

ELKHORN SLOUGH AT THE CROSSROADS

Natural Resources and Conservation Strategies for the Elkhorn Slough Watershed

*Prepared by
The Elkhorn Slough Foundation
&
Tom Scharffenberger
Land Planning and Design*

March 6, 2002

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PREFACE

Elkhorn Slough is one of central California's coastal treasures. Ocean tides bathe the luxuriant salt marshes, intricate channels and teeming tide flats. This is a rich habitat – home to a remarkable diversity of living things. In spite of the significant investment in protecting the slough and its environs, its long-term health remains threatened. The path we choose today will determine the fate of this unique estuary. Elkhorn Slough is at the Crossroads.

This report and the accompanying maps identify key natural resources of the slough and suggest strategies for conserving them. The basis for this document came from the 1999 Elkhorn Slough Watershed Conservation Plan. Maps and tables have been updated and refined from the 1999 plan and incorporated into this document. The process of developing the Geographic Information System (GIS) and the layers of information behind the maps has brought a new appreciation for the importance, beauty and fragility of the slough. The GIS maps (available on the web at www.elkhornslough.org) are the most detailed and accurate yet produced. Accurate mapping provides the basis for sound land use decisions and we supply this information in the spirit of informed dialogue as the community works toward a vision of the future of this part of the coast and toward a new General Plan for the County.

Many people, representing many organizations, agencies and experiences, contributed to development of this review and to the suggested strategies for resource conservation. The Elkhorn Slough Foundation remains solely responsible for the content and recommendations in this document and for any errors or omissions. We greatly appreciate the time and expertise that was contributed and hope that this effort will be useful to the community as guidance in pursuing a productive path toward planning the future of Elkhorn Slough.

Mark Silberstein
Executive Director
Elkhorn Slough Foundation
February 20, 2002

ACKNOWLEDGEMENTS

We thank the many agencies, individuals and organizations that contributed information and expertise in the development of the maps, identification of natural resources, and suggestions for conservation strategies of Elkhorn Slough. We also want to acknowledge and thank the people who generously contributed time developing the 1999 Elkhorn Slough Watershed Conservation Plan, which provided basic information and a springboard to this document. The participants of that effort are listed in Appendix B. A panel of experts shared information and conservation strategies incorporated into this document. They are listed in Appendix A.

The Audubon Society of California, the Elkhorn Slough National Estuarine Research Reserve and the David and Lucile Packard Foundation assisted with funding and support for the creation of the updated maps and biological information.

The Elkhorn Slough Foundation remains solely responsible for the content of this document and for any errors or omissions. This entire document and the accompanying maps are available on the web at www.elkhornslough.org.

EXECUTIVE SUMMARY

The Elkhorn Slough Watershed is an ecological treasure of both local and national significance (See Figure 1). Elkhorn Slough, like Monterey Bay, into which it flows, is one of Monterey County's most important assets. The State of California has designated Elkhorn Slough as an ecological reserve; the federal government has included its tidal waters within the Monterey Bay National Marine Sanctuary and established a National Estuarine Research Reserve on its eastern shore.

The Elkhorn Slough Watershed is an incredibly rich biological area. It contains a high number of interdependent aquatic and upland habitats and a diversity of species that may be the highest in California for a watershed this size. The Watershed includes:

- 4,000 acres of coastal estuary, one of California's most threatened ecosystems, protected by a series of largely intact barrier dunes;
- over 270 species of resident and migratory birds;
- freshwater ponds and riparian wetlands upstream of the estuaries, which provide habitat for rare plants and animals including three rare amphibians, the California Red-legged Frog, Santa Cruz Long-toed Salamander and the California Tiger Salamander; and
- upland ridges covered with the rare maritime chaparral plant community, which supports numerous other rare plants that are unique to this Watershed.

Elkhorn Slough's plant and animal habitats are particularly vulnerable to human disturbance due to the fact that most of the Watershed lies within a fragile geologic formation of ancient sand dunes. The federal Natural Resource Conservation Service has documented, on hillside fields, an average erosion rate of over 33 tons per acre per year, one of the highest rates of erosion west of the Mississippi River. Sediment from these hillsides, and chemicals and nutrients used on agricultural fields, end up in the slough and eventually Monterey Bay. Erosion control is extremely important, both for the health of the estuary and Monterey Bay, as well as for the long-term protection of productive agriculture.

Our proposed vision for the slough includes an intact and interconnected network of natural communities including over 4,000 acres of coastal marsh within Elkhorn Slough and Moro Cojo Slough, enhanced freshwater wetlands of McClusky Slough, a restored stream-side forest along the lower Carneros Creek Floodplain and a series of upland ridges with unfragmented maritime chaparral in the Elkhorn Highlands.

We envision these natural communities surrounded by productive, habitat-compatible farmland, scenic vistas and residences.

To reach this vision of Elkhorn Slough requires elimination, over time, of the major threats to the watershed's irreplaceable and valuable biological, agricultural, scenic and water resources, to prevent further degradation, to reverse habitat loss and to restore the healthy functioning of the watershed.

The purpose of this report is to identify and to recommend conservation strategies that will allow this vision to be realized.

This report can be downloaded from the internet at www.elkhornslough.org



Figure 1 - Regional Context Map

I. INTRODUCTION: Elkhorn Slough's Unique Resources Are a National Treasure

- A. The Elkhorn Slough Watershed is an ecological gem of national significance. The State of California has designated Elkhorn Slough as an ecological reserve; the National Oceanic and Atmospheric Administration has included its tidal waters as part of the Monterey Bay National Marine Sanctuary, and established a National Estuarine Research Reserve on its eastern shore. Elkhorn Slough has been designated a Globally Important Bird Area by the American Birding Conservancy and a Western Hemisphere Shorebird Reserve by the Manomet Bird Observatory. In a recent poll of Monterey citizens, Elkhorn Slough was regarded as one of the County's most important assets, on a par with the Big Sur Coast. Over the last three decades investments by national, state and local foundations and agencies have exceeded \$40 million to protect Elkhorn Slough's unique combination of resources.
- B. The Elkhorn Slough Watershed includes the coastal estuaries of Elkhorn and Moro Cojo Sloughs. These coastal estuaries are among California's most threatened ecosystems. Surrounding these estuaries is a diverse landscape of working farms and relatively undeveloped hills of native upland vegetation that are remarkably intact, considering the Watershed's close proximity to the metropolitan San Francisco Bay Area.
- C. The Elkhorn Slough Watershed is a biologically rich system. It contains a high number of interdependent aquatic and upland habitats and a diversity of species that may be the highest in California for a watershed this size.
- D. The Elkhorn Slough Watershed supports over 270 species of resident and migratory birds, and provides critical breeding areas for several species. The Elkhorn Slough and Moro Cojo estuaries serve as an important fish nursery and source of nutrients for Monterey Bay. Buffering these estuaries from the ocean waves is a barrier dune system that includes several rare plants and animals, including nesting snowy plovers – a federally listed species.
- E. Freshwater ponds and riparian wetlands upstream of the estuaries support three rare amphibians, the California Red-legged Frog, Santa Cruz Long-toed Salamander and the California Tiger Salamander.
- F. To the east of Elkhorn Slough is a series of ridges covered with the rare maritime chaparral plant community. Several of its native plants are almost entirely endemic to the Watershed and nearly a dozen are considered rare or threatened.



- G. In addition to these diverse and unusual biological resources, the Elkhorn Slough Watershed includes a mosaic of lands with significant agricultural and scenic resources. Interspersed throughout are rural residences and small communities. This mosaic of unique natural resources and rural residences are dependent upon diminishing groundwater resources.

II. The Elkhorn Slough Watershed Is Environmentally Sensitive.

- A. The Elkhorn Slough Watershed's unique assemblage of plant communities and animal habitats are particularly vulnerable to human disturbance due to the fact that most of the Watershed lies within a fragile geologic formation of ancient sand dunes.
- B. The hills surrounding the estuary are highly susceptible to erosion. The Natural Resource Conservation Service (NRCS) has documented on hillside strawberry fields an average erosion rate of over 33 tons per acre per year, one of the highest rates of erosion west of the Mississippi River. Without proper management, the sediments and agricultural chemicals carried by this erosion eventually make their way into the estuary. Proper management of upland areas throughout the Watershed is extremely important, both to the health of the estuary, as well as to the long-term sustainability of the Watershed's rich agricultural resources.
- C. Resources in the Elkhorn Slough Watershed are threatened by other human activities. The maritime chaparral community is threatened by a slow but steady increase in residential development. This development has contributed to habitat fragmentation, compromised scenic ridgelines, led to an increase in erosion of soil, sedimentation in nearby streams, and a proliferation of non-native weeds, such as pampas grass. The Slough's estuarine habitats have suffered from ongoing contamination caused by runoff that drains into the Slough from several tributaries: The Pajaro River/Watsonville Creek, Old Salinas River channel /Tembladero Slough, and Carneros Creek. In 1995 an entire generation of Caspian Terns, hatched in the Elkhorn Slough was lost to mortality. Scientists determined the cause of this failure to be residual agricultural chemicals, DDT & PCBs eroded from soil and carried by floodwaters of the Pajaro and Old Salinas Rivers. Some of the nation's highest concentrations of nitrates have been recorded in the Old Salinas River/Tembladero Slough, which flows into the Elkhorn Slough near Moss Landing.
- D. The groundwater aquifers within the Watershed are overdrawn so that seawater has infiltrated much of the shallow aquifer. Seawater infiltration now threatens the



deeper aquifers. Almost all residential areas within the Watershed depend on groundwater wells for potable water supplies. In addition to the intrusion of salt water into the aquifers, nitrates have contaminated groundwater wells in several areas. Finally, portions of the Slough's vast Salicornia, or pickleweed, saltmarsh are slowly being eroded away by a large increase in daily tidal flows as a consequence of the opening of the slough mouth at Moss Landing in 1946 for the commercial and recreational harbor.

- E. Despite these threats, the Elkhorn Slough Watershed remains a largely intact and functioning ecosystem. Private landowners, farmers, non-profit organizations, agencies, universities, community groups, and individual citizens are working diligently to minimize these threats, protect remaining natural areas and restore disturbed habitats.

III. A Vision for the Watershed

Our proposed vision for the slough includes an intact and interconnected network of natural communities including over 4,000 acres of coastal marsh within Elkhorn Slough and Moro Cojo Slough, enhanced freshwater wetlands of McClusky Slough, a restored stream-side forest along the lower Carneros Creek Floodplain and a series of upland ridges with unfragmented maritime chaparral in the Elkhorn Highlands.

We envision these natural communities surrounded by productive, habitat-compatible farmland, scenic vistas and residences.

To reach this vision of Elkhorn Slough requires elimination, over time, of the major threats to the Watershed's irreplaceable and valuable biological, agricultural, scenic and water resources, to prevent further degradation, to reverse habitat loss and to restore the healthy functioning of the watershed. It requires that existing development becomes more resource-compatible and that new development will not substantially expand within the Elkhorn Slough Watershed.

IV. Purpose of This Report

- A. The purpose of this report is to summarize the unique resources of the Elkhorn Slough Watershed, and to recommend conservation strategies to protect these



resources over time. These strategies can provide guidance to Monterey County in its General Plan Update for the North County Area. The strategies in this report are consistent with the “General Plan Objectives” recently adopted by the county for its General Plan Update. Of particular relevance are the following objectives taken directly from the plan:

1. **OBJECTIVE 1** “Preserve the unique character of areas throughout Monterey County as represented by the different Area Land Use Plans.”
2. **OBJECTIVE 2** “Identify land that is adequate and appropriate for residential, commercial, and industrial development needs of Monterey County during the next twenty years, taking into account land located within cities, existing legal lots of record, and resource and infrastructure constraints.”
3. **OBJECTIVE 6** “Promote, preserve and support agriculture and the industries that serve it. Promote industries that preserve and support environmental quality or serve the local needs of our communities.”
4. **OBJECTIVE 7** “Minimize development of commercially viable agricultural land. Ensure that recognized needs for growth are met by infill and contiguous, compact development.”
5. **OBJECTIVE 8** “Provide adequate infrastructure and public services for existing residents and businesses. Ensure that infrastructure and public services are available, fully funded and constructed concurrently with new development. Ensure that new development neither increases the infrastructure and public service cost for existing residents and businesses nor reduces their quality of service by any significant amount.”
6. **OBJECTIVE 9** “Provide long-term protection of identified resources and critical habitat areas.”
7. **OBJECTIVE 10** “Protect the visual integrity of ridgelines, designated scenic corridors, and other identified sensitive visual resources through Monterey County.”



8. **OBJECTIVE 11** “Seek to provide an adequate and sustainable water supply while protecting the County’s watersheds and marine environment, including surface water, ground water and aquifer recharge areas.”
 9. **OBJECTIVE 12** “Provide a clear statement of county land use values and policies to provide clarity in the county’s permit processing system and to simplify review of projects that are consistent with the General Plan.”
- B. This report focuses on four major resources: (a) biological; (b) agriculture; (c) scenic, and (d) water (surface and groundwater).
- C. This report is an outgrowth of *The Elkhorn Slough Watershed Conservation Plan*, a study sponsored by the David and Lucile Packard Foundation, and jointly prepared by the Elkhorn Slough Foundation and The Nature Conservancy. Over twenty experts from biological, agricultural and planning agencies, local organizations and academic institutions provided feedback throughout preparation of the Plan (see Appendix B for list). The Plan was adopted last year by both the California State Coastal Conservancy and the California Coastal Commission and is on the Internet at www.elkhornslough.org.
- D. The Watershed Conservation Plan’s Implementation Category 5 calls for “assisting the County in its upcoming North County General Plan update.” In addition, the Plan calls for educating the community on “conservation issues and encouraging their involvement in the County Planning Process.”
- E. On May 9th, 2001, the Elkhorn Slough Foundation and National Estuarine Research Reserve hosted a workshop at the Elkhorn Slough National Estuarine Research Reserve (see Appendix A for workshop participants). The purpose of the workshop was to update and refine our understanding of the Watershed’s sensitive habitats, as well as identify appropriate strategies for resource protection. The workshop confirmed the uniqueness of the Elkhorn Slough Watershed, identified a high diversity of unusual, interdependent habitats, and reinforced the need to properly manage land uses throughout Watershed due to the fact that aquatic resources are so heavily impacted by runoff from cultivation and development. The findings of the workshop are incorporated in this report.



- F. In addition, several workshops will be held in upcoming months to make local residents aware of the report's findings, and to encourage residents to become involved in the General Plan Update process, especially in regard to conservation issues.

V. Four Key Resources of the Elkhorn Slough Watershed

The following outline addresses four key resources of concern in the Elkhorn Slough Watershed. Biological resources include the unique habitats, species of plants and animals, and concentrations of wildlife found in the watershed. Agricultural resources include the unique soils and growing conditions in the watershed that make the area attractive for farming. Scenic resources include the landscape and beautiful vistas of the central Monterey Bay. The farms, fields, wetlands, hills and ridges make this one of California's scenic destinations. Lastly, water is the key to all of the above mentioned resources. The productive farms, residences and wildlife depend on an adequate supply of clean water.

A. Biological Resources

1. Overall conservation objectives for biological resources in Elkhorn Slough should include to:
 - a) Reduce, and, where possible, eliminate threats to existing populations of sensitive species.
 - b) Protect in perpetuity large connected blocks of associated sensitive habitats, along with appropriate buffers.
 - c) Maintain wildlife corridors and genetic linkages between large blocks of protected habitats.
 - d) Restore habitats for sensitive species within permanently protected lands and, when appropriate, reintroduce extirpated species such as the California Clapper Rail.
 - e) Monitor populations of sensitive species over time, and conduct research to better understand the factors that affect these populations.
 - f) Promote the maintenance of functioning healthy ecosystems.



2. Species diversity: over 500 aquatic invertebrate species, 100 species of fishes and 270 bird species occur within the Watershed. Of these, many are sensitive species and are protected with state or federal designation (see complete list in Appendix C).
3. Animal species found in the Watershed that are listed or proposed to be listed by US Fish and Wildlife Service as either threatened or endangered:
 - a) California Red-legged Frog
 - b) Santa Cruz Long-toed Salamander
 - c) California Tiger Salamander
 - d) Western Snowy Plover
 - e) Brown Pelican
 - f) Mountain Plover
 - g) California Clapper Rail (extirpated)
 - h) Tidewater Goby
 - i) California Sea Otter
4. Plant species found in the Watershed that are listed or proposed to be listed by US Fish and Wildlife Service as either threatened or endangered:
 - a) Monterey Spineflower
 - b) Sand Gilia
 - c) Santa Cruz Tarplant
 - d) Yadon's Piperia
5. Elkhorn Slough Watershed's most sensitive habitats include: (see Figure 2,



Elkhorn Slough Vegetation Map and associated metadata in Appendix D):

- a) Coastal Salt Marsh
- b) Freshwater Wetlands, Ponds and Riparian Stream Corridors
- c) Dunes and Dune Scrub
- d) Central Maritime Chaparral (see Appendix E for special notes) and adjacent Fallow Agricultural Fields and Live Oak Woodlands
- e) Bird Colony Roosting and Nesting Sites (see Appendix F for special notes)

6. Stresses and sources of stress to biological resources:

- a) Loss of aquatic habitats and species diversity due to sediment accumulation, contamination and turbidity from uncontrolled runoff of agricultural land and development.
- b) Loss of aquatic habitats and species diversity due to diking, ditching, tidal scour and conversion of habitat to agriculture and other land uses.
- c) Loss of dune habitats and species diversity due to disturbance by pedestrian and equestrian traffic and the introduction of non-native invasive plants.
- d) Loss of amphibian habitats due to improper management of freshwater ponds and development of barriers to amphibian dispersal.
- e) Loss of central maritime chaparral habitat due to agricultural and residential development, soil erosion, and competition from invasive non-native plants (see Figure 3 and associated metadata in Appendix D).
- f) Loss of bird habitats and species diversity due to introduction of predators, contamination from agricultural chemicals in runoff and disturbance from domestic animals and human activities.

7. Recommended strategies for the long-term protection of sensitive habitats in the Watershed:



- a) Strengthen County policies to discourage any further alteration of sensitive habitats and enforce policies evenly.
- b) From willing landowners, accept gifts of land and easements or purchase fee or conservation easements over the largest blocks of connected sensitive habitats.
- c) Restore areas suitable for key habitats.
- d) Strengthen County policies to ensure that all land uses throughout the Watershed provide on-site stormwater retention facilities that will release stormwater at a rate that is not substantially greater than a natural, undisturbed landscape.
- e) Strengthen County policies to encourage new land uses to maintain a 100-meter buffer from the edges of all sensitive habitats for the purposes of: (a) capturing sediment and chemicals in runoff from adjacent land uses, (b) sustaining groundwater aquifer levels and (c) restoring natural habitats and native species movement (see Figure 4 showing this buffer from sensitive aquatic habitats, and see metadata in Appendix D). (Note: The 100-meter width is partially based on the US Fish and Wildlife Service's Final Determination of Critical Habitat for the California Red-legged Frog. It specifies a 90-meter wide barrier-free buffer surrounding frog habitats. In the Draft Recovery Plan for the California Red-legged Frog, the US Fish and Wildlife Service recommends a 500-meter buffer between intensive farming and wetlands.).
- f) Inventory existing conservation and scenic easements recorded by the county and monitor to insure they are protected (see Appendix G).
- g) Where incompatible land uses occur within the 100-meter buffer, purchase from willing landowners either conservation easements or fee interest in order to establish a 100-meter buffer, restore habitats within the buffer, and retire groundwater irrigation and/or pumping of groundwater within the buffer to restore water balance to the aquifer.
- h) Provide incentives to landowners to protect sensitive habitats by exploring the possibility of implementing a Watershed-wide Habitat Conservation Program



(HCP) or Natural Community Conservation Plan (NCCP).

- i) Provide incentive programs to private landowners to manage ponds for California red-legged frog and other rare amphibians, as well as migrant shorebird species (especially for the latter where ponds exist adjacent to Elkhorn Slough). To increase habitat of California red-legged frog, encourage agricultural landowners to provide two-stage ponds systems. These utilize an upper pond for retaining stormwater and removing sediment, and a lower pond that is managed for habitat. Discourage development, roads and other land uses that could become barriers to the upland migration and dispersal of amphibians.
- j) Strengthen County policies that confine foot traffic to designated beach access points to maintain dune vegetation, prevent erosion and protect Snowy Plovers.
- k) Strengthen County policies that: (a) discourage conversion of any naturally vegetated area within Elkhorn Highlands into new cultivated agriculture, (b) encourage landowners to retire agriculture on slopes exceeding 20%, to stabilize fallow fields from erosion and over time to restore habitats, (c) encourage landowners to control invasive non-native species throughout their property, and (d) discourage development within 100 meters of maritime chaparral to avoid conflicts between management and habitat protection.
- l) Provide landowners incentives for proper management of special bird habitats, especially freshwater ponds. Freshwater ponds that are within close proximity to the Monterey Bay (within one mile from the shore) and close to marshes are particularly valuable to migratory and resident shorebird populations. Landowners should be encouraged to manage them for these bird populations. When and where appropriate, reintroduce extirpated species, such as California Clapper Rail.
- m) Throughout the Watershed, strengthen ordinances that discourage removal of “heritage native trees.”
- n) Develop a restoration and enhancement plan for the McClusky Slough Wetlands.
- o) In Environmentally Sensitive Areas (see Figure 5), strengthen County policies



to encourage passive recreational uses where appropriate, and discourage high impact recreational uses, particularly where it would entail habitat conversion.

- p) To protect sensitive habitats, evaluate the feasibility of designating “receiver” sites outside the Watershed for purchase of development rights (PDR program) purchased from existing lots of record within the Watershed.
- q) Discourage urban/suburban growth within the Watershed by adopting policies which: (a) encourage infill development within existing cities; (b) promote compact, mixed use development where existing public water, sewer, and other public services exist or can be developed; and (c) where development cannot be accommodated by infill alone, direct new development to designated growth areas outside of the Watershed.
- r) Expand support for animal control/SPCA activities in the rural watershed lands where feral populations of dogs and cats can severely impact native animals.
- s) Strengthen monitoring and enforcement of water quality standards to reduce non-point source pollution in the watershed.

B. Agricultural Resources

1. Farmlands in the Watershed are unique in California. The combination of well-drained, sandy soils and a warm Mediterranean climate tempered by summer fog allows for a year-round production of crops like strawberries, cut flowers and artichokes. Approximately 24% of the Watershed acreage is in cultivated agriculture, 8% of the Watershed acreage is planted in strawberries alone which represents 14% of the total California acreage planted to strawberries. The largest, most productive farms are concentrated in Springfield Terrace and Moro Cojo Slough areas. The existing Land Use Plan for the North County designates these farmlands as Agricultural Preservation zoning. These farms can also serve as critical buffers; when well managed, they protect sensitive aquatic habitats in the Sloughs from incompatible residential, industrial and commercial development. Smaller farms are scattered within the Carneros Creek and Elkhorn Highlands areas. Elkhorn Slough farms are a vital component of the local and county economy, but they can also contribute sedimentation, the chief stress to aquatic habitats. Agriculture can be made compatible with natural habitats



through the use of Best Management Practices and techniques promoted by the Natural Resource Conservation Service. Typically these call for a mix of proper stormwater management (especially in regard to farm access roads) and providing vegetated buffers and retention ponds at the edge of habitats.

2. Major Stresses to Agricultural Resources, and the Sources of this Stress:
 - a) Uncertainty in the economics of strawberry and other crop production may phase out smaller, more marginal farms, especially those in the Elkhorn Highlands, which could lead to increased development.
 - b) A severe overdraft of groundwater from agricultural wells has caused aquifers to retreat and seawater to intrude. Without feasible sources of imported water, and/or a willingness of landowners to voluntarily reduce water use, the overdraft may eventually result in loss of productive farmlands, especially those in Springfield Terrace, and future conversion of farms to residential uses. This depletion of usable water has increased the need for deeper wells. A recent increase in energy prices is making it more costly to pump water from these deeper wells and less profitable for farming.
 - c) Conflicts between residential and agricultural uses, especially with regards to the spraying of pesticides, are making it more difficult to farm. Recent State-imposed buffer requirements for the application of methyl bromide, necessary for most conventional strawberry production, has increased the difficulty of farming strawberries. This is a particular concern for smaller strawberry farms in the Elkhorn Highlands, which are often in close proximity to residential areas.
3. Recommended Strategies for the Protection of Agricultural Resources in the Watershed:
 - a) To protect the long-term viability of existing productive agriculture in groundwater overdraft areas, discourage new expansion of agriculture that would increase the overdraft problem.
 - b) Encourage the creation of a North County Groundwater Recharge Plan.
 - c) To protect the diminishing groundwater supply for existing productive agricultural areas, acquire marginal farmland from willing landowners,



particularly in areas that: 1) historically have or are immediately adjacent to sensitive habitats, 2) occur within habitat buffer areas, 3) occur on slopes exceeding 20%. Within these acquired lands, fallow non-productive agriculture, retire irrigation wells and restore habitat where appropriate.

- d) Provide new County policies that discourage transfers of groundwater from agriculture to new residential development.
- e) Encourage rotation of crops and periodic fallowing of farmlands to replenish soils and restore groundwater resources through tax incentives and other programs.
- f) Strengthen the County's existing soil erosion ordinances to prohibit agricultural practices that allow runoff and sediment to be released in amounts that are substantially greater than areas with natural vegetation.
- g) Strengthen County policies to discourage conversion of natural vegetation to farming within sensitive habitats and their buffers.

C. Scenic Resources

1. The scenic panoramas of marshland, farm fields, forested uplands and open space that unfold as one travels along Elkhorn Road, Hall/Tarpey Roads and Highway 1 are outstanding. Monterey County has designated three scenic routes in the area, including Highway 1, Highway 156 and portions of Elkhorn Road. The County has also made Elkhorn Slough an official "Scenic Waterway." However, no protective land use regulations come with these designations. Additional scenic areas in the Watershed that should be protected include the bluffs and bluff tops west of Elkhorn Slough, the hillsides and ridge tops east of Elkhorn Slough, the agricultural landscape along Carneros Creek as seen from Hall/Tarpey Roads, and Elkhorn Highland ridge tops.
2. Major stresses to scenic resources, and the sources of this stress:
 - a) New industrial, commercial and residential developments are constructed along scenic roadways and within viewsheds due to a lack of County policies, which regulate such development.



- b) Residential development and road construction on scenic ridge-tops
- 3. Recommended strategies for the protection of scenic resources in the Watershed:
 - a) Designate Hall and Tarpey Roads as scenic roadways, and the Carneros Valley as a scenic agricultural region.
 - b) Implement and enforce throughout the Watershed scenic viewshed protection policies that are similar to those of Big Sur, except in existing areas of dense habitation, such as Moss Landing and the town of Las Lomas, Castroville and Prunedale.
 - c) Inventory existing conservation and scenic easements recorded by the county and monitor them to insure they are protected (see Appendix G for special notes on conservation easements).
 - d) Where there are willing landowners, purchase scenic easements along the shoreline of Elkhorn Slough, as well as the bluffs and bluff-tops west of Elkhorn Slough, and the hillsides east of the Slough which are within the Elkhorn Slough viewshed.
 - e) Strengthen and enforce existing policies, which prohibit all ridge-top development (not just the ridge-tops visible from scenic roads).

D. Water Resources

- 1. Nearly all land uses in the Elkhorn Slough Watershed are served by water pumped from local wells. The major aquifer is in the Aromas Sands Formation, which reaches a thickness of 800 feet near the coast. Although the storage capacity of this aquifer is substantial, the long-term safe yield is difficult to estimate. The ongoing overdraft of the aquifer will lead to continued saltwater intrusion, and eventually create water shortages in various parts of the Watershed. In addition, the slow migration of nitrates from agriculture and septic systems through the Aromas Sand formation may eventually contaminate the aquifers so that they will become non-potable. Potential sources of imported water are not likely in the foreseeable future.
- 2. The surface waters of the Watershed are contaminated by various sources, including agriculture, residential septic systems and waste disposal. The



Watershed's sandy soils are particularly prone to erosion, and deposition in streams causes excessive turbidity in these waterways.

3. Major stresses to water resources, and the sources of this stress:
 - a) Continued overdraft of aquifer and accompanying saltwater intrusion due to a mix of land uses which are not sustainable in the long term.
 - b) Contamination of surface waters due to heavy applications of agricultural chemicals and uncontrolled runoff, as well as failed septic systems.
 - c) Nitrates applied to agricultural fields percolate down through the Watershed's sandy soils and can contaminate potable drinking supplies.
 - d) The loss of aquifer recharge areas, due to conversion of natural areas into residential and agricultural uses, is decreasing percolation, thereby worsening the groundwater overdraft.

4. Recommended strategies for water resource protection in the Watershed:
 - a) Create a North County Groundwater Recharge Plan.
 - b) Promote integration, communication and coordination between the various water agencies in North County, and provide new groundwater monitoring wells in overdraft areas.
 - c) To protect groundwater supplies over the long term, adopt policies that discourage new development within Environmentally Sensitive Areas, including Elkhorn Highlands, Moro Cojo, Springfield Terrace, Carneros Creek and Elkhorn Slough Areas (see Figure 5).
 - d) Strengthen County policies that prohibit conversion of sensitive habitats to other uses.
 - e) While the most Environmentally Sensitive Areas are clustered near the slough, the health of the upper Watershed is important to sustain the natural resources of the downstream wetlands and habitats. The upper Watershed encompasses rich biological and scenic resources and provides key functions to the region, including potential groundwater recharge areas, riparian habitat,



and fertile farmland. To prevent degradation of important resources in the remainder of the Watershed, the General Plan should discourage growth within the Watershed, and within adjacent rural community centers ensure that infrastructure and public services are available, fully funded and constructed concurrently with any new development proposed.

- f) To protect the diminishing groundwater supply for existing productive agricultural areas, acquire marginal farmland from willing landowners, particularly in areas that: 1) historically have or are immediately adjacent to sensitive habitats, 2) occur within habitat buffer areas, 3) occur on slopes exceeding 20%. Within these acquired lands, fallow non-productive agriculture, retire irrigation wells and restore habitat where appropriate.
- g) For lands outside of environmentally sensitive areas that are covered by natural vegetation, or agricultural lands that have been fallowed for more than five years, provide new County policies which limit the conversion of natural vegetation to no more than 10% of the parcel area to other uses.
- h) Strengthen policies that discourage new development of agriculture on slopes exceeding 20% in the Aromas Sands Formation.
- i) Develop policies and programs promoting agricultural practices that conserve groundwater resources.
- j) Adopt health codes that prohibit new septic leaching fields in areas that have a percolation rates in excess of one inch per minute.
- k) Ensure that stormwater runoff from all parcels in non-urban areas does not exceed a rate that is substantially greater than that of natural vegetation.



Figure 2- Vegetation in the Elkhorn Slough Watershed

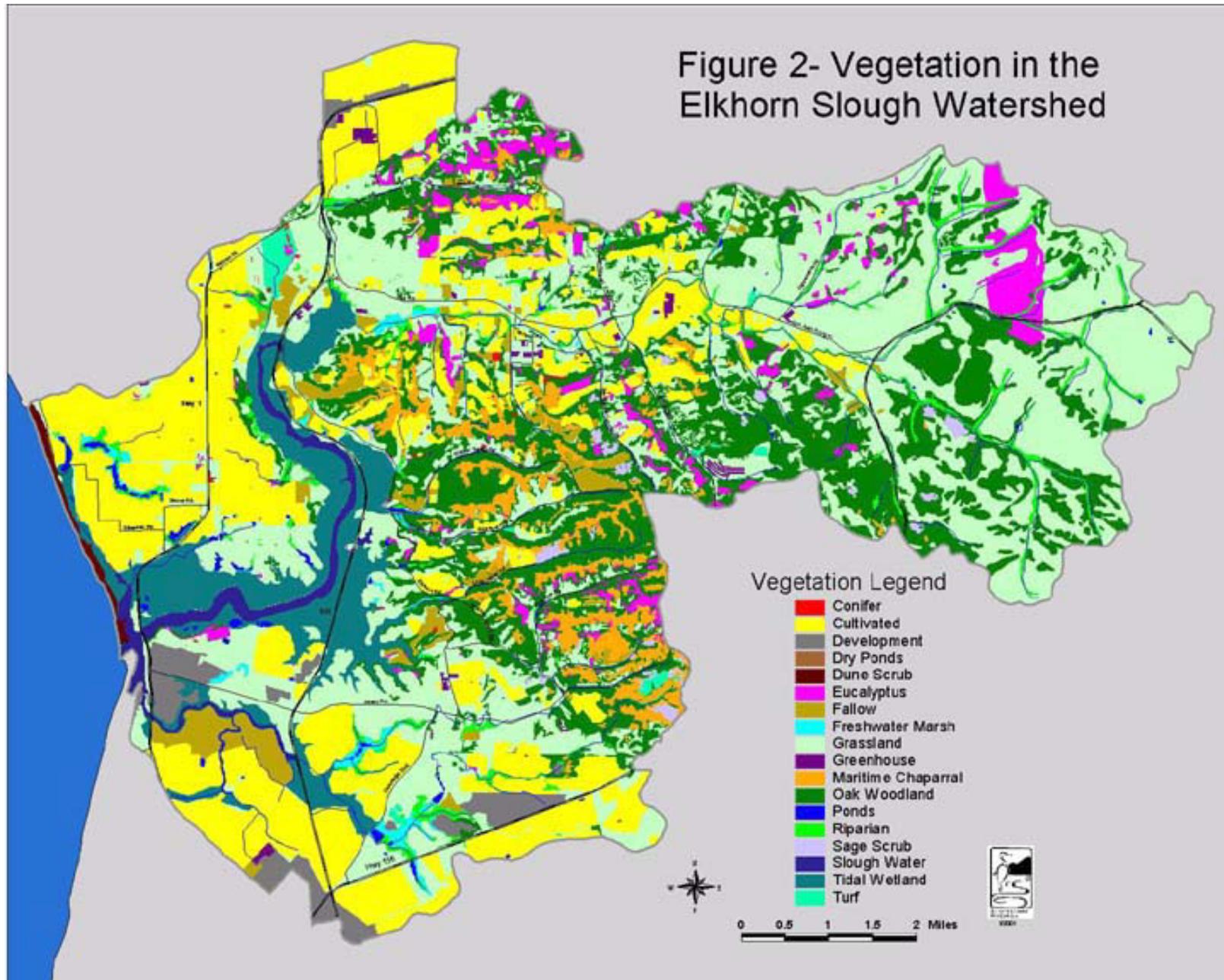


Figure 3- Existing and Potential Maritime Chaparral Distribution in the Elkhorn Slough Watershed

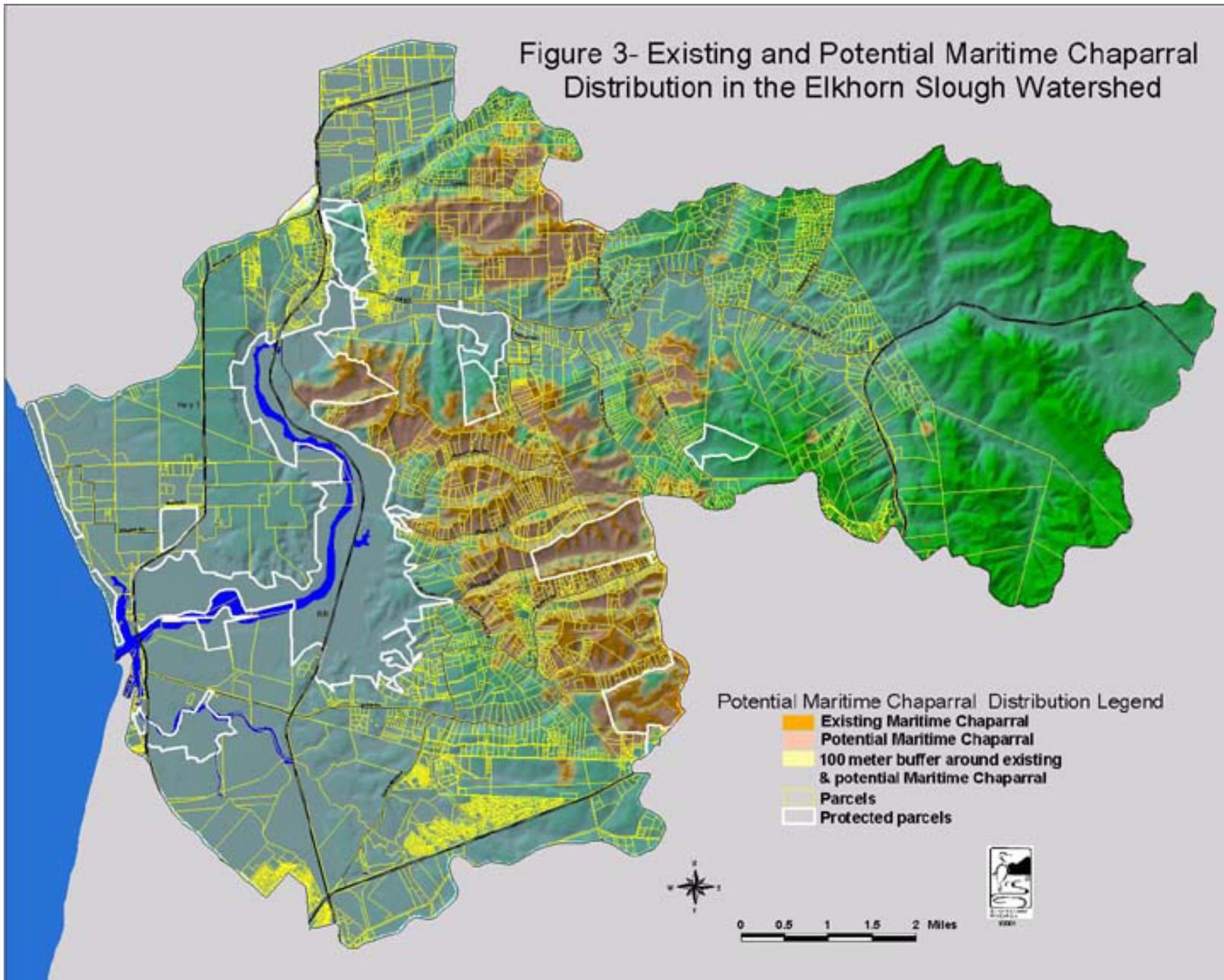


Figure 4- Elkhorn Slough Watershed--
100 Meter Buffer Around Water Features

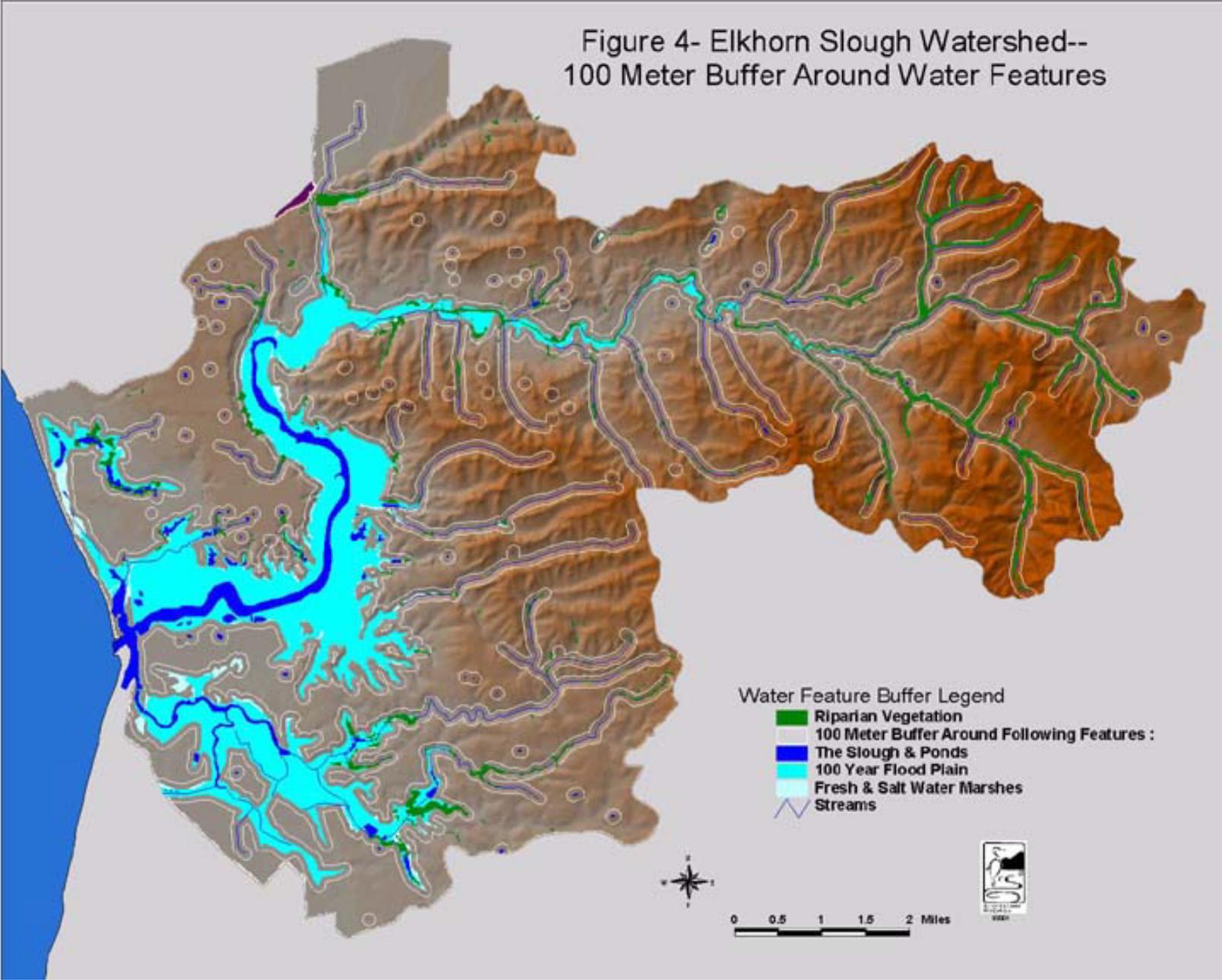
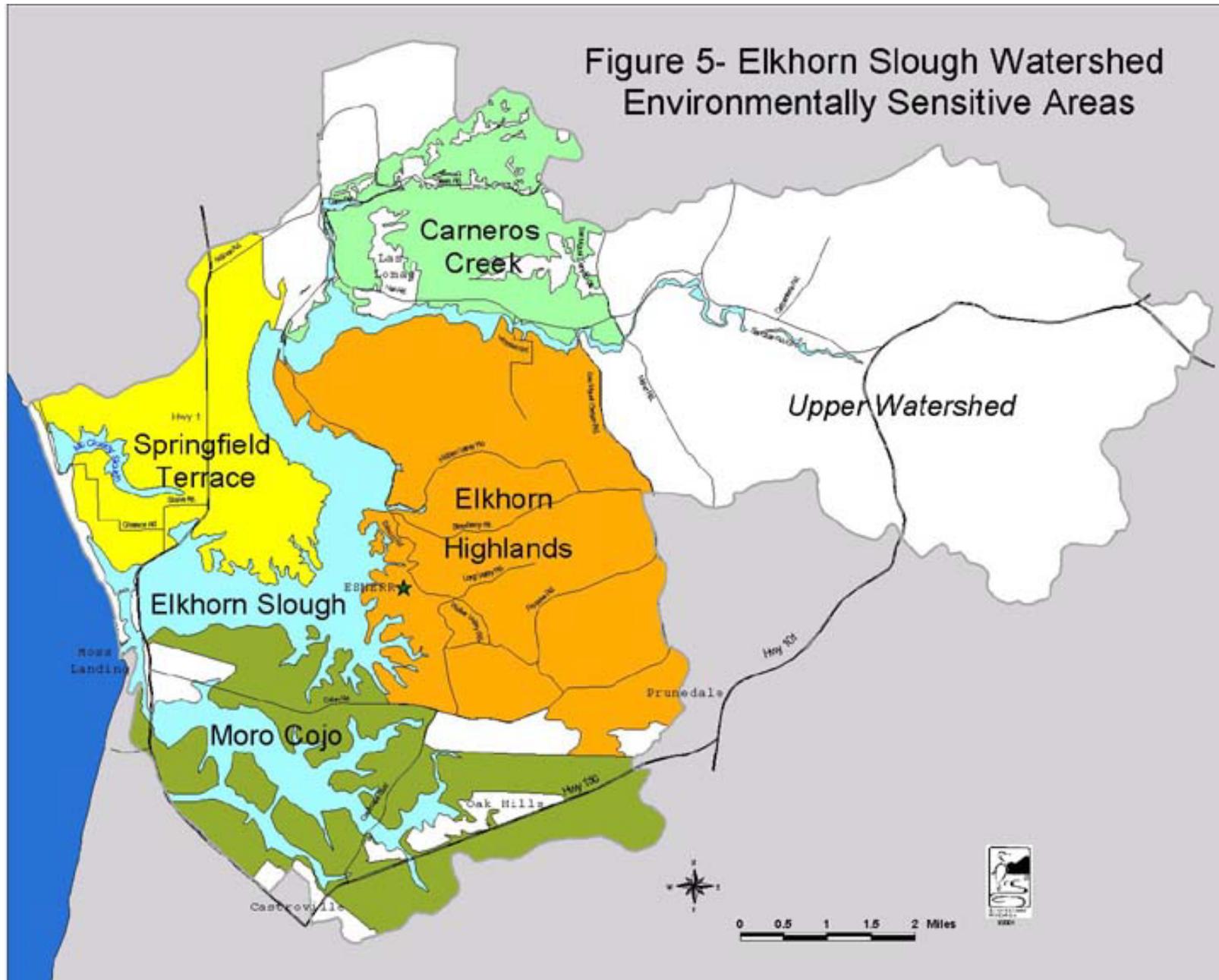


Figure 5- Elkhorn Slough Watershed
Environmentally Sensitive Areas



APPENDIX A: WORKSHOP ATTENDEES AND PARTICIPANTS

The following people contributed to the development of this document through their participation in a planning workshop held May 9th, 2001 at the Elkhorn Slough National Estuarine Research Reserve.

Last Name	First Name	Affiliation
Almanza	Ed	Monterey County
Anderson	Carolyn	North County Citizens Oversight Committee
Berkey	Jonathan	Carmel Watershed Coordinator
Christensen	Becky	Department of Fish and Game (DFG)
Clark	Ross	California Coastal Commission
Classen	Howard	Friends Artists And Neighbors (FANS)
Contreras	Kevin	Elkhorn Slough Foundation (ESF)
Cuffe	Kelly	California Coastal Commission
Darlington	Sherwood	Monterey County Agriculture & Historical Land Conservancy
Earnshaw	Sam	California Alliance of Family Farmers
Engalls	Julie	Oak Hills Homeowners Association
Hennessy	Scott	Monterey County
Hillyard	Deb	Department Of Fish & Game
Holte	Jane	ESF
Hyman	Rick	California Coastal Commission
Inman	Beth	Elkhorn Slough National Estuarine Research Reserve (ESNERR)
Kephart	Paul	Rana Creek Restoration
Largay	Bryan	Resource Conservation District
Leahy	Bill	The Nature Conservancy
Maki	Steven	Monterey County Planning
Mountjoy	Daniel	Natural Resource Conservation Service (NRCS)
Palmisano	Terry	DFG
Parker	Kenton	ESNERR
Pratt	Dianne	United States Fish and Wildlife Service (USFWS)
Pereksta	Dave	USFWS
Reis	Dawn	HRG
Roberson	Don	Audubon--Monterey Peninsula
Scharffenberger	Tom	Land Planning and Associates
Silberstein	Mark	ESF
Vandyke	Eric	ESNERR
Van Houten	Jim	ESF Board
Wasson	Kerstin	ESF
Watt	Terry	Planning Consultant
Woolfolk	Andrea	ESNERR
Yadon	Vern	Botanist
Yeates	Bill	Audubon



APPENDIX B: WATERSHED CONSERVATION PLAN PARTICIPANTS

The following people contributed to the development of the 1999 Elkhorn Slough Watershed Conservation Plan. This plan provided basic information for the development of this document.

Last Name	First Name	Affiliation
Baudler	Carol	The Nature Conservancy (TNC)
Beall	Kris	Elkhorn Slough Foundation (ESF)
Berkey	Jonathan	Carmel Watershed Coordinator
Caffrey	Jane	Elkhorn Slough National Estuarine Research Reserve (ESNERR)
Capurro	Frank	ESF
Chan	Sue	University of California Berkeley
Christensen	Becky	Department of Fish and Game (DFG)
Cooley	Diane	ESF
Darington	Sherwood	Monterey County Agriculture & Historical Land Conservancy
Driscoll	Jean	Packard Foundation
Dwyer	Lynn	Sustainable Conservation
Giberson	Nancy	Santa Cruz County Office of Education
Hennessy	Scott	Monterey County
Hillyard	Deb	DFG
Hyman	Rick	California Coastal Commission
Ingram	Candy	Monterey County LAFCO (ESF)
Johnson	Rob	Monterey County Water Resources Agency
Kephart	Paul	Rana Creek Restoration
Leong	Cory	TNC
Little	Henry	TNC
Maki	Steven	Monterey County Planning
Malzone	Chris	United States Geological Survey
Mantell	Michael	California Environmental Trust
McCormick	Steven	TNC
McNeish	Charlie	Pajaro Valley Water Management Agency
Ed	Mecurio	Hartnell College
Mountjoy	Daniel	Natural Resource Conservation Service (NRCS)
Oliver	John	Moss Landing Marine Lab
Orman	Larry	GreenInfo Network
Palmisano	Terry	DFG
Parker	Kenton	ESNERR
Piini	John	Piini Reality
Reis	Dawn	San Jose State University



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Last Name	First Name	Affiliation
Roberson	Don	Audubon--Monterey Peninsula
Schauss	Martha	DFG
Sedgwick	Jeanne	Packard Foundation
Simmons	Woody	Pacific Meridian
Smith	Wil	ESF
Smith	Sean	TNC
Stephens	Robert	Elkhorn Native Plant Nursery
Taylor	Jack	ESF
Tibbott	Emily	TNC
Tillson	Tilly	TNC
Valentine	Mark	Packard Foundation
Van Houten	Jim	Santa Cruz County LAFCO (ESF)
Chris	Zachariadas	Rural Development Center



APPENDIX C: CRITICAL BIOLOGICAL RESOURCES UPDATED AUGUST 24, 2001

COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
PRIMARY COMMUNITIES			
Coastal Salt/ Coastal Brackish Marsh	G2		
Coastal and Valley Freshwater Marsh	G2		
Central Maritime Chaparral	G2		
SECONDARY COMMUNITIES			
Coast Live Oak Woodland (Associated with Maritime Chaparral)	G3		
Central Coast Arroyo Willow Riparian Forest	G3		
Coastal Dune Scrub	G2		
SENSITIVE PLANT SPECIES			
<i>Arctostaphylos hookeri ssp hookeri</i> Hooker's manzanita	G3T2	K	Chaparral
<i>Arctostaphylos pajaroensis</i> Pajaro manzanita	G2 FSC	K	Chaparral



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COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
<i>Ceanothus cuneatus var. rigidis</i> Monterey ceanothus	FSC	K	Chaparral
<i>Chorizanthe pungens var pungens</i> Monterey spineflower	G2T2 FT	K	Coastal Dunes, Grasslands, Maritime Chaparral
<i>Ericameria fasciculata</i> Eastwood's goldenbush	G2 FSC	K - Kirby Park and Manzanita Park	Maritime Chaparral
<i>Erysimum ammophilum</i> Coast wallflower	FSC	P	Coastal Dune Scrub
<i>Fritillaria liliacea</i> Fragrant fritillary	G2	K - Brigatinos Property, Red Barn near 101	Grasslands, esp. Coastal Prairie
<i>Gilia tenuiflora ssp. arenaria</i> Sand gilia	FE	K - Moss Landing Marine Lab and Castroville Blvd. site	Coastal Dune Scrub
<i>Hemizonia parryi ssp congdonii</i> Congdon's tarplant	G5T1	K - Long Valley	Grasslands
<i>Holocarpha macradenia</i> Santa Cruz tarplant	G1 FT CE	K - Porter Preserve Property	Coastal Terrace Prairie, Grasslands
<i>Lomatium parvifolium</i> Small-leaved lomatium		K - Blohm Ranch	Maritime Chaparral, Pine Forest
<i>Perideridia gairdneri ssp. gairdneri</i> Gairdner's yampah	FSC	K - Brigatinos Property	Grasslands, Chap- arral, Oak Woodlands



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COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
<i>Piperia michaelii</i> Michael's rein orchid	CNPS 4	K - Blohm Ranch	Maritime Chaparral
<i>Piperia yadonii</i> Yadon's piperia	G1 FE FSC	K - Long Valley, Blohm Ranch, Whitehead Property	Maritime Chaparral
<i>Plagiobothrys diffusus</i> San Francisco popcornflower	SE	K - Brigantinos Property	Coastal Terrace Prairie, Grasslands
<i>Trifolium buckweticorum</i> S.C. Clover	CNPS 1B	K - Moro Cojo	Alkali Grasslands
<i>Trifolium depauperatum</i> var. <i>hydrophilum</i> Sac Clover		K - Moro Cojo	Alkali Grasslands
<i>Castilleja latifolia</i> Monterey Indian Plant		K	Coastal Dune Scrub
SENSITIVE ANIMAL SPECIES			
Elephant seal		K	Slough Channels, Sand Bars
Southern sea otter	FT	K	Slough Channels
Black legless lizard	G4QT2S2 CSC	K - dunes near Moss Landing Marine Lab	Coastal Dune Scrub, Oak Woodlands, Maritime Chaparral
California brackishwater snail	G2G3S2S3 FSC	K - Parson=s and Moro Cojo	Slough/Aquatic Habitats



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COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
		Sloughs, Azevedo Ponds	
Monarch butterfly	G5S3	K - Eucalyptus Grove near PG&E	Eucalyptus Groves
California red-legged frog	G4T2T3S2S3 FT CSC	K - ESNERR, Strawberry Pond	Freshwater Ponds, Willow Riparian, Chaparral
California tiger salamander	G2G3S2S3 FSC CSC	K - Moro Cojo	Freshwater Ponds and Wetlands, Brackish and Salt Marsh, Grasslands
Globose dune beetle (verify)	G1S1	P	Coastal Dune Scrub
Santa Cruz long-toed salamander	G5T1S1 FE SE	K - McClusky, Bennett and Moro Cojo Sloughs; one ESNERR siting	Freshwater Ponds, Grasslands, Willow Riparian, Chaparral
Southwestern pond turtle	G4S3S2S3 FSC CSC	K - ESNERR, Carneros Creek	Freshwater Ponds and adjacent south-facing uplands
Tidewater goby	G2G3S2S3 FE SCS	P	Brackish Marsh, Slough Canals, Bennett Slough
California brown pelican	G4T3S1S2 FE SE	K - non-breeding roosts on Salt Ponds	Salt Ponds
Double-crested cormorant	G5S3	K - ESNERR Rookery Site	Saltwater and Brackish Marsh, Freshwater Marsh
American bittern	G5S4	K - Zmudowski	Freshwater and



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COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
		Pond	Brackish Wetlands
Great blue heron	G5S3	K - ESNERR Rookery Site	Saltwater and Brackish Marsh, Freshwater Marsh and Ponds
Great egret	G5S4	K - ESNERR Rookery Site	Saltwater and Brackish Marsh, Freshwater Marsh and Ponds
Snowy egret	G5S4	K - Zmudowski Pond Rookery Site	Saltwater and Brackish Marsh
Black-crowned night-heron	G5S3	K - Zmudowski Pond Rookery Site	Saltwater and Brackish Marsh
Black brant		K - winter site	Saltwater Marsh
Osprey	G5S3	K (wintering)	Saltwater and Freshwater Marsh
White-tailed kite	G5S3 MNBMC	K - several pairs on ESNERR and Packard Ranch	Riparian Woodlands and Adjacent Fields
Northern harrier	G5S3 CSC	K -McCluskey Slough and ESNERR, ----- ----- Zmudowski pond	Grasslands, Saltwater and Freshwater Marsh
Sharp-shinned hawk	G4S3	K	Conifer forests
Cooper's hawk	G4S3 CSC	K	Woodlands and Riparian Corridors
Ferruginous hawk	G4S3S4 FSC CSC	K - winters in Moro Cojo Grasslands	Open Grasslands
Golden eagle	G4S3 CSC	K - nesting pair on Packard Ranch	Grasslands and Oak Savanna
Merlin	G5S3 CSC	K - (winter only)	Saltwater Marsh



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COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
California black rail	G4T1S1 ST FSC	P	Saltwater marsh
California clapper rail	G5T1S1 FE SE	E,P	Saltwater marsh
Western snowy plover	FT CSC	K	Beaches, Salt Ponds, Coastal Dune Scrub
Mountain plover	G3S2 FSC	K -migrant on Moro Cojo grasslands	Open Grasslands
Caspian tern	G5S4	K - Colony on ESNERR	Saltwater Marsh and Beaches
Forster's tern	G5S4	K - migrant spring & fall; formerly nested	Saltwater Marsh and Salt Ponds
California least tern	G4T2T3S2S3 SE FE	K - migrant spring & fall; formerly nested	Saltwater Marsh and Beaches
Black skimmer	G5S1S3 CSC	P - expanding range with Caspian Tern colonies	Saltwater Marsh
Burrowing owl	G4T2S2 FSC CSC	K - nesters recently extirpated but may recolonize	Open Grasslands
Short-eared owl	G5S3	K - winter only; formerly nested but unlikely to do so again	Saltwater Marsh and Open Grasslands
Belted Kingfisher		K - Elkhorn Slough	Saltwater and Freshwater Marsh
Olive-sided flycatcher	G?S4	K	Tall forests (pine, eucalyptus,



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COMMUNITY/SPECIES	STATUS	OCCURRENCE	HABITAT
			cottonwoods)
Loggerhead shrike	G4S4 FSC CSC	K - in dunes near Zmudowski Pond	Coastal grasslands and Dune Scrub
California horned lark	G4G5T3S3 CSC	K - San Benito Co. Portion of Watershed	Interior grasslands
Monterey pygmy nuthatch		K - Eucalyptus forest adjacent to Moonglow Dairy	Dense Pine and other Conifer Forests
Grasshopper sparrow	G5T2S2	K	Interior Grasslands
Tricolored Blackbird	G3S3	K - Moonglow Dairy Ponds Winter Site	Grasslands, Fresh- water Ponds, Brack- ish and Freshwater Marsh
Yellow-headed blackbird	G4G5S3S4	K - Moonglow Dairy Ponds, mostly wintering site but have nested	Grasslands and Saltwater Marsh
Lawrence's goldfinch	G3S3	K - sometimes nests in eucalyptus grove adjacent to Moonglow Dairy	Dry Interior Woodlands

LEGEND:

Status:

First set of symbols – Heritage Designation:

Global Ranking:

G1 - Less than 6 viable element occurrences (EOs) OR less than 1,000 individuals OR less than 2,000 acres

G2 – 6-20 EOs OR 1,000-3,000 individuals OR 2,000-10,000 acres

G3 – 21-100 EOs OR 3,000 – 10,000 individuals OR 10,000 – 50,000 acres

G4 – Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern, i.e., there is some threat, or somewhat narrow habitat



G5 – Population or stand demonstrably secure to ineradicable due to being commonly found in the world

State Ranking:

S1 – Less than 6 EOs OR less than 1,000 individuals OR less than 2,000 acres

S2 – 6-20 EOs OR 1,000-3,000 individuals OR 2,000-10,000 acres

S3 – 21-100 EOs OR 3,000 – 10,000 individuals OR 10,000 – 50,000 acres

S4 – Apparently secure within California; this rank is clearly lower than G3 but factors exist to cause some concern, i.e., there is some threat, or somewhat narrow habitat.

S5 – Population or stand demonstrably secure to ineradicable in California

Second set of symbols - Federal Designation:

FE - Listed as Federally Endangered by the Federal Government

FT- Listed as Federally Threatened by the Federal Government

FSC - Federal Species of Concern

Third set of symbols - State of California Designation:

SE - Listed as Endangered by the State of California

ST - Listed as Threatened by the State of California

SCS - California Dept. Of Fish and Game Species of Special Concern

Occurrence:

K- Known Occurrence

P - Potential Occurrence

E - Extirpated



APPENDIX D

METADATA FOR THE FOLLOWING MAPS: VEGETATION (Fig.2), MARITIME CHAPARRAL (Fig.3), AND WATER FEATURE BUFFER (Fig 4). REVISED 11/5/01

This section describes three maps produced by ESF staff during the process of updating the Watershed Conservation Plan's biological and agricultural resource inventories. Each map consists of a set of ESRI ArcView shapefiles. They are projected to Universal Transverse Mercator using the WGS84 coordinate system and datum. Digital imagery used in the preparation of these maps include Monterey County's December 1999 0.6m digital ortho quads (east and south of the main channel), US Geological Survey (USGS) 1995 1.0m digital ortho quads (north and west of the channel), and October 1999 3.0m pseudo-infrared imagery provided by the Don Potts hyperspectral laboratory at UCSC. Slopes and background shaded topographic relief were derived from USGS digital elevation models using the ArcView Spatial Analyst extension.

DISCLAIMER--No warranty expressed or implied is made regarding the accuracy or utility of the data for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. The Elkhorn Slough Foundation shall not be held liable for improper or incorrect use of the data described and/or contained herein. This is writable data that may have been altered from the original. The Elkhorn Slough Foundation assumes no legal responsibility for the user's reliance or interpretation of the data provided by the Elkhorn Slough Foundation contained herein. These data are intended for landscape level natural resource conservation planning. Field verification of resource patterns is strongly recommended. The Elkhorn Slough Foundation does not guarantee the accuracy, completeness, or timeliness of the information shown, and shall not be liable for any loss or injury resulting from reliance upon the information shown. Data evaluation and improvement may be ongoing.

VEGETATION MAP

The primary deliverable is a refined and updated map of the Watershed's vegetation, classified according to the 18 mapping units described below. A variety of field methods and GIS techniques were employed to produce the various layers. Portions of the Watershed east of



Carpenteria Avenue (San Benito County) and east of Highway 101 (eastern Monterey County) were included but not given high priority—more accurate mapping of these areas will be completed at a later date. The revised map comprises nearly 2056 separate polygons.

Vegetation Mapping Units

I. Tree Canopy

A. Oak Woodland

Regions where coast live oak canopy covers at least half of the ground surface.

Note: There is no mapping unit representing grasslands with sparse oak cover (e.g. oak savanna); these areas are classified as either grassland or oak woodland according to the 50% cover rule.

Dominant species: *Quercus agrifolia*

This layer is derived from the Watershed Conservation Plan's "live oak woodland" layer, refined by re-digitizing incorrect boundaries whenever encountered either on aerial imagery or in the field. Accuracy is now fairly high, although we will continue to refine this layer to bring it up the standard of those produced by ESF staff (e.g. eucalyptus, chaparral, riparian, agriculture).

B. Conifer

Introduced pine, fir, and cypress stands.

Dominant species: *Pinus radiata*, *Cupressus macrocarpa*

This is a newly created layer, produced by outlining stands on large-format paper maps during exhaustive field surveys, then accurately transferring these boundaries to GIS by digitizing over digital ortho imagery.

C. Eucalyptus

Introduced eucalyptus stands. There are several locations where eucalyptus has invaded chaparral or oak woodland; once again, these areas were classified according to the 50% rule.

Dominant species: *Eucalyptus globulus*

This map layer was produced using the same methods described for the Conifer layer.



D. Riparian

Patches of native willow with occasional cottonwoods and sycamores.

Dominant species: *Salix* ssp.

This map layer was produced using the same methods described for the Conifer layer.

II. Shrub Canopy

A. Maritime Chaparral

Boundaries between central maritime chaparral and oak woodland tend to be distinct, although remnant manzanita or other chaparral-associated shrubs are often present beneath oaks or eucalyptus; these areas are classified as chaparral only where the shrub cover is at least 50%.

Dominant species: *Arctostaphylos pajaroensis*, *Arctostaphylos hookeri*

This layer was newly produced, based on extensive field mapping during 1999-2000 and digitized using the same methods described for the Conifer layer.

B. Sage Scrub

This unit includes areas that are native coastal sage scrub. This mapping unit is often mostly poison oak; elsewhere coyote bush, sage, sagebrush, or monkeyflower dominate. The majority are old fields or other disturbed areas within chaparral or oak woodland. These regions are classified as sage scrub only if succession has proceeded to the stage that shrubs such as coyote brush have achieved at least 50% cover; otherwise they are classified as grasslands.

Dominant species: *Toxicodendron*, *Baccharis*, *Ceanothus*, *Salvia*, *Artemisia*, *Mimulus*.

Status: Newly produced using the same methods described for the Conifer layer.

C. Dune Scrub

Coastal dunes in the vicinity of Zmudowski Beach, sparsely vegetated with European dunegrass, native dunegrass, and various other native and non-native dune plants.

Dominant species: *Ammophila arenaria*

Status: This is taken from the Watershed Conservation Plan's "coastal dune scrub" layer.

III. Grassland

This unit includes a few remnant patches of native coastal prairie (characterized by the presence of *Danthonia californica* and other bunchgrasses) within grasslands dominated by



exotic European species. Early successional disturbed areas where shrub cover is less than 50% are also included. A number of areas in this mapping unit are used for cattle grazing.

Dominant species: *Bromus* ssp., *Lolium* ssp.

This is essentially a “catch-all” unit for vegetated areas that lack a canopy; it was produced mostly by subtraction (assigning canopied areas to other categories). In the future, we plan to distinguish patches of remnant native coastal prairie from European grasslands, grazed lands, and old fields. This unit could benefit from additional research and ground-truthing.

IV. Agriculture

A. Cultivated

Actively cultivated agricultural plots (strawberries, artichokes, etc.).

This layer was prepared in conjunction with Natural Resource Conservation Service (Daniel Mountjoy and Cheryl Lambert) and is based on their extensive field knowledge. Each plot was assigned an identifying index to enable cross-referencing and future updates. Additional plots, when encountered in the field, have been temporarily assigned index -1. Exact boundaries were digitized to GIS using digital ortho photos.

B. Fallow

Plots that are currently fallow but are known to have been recently cultivated. Many other fallow agricultural plots whose history is not known are probably scattered throughout the Watershed; these successional areas would be classified as grassland where shrub cover (typically *Baccharis*) does not exceed 50%; otherwise they would be classified as sage scrub.

This map layer was produced in conjunction with the cultivated layer. Initial determination that a plot is currently fallow was made by NRCS, and then verified according 1999 pseudo-IR aerial imagery.

C. Greenhouse

Footprints of larger greenhouse structures.

Located in the field and digitized to GIS using digital ortho photos.

D. Turf

Non-agricultural irrigated grasslands, including golf courses, playing fields, etc.

These resources were located in the field and digitized to GIS using digital ortho photos.



V. Wetlands and Water

A. Slough Water

Salt and brackish open water.

This is an unmodified copy of the Watershed Conservation Plan's "open water" layer. It will be completely updated and re-digitized as part of the upcoming Elkhorn Slough Historical Ecology project.

B. Tidal Wetlands

Salt and brackish wetlands, whether vegetated (typically dominated by *Salicornia virginica*) or unvegetated (mudflats).

This is a lightly corrected copy of the Watershed Conservation Plan's "coastal marsh" layer. It will be re-digitized and subdivided (mudflats, pickleweed marsh, etc.), as part of the upcoming Elkhorn Slough Historical Ecology project.

C. Ponds

Freshwater bodies. Occasional natural (spring-fed) lakes plus a large number of small, artificial agricultural reservoirs that appear to be filled during much of the year.

Newly created layer. Ponds were either encountered in the field or visible on aerial imagery.

D. Dry Ponds

Ponds, mostly agricultural, which appear to have been abandoned. They generally fill with rainwater during the wet season, and typically support various wetland species before drying out late in the year.

This layer is newly created in conjunction with the Ponds layer. Determination that a pond is abandoned was made in the field or, occasionally, from appearance on aerial imagery.

E. Freshwater Marsh

Areas without a willow canopy that are seasonally inundated with freshwater; often indicated by cattails, rushes, and sedges.

Dominant species: *Typha* ssp., *Juncus* ssp., *Carex* ssp., etc.



This is a new layer developed from field surveys. This is probably the most difficult unit to classify; a number of smaller areas were probably overlooked. Work on this layer will continue.

VI. Development

Industrial areas (powerplant, railroad yard) and intensively developed residential areas (Castroville, Oak Hills) where the natural vegetation type is unrecognizable.

Status: Newly created by digitizing areas without recognizable background vegetation on aerial imagery.

Vegetation map summary *

Mapping unit	Polygons	Acres	Percentage
Oak Woodland	316	9115	20%
Conifer	30	33	0.07%
Eucalyptus	378	1510	3.3%
Riparian	446	1214	2.7%
Maritime	157	1704	
Chaparral			3.8%
Sage Scrub	32	254	0.6%
Dune Scrub	1	143	0.3%
Grassland	296	15,257	33.7%
Cultivated	243	9635	21.3%
Fallow	56	1181	2.6%
Greenhouse	38	150	0.3%
Turf	9	188	0.4%
Slough Channel	5	587	1.3%
Tidal Wetlands	6	2833	6.3%
Ponds	115	206	0.4%
Dry Ponds	36	15	0.03%
Freshwater	37	267	
Marsh			0.6%
Development	13	501	2.0%
Total	2214	45,218	100%

* Acreage is from classifications of aerial images from 1995 to 1999.



WATER FEATURE BUFFER MAP

The interface between human activities and natural areas is dynamic, with many human influences modifying natural ecosystem functioning. Agricultural chemicals flow into water bodies and stream courses and can degrade water quality; Riparian corridors can be narrowed or constricted to the point of restricting species movement, thereby severing connections between larger habitat areas. Viable connections between larger habitat areas, promotes species diversity, maintains genetic diversity within populations, facilitates species migration in response to environmental change, and enables the recolonization of populations extirpated by disturbance events. The size or width of buffers necessary for these ecosystem functions is not fully understood.

Scientific research on width of buffers around key habitats needed to maintain ecological function suggest ranges from 30 meters for wetland protection to 200 meters for diverse bird communities. The U.S. Fish and Wildlife Service's January 2000 Draft Recovery Plan for the California Red-Legged Frog specifies a 500 meter buffer between intensive agriculture and wetlands to prevent aerial drift and overland flow of agricultural chemicals.

On this figure we mapped buffers of 100m around sensitive resources. This map delineates as a white outline a 100m buffer around streams, salt and fresh water wetlands, ponds, and FEMA's 100-year flood plain. The buffer was created using ArcView's buffering utility.

EXISTING AND POTENTIAL MARITIME CHAPARRAL MAP

This map shows areas of existing and potential maritime chaparral as red and dark green respectively. Existing chaparral was used from mapped chaparral described above. Potential chaparral was derived by extending the edge of existing chaparral down south-facing slopes to the bottom of the drainage. This reflects understanding that chaparral once covered most south facing slopes and has since been replaced by agriculture and housing. A 100m buffer was then drawn as light green around the combination of existing and potential chaparral. The buffer reflects the value of remaining maritime chaparral and the need to protect the ecotone between these shrublands and grasslands. These ecotones, the interfaces between different habitats, harbor protected species.



APPENDIX E

SPECIAL NOTES REGARDING CENTRAL MARITIME CHAPARRAL

Central maritime chaparral is a rare plant community that occurs within the central California coastal zone. The community requires both cool, foggy summers and well-drained sandy soils. In the Elkhorn Slough Watershed, central maritime chaparral occurs on ridges and south-facing slopes in an area known as the Elkhorn Highlands, located east of the main Slough channel. The habitat is dominated by two woolly-leaved Manzanitas, which are narrowly endemic, primarily in the Watershed. At one time, central maritime chaparral covered extensive areas in the Watershed, however, in the past forty years many of the south-facing chaparral slopes were converted to agriculture and rural residential uses. Much of the agriculture is now fallow and reverting to transitional coastal scrub vegetation. There are several federally listed rare and endangered plants associated with Elkhorn Slough's central maritime chaparral. Typically these plants occur in gaps and disturbed areas either within the habitat itself, within the fallow south-facing fields adjacent to the habitat, or occasionally within gaps in Live Oak Woodlands found on the north-facing slopes also adjacent to the habitat. Due to the fact that ridge-tops and south-facing slopes in Elkhorn Highlands are highly desirable by both agriculturists and residential buyers, the remaining relatively large areas of undisturbed central maritime chaparral are highly threatened. The health of Elkhorn Slough's aquatic habitats is intertwined with central maritime chaparral. This is due to the fact that the sandy soils beneath maritime chaparral are highly erosive, and, if not carefully managed, can be washed away by winter runoff and greatly impact downstream wetlands. Residential development within or adjacent to central maritime chaparral is problematic due to the fact that the habitat is naturally dependent on fire for regeneration. Manzanita, of all the California chaparral plants, may be the most explosively flammable. Residents are not only at risk due to fire, but state fire codes which require extensive landscape clearing are in direct conflict with federal laws which protect rare and endangered species.



APPENDIX F

SPECIAL NOTES REGARDING BIRD COLONY ROOSTING AND NESTING SITES, INCLUDING ROOKERIES

The Elkhorn Slough Watershed provides important feeding, roosting, and nesting habitats for a large variety of migrant and resident birds. Over 270 bird species have been recorded, including a number of federal or state-listed threatened and endangered species. There are two colonial waterbird rookeries, one located north of Moss Landing on Zmudowski Pond at the northwest end of McClusky Slough (an incipient colony of Snowy Egrets and Black-crowned Night-Herons nest here along with non-colonial American Bitterns), and one in a pine and eucalyptus grove on the Elkhorn Slough National Estuarine Research Reserve property (Great Blue Herons, Great Egrets, and Double-crested Cormorants). The Salt Ponds just northeast of Moss Landing, as well as Moss Landing Beach, support significant breeding populations of Western Snowy Plovers, a federally threatened species. A pair of nesting Golden Eagles and several pairs of White-tailed Kites utilize the Packard Ranch north of the Slough. Mountain Plovers, a Federal species of concern, have used the alkaline grasslands south of Moro Cojo slough in migration. Burrowing Owls, a State endangered species, has nested in Moro Cojo grasslands until extirpated by Red Foxes in the 1980s; they may naturally re-colonize with the reduction of that non-native predator. Caspian Terns have recently re-established a nesting colony on the ESNERR; Forster's Terns and the endangered California Least Tern have nested in the past and may do so again, as may the Black Skimmer, another colonial waterbird. The Moonglow Dairy ponds, at the southern edge of Elkhorn Slough, and the adjacent eucalyptus grove, support a tremendous variety of migrants, including such species of State special concern as Yellow-headed Blackbirds, Tricolored Blackbirds (a large non-breeding aggregation each fall & winter), and sometimes nesting Lawrence's Goldfinches. Pine and mixed pine/oak forests throughout support nesting Olive-sided Flycatchers and Monterey Pygmy Nuthatch, both California species of special concern, and such special status raptors as Cooper's Hawk and Sharp-shinned Hawk. Elkhorn Slough's dunes and coastal grasslands support nesting populations of Loggerhead Shrike, a species that is declining nationally. Elkhorn Slough's marshy shores were once habitat for the California Clapper Rail, a federally endangered species that was locally extirpated by predation of introduced Red Fox. The last pair of rails was seen in the early 1980s. A successful Red Fox control program by the U.S. Fish and Wildlife Service may allow California Clapper Rails to one day be reintroduced to the ES Watershed.



APPENDIX G

SPECIAL NOTES REGARDING COUNTY CONSERVATION AND SCENIC EASEMENTS

Conservation and scenic easements are established by the county as a condition of building permit or subdivision approval to protect in perpetuity critical/sensitive ecological and scenic resources potentially impacted by development. The effectiveness of the easement program appears mixed. Some easements protect all the resources other than the building footprint; others protect only a small proportion of the resources, while many require no easement protection of sensitive resources. This inconsistent application of easements promotes habitat fragmentation of maritime chaparral, riparian and oak woodlands. We recommend that county planners consistently delineate easements that protect all critical/sensitive ecological and scenic resources. In addition, we recommend that planners incorporate resource patterns across ownership boundaries to ensure that large, viable, interconnected areas of natural habitat are protected.

Currently no baseline study of an easement's initial conditions, or monitoring of ongoing conditions appears to be required or performed. Because baseline studies are essential for monitoring, we recommend that these studies be consistently conducted and that annual monitoring be performed. In addition, we recommend that the county enforce provisions of conservation and scenic easement deeds that allow access for monitoring and scientific research.

The boundaries of these easements appear to be insufficiently marked and documented. Easement boundaries are mapped on AutoCAD parcel records and referred to as 'S.E.' although they are conservation and scenic easements. This method makes it extremely difficult to assess the distribution and patterns of easements across large areas and makes it almost impossible to overlay easements with other data such as vegetation types and aerial photographs. Therefore, we recommend that easements be referred to as conservation and scenic easements (C.S.E), and that mapping be completed in a format usable by the county's Geographic Information System (GIS), preferably in ArcView's shape file format.

