences between the Monterey subpopulations. However, some studies using these collections suggest differences between subpopulations in some parameters including needle blight susceptibility (Ades and Garnier-Gere 1997), salt tolerance (Cromer et al. 1982) and height or basal area (Johnson 1997).

Hong et al. (1993) studied chloroplast DNA from almost 400 trees representing 19 populations of three closely related closed-cone pines (knobcone, bishop, and Monterey pine), including Monterey pines from the Russell Reservation collection, and concluded that "knobcone pine and Monterey pine displayed almost no genetic variation within or among populations." However, chloroplast DNA often does not vary considerably within a species, or even sometimes across related species, and thus is not typically a reliable parameter for evaluating fine-scale genetic structure.

Many of the studies noted above were based on the same collections and cannot strictly be considered independent assessments of genetic differences within populations or fine-scale genetic structure of Monterey pine. For determining genetic structure, especially within populations, the value of genetic studies with other (usually broader) objectives may be limited by the study design and number of samples. Solid information about within-population genetic structure would ideally be based on several types of genetic data (e.g., growth data from long term field trials, several types of DNA data, etc.), include a large number of samples taken from trees with various ages and phenotypes, stratify samples according to all probable structuring variables, exclude any influence from genetic contamination, etc. Along those lines, a recent and continuing study to analyze genetic and morphological variation of Monterey pine on the Monterey Peninsula, including the distribution and heritability of resistance to pitch canker, uses several techniques including field studies, common garden experiments, greenhouse studies, and genetic analysis (Beales 2002). Preliminary results from that work indicate variation in growth, respiration, heat rates and optimal growth temperatures associated with site of origin.

While there is relatively little information available on fine-scale (within population) genetic structure, genetic studies conducted to date have investigated a wide range of parameters and the collections most widely used appear to have fairly broad representation. Only a limited number of these studies suggest differences in the fine scale genetic structure of Monterey pine, but no conclusive information is available.

4.1.6 Conservation Status of Native Populations

Monterey pine and Monterey pine forest have been the focus of conservation concern because of increased threats, especially human-generated, to the sustainability of the remaining native stands. Goat grazing has all but eliminated the native population on Guadalupe Island. Land conversion (e.g. clearing for agriculture) and urbanization, genetic contamination (from reintroduced stock imported into the U.S.), threats from native pathogens (e.g. western gall rust), fire suppression and, more recently, the appearance and spread of the introduced pine pitch canker fungus, have all added a sense of urgency to the Monterey pine conservation effort.

The conservation biology community has focused attention on conservation of the five native populations in their native habitat; the general approach to managing Monterey pine in California is to maintain and restore native populations and control or eliminate non-native stands.[5] The tree (and its associates) can be valued and protected or it can be viewed as an invasive non-native weed. Thus, for the Monterey Peninsula, Huffman (1994) estimated that over 2,800 acres out of 6,900 acres (over 40%) of Monterey pine were afforded some type of permanent protection, while in other areas, such as at Jughandle State Reserve in Mendocino County, the species is aggressively removed through ecological restoration projects (Millar 1998).

At Año Nuevo the pine still occurs over all of its (approximately 1500 acre) historic range and may have expanded in recent years (Huffman and Associates 1994, Nossaman et. al. 1999). About 30 acres of the Año Nuevo population are protected under the ownership of the California Department of Parks and Recreation. The rest (approximately 98%) of the population is within private ownership, but located on agriculturally-zoned lands along a section of coast that is not subject to development pressure and afforded some protection by the agricultural zoning and San Mateo/Santa Cruz County LCP policies. One of the private owners, California State Polytechnic University, San Luis Obispo, was granted its land at Swanton Pacific Ranch pursuant to a deed restriction, which permanently restricts the development of the forest. Cal Poly manages the ranch for forestry, conservation and research purposes and has recently undertaken a study of pine regeneration to investigate pitch canker resistance (Yun, et. al. 2000).

The Cambria population of Monterey pine forest covers approximately 3,500 acres, of which about 2,300 acres remain undeveloped and an additional 1,200 acres intergrade with developed

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[5] The pines on both Cedros and Guadalupe Islands are very vulnerable; in the absence of active (and probably off-site or *ex situ*) conservation, the threat of extinction of these isolated, distinct and limited populations of the species is real. In May, 2001, a group of scientists and others from the USA, Mexico, and Australia visited these islands to make genetic collections for restoration, conservation, and research purposes. The researchers secured seed collections from approximately 80 Monterey pines on Guadalupe Island and from approximately 100 Monterey pines on Cedros Island. The cones from both collections now reside at the national forest tree facility at Ensenada, Mexico.

areas (Jones & Stokes Associates 2002). Within the community of Cambria itself, Monterey pine occurs on multiple small private ownerships, but outside the community, the forest exists on larger parcels. About 100 acres of the Cambria Monterey pine forest is protected within the San Simeon State Park. The San Luis Obispo County General Plan and LCP provide further protection for all of the remaining native Monterey pine forest that occurs in the Coastal Zone. A plan was recently prepared for the management of the indigenous stand of Monterey pines in the Cambria community and surrounding area under a grant from the California Department of Forestry and Fire Protection (Jones & Stokes Associates 2002). Recognizing the pressures on Monterey pine from the spread of pitch canker and the accelerating pace of development in the Cambria area, the Cambria Forest Management Plan provides an integrated framework of techniques for forest management to ensure comprehensive and effective management of a sustainable forest.

The Monterey Peninsula population of native Monterey pine occurs over an area estimated to range between 6,900 (according to Huffman) and 9,400 acres (according to Jones & Stokes - see discussion below) on lands in Monterey County and the cities of Monterey, Carmel and Pacific Grove. As noted above, Huffman (1994) estimated that over 2,800 acres of Monterey pine forest on the Monterey Peninsula were managed for conservation purposes and were permanently protected through fee title, conservation easement or other legal means. However, the 1994 Huffman estimate did not anticipate several other properties, with stands of native Monterey pine, that have subsequently been designated for open space protection. These include approximately 46 acres supporting Monterey pine at Hatton Canyon, a 95-acre stand of Monterey pine protected on the adjoining Palo Corona Ranch and Santa Lucia Preserve properties, large and small stands totaling over 200 acres at Monterra Ranch and approximately 50 acres of small native stands at Canada Woods (see Table 4-2). Dedication of these properties has added over 480 acres to the preserved Monterey pine forest inventory since 1994, for a total of approximately 3,284 acres under some form of protection. Approximately 2,768 acres occur in separate stands of 20 acres or greater, with another 516 acres in stands of less than 20 acres (see Table 4-2). The preserved areas include sizable and widely distributed areas such as Jack's Peak Regional Park, Point Lobos State Reserve, Huckleberry Hill Natural Reserve, and Samuel F.B. Morse Botanical Reserve.

The general protections afforded Monterey pine by the DMF LUP were discussed in Chapter 2.0, and similar protections apply throughout the Coastal Zone pursuant to the Monterey County LCP. In addition to the protective provisions within the Coastal Zone, the Monterey County General Plan and other regulations also provide for the protection, preservation and management of Monterey pine forest in unincorporated areas of the County outside the Coastal Zone. County policies and objectives for conservation, preservation and protection of native Monterey pine trees and Monterey pine forest habitats are implemented through the Monterey County Code and project-level environmental review. The preservation of over 250 acres of Monterey pine forest habitat at Monterra Ranch and Canada Woods, as noted above, is a direct result of these County policies and objectives. The cities of Monterey, Pacific Grove and Carmel also implement and enforce general plan-level policies and municipal ordinances to preserve and protect Monterey pine and its associated habitat. Each city employs a full time forester to administer and enforce these policies and ordinances on private lands and to manage stands of Monterey pine of city-owned lands.

Table 4-2
Protected Monterey Pine Stands in the Monterey Area

Stand Name	Huffman Acres	Huffman Plot #	Comments
Stands >20 Acres			
Forest Lake 18	28	12	PBCSD around Reservoir
Pt. Lobos State Reserve	138	83	See Pt. Lobos Ranch also
Pt. Lobos Ranch	234	29	State Park and Big Sur Land Trust
Jacks Peak Park	693	85, 30b	Incl Monterra Ranch & Pacific Meadows dedicatn
Macomber OS	40	34a	Deed restricted Open Space
Pacific Meadows OS	73	36	Deed restricted Open Space
Country Club 16-2	29	48	MPCC Forest Course
Pescadero Canyon	88	78	Excludes 2 PBC parcels for CDF Fire Station
DMFF Navajos/RvW Park	51	79b,89	2 DMFF parcels 25.5 acres
Huckleberry Hill NR	268	80	DMFF Easement
SFB Morse Botanic Reserve	39	81	DMFF Easement
Indian Village	36	82	DMFF fee 21 +_ Easement 15
Asilomar	45	84	State Park hard hit by pitch canker
Veterans Memorial Park	50	86	City of Monterey park
Huckleberry Hill Preserve	69	87	50 year lease from Army to City of Monterey
George Washington Park	21	88	Pacific Grove
Mission Trails Park	26	92	Carmel
Don D. Greenbelt	98	94	City of Monterey
Skyline Forest Greenbelt	156	95	City of Monterey
Del Mesa Carmel OS	228	97a	Deed restricted open space beside Jacks Peak Park
Fish Ranch 1 & 3	56	109,111	Now part of Palo Corona open space
Deer Flats Parks	35	119	HOA deeded easement greenbelt
Aguajito Oaks	28	121	HOA deeded easement greenbelt
Hatton Canyon	46	98	Now Park, formerly Caltrans
Palo Corona/Santa Lucia Pres.	95	NA	Large stand on adjoining properties
Monterra Ranch	98	30a	Contiguous stands > 20 acres
Subtotal	**2768**		
Stands < 20 Acres			
Monterey Peninsula Country Club	75	2,3,4,5,6,7,8,9,40, 41,42,43,44,45,46, 47,49,50,51,52	Open space parcels managed as natural forest surrounding fairways of MPCC
Pescadero Drainage	14	35	Open space drainage area upstream of The Lodge and Pebble Beach Golf Links
Spanish Bay	15	37,38,39	Open space parcels managed as natural forest surrounding fairways of Spanish Bay
Spyglass Cypress	88	53,54,55,56,57,58, 59,60,61,62,63,64, 65,66,67,68,69	Open space parcels managed as natural forest surrounding fairways of Spyglass Hill and Cypress Point Golf Courses
Poppy Hills	83	70,71,72,73, 74,75,76,77	Open space parcels managed as natural forest surrounding fairways of Poppy Hills
Pacific Grove Parks	6	91	4 developed park parcels
Fisherman's Flat Park	5	96	n/a
Fish Ranch 2	19	110	Now part of Palo Corona open space
Warren	15	112	Carmel Highlands
State of California	6	118	Near Gibson Creek near Pt. Lobos
Flagg Hill HOA	11	120	n/a
Whispering Pines	13	132	City of Monterey
Monterra Ranch	103	30a	Naturally small native stands at eastern range limit
Canada Woods	50	107, 108	Naturally small native stands at eastern range limit
Subtotal	**516**		
Total	**3284**		

4.2 Monterey Pine Forest in the Monterey Vicinity

4.2.1 Range and Extent

Both the historical and current geographic distribution of Monterey pine in the vicinity of Monterey has been evaluated by several investigators (McDonald 1959, Scott 1960, Forde 1964, Roy 1966, Huffman and Associates 1994, and Jones & Stokes Associates 1994a). Scott stated that the extent of Monterey pine forest at Monterey in 1931 was 6,000 acres. In 1959, McDonald estimated that the Monterey occurrence of the species comprised about 12,000 acres. Roy (1966) estimated the size of the Monterey pine forest at Monterey to be between 8,000 – 12,000 acres. Most recently, both Huffman and Associates and Jones & Stokes Associates compiled information, reviewed the record and provided estimates on the extent of the species in Monterey. As noted above, even these more recent estimates varied. Huffman estimated that the historic extent of Monterey pine forest in the Monterey vicinity was approximately 11,000 to 12,000 acres compared with over 18,000 acres estimated by JSA. Similarly, Huffman estimated the current Monterey population occupies approximately 6,900 acres of "native stands" (Figure 6) while JSA identified approximately 9,400 acres of Monterey pine with native understory at Monterey today (Figure 7), a discrepancy of about 36%. The latter authors acknowledged differences in methodology that might account for these discrepancies. Different forest cover criteria were used, mapping was conducted at different resolutions and mixed stands were included by JSA that may not have been included by Huffman. These different methodologies possibly resulted in more restricted categories and finer resolution by Huffman, thus reducing the amount of acreage mapped in that study (Jones & Stokes 1994a). Both authors noted losses in the extent of historic forest due to logging and conversion to agriculture and development.

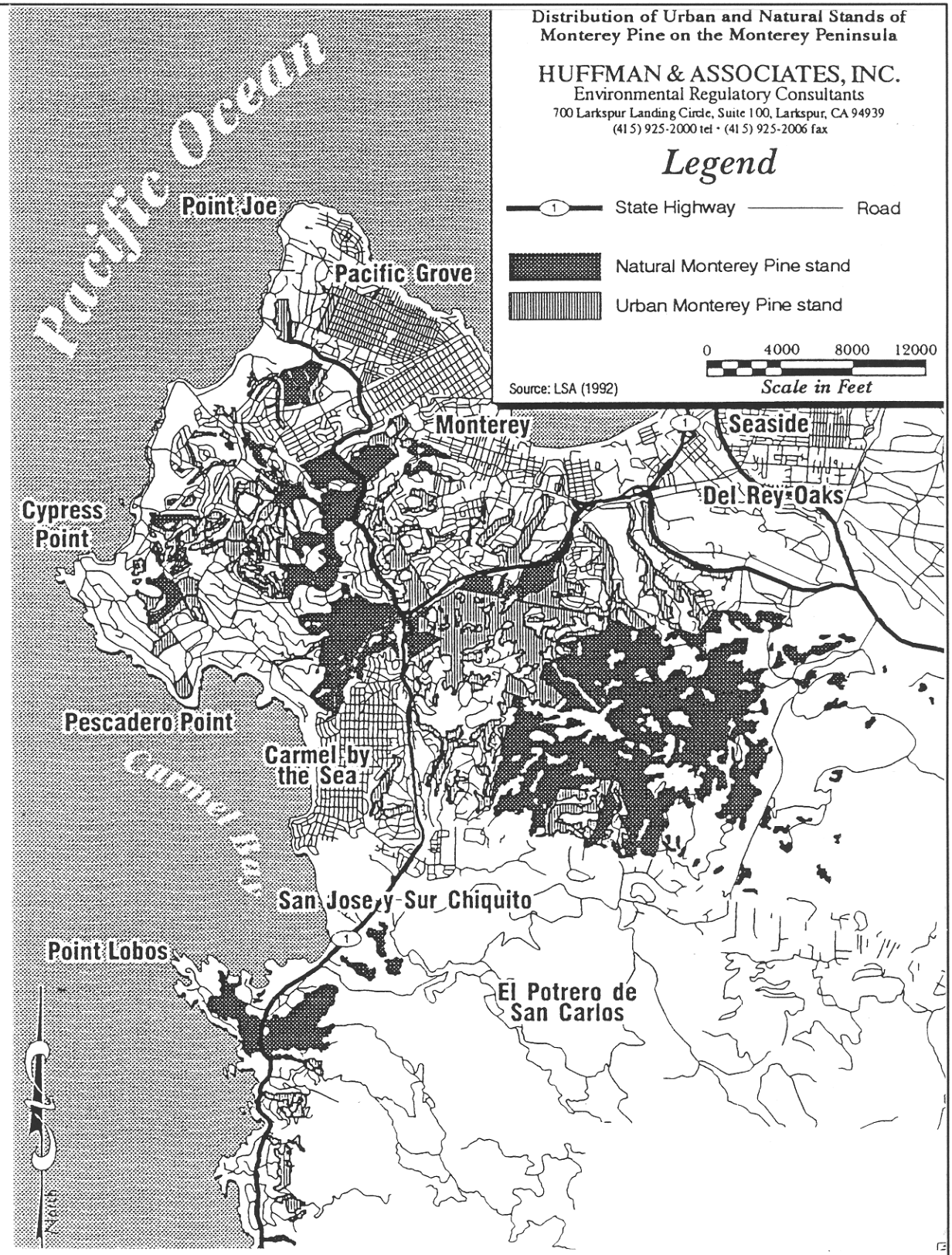
Regardless of these differences in estimates of historic and current extent of Monterey pine on the Monterey Peninsula, both authors map nearly identical boundaries and extent of remaining undeveloped forest (JSA) and urban and natural forest stands (Huffman) within the Del Monte Forest planning area (Figure 8). Using the Huffman and JSA maps (checked against aerial photography) as the basis, the total amount of remaining undeveloped stands of Monterey pine forest in the Del Monte Forest can be estimated at over 1,400 acres.

4.2.2 Stand Characterization

Both the Huffman and JSA reports discussed above characterized and mapped the current existing stands of Monterey pine on the Monterey Peninsula based primarily on underlying land uses. JSA defined and mapped (Figure 7) the following categories using minimum mapping units of five acres:

- *Urban*: These areas are heavily developed with sparse occurrences of Monterey pine, mostly as street trees and never forming a forest. Many other species of horticultural trees occur here.

- *Urban, Golf Course, Urban Park*: These areas support mostly development, but scattered Monterey pine are present, sometimes with up to 20% canopy cover. Many other species of horticultural trees also occur here.



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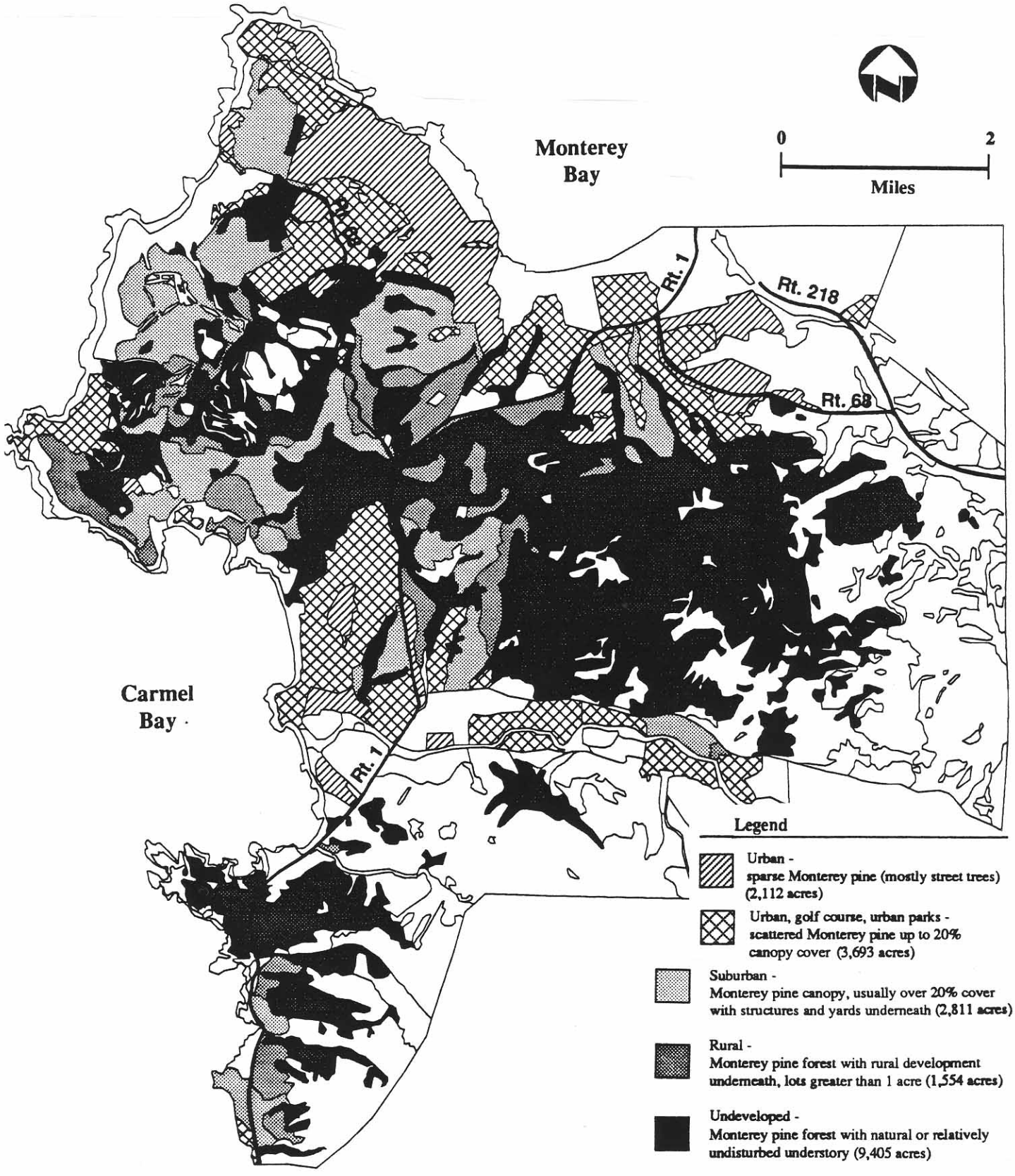
Distribution of Urban and Natural Stands of Monterey Pine on the Monterey Peninsula As Mapped by Huffman and Associates, Inc., 1994 Monterey County, California

Figure 6



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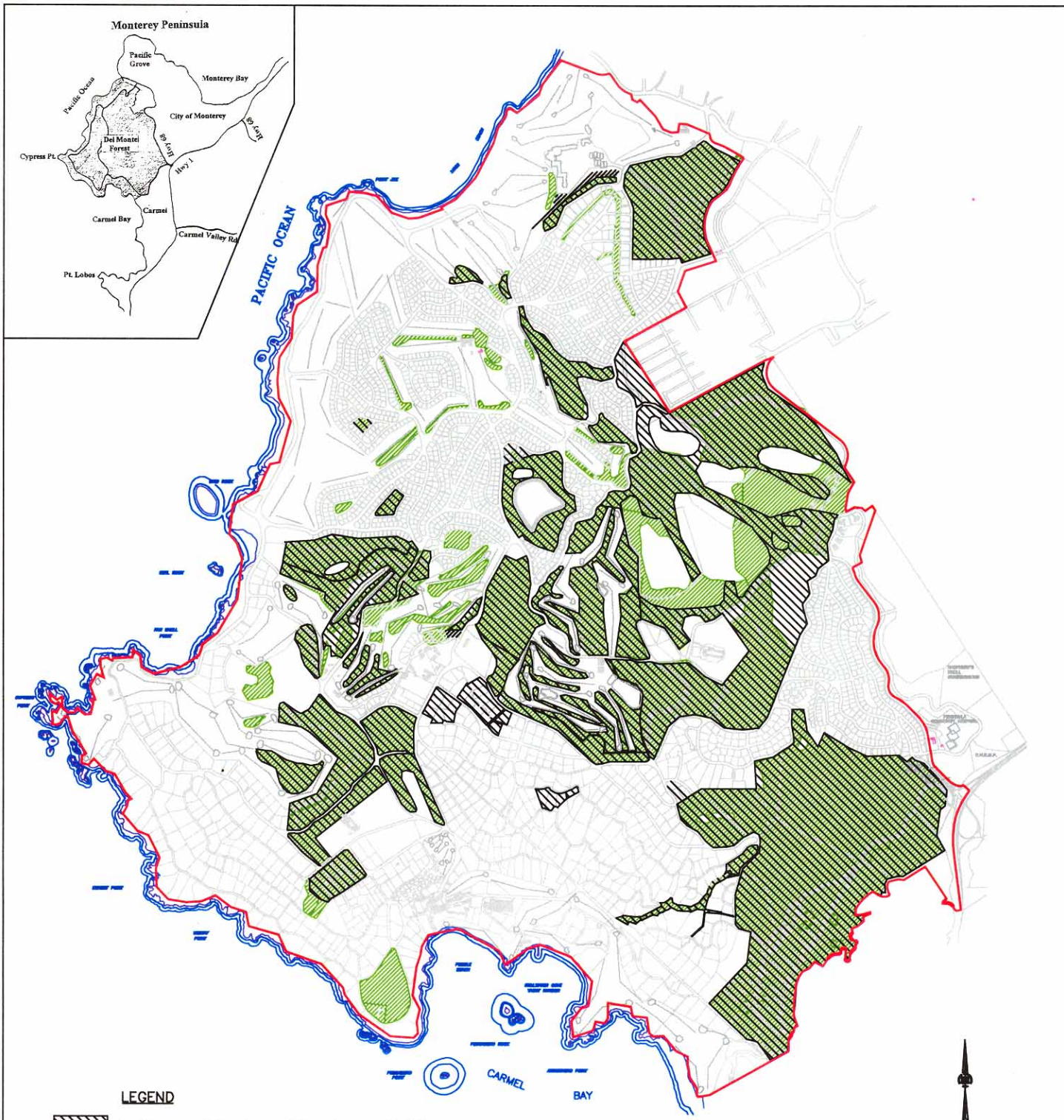
Distribution of Monterey Pine Forest
By Land Use on the Monterey Peninsula
As Mapped by Jones & Stokes Associates, Inc., 1994
Monterey County, California

Figure 7



Sources: Jones & Stokes Associates, Inc., 1994
Huffman & Associates, Inc., 1994

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Comparison of Huffman and JSA Monterey Pine Distribution within the Del Monte Forest Monterey County, California

Figure 8

- *Suburban*: These areas support a Monterey pine canopy, usually over 20% cover, with structures and yards underneath. Vegetation in the understory is usually non-native landscaping. It is uncertain where the Monterey pine forest is planted or naturally established within these areas.

- *Rural*: These areas support Monterey pine forest with rural development underneath. Lot sizes are greater than one acre. Much of the understory may be natural vegetation except around structures and roads. In some areas the understory may be cleared or highly managed.

- *Undeveloped*: These areas support Monterey pine forest with naturally established, relatively undisturbed understory. Structures and roads may be present, but do not substantially break up the forest cover.

Huffman characterized the currently existing stands on the basis of size, degree of fragmentation, proximity to development and other factors. The Huffman report distinguished between landscape trees, urban forest stands and natural forest stands (Figure 6). This classification system is described below.

- *Landscape Forest Stand:* A landscape forest stand is primarily comprised of individual trees and small groves where past development within the native forest removed the majority of the trees and/or the understory vegetation. Landscape forest is generally found in developed areas with large lots, golf courses, streetscapes and continuous canopy except where development has covered the forest soils. Development of the Monterey Peninsula involved, for the most part, selective placement of residences that did not involve mass grading. This process left many Monterey pines and occasionally other native forest plants in place. The desired effect was to retain these trees as landscape amenities. An aerial view of the region from above suggests that the residences are closely situated within the forest. From a biological perspective, however, this is not the case. In landscape forest stands the natural understory elements are largely gone being replaced by structures, pavement, and landscaping. In some cases, cultivated landscape plants have been the source of invasive non-native plants into urban and natural areas of the remaining forest. The landscape forest stands largely consists of fragmented stands of individual trees with limited ecological function.

- *Urban Forest Stand:* An urban forest stand is generally associated with development areas where a conscious effort has been made to preserve at least a portion of that native forest. Urban forest stands are often not as extensive as natural forest stands, are generally fragmented, and possibly more susceptible to genetic contamination and human disturbance. Nevertheless, the trees in an urban forest stand are important to the preservation of the genetic characteristics of Monterey pine, if less important and/or manageable for the preservation of the Monterey pine forest ecosystem. Forest habitat values in an urban forest stand may be high in some cases, especially if they are contiguous with other open space, or they may be limited where they are fragmented or dominated by an understory of non-natives. Urban forest stands have limited potential for the use of fire as a management tool.

- *Natural Forest Stand*: The term, natural forest stand, is used to describe stands that still exhibit significant habitat values, associated species diversity, age class distribution, and natural regeneration. These forest stands are generally larger (almost always more than 20 acres) than the more fragmented urban forest stands. Because they are closer to the naturally occurring forest condition than other types of pine stands, natural forest stands are the most likely areas for long-term sustainability of the Monterey pine forest habitat. Because sources of potential contamination are further removed, they are also the best areas to support the sustainability of the trees' genetic characteristics. Natural forest stands may be the most suitable areas for the use of fire as a management tool. According to Huffman, about 3,500 acres of Monterey pine forest on the Monterey Peninsula occur in natural stands of over 100 acres.

4.2.3 Forest Habitat Types

The assessment conducted for the Lot Program identified four main plant associations of Monterey pine forest based on associated species and understory characteristics: Monterey pine/coast live oak; Monterey pine with shrubby understory; Monterey pine with herbaceous understory and Monterey pine on young stabilized dunes. Variation in physical environment (soils, hydrology, topography, aspect, microclimate, etc.) and vegetation history gives individual patches of forest distinctive characteristics of tree appearance and associated species. These characteristics may be either clearly evident or very subtle. The plant associations are not always present as discrete patches that can be easily mapped and quantified. Rather, they occur generally in a continuum, with one type gradually merging into another. The occurrence and distribution of these plant associations are important biologically because they create a mosaic of habitat opportunities within forest stands as well as connectivity for plant dispersal and wildlife movement throughout the forest.

- *Monterey Pine in Association with Coast Live Oak:* This plant association tends to represent the older stages of forest succession on the deeper soils of the Monterey Peninsula. It is composed of scattered emergents, or occurs as a canopy of Monterey pine varying from 20-80% cover with a subcanopy of coast live oak varying from about 20-60% cover; in well developed pine/oak forest, total absolute canopy cover exceeds 100%. The herbaceous layer is variable, but it is usually sparse due to shade.

- *Monterey Pine in Association with Woody Understory:* This plant association is characterized by a tree stratum that may be very sparse (10-20% cover) or relatively dense (up to 60-70%), with a woody understory of various shrubs. Trees in this type of forest plant association are generally small to moderate in size. The shrub stratum varies as a continuum without sharp distinctions from a mesic shrub association [coffeeberry, poison-oak, coyotebrush, bush monkeyflower, California lilac (*Ceanothus thyrsiflorus*), snowberry (*Symphoricarpos* spp.), and California blackberry (*Rubus ursinus*)] to central maritime chaparral [primarily Manzanita (*Arctostaphylos* spp.), huckleberry, and Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*)]. The herb layer is either absent where shrubs are dense, or apparent in gaps between shrubs.

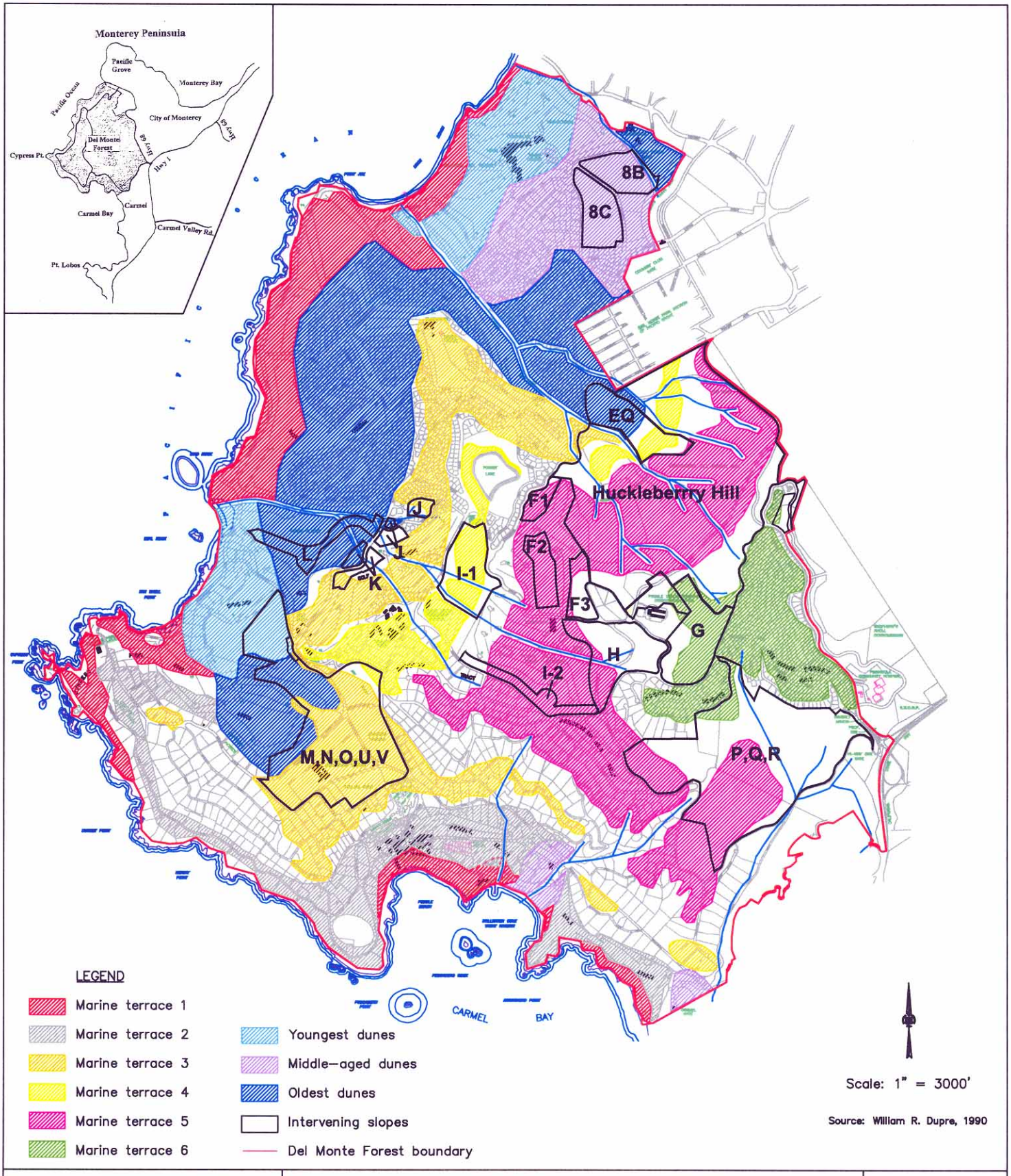
- *Monterey Pine in Association with Herbaceous Understory:* The tree canopy in this plant association varies from essentially closed (nearly 100% cover) to quite open (less than 40% cover). Canopy trees vary in trunk size (diameter at breast height, or dbh) from moderate (12 inches) to large (over 30 inches), and the shrub layer is virtually absent. The herbaceous layer varies from a slightly drier association of tufted hairgrass (*Deschampsia caespitosa*), blue wild-rye (*Elymus glaucus* ssp. *glaucus*), thingrass (*Agrostis pallens*), and various herbs, to a more mesic association of pacific reedgrass (*Calamagrostis nutkaensis*), California canary grass (*Phalaris californica*), and occasional sedges (*Carex* spp.) and rushes (*Scirpus* spp.).

- *Monterey Pine on Young Stabilized Sand Dunes:* This plant association is of very limited occurrence, primarily in the vicinity of sites L and M and off-site at Spanish Bay. It is composed of patches of forest that are in the process of colonizing recently stabilized dunes. Areas between the patches are dominated by dune scrub species such as mock heather (*Ericameria ericoides*), beach sagewort (*Artemisia pycnocephala*), and beach evening-primrose (*Camissonia cheiranthifolia* ssp. *cheiranthifolia*). The understory in larger pine patches includes coast live oak, bush monkeyflower, California blackberry, bracken fern, and coffeeberry. Canopy closure is variable (40-70%), and the trees are moderate- to large-sized in DBH but may be relatively short-lived. Another unique aspect of this plant association is that the trees tend to retain their lower branches. The lower branches become twisted and curve down into contact with the ground, then rise again. This plant association provides wildlife habitat because of the unusual abundance of snags and downed trees and the diverse character of the understory. In stands of other plant associations these lower branches are frequently lost.

4.2.4 Marine Terrace Ecological Staircase Concept

As noted above, JSA characterized variation within Del Monte Forest natural stands of Monterey pine forest based upon the "ecological staircase" concept originally described for the Mendocino area (Jenny et al. 1969). According to this concept, distinct ecological relationships were observed on each of five marine terraces that support various forest subtypes on the Mendocino coast. JSA extrapolated this concept to the Del Monte Forest using the geology map prepared by William Dupré (1990), which identified a series of six marine terraces and three different aged dune deposits within the forest (Figure 9). JSA conducted field surveys on six different occasions in 1994 to evaluate soils and vegetation on at least two sites supporting natural vegetation on each geomorphic surface (Jones & Stokes Associates 1994b). Using the Dupré map and its field evaluations, JSA concluded that each of the marine terraces exhibited distinct soil characteristics and vegetation associations similar to what was described in the Mendocino ecological staircase.

Seventeen different geomorphic surfaces supporting Monterey pine forest were identified; five on marine terraces, five on the granite slopes between terraces; two on Pleistocene dunes; and four on inland bedrocks and drainages (Jones & Stokes Associates 1994b). Forest subtypes were described based on canopy and understory composition and structure and generally follow geomorphic surfaces, however, there are several geomorphic surfaces with the same forest subtype and some geomorphic surfaces where more than one forest subtype was identified.



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Marine Terrace Locations
Del Monte Forest
Monterey County, California

Figure 9

Although three different forest subtypes were found on Terrace 4 and Terrace 5, and one forest subtype was described for middle aged dunes and Terrace 2 and another type for older dunes and Terrace 3, JSA generally classifies forest subtypes based on the geomorphic surfaces mapped by Dupré. JSA described but did not delineate the distinct forest subtypes within terraces.

The classification of forest subtypes, also referred to as the "terrace concept" was used in developing a conservation strategy for the Monterey pine forest and continues to be referenced in the discussions of Monterey pine forest conservation. However, there is not universal concurrence with the conclusions reached by the terrace concept. The County of Monterey, in its review of the Lot Program, concluded that available scientific information, derived from the published literature, from more intensive field observation, and from discussions with recognized experts on Monterey pine did not support the central points of the marine terrace hypothesis (EIP 1997). The County cited genetic principles, the weak correlation of soils with terrace mapping, and the unsupportable ecological differentiation of vegetation between adjacent terraces as reasons for its findings. While it acknowledged some trends in vegetation associated with Monterey pine are clearly exhibited in the Del Monte Forest, it concluded that the fine ecological differentiation described between adjacent terraces was not supported by the data presented.

The County's Final EIR stated that the marine terrace mapping appeared not to be a useful method for identifying areas of apparent ecological differences that are likely to be important in planning for the conservation of Monterey pine and Monterey pine forest habitat. Rather, the EIR concluded that the forest habitat subtypes described in the assessment conducted for the Lot Program (See Section 4.2 3 above), were better indicators of forest diversity and therefore more important from the perspective of conservation planning.

4.2.5 Assessment of Monterey Pine as ESHA

Monterey County, in its application of ESHA policies and standards, has historically viewed DMF LUP Appendix A as a complete listing of ESHAs in the Del Monte Forest. This same standard of review was assumed by the County in its preparation of the Lot Program Final EIR. Nonetheless, the County considered impacts and mitigation measures to sensitive coastal resources through its review of the Lot Program EIR whether they were included on the Appendix A designated ESHA list, or not.

Coastal Commission staff, however, have commented that this treatment does not adequately apply the ESHA definition to the Monterey pine forest and other rare and sensitive species and habitats. (Grove 1999a). Regarding Monterey pine forest, Coastal Commission staff have suggested that because the native range for Monterey pine is limited, the species has been listed (1B) by the CNPS, and the threat to the species has increased due to pitch canker, the Monterey pine forest resource in the Del Monte Forest is more environmentally sensitive than indicated in the DMF LUP and therefore may warrant the increased protection afforded by ESHA designation.

Coastal Commission staff have advised that "…rather than categorically describing all Monterey pine forest as ESHA, some Monterey pine habitat areas may meet the ESHA criteria while others may not.…different areas of Monterey pine forest need to be distinguished according to their

varying degrees of biologic importance and sensitivity" (Grove, 1999a&b). To assist the County in determining ESHA for the Monterey pine forest, Coastal Commission staff recommended that "the large, intact tracts which lend themselves well to active management and represent major reserves of genetic diversity be recognized and formally identified [as ESHA]" (Grove 1999b). In addition, they suggested that smaller, more fragmented stands could qualify as ESHA depending on the sensitivity of the underlying habitat characteristics (e.g. habitat for rare or endemic species, special value for wildlife, adaptability to active management (Ibid).

PBC considered the comments provided by the Coastal Commission relative to ESHA designation for the Monterey pine resource and directed a field sampling and assessment program to evaluate forest characteristics within the DMF/PDP plan area in an effort to determine whether a quantitative method could identify different levels of sensitivity in different areas of the forest. The following chapter of this report presents the methods, results and an analysis of the data from that program.

5.0 MONTEREY PINE FOREST SUPPLEMENTAL ASSESSMENT

Over time, various investigators have collected field data on Monterey pine forest on the Monterey Peninsula. In one of the earliest studies, G. A. Coleman (1905) conducted a 2.5% strip cruise of the Del Monte Forest for the Pacific Improvement Company (precursor of the Pebble Beach Company). In 1916, Duncan Dunning also conducted a cruise for the Pacific Improvement Company to evaluate forest production. Dunning observed and mapped consistent size and age classes of trees distributed in distinct blocks through the forest. In 1959, McDonald evaluated a variety of factors at several sites in the Monterey pine forest in an effort to address growth, development and range limitations on Monterey pine. He concluded that soil depth, fog drip, soil moisture and soil nutrients all contributed to site quality and the extent of the range for Monterey pine. Others, including Roy (1966), McDonald and Lacke (1990), Perkins (1995), White (Vogl et al 1977), and White (1999), in addition to the work by Jones & Stokes Associates (1994 a,b,c & 1996b) and Huffman and Associates (1994) summarized earlier this report, have contributed to the site-specific knowledge of Monterey pine in the Del Monte Forest.

In an effort to supplement and update the existing record of field information on Monterey pine in the Del Monte Forest, Pacific Southwest Biological Services, Zander Associates and Webster & Associates completed a sampling and assessment program during the spring and autumn of 2001. The purpose of the field program was to collect data on trees and associated vegetation types throughout the DMF/PDP area for comparison with other studies, to provide a current "snapshot" of forest characteristics, and to help determine appropriate forest maintenance standards to be applied in the designated preservation areas. Another goal of the sampling program was to determine if, based on forest structure and understory characteristics, there were any areas of particular value in the forest, excluding those habitats already designated as environmentally sensitive habitat areas (e.g. HHNA, Signal Hill Dunes, wetlands, riparian corridors and rare or endangered species habitats).

The sampling program was designed to provide quantitative, replicable results following accepted standard methods. Forest stands were evaluated using standard forestry parameters including tree density, size class, canopy cover, seedling regeneration, and evidence of pitch canker. The associated understory was evaluated by collecting data on plant species composition and cover. A thorough inventory of all plant species in the Del Monte Forest west of Highway 68, excluding HHNA, was completed over the course of the 2001 growing season to generate a floristic database and evaluate species richness. Details of the methodology used for forest plots, vegetation sampling and floristic surveys are provided in the following section.

5.1 Assessment Methodology

Field sampling was conducted in April and October 2001 to collect data on the structure of the forest, seedling regeneration, distribution of pitch canker and understory composition and distribution. The study area consisted of all existing undeveloped forest stands within the component areas of the DMF/PDP and included the Monterey pine/Bishop pine/Gowen cypress forest in Huckleberry Hill. General floristic surveys were completed March through September

2001 over the entire Del Monte Forest west of Highway 68, excluding HHNA, to compile an inventory of all plant species present.

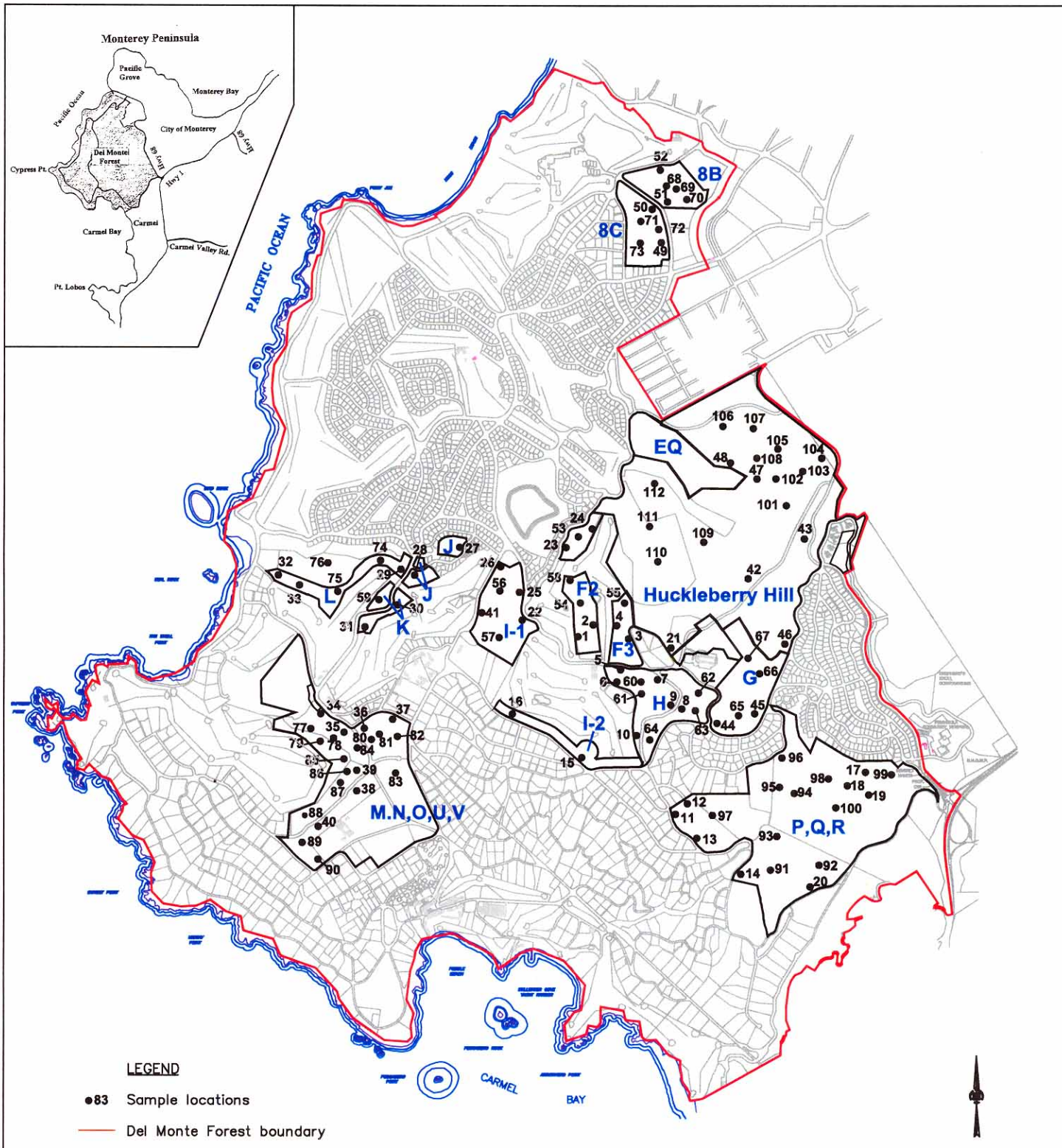
The data were sorted and evaluated to provide information on the density and size-class distribution of Monterey pine and other codominant species within the tree layer, characterize vegetation associations in the understory, and assess trends in seedling density, pitch canker distribution and other parameters relative to the forest and understory structure. The data were also sorted for comparison with previous studies related to the structure and diversity of the Del Monte Forest. Following are descriptions of the specific methodology used for collection and analysis of forestry, vegetation and general floristic data.

5.1.1 Forestry Plots

Forestry data were collected from 164 1/10-acre plots situated throughout the DMF/PDP area and in Huckleberry Hill (Figure 10). This represents a 2.4% cruise of the existing undeveloped forest within the study area. For the first 52 sampling locations, two forestry plots were inventoried. One plot was located at the beginning of a 50 meter transect line at or near the edge of a road and the second plot was more interior into the forest. For the 60 remaining locations, a single plot was inventoried. A separate forest inventory was conducted on the site of the new Equestrian Center because the majority of that site is disturbed and the forest consists mostly of planted trees that were provided as part of a restoration effort for the former quarry. The data were collected in all areas, including the new Equestrian Center, following standard forestry methods as described below.

All trees within the sample plot were tallied by size class based on diameter at breast height (dbh); 1"-4", 4"-12", 12"-24" and > 24". Tree seedlings were counted within a 1/1000-acre area in the center of the 1/10-acre plot (6.6' x 6.6' square). Seedlings were defined as tree specimens less than 12" tall. Evidence of pitch canker was determined using the characters identified in the University of California pitch canker rating system but actual rating was not done. A simple tally of trees with symptoms of pitch canker (branch tip kill, leader kill, and stem cankers) was completed for each plot. Distinctions by size class were not made. Canopy coverage was estimated visually and recorded by class where Class 1 = 0-25% closure, Class 2 = 26-50% closure, Class 3 = 51-75% closure and Class 4 = 76-100% closure.

The forestry data were sorted into stands following the former subdivision areas in the DMF LUP for comparison with previous inventories (Perkins 1995) and for evaluating forest impacts of the DMF/PDP. Estimates of the density (trees per acre) of Monterey pine and coast live oak were calculated by size class for each stand and for the entire study area, excluding Huckleberry Hill. Density of Bishop pine and Gowen cypress was estimated separately for the data collected in Huckleberry Hill. Forest inventory data collected at the site of the new Equestrian Center were not included in the assessment of existing conditions but were used to calculate forest impacts as described in Section 6.0. The seedling data were used to calculate an average density of Monterey pine seedlings for the study area and were compared with tree density, canopy and vegetation data to identify relationships.



Zander Associates Environmental Consultants 150 Ford Way, Suite 101 Novato, CA 94945 (415) 897–8781	Forest Assessment Sample Locations Del Monte Forest Monterey County, California	Figure 10

5.1.2 Vegetation Sampling

Vegetation sampling was conducted generally following the Relevé Protocol drafted by the California Native Plant Society Vegetation Committee (Draft # 2, November 20, 1998) and was focused on the understory of the existing undeveloped forest stands in the DMF/PDP area. Vegetation data were collected in 112 1/10-acre plots simultaneously with the forestry sampling and in the same locations (Figure 10). Sample locations were selected to adequately cover the forest stands within the study area, to represent the various understory habitats apparent through visual observation or aerial photographic interpretation, and to compare vegetation composition at the edge of roads with the interior of the forest.

The purpose of this assessment was to characterize the typical forest habitat within the DMF/PDP area. Separate assessments of special status-species habitat, wetland and riparian areas and dune vegetation in the Signal Hill Dune/Spyglass Pit area are provided in other reports (Wetlands Research Associates 2001, Zander Associates 2001a & b). However, sample sites were located in HHNA so that comparisons could be made on the structure of the understory in areas subjected to fire and on different soil types.

Vegetation data were collected in April and October 2001. At each sampling location, all plant species observed within the plot were listed and relative cover estimates were assigned. Species were categorized as herbs or shrubs and as native or exotic in the field. Information on the composition and density of the tree layer was obtained from the forestry data.

The data were sorted in various combinations to test trends observed in the field and to compare with descriptions of the forest understory presented by others. The data were also used to evaluate relationships between understory structure and tree and seedling densities. The abundance of native and exotic species and their distribution in the understory was also assessed.

5.1.3 Floristic Surveys

Seasonally timed surveys of the entire Del Monte Forest west of Highway 68, excluding HHNA, were conducted throughout the spring and summer of 2001 by Mr. Vern Yadon, Emeritus Director of the Pacific Grove Museum of Natural History. The purpose of these floristic surveys was to create a complete inventory of the plant species present in each area. The inventory was developed by walking the periphery of each area and traversing several times through the interior, recording different species as they were encountered. The initial surveys were conducted in March 2001 and sites were revisited throughout the spring and summer to account for seasonal annuals. A complete list of species recorded for each area is provided in Appendix B.

The floristic data were used to evaluate species richness for natives in each of the areas relative to the entire forest. The number of species observed in each area was compared to and represented as a percentage of the total number observed in the forest. The data were also used in evaluating the presence percentage of the dominant species encountered in the vegetation plots.

5.2 Results

Data collected in 164 forestry plots and 112 vegetation sampling locations provide information on the current structure of the forest within the DMF/PDP area and the characteristics of the understory vegetation. The data also identify trends with respect to seedling regeneration, understory vegetation associations and distribution of exotics.

5.2.1 Forest Structure

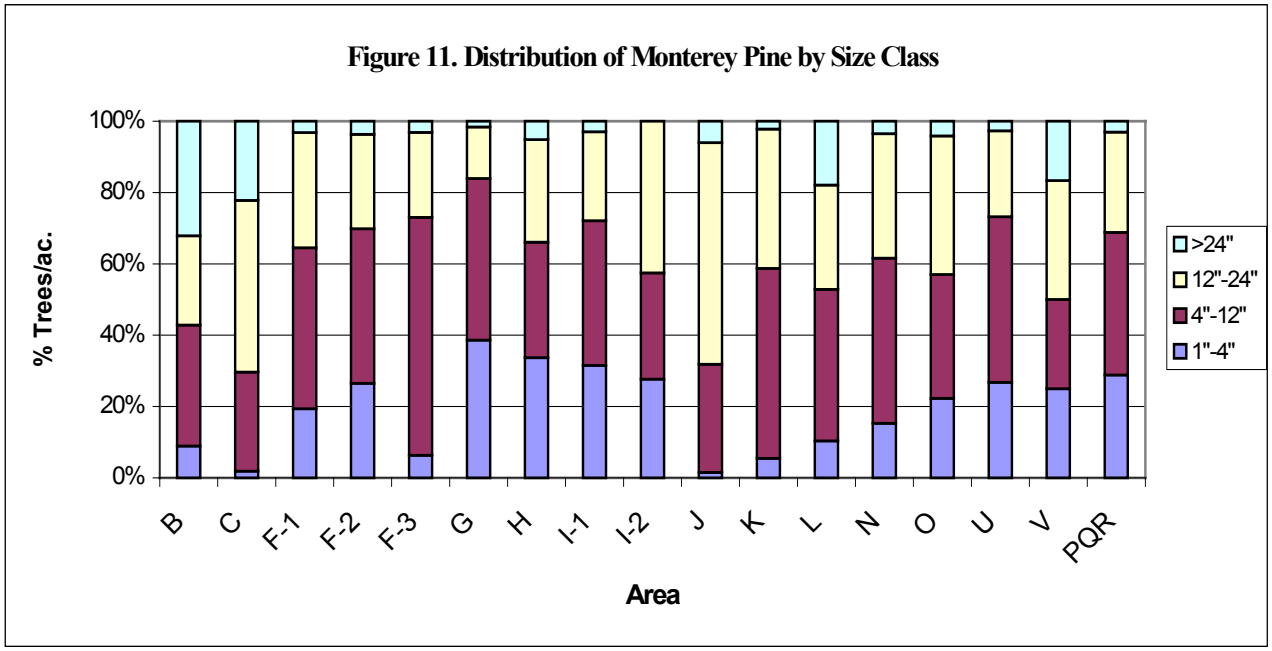
The forest consists almost exclusively of Monterey pine, except in Huckleberry Hill where Bishop pine and Gowen cypress are nearly codominant with Monterey pine. Coast live oak is a measurable component in several areas but when per acre estimates are extrapolated out over the entire study area, oaks average 20 trees per acre compared to 177 trees per acre for Monterey pine. In Huckleberry Hill, the composition of the tree layer is very different from the other portions of the study area. Monterey pine is dominant with a density of 146 trees per acre but Bishop pine is also relatively dense averaging 120 trees per acre. Coast live oak and Gowen cypress are included in the tree layer at densities of 33 and 9 trees per acre, respectively. Bishop pine and Gowen cypress were recorded in other portions of the study area adjacent to Huckleberry Hill in Areas F-1, F-2 and F-3, but were not measurable components of the tree layer.

Tree densities for the various size classes of Monterey pine and coast live oak based on the 2001 data are summarized in Table 5-1 and the distribution of size classes in each stand is illustrated in Figure 11 (for Monterey pine only). Monterey pine in the study area are distributed relatively equally throughout the various size classes except that only 6% of the total number of trees inventoried fall within the >24" dbh size class. The distribution of trees in the remaining size classes is as follows: 24% in the 1"-4" dbh, 40% in the 4"-14" dbh, and 30% in the 12"-24" dbh. A similar pattern is seen for coast live oak in that only 9% of the total are within the > 12" dbh size class and the majority of the trees inventoried are in the smaller size classes – 33% in the 1"-4" dbh and 57% in the 4"-12" dbh. With the exception of Area I-2, all areas surveyed had some Monterey pine in the >24" dbh size class. Areas B, C, L and V have the highest number of trees per acre in the >24" dbh size class compared to other stands in the study area.

The lowest density of Monterey pine occurs in Area C (86 trees per acre) and the highest density is in Area G (374 trees per acre). Approximately 70% of the trees in Area C fall within the $\geq$ 12" dbh size class and 84% of the trees comprising the total in Area G are in the $\leq$ 12" dbh size class. This trend is repeated in the data for the remaining areas where, as the density of trees decreases, so does the percentage of trees in the smaller size class ($\leq$ 12" dbh). Other sites with relatively low Monterey pine densities include Areas B and L and less than 52% of the trees inventoried in these areas are in the smaller size class. The reverse trend is observed in Areas I-1, PQR, F-2 and H, in addition to Area G, where the density of Monterey pine is relatively high and greater than 65% of the trees inventoried are in the smaller size class.

Table 5-1
Per Acre Summary of Monterey Pine and Coast Live Oak by Area and Size Class[6]

	Monterey Pine (MP)				Coast Live Oak (CLO)			MP	CLO	TOTAL Trees
	1"-4"	4-12"	12-24"	>24"	1"-4"	4-12"	12-24"	Trees/ac.	Trees/ac.	
Area	Trees/ac.	Trees/ac.	Trees/ac.	Trees/ac.	Trees/ac.	Trees/ac.	Trees/ac.			
B	8	30	22	29	6	25	6	89	38	127
C	2	24	41	19	11	19	14	86	44	130
F-1	25	59	42	4				130	0	130
F-2	65	107	65	9				246	0	246
F-3	8	88	31	4				132	0	132
G	144	170	54	6	1			374	1	376
H	82	79	70	13	2	1		244	3	246
I-1	100	128	79	9	39	45		316	84	399
I-2	33	35	50	0	28			118	28	145
J	3	50	103	10		30		165	30	195
K	10	103	75	4	19	63	10	193	92	285
L	13	54	37	23	13	11		128	24	152
N	29	87	66	7		3		188	3	192
O	43	67	75	8	2	10	2	192	13	205
U	54	94	49	5			2	202	2	204
V	39	39	52	26		26		156	26	182
PQR	72	100	70	8	7	18	8	249	33	282



[6] Because Area M consists primarily of sand dunes, no forestry plots were located in this area. However, forestry plots were placed immediately adjacent in Area N. It is assumed that the data from the plots in Area N are also representative of the forest in Area M.

When extrapolated out over the entire study area, the number of oak trees per acre is small compared to Monterey pine (20 trees per acre vs. 177 trees per acre). However, there are sites in the forest where oak trees comprise $\geq$ 30% of the total tree density - Areas B, C and K and the ratio of oaks to pines approaches 50%. There are also sites where oak tree densities are less than 4 trees per acre – Areas F-1, F-2, F-3, G, H, N and U. Excluding Areas B, C and K, the ratio of oaks to pines in the study area is low, ranging from 0% to 26%.

5.2.2 Seedling Density/Regeneration Potential

The average density of seedlings in the study area calculated from the 2001 data is 224 per acre. Seedling densities vary from 0 to 1375 per acre by stand but when the extremes are removed, densities of between 0 and 200 seedlings per acre are estimated in approximately 70% of the stands sampled. There is a positive correlation between the number of seedlings per acre and the number of trees per acre in the 12"-24" dbh size class; in some of the areas where seedling density is lower (G, H, I-1, K) the number of trees in the <12"dbh size class is high compared to trees in the >12" dbh size class. The stands with the highest density of trees > 12" dbh relative to the other size classes are Area J and Area O and these sites also have high seedling counts.

Approximately 90% of the plots with Monterey pine seedlings had an herbaceous-dominated understory. Comparing the number of seedlings observed with the understory composition indicates a decrease in seedling density with an increase in shrub cover. There is also a slight decrease in seedling densities as the tree canopy cover increases but this is not strongly correlated in the data.

5.2.3 Pitch Canker

Evidence of pitch canker was found in Monterey pine throughout the study area. About 84% of the plots sampled had trees with evidence of pitch canker, although in more than two thirds of those, less than half of the trees in the plot were observed with symptoms. Area G and Huckleberry Hill had the lowest percentage of trees with evidence of pitch canker (5% and 7% respectively) and Areas J and I-2 had the highest (67% and 64%). Most of the remaining areas sampled had between 20% and 50% of the trees exhibiting pitch canker symptoms.

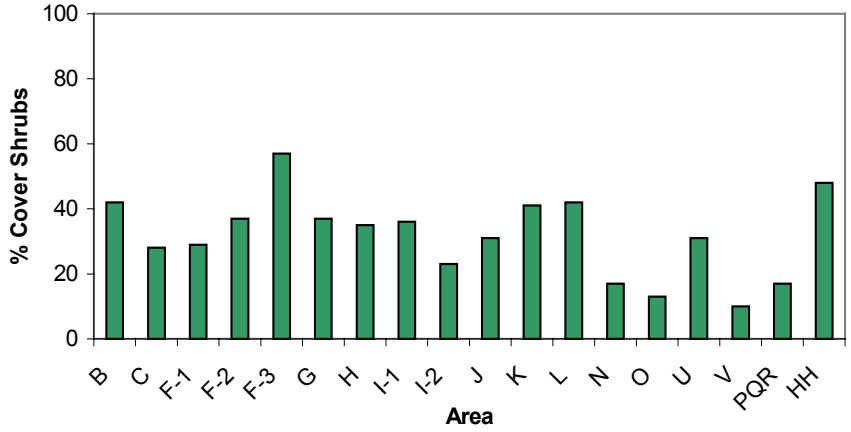
There is only a slight increase in the number of trees showing evidence of pitch canker between forestry plots sampled at the edge of roads, trails, etc. and forestry plots situated interior of disturbance. Out of a total of 52 “edge” plots sampled, 44 ($\pm$84.6%) had some trees that showed evidence of pitch canker and 94 out of 112 ($\pm$84%) “interior” plots had some symptomatic trees. In 20 (approximately 38.5%) of the “edge” plots, compared with 24 (about 21.4%) of the “interior” plots, more than half of the trees were symptomatic.

5.2.4 Understory Composition

The forest understory is relatively open with herbaceous species comprising greater than 50% of the cover in 79% of the vegetation plots sampled. Shrubs are present but occur in patches at varying densities throughout the understory and rarely form impenetrable masses. The average

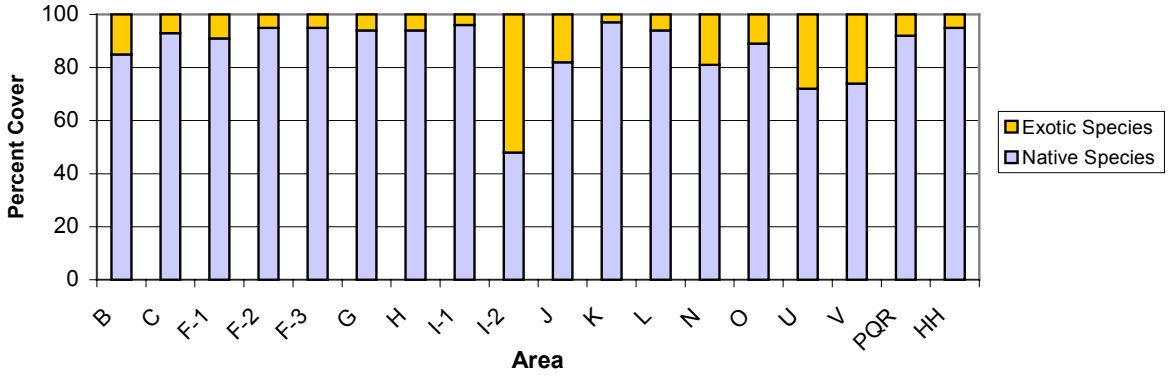
cover of shrubs in the study area is approximately 30% and densities vary from 10% in Area V to 57% in Area F-3. Canopy class and tree densities do not correlate strongly with shrub densities.

Figure 12. Shrub Cover by Area



Native species dominate the understory. Of the 349 total species inventoried in the study area, 227 are natives and 122 are non-native or exotic species. The extent of native species coverage in each area is illustrated in Figure 13. In all but Area I-2, greater than 75% of the vegetative cover in the understory is comprised of native species.

Figure 13. Cover of Native and Exotic Species by Area



A list of the most dominant species encountered in all of the vegetation plots is provided in Table 5-2 along with the species presence percentage based on occurrence in 14 different stands sampled [7].

[7] Each area represents a stand. Areas NOUV constitute one stand and Huckleberry Hill is not included in this comparison.

Table 5-2
Dominant Species Encountered in Vegetation Plots

Species	Growth Form	Presence (%) in stands
Agrostis pallens	herb	100
Vaccinium ovatum	shrub	93
Arctostapyhlos tomentosa	shrub	86
Elymus glaucus	herb	100
Rubus ursinus	shrub	100
Calamagrostis nutkaensis	herb	93
Deschampsia caespitosa	herb	100
Toxicodendron diversilobum	shrub	100
*Briza maxima**	herb	93
Pteridium aquilinum	herb	86
Carex harfordii	herb	93
Mimulus aurantiacus	shrub	100
Rhamnus californica	shrub	100
Arctostapyhlos hookeri	shrub	64
Phalaris californica	herb	93
*Genista monspessulana**	shrub	100
Baccharis pilularis	shrub	100
Satureja douglasii	herb	93

* Non-native species

As the presence percentage indicates, these dominant species are widely distributed throughout the study area but they occur at varying densities and in different associations. There are six different associations of dominant species repeated consistently in the data that characterize the various understory compositions of the forest. These understory subtypes are variations on the forest subtypes described by others in that they include herb-dominated and shrub dominated associations with similar species compositions. However, since the 2001 data were collected from 112 plots that can be specifically located in the study area, the identification of these subtypes allows for further analysis of how the understory composition varies in the forest. Following is a description of the understory subtypes identified by the 2001 data and a discussion of their distribution in the study area:

- Herbaceous Subtype 1 (H1): This understory is characterized by greater than 50% cover of annual and perennial grasses and herbs. The dominant species include Pacific reedgrass (*Calamagrostis nutkaensis*), several different species of sedges (*Carex* spp.) and rushes (*Juncus* spp.). Common associates include hedge-nettle (*Stachys bullata*) and wood rush (*Luzula comosa*).

- Herbaceous Subtype 2 (H2): This is also an herbaceous understory dominated by annual and perennial grasses and herbs. The recurring species associations in this subtype include common bent grass (*Agrostis pallens*), blue wild rye (*Elymus glaucus spp. glaucus*), rattlesnake grass (*Briza maxima*), and yerba buena (*Satureja douglasii*). The typical coastal terrace prairie grasses such as tufted hairgrass

(*Deschampsia caespitosa*) and oatgrass (*Danthonia californica*) are frequently found in this subtype, although they also occur occasionally with the species in H1.

- Shrub Subtype 1 (S1): This subtype has greater than 50% cover of soft-leaved shrubs that includes California blackberry (*Rubus ursinus*), bush monkey flower (*Mimulus aurantiacus* var. *aurantiacus*) and California coffeeberry (*Rhamnus californica*). Other common associates are bracken fern (*Pteridium aquilinum*), poison oak (*Toxicodendron diversilobum*), coyote brush (*Baccharis pilularis*) and snowberry (*Symphoricarpos mollis*).

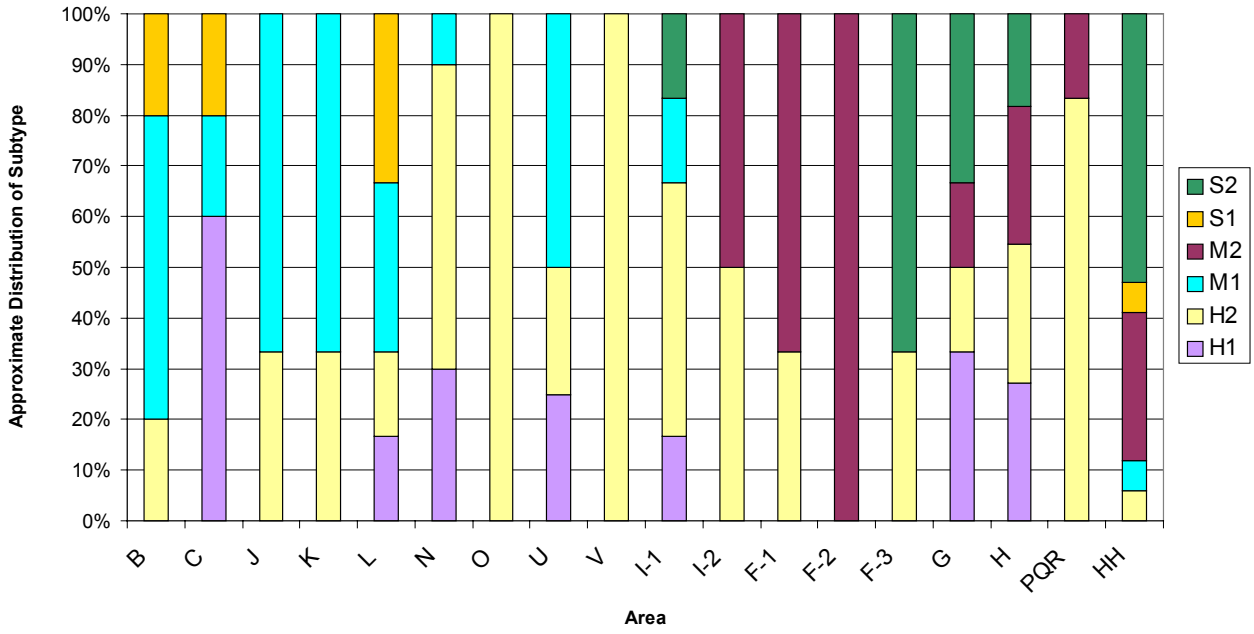
- Shrub Subtype 2 (S2): This understory includes hard-leaved shrubs such as shaggy-barked manzanita (*Arctostaphylos tomentosa* ssp. *tomentosa*) and huckleberry (*Vaccinium ovatum*) that comprise greater than 50% cover in the understory. Associates include poison oak, blue blossom (*Ceanothus thrysiflorus*), and other species of manzanita (*A. hookeri*, *A. pumila*).

- Mixed Subtype 1 (M1): This understory consists of a combination of herbs and shrubs with relatively equal distribution in terms of percent cover. The dominant herbs and shrubs are a combination of the prairie grassland described for H2 and the soft-leaved shrubs in S1, although pacific reedgrass can also be codominant with the soft-leaved shrubs in areas that are typically more moist.

- Mixed Subtype 2 (M2): This understory is characterized by a combination of hard-leaved shrubs and the prairie grasses described for H2. Shrubs and herbs are essentially codominant. The species in H1 are rarely associated with the hard-leaved shrubs in the study area.

The distribution of the understory subtypes does not follow discrete, mapable boundaries. Several different subtypes can occur in the same general area where there are no obvious distinctions in the forest structure or physical characteristics such as soils or geomorphic surface. However, there are trends in the distribution that appear to follow an elevation and moisture gradient, and to some extent, type and depth of soils. For instance, the H1, S1, and M1 subtypes are descriptive of the understory at lower elevations such as Areas B, C, J, K and L and are only occasionally present at higher elevations like Area G and Huckleberry Hill along drainages or in canyons – moister microclimates. The S2 and M2 subtypes are descriptive of the understory at the higher elevations and on drier sites like Areas F-2, F-3, G, H and Huckleberry Hill and are not found at the lower elevations. Figure 14 illustrates how the various understory subtypes are distributed throughout the study area. The areas are organized along an elevation gradient to visually illustrate the trends discussed.

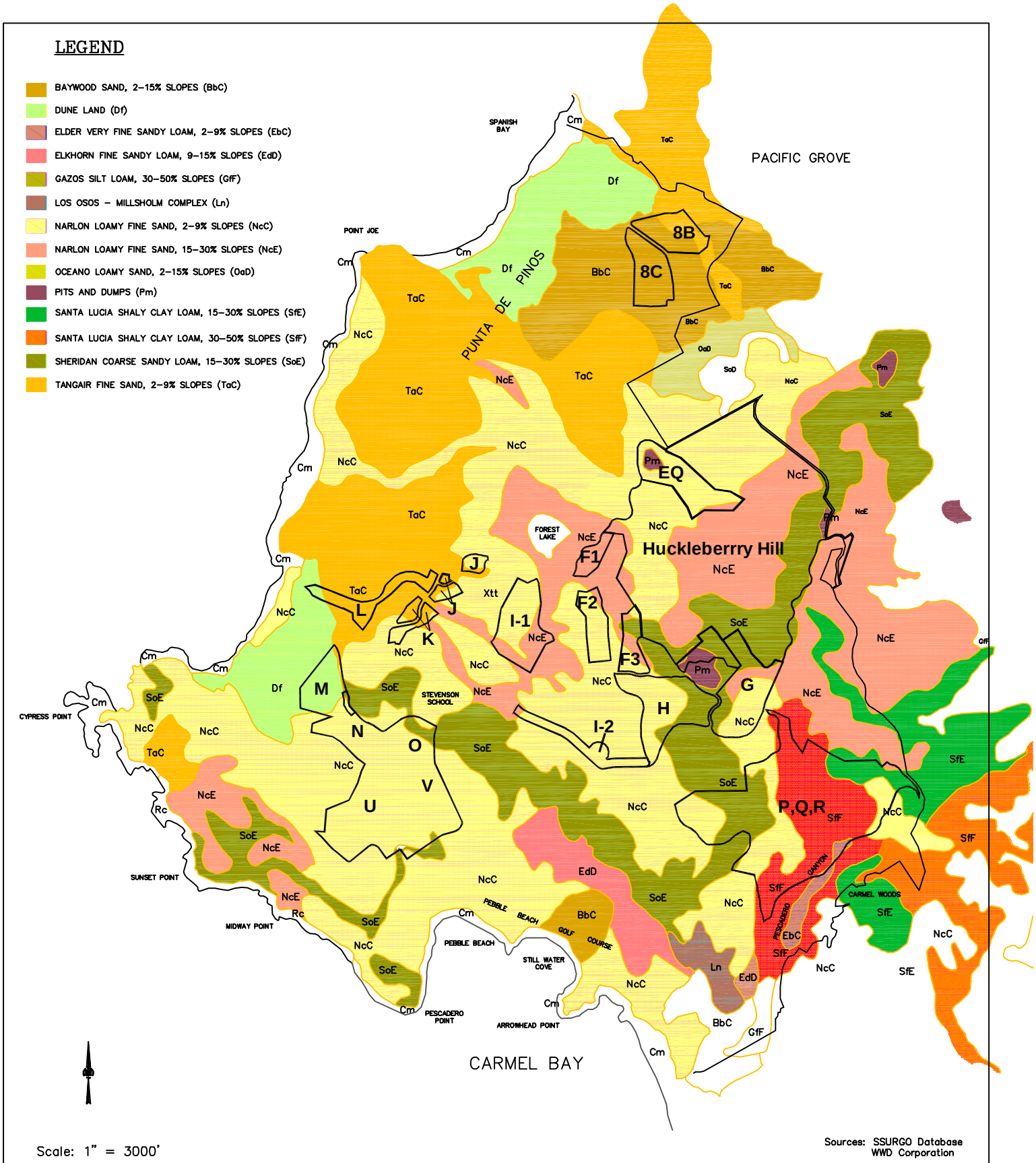
Figure 14. Distribution of Understory Subtypes in the Study Area



The variation in understory between sites at similar elevations appears to correlate well with the distribution of soil types in some areas. The deeper Baywood Sands in Areas B and C and the Tangair Sands in Areas J, K and L (Figure 15) tend to support understories with a higher shrub component than the Narlon soils in Areas N, O, U and V. At the higher elevations, the Sheridan and Santa Lucia Series mapped in portions of PQR, G, H and HH are associated with a predominantly herbaceous understory while shaggy-barked manzanita and huckleberry are more prominent components of the understory on Narlon soils.

Nine of the dominant species listed in Table 5-2 were found in every one of the DMF/PDP areas. The remainder were found in greater than 60% of the areas. Of the 227 native species inventoried during the 2001 floristic surveys, 70 (31%) were found in 7 or more of the 14 areas sampled, 86 (38%) occur in 2 to 6 of the areas sampled and 71 (31%) were found in only one area. Species richness is expressed for each area as a percentage of the total number of native species inventoried. As would be expected, richness generally decreases with the size of the area however the data point to a few exceptions to that trend. Areas H, I-1 and L have higher species richness proportionally compared to size. This is probably related to the diversity of understory subtypes found in each (See Figure 14).

French broom (*Genista monspessulana*) is one of the two non-native species most commonly found throughout the study area (Table 5-2). Although it was observed in every area, it does not comprise a large percentage of the understory in any area. French broom was encountered most frequently in vegetation plots sampled near the edge of roads or trails. It was present in 24 of the 52 vegetation plots placed at the edge and in only 3 of the 60 vegetation plots sampled further



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Soils Map
Del Monte Forest
Monterey County, California

Figure 15

than 50 meters interior of edges. Pampas grass (*Cortaderia jubata*), another invasive exotic, was observed in 14 of the 112 vegetation sampling locations but it was found primarily in interior areas. Both of these species colonize disturbed areas and both have been the focus of weed eradication programs implemented by PBC. According to PBC (Cain pers. com. 2002), eradication of pampas grass has been relatively successful because it does not require repeated applications of herbicides. French broom on the other hand continues to regenerate even after being sprayed and must be constantly managed.

The fact that French broom was found more often near the edge of roads and pampas grass was found interior of roads can be explained to some extent by PBCs weed eradication efforts and the nature of seed dispersal for both species. Pampas grass that is spotted along the roadways or trails is sprayed and the plant or plants are eradicated. However, since the seeds of this species are wind dispersed, they are distributed widely throughout the forest and reach interior areas that are not as accessible or visible and may not be targeted for spraying. The seeds of French broom are dispersed through ground disturbance or runoff and aren't typically spread as far as pampas grass. The seeds can also germinate at various intervals and the seed bank can remain in tact for a long period of time. Application of herbicides or other methods for removal of French broom are only effective in eradicating plants that have germinated while the cached seed bank continues to provide the next generation of seedlings. The 2001 data suggest that PBCs eradication efforts are effective but that French broom requires continual management and that extending control of pampas grass further into the forest could essentially remove the species from the area.

5.3 Discussion

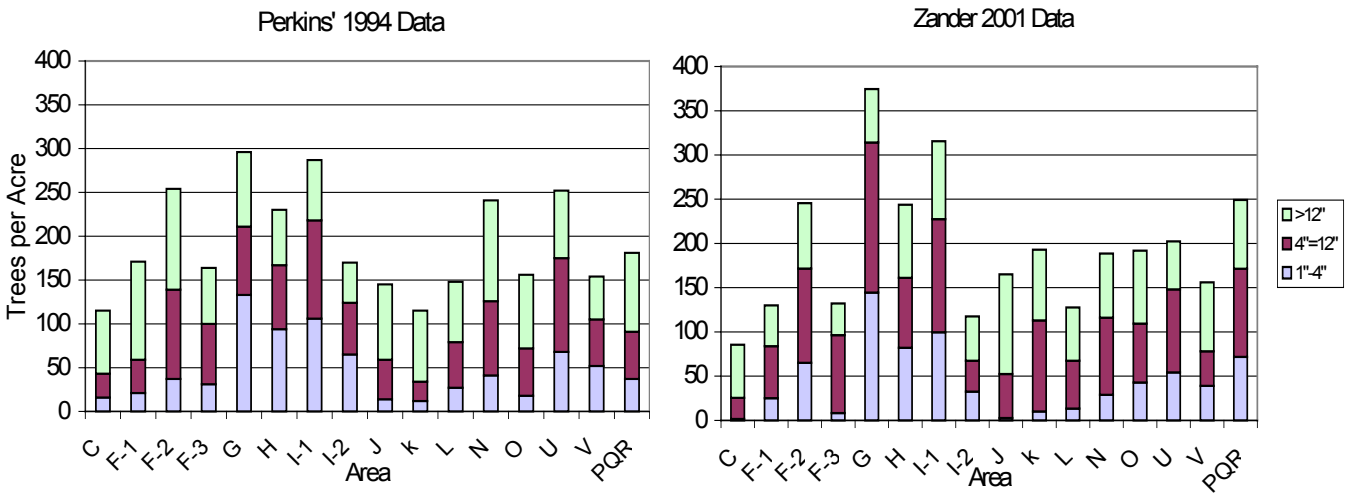
5.3.1 Forestry Data

Monterey pine, in a range of size classes, remains the dominant canopy tree in the Del Monte Forest with coast live oak as a common associate, although far less frequent and occurring in smaller size classes in most areas. Diversity of size class, as observed in the 2001 data, is suggestive of an uneven or mixed-age forest. Data on the relationships between Monterey pine tree age and trunk diameter indicate a roughly proportionate, but not strictly linear increase in size with age (Dunning 1916, McDonald 1959, JSA 1994a, White 1999). While some trees of different size classes occur in even-aged stands, low diversity of size classes is generally indicative of even-aged stands.

Smaller and moderately-sized Monterey pine trees are fairly evenly distributed in the forest, but the largest ($\geq$24" dbh) trees occur less frequently than the other size classes (Table 5-1 and Figure 11). These scattered larger trees are probably remnants of earlier, more even-aged forest stands. Extensive logging in the 1860s and 1870s and widespread fire in the early 1900's over about a quarter of the Del Monte Forest establish the starting points for large blocks of pine regeneration whose survivors are today's oldest and largest trees. Since that period, natural tree loss and recruitment, subsequent land use practices including logging and development, and active fire suppression have broken the signature dominance of single cohort even aged forest stands. The exception is in the Huckleberry Hill area where a 1987 fire over an approximately 198-acre area resulted in a new block of single cohort regeneration.

In the absence of fire, stocking densities (number of trees per acre) for Monterey pine have remained within a relatively constant range in recent years, although some shift in the distribution of size/age classes is discernable. A direct comparison can be made between the 2001 data set and the data collected in the Del Monte Forest in 1994 by Perkins (1995) because the two sampling methods and locations were very similar (Figure 16).

Figure 16: Comparison of Tree Densities from 1994 - 2001



Perkins calculated an average of 197 trees per acre with highest densities in the ≥12" dbh size class while calculations from the 2001 data yield an average density of 177 trees per acre with highest average densities in the 4"-12" dbh range. Densities in the areas sampled by Perkins varied from a low of about 115 trees per acre (in Area C) to a high of about 296 trees per acre (in Area G). These areas also had the lowest and highest densities in 2001, but with lower densities in Area C (86 trees per acre) and higher densities in Area G (374 trees/acre). Densities in Area C decreased in all size categories between 1994 and 2001 while densities in Area G increased in both the lower (1"-4"dbh) and mid-range (4"-12" dbh) classes. Decreased pine densities in Area C (and in Area B, where Perkins did not provide data) may be attributable to dense understory limiting pine regeneration and increased canopy dominance of oaks (see discussion below). Increased pine densities in Area G are probably explained by data collected in areas affected by the 1987 burn. Similar variation in stocking densities between the two data sets can be observed in other areas sampled, but overall, the differences are not significant and can be explained by natural forest turnover without fire or other major disturbance.

Comparison with studies conducted by White (1999) in 1965/66 and 1994 is also instructive. White conducted repeat sampling of 19 native Monterey pine stands on the Monterey Peninsula after a 28-29 year interval (initial sampling in 1965/66 with resampling in 1994). He reported that, excluding five stands with unusually high densities, the average number of trees per acre was nearly the same between sampling events: an average of 184 trees per acre in 1965/66 and

186 trees per acre in 1994.[8] Densities ranged from highs of 486 trees per acre (in younger, previously burned stands) to lows of 135 trees per acre in older stands. Although White's work was weighted to inland plots outside of the Del Monte Forest and other aspects of his methodology do not allow direct comparison, his data are consistent with the Perkins and 2001 observations.

Both White and Perkins commented on the low number of pine seedlings observed in the forest relative the seedling densities observed after fire. Given the very high numbers White reportedly observed after the Huckleberry Hill fires (±40,500 seedlings/acre), the maximum numbers he recorded in 1994 (±133 seedlings/acre) are clearly less by orders of magnitude. However, others have observed that site-specific seed regeneration and recruitment in natural forest gaps can result in recruitment densities in excess of 890 new recruits per acre (Storer et al 2001). While the average seedling densities for the Del Monte forest that can be extrapolated from our 2001 data (±224 seedlings/acre) are consistent with White's observations, plot-specific densities vary from highs of 1375 seedlings/acre to 0 in keeping with the gap-regeneration observations noted above. This type of scattered or site-specific seedling regeneration and recruitment will not result in large blocks of single cohort stands that would occur after a burn, but appears to serve well in perpetuating the type of mixed-age class forest described above that has become the norm in the absence of fire.

White suggested that increasing dominance of coast live oak under the regime of complete fire control on the Monterey Peninsula could result in gradual type conversion of Monterey pine forest. Especially with the initial high mortality from the spread of pitch canker in the mid-1990's, the concern about loss of the Monterey pine forest and its replacement by an oak woodland increased. The 2001 data show ratios of oaks to pines approaching 50% in some areas of the Del Monte Forest, notably in Areas B, C and K. Tree mortality from pitch canker has been most devastating in these lower areas of the forest. Area C, in particular, has a high percentage of large (12"-24" dbh) oaks and the largest number of seedling oaks recorded. There is also clear evidence of the potential for conversion to oak woodland nearby (see Figure 17). However, in most areas of the forest, no seedling oaks were recorded in the plots sampled and the percentages of oaks to pines were considerably smaller ranging from 0% to 26%.

The concerns about the spread of pitch canker and increasing dominance of coast live oak are real, especially in the absence of fire. Even moderate prescribed fires could probably injure or kill thin-barked live oak saplings. Those same fires could also increase the seedling regeneration rates of Monterey pine and introduce new genetic stock resistant to pitch canker. Nonetheless, without fire, coast live oak seems to be under control in most areas of the forest due to heavy deer browsing and continued successful competition by Monterey pine, including successful seedling regeneration and establishment. While pitch canker symptoms were observed in all areas of the forest, heavy infestations and high incidence of tree mortality from the disease were not; its most damaging effects appear to have subsided. It is primarily in those areas where canopy shading and dense understory preclude successful reproduction and growth of pines that a trend toward coast live oak dominance is apparent.

[8] Tree density numbers presented by White include a relatively small fraction of coast live oaks and do not include saplings (1"-4" dbh trees). Those excluded stands with high densities in 1996 were smaller-sized trees, presumably from fire in the 1940's.

Figure 17
Oak Woodland in Vicinity of Area C
Del Monte Forest, January 2001

Photo 1: Monterey pine forest in Area C looking east from Majella Road.

Photo 2: Oak woodland on lot directly across from Area C looking west from same location on Majella Road as above.

Various authors have characterized the Monterey pine forest at Monterey as an aging, older, overmature, senescent, or degenerate phase forest (White 1994, Jones & Stokes Associates 1994a, Perkins 1995, EIP Associates 1995, Storer et al 2001). In most cases, this characterization is based on the absence of large areas of vigorous pine regeneration and stands (or blocks) of distinct age class trees in clear successional patterns as reported by Dunning (1916). Fire suppression (or discontinuation of clear cutting) in an ecosystem adapted to periodic renewal by fire (or equivalent large-scale disturbance) is usually identified as the main reason for today's forest structure. The 2001 data presented here are consistent with most recent observations. There is not a dominance of even-aged stands but rather a trend toward a mixed aged structure in keeping with the irregular type forest described by Dunning. However, such forest structure is not necessarily indicative of an unhealthy forest as some of the descriptive terms above may imply. The natural processes of regeneration, growth, maturity and senescence continue to occur in the Monterey pine forest, albeit in a steady rather than dynamic state. While fire or an equivalent stand-replacing disturbance may expand and accelerate the cycle of forest renewal, that cycle appears to be working at a sustainable pace without such disturbance.

5.3.2 Vegetation Data

Trends in the composition and distribution of understory vegetation in the Del Monte Forest indicated by the 2001 data are generally consistent with observations recorded by previous investigators. White (Vogl et al. 1977) measured highly variable shrub cover in natural Monterey pine forest ranging between 0 and 71%, but averaging about 34% in 48 stands (38 of which were on the Monterey Peninsula). Allen (1992a, 1992b) conducted focused surveys in the Del Monte Forest and recorded a shrub cover of about 30% with 26% cover of coast live oak in some areas. Common associated species listed by each of these authors and their frequency of occurrence compare well with similar data recorded in 2001 (see also Huffman 1994).

The understory vegetation types identified by this assessment are variations on the forest subtypes identified for the Lot Program EIR (EIP Associates 1995; also see description in Section 4.2.3).[9] The 2001 data allow further distinctions to be made in shrub and herbaceous subtypes. The Lot Program EIR concluded that the forest subtypes are not always present as discrete patches that can be mapped and quantified but occur generally in a continuum, with one type gradually merging into another. Some spatial relationships can be discerned from the 2001 vegetation data as discussed below, but we generally concur that vegetation types do not follow any clear distribution pattern that can be easily mapped.

White (Vogl et al. 1977) speculated on a successional model of understory shrub species composition and coverage related to Monterey pine canopy cover following fire. He suggested a progression over time from a dense ($\pm$50% cover) understory of huckleberry and manzanita in an even-aged (45 year old) stand to a relatively sparse ($\pm$10%) cover of bush monkey flower and poison oak with increased presence of coast live oak and younger ages classes of pines in an older, more uneven aged stand. While several areas of high shrub cover dominated by huckleberry and manzanita, and other areas of sparse shrub cover dominated by monkey flower and poison oak were recorded in the 2001 surveys, the different associations can be found in

[9] We would add Monterey pine/Bishop pine/Gowen cypress as another subtype to include the unique associations observed on Huckleberry Hill. See discussion under Results

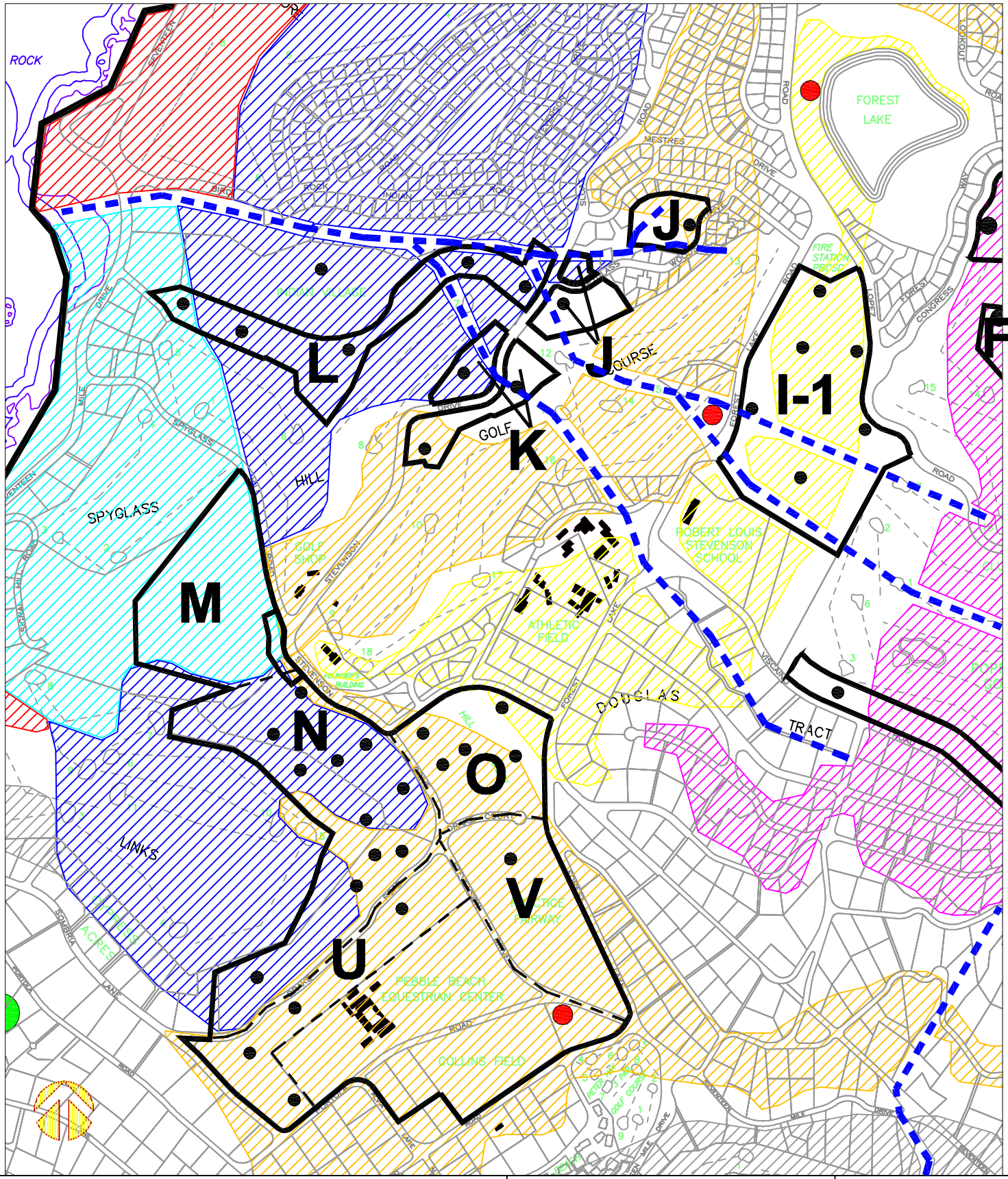
areas with about the same fire (or disturbance) history in mixed age class forest stands under varying canopy cover. The understory vegetation associations occurring in the Del Monte forest appear to result as much from spatial as from temporal influences. Soils, slope, elevation, exposure, moisture regime, microclimate and numerous other factors, in addition to canopy closure and disturbance history, all affect the nature and distribution of the pine forest understory in the Del Monte Forest.

We did not observe the distinct, marine terrace-specific vegetation associations suggested by Jones & Stokes Associates (1994b), but trends in the vegetation data are evident on an elevational gradient. For example, the 2001 vegetation data indicate a shrub cover dominated by shaggy-barked manzanita and huckleberry (subtype S2) in the higher and drier elevations of the forest on thin Narlon soils in and around the Huckleberry Hill area (terraces 4, 5 and 6), and a shrub cover characterized by blackberry, poison oak and bush monkey flower (subtype S1) in the lower, more mesic areas of the forest, often on deeper sandy soils (terrace 3, oldest and middle-aged dunes). Similarly, a higher frequency of moisture-tolerant herbaceous species such as reedgrass, rushes and sedges (subtype H1) can be found in the lower terraces, oldest and middle-aged dunes. On the other hand, vegetation patterns do not always correlate with location in the forest. The prairie grassland herbaceous vegetation type (H2) is well-represented in many areas of the forest including the proposed new golf course area (Area MNOUV) and the Pescadero Tract (Area PQR), independent of elevation or terrace position.

The continuously merging nature of forest subtypes and absence of fine ecological distinctions among marine terraces is most apparent when site-specific data are evaluated. Of the six plots sampled in Area I-1 during the 2001 field program (Figure 18), three supported the prairie grassland herbaceous cover type (subtype H2), one had a prevalence of the mesic reedgrass cover type (H1), one was dominated by shaggy-barked manzanita (subtype S2) and one supported mixed grasses, herbs and soft-leaved shrubs (subtype M1). Although most of Area I-1 is mapped as a single marine terrace (Terrace 4), the understory vegetation is mixed and does not follow any distinct pattern that can be easily mapped or characterized.[10] Similarly, oldest dunes are mapped in both Areas L and N, but the vegetation patterns vary considerably between the two locations. Shrub cover is much greater in Area L as it is in the adjacent Areas J and K, mapped on intervening slopes and Marine Terrace 3. The prairie grassland and mesic reedgrass herbaceous cover types dominate in most parts of Area N and in the adjacent areas proposed for the new golf course, which are primarily mapped as Terrace 3. Vegetation sampling data from over 20 plots in the proposed new golf course area do not indicate any marked differences in understory composition or cover associated with the boundary between Marine Terrace 3 and the oldest dunes in Area N.[11]

[10] A distinct forest subtype was assigned to Terrace 4 by Jones & Stokes Associates based on very limited sampling of Terrace 4 in the Del Monte Forest, primarily around Forest Lake.

[11] Jones & Stokes Associates sampled vegetation at only one location in the proposed new golf course area described as a narrow strip of natural to semi-natural forest area with disturbed understory vegetation on the southeast side of the Pebble Beach riding stable. This and two other locations, one a disturbed site at George Washington Park and the other "a small remnant of Terrace 3 wedged between two drainages" at the SFB Morse Reserve are the basis for the vegetation description of Terrace 3. According to Jones & Stokes Associates, "Probably none of the sites surveyed on Terrace 3 support typical Terrace 3 vegetation, but hints of the natural cover are provided by small patches of less disturbed vegetation at George Washington Park and near the Pebble Beach riding stables."



LEGEND

- Marine terrace 1
- Marine terrace 2
- Marine terrace 3
- Marine terrace 4
- Marine terrace 5
- Intervening slopes
- Youngest dunes
- Oldest dunes
- JSA sample point
- ZA sample point
- Drainage

Scale: 1' = 1000'

Sampling Points and
Marine Terraces
Del Monte Forest
Monterey County, California

Figure
18

5.3.3 Conclusions

Monterey pine and its associated forest habitat in the Del Monte Forest appear to be self-sustaining, but in a controlled state that could be characterized as gradual succession. In the absence of fire or other stand-replacing disturbance, trees continue to grow and reproduce, if not thrive, in a perpetual mixed age class ecosystem supporting an array of associated species. Certain fire-followers, like Monterey clover, may suffer losses over time in this condition, but most of the species that have been historically associated with Monterey pine forest on the Monterey Peninsula continue to occur. Non-native, invasive plant species represent a threat to the integrity of the Monterey pine forest ecosystem, but they have not overtaken large areas of the forest to date; ongoing control measures appear to be effective. Over time, slower forest turnover and reduced species succession could result in increased susceptibility to epidemics like pitch canker, changes in the distribution of some species associations or even type conversion in some areas, especially in the absence of directed management efforts. The pitch canker threat increased awareness of the need for more aggressive monitoring and management in the forest. However, pitch canker may also be considered an agent of change from a degenerate phase forest, hastening the process toward a gap phase in the forest cycle leading to subsequent building and mature phases (Storer et al. 2001). Appropriate resource management goals and procedures, like a gap-phase program, should be developed, based on continued monitoring, to identify and address trends that might threaten the long-term sustainability of the forest.

Certain areas of the Del Monte Forest have long been long acknowledged for their special or unique ecological significance. Huckleberry Hill, the Signal Hill Dune, Spruance Meadow, riparian areas and other designated environmentally sensitive areas support distinct combinations of resources, important habitats and rare species. The ecological diversity of these areas is well-documented and their conservation importance is clear (see also companion reports on Coastal Dunes, Special Status Species, Wetlands). More recently, an attempt to define ecological significance based on an association with marine terraces, and a forest conservation strategy that assigns priority rankings by terrace has been suggested. As noted previously in this section, with the exception of a separate assessment of Huckleberry Hill, the 2001 sampling and assessment program did not attempt to characterize the resource values of designated environmentally sensitive habitat areas. However, one of the purposes of the 2001 investigation was to determine whether other such environmentally sensitive areas or areas that warrant high priority for conservation can be identified through systematic assessment. The 2001 data indicate that forest structure is relatively consistent and that there are discernable trends in understory vegetation composition and cover. The trends allow characterization by soil type, elevational gradient and other factors (e.g. presence of moisture), but depict a mosaic of species associations with no clear boundaries distinguishing particular areas. The data do not point to additional unique or environmentally sensitive habitat areas or high priority locations for conservation. Rather, the data validate previous conclusions that a sound conservation strategy would include preservation of all differentiated vegetation types in large enough and connected blocks of natural habitat to maintain a self-sustaining forest and provide opportunity for enhancement through appropriate ecological management.

6.0 DMF/PDP EFFECTS ON MONTEREY PINE AND FOREST HABITAT

As noted previously, the long-term sustainability of native stands of Monterey pine through preservation and management of forest resources is a principal component of the DMF/PDP. The DMF/PDP eliminates medium density residential uses planned for large tracts of forested lands contiguous with existing forest open space and allows only permanent resource conservation uses and practices on those lands. However, proposed golf course, driving range, recreation/resort and limited residential uses will result in the direct loss of approximately 105 acres of the existing inventory of undeveloped Monterey pine forest habitat and removal of an estimated 6,371 Monterey pine trees greater than 12" diameter at breast height (dbh). Table 6-1 presents a summary of forest acreage and tree losses associated with the DMF/PDP.

Table 6-1
DMF/PDP: Summary of Forest Acreage & Tree Removal Estimates

Development Area	Est. Acres Removed	Estimated Monterey Pine Removed by Diameter Class			Estimated Coast Live Oak Removed by Diameter Class		
		4-12"	12"+	Total	4-12"	12"+	Total
Golf Course-MNOUV	60.8	4808	4371	9179	428	61	489
Equestrian Center*	16.5	1031	283	1314	271	1	272
Driving Range-C	16.9	406	1014	1420	321	237	558
Inn at Spanish Bay	0.5	22	30	52	--	--	--
Employee Housing-B	2.2	66	112	178	55	13	68
Residential Units	8.6	701	532	1233	43	15	58
Lodge at Pebble Beach	n/a	4	22	26	23	44	67
Corporate Yard	--	1	7	8	--		--
Total	**105.5†**	**7039**	**6371**	**13410**	**1141**	**371**	**1512**

* The total affected acreage, including reclamation areas, and estimated losses of both natural and planted Monterey pines and planted Bishop pines are shown for the Equestrian Center. See Table 6-4 for a breakdown for each pine species and estimated losses of planted Gowen cypress.
† Estimated acreage does not include approximately two acres removed for proposed improvements along Congress Road.

With the dedication of over 423 acres of open space forest, combined with the 200-acre portion of the Huckleberry Hill Natural Area previously dedicated by the LUP to mitigate remaining forest buildout, mitigation for the DMF/PDP approaches a 6:1 ratio of forest set aside to compensate for the forest habitat losses associated with its development components (Table 4). This ratio far exceeds the agreement (3:1 ratio) reached with the California Department of Fish and Game (CDFG) for the Lot Program and CDFG's original recommendation of a 4:1 ratio for forest set aside to offset forest acreage impacts (Hunter 1999a & b). As CDFG further agreed, "Mitigation based on total acreage impacted would also address loss of trees over 12" dbh, as required by the LUP" (Hunter, 1999a). The estimated number of trees (both greater and less than 12" dbh) retained in these new open space forest areas is also shown in Table 4. Thus, the DMF/PDP is self-mitigating for forest acreage and tree removal impacts in response to PBC's consultation with CDFG.

Table 6-2
DMF/PDP: Forest Acreage & Tree Preservation in New Open Space Forest

Preservation Areas	DMF LUP OSF(Ac)	New OSF(Ac)	Total OSF (Ac)	Estimated Monterey Pine Retained in New OSF by Diameter Class			Estimated Coast Live Oak Retained in New OSF by Diameter Class		
				4-12"	12"+	Total	4-12"	12"+	Total
B	6.2	15.14	21.34	454	772	1226	379	91	470
F-3	0.0	8.63	8.63	758	301	1059	--	--	--
G	14.59	33.33	47.92	5666	2000	7666	--	--	--
H	29.78	23.37	53.15	1846	1940	3786	23	--	23
I-1	11.24	29.24	40.48	3743	2573	6316	1316	--	1316
J	0.0	0.8	0.8	40	90	130	24	--	24
L	0.0	18.15	18.15	980	1089	2069	200	--	200
PQR	88.00	145.05	233.05	14505	11313	25818	2611	1160	3771
Subtotal	**149.81**	**273.71**	**423.52**	**27992**	**20078**	**48070**	**4553**	**1251**	**5804**
HHNA*	200		200	9000	7800	16800	1800	--	1800
Total	**149.81**	**273.71**	**623.52**	**36992**	**27878**	**64870**	**6353**	**1251**	**7604**

*New OSF acreage for HHNA includes the pre-dedication of approximately 200 acres of Monterey pine forest to compensate for losses associated with LUP build out.

In addition to the dedication of new open space forest preserves, the DMF/PDP includes retained forested lands around the new golf course, equestrian center and driving range that will be managed under appropriate forest maintenance standards. These areas will provide natural buffers and transitional habitat between preserved and developed portions of the forest.

The proposed golf course results in losses of about 61 acres of existing forest, but also preserves nearly 55 acres. About 13 acres of the new Equestrian Center and 12 acres of the new driving range will also remain as natural forested areas. Finally, each proposed new residential lot will undergo site-specific environmental review prior to development so that forest habitat and tree losses are minimized. For the purposes of this assessment, we have assumed that an average of about 0.22 acre/lot of forest will be removed for residential construction in addition to necessary infrastructure (driveways, utilities, etc.). Table 6-3 provides a comparison between the forested acres and number of trees ($\geq$12"dbh) lost versus those retained in the development and preservation areas of the DMF/PDP.

The following section summarizes the general habitat character for each development area, briefly discusses the nature and extent of effects on Monterey pine forest habitat, including tree loss and forest impacts for each, and discusses how the DMF/PDP further compensates for them through design and appropriate conservation measures, beyond the establishment of substantial new forest open space preserve areas.

6.1 Proposed Golf Course and Associated Facilities

6.1.1 Forest Habitat Character

Development of the proposed golf course on approximately 216 acres in Areas MNOUV will occur on lands currently used for the Pebble Beach Equestrian Center toward the south (Area U

Table 6-3
DMF/PDP: Forest Acreage and Trees Removed and Retained

DMF/PDP AREA				MONTEREY PINE								COAST LIVE OAK					
Designation	**Forest Acreage**			**Removed**				**Retained**				**Removed**			**Retained**		
	Existing	Removed	Retained	4-12"	12-24"	24"+	Total	4-12"	12-24"	24"+	Total	4-12"	12"+	Total	4-12"	12"+	Total
B[1]	24.34	2.2	21.34	66	48	64	178	664	487	642	1793	55	13	68	554	133	687
C	29.05	16.9	12.15	406	693	321	1420	292	498	231	1021	321	237	558	231	170	401
Inn[2]	--	0.48	--	22	30	--	52	--	--	--	--	--	--	--	--	--	--
Lodge[3]	--	--	--	4	15	7	26	--	--	--	--	23	44	67	--	--	--
F-2[4]	19.5	2.92	--	312	190	26	528	1774	1078	149	3001	--	--	--	--	--	--
F-3[5]	16.81	1.34	8.63	118	42	5	165	1361	480	62	1903	--	--	--	--	--	--
I-2[6]	18.72	2.53	--	89	127	--	216	567	810	--	1377	--	--	--	--	--	--
J	0.8	--	0.8	--	--	--	--	40	82	8	130	--	--	--	24	--	24
K[7]	10.62	0.22	--	23	17	1	41	1071	780	42	1893	14	2	16	655	104	759
MNOUV[8]	116.0	60.84	55.16	4808	3823	548	9179	4302	3420	496	8218	428	61	489	386	55	441
Eq.Center[9]	41.22	16.5	13.05	1031	267	16	1314	1749	848	65	2662	271	1	272	1109	--	1109
Corp.Yard[10]	--	--	--	1	7	--	8	--	--	--	--	--	--	--	--	--	--
PQR[11]	245.88	1.59	233.05	159	111	13	283	24429	17101	1954	43484	29	13	42	4397	1954	6351
G	47.92	0	47.92	0	0	0	0	8146	2588	288	11022	--	--	--	--	--	--
H	53.15	0	53.15	0	0	0	0	4199	3721	691	8611	0	--	0	53	--	53
I-1	40.48	0	40.48	0	0	0	0	5181	3198	364	8743	0	--	0	1822	--	1822
L	18.15	0	18.15	0	0	0	0	980	672	417	2069	0	--	0	200	--	200
Subtotal	**682.64**	**105.52**	**503.88**	**7039**	**5370**	**1001**	**13410**	**54755**	**35763**	**5409**	**95927**	**1141**	**371**	**1512**	**9431**	**2416**	**11847**
HHNA[12]			200	0	0	0	0	9000	6800	1000	16800	0	--	0	1800	--	1800
Total		**105.52**[13]	**703.88**[14]	**7039**	**5370**	**1001**	**13410**	**63755**	**42563**	**6409**	**112727**	**1141**	**371**	**1512**	**11231**	**2416**	**13647**

1. Area B tree loss estimates assume 2.2 acres removed for employee housing development; trees retained based on remaining undeveloped acreage. Retained forest acreage credit applies only to 21.34 acres dedicated open space. Retained forest acreage calculation does not include 0.8 acre of forest to be conserved within development area.
2. Forest acreage calculations for The Inn at Spanish Bay assume 0.48 acre of landscape forest removed for guestroom additions but do not include 1.2 acres to be conserved; tree loss based on actual counts.
3. No forest habitat acreage loss will occur as a result of improvements at The Lodge at Pebble Beach; loss of landscape trees based on actual counts.
4. Area F-2 tree loss estimates assume 2.92 acres removed for residential development; trees retained based on remaining undeveloped acreage. No credit for retained forest acreage.
5. Area F-3 tree loss estimates assume 1.34 acres removed for residential development; trees retained based on remaining undeveloped acreage. Retained forest acreage credit applies only to 8.63 acres dedicated open space.
6. Area I-2 tree loss estimates assume 2.53 acres removed for residential development; trees retained based on remaining undeveloped acreage. No credit for retained forest acreage.
7. Area K tree loss estimates assume 0.22-acre removed for residential development; trees retained based on remaining undeveloped acreage. No credit for retained forest acreage.
8. Acreages for new golf course include only forested areas. Tree loss estimates include improvements at Ondulado/Alva Roads and at Stevenson Drive/Forest Lake Road.
9. Equestrian Center tree loss estimates include both planted and native Monterey pine and planted Bishop pine within the development footprint. Tree loss estimates also include improvements at entry and at Congress Road. Credit for trees and forest acreage retained applies only to undeveloped areas designated as native forest (Forest Type 1—see text).
10. Corporate Yard employee housing will not remove habitat or trees. However, tree losses from Sunridge/Lopez Road improvements are included here.
11. Area PQR tree loss estimates assume 1.59 acres removed by residential development; trees retained based on remaining undeveloped acreage. Retained forest acreage applies only to $\pm$233 acres dedicated to open space forest.
12. Pine trees retained in HHNA may include a combination of Bishop and Monterey pine. No estimates made for native Gowen cypress retained.
13. Estimated forest acreage removed does not include approximately 2.02 acres for proposed improvements along Congress Road.
14. Calculations for retained forest do not include 73.74 acres of undeveloped remnant forest acres as follows: Equestrian Center (+11.67ac), F-2 (+16.58ac), F-3 (+6.84ac), I-2 (+16.19ac), K (+2.73ac), PQR (+11.24ac), B (+0.8ac), Corporation Yard (+6.49ac), Spanish Bay (+1.2 ac). As noted in other footnotes herein, no preservation was assumed to occur in residential lots.

in part), on previously disturbed areas associated with the Spyglass Quarry toward the north (Area M in part), and on forested areas in between along Stevenson Drive and Drake Road (primarily Areas N, O and parts of U, M & V) (see Figure 19). This central part of the golf course site supports Monterey pine forest of varying character with understory associations ranging from herbaceous and woody species on predominantly drier slopes in Area O and parts of Areas N & V to more mesic conditions supporting moisture-tolerant herbaceous understory plants, especially toward the westerly ends of Areas N & U. Several special-status species and seasonal wetlands have been identified and mapped in the area (see accompanying Special-Status Species and Wetlands reports). The forest in this area is surrounded by a variety of uses (e.g. Cypress Point Club, Pebble Beach Driving Range, Pebble Beach Equestrian Center, Spyglass Quarry, residential neighborhoods, Spyglass Golf Course) and fragmented by existing trails and roads through and adjoining the area, including Stevenson Drive, Bristol Curve, Sombria Lane, and Drake, Ondulado and Portola Roads as well as two other gated, wide, unpaved roads in Area V.

6.1.2 Forest Resource Impact

Habitat Loss

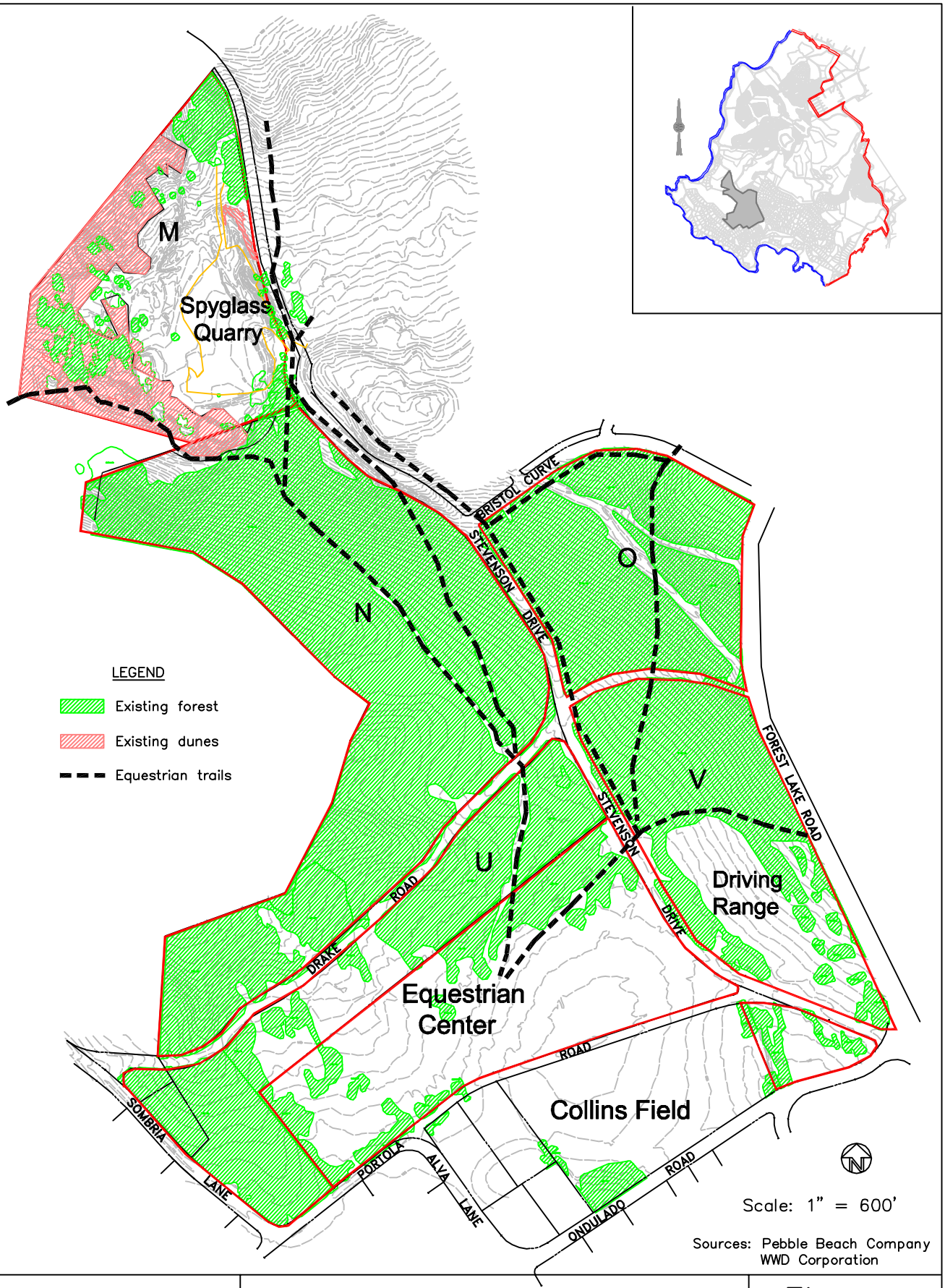
Development of the proposed golf course will require clearing and grading of approximately 61 acres of forest lands. Approximately 4.25 acres of additional forest area is proposed to have the underbrush hand cleared within the golf course layout (see Figure 20). These forested areas occur primarily on Narlon soils and support a mix of shrubby and herbaceous understory vegetation common throughout the Del Monte Forest. Special status species including Hooker's manzanita and Yadon's piperia, will be affected by development of the course. These species are widespread throughout the forest. Species of more limited distribution including Pacific Grove clover and Hickman's onion will be avoided. All delineated wetland habitats in the area will be avoided with appropriate setbacks (Wetlands Research Associates 2001).

Tree Losses

Construction of the course and all additional recreational and resort-related facilities in Areas MNOUV will involve the removal of an estimated total of 4,371 Monterey pine trees over 12" dbh and about 61 oak trees over 12" dbh. Infrastructure improvements along Stevenson and Forest Lake Roads will result in the removal of 40 Monterey pine and 2 coast live oak over 12" dbh. Improvements along Ondulado and Alva Roads will remove 11 Monterey pine over 12" dbh. Tables 6-1 and 6-3 provide a breakdown of the tree removal estimates.

6.1.3 Conservation Measures

Approximately 55 acres of forested lands within the proposed new golf course will be retained and will be managed following best ecological principles. In addition, the entire Equestrian Center/Collins Field area will be recontoured and restored with replanted pine and native landscaping. Finally, several of the roads that now run through the area will be removed, providing opportunity for rehabilitation and replanting of over five acres of area that is



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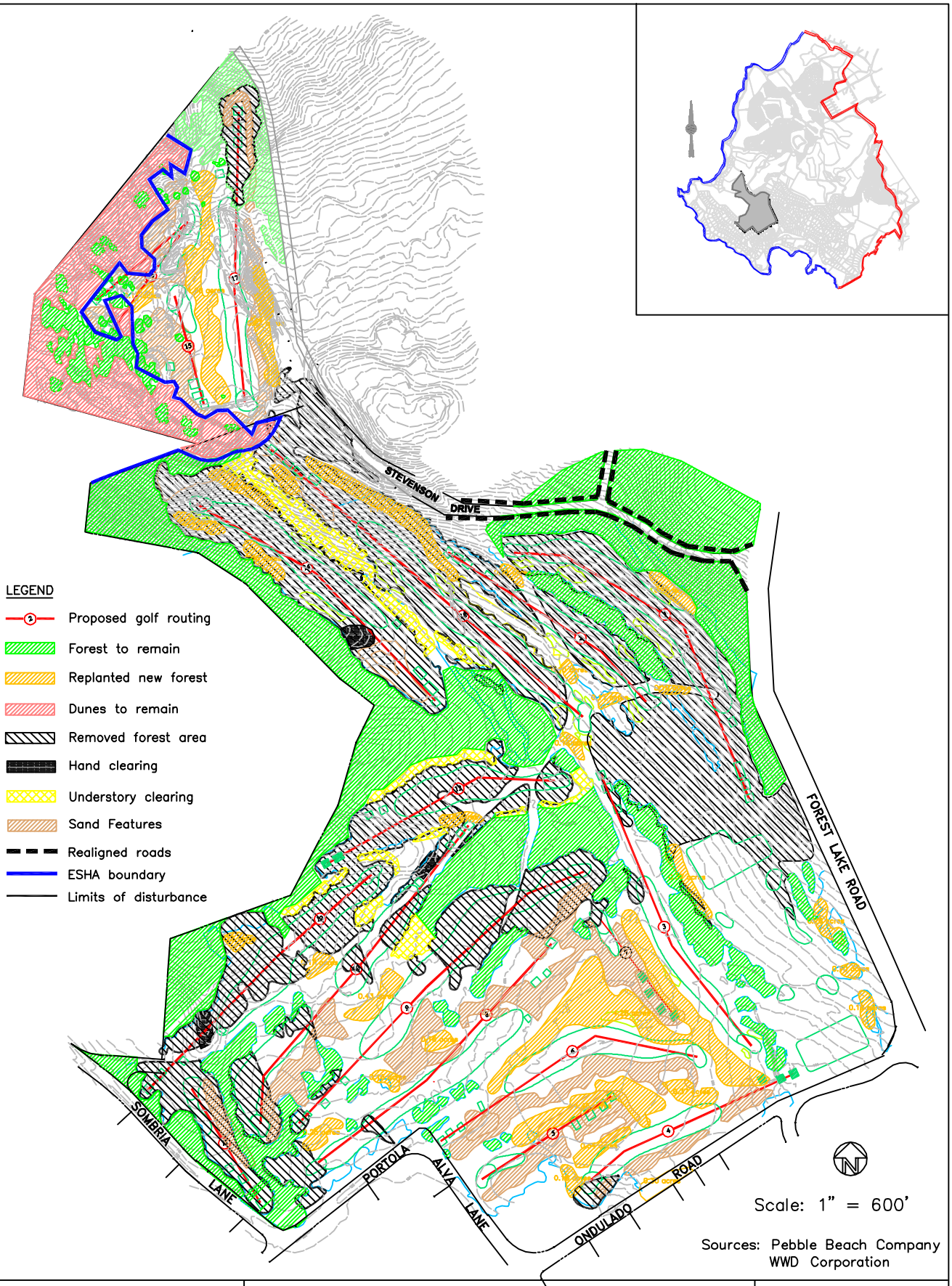
Existing Conditions Areas M,N,O,U,V
Del Monte Forest
Monterey County, California

Figure 19



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Proposed Routing and Limits of Disturbance
New Golf Course Areas M,N,O,U,V
Del Monte Forest
Monterey County, California

Figure 20

currently paved. Approximately 15 acres of new replanted areas of pines will abut the golf course along with an additional 32 acres of other native landscape elements.[12] Plant materials, especially special-status plants like Yadon's piperia, will be salvaged prior to grading and introduced into the newly recontoured and rehabilitated areas (see also Special-Status Species report). Landscape management guidelines and appropriate forest maintenance standards will be established in the areas surrounding the golf course to maintain these forest elements in a natural condition.

6.2 New Equestrian Center

6.2.1 Forest Habitat Character

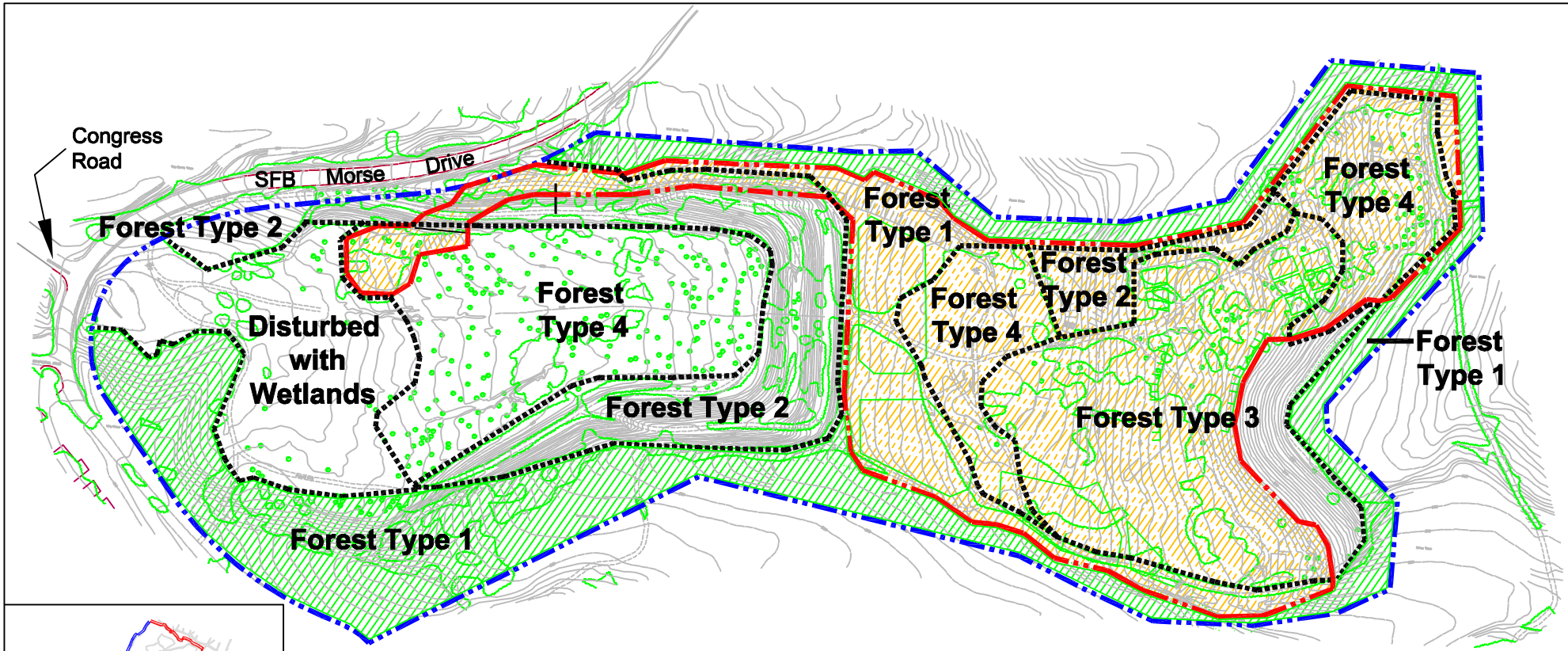
The Pebble Beach Equestrian Center will be relocated to the Sawmill Quarry, an area previously disturbed by excavation for sand mining. The approximately 45.48-acre area is comprised of an upper and lower site bounded on the north, east and south by Huckleberry Hill and the S.F.B. Morse Botanical Reserve. The former quarry sites are thus surrounded on three sides by the Gowen cypress/Bishop pine/Monterey pine forest habitat. Approximately 16.2 acres within the quarry polygon boundary remain as relatively natural forest on the perimeter with a mix of herbaceous and shrubby understory (Forest Type 1 - see below). Reclamation of the site was required with termination of the original silica mining and subsequently with approval of the Spanish Bay project, but planted trees have not become well-established on the disturbed and relatively barren substrates remaining in the borrow areas. Existing vegetation consists mostly of sparse plantings of Gowen cypress, Bishop and Monterey pine with limited understory. Large open areas remain, especially on the lower site. Small wetland areas, probably created by exposure of subsurface seepage as a result of mining, occur in both portions of the former quarry.

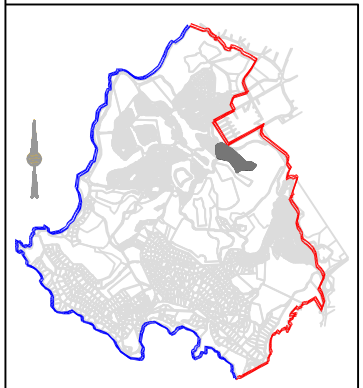
6.2.2 Forest Resource Impact

<u>Habitat Loss</u>

The Equestrian Center will occupy both the upper (18.13-acre) and lower (27.35-acre) sites with most permanent buildings and uses on the upper portion and temporary events and overflow parking in the lower area. Approximately 13.5 acres of the reclaimed quarry area that currently supports planted trees would be cleared for Equestrian Center facilities (see Figure 21). An additional 3-acre area at the southeastern boundary of the site that supports native undisturbed Monterey pine forest with mixed herbaceous and shrubby understory (Forest Type 4 - see below) would also be used for the project. Approximately 13 acres of the native forest on the edges of the new facility will be retained and all the delineated wetland areas on the site will also be avoided with appropriate setbacks.

[12] For the purposes of this assessment, this acreage of native revegetation and tree-planting is not included as a credit against forest habitat loss.





LEGEND

- Proposed development
- Forest Type 1 to remain
- Forest type boundary
- Limits of disturbance
- Equestrian Center polygon boundary

Scale: 1" = 300'

Source: Webster & Associates

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Existing Conditions and Limits of Proposed Disturbance
Sawmill Quarry Equestrian Center
Del Monte Forest
Monterey County, California

Figure 21

Tree Losses

Construction of the Equestrian Center facilities in the Sawmill Quarry area will result in the removal of mostly planted Monterey pine, Bishop pine and Gowen cypress. However, some naturally established Monterey pine trees growing in the relatively undisturbed native forest area at the southeast boundary of the area will also be removed. Although not technically native Monterey pine forest under existing conditions, the tree losses that will result from development of the new Equestrian Center on previously mined substrates have been factored into the tree removal estimates and mitigation ratios for the DMF/PDP.For tree loss assessment purposes, the area was divided into four forest types as described below and presented in Table 6-4 (see also Figure 21).

- Forest Type 1: Residual, undisturbed forest where all trees were naturally seeded. Aside from the presence of over-mature trees, this forest type may also be defined by the mature state of the understory. The understory is dominated by huckleberry, manzanita, salal, and small multi-stemmed coast live oak.
- Forest Type 2: Areas that were planted following mining operations with trees that have sustained relatively higher growth rates. This type has a relatively high density of trees dominated by tall pines with few cypress, and little to no understory species.
- Forest Type 3: Areas that were planted following mining operations with trees that have had relatively moderate growth rates. This forest stand has a relatively high density of trees that grow at a relatively retarded rate. Species composition is dominated by pines, however cypress makes up 1/3 of the tree population. Understory consists of exotic-invasive plants such as acacia, French broom and a variety of non-native grasses.
- Forest Type 4: Areas in which tree planting was attempted after mining operations, but since these areas have little-to-no soil required for tree establishment, trees are very sparse in number and in shape. Trees grow at the lowest rate within these areas and are often stunted; actual and potential and habitat values are very low.

Table 6-4
Del Monte Forest Plan Equestrian Center Development Tree Removal Estimate

Forest Type (Acres)			Monterey Pine				Bishop Pine			Coast Live Oak			Gowen Cypress		
	Existing	Removed	1"-4"	4"-12"	12+	Total	1"-4"	4"-12"	Total	1"-4"	4"-12"	Total	1"-4"	4"-12"	Total
Type 1	16.2	3.15	158	134	16	308	0	0	0	599	268	867	0	0	0
Type 2	6.74	1.77	97	159	159	415	0	0	0	0	0	0	18	0	18
Type 3	8.28	6.92	127	542	58	727	219	162	381	0	0	0	369	150	519
Type 4	10.0	4.69	141	0	0	141	47	0	47	0	0	0	47	0	47
Total	41.22	16.53	523	835	233	1591	266	162	428	599	268	867	434	150	584

The improvements for the entry and improvements along Congress Road are not indicated in Table 6-4 but were included in the overall tree loss estimates for the Equestrian Center as presented in Table 6-3.

6.2.3 Conservation Measures

The retention of 13 acres of native forest on the edges of the new facility will act as a buffer to the adjacent Huckleberry Hill Natural Area, provide an opportunity for restoration and ultimately add to the Huckleberry Hill preservation acreage. Degraded areas within the Huckleberry Hill preserve, including an abandoned skeet range and several unpaved roads that are not part of the fire road system, provide additional opportunity for the reestablishment of planted Gowen cypress removed from the quarry area. An active non-native species eradication program associated with the day to day Equestrian Center operations could greatly improve the present degraded quality of the habitat on the periphery of the quarry area. Controls on equestrians and other users of the Huckleberry Hill trail system are proposed so that increased use does not result in habitat degradation in the HHNA.

6.3 New Driving Range

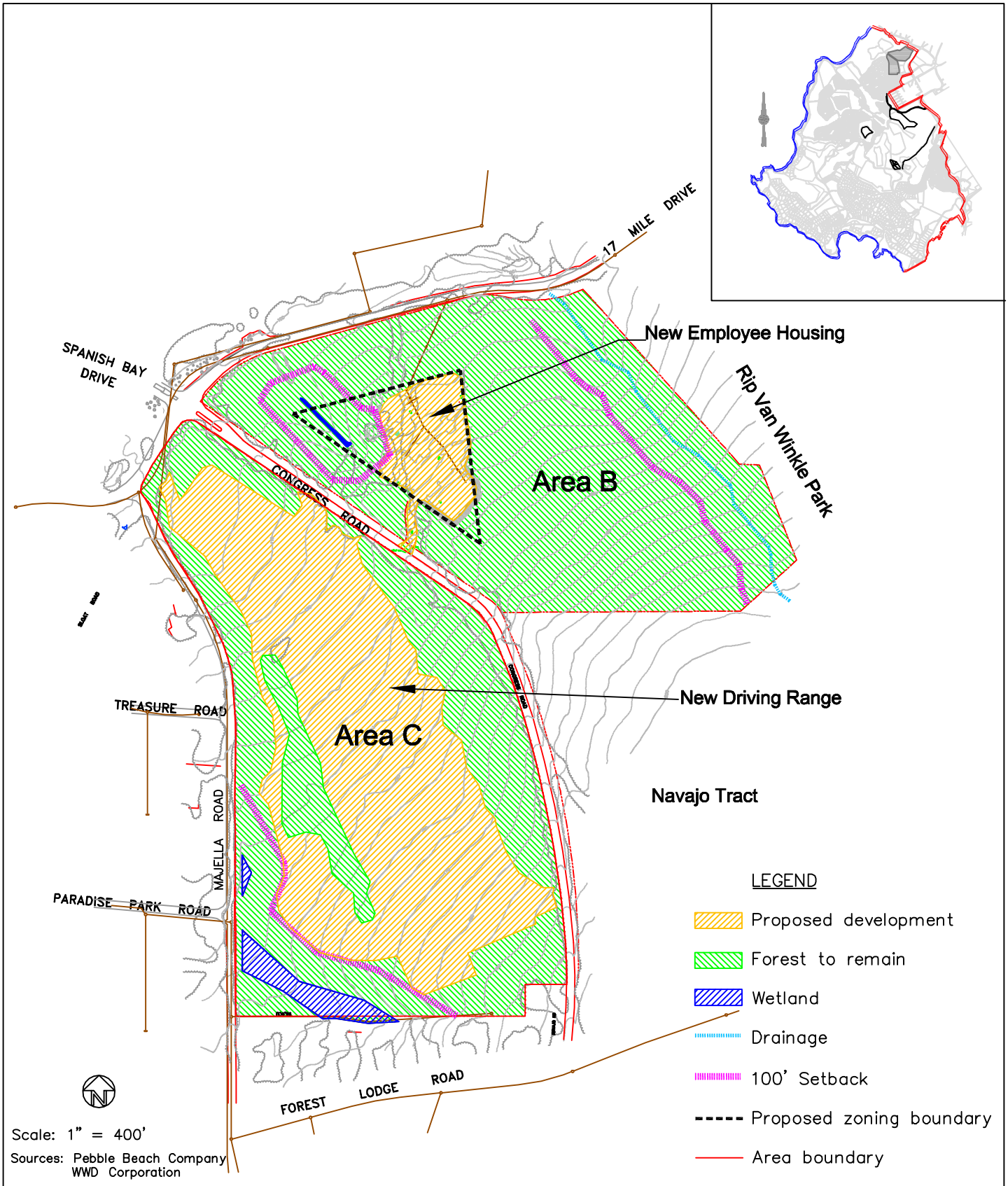
6.3.1 Forest Habitat Character

A new driving range, golf teaching facility and additional parking are proposed on an approximately 29.05-acre parcel known as Area C, located at the southeast corner of 17 Mile Drive and Congress Road. Both Monterey pine and coast live oak share the canopy in this area with a mix of mesic herbaceous and shrubby vegetation in the understory. There are small patches of chaparral species on the drier portions of the site, but most of the site supports dense, moisture-tolerant understory vegetation with relatively low pine seedling regeneration and recruitment. Area C and the adjacent Area B (see below) support some of the largest and most abundant oak trees observed in the DMF/PDP area. No special-status species have been recorded from the area, but a small wetland has been delineated near the southwestern corner of the parcel. The density and mesic nature of the understory, relatively limited pine regeneration and co-dominance of oak trees and pines in the overstory may be attributable in part to the nature of the underlying soils (mapped as Baywood Sands).

6.3.2 Forest Resource Impact

<u>Habitat Loss</u>

Development of Area C for the driving range and associated facilities will result in the loss of approximately 17 acres of Monterey pine forest habitat (see Figure 22). The remainder of the site (about 12 acres), including the delineated wetland and appropriate setback area, will be left in a more or less natural state to provide a buffer and visual screen for the range. Habitat values in these remaining areas would be reduced by fragmentation, but with appropriate management and maintenance, the undeveloped lands on the boundary of the driving range could provide some habitat continuity with adjacent preserved lands in Area B (see also discussion below).



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Proposed Development in Areas B and C
Del Monte Forest
Monterey County, California

Figure 22

Tree Losses

Construction of the driving range and associated facilities in Area C will result in the removal of an estimated total of 1,014 Monterey pine trees over 12" dbh and about 237 oak trees over 12" dbh. Tables 6-1 and 6-3 provide a breakdown of the tree removal and retention estimates.

6.3.3 Conservation Measures

Approximately 12 acres of forested lands around the perimeter of the proposed new driving range will remain undeveloped and will provide habitat continuity with adjacent preserved lands in Area B. Landscape management guidelines and appropriate forest maintenance standards, especially regarding the use of native landscape materials and controlling the establishment and spread of non-native invasive plant species like French broom, will be established in the remaining natural areas surrounding the new range. Maintenance standards have been developed to maintain the freshwater wetland area at the southwestern corner of the site (see also Wetlands report).

6.4 Employee Housing

Employee housing is proposed for two areas of the forest: near the existing PBC Corporation Yard and in Area B. The former site is located in a previously cleared and disturbed area adjacent to the active quarry near the existing corporate offices and is heavily used for storage, and as a materials handling and staging area without any substantial biological resource value.[13] Thus, development at the PBC Corporation Yard would not directly affect any forestry resources. The other area of employee housing will be located on approximately three acres at the northwest corner of Area B and is addressed below (see also Figure 22).

6.4.1 Forest Habitat Character

Area B (24.34 acres) is located at the intersection of 17 Mile Drive and Congress Road. The employee housing site is on and west of an unpaved forest road designated as Fire Road #11 in the Fire Defense Improvement Plan. Most of the proposed housing site has been used in the past for various forest and recreational operations (e.g. the excavated trench for the conveyor that transported sand to construct Spanish Bay passes through the site) and is depicted as disturbed in the DMF LUP. The forest character of Area B is very similar to Area C (Spanish Bay Driving Range). Monterey pine and coast live oak share the canopy with a mix of dense, mesic herbaceous and shrubby vegetation in the understory. There is relatively low pine seedling regeneration and recruitment. Large oak trees occur in this area and some localized occurrences of special-status species (Yadon's piperia) were recorded during 1995 and 2001 surveys. The area is adjacent to the Navajo Tract and Rip Van Winkle Park, both of which are dedicated forest open space areas.

[13] The parcel for the Corporation Yard includes approximately 6.5 acres of forested land adjacent to the Huckleberry Hill Natural Area which occur well outside of the development footprint and would be preserved.

6.4.2 Forest Resource Impact

Habitat Loss

Rezoning of an approximately three acre area at the disturbed western tip of Area B and development of just over two acres within it will not substantially affect forest values on the site and will allow the retention and ecological management of the majority of the parcel (21.34 acres) adjacent to the Navajo Tract. Non-native invasive plants have become established in the proposed development area and provide a seed source for spread to other areas. Proximity to residential areas already results in heavy use of Area B for recreational purposes, which can be detrimental to habitat values.

Tree Losses

Construction of employee housing units on this site will result in the removal of an estimated total of an estimated 112 Monterey pine trees over 12" dbh and approximately 13 oak trees over 12" dbh. Infrastructure improvements along Sunridge/Lopez Roads necessitated by development of the PBC Corporation Yard will remove 7 Monterey pine greater than 12" dbh. Table 6-3 provides a breakdown of the tree removal estimates.

6.4.3 Conservation Measures

Limited development of the site will result in the retention and ecological management of approximately 21.34 acres adjacent to the Navajo Tract. Appropriate forest maintenance standards, such as controlling establishment and spread of non-native invasive plant species and appropriate limitation on access and use of the area are being proposed in the preservation areas surrounding the new employee housing site.

6.5 Residential Lots

New residential lots are proposed in Areas F-2, F-3, I-2, K, and P for a total of 33 new lots. For the purpose of this analysis, a cleared area of approximately 0.22-acre (9,580 square feet) is assumed for each lot, with additional allowances in some subdivisions for infrastructure improvements. Where appropriate, the remaining area of each lot/subdivision will be maintained in a natural state. Table 6-5 provides a summary of estimated forest acreage and Monterey pine tree (>12" dbh) losses and gains associated with the proposed residential lots.

6.5.1 Forest Habitat Character

Areas F-2 and F-3 abut Poppy Hills Golf Course and are located on the edges of the Huckleberry Hill Natural Area/S.F.B. Morse Botanical Reserve. Both of these areas are characterized by a Monterey pine canopy with occasional Gowen cypress and a mix of more xeric chaparral and herbaceous understory. Each exhibits disturbance due to fragmentation and proximity to roads and the golf course. Special-status species including Yadon's piperia, Hooker's manzanita and Hickman's onion are found in these subdivision areas. Area I-2 is a strip of undeveloped Monterey pine forest with primarily herbaceous understory along Viscaino and Ronda Roads and

Poppy Hills Golf Course (approximately 18.72 acres). Yadon's piperia has also been found here, as it is widely distributed throughout the Del Monte Forest. Area P is a part of the larger Area PQR with the subject lots located adjacent to existing houses and streets at the northwestern boundary of the area. Monterey pine with predominantly herbaceous understory characterizes this part of Area P. Area K is a relatively small (10.62 acres) isolated area located lower in the forest just above Stevenson Drive and Spyglass Hill Golf Course. Forest characteristics on this site tends toward mesic conditions with a mix of herbaceous and shrubby understory. Yadon's piperia is also found in this area.

6.5.2 Forest Resource Impact

Habitat Loss

All of the proposed lots occur in small, fragmented parcels or as infill development at the periphery of larger areas. No large tracts of natural forest will be adversely affected by these proposed residential lots. Lot development in Areas F-2 (10 lots) and F-3 (4 lots) will result in the loss of approximately 4.3 acres of Monterey pine forest with good representation of chaparral understory at the margins of Huckleberry Hill. Area F-2 currently serves as the PBC nursery annex and materials storage yard, and is heavily disturbed. No naturally occurring Gowen cypress will be removed as a result of the DMF/PDP proposal. Approximately 2.5 acres of forest land in Area I-2 will be converted to development for 11 lots with access directly off Viscaino and Ronda Roads. Development of seven lots in Area P will remove approximately 1.6 acres of Monterey pine forest at the northwestern border of Area PQR. One residential lot in Area K will remove 0.22 acre of forested land in that subdivision. Thus, a total of approximately 8.6 acres of forested land will be converted as a result of the residential component of the DMF/PDP.

Tree Losses

Construction of residential lots in Areas F-2, F-3, I-2, K and P will result in the removal of an estimated total of about 532 Monterey pine trees ≥ 12" dbh and about 15 oak trees ≥ 12" dbh (Table 6-3). Table 6-5 provides summary of the estimated losses and retention of Monterey pine trees (≥ 12"dbh) associated with each residential subdivision area.

Table 6-5
DMF/PDP Residential Component: Summary of Forest Acreage and Pine Tree Removal and Retention

Subdivision Designation	Total Area	# of Lots	Estimated Forest Acres Removed	Estimated Pine Trees Removed (≥ 12" dbh)	Estimated Forest Acres Remaining	Estimated Pine Trees Remaining
F-2	19.5	10	2.92	216	16.58	1227
F-3	16.81	4	1.34	47	15.47	542
I-2	18.72	11	2.53	127	16.19	810
K	10.62	1	0.22	18	10.4	822
P	12	7	1.59	124	10.41	877
Total	77.65	33	8.6	532	69.88	4278

6.5.3 Conservation Measures

All lots proposed as part of the DMF/PDP will be of sufficient size to allow for building sites while avoiding or minimizing removal of sensitive resources such as Gowen cypress, Hooker's manzanita, Yadon's piperia and Hickman's onion. Site-specific forest management plans will be completed for each lot as it is developed in accordance with the DMF LUP. Encroachment into the Huckleberry Hill NHA/SFB Morse Reserve, riparian areas, wetlands or other sensitive areas will also be avoided by design. For example, lots in Area F-3 are large (1.5 acre minimum) and clustered away from the Huckleberry Hill/S.F.B. Morse Botanical Reserve boundary. Open space forest dedication (through easement or deed restriction) of over eight acres in Area F-3 will accompany the lot designation in this area. All lots in Area P are located immediately adjacent to existing residential development to avoid degradation of the large open space forest of Area PQR.

6.6 The Inn at Spanish Bay

6.6.1 Forest Habitat Character

The areas immediately around the existing facilities at The Inn at Spanish Bay are best characterized as landscaped forest. A sparse canopy of native pines and oaks remains in many of the developed areas, adjacent to golf courses and parking lots, and along cart paths and trails. Landscaping with a variety of native and adapted ornamental plants has occurred in most areas near the facilities and non-native species like French broom and iceplant have gained a foothold in many of the less visible areas. The effects of pitch canker have been severe in the Spanish Bay area, with some of the highest tree losses from the disease in the forest.

6.6.2 Forest Resource Impact

Habitat Loss

Approximately one-half acre of landscaped forest will be removed by expansion of the existing guestrooms at The Inn at Spanish Bay. A mix of mostly herbaceous natives, introduced landscape materials and non-native invasive species in the understory will be displaced. No substantial habitat values will be lost, but the removal of this area constitutes a forest habitat impact that factors into the replacement ratio calculation discussed above.

Tree Losses

Expansion of The Inn will result in the removal of 30 Monterey pine trees over 12" dbh. Tables 6-1 and 6-3 provide a breakdown of the tree removal estimates.

6.6.3 Conservation Measures

As noted above, no substantial habitat values will be lost, but the removal of this area constitutes a forest habitat and tree loss impact that factors into the replacement ratio calculation discussed previously.

6.7 The Lodge at Pebble Beach

6.7.1 Forest Habitat Character

The existing facilities at The Lodge at Pebble Beach occupy approximately 35 acres on several parcels. The proposed improvements will occur within or adjacent to the existing development footprint. The areas immediately around the existing facilities are best characterized as landscaped forest with a variety of native and adapted ornamental plants.

6.7.2 Forest Resource Impact

Habitat Loss

No forest habitat acreage loss will occur as a result of the improvements at The Lodge but some landscape trees will be removed for construction of the project components.

Tree Losses

Construction of the facilities for The Lodge will result in the removal of 22 Monterey pine trees and 44 coast live oak trees $\geq$ 12" dbh that are included in the existing landscaping.

6.7.3 Conservation Measures

As with the expansion of The Inn at Spanish Bay, no substantial habitat values will be lost through the proposed improvements to The Lodge at Pebble Beach. However, the removal of trees for this construction factors into the replacement ratio calculation discussed previously.

6.8 Preservation Areas

Over 620 acres of Del Monte Forest lands (including the 200 acres of Huckleberry Hill pre-dedicated as compensation LUP build out) with a diversity of habitat subtypes and sensitive species will be designated and managed as permanent open space forest under the DMF/PDP. Some of these preservation areas (Area PQR, Huckleberry Hill) are large, unfragmented blocks of forest habitat, several (Areas G, H, a portion of F-3) are contiguous with these large blocks, others (Areas B & L) add to the acreage of an existing preserve area, thereby enhancing its habitat value. With the addition of these habitat lands, the area of undeveloped forest that will be under permanent preservation totals over 1,100 acres or about 80% of the remaining undeveloped forested lands in the Del Monte Forest.

Following is a brief description of each of the preservation areas associated with the DMF/PDP.

6.7.1 Huckleberry Hill Natural Area (HHNA)

The Huckleberry Hill area has long been recognized as one of the most ecologically distinct areas on the Monterey Peninsula (Axelrod 1982, Vogl et al. 1977, Griffin 1972b, Howitt 1972). Beginning with the formal designation of the $\pm$84-acre SFB Morse Reserve as a botanical

preserve in the early 1970s, followed by the designation of virtually all of Huckleberry Hill (about 372 acres) as a Natural Habitat Area and large portions as ESHA by the DMF LUP in the early 1980s, protection measures have been in place to protect its unique characteristics and habitat diversity. So important were the ecological values of this area, that the DMF LUP assumed that the set aside of Huckleberry Hill would provide adequate mitigation for additional loss of Monterey pine forest habitat in the rest of the Del Monte Forest as a result of DMF LUP build out. The DMF/PDP consummates that arrangement by providing a template for full build out of the forest that not only preserves Huckleberry Hill, but adds significantly to its acreage and value by annexing adjacent, contiguous areas (former development subdivisions G, H, and part of F-3) as open space forest reserve lands.

The mixture of conifer forest types (Bishop pine and Gowen cypress along with Monterey pine), the dwarfed or pygmy forest area on thin, ancient marine soils, the extensive chaparral understory, the unique and diverse assemblage of species and the large drainage canyons that traverse the area from their headwaters at the top of the watershed, all contribute to the ecological value of this area. Huckleberry Hill is the only place where Monterey pine and Bishop pine, two closely-related species, have survived together with very little hybridization. Huckleberry Hill is one of only two locations where the federally threatened Gowen cypress occurs naturally. Huckleberry Hill supports many rare or limited range plants including Monterey clover, Yadon's piperia, Hooker's manzanita, and Eastwood's ericameria. In the words of James Griffin, "The greatest value [of Huckleberry Hill] is not simply the pine, the cypress, or any one of the associated plants—it is the maintenance of an example of a unique interrelated system of interesting plants on an island of special soil under an exceptionally temperate climate" (Griffin 1972b).

6.7.2 Area PQR—Pescadero Canyon Preserve

After Huckleberry Hill, the approximately 233-acre PQR preserve area is the largest, unfragmented tract of Monterey pine forest remaining in the Del Monte Forest. It is adjacent to and forms the primary watershed area for Pescadero Canyon, which combines with this forest to form an approximately 380-acre preserve area. PQR is mostly vegetated by Monterey pine forest with areas of co-dominance by coast live oak; some shrub-dominated areas, meadows, and other relatively open habitats (e.g., Hickman's onion habitat) also occur. Much of the ground is moderately to steeply sloping, but portions of it are gently sloping. Several major ravines and many smaller ones cut through the area.

The Monterey pine forests in Area PQR vary from even-aged to mixed-age stands. Large trees occur in places. The understory in parts of the forest is composed of chaparral species and in other parts, native grasslands and meadows dominate. On the south slopes of the area, the Monterey pine canopy is very broken (30 percent cover), composed of trees that are typically 18" to 24" in diameter. This open pine stratum extends above groves of oaks.

Several significant non-forested or sparsely forested habitats occur in the west-central portion of Area PQR. A relatively large expanse of approximately six acres of meadows, locally referred to as Spruance Meadow, is found in this area. The meadows occur where soil is very shallow or even non-existent (outcroppings of bedrock). This soil condition creates a seasonally-saturated

soil moisture regime in the winter and little or no available moisture in the summer. Consequently, trees and shrubs cannot survive and are replaced by a variety of herbs that are rare elsewhere: coyote thistle, large-flowered star-tulip, sun cups, shooting star, tarweed, and Hickman's onion. Hairgrass and thingrass, which are common elsewhere, are replaced by purple needlegrass and California brome.

Relatively large ravines traverse the central part of Area PQR and support areas of riparian vegetation. A series of small seasonal wetlands have also been mapped in the area (see Wetlands report). Finally, the area supports large colonies of several special-status or otherwise sensitive species including the forest's largest population of Yadon's piperia, extensive areas of Hooker's manzanita, thousands of Hickman's onion, and several "significant occurrences" of sandmat manzanita.[14]

6.7.3 Area G—Southeast Addition-HHNA

This nearly 48-acre area of undeveloped natural forest habitat is a significant addition to the HHNA. The site also adds a substantial degree of connectivity to Area PQR and the Pescadero Canyon preservation area.

The northern third of the area burned in 1987. Within the burn area, fire-adapted shrubs have resprouted and Monterey pine saplings form an almost impenetrable stand at the margins with the HHNA. In addition, a large population of Monterey clover, a rare Monterey County endemic, was recorded from the burn area in the years following the fire.

Monterey pine is the dominant overstory species with only a few coast live oaks on the parcel. Huckleberry is the dominant understory species. Shaggy bark manzanita, coyote brush, and poison oak are also common in the understory. Herbaceous plants dominate between widely spaced huckleberry and manzanita. Scattered madrones (*Arbutus menziesii*) and California lilacs are also found. The site also supports Hickman's onion, Yadon's piperia and a medium density understory of Hooker's manzanita.

6.7.4 Area H—South Central Addition-HHNA

Area H is another relatively large (±53-acre) addition to the Huckleberry Hill Natural Area that supports a variety of habitats. Two intermittent drainages flow through the steep eastern third of the area creating a large bowl which drains into the west-central flat area, where the Monterey pines are exceptionally large in girth and reach heights of approximately 90 feet (noted as an area of "vegetation of scientific or aesthetic value" by the DMF LUP—see Figure 4). The forest floor in this area is dominated by native grasses, such as Pacific reedgrass, and wildflowers, including blue-eyed grass, wild iris, and checkerbloom. The drainages support large specimen Monterey pines and thickets of coffeeberry, coast live oak, California blackberry, and huckleberry.

In the western portion of the area, the pines are widely spaced and hairgrass, other typical herbaceous species and Hooker's manzanita dominate the groundcover. In addition to Hooker's manzanita, the site also supports Hickman's onion and Yadon's piperia. An unpaved and gated

[14] These "significant occurrences" are considered ESHA under the LUP.

section of Spruance Road runs through the middle of this area, dividing it into two distinct parcels.

6.7.5 Area F-3—Southwest Addition-HHNA

The northern portion of this approximately 16.8-acre area (comprising approximately 8.6 acres or over half of the area) will be preserved as dedicated open space forest habitat. The preserve area is adjacent to the Huckleberry Hill Natural Area and is characterized by a Bishop pine/Monterey pine/Gowen cypress canopy, typical of the margins of Huckleberry Hill in this vicinity. Gowen cypress forms relatively dense stands along the edges of the area. Bishop pines are dense in the northern portion of this area and become widely spaced to the south.

The northern, steeper one-third of Area F-3 supports a dense understory of huckleberry, salal, and shaggy bark manzanita. In the southern two-thirds of the site, Hooker's manzanita becomes dominant over shaggy bark manzanita, and it grows in 20-feet wide circular patches that are only 6-10 inches high. Between these widely spaced patches of Hooker's manzanita, sparse grasses (*Deschampsia caespitosa* and *Festuca* sp.), sticky monkeyflower, and coyote brush are co-dominant forest floor species, but all appear somewhat stunted. These growth patterns indicate that the soil may be a nutrient-poor soil similar to the soil within the Huckleberry Hill Natural Area.

6.7.6 Area I-1—Forest Center

This approximately 40.5-acre area is surrounded by roads and development on all sides, but remains as an intact block of Monterey pine forest habitat with a mix of herbaceous and shrubby understory associations. Coast live oaks form an intermediate canopy layer in the southern portion of the site. The understory is a mosaic of shrubs and herbs with either vegetation type dominating in certain areas. Standing snags and fallen trees are relatively abundant. This feature, coupled with the diverse understory, contributes to valuable wildlife habitat.

The site supports colonies of Hickman's onion, populations of Yadon's piperia in patches over much of this area and varying densities of Hooker's manzanita over much of the site. A very small occurrence of sandmat manzanita is found at the southwestern portion of the area.

The northern and southern channels of Seal Rock Creek are located in the southern half of Area I-1. The DMF LUP designates riparian areas bordering these channels as ESHA. The entire area, which constitutes the last undeveloped reach of the headwaters of Seal Rock Creek will be permanently preserved as forest open space by the DMF/PDP.

6.7.7 Area L—Indian Village Annex

This approximately 18-acre preservation area will add to and enhance the existing preserved area around the Indian Village, resulting in a total of about 60 acres of preserved forest open space. Densely-vegetated Monterey pine forest is the dominant plant community with an understory composed of the more mesic shrubs and herbs associated with Monterey pine forest. Coast live oak trees are especially well developed in this area. A small, remnant dune formation is located

at the western end of the area and adds to the diversity of the preserve. The western border of the site that abuts this area is composed of Monterey pine merging into coastal strand plants that inhabit sand dunes.

A stream course, tributary to Seal Rock Creek, enters the site from the adjacent seventh green of Spyglass Hill Golf Course. This water course supports cattail, rush, sedge, blackberry, Pacific reedgrass, horsetail, currant, coffeeberry, wax-myrtle, and chain fern. In addition, seepage near the center of the area may have importance hydrologically for the only known extant population of Hickman's potentilla and a population of Pacific Grove clover, both of which occur about 400 feet to the west (downslope) in Indian Village.

6.7.8 Area B—Navajo Tract Annex

Approximately 21.34 acres of Area B will be set aside as forest open space and an additional 0.8 acre of forest within the employee housing site will be retained. Monterey pine forest in association with coast live oak is the dominant plant community in this area. The understory is relatively dense and composed of the more mesic type shrubs and herbs associated with Monterey pine forest. There is little bare ground except for the fire roads and numerous trails crossing the site. The Monterey pine and coast live oak overstory is an uneven-aged stand with a closed canopy providing nearly 100 percent cover. Seedlings and recruits are not as abundant in this area, primarily because of the dense canopy and understory characteristics. Rather the area supports larger, mature trees with diameters up to and surpassing three feet. Snags are common and provide habitat for cavity nesting birds, including woodpeckers, chickadees, nuthatches and screech owls. There is also a moderate amount of downed wood.

The area is adjacent to the Navajo Tract and Rip Van Winkle Park and its dedication as forest open space will create an approximately 48-acre contiguous forest preserve area.

7.0 THE DMF/PDP AND MONTEREY PINE CONSERVATION

Many authors have considered conservation strategies for Monterey pine on the Monterey Peninsula (Huffman and Associates 1994; Jones & Stokes Associates 1996b, EIP Associates 1995; Ecosynthesis Scientific and Regulatory Services 1999, Barbour 1995, Cylinder 1997, Rogers 2002). There is general consensus that the priority areas for conservation in the Del Monte Forest are the remaining unfragmented, larger-sized native Monterey pine stands with relatively undisturbed understory along with adequate area supporting representative populations of special-status-species and unique habitats. The acceptable minimum stand size (greater than 20 acres according to Huffman, greater than 40 acres according to JSA, about 200 acres according to Barbour) remains a subject of debate, but most parties agree that sufficient area to allow natural ecological processes is important for long-term genetic and habitat sustainability of Monterey pine and its associated species. There is also general concurrence that appropriate ecosystem management is important to the maintenance of a viable Monterey pine forest. Maintenance and improvement of the diversity and restoration of the natural ecological processes of Monterey pine forest habitat requires active ecological management because, in the Del Monte Forest, Monterey pine forest no longer occurs as continuous unbroken forest. Furthermore, public safety concerns dictate that uncontrolled wildfires, which were a primary cause of ecological succession prior to settlement of the area, be suppressed to the extent possible.

PBC developed the DMF/PDP in full recognition of these conservation concepts. The preservation component of the DMF/PDP is intended to balance reasonable and appropriate use of PBC-owned land with assurances for the long-term sustainability of the Monterey pine forest and its associated species and habitats in the Del Monte Forest. The DMF/PDP limits and consolidates its development components to existing disturbed areas or already fragmented forest areas and preserves large, intact, functioning ecosystems. It conserves diverse areas of the forest and conserves species or groups of species of special interest. It establishes habitat linkages and connectivity between and among remaining undeveloped areas of the forest. Finally, the DMF/PDP is accompanied by a commitment to manage the preserve and other open space areas of the forest in an ecologically sound manner, consistent with OSAC standards.

7.1 Preservation of Large, Intact, Functioning Ecosystems

The DMF/PDP establishes large, unfragmented Monterey pine forest preserves that are connected to other habitats and habitat areas. The preserve areas include Huckleberry Hill and Area PQR which encompass most of the remaining undeveloped watershed of Seal Rock Creek and Sawmill Creek (Huckleberry Hill and associated new open space forest preserve areas) and Pescadero Creek (PQR and the adjacent Pescadero Canyon open space forest area). The designation of new open space forest habitat areas adjacent to Huckleberry Hill (Areas G, H, F-3 and I-1) enhance and expand the habitat connectivity and buffer area around the HHNA established by the LUP and provide additional high value habitat. These preserves allow adequate separation from residential and other uses, natural processes of forest decay and regeneration, wildlife movement, opportunity to consider use of prescribed fire, and the ability to implement an ecological management and monitoring program less constrained by proximity to urban, suburban and active recreational uses. Smaller, but equally as important components of

the preserve system include Area L, which enhances the habitat values and expands the protections for the sensitive species in the Indian Village and Seal Rock Creek areas, and Area B, which adds to the Navajo Tract and Rip Van Winkle Park forest preserve.

7.2 Conservation of Full Range of Species/Genetic Diversity

In establishing its forest preserve areas, the DMF/PDP considered the diversity represented by the various Monterey pine forest habitat associations as well as the applicability of the marine terrace hypothesis. The distribution of special-status species, remnant dunes, riparian corridors and other environmentally sensitive habitats was also considered.

Collectively, the forest preserve areas include blocks of habitat representing each of the habitat subtypes identified by others and confirmed by the supplemental assessment describe herein: Monterey pine-shrubby understory, Monterey pine-herbaceous understory, Monterey pine-coast live oak, and Monterey pine on young dunes. Perhaps most notably, the Gowen cypress/Bishop pine/Monterey pine (ESHA) areas associated with Huckleberry Hill and adjacent areas (JSA Marine Terrace 5) are firmly established as preserve areas by the DMF/PDP (in conformance with the conservation program for ultimate buildout of the Del Monte Forest established by the LCP). All of the remaining naturally occurring remnant dunes (JSA youngest dunes) and their associated species (both species and habitat, also designated as ESHA), riparian areas and wetlands are also preserved. Sensitive species with limited occurrence in the forest such as Monterey clover (Area G, JSA Marine Terrace 6), sandmat manzanita (Area PQR, JSA Marine Terrace 5), Hickman's potentilla and Pacific Grove clover (Area L, JSA oldest dunes) are protected by the forest preserve designation established by the DMF/PDP.

With respect to the marine terrace hypothesis, a significant portion of mapped terrace 4 (Area I-1, Huckleberry Hill in part), Terrace 5 (Huckleberry Hill, Area PQR, Area F-3) and Terrace 6 (Area G, Area PQR in part) along with areas identified by JSA as oldest dunes (Area B in part, Area L and Indian Village), middle-aged dunes (Area B in part), and youngest dunes (Signal Hill and natural dune substrates in Area M) occur in preservation areas established by the DMF/PDP. Much of the retained and replanted forest for the new golf course (Areas MNOUV) occurs on Terrace 3 and on oldest and youngest dunes. Thus, all "high priority" geomorphic surfaces identified by JSA (1996) are well-represented in forested open space areas.[15]

7.3 Improvement and Maintenance of Ecosystem

The DMF/PDP establishes large habitat preserve areas that enable ecologically-based habitat management of the forest. Elements of the management program may include replanting, localized short-term removal of competing vegetation, control of non-native species, and accelerated forest succession through selective tree removal, the creation of gaps, and possible limited use of prescribed fire, if warranted and allowed. Just as the natural ecological processes that prevailed in the Del Monte Forest area prior to its development included periodic removal of large numbers of pines and large areas of habitat (primarily through wildfires), similar processes

[15] The designation of "high priority" conservation areas based on geomorphic surfaces is not supported by data reviewed herein, as noted previously. The DMF/PDP does not extend into any undeveloped portions of Terraces 1 or 2 as mapped by Dupré (1990).

may occur, albeit on a smaller scale, as management activities in the habitat preserve areas. Acceleration of the process of ecological succession, that might occur naturally on a small scale or very slowly forest-wide, could create a patch mosaic of habitat subtypes and forest age classes resulting in greater forest diversity and vigor.

Gap creation would involve the removal of selected trees in locations where forest openings can be created with a minimum of tree removal, treatment of the understory and soil appropriate to the forest subtype, and seeding/planting of Monterey pines and suitable understory species. Effective forest gaps could be created in all preserved forest areas, however, the size of created gaps and other treatments would be adapted to each setting. For example, gaps created in narrow forest corridors would be much smaller (possibly as small as 0.01 acre) than those in larger preserve areas. Locations for gaps would be selected based upon removal of a minimum number of trees, preferably diseased or damaged ones.

While prescribed burning may be the ideal management procedure for Monterey pine from a purely ecological perspective, safety and liability issues pose strict limitations on its use in the Del Monte Forest. In addition, strictly controlled, small, prescribed burns may not produce the desired results based on recent experience in the forest (e.g. a small burn in the Indian Village area resulted in an increased incidence of invasive plants). Assuming that controlled burns are generally infeasible or inadvisable, other treatments may be used to good advantage to create forest patches, such as physical removal of individuals or small groupings of common shrubs, that would compete with tree seedlings for light and/or water.

Pitch canker resistant stock of Monterey pines, developed by PBC in concert with researchers from the University of California, may be introduced into appropriate locations in the forest (mostly landscaped settings and revegetated areas). PBC has been planting Monterey pine trees in the Del Monte Forest area for many years, and the Company's experience indicates that the establishment of seedlings planted in suitable habitats, without irrigation, can be very high, generally more than 90 percent, when planting occurs in the late fall or early winter (the normal season of seedling establishment) under average climatic conditions. Higher mortality (up to 30 percent) can occur in drought years, or in areas where appropriate soils are absent. These results are in accordance with worldwide plantation experience, which demonstrates that Monterey pine is one of the easiest forest trees to grow by planting seedlings. Areas that are proposed for native tree planting and revegetation (e.g. in the 15-acre reforested area associated with the new golf course) provide opportunity for the introduction of resistant stock propagated from on-site trees.

Dune habitat restoration, sensitive species management, wetlands protection and enhancement and water quality protection measures are described in other resource-specific companion documents to this report. A directed, ecological approach to management of the forest resources within the DMF/PDP area as discussed here and in the companion documents will have benefits, not only to the Del Monte Forest, but as a model for Monterey pine forest conservation and management throughout the Monterey Peninsula and possibly throughout the range of the species.

7.4 Implementation

PBC prepared an updated Ecological Management Plan (EMP) for the DMF/PDP, based on the County's earlier EMP for the Lot Program (RA2), as part of its application materials submitted to Monterey County in October 2001. The EMP provides both habitat and species-specific management and monitoring guidelines for the maintenance of a healthy, diverse, and sustainable ecosystem composed of Monterey pine forest and associated habitats. The guidelines in the EMP are flexible enough to accommodate differences in site conditions and to adjust to changes in ecological circumstances and improvements in understanding of ecosystem management, but sufficiently detailed to permit public evaluation of the effectiveness of proposed measures and to form the foundation for monitoring methods and criteria, where appropriate. Accordingly, the EMP is not intended to be a rigid set of specifications, but rather to recommend a sufficiently detailed set of effective and feasible forest management and monitoring measures that are available and can be made conditions of County approval of the project.

The actions specified in the EMP are intended to help achieve the following goals within existing biological and practical limitations:

- To provide for Monterey pine seedling regeneration and ecological succession within forest preserve areas;
- To provide for the maintenance and/or increase in populations of special-status species, and of populations of other plant and wildlife species that are dependent upon habitats of limited occurrence;
- To provide for the long-term maintenance of regional biodiversity in the Del Monte Forest area; and
- To effectively reduce the incidence of invasive non-native species and preserve and enhance the habitat for endemic species

The EMP also incorporates by reference the management goals, objectives, and standards of Chapter 7 of the DMF LUP, also referred to as the OSAC Plan, and commits to applying those OSAC Plan standards, in a flexible manner compatible with the specific resources and sensitivities of each site, to all designated open space forest areas of the DMF/PDP. Furthermore, the EMP states that all areas managed ecologically as part of the DMF/PDP will be protected by some enforceable means, for example transfer of title to an entity such as the Del Monte Forest Foundation, granting of a permanent conservation easement, or a condition of project approval.

The OSAC Plan establishes open space categories for the purpose of applying ecological management practices, or prescriptions, in areas that differ in inherent open space values and anticipated end use based on the land use designations of the LUP. The OSAC Plan lists generic Forest Maintenance Standards (FMS) that are to be applied in each resource category, and establishes an institutional framework (e.g. delegation of management responsibilities to the Del Monte Forest Foundation) for implementation.

To implement both the OSAC Plan and the EMP for the DMF/PDP, site-specific management prescriptions and maintenance standards will be developed and consolidated into an overall Resource Management Plan (RMP) for the project. These maintenance standards and management prescriptions will be formulated through the public review process. Guidelines for resource management provided in the EMP and the existing OSAC Plan Forest Maintenance Standards, currently used in the Del Monte Forest, will be refined to incorporate applicable results of County and resource agency review and then consolidated as resource management prescriptions and site-specific FMS for each area within the DMF/PDP. The resulting RMP would become a "field-friendly" template for mitigation monitoring to guide the long term ecological management, maintenance and enhancement of the open space components of the DMF/PDP. However, it would also be a dynamic document, subject to periodic modification to reflect the full range of management techniques available and to incorporate knowledge gained through scientific research and progressive management of designated open space forest areas of the DMF/PDP.

Initial standards and prescriptions, responsive to recommended mitigation measures and conditions of project approval, will be established for each area of the DMF/PDP to address specific management issues (e.g. localized establishment and spread of non-native, invasive plants; trail erosion; poor seedling regeneration; spread of pitch canker, effects of other uses, proximity to developed areas). The maintenance standards and management prescriptions may vary depending on the nature of the existing conditions in a given site, its size, location, and other factors. For instance, smaller preserve areas, restored habitats or more urbanized or disturbed parts of the forest adjacent to developed uses may require more active management than the interior areas of larger preserves. However, the interior areas may be good candidates for evaluating various techniques for accelerating natural succession and increasing diversity, as discussed previously. Since forest management will be implemented over an extended period of time, the location and focus of management and maintenance activities may change to adapt to evolving management issues and needs.

Forest managers will draw from an array of management tools and actions to meet the standards and prescriptions established for each site and plan area. Management actions would be designated to suit the particular goals of an area and would not necessarily be applicable in all areas of the forest. Management measures could range from indirect actions such as prohibiting seasonal or general access to certain areas, to more directed approaches to controlling erosion and siltation, creating forest gaps, and controlling the spread of invasive plants using herbicides. Some examples of the types of active management measures that may be implemented include:

- Gap creation to accelerate forest succession. Selective removal of trees (focused on diseased, moribund, unsafe or otherwise damaged trees) in relatively small areas to expand existing openings in the forest, thereby increasing light and space to encourage natural regeneration.

- Understory treatment in the absence of fire. Although prescribed burns are ecologically desirable for inducing forest succession, fire will not normally be the management tool of choice in most cases in the Del Monte Forest for public safety reasons. Mechanical and other methods may be used to control competing vegetation within created gaps and other areas to assist in the successful establishment of Monterey pine.

- Seed dispersal in sparsely colonized areas. Pine seeds from site-specific collections may be scattered in forest areas, especially in created gaps, that have demonstrated (through monitoring) low regeneration. Seeds would typically be sown in winter when conditions are optimal for germination and growth.

- Native tree planting in restored landscapes and to supplement the natural regeneration of forest trees. Monterey pines from on-site native seed stock will be planted in restoration and landscape areas and in other areas determined appropriate on a site-specific basis. To the extent feasible, planted pines will be propagated from stock with demonstrated resistance to pitch canker. Seedlings of coast live oaks and Gowen cypress (and possibly Bishop pine, willows and other native trees) will also be introduced into appropriate areas.

- Introduction of native understory vegetation. Assuming that common herbs and shrubs will readily colonize created gaps and other forest areas, introduction of native plants in the forest understory will focus on special-status species. Planting of certain special-status plant species may be required for mitigation purposes. This will be achieved through planting of seeds or container-grown stock, or by transplanting salvaged individuals, from DMF/PDP development impact areas.

- Salvage of intact forest soils from development areas. Surface soil and duff layers supporting native vegetation, seedlings and soil microflora and fauna will be salvaged prior to ground-disturbing activities in DMF/PDP development areas and used in restoration and landscape areas as determined appropriate on a site-specific basis.

- Retention of large standing dead trees, snags, fallen logs, and brush piles to provide important habitat elements for a variety of wildlife species. Such elements will be left in place or created to the extent compatible with the safety of people and property, aesthetic concerns, and the need to minimize breeding opportunities for tree disease vectors.

- Restoration of habitat in areas that have been disturbed and are now barren, dominated by non-native invasive species or otherwise represent low quality habitat. Restoration may include removal of potentially competing non-native vegetation, recontouring, introduction of seed or nursery grown, locally-collected native plant materials and other habitat elements (e.g. brush piles, downed logs).

- Control of erosion and siltation in trails, pathways, drainages and other forest areas. Erosion control actions could include minor recontouring, creation and maintenance of water bars, revegetation, installation of silt fencing and matting and/or other measures to stop, slow or redirect surface water flow where it may cause localized or broader environmental degradation.

- Control of the establishment and spread of non-native, invasive plants. Directed eradication of non-native weeds, through application of approved chemical herbicides (e.g. glyphosate) and/or hand-clearing and other mechanical means will (continue to) occur as a regular program in the forest.

Monitoring protocol and success criteria will be established and regular, systematic field review will be conducted to evaluate the effectiveness of these management measures over time. Following the principle of adaptive management, these measures would be reviewed periodically and modified, as appropriate, on the basis of monitoring results, new biological information, changing trends in restoration ecology and/or experience gained through "hands-on" forest resource restoration and management. The forest management program for the DMF/PDP will be implemented through the RMP in a flexible manner and guided by the best professional judgment of foresters and ecologists charged with assuring the forest's long-term sustainability.

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APPENDIX A

List of Acronyms

APPENDIX A

LIST OF ACRONYMS

CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CNPS	California Native Plant Society
DBH	Diameter at Breast Height
DEIR	Draft Environmental Impact Report
DFG	California Department of Fish and Game
DMF LUP	Del Monte Forest Land Use Plan
DMF/PDP	Del Monte Forest Preservation and Development Plan
EIR	Environmental Impact Report
EMIP	Ecological Management Implementation Plan
EMP	Ecological Management Plan
ESHA	Environmentally Sensitive Habitat Area
FEIR	Final Environmental Impact Report
GIS	Geographic Information System
HHNA	Huckleberry Hill Natural Area
JSA	Jones and Stokes Associates
LCP	Local Coastal Program
LUP	Land Use Plan
MAB	Man and the Biosphere
OSAC	Open Space Advisory Committee
PBC	Pebble Beach Company
PUD	Planned Use Development
RA2	Revised Alternative 2
RMP	Resource Management Plan
TNC	The Nature Conservancy
UNESCO	United Nations Educational, Scientific and Cultural Organization

APPENDIX B

Plant Species Encountered During 2001 Floristic Surveys

Scientific Name	Comon Name	Native	Family	# Occur	P-R	M-V	H	G	I-1	C	B	F-2	I-2	L	F-3	K	F-1	J
Abronia latifolia	Yellow Sand-Verbena	1	Nytagin	1										1				
Abronia umbellata ssp. umbellata	Beach San-Verbena	1	Nyctagin	1										1				
Acacia baileyana*	Acacia		Fab	1	1													
Acacia longifolia*	Golden Wattle		Fab	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Acacia melanoxylon*	Blackwood Acacia		Fab	2	1				1									
Acacia verticillata*	Star Acacia		Fab	10	1	1	1		1	1	1	1		1			1	1
Achillea millefolium	White Yarrow	1	Aster	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Adenostoma fasciculatum	Chamise	1	Ros	1					1									
Agave americana*	Agave		Lili	1													1	
Agrostis exarata		1	Po	1	1													
Agrostis microphylla		1	Po	1	1													
Agrostis pallens	Common Bent	1	Po	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Agrostis stolonifera*			Po	1										1				
Agrostis viridis*			Po	1					1									
Aira carophyllea*	Hairgrass		Po	11	1	1	1	1	1			1	1	1	1	1		1
Allium hickmanii	Hickman's Onion	1	Lili	3	1		1		1									
Allium triquetrum*	White Onion		Lili	8			1	1	1	1	1		1	1				1
Amaryllis belladonna*	Naked Ladies		Lili	2										1				1
Ambrosia chamissonis	Beach-bur	1	Aster	1										1				
Ammophila arenaria*	European Beach Gr.		Po	1		1												
Amsinckia spectabilis var. spectabilis	Seaside Amsinckia	1	Borag	1		1												
Anagallis arvensis*	Scarlet Pimpernel		Primul	8	1	1	1	1	1	1		1			1			
Anaphalis margaritacea	Pearly Everlasting	1	Aster	3			1	1									1	
Aphanes occidentalis	Lady's Mantle	1	Ros	1					1									
Arbutus menziesii	Madrone	1	Eric	1	1		1											
Arceuthobium littorum	Dwarf Mistletoe	1	Visc	8		1	1	1	1	1		1		1				1
Arctostaphylos hookeri ssp. hookeri	Hooker's Manzanita	1	Eric	9	1	1	1	1	1			1	1		1		1	
Arctostaphylos pumila	Sandmat Manzanita	1	Eric	5	1		1		1			1			1			
Arctostaphylos tomentosa ssp. bracteosa	Manzanita	1	Eric	1	1													
Arctostaphylos tomentosa ssp. tomentosa	Shaggy Bark Manzanita	1	Eric	12	1	1	1	1	1		1	1	1		1	1	1	1
Arctostaphylos tomentosa var. hebeclada	Manzanita	1	Eric	2											1			1
Arnica discoidea	Rayless Anica	1	Aster	1			1											
Artemisia californica	Calif Sagebrush	1	Aster	2	1			1										
Artemisia douglasiana	Mugwort	1	Aster	4			1			1	1					1		
Artemisia pycnocepala	Beach Sagewort	1	Aster	1										1				
Asparagus densiflorus	Sprenger Asparagus	1	Lili	1						1								
Aster chilensis	Common Calif. Aster	1	Aster	7	1	1	1	1					1	1		1		
Aster radulinus	Broad-leaf Aster	1	Aster	11	1		1	1	1			1	1	1	1	1	1	1
Athyrium filix-femina var. cyclosorum	Lady Fern	1	Dryopterid	4		1					1					1		1
Atriplex triangularis	Spearscale	1	Chenopodi	1		1												
Avena barbata*	Slender Wild Oat		Po	10	1		1	1	1	1		1		1	1	1		1
Avena fatua*	Wild Oat		Po	2		1					1							
Avena sativa*			Po	1		1												
Baccharis douglasii	Marsh Baccharis	1	Aster	8		1	1		1	1		1		1		1		1
Baccharis pilularis	Coyote Brush	1	Aster	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bellis perennis*	English Daisy		Aster	8	1	1	1	1	1					1		1		1
Billbergia nutans*	Queen's Tears		Bromilid	1			1											
Borago officinalis*	Borage		Boragin	1	1													
Briza maxima*	Rattlesnake Grass		Po	13	1		1	1	1	1	1	1	1	1	1	1	1	1
Briza minor*	Little Quaking-grass		Po	6	1	1	1	1	1		1							
Brodiaea terrestris ssp. terrestris	Dwarf Brodiaea	1	Lili	5	1	1	1	1	1									

Bromus carinatus var. carinatus	Calif. Brome	1	Po	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bromus diandrus*	Giant Ripgut Brome		Po	11	1	1	1	1		1	1			1	1	1	1	1	1
Bromus hordaceus*	Soft Chess		Po	8		1	1		1	1	1	1		1		1			
Bromus pseudolaevipes		1	Po	9	1	1	1	1			1		1			1	1	1	1
Calamagrostis nutkaensis	Pacific Reed Grass	1	Po	13	1	1	1	1	1	1	1	1		1	1	1	1	1	1
Callitriche marginata	Water Starwort	1	Callitrich	1														1	
Calochortus albus	Globe Lily	1	Lili	8	1		1	1	1			1	1					1	1
Calochortus luteus??	Yellow Calochortus	1	Lili	1	1														
Calochortus uniflorus	Lg Fl. Star Tulip	1	Lili	6	1	1	1		1			1	1						
Calystegia macrostegia ssp. cyclostegia	Coast Morning-glory	1	Convolvul	2	1						1								
Camissonia cheiranthifolia ssp. cheiranthifolia	Beach Primrose	1	Onagr	1										1					
Camissonia ovata	Sun Cup	1	Onagr	8	1	1	1	1	1			1	1		1				
Cardamine californica var.integrifolia	Milk Maids	1	Brassic	9	1		1	1	1	1	1			1		1		1	
Cardamine oligosperma	Hill Cress	1	Brassic	5	1				1					1		1		1	
Carduus pycnocephalus*	Italian Thistle		Aster	1							1								
Carex brevicaulis		1	Cyper	8			1		1	1	1	1			1		1	1	
Carex gynodynama		1	Cyper	2	1							1							
Carex harfordii		1	Cyper	13	1		1	1	1	1	1	1	1	1	1	1	1	1	1
Carex obnupta		1	Cyper	6			1		1	1	1					1		1	
Carex pansa	Pansa Sedge	1	Cyper	9		1	1	1		1	1	1		1			1	1	
Carex tumulicola		1	Cyper	5	1		1	1	1				1						
Carpobrotus chilensis*	Ice Plant		Aizo	1		1													
Carpobrotus edulis*	Ice Plant		Aizo	5	1	1				1	1			1					
Castilleja ambigua ssp. insalutata	Paint Brush Orthocarpus	1	Scrophulari	1	1														
Castilleja latifolia	Seaside Painted Cup	1	Scrophulari	2		1								1					
Castillleja exserta ssp. exserta	Owl's Clover, Escobita	1	Scrophulari	1			1												
Ceanothus thyrsiflorus	Blue Blossom	1	Rhamn	11	1	1	1		1	1	1			1	1	1	1	1	
Centaurium davyi	Canchalagua	1	Gentian	1	1														
Centrunculus minimus	Chaffweed	1	Primul	3	1		1		1										
Cerastium glomeratum*	Chickweed		Caryophyll	10		1	1		1	1	1	1		1		1	1	1	
Chamomilla suaveolens*	Pineapple Weed		Aster	1		1													
Chasmanthe floribunda*				2	1									1					
Chlorogalum pommeridianum var. pommeridianum	Soaproot	1	Lili	9	1	1	1	1	1	1	1		1			1			
Chlorophytum comosum*	Spider Plant		Lili	1															1
Chorizanthe pungens	Mnt. Spineflower	1	Polygon	1										1					
Chrysanthemum paludosum*			Aster	1							1								
Cicendia quadrangularis	Yellow Gentian	1	Gentian	1	1														
Cirsium brevistylum	Indian Thistle	1	Aster	2	1				1										
Cirsium vulgare*	Bull Thistle		Aster	10	1	1	1			1	1	1		1		1	1	1	
Claytonia perfoliata ssp. perfoliata	Miner's Lettuce	1	Portulac	5	1	1	1	1			1								
Conium maculatum*	Poison Hemlock		Api	8	1				1			1	1	1		1	1	1	
Conza bonariensis*	Flax-leaf Fleabane		Aster	5		1			1			1		1			1		
Conza canadensis	Horseweed	1	Aster	3	1	1									1				
Coprosma repens*	Mirror Plant		Rubi	1										1					
Cordyline australis*	Cordyline		Lili	1															1
Corethrogyne filaginifolia var. californica	Calif.Corythrogyne	1	Aster	4		1	1	1						1					
Corethrogyne filaginifolia var. filaginifolia	Common Corythrogyne	1	Aster	8	1	1	1	1	1			1	1				1		
Coronopus didymus*	Lesser Wort-cress		Brassic	1							1								
Cortaderia jubata*	Pampas Grass		Po	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cotonneaster pannosa*	Cotonneaster		Ros	3	1		1			1									
Cotula australis*			Aster	2		1								1					
Cotula coronopifolia*	Brass-buttons		Aster	1		1													

Crassula connata	Sand Pygmy	1	Crassul	2					1						1			
Crassula multicava ssp. floribunda*			Crassul	2			1											1
Crassula tillaea*			Crassul	1							1							
Crocosmia X crocosmiiflora*	Montbretia		Irid	3				1	1									1
Cryptantha leiocarpa	Coast Cryptantha	1	Boragin	1										1				
Cupressus goveniana	Gowen Cypress	1	Cupress	5					1			1		1	1		1	
Cupressus macrocarpa	Mont. Cypress	1	Cupress	3		1							1		1			
Cymbalaria muralis*	Kenilworth Ivy		Scrophulari	1														1
Cynodon dactylon*	Bermuda Grass		Po	1		1												
Cyperus eragrostis	Umbrella Sedge	1	Cyper	8	1	1	1			1		1	1			1		1
Dactylis glomerata*	Orchard Grass		Po	3					1	1								1
Danthonia californica var. americana	Oatgrass	1	Po	9	1	1	1	1	1			1			1		1	1
Danthonia californica var. californica	Calif. Oat Grass	1	Po	2			1								1			
Daucus pusillus	Rattlesnake Weed	1	Api	1										1				
Deinandra corymbosa ssp. corymbosa	Corymbose Tar Plant	1	Aster	3	1		1	1										
Delairea odorata*	Cape Ivy		Aster	3	1	1				1								
Deschampsia caespitosa ssp. caespitosa	Tufted Hairgrass	1	Po	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Deschampsia danthonioides	Annual Hairgrass	1	Po	1	1													
Dichelostemma capitatum ssp. capitatum	Blue Dicks	1	Lili	2	1	1												
Dichondra donelliana	California Dichondra	1	Convolvul	1														1
Digitalis purpurea*	Foxglove		Scrophulari	1								1						
Dimorphotheca sinuata*	Cape-marigold		Aster	1		1												
Distichlis spicata	Saltgrass	1	Po	2		1								1				
Dodecatheon clevelandii ssp sanctarum	Shooting Star	1	Primul	2	1				1									
Dracaena spp.*	Dracaena		Lili	1												1		
Dryopteris arguta	Wood Fern	1	Dryopterid	7	1				1	1	1			1			1	1
Dudleya farinosa	Dudleya	1	Crassul	1					1									
Echium candicans*	Pride of Madeira		Boragin	4		1					1	1						1
Ehrharta erecta*	Erect Ehrharta		Po	6	1		1	1		1	1							1
Elymus glaucus ssp. glaucus	Blue Wild Rye	1	Po	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Epilobium canum ssp. canum	Zauschneria	1	Onar	1												1		
Epilobium ciliatum ssp.watsonii	Coast Cottonweed	1	Onagr	9	1		1	1	1	1	1			1		1		1
Epipactis helleborine*			Orchid	1	1													
Equisetum telmateia braunii	Giant Horsetail	1	Equiset	5	1	1					1			1		1		
Erechtites minima*	Toothed Fireweed		Aster	11	1	1	1	1	1	1		1	1	1		1	1	1
Ereichtites glomerata*	Cut-leaved Fireweed		Aster	13	1	1	1	1	1	1		1	1	1	1	1	1	1
Ericameria ericoides	Mock Heather	1	Aster	1										1				
Erigeron glaucus	Seaside Daisy	1	Aster	2	1									1				
Erigeron karvinskianus*			Aster	1									1					
Eriogonum parvifolium var. parvifolium	Dune Buckwheat	1	Polygon	2		1								1				
Eriophyllum confertiflorum var. confertiflorum	Golden Yarrow	1	Aster	3			1	1							1			
Erodium botrys*	Long-beaked Filaree		Gerani	3		1		1			1							
Eryngium armatum	Button Celery	1	Api	4	1		1	1	1									
Eschscholzia californica	Calif. Poppy	1	Papaver	1	1													
Euphorbia peplus*	Petty Spurge		Euphorbi	7		1	1		1	1				1		1		1
Festuca arundinacea*	Tall Fescue		Po	6		1				1	1			1		1		1
Festuca rubra	Red Fescue	1	Po	7			1			1			1	1		1	1	1
Filago californica	Calif Filago	1	Aster	1		1												
Filago gallica*	Nallow-leaved Filago		Aster	4	1	1	1		1									
Fragaria vesca	Wood Strawberry	1	Ros	13	1	1	1	1	1		1	1	1	1	1	1	1	1
Fritillasria affinis	Checker Lily	1	Lili	1												1		
Galium aparine	Goose Grass	1	Rubi	8	1	1			1	1	1			1		1		1

Galium californicum ssp. californicum	Calif Bedstraw	1	Rubi	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gastridium ventricosum*	Nitgrass		Po	2	1					1								
Gaultheria shallon	Salal	1	Eric	8	1	1	1	1	1			1			1		1	
Genista monspessulana*	Genista		Fab	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Geranium dissectum*	Cutleaf Geranium		Gerani	12	1	1	1	1	1	1	1	1	1	1		1		1
Geranium retrorsum*	New Zealand Geranium		Gerani	1	1													
Gnaphalium californicum	Calif Everlastine	1	Aster	4		1	1				1							1
Gnaphalium canescens ssp. beneolens	Fragrant Everlasting	1	Aster	1										1				
Gnaphalium luteo-album	Cudweed	1	Aster	11	1	1	1	1	1	1		1	1		1		1	1
Gnaphalium palustre	Lowland Cudweed	1	Aster	1		1												
Gnaphalium purpureum	Purple Cudweed	1	Aster	13	1	1	1	1	1	1	1	1	1	1	1		1	1
Gnaphalium ramosissimum	Pearly Everlasting	1	Aster	2		1									1			
Gnaphalium stramineum	Cotton Batting Plant	1	Aster	1		1												
Grindelia stricta	Gumplant	1	Aster	8		1	1		1	1	1	1			1	1		
Hedera helix*	English Ivy		Arali	9	1	1	1	1	1	1	1					1		1
Helenium puberulum	Sneezeweed	1	Aster	2	1						1							
Helianthemum scoparium var. scoparium	Rush Rose	1	Cistaceae	1					1									
Heracleum lanatum	Cow Parsnip	1	Api	1	1													
Heteromeles arbutifolia	Toyon	1	Ros	9	1		1	1	1		1	1	1		1		1	
Hieracium albiflorum	White Hawkweed	1	Aster	7	1		1	1	1							1	1	1
Hierochloe occidentalis	Vanilla Grass	1	Po	6			1		1	1				1		1		1
Hirschfeldia incana*	Summer Mustard		Brassic	1	1													
Holcus lanatus*	Velvetgrass		Po	11		1			1	1	1	1	1	1	1	1	1	1
Hordeum murinum ssp. leporinum*	Barnyard Foxtail		Po	4		1					1					1		1
Horkelia californica ssp. californica	California Horkelia	1	Ros	2			1								1			
Horkelia cuneata ssp. cuneata	Calif. Horkelia	1	Ros	5	1	1	1		1						1			
Hypochaeris glabra*	Smooth Cat's Ear		Aster	6	1	1	1	1	1					1				
Hypochaeris radicata*	Rough Cat's Ear		Aster	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ilex aquifolium*	English Holly		Aquifoli	3						1	1							1
Iris douglasiana	Douglas' Iris	1	Irid	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Isoetes orcuttii		1	Isoet	1	1													
Juncus articus var. balticus	Wire Rush	1	Junc	6		1				1	1			1		1		1
Juncus articus var. mexicanus	Mexican Wire Rush	1	Junc	5	1		1	1		1				1				
Juncus bufonius var. bufonias	Toad Rush	1	Junc	12	1	1	1	1	1	1	1	1	1		1		1	1
Juncus effusus var. pacificus	Pacific Rush	1	Junc	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Juncus falcatus var. falcatus	Falcate Rush	1	Junc	6	1	1		1		1		1		1				
Juncus occidentalis		1	Junc	6	1		1	1	1				1				1	
Juncus patens	Rush	1	Junc	3	1						1						1	
Juncus phaeocephalus var. phaeocephalus	Iris-leaved Rush	1	Junc	13	1	1	1	1	1	1	1	1	1		1	1	1	1
Koeleria macrantha	Koeleria	1	Po	2	1		1											
Lasthinea californica	California Goldfields	1	Aster	1					1									
Lathyrus vestitus var. ochropetalus	Bolander Pea	1	Fab	11	1	1	1	1	1		1		1	1		1	1	1
Lepechinia calycina		1	Lami	1	1													
Leptospermum laevigatum*	Aus. Tea		Myrt	1	1													
Leymus condensatus	Giant Ryegrass	1	Po	4	1		1	1			1							
Leymus triticoides	Beardless Wild Ryegrass	1	Po	3					1					1		1		
Limosella acaulis	Limosella	1	Scrophulari	1	1													
Linanthus parviflorus		1	Polemoni	4	1		1		1					1				
Linaria canadensis	Toadflax	1	Scrophulari	1		1												
Lolium multiflorum*	Italian Ryegrass		Po	7		1	1		1		1	1	1	1				
Lolium perenne*	Perrenial Ryegrass		Po	8		1	1		1	1	1			1		1		1
Lomatium parvifolium var. parvifolium	Small-leaved Lomatium	1	Ape	12	1	1	1	1	1			1	1	1	1	1	1	1

Lonicera hispidula var. vacillans	Honeysuckle	1	Caprifoli	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lotus benthamii		1	Fab	6	1		1		1			1			1		1	
Lotus formosissimus	Witches Teeth	1	Fab	10	1	1	1	1	1			1	1		1	1		1
Lotus humistratus	Short-podded Lotus	1	Fab	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lotus junceus var. biolettii	Rush Lotus	1	Fab	1				1										
Lotus micranthus	Small Fl. Lotus	1	Fab	6	1		1		1			1	1		1			
Lotus purshianus	Spanish-clover	1	Fab	4			1			1			1	1				
Lotus scoparius ssp. perplexans	Deerweed	1	Fab	1		1												
Lotus strigosus		1	Fab	2		1								1				
Lupinus arboreus	Yellow bush Lupine	1	Fab	4		1				1	1							1
Lupinus bicolor		1	Fab	1		1												
Lupinus nanus	Sky Lupine	1	Fab	1		1												
Lupinus truncatus	Wood Lupine	1	Fab	1										1				
Luzula comosa	Hairy Wood Rush	1	Junc	13	1	1	1	1	1		1	1	1	1	1	1	1	1
Lythrum hyssopifolia*	Wallow Poly		Lythr	7	1		1		1		1	1	1				1	
Madia exigua		1	Aster	2	1		1											
Madia gracilis	Slender Tar Plant	1	Aster	3	1				1					1				
Madia sativa	Coast Tarweed	1	Aster	3			1		1								1	
Marah fabaceus	Cal Man-Root	1	Cucurbit	3	1					1	1							
Medicago polymorpha*	Bur Clover		Fab	8	1	1	1	1	1	1	1	1						
Microseris paludosa	Marsh Scorzonella	1	Aster	4	1	1	1		1									
Mimulus aurantiacus var. aurantiacus	Bush Monkey Fl.	1	Scrophulari	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Muehlenbeckia complexa*	Mattress Vine		Polygon	1	1													
Myoporum laetum*	Myoporum		Myopor	5		1	1		1				1	1				
Myosotis latifolia*	Forget-Me-Not		Boragin	4	1		1			1								1
Myrica californica	Wax Myrtle	1	Myric	9	1	1	1	1	1	1			1	1				1
Narcissus pseudonarcissus	Daffodil (Waif)	1	Lili	2										1				1
Nassella pulchra	Purple Needlegrass	1	Po	4	1		1		1					1				
Oemleria cerassiformis	Oso Berry	1	Ros	2	1					1								
Oenanthe sarmentosa	Water Parsley	1	Api	1						1								
Ophioglossum californicum	Adder's Tongue	1	Ophiogloss	1	1													
Osteospermum ecklonis*	African Daisy (perennial)		Aster	2		1								1				
Oxalis albicans ssp. pilosa	Hairy Wood-sorrel	1	O1alid	2		1	1											
Oxalis corniculata*	Yellow Sorrel		O1alid	2		1	1											
Oxalis incarinata*	Oxalis		O1alid	3							1			1				1
Oxalis pes-caprae*	Bermuda Buttercup		O1alid	12	1	1	1	1	1	1	1	1	1	1		1		1
Oxalis purpurea*			O1alid	2					1					1				
Pedicularis densiflora	Indian Warrior	1	Scrophulari	2					1						1			
Pennisetum clandestinum*	Kikuyu Grass		Po	7	1	1				1	1	1		1				1
Perideridia gairdneri ssp. gairdneri	Gairdner's Yampah	1	Api	2	1		1											
Phacelia malvifolia	Stinging Phacelia	1	Hydrophyllac	2	1						1							
Phacelis nemoralis ssp. nemoralis	Shade Phacelia	1	Hydrophyll	1	1													
Phalaris aquatica*	Harding Grass		Po	1		1												
Phalaris californica	Calif Canary Grass	1	Po	13	1	1	1	1	1	1	1	1		1	1	1	1	1
Picris echioides*	Bristly Ox-tongue		Aster	1						1								
Pinus muricata	Bishop Pine	1	Pin	2								1			1			
Pinus radiata	Monterey Pine	1	Pin	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Piperia yadonii	Yadon's Reinorchid	1	Orchid	12	1	1	1	1	1			1	1	1	1	1	1	1
Plantago coronopus*	Cut-leaved Plantain		Plantagin	12	1	1	1	1	1	1	1	1	1	1	1			1
Plantago erecta		1	Plantagin	4	1	1	1		1									
Plantago lanceolata*	Ribwort		Plantagin	7	1	1	1	1					1	1	1			
Plantago major*	Common Plantain		Plantagin	4		1	1			1	1							

Poa annua*	Annual Bluegrass		Po	11	1	1	1	1	1	1	1	1			1	1		1
Poa douglasii	Dune Bluegrass	1	Po	1										1				
Polycarpon tetraphyllum*	Four-leaf Polycarp		Caryophyll	2		1					1							
Polygala californica	Calif. Milkwort	1	Polygal	5	1		1	1	1								1	
Polygonum arenastrum*	Common Knotweed		Polygon	2		1								1				
Polygonum paronychia	Beach Knotweed	1	Polygon	1										1				
Polypodium calirhiza	Polypody	1	Polypodi	4			1	1	1									1
Polypogon monspeliensis*	Rabbitfoot Grass		Po	3		1			1			1						
Polystichum munitum	Sword Fern	1	Dryopterid	7	1		1		1				1	1		1		1
Potentilla anserina ssp. pacifica	Silverweed	1	Ros	2		1				1								
Potentilla glandulosa ssp. glandulosa	Sticky Cinquefoil	1	Ros	3	1				1			1						
Prunus spp.** (Seedling) & P. cerasifera**	Flowering Plum		Ros	1	1													
Pseudotsuga menziesii var. menziesii** (planted)	Douglas Fir		Pin	1	1													
Psilocarphus brevissimus var. brevissimus	Dwarf Woolly-heads	1	Aster	2	1				1									
Pteridium aquilinum var. pubescens	Bracken Fern	1	Dennstaedti	12	1	1	1	1	1	1	1		1	1	1	1		1
Quercus agrifolia var. agrifolia	Coast Live Oak	1	Fag	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ranunculus californica ssp. californica	Calif. Buttercup	1	Ranuncul	11	1	1	1	1	1	1			1	1		1	1	1
Ranunculus muricatus*			Ranuncul	1											1			
Rhamnus californica ssp. californica	Coffee Berry	1	Rhamn	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ribes divaricatum var. pubiflorum	Scraggly Gooseberry	1	Grossulari	2	1											1		
Ribes malvaceum var. malvaceum	Chaparral Currant	1	Grossulari	6	1		1	1	1		1			1				
Ribes sanguineum var. glutinosum	Flowering Currant	1	Grossulari	6			1	1				1		1		1		1
Rorippa nasturtium-aquaticum	Water Cress	1	Brassic	1							1							
Rosa californica	Calif. Rose	1	Ros	9	1		1	1	1	1	1				1	1		1
Rosa gymnocarpa		1	Ros	5					1						1	1	1	1
Rosa pinetorum	Pine Rose	1	Ros	9		1	1	1	1			1	1	1	1		1	
Rosa pinetorum toward Rosa californica	Pine Rose	1	Ros	1	1													
Rubus ursinus	Calif. Blackberry	1	Ros	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rumex acetosella*	Sheep Sorrel		Polygon	12	1	1	1	1	1	1	1	1	1		1	1	1	1
Rumex crispus*	Curly Dock		Polygon	6		1			1	1	1			1				1
Sagina maxima ssp. crassicaulis		1	Caryophyll	1		1												
Salix scouleriana	Scouler's Willow	1	Salic	8			1		1	1			1	1		1	1	1
Salvia mellifera	Black Sage	1	Lami	1			1											
Sanicula crassicaulis	Pacific Sanicle	1	Api	7	1		1	1	1		1		1	1				
Sanicula laciniata	Coast Sanicle	1	Api	12	1	1	1	1	1			1	1	1	1	1	1	1
Satureja douglasii	Yerba Buena	1	Lami	13	1	1	1	1	1	1	1	1		1	1	1	1	1
Scirpus cernuus	Club Rush	1	Cyper	3	1	1	1											
Scirpus koilolepis		1	Cyper	1					1									
Scirpus microcarpus		1	Cyper	1						1								
Scrophularia californica ssp. californica	Coast Figwort	1	Scrophulari	1	1													
Senecio vulgaris*	Common Groundsel		Aster	10	1	1	1		1	1	1	1		1	1		1	
Sequoia sempervirens** (planted)	Coast Redwood		Cupress	5	1				1					1		1		1
Sidalcea malviflora ssp. malviflora	Checker Bloom	1	Malv	4	1	1	1						1					
Silene gallica*	Catchfly		Caryophyll	3		1	1				1							
Silybum marianum*	Milk-thistle		Aster	4	1	1					1	1						
Sisyrinchium bellum	Blue-eyed Grass	1	Irid	11	1	1	1		1			1	1	1	1	1	1	1
Sisyrinchium californica	Golden-eyed Grass	1	Irid	1						1								
Smilacena racemosa	West. Solomon's Seal	1	Lili	3					1							1		1
Solanum aviculare*			Solan	1							1							
Solanum douglasii	Douglas' Nightshade	1	Solan	4	1									1	1			1
Soleirolia soleirolii*	Baby-Tears		Urtic	3						1				1				1
Solidago califonica	Common Goldenrod	1	Aster	3			1		1		1							

Solidago spathulata ssp. spathulata	Goldenrod	1	Aster	11	1	1	1		1			1	1	1	1	1	1	1
Soliva sessilis*			Aster	10	1	1	1	1	1	1	1	1				1	1	
Sonchus asper*	Prickly Sow Thistle		Aster	9		1	1		1	1	1	1	1			1		1
Sonchus oleraceus*	Sow-tistle		Aster	6	1				1			1	1	1			1	
Sparaxis tricolor*	Harlequin Flower		Irid	1								1						
Spiranthes romanzoffiana	Ladies Tresses	1	Orchid	3	1		1		1									
Stachys bullata	Hedge Nettle	1	Lami	13	1	1	1	1	1	1	1	1	1	1		1	1	1
Stellaria media*	Com. Chickweed		Caryophyll	11	1	1	1	1		1	1	1		1		1	1	1
Symphoricarpos mollis	Creeping Snowberry	1	Caprifoli	9	1		1	1	1	1	1			1		1		1
Taraxacum officinale*	Common Dandelion		Aster	10	1	1	1	1	1	1		1	1	1		1		
Toxicodendron diversilobum	Poison Oak	1	Anacardi	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Trifolium angustifolium*-			Fab	1	1													
Trifolium barbigerum var. barbigerum		1	Fab	1		1												
Trifolium depauperatum var. amplectens	Bladder Clover	1	Fab	1					1									
Trifolium dubium*	Shamrock		Fab	1		1												
Trifolium hirtum*	Rose Clover		Fab	2						1	1							
Trifolium hybridum*	Allsike Clover		Fab	1										1				
Trifolium macraei	Double-headed Clover	1	Fab	1		1												
Trifolium microcephalum		1	Fab	1		1												
Trifolium microdon		1	Fab	1		1												
Trifolium repens*	White Clover		Fab	2			1				1							
Trifolium subterranium*			Fab	2		1			1									
Trifolium trichocalyx (Specimen Records)	Monterey Clover	1	Fab	2								1			1			
Trifolium variegatum var. variegatum	White-tipped Clover	1	Fab	1		1												
Trifolium willdinovii	Tomcat Clover	1	Fab	1		1												
Trifolium wormskiodii	Cow Clover	1	Fab	3				1						1				1
Triteleia hyacinthina	Hyacinth Brodiaea	1	Lili	3	1		1							1				
Triteleia ixioides ssp. ixioides	Golden Brodiaea	1	Lili	4	1		1	1	1									
Ulex europaea*	Gorse		Fab	6			1		1	1		1	1		1			
Urtica dioica ssp. holosericea	Hoary Nettle	1	Urtic	1	1													
Vaccinium ovatum	Ever Gr. Huckleberry	1	Eric	13	1	1	1	1	1	1	1	1	1	1		1	1	1	1
Veronica arvensis*			Scrophulari	1		1												
Vicia sativa ssp. sativa	Spring Vetch	1	Fab	1							1							
Vinca major*	Periwinkle		Apocyn	2	1													1
Viola adunca (Private Land)		1	Viol	1		1												
Vulpia myuros var. myuros*	Annual Fescue		Po	13	1	1	1	1	1	1		1	1	1	1	1	1	1
Woodwardia fimbriata	Chain Fern	1	Blechn	1	1													
Zantedeschia aethiopica*	Calla Lily		Ar	9	1	1	1		1	1		1		1		1		1