Task 5.10
(FY85)

DRAFT

MARINA DUNES PLAN
SUPPORTING TECHNICAL STUDIES

November 1987

COASTAL ZONE
INFORMATION CENTER

Prepared for:

Marina Coastal Zone Planning Task Force

Prepared by:

Thomas Reid Associates and

The Planning Collaborative, Inc.

GC
1018
.M37
1987

COASTAL ZONE INFORMATION CENTER

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PREFACE

The Marina Dunes Coastal Zone Planning Task Force was formed in February 1986 to resolve conflicts resulting from proposed development within the habitat of a Federally listed endangered species, Smith's Blue Butterfly. The Task Force decided to prepare a plan, known as the Marina Dunes Plan, which would reconcile mandates of the Federal Endangered Species Act, the California Coastal Act, and local ordinances and policies of the City of Marina and Monterey County. The Plan would ultimately allow well planned, orderly development, consistent with needs of the local and regional population, and conservation of the important biological and coastal resources.

The Marina Dunes Plan will ultimately consist of a 1) Habitat Conservation Plan (HCP) which will set forth a program to conserve the dune ecology and the rare species found at the dunes, and 2) an amended Local Coastal Plan for Marina which would contain implementing policies consistent with the HCP. The HCP will be used as the basis for the City's application to the U.S. Dept. of Interior, Fish and Wildlife Service for a Section 10(a) permit which will allow the incidental taking of the endangered species in conjunction with limited development.

In addition to endangered species constraints, there are land use goals (public access, recreation and facilities), geotechnical constraints (slope and shoreline recession) and aesthetic values which need to be incorporated into the Marina Dunes Plan.

The Task Force hired Thomas Reid Associates (TRA) and The Planning Collaborative (TPC) to assist with the preparation of the Marina Dunes Plan. The first stage of Plan preparation involved obtaining background data on the pertinent issues. In order to cover all of the issues thoroughly TRA/TPC were assisted by experts who helped in the preparation of the technical background studies. In most instances extensive field work was involved in the preparation of the background studies.

The background technical studies presented here are meant to be used in developing an integrated plan for Marina Dunes. The studies will be used as the basis for

1) determining the initial land use concepts,
2) refining the initial concepts into a specific workable land use/conservation plan, and
3) assessing the environmental impact of actions proposed under the Plan.

In this process, each issue will be balanced against others so that the completed plan will meet the overall goals of the Marina Dunes Task Force.

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I. Public Access and Recreation

I. PUBLIC ACCESS AND RECREATION

Jeff Loux
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November 1987

A. INTRODUCTION

The following section briefly summarizes the key issues associated with Public Access and Recreation in Marina Dunes. The section is organized into three parts: the existing setting and issues; the current policy basis including both state-level and local policies; and future planning guidelines and choices.

The guidelines are not meant to be as detailed as they would be for inclusion in the Local Coastal Program. They are intended as a point of departure to focus on future desired policies. Once the Habitat Conservation Plan and land use plan is prepared and refined, the specific choices for public access can be clarified.

B. EXISTING CONDITIONS

Figures I-1 and I-2 show existing ownership and land use policy, as well as land uses and vehicular and pedestrian access within the Study Area.

Lake Drive and Reservation Road, directly off Highway 1, provide the only formal beach access in the City of Marina. Dunes Drive, off Reservation Road, is the other access point to Marina Dunes.

Lateral access exists along the entire length of the shoreline. Informal access to the dunes and use by off-road vehicles has resulted in the destruction of vegetation in some areas. Safety hazards in the dune area include the proximity of the southernmost access point to the Fort Ord rifle range to the south, and the presence of sand mining equipment and drag lines in the area between the Reservation Road and Dunes Drive access points.

The current conditions and use of each of the three existing accessways are described briefly below.

Reservation Road. This is the only developed shoreline access point in Marina. The area is owned by State Parks and provides access to Marina State Beach, as well as to the Marina County Water District (MCWD) facilities. A parking lot for 50-75 cars is located at the western end of the road at the beach; minimal restroom facilities are also available. Access to the MCWD facilities is via the parking lot. This is the only place where barrier-free access to the beach is available.

Dunes Drive. This informal access point is located at the end of Dunes Drive, where an opening in the fence is used by walkers. The property is owned by the Marina Beach Company. No formal parking lot exists; users park on the street.

Lake Court. This access is owned by the State as part of Marina State Beach. Caltrans has fenced the area and a special gate has been installed for users. An informal trail extends one-half mile to the beach. No designated parking is available; users park on the street.

Bicycle Access. Bicycle access is not formally provided to the dunes at any of the access points. A separate bicycle path along Reservation Road from Del Monte, and along the east side of Dunes Drive to Dunes Court is proposed in the City's LCP.

Future public access and recreation in Marina Dunes must be designed to respond to complex and sometimes conflicting influences. The California Coastal Act clearly identifies the potential contradiction in declaring: (1) that the coastal zone is a "delicately balanced ecosystem of vital and enduring interest to all the people," and (2) that public access to and along the coast and recreational opportunities in the coastal zone should be maximized consistent with the protection of natural resources and the rights of private property owners.

The physical setting of the dunes supports existing commercial use, existing active recreational use (i.e., hang-gliding, picnic, beach use, nature study) a sand mining industry and open dunes providing habitat for several rare and endangered plant and animal species. Future access and recreational development planned in this area must respond to all of these elements. In addition, public safety concerns related to beach access, drag-line mining at the surf zone and military operations at Fort Ord must be considered.

In addition to the existing active recreational function of the State Beach, Marina Dunes represent a coastal environment with unique opportunities for dispersed, passive recreation and interpretive programs focused on dune ecology and geology and endangered species habitats, life histories, and protection.

Two of the major tasks in future recreational planning are defining the appropriate level of use for different areas of the dunes, and determining areas which should not be served by public access. The numbers of people using an area, and hence the extent of dune erosion and destruction of vegetation, can be controlled through size, design, location, and type of trails, parking areas and other facilities, as well as by limitations on areas open to access. Existing trails along the top of the dunes and bluffs have been informally created; as a result, off-road vehicles and pedestrians have caused erosion which has diminished the extent of undisturbed native vegetation.

Policies for future access and recreation opportunities can meet Coastal Act goals only by creating a balance between public enjoyment of the dunes and protection of sensitive habitat areas. These habitat areas will demand a lower intensity of use, and, potentially, means to discourage informal access, for long-term protection. Other areas of the dunes where

informal access already exists or where habitat value is low, can support higher levels of recreational use, including development of support facilities such as picnic areas, and barrier-free access to the dunes or beach.

C. EXISTING POLICIES

The following policies provide guidance for public access within the Marina Dunes.

1. California State Coastal Act

Article 2, Sections 30210 through 30214 address public access from the state's perspective:

(1) Section 30211 states that development shall not interfere with the public's right of access to the sea including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation.

(2) Section 30212 allows exceptions to providing public access from the nearest public roadway to the shoreline in new development projects.

(3) Section 30212.5 states that parking areas shall be distributed throughout an area to mitigate against the impacts of overuse of any single area.

(4) Section 30213 encourages the provision of lower cost visitor and recreational facilities where feasible.

(5) Section 30214 describes circumstances that can be used as a basis for regulating the time, place, and manner of public access, including topography and geology, use-capacity of the site, fragility of natural resources, and the rights of private landowners.

The Coastal Commission and Coastal Conservancy have jointly adopted standards for accessway location, development and design which apply to undeveloped shorefront land. These standards provide guidance for future access rights-of-way along the coast to ensure that a consistent approach is used in establishing lateral and vertical access, upland trails, scenic overlooks, bike trails, and support facilities. Barrier-free design standards and coastal access sign standards are also addressed. These design standards should be reflected in the Local Coastal Program.

2. City of Marina Local Coastal Program

Existing policies adopted in the LCP Land Use Plan to safeguard access to the coast in the City of Marina include the following:

(1) To insure access to and along the beach consistent with the recreational needs and environmental sensitivity of Marina's Coastal area.

(2) To provide beach access and recreational opportunities consistent with public safety and the rights of property owners.

(3) To provide beach access in conjunction with new development where it is compatible with public safety, military security and natural resource protection.

(4) To provide adequate parking at designated access points. Other policies provide guidelines for access to protect visual quality in the dunes:

(5) Off-road vehicles should be prohibited on the dunes.

(6) Trails across the dunes shall be designed to protect vegetation and reduce effects of wind erosion.

The Marina LCP Land Use Plan includes a detailed discussion of access guidelines and design and management recommendations for the three designated access points -- Reservation Road, Dunes drive, and Lake Court. These guidelines provide information for future improvements and establish future levels of use.

D. SUGGESTED PLANNING GUIDELINES

The protection of sensitive habitats and potential conflicts with private property interests are likely to be the most significant constraints on public access and recreational opportunities. The designation of protected habitat areas will play an important role in determining where accessways should be located, where support facilities that encourage higher levels of use should be developed, and where special design and management guidelines should be employed to permit access without damaging habitat areas.

The location and type of future land uses in the dunes will also play an important role in determining the placement of access and recreational facilities. A specific development plan would be needed before detailed policies on site-specific access improvements can be made.

Several general guidelines provide a framework for considering public access at the dunes:

1) Compatibility with Private Land Use. Future public access improvements should be functionally and visually compatible with new development and should minimize unnecessary intrusion of public uses into private development areas.

2) Active Recreation. The more active recreational uses should be established in areas where public ownership, public facilities, and management capabilities can best be provided as they are already at the State Beach.

3) Passive Recreation/Limited Access Areas. Less developed recreation areas, where public facilities and management are not available, should

be limited to uses compatible with private land and sensitive habitats such as passive recreation, nature observation, research, and education.

More specific locational policies and design guidelines offer several feasible options:

4) Existing Access Points. Maintain the existing access options in the LCP, limited to three points: Reservation Road and Lake Court, which serve the State Beach and are proposed for the most intensive public improvement; and Dunes Drive, proposed as an access easement across privately-owned property improved minimally for use by passive recreation users. Limiting access to these three areas would concentrate use of the dunes in the southern portion of the Study Area away from the northern, more environmentally sensitive portions of the site.

This option met with general support in early Task Force meetings, except for several property owners who felt that access should be precluded at Dunes Drive to discourage public/private conflicts and keep public users near the State Beach and away from sensitive dune areas. The State Parks representative recommends that access to the northern portions of the Study Area only be allowed if the area can be responsibly protected from disturbance. To accommodate such concerns, the following modifications are suggested.

5) Existing Access with Additional Protection Guidelines. Maintain existing LCP access policies for the three access points, but add additional policies to protect dune habitat and private uses from increased public use. Protection policies could include:

   a. Boardwalks in and around intensively developed recreation areas to minimize erosion and plant disturbance (and allow physically disabled access).

   b. Fencing and gates to discourage unauthorized access onto the dunes and private areas. Barriers should be constructed around parking lots and along access roads to prevent off-road vehicles from entering the dunes.

   c. Heavily planted areas to discourage intrusion in dunes or private use areas.

   d. A uniform system of signs and maps to identify public accessways and areas where access is hazardous or restricted, private areas prohibited from use, and to provide interpretation of the habitat and natural history of the dunes.

   e. Increased State Beach and City patrol to monitor use of trails and recreational areas. Patrols could be coordinated through cooperative agreements with private landowners, State Beach, City, and other agencies if appropriate (i.e., U.S. Fish and Wildlife Service). Given the concerns for habitat preservation and private land use, guideline 5 is recommended over guideline 4.

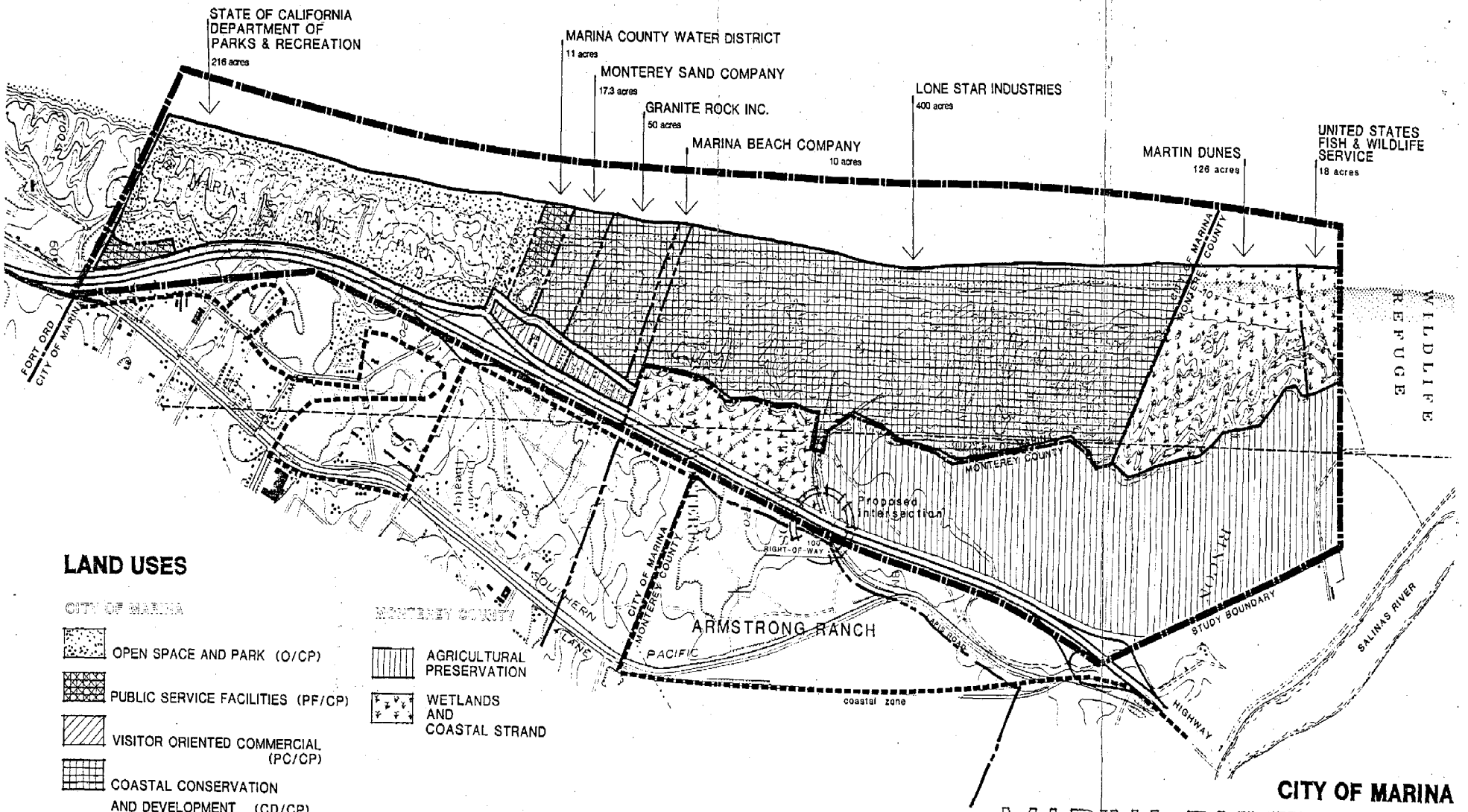
6) Additional Access Options. Several points not currently in the LCP could offer access potentials. Each needs to be studied carefully prior to final determination:

   a. The Marina Beach Company property may offer a logical access because of its inherent limitations for development. Appropriate acquisitions or easements would be needed.

   b. The main Lapis Road entry to the Lone Star property may also be useful for more intensive public access and parking as a direct link from Highway 1, if an interchange is built. The Lapis Road option is only feasible if it can be compatible with sand mining uses.

7) Passive Recreational Access to the Northern Dunes Area. Depending on the type and intensity of land use development proposed in the area adjacent to and north of the existing Lone Star mining area, additional access could be opened to the northern portions of the dunes. Portions of the existing system of informal pathways (shown on Figure I-1) could be used for trails both vertically and horizontally. Consolidating accessways would allow for revegetation of eroded areas, and limit informal "straying" into the northern portion of the dunes. Development of accessways should be concentrated in areas where development is proposed and minimized in habitat protection areas. All public access should be limited to passive activities in relatively restricted numbers to ensure habitat protection.

FIGURE I-1
OWNERSHIP AND LCP POLICY



LAND USES

CITY OF MARINA

- OPEN SPACE AND PARK (O/CP)
- PUBLIC SERVICE FACILITIES (PF/CP)
- VISITOR ORIENTED COMMERCIAL (PC/CP)
- COASTAL CONSERVATION AND DEVELOPMENT (CD/CP)

MONTEREY COUNTY

- AGRICULTURAL PRESERVATION
- WETLANDS AND COASTAL STRAND

CITY OF MARINA

MARINA DUNES PLAN

COASTAL ZONE PLANNING TASK FORCE

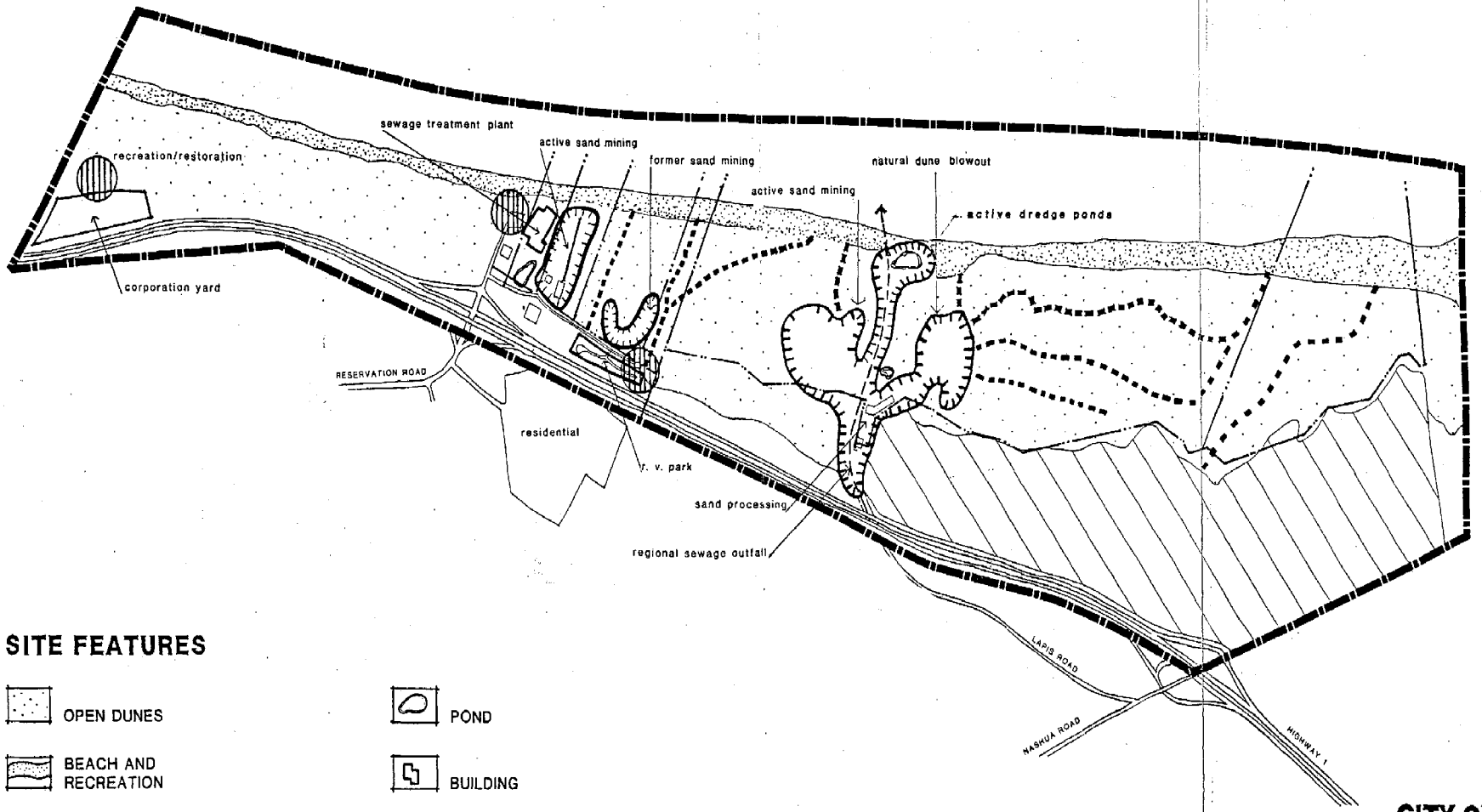
THOMAS REID ASSOCIATES
PLANNING COLLABORATIVE

AND SUPPORTING CONSULTANTS

1 acre
4 acre
north
0 400 1000 2000

NOVEMBER, 1987

FIGURE I-2
LAND USE CONTEXT



SITE FEATURES

- OPEN DUNES
- BEACH AND RECREATION
- DISTURBED AREAS
- ACTIVE AGRICULTURE
- PLANNED PEDESTRIAN ACCESS
- POND
- BUILDING
- OFF-ROAD VEHICLE
- VACANT LAND

CITY OF MARINA

MARINA DUNES PLAN

COASTAL ZONE PLANNING TASK FORCE

THOMAS REID ASSOCIATES
PLANNING COLLABORATIVE

AND SUPPORTING CONSULTANTS

1 acre
north
4acre
0 400 1000 2000

NOVEMBER, 1987

II. Public Facilities

II. PUBLIC FACILITIES

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November 1987

A. INTRODUCTION

This section summarizes information on Public Facilities issues at the Marina Dunes and provides a set of planning guidelines and policy options for future land use development. It is meant to be a relatively general treatment to accommodate a flexible range and type of potential land uses within the Study Area.

B. EXISTING CONDITIONS

The public facilities of greatest concern for future development-conservation options are water service, wastewater service, and circulation-traffic. Other utility concerns, police and fire services can only be addressed after development plans are specifically defined.

1. Water

The Marina County Water District serves the southern portions of the Study Area, while most of the northern portion is unserved or served by private wells. The District owns four wells (two in the deeper aquifer now pumping as deep as 1500 feet below the surface and two in the "middle" 400 foot aquifer of which only one is actively used) which account for all of their current supply. A six-inch water line extends along Dunes Drive to the Recreational Vehicle park and is available to serve all of the uses in that area. Limited data are available on private wells in the Study Area.

The availability and long-term capacity of high quality potable water in the Salinas Valley/Marina/Fort Ord area has been of regional concern for many years. Seawater intrusion into the usable groundwater supply of the northern Salinas Valley including the Marina/Fort Ord area has become an increasingly difficult issue. For the past three years, the Salinas Valley Seawater Intrusion Committee has been actively seeking regional solutions. The proposed Seawater Intrusion Program includes recommendations for developing a secure future water supply both for domestic users in the Marina/Fort Ord area, and for agricultural users in the Castroville area.

The Program includes an agricultural irrigation system to deliver water from a reservoir built on the Salinas River to individual farms in the areas where groundwater has become too saline for irrigation use.

The Program's potable urban water system would rely on 10 to 12 dispersed wells located between Spreckels and Chualar to supply high quality

groundwater through a pipeline to the existing water supply systems of Marina and Fort Ord. Construction of the potable water system would be paid for by bonds and annexation fees from Marina and federally allocated funds from Fort Ord. To secure the institutional changes necessary for the various financing mechanisms and to gain control over private well development, the enabling act of the Monterey County Flood Control and Water Conservation District will have to be amended; a process underway in the State legislature.

Under the proposed Program, existing private and public wells in Marina and Fort Ord would remain in service for emergency use only. The limit on the entitlement of water delivered to Marina through the project would be approximately 7,500 acre-feet per year, (an additional 7500 acre-feet per year would be used by Fort Ord), expected to be reached early in the next century. This capacity is based on future population growth figures developed by the Association of Monterey Bay Area Governments (AMBAG) and estimates of future development.

Although these estimates assume substantial commercial development of the Armstrong Ranch property, they do not reflect potential development in the Marina Dunes Study Area. As a result, service capacities based on the ultimate 7,500 AF/year limit may limit the ability of the MCWD to serve proposed future uses in the dunes. However, if private wells within the Study Area are deeded to either the Water District or Monterey County in exchange for water service, the overall entitlement for Marina may be increased to reflect this coastal pumping reduction.

At the present time, the Monterey County Flood Control and Water Conservation District, which will own and operate the irrigation and potable water systems, is gathering baseline information on wells in the affected areas and is involved in preliminary design of the system. The State legislature will be considering the amended legislation to give the County authority over private wells within the project service area and prevent the export of water from Salinas Valley aquifers. Loan and Grant applications to the Department of Water Resources and Bureau of Reclamation are pending for project support, and a subsequent environmental impact assessment will also be required before the project can be submitted for final approval.

2. Wastewater Service

The Marina County Water District currently owns and operates a 2.0 million gallons per day (mgd) treatment plant located at the western end of Reservation Road in the Marina Dunes. An eight-inch sewerage line is in place on Dunes Drive to serve that area. Excess capacity is available at the plant to serve the District's service area for buildout of uses as designated in the 1978 Marina General Plan. However, there are several unresolved issues at the present time regarding the capacity for treating wastewater generated by future use in the dunes area and about regional capacity issues.

The District's outfall into Monterey Bay is not in full compliance with Regional Water Quality Control Board requirements because the plant currently discharges into the "zone of prohibition." Decisions about whether or not the District will continue to use its existing treatment plant and dispose of wastewater through the regional outfall, or use both

the regional treatment plant and outfall line are unresolved at this time. The Marina County Water District originally declined to be a member of the regional sewage agency, due to excess capacity in the City's own sewage treatment plant. Subsequently, in the past three years, the District has been negotiating with the regional sewage agency to determine what capacity allocation might be available for Marina.

In 1980, the California Coastal Commission approved a permit for a regional sewage treatment plant and outfall line for the northern Monterey Bay/Salinas area. The regional system includes a network of five sewage plants serving Salinas, Seaside, Monterey, Castroville and Fort Ord connected to a major regional outfall built across the Lone Star property and discharged well out of the "zone of prohibition" in the Monterey Bay. A major concern facing users of the new plant is that its capacity already has been exceeded in commitments for future sewer permits. Proposed expansion has been delayed by the Environmental Protection Agency because of inconsistencies with the region's 1982 Air Quality Attainment Plan.

3. Vehicular Circulation

Highway 1 is the principal roadway serving the Study Area. Lapis Road, Reservation Road, Dunes Drive and Lake Court are the existing local roadways serving the Study Area.

According to the most recent available traffic counts gathered by Caltrans and the City of Marina Public Works Department, and based on information from a recent traffic study for the proposed Marina Landing Shopping Center (EarthMetrics, 1987), the following levels of traffic are currently supported:

Reservation Road (Source: City of Marina Dept. of Public Works)

West of Highway 1 -- 1,360 veh./day, both directions (1984 count)
East of Highway 1 -- 8,888 veh./day, both directions
15 veh./pm peak hours (1987 count)

Highway 1 (Source: CalTrans 1986 Highway Manual)

At the Salinas River Bridge -- 34,000 veh./day average
At Reservation Road -- 29,500 veh./day average
4,050 veh./peak hour

Based on these and other counts, all of the roadways (or highway) serving the Study Area are now operating at acceptable service levels (B or above). Improvements to the roadway system have been recommended in the policies of the City Circulation Element to respond to future General Plan buildout, including potential development of the Armstrong Ranch area. Improvements to the roadway system have neen recommended in the policies of the City Circulation Element to respond to future General Plan buildout, including potential development of the Armstrong Ranch area.

According to Earthmetrics Draft EIR on Marina Land (1987): "buildout of the City in accordance with the General Plan, including the Armstrong Ranch site, will significantly reduce p.m. peak hour operating conditions at most locatons. The intersection of Del Monte Boulevard and Beach Road,

assuming signalization and Beach Raod widened to four lanes, is projected to be operating at an LOS F (jammed conditions) during the p.m. peak hour, as is the intersection of Reservation Road with Beach Road and Del Monte Boulevard, assuming Reservation Road is widened to four lanes. The intersection of Reservation Road and Cardoza Avenue would be operating at an LOS D during the p.m. peak hour if signalized. The intersections of Reservation Road with Lake Drive and Seaside Avenue are projected to operate at an acceptable LOS (D or less) without signalization assuming..."

These projects suggest tha an development of the dunes needs to be coordinated and phased with development of Armstrong Ranch and accompanying roadway improvements.

C. EXISTING POLICIES

The following policies currently guide public facilities decisions in the Study Areas.

1. California State Coastal Act Policies

Article 6, Section 30254 of the Coastal Act (Development) states that new or expanded public works facilities shall be designed and limited to accommodate needs generated by development or uses permitted consistent with the provision of this division. Special districts shall not be formed or expanded except where assessment for, and provision of, the service would not induce new development inconsistent with this division. Where existing or planned public works facilities can accommodate only a limited amount of new development, services to coastal dependent land use, essential public services, basic industries vital to the economic health of the region, and recreation and visitor-serving land uses shall not be precluded by other development.

Section 30412 of the Coastal Act addresses the responsibility of the State Water Resources Control Board over water quality, and also states that any development which provides service within the coastal zone which constitutes a treatment work shall be reviewed by the Coastal Commission. Specifically, the following items with respect to such development would be reviewed: the siting and visual appearance of treatment works, the geographic limits of service areas within the coastal zone, and development projections which determine the sizing of treatment works.

2. City of Marina Local Coastal Program Policies

The Local Coastal Plan's general policy statements regarding public facilities include the following:

1) To encourage and support wastewater reclamation, where consistent with public health objectives.

2) To encourage all future development within the Coastal Zone to be served with public water.

3) To accommodate pubic works facilities which are consistent with the environmental capability of the Coastal area.

It should be noted that part of the dunes area north of Dunes Drive (i.e. Lone Star parcel) lies within the corporate limits of the City of Marina, but outside the boundaries of the Marina County Water District and also outside the District's sphere of influence. Annexation into the MCWD will require a change in the sphere of influence by LAFCO and approval of the MCWD. This property is now served from a well supporting sand mining uses. LCP policy recommends all future development should be served by public systems, but does not preclude existing uses from continuing private well use.

Circulation, access and mass transit policies are summarized and described in the LCP Land Use Plan:

1) To encourage continued and improved service by mass transit in the Coastal zone.

2) To provide adequate parking at designated beach access points to allow public access at a level consistent with the protection of the natural resource.

3) The LCP also contains guidelines for location and nature of road extensions in the Dunes Drive-Lapis Road area and provision of a new Highway 1/Lapis Road freeway interchange.

D. SUGGESTED PLANNING GUIDELINES

Future policies regarding public facilities in the dunes will depend on the exact location and intensity of development, especially in the area north of Dunes Drive where few services currently exist. The following are general guidelines appropriate at the land use plan stage. Water.

1. Water

Although future water service policies will depend on regional decisions and projects, it is clear that any new developed uses within the dunes will require public water service from the Marina County Water District, a new district served by water from Monterey County Flood Control and Water Conservation District or some feasible arrangement providing an added source of supply. To accomplish this, several actions are needed prior to development:

1) Adequate Water Supply. Development shall only occur in the dunes as adequate water supply (and quality) are available. The quantity shall be sufficient for fire protection and include an emergency factor for reserve use during a drought.

2) District Annexation. The Marina Dunes should be annexed into the Monterey County Flood Control and Water Conservation District and/or the Marina County Water District as new development is proposed to ensure adequate quality and quantity of water service. Only those areas where the Land Use Plan designates developed uses (recreation or commercial use needing a potable supply) should be annexed to prevent future growth increases outside the planned development zones. All

annexations should be consistent with LAFCO policy and Coastal Commission policy. Prior to annexation to the Marina Water District, the areas should be annexed into the District's Sphere of Influence.

3) Private Well Use. The use of existing private wells for continued sand mining operations is allowable until a feasible alternative source is developed. For all new urban uses, existing private wells are to be abandoned for emergency use only in exchange for District service. The district shall investigate whether their total Seawater Intrusion Program entitlement can increase as a result.

4) Water Allocations from Districts. As development proposals are set forth, the Water District and the Flood Control District should be apprised to initiate a review of future water planning commitments within their Spheres of Influence and district boundaries. Plans for the Armstrong Ranch and the Dunes Area should be included.

5) Water Conservation. All development within the dunes shall maximize water conservation techniques including low-flow plumbing and fixtures, and native drought-tolerant dune landscaping.

6) Wastewater Reclamation. The City should support wastewater reclamation research and projects that could contribute to the solution of the problem of increasing saltwater intrusion in northern Monterey County and that are complementary to the proposed Saltwater Intrusion Program.

2. Wastewater

Ultimate wastewater service policies are also dependent on regional decisions and commitments. The following planning guidelines are:

1) Assured Wastewater Treatment Capacity. Development shall occur as assured capacity for wastewater treatment in the regional treatment system and/or the local treatment plant is available as guaranteed through commitments from public service agencies.

2) Regional Treatment Capacity. The City of Marina and the MCWD should continue to negotiate for entitlement to capacity in the regional sewer system. To meet objectives which establish protection and restoration of the ocean's water quality and biological productivity, the existing sewage outfall line located in the Marina Dunes should be abandoned when a regional sewage agency connection is made.

3) Expanded Service Area. The MCWD should be advised of all proosed dune develoments so their service area can be expanded as necessary to serve future development designated in the Land Use plan. Capacity for wastewater service in this area should be reserved according to the following ranking of priorities:

   a. New or expanded coastal-dependent uses.

   b. New or expanded essential public service, basic industries and public recreational uses.

   c. Other uses.

4) Easements. Appropriate easements, access and alignments for utilities should be incorporated into future development plans in the dunes as consistent with other constraints and land use needs.

3. **Circulation**

Specific roadway location and design policies can not be established until a more definitive Land Use Plan has been defined. However, several general circulation/roadway policy options are available.

1) Existing Circulation Policy. Maintain existing guidelines by accepting current public road alignments and intersections (Lapis, Reservation, Lake Court, Dunes Drive) and all existing transit and parking requirements; as well as City road standards and emergency access requirements.

2) Road Extensions. Require substantial improvements to those roads logically serving proposed development areas; specifically Reservation Road, Lapis Road and Dunes Drive extension. Consider an extension or connection between Nashua Road and Dunes Drive and another between Dunes Drive and Lapis Road (possibly for emergency use only). Phase all roadway improvements to coincide with development needs.

3) Roadway Guidelines. Once a definitive land use plan is completed, consider design guidelines which limit vehicular access to the dunes to maximize long-term resource protection, yet ensure adequate and safe circulation. Examples include:

   a. Restricting the width and design of roads in the dunes to reduce grading and disturbance.

   b. Using a gate or extensive signage to limit public access to dune roads.

   c. Requiring that new development shall not significantly impact service levels on adjacent roadways or intersections.

4) Highway 1 Interchange. If future development plans are proposed for either the Armstrong Ranch area or Lone Star area, a new interchange should be constructed near Highway 1/Lapis Road to accommodate the uses. This supports existing LCP policy and Caltrans preliminary plans.

III. Views and Visual Quality

III. VIEWS AND VISUAL QUALITY

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November 1987

A. INTRODUCTION

The purpose of this issue paper is to describe the existing visual setting, define the current set of policies affecting visual resources (including state and local direction) and identify a series of options for future policy direction.

B. EXISTING CONDITIONS

For the traveller approaching the Monterey Peninsula from the north on Highway 1, the dunes, which stretch from the mouth of the Salinas River south beyond Marina State Beach and Fort Ord to Sand City, are the first visual hint of Monterey Bay.

Prominent views of the Marina dunes are first seen from the highway as it crosses the Salinas River. The dunes create the middleground and background views for both northbound and southbound travellers from the Salinas River crossing to Marina's southern city limits.

Only in the middle portion of the dunes, where natural blowouts and active sand mining have taken place, are there direct views to the waters of Monterey Bay. Water views are prominent because of the elevated freeway in this portion of Highway 1 and the removal of the back dunes from mining. This "window to the water" provides variety in the visual setting and gives the first indication that this area is the "gateway" to the Monterey Peninsula. Reconstruction of the original dunes in this location would screen the area disturbed by sand mining, but would also block or restrict views to the water.

From the beach, steep bluffs rise sharply along the State Park portion of the dunes and throughout the middle sections of the dunes, blocking most views of the interior. At the northern end of the dunes (Martin property), the beach bluffs are lower and less continuous allowing some views to the interior.

The topography of the dunes create areas which cannot be seen from either the highway or from the beach. These unseen areas vary in extent and location, but are generally within central swales between east-west trending dune ridges. The visibility of these areas from other points within the dunes varies with the elevation of the viewer. From the ridgelines, much of the dune complex is visible; from the swales between dunes, areas on top of the dunes remain hidden.

Existing structures which are visible within the dunes include the Marina County Water District facilities; several mining-related facilities standing 30 to 50 feet in height; and the motel and recreational vehicle park uses served by Dunes Drive. Several future uses have been proposed which affect views including a hotel adjacent to the Best Inn on Dunes Drive and across the road from the Monterey Sand Company property.

Figure III-1, entitled Visual Analysis, defines key visual features within the Study Area between Reservation Road and the Salinas National Wildlife Refuge. Figure III-2 defines similar, although less detailed, information for the Marina State Beach property. Less detail is provided for the State Beach because of the coarser scale of topographic data available.

Figure III-1 defines the following visual elements:

1) The zones inland of the dune ridgeline and seaward of the beach bluff (shown with a "V") which are clearly visible from both Highway 1 and the beach, respectively.

2) The zones behind the ridgeline with the darkest shading are the least visible areas, capable of "hiding" structures 35 feet high (approximately three stories) or higher from both the beach and Highway 1.

3) The zones of lighter shades are also not visible from the highway or beach. However, because of topography, these zones could only "hide" structures up to 25 feet in height (two stories) and 15 feet in height (one story), respectively. Screening or dune reshaping could further mask these areas.

4) The unshaded zones behind the ridgelines are also not visible from the highway or beach. However, most structures when built would be partially viewed from the highway. Landscape screening or dune reshaping could assist in masking structures from view.

5) The zone in the center of the Study Area (identified by view lines) where north and south bound travellers on Highway 1 experience direct water views. It should be noted that this view is experienced for a relatively short time period and is less discernible in fog, a frequent local condition.

Figure III-2 defines the dune ridgeline and beach bluff line for the State Beach. It also shows pockets within the interior of the State Beach dunes where structures could be hidden from view, although, without more precise topographic data, the extent and height of these unseen "envelopes" can not be determined.

C. EXISTING POLICIES

The following summarizes the existing policies which affect visual resources in Marina Dunes area.

1. **State-wide**

The California Coastal Act (1976, revised as of January 1987) provides the basic policy direction for protecting visual quality along the coast. Scenic and visual quality is addressed in Article 6, "Development", Section 30251 of the Coastal Act. A summary of key policies are as follows:

1) Permitted development should be sited and designed to protect views to and along the ocean and scenic coastal areas.

2) Alteration of natural land forms should be minimized.

3) Development should be visually compatible with the character of surrounding areas.

4) Development should restore and enhance visual quality in visually degraded areas where feasible.

2. **Marina**

These general policies have been translated into specific policies for the dunes in the City of Marina Local Coastal Program (April 1982). The LCP policies for protecting views of the dunes from both highway and beach can be summarized as follows:

1) Development should be prohibited on the primary ridgeline.

2) Development below the ridgeline should be limited in height and bulk to blend into the face of the dune.

3) Where physical and habitat constraints allow, structures should generally be hidden from public view; otherwise, development should be clustered and sited inconspicuously.

4) In areas where mining or blowouts have removed sand dunes, new development shall not extend above the height of the nearest adjacent sand dunes.

5) Highly visible disturbed areas should be revegetated.

6) Views of vernal ponds within the dunes should be protected.

7) No new development requiring shoreline protection structures shall be approved (with exceptions for small boat harbors, coastal dependent uses, or to protect public beaches from erosion).

3. **North Monterey County**

The northern part of the study area (Martin property) is within Monterey County and under the direction of the North Monterey County Local Coastal Program (June 1982). Although the policies strictly apply only to the northern end, the Task Force could choose to apply selected policies (or variations) to the entire Study Area.

The beaches and dunes of northern Monterey County are cited as areas

"particularly susceptible to visual damage" due to "inappropriate development." The policies pertaining to future land uses are as follows:

1) Development should be prohibited to the fullest extent possible in beach, dune, estuary, and wetland areas. Only low intensity development that can be sited, screened or designed to minimize visual impacts shall be allowed on scenic hills, slopes, and ridgelines.

2) Views to the ocean shoreline from Highway 1 shall be protected.

3) Coastal dune sand beaches should be designed for recreation or conservation land uses compatible with protection of scenic resources.

4) Scenic areas, including coastal beaches and dunes, shall be zoned for scenic conservation treatment.

5) Highly sensitive scenic areas unable to be effectively protected through regulation should be considered for public acquisition by agencies with the capacity for future management.

6) Structures shall be sited so as not to block public views of the shoreline.

7) Access roads should be allowed only where common use of neighboring roads is infeasible, and should not be allowed to intrude upon public views of open slopes or ridgelines visible from scenic routes or viewpoints.

8) Existing trees and native vegetation shall be retained to the maximum extent possible.

9) Outdoor advertising signs shall be restricted.

D. SUGGESTED PLANNING GUIDELINES

There are several planning options including maintaining existing policies, adopting variations of Monterey County's policies or applying new map-based guidelines relying on the Visual Analysis Map (Figures 1 and 2). The following options are preliminary choices covering a broad range from relatively flexible to highly restrictive. The choices are organized by issue. They are conceptual only; precise policy language will be developed later for the LCP. Additional options, "mix and match" and variations are all possible and should be considered. These planning guidelines related solely to visual resources; trade-offs between visual guidelines and other issues such as habitat protection on land use development are not examined here. The trade-offs discussion is included in the Land Use Issues Paper and will be reflected in the LCP and HCP.

1) Views from Highway 1

Option 1 - Maintain existing policy prohibiting ridgeline development; blending development into the dunes below the ridgeline; and "generally hidden" from public view.

Option 2 - Prohibit development in high visibility areas (marked "V" on the map); allow development of one to three stories in all areas within the ridgelines provided its bulk, massing, color and materials minimize visual impact to coastal scenic resources.

Option 3 - Require all development to be "hidden" from view by regulating the height and bulk of structures in the various mapped zones (three stories, one story, etc.) and screening open areas from view from both beach and highway using dune reshaping and/or revegetation.

Consensus was not reached on these options or a variation. Option 1 was preferred by some because it is flexible enough to account for changing visual conditions, whereas Options 2 and 3, linked to the Visual Analysis Map, are not readily adapted to the dynamic dune environment. Several individuals and the State Parks and Coastal Commission staffs stated that more specific guidelines need to be added to strengthen any of the three options. State Parks and Commission staffs were also concerned about an unspecified amount of dune reshaping allowed under Option 3.

For further planning purposes, the consultant recommends maintaining existing LCP policy (Option 1), but adding more specific criteria which define: allowable building envelopes and heights based on the results of the HCP/LCP and the Visual Analysis Map; required architectural standards (e.g. color, materials, detailing) and design treatment; type and amount of allowable screening (if any) and a definition for "generally or partially hidden." Such criteria could be developed as part of the LCP amendment or later as development proceeds.

2) Views of Water

Option 1 - Adopt Monterey County policy of protecting all views to water.

Option 2 - Maintain view corridors to the water allowing low-scale development in selected portions of the water view (i.e., where structures, tree masses or disturbed areas are currently located).

Option 3 - Eliminate part or all of the water view by constructing a restored dune ridgeline, thereby creating "hidden" areas for development.

Opinion was again split; private landowners generally favored Option 3 while Coastal Commission staff, State Park staff and others preferred Options 1 or 2.

For further planning purposes, the consultant recommends Option 2 as an acceptable compromise, particularly since the existing water view is brief and severely impaired by sand mining structures and activities. Option 2 could be modified to allow for "minor dune restoration or reshaping in disturbed areas to visually blend developed uses with the surrounding dune landscape." The State Parks representatie favored Option 1. Option 2 would severely limit developed uses in the Lone Star area and/or require major

dune reshaping.

3) Views from the Beach

Option 1 - Maintain existing policy offering no definitive direction.

Option 2 - Prohibit development in the High Visibility Areas (the erosion set-back policy may make this redundant); require all structures to be hidden within one, two or three-story zones.

Option 3 - Allow development to be partially viewed from the beach provided that architectural treatment (color, materials, etc.) is compatible with the setting and does not detract from the recreational experience.

Option 4 - Allow dune reshaping to create hidden pockets for development.

Several property owners supported Policy 3, while Coastal Commission and State Parks staff members preferred Option 2 if it could be achieved consistent with other resource constraints. Commission staff does not feel that any policy allowing dune reshaping for visual screening is consistent with the Coastal Act.

For further planning purposes, the consultant recommends Option 3 with a minor addition: "and does not require dune reshaping to create developable zones." Option 1 provides no direction; Option 2 may be moot given setback requirements; and Option 4 appears inconsistent with the Coastal Act.

4) Architectural Treatment Materials and Design

Option 1 - Maintain existing policy requiring "blending" and "inconspicuous" structures.

Option 2 - Require that all architectural design be compatible with the dune setting and respond to pre-stated criteria such as use of dune colors; wood/stucco or other non-reflective material; articulated rooflines which mimic the dune ridgeline or repeat the duneform; minimal signage; etc.

City Planning Commission would assess findings of compatibility and recommend to the City Council.

There was general agreement that Option 2 is preferred. It is similar to Option 1, but provides more definitive guidance.

5) Landscaping

Option 1 - Require revegetation of all dune areas disturbed by mining, blow-outs or development limiting landscaping to native dune plants which provide suitable habitat for Smith's Blue Butterfly, Black Legless Lizard and other species of concern.

Option 2 - Allow an exception to the above for selected naturalized trees to be planted for screening or aesthetic purposes (cypress, Monterey Pine, Melalenca, Myoperum).

Option 3 - Same as Option 1, except "encourage" instead of "require".

Several members felt that Option 1 was too restrictive and not feasible in several large mined areas. Coastal Commission and State Parks staffs were concerned that non-native landscaping was in conflict with Coastal Act habitat objectives. This precluded Option 3 and led them to prefer Option 1. State Parks felt that trees should only be allowed where they would be hidden from view within developed areas.

For continued planning purposes, the consultant recommends Option 2 with the caveat that non-native landscaping and trees are only to be allowed in "already-disturbed areas within future development zones on a limited case-by-case basis."

6) Dune Restoration

Option 1 - Maintain existing policy that highly visible disturbed areas should be restored.

Option 2 - Require dune reshaping and revegetation in all sites disturbed by mining or ORV use as development occurs.

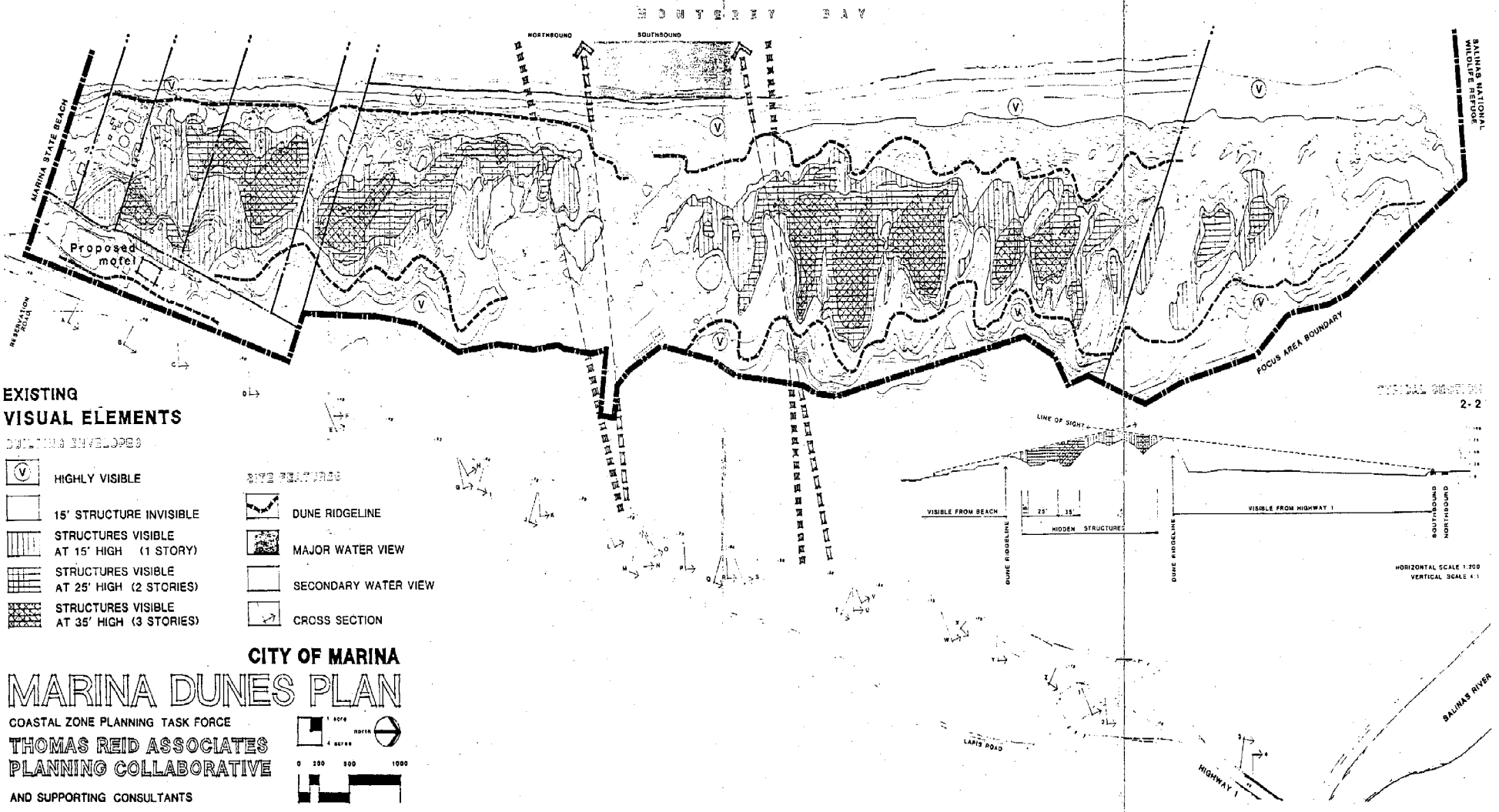
Option 3 - Allow dune reshaping and revegetation in all sites disturbed by mining or ORV use as development occurs, where it would enhance the area's visual value.

Landowners generally favor Option 3, while several public agency and environmental representatives favor Option 2, requiring restoration as development occurs. A compromise position could be to "encourage" dune restoration using native dune species and returning dunes to a naturalized height, slope and form in all disturbed areas, and to require restoration in specific problem spots identified for restoration by the HCP.

7) Access Roads

Minimize the visual impact resulting from access roads, driveways and parking areas needed to serve developed uses from both Highway 1 and the beach. Site roadways in less visible locations where feasible, and minimize the necessary grading and cut and fill slopes. Revegetate the edges of access roads and driveways with native dune plants to reduce visual impact.

FIGURE III-1
VISUAL ANALYSIS



EXISTING VISUAL ELEMENTS

VISUAL ENVELOPES

- HIGHLY VISIBLE
- 15' STRUCTURE INVISIBLE
- STRUCTURES VISIBLE AT 15' HIGH (1 STORY)
- STRUCTURES VISIBLE AT 25' HIGH (2 STORIES)
- STRUCTURES VISIBLE AT 35' HIGH (3 STORIES)

SITE FEATURES

- DUNE RIDGELINE
- MAJOR WATER VIEW
- SECONDARY WATER VIEW
- CROSS SECTION

CITY OF MARINA

MARINA DUNES PLAN

COASTAL ZONE PLANNING TASK FORCE

THOMAS REID ASSOCIATES
PLANNING COLLABORATIVE

AND SUPPORTING CONSULTANTS

1 acre
4 acres
north
0 250 500 1000

NOVEMBER, 1987

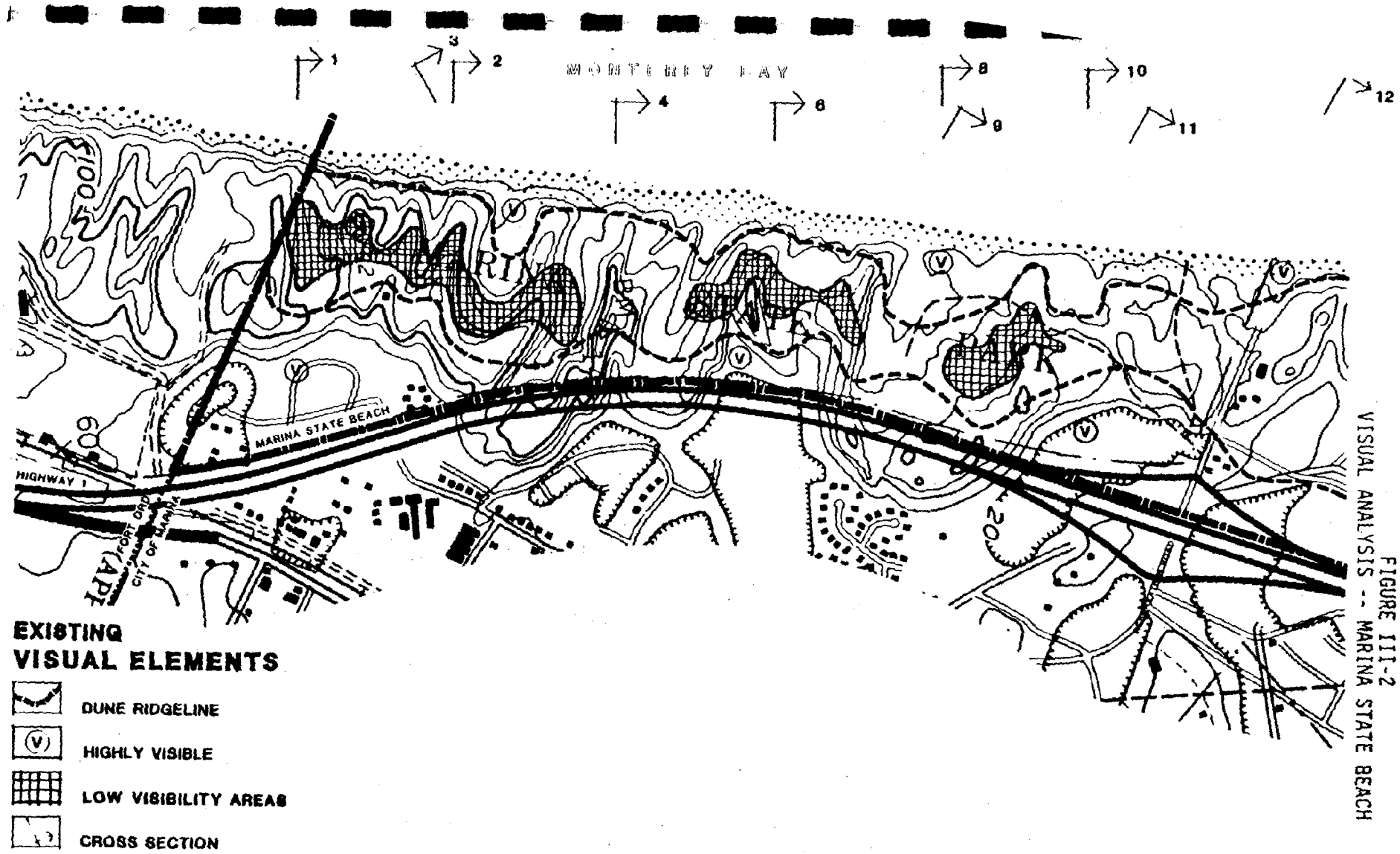


FIGURE III-2
VISUAL ANALYSIS -- MARINA STATE BEACH

CITY OF MARINA

MARINA DUNES PLAN

COASTAL ZONE PLANNING TASK FORCE

THOMAS REID ASSOCIATES
PLANNING COLLABORATIVE

1 acre
4 acres
north

0 200 500 1000

NOVEMBER, 1987

IV. Rare Plant Survey

IV. RARE PLANT SURVEY

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November 1987

A. INTRODUCTION

The purpose of this issue paper is to describe the plant communities found at Marina Dunes and identify specific locations where rare plants occur. The information contained in this paper will be used as a basis for preparing a Habitat Conservation Plan (HCP) for Marina Dunes, along with other issue papers. The HCP will integrate information contained in this paper and address specific conservation strategies for rare plants. This paper should be used as a background report when reading the papers on the Smith's Blue butterfly and Black Legless Lizard.

B. EXISTING CONDITIONS

1. Regional Context

The Monterey Bay dune system extends from Monterey harbor to just beyond the Salinas River mouth in Monterey County, California. The system is comprised of three types of dunes defined by their geologic age: 1) recent dunes, formed from recent alluvial depositions of the Salinas and Pajaro rivers, 2) Flandrian dunes formed and stabilized during the Wisconsin glaciation, and 3) pre-Flandrian dunes formed and stabilized before the Wisconsin glaciation (Cooper 1967, Pavlik 1980).

The different geologic histories of these dunes gives rise to an unusual mosaic of dune vegetation, a mosaic that is found nowhere else along the Pacific Coast of North America (Pavlik and Zoger, in prep.). The ecological and historical factors that lead to such a rich assemblage of dune plant communities are the same factors that lead to the origin and evolution of new plant varieties. It is not surprising, therefore, to find three rare, threatened and/or endangered (RTE) plant taxa growing on these dunes: Erysimum menziesii (Hook.) Wettst., Gilia tenuiflora Benth. ssp. arenaria (Benth.) A. & V. Grant, and Chorizanthe pungens Benth. var. pungens (Table IV-1).

To provide protection for these species populations, accurate descriptions of their actual and potential distributions, demographic attributes and habitat requirements should be obtained. Preservation of these species requires that the unique physical and biological conditions upon which they ultimately depend also be preserved.

2. Study Objectives

The main objectives of the survey were to determine the 1) location and characteristics of RTE plant populations and 2) distribution and characteristics of dune vegetation that is likely to support RTE plant populations in this and other years. These two objectives allow for the delineation of actual and potential RTE plant habitat, respectively, for the study area as a whole. Such delineations will be expressed in the form of a vegetation/habitat map as well as textual descriptions of the populations and their apparent habitat requirements. The vegetation/habitat map in shown as Figure IV-1. The study methodology is described in Appendix IV-A. A list of acronyms used in this paper is included in Appendix IV-B.

3. Study Location

The Monterey Bay dunes were surveyed from the southern border of Marina State Beach to the northern border of the Martin dunes, covering six different properties:

1) Marina State Beach,
2) Monterey Sand Company,
3) Graniterock Company,
4) Gullwing,
5) Lone Star Industries, and
6) Martin Dunes

The general geology, climate and vegetation of this region has been discussed by Griffin (1978), Pavlik (1980) and Axelrod (1982). The portion of the Monterey Bay dunes surveyed is located within the City of Marina and Monterey County. In order to distinguish between the study site and the entire dune system, the study site dunes are referred to as Marina Dunes throughout this report.

Table IV-1. The status of Erysimum menziesii (ERME), Gilia tenuiflora ssp. arenaria (GITE), Chorizanthe pungens var. pungens (CHPU) and Erysimum ammophilum (ERAM) as recognized by the California Native Plant Society (CNPS), State of California and the United States Government.

	CNPS* r-e-v-d	State	Federal
ERME	2-2-2-3	endangered	considered for listing
GITE	3-3-3-3	threatened	considered for listing
CHPU	2-2-2-3	---------	----------
ERAM	1-2-2-3	---------	considered for listing

* CNPS listing system:

RARITY (r) 1 = rare, 2 = several populations, 3 = one population
ENDANGERMENT (e) 1 = not endangered, 2 = endangered in portion of range, 3 = throughout range

VIGOR (v) 1 = increasing, 2 = declining, 3 = near extinction
DISTRIBUTION (d) 1 = widespread, 2 = rare outside Calif. 3 = endemic to California

4. Results and Discussion

a. Presence of RTE Plant Populations

There were three RTE plant species found on five of the six properties surveyed; the Marina State Beach, Granite Rock, Gullwing, Lone Star and Martin properties (Table IV-2, Figure IV-2). These were Erysimum menziesii, Gilia tenuiflora ssp. arenaria, and Chorizanthe pungens var. pungens. (Table IV-5).

Table IV-2. Presence of RTE plants on the properties included in the survey. Erysimum menziesii (ERME), Gilia tenuiflora ssp. arenaria (GITE) and Chorizanthe pungens var. pungens (CHPU).

	ERME	GITE	CHPU
Marina State Beach	X	X	X
Monterey sand			
Graniterock		X	X
Gullwing			X
Lone star	X	X	X
Martin		X	X

b. Habitat Requirements of RTE Plant Populations

Erysimum menziesii

Erysimum menziesii grows on the strand, close to the highest high tide line with other strand species, such as Camissonia cheiranthifolia, Calystegia soldanella, Cakile maritima, Ambrosia chamissonis, Carpobrotus spp., and Abronia latifolia. Here the vegetation is very open. The sand is loose with very little organic matter and low mineral nutrient content. Exposure to wind and salt spray is high (Table IV-3). The plant has bright flowers and unusual form, making it easy to spot and identify (R. Price, personal communication, 4/87) and (K. Berg 1987). Because strand vegetation is particularly vulnerable to wind, wave and storm action, populations of Erysimum menziesii can be very dynamic, disappearing from a known locality due to a storm surge, and then appearing at a new location as seeds are washed on shore by waves. Therefore, the entire strand could be considered potential habitat for Erysimum menziesii. In addition, areas of recent bluff scrub might also constitute potential habitat because similar physical conditions and species exist there. Areas of recent bluff scrub were searched for E. menziesii but no individuals were found.

Table IV-3. Macro- and micro- indicators of potential habitat for Gilia tenuiflora ssp. arenaria (GITE), Erysimum menziesii (ERME), and Chorizanthe pungens var. pungens (CHPU). Indicators include vegetation type, slope, soil, and associate species.

	GITE	ERME	CHPU
MACRO	Flandrian veg. northwest-facing slopes	strand, recent bluff	all vegetation types
MICRO	moss on dune surface soil build up associate spp: Vulpia octoflora, Linaria canadensis, Plagiobothrys sp.	loose sand little organic matter high salt spray associate spp: Abronia latifolia Ambrosia chamissonis Calystegia soldanella Camissonia cheiranthifolia Dudleya farinosa	open, sandy patches low cover

Gilia tenuiflora ssp. arenaria

Gilia tenuiflora ssp. arenaria is known to occur on Flandrian dunes with other Flandrian dune scrub species, such as Artemisia pycnocephala, Corethrogyne leucophylla, Dudleya farinosa and Eriogonum latifolium. In addition, it is more likely to appear where there is denser, woodier vegetation, some litter accumulation, soil development, and less exposure to salt spray, high winds, waves and storm surges. Open patches of sand and soil still comprise a significant portion of the ground area and these patches are apparently important for Gilia colonization (J. Ferreira, pers. comm. 4/87). While searching for G. tenuiflora ssp. arenaria, it was noted that populations tended to occur in small, open swales, on northwest-facing slopes where there was litter accumulation due to species like Chorizanthe spp., Cardionema ramosissimum and Polygonum paronychia. These species all have a mat-like growth form that stabilizes the dune surface. In addition, there was some soil development and stabilization due to mosses and lichen on the dune surface. G. tenuiflora always occurred with Vulpia octoflora, a small annual grass (approximately 2 cm tall, easy to overlook, but usually abundant), and generally with several other small annuals: Linaria canadensis and Plagiobothrys sp. (Table IV-3). These are good species to use when attempting to locate the small, delicate G. tenuiflora which is easy to miss after the plants finish flowering and become senescent.

Chorizanthe pungens var. pungens

Chorizanthe pungens var. pungens has been found as close to the ocean as the strand and as far inland as the pre-Flandrian dune surface. It is associated with many different species, including Ambrosia chamissonis, Artemisia pycnocephala and Ericameria ericoides (Table IV-3). It has a wide habitat range and tends to occur on bare sandy patches where there is not much vegetation cover (V. Yadon, personal communication, 5/87). Thus, the entire

study location can be considered potential habitat for C. pungens var. pungens.

In addition, there are two other species of Chorizanthe found at the Marina Dunes; C. cuspidata and C. diffusa. These are very similar to C. pungens var pungens. These three can be easily mistaken for each other in the field and can only be distinguished by careful examination using a dissection microscope. Neither of the three appears to be more common in one habitat than another (V. Yadon, pers. comm. 4/87).

c. RTE Plant Population Survey

Using the habitat requirements of each taxon, information from institutions and individuals and the vegetation map (Figure IV-1), known populations of Erysimum menziesii, Gilia tenuiflora ssp. arenaria and Chrorizanthe pungens var. pungens were re-located and described. New populations were also found and described. Previously known and new populations are shown on the RTE plant survey map (Figure IV-2).

Erysimum menziesii

Erysimum menziesii occurs in Monterey and Mendocino counties, occupying similar strand and foredune habitats. The Marina dunes population, however, is significantly different from those in Mendocino and even other populations in Monterey county (R. Price, pers. comm. 4/87). The Marina population flowers 2 months later than the population at Asilomar near Pacific Grove and those in Mendocino County. It is more strongly perennial and retains the leaf petioles from successive years of growth, thus allowing for estimates of plant age (R. Price, pers. comm. 4/87). Apparently, the Marina population is reproductively isolated from other populations and some systematists feel it should be recognized as a distinct and, therefore, highly endemic subspecies of E. menziesii (R. Price, personal communication).

There are only two localities for the Marina race of E. menziesii in Marina Dunes; Marina State Beach and Lone Star property (Figure IV- 2). The population on Lone Star property consists of 13,900 individual plants, approximately half of which are first year rosettes. These 13,900 individuals cover an area of the strand and lower foredune from the dredging pond to the "No Trespassing" sign on the north side of the property. They were very dense (16.3 plants/m2 on the average) and in good health. Only 0.2% of all plants were infected by a leaf fungus. This could be an underestimate of the fungal impact on the population, since the fungus caused leaves to be shed early and plants with those leaves would not have been included in our estimate (Table IV-4). At the time of the survey (early May 1987), the plants were just displaying flower buds and only a few plants had open flowers. The Lone Star population is much larger and denser than the population at Marina State Beach.

Table IV-4. Population attributes of Erysimum menziesii on Marina Dunes properties. All data gathered during the present study.

Population Attributes	PROPERTIES: Lone Star	Gullwing, Granite Rock, Monterey Sand, Martin
Number of plants	13,900	0.0
Area of pop.	851 m2	0.0 m2
Density of pop.	16.3/m2	0.0
Spatial arrangement	dense, clumped	-----
Vigor of pop.	strong	-----
Fungal infection.	0.2% of population	-----
Age structure of pop.	50% of population first year rosettes	-----

The Marina State Beach population had shrunk to 300 individuals by 1985 (Table IV-5). As part of the revegetation program conducted by California State Parks (CSP), 8,000 E. menziesii individuals were propagated and planted in the winter of 1985-86 and 5,000 in the winter of 1986-87 (Table IV-10). The survival rates of these propagules have been described, but not yet quantified by CSP staff. Some areas had a 100% survival rate, while others had a 100% mortality rate. An estimate of the average survival rate would be 80% (J. Ferriera, pers. comm. 6/87). Thus, even with artificial propagation (whose success is not yet guaranteed), the MSB population is smaller (approximately 10,700 individuals) than that of the Lone Star population (approximately 13,900 individuals). In the event that the Lone Star population were to be threatened or destroyed, the remaining population at Marina State Beach is primarily comprised of propagated genotyped that have an uncertain long term survival rate and an unknown ability to propagate themselves.

Table IV-5. Comparative sizes of Erysimum menziesii populations from the Marina State Beach original population (MSBO), the propagated population from Marina State Beach (MSBP), and the population at Lone Star properties (LS).

YEAR	MSBO	MSBP	LS
1985-86	300	8,000*	----
1986-87	----	5,000*	13,900

* Number of plants propagated during this year, not including previous years.
---- data unavailable for this year

Populations of E. menziesii are very dynamic, in part because the plants are short-lived perennials and also because they occur in a very dynamic habitat. As a result, Monterey Bay populations are known to appear and disappear all along the coastal strand. Storm waves, tides, strong

winds and water currents remove established plants and deposit their fruits and seeds in a new locality. For example, in the late 1970's a large population was know to occur in the strand immediately south of the Salinas River mouth (Specimens from this locality were collected by A. Johnson and deposited at the U.C. Davis herbarium.). By 1980, storm waves and changes in the river mouth had completely obliterated the population (Pavlik 1980). Apparently, propagules from this population were transported south, contributing to the wide distribution of E. menziesii along the Lone Star property. Given this kind of dynamism, it is important to preserve the areas where populations now occur and areas of potential habitat all along the central coast of Monterey Bay.

Gilia tenuiflora ssp. arenaria

Gilia tenuiflora ssp. arenaria is found within the Monterey Dunes from just north of the City of Monterey to north of the Salinas River mouth. It is also found in the Asilomar Dune system. There is a great deal of fluctuation in the population size of this species from year to year. In addition, when surveys are done by different individuals, the method and results are not necessarily comparable, and the actual differences between these populations are obscured.

The largest populations of G. t. ssp. arenaria at Marina Dunes were found on the northern section of Lone Star property (Figure IV-2). Approximately 2295 individuals were counted and the population had an average density of 0.40 plants/m2 (Table IV-6). The 1987 census is the only census that has been taken of the Lone Star population. Because it was a drought year, it is likely that this is an underestimate of the population for two reasons: 1) many of the seeds in the seed bank probably lay dormant due to poor rainfall levels, and 2) most of the individuals in the population were senescent at the time of the census (April and May, 1987) and were therefore difficult to find. For these reasons it seems likely that the Lone Star population of G. t. spp. arenaria is several order of magnitudes greater than the present estimate. Despite the above difficulties, it is clear that the population of the Gilia on the Lone Star property is one of the largest populations found anywhere in this species' range (Table IV-7).

Table IV-6. Population attributes of Gilia tenuiflora ssp. arenaria on the Marina Dunes properties. All data gathered during the present study.

	PROPERTIES				
Population Attributes	All	Lone Star	Martin	Granite Rock	Gullwing, Monterey Sand
number of plants	2295	2229	60	6	0
area of pop.	5698 m2	5596 m2	60 m2	42 m2	0
density of pop.	0.4/m2	0.4/m2	1/m2	0.14/m2	0
percent flowering	0.7%	0.7%	3.3%	0.0%	0
percent senescent	99%	99%	97%	100%	0

Table IV-7. Comparative sizes of Gilia tenuiflora spp. arenaria populations from Marina State Beach (MSB), Salinas River State Beach (SRSB), Sand City (SC), the Lone Star Properties (LS), the Graniterock property (GR) and the Martin Dunes (MD).

Year	MSB	SRSB	SC	LS	GR	MD
1985	10,000*	-	-	-	-	-
1986	300*	10,000*	10,000*	-	-	-
1987	-	1,165*	5,000	2,229	6	60

* data collected by California State Parks
\- data unavailable for this year

The Flandrian dune habitat of Gilia tenuiflora ssp. arenaria is less subject to disturbance by storm waves and tides, but the open nature of its characteristic vegetation (Pavlik 1980, Pavlik and Zoger in prep.) permits disturbance of the dune surface by wind. As a result, propagules of this taxon, being lightweight, are dispersed throughout the dune. The population is widely and contiguously distributed on a local scale but interrupted by large areas of unpopulated, high quality dune habitat (Figures IV-1 and IV-2). The factors that lead to such a distribution remain obscure.

Chorizanthe pungens var. Pungens

Chorizanthe pungens is one of three Chorizanthe species found on the dunes of Monterey Bay: Chorizanthe pungens var. pungens (the RTE taxon of interest here), C. cuspidata and C. diffusa. The three species of Chorizanthe were widely distributed throughout the study site. Of the Chorizanthe spp. sampled, 18.9% were C. pungens var. pungens, 28.6% were C. cuspidata/pungens (these individuals showed characteristics of both species), 37% were C. cuspidata, and 15.4 % were C. diffusa. (Table IV-8).

Table IV-8. Chorizanthe taxa found on Marina Dunes: Chorizanthe pungens var. pungens (CHPU) the species of interest, Chorizanthe cuspidata (CHCU), Chorizanthe diffusa (CHDI), and individual plants that had characteristics of both C. pungens and C. cuspidata (CHCU/PU). The total number of plants (observed in all samples) belonging to each taxon is followed by the percentage of each in parentheses.

	All Sites	Martin and Lone Star	Graniterock and Gullwing
CHPU	43 (18.9%)	30 (28.0%)	13 (10.8%)
CHCU	84 (37%)	45 (42.0%)	39 (32.5%)
CHDI	35 (15.4%)	15 (14%)	20 (16.7%)
CHCU/PU	65 (28.6%)	17 (15.9%)	48 (40.0%)
Total	227 (100%)	107 (100%)	120 (100%)

These are rough estimates of the proportion of the total Chorizanthe population comprised by each of these three species.

Of the three Chorizanthe species, only C. diffusa is readily distinguished from the other two species in the field. C. cuspidata and C. pungens var. pungens are much more difficult to identify in the field. The characteristic that distinguishes C. cuspidata from C. pungens var. pungens is the shape of the sepals (which look like petals in this genus) (Figure IV-1), but this characteristic presents a number of difficulties. First, this feature is best detected with a dissecting microscope in the lab. It can be seen with a 7x hand lens, but not reliably. As a result, C. pungens var. pungens is a very difficult species to detect and census during a field survey. Secondly, Vern Yadon of the Pacific Grove Natural History Museum has noted that C. pungens var. pungens tends to be more readily identified towards the end of the summer season (August), among individuals that he had identified as C. cuspidata during the spring. At best, this observation indicates that the timing of our census was inappropriate. Finally, Mr. Yadon regularly finds individuals with flowers that exhibit C. cuspidata or C. pungens var. pungens characteristics at the same time. These observations call into question the validity of these two species, leading Mr. Yadon to speculate that they are instead varieties or subspecies of the same species. There is no concrete evidence, however, to show that C. cuspidata and C. pungens hybridize. Clearly, there needs to be more work done on the systematics of these taxa before the distribution and abundance of RTE Chorizanthe taxa can be resolved at the study site.

Other Taxa of Concern

Also found throughout the study site were the following taxa of concern:

1) Erysimum ammophilum is a Federal category 2 Candidate species and is listed as threatened by CNPS (1-2-2-3). This plant is widely distributed among Flandrian dunes of the Lone Star Property. It is particularly abundant on dune slopes that face the ocean. E. ammophilum is also found in strand and recent bluff scrub vegetation. It is abundant from the south on the Marina State Beach property all the way to the north on the Martin property.

2) Eriogonum latifolium and E. parvifolium are of concern because they support populations of Smith's Blue Butterfly (Euphilotes enoptes smithi). E. parvifolium is found on the strand in Marina State Beach and on the Lone Star property. E. latifolium is found throughout the study site in Flandrian dune, recent dune and mesic swale scrub vegetation.

4. Potential Habitats of the RTE Plants

Areas of undisturbed vegetation (see Appendix IV-A section and Figure IV-1) were designated as potential RTE plant habitat and used to focus the intensive surveys for each taxon. Thus, the strand vegetation and recent bluff scrub are to be regarded as potential habitat for Erysimum menziesii (Table IV-2), while Flandrian dune scrub is potential habitat for Gilia tenuiflora ssp. arenaria (Table IV-2). All undisturbed dune vegetation

(recent dune scrub, recent bluff scrub, Flandrian dune scrub, and pre-Flandrian dune scrub) should be considered as potential habitat for Chorizanthe pungens var. pungens until the aforementioned taxonomic problems are resolved (Table IV-2).

5. Rare and Endangered Dune Vegetation along Monterey Bay

The Flandrian dune scrub, chiefly found on the Martin and Lone Star Properties (Figure IV-1), is a unique vegetation type not found at any other location along the coast of western North America (Pavlik and Zoger, in prep.). The species that comprise this vegetation are, for the most part, not unique because they may be found in other stands of dune scrub vegetation to the north and south (Barbour and Johnson 1977). It is the structure of this vegetation that is unique. The community-level relationships of these species, the way in which they grow together, makes the Flandrian dune scrub of the Monterey Bay different from any other dune scrub (Pavlik and Zoger, in prep.). In addition, these dunes also have the distinction of being practically free of Ammophila arenaria, an introduced beach grass that invades and degrades native strand and dune communities along the Pacific coast (Barbour and Johnson 1977, Pavlik 1982). It is rare to find dune vegetation today in California that is not slowly, or not so slowly, being destroyed by this exotic grass. The preservation of contiguous areas of pristine Flandrian dune vegetation would allow for the dynamism that sustains and characterizes the RTE plant populations and the Monterey Bay ecosystem as a whole.

6. Conclusions

The growth of California's population and the subsequent development of its land and resources threatens a large and growing number of rare and endangered plants species and their habitats. California's dune systems are among the areas that are rapidly being developed for minerals, construction materials, housing and recreation. The dunes of Monterey Bay are no exception to this trend. The Monterey Dunes are, however, unique with respect to floristic composition and vegetation structure. We know of no other dunes of this kind that have been preserved, other thant the small parcel at the Salinas Lagoon National Wildlife Refuge.

There are at least three RTE plant species found in the study site near the city of Marina. Of these three species, the distinctive populations of Erysimum menziesii (perhaps a new subspecies) are restricted to the study location. The E. menziesii population found on the Lone Star property is the largest (14,000 individuals) and most vigorous of the two populations known at the present time. The other, smaller population occurs at Marina State Beach. One of the largest known populations of Gilia tenuiflora ssp. arenaria occurs on the Lone Star property. The estimate of 2300 individuals of G. tenuiflora ssp. arenaria is conservative because of the condition of the population at the time of the survey. We also think that Chorizanthe pungens var. pungens occurs throughout the study site, but taxonomic difficulties preclude any concrete designation of actual or potential habitat.

These taxa are comprised of dynamic populations that do not necessarily remain in one place for many successive years. To protect the survivability of these populations, large, contiguous areas of potential habitat should be

preserved and protected. The areas of greatest concern are areas of potential habitat for the RTE plant species listed below:

Erysimum menziesii. The potential habitat includes all strand and recent bluff scrub vegetation, regardless of disturbance. This is a very dynamic habitat, subject to frequent natural disturbance (wind, wave, storm) that could destroy one population in one area and transport its propogules to a new and disjunct location.

Gilia tenuiflora ssp. arenaria. The potential habitat for this species encompasses all Flandrian dune scrub that has not suffered major disturbance (e.g. mining, ORV use).

Chorizanthe pungens var. pungens. The potential habitat for this species would be all of the vegetation types-strand, recent bluff scrub, recent dune scrub, Flandrian dune scrub, mesic swale scrub, pre-Flandrian oak woodland, disturbed vegetation, and bare sand (e.g. ORV caused blow outs).

Large storms are a regular occurrence on this coast, and Erysimum menziesii populations are frequently destroyed. They subsequently reappear in other stands of strand vegetation around the central Monterey Bay. Populations of the annual Gilia tenuiflora ssp. arenaria are also mobile, being dispersed through its open dune habitat by the wind. Such plants are also susceptible to fluctuations in yearly rainfall, temperature, and the relative abundance of other, competing species. The beach and dunes that form the foundation of these coastal habitats are dynamic geological structures, constantly in motion, constantly built and degraded, constantly in a state of change. The propensity for change observed in these biological and geological entities should be accommodated by management plans devised for the study site. The preservation of large contiguous areas of potential habitat will allow natural plant migration and provide a buffer against future disturbance.

C. EXISTING POLICIES

Existing laws and policies relevant to rare plants are described in a separate paper (section XIII) and relate to all biological resources. Please refer to this paper.

D. RECOMMENDED PLANNING GUIDELINES

These suggested planning guidelines are specific to rare plants and are in addition to those described for overall biological resources (see Section VIII).

1) Minimize the taking of the known populations of Erysimum menziesii, Gilia tenuiflora spp. arenaria and Chorizanthe pugens var. pugens and provide mitigation measures if taking occurs.

2) Protect and enhance sufficient areas of adjoining potential habitat to account for the mobility of Erysimum and Gilia.

3) Establish restoration areas appropriate for the above designated

species to maintain the population of such species at Marina Dunes as a means of mitigating loss of plants due to taking. The restoration should be done in areas appropriate for each species (i.e. Flandrian dune habitat for the Gilia and Chorizanthe, and coastal stand habitat for the Erysimum, in order to increase the population of each of the RTE plants at Marina Dunes. Determine appropriate propagation methods for each species prior to large scale planting.

4) Control invasive, exotic species (especially Ammophila arenaria and Carpobrotus spp.) and regulate actions that encourage their propagation within stands of native vegetation. The latter includes landscaping and gardening practices, dumping of large amounts of wastewater onto the dunes (as is being done on the northern section of the Lone Star property) and dumping of garbage containing live plant material.

5) A status survey of the population of the RTE plant species at the Marina Dunes should be made annually during the initial years of implementation of the Habitat Conservation Plan.

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APPENDIX IV-A: STUDY METHODOLOGY

1. Sites of Known Occurrence

In order to document the distribution, demographic attributes and habitat requirements of the known RTE plant populations in Marina Dunes area, the following institutional sources were consulted: California Natural Diversity Data Base (CNDDB, administered by the state of California, Department of Fish and Game), herbaria administered by the University of California at Berkeley and the California Academy of Science, the Pacific Grove Natural History Museum, the Nature Conservancy, and the Monterey Chapter of the California Native Plant Society (CNPS).

Expert individuals were also contacted with regards to these populations: 1) Ms. Jean Ferreira, California state parks resource ecologist, has been surveying Gilia tenuiflora ssp. arenaria for several years and was able to provide detailed information on habitat requirements and potential habitat, 2) Mr. Robert Price, a Ph.D candidate at U.C. Berkeley, is completing a thesis on the genus Erysimum and has been observing the Erysimum menziesii population at Marina for several years, 3) Mr. Vern Yadon, Curator of the Pacific Grove Natural History Museum, provided information on the distribution, identification and demographics of Chorizanthe pungens var. pungens which he has observed for a number of years. These institutions and individuals provided up-to-date localities and field observations that were used to select some of the sites for intensive search. When confirmed by this survey, these locations were mapped on the RTE plant survey map.

2. Sites of Potential Occurrence

Additional sites for intensive search were selected on the assumption that previously unknown populations of RTE taxa might occur in the Marina Dunes. Habitat information obtained from herbarium labels, CNDDB, CNPS rare plant status reports and the individuals cited above was superimposed on the vegetation map so that "high probability" areas could be identified and searched. It was determined that Erysimum menziesii is associated only with strand vegetation and, therefore, the area that had been mapped as strand vegetation was intensively searched. Gilia tenuiflora ssp. arenaria has been found in Flandrian dune scrub in association with certain species and soil characteristics. These areas were intensively searched. Chorizanthe pungens var. pungens has been found in all of the habitat types from the strand to the pre-Flandrian dunes, therefore the entire study site was searched for C. pungens. Areas that did not conform to the potential habitat characteristics for these species, were surveyed less intensively.

3. RTE Plant Population Survey

The site was surveyed to determine vegetation units and to map potential habitat locations from April 21 through May 4, 1987, taking a total of 170 man-hours. The intensive search for RTE plant populations overlapped with the vegetation mapping and took place from April 26 through May 10, 1987, taking a total of 115 man-hours. Areas previously determined to be potential habitat were walked by two individuals in order to give thorough search coverage.

4. Description of RTE Plant Populations and Their Habitat Requirements

Once the previously known and the new populations were located, their density, spatial distribution, phenology, vigor, and microhabitat were either quantified or described in detail. The limits and boundaries of each population were determined, and that area was then measured on site, if possible. That area was then walked by two individuals, in a parallel fashion, in order to estimate the number of RTE plant individuals. The number divided by the area, was the estimated density. In the case of the main Erysimum menziesii population, the overall area was delineated on a topographic map (provided by Lone Star Mining Co.). Four sample quadrats, 12 meters by 12 meters, were established, and the number of E. menziesii individuals counted. Those four samples were then used to estimate the total number of individuals in that population, and thus the density. Spatial distribution, vigor, and associated species were noted and recorded. Individuals in flower, showing any sign of disease or senescence were recorded and using the total population number, the percentage of these individuals in the population was estimated.

In the case of Chorizanthe pungens var pungens, all of the vegetation types were sampled by property. The ratio of the number of Chorizanthe pungens var. pungens individuals to those of C. cuspidata and C. diffusa was recorded.

5. Generation of the Vegetation Map

The study location was extensively surveyed so that areas for intensive search (those most likely to support populations of RTE plants) could be identified. This extensive survey also generated the data used in mapping potential habitat by documenting different vegetation/habitat types. Releve samples (#1 through 48) were taken using the Braun-Blanquet cover/abundance scale (Mueller-Dombois and Ellenberg 1977) and a minimal area of 50 m2 per releve (Pavlik 1980). These samples provided a qualitative basis for the map units using species composition and vegetation structure. A full listing of these samples can be found in Table A-1. The total amount of each plant community found in the study area is provided in Table A-2. The presence of vegetation types on the properties included in the survey is shown in Table A-2. Some representative species of the different vegetation types found on Marina Dunes are included in Table A-4. Along with information on dune geology and the degree and nature of disturbance, major vegetation/habitat units were delineated and mapped.

Table A-1: Map units based on dune geology, dune vegetation (releve samples) and the degree and nature of disturbance.

1) Strand - the vegetation of the beach, found between mean high tide and the leading edge of the foredune

2) Recent dune scrub - dense, shrubby vegetation found on recent dunes, usually close to the strand

3) Recent bluff scrub - sparser, less woody than dune scrub, found perched on "bluff" faces from the southern end of the Lone Star property to Marina State Beach (the bluff is actually an unusual, stabilized face of recent dune)

4) Flandrian dune scrub - sparse scrub vegetation growing on flandrian dunes

5) Mesic swale scrub - very similar in species composition and structure to the recent dune scrub, but found in deep depressions (swales) within the flandrian dunes

6) Pre-Flandrian oak woodland - a small outcrop of pre-flandrian dune sheet with coast live oaks, grasses and sedges (see Plate 8, Figure 2 of Cooper, 1967), found only on the Martin property

7) Disturbed vegetation - a vegetation of composed mostly of invasive, exotic species in areas that have been disturbed due to mining and/or off-road vehicle (ORV) use

8) Bare sand - areas that have been severely altered by storm/wave/wind damage, mining, dredging, ORV activity, and extensive foot traffic, with negligible plant cover

These map units were subdivided on the basis of actual and potential disturbance, also taking into account the nature and intensity of disturbance factors:

1) degree and nature of actual disturbance (1=no disturbance 2= natural (wave, wind,storm) 3= foot 4= ORV 5= mining, development

2) potential for future disturbance (proximity to roads, development, natural forces) (1= no disturbance 2= natural (wave, wind, storm) 3= foot 4= ORV 5= mining, development.

Table A-2. Total areas of eight vegetation types on Marina Dunes (not including Marina State Beach). Data obtained from digital computer analysis of aerial photos.

VEGETATION TYPE	AREA (hectares)
strand	16.89
recent dune scrub	17.71
recent bluff scrub	5.92
Flandrian dune scrub	86.84
mesic swale scrub	9.62
Pre-Flandrian oak woodland	0.97
disturbed vegetation	13.37
bare sand	48.19*

* mining accounts for 9.39 hectares (4.224 ha Lone Star and 5.17 ha Monterey Sand)

Table A-3. Presence of vegetation types on the properties included in the survey.

	STR	RDS	RBS	FDS	MSS	PFO	BS	DV
Marina State Beach	X	X		X			X	X
Monterey Sand	X						X	X
Granite Rock	X		X	X	X		X	X
Gullwing	X		X	X	X		X	X
Lone Star	X	X	X	X	X		X	X
Martin Dunes	X	X		X	X	X	X	

Strand vegetation (STR), recent dune scrub (RDS), recent bluff scrub (RBS), Flandrian dune scrub (FDS), mesic swale scrub (MSS), Pre-Flandrian oak woodland (PFO), bare sand (BS), and disturbed vegetation (DV).

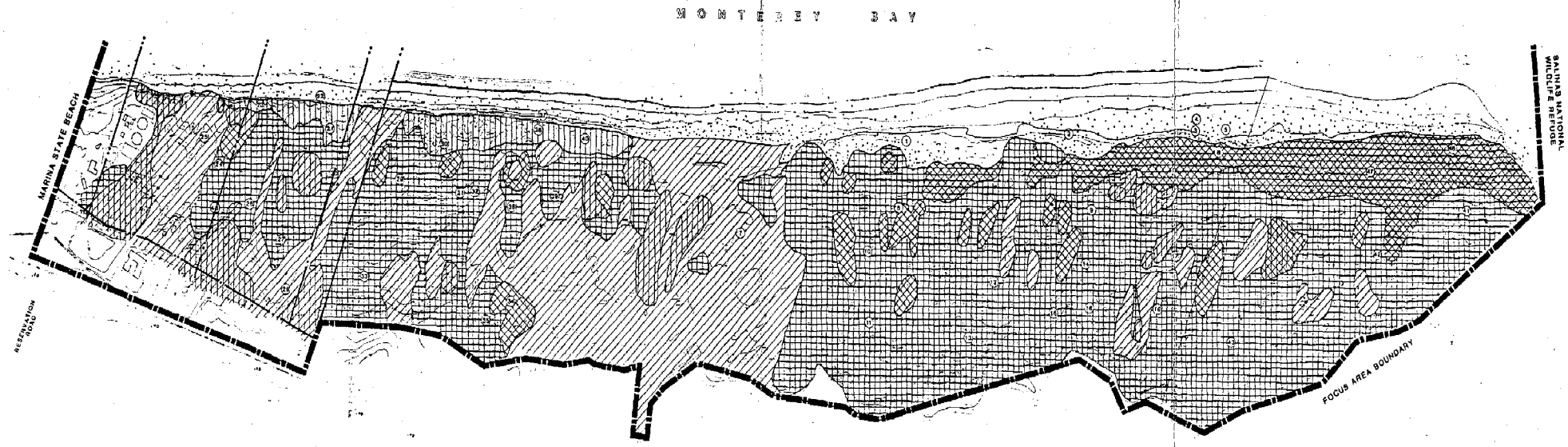
Table A-4. Some representative species of the different vegetation types found on Marina Dunes.

VEGETATION TYPE	REPRESENTATIVE SPECIES
strand	Abronia latifolia, Ambrosia chamissonis, Cakile maritima, Calystegia soldanella, Camissonia cheiranthifolia, Carpobrotus spp.
recent dune scrub	Corethrogyne leucophylla, Ericameria ericoides, Eriogonum latifolium, Eriophyllum staechadifolium, Lupinus chamissonis.
recent bluff scrub	Abronia latifolia, Agoseris apargioides, Ambrosia chamissonis, Calystegia soldanella, Camissonia cheiranthifolia, Carpobrotus spp., Poa douglasii.
Flandrian dune scrub	Artemisia pycnocephala, Cardionema ramosissimum, Corethrogyne leucophylla, Dudleya farinosa, Eriogonum latifolium, Eschscholzia californica, Lotus scoparius, Polygonum paronychia,
mesic swale scrub	Corethrogyne leucophylla, Dudleya farinosa, Ericameria ericoides, Eriogonum latifolium, Lupinus chamissonis.
Pre-Flandrian oak woodland	Quercus agrifolia, Carex spp.
disturbed vegetation	Brassica spp., Bromus diandrus, Carpobrotus spp., Erodium cicutarium, Eucalyptus spp., Plantago spp.
bare sand	Abronia latifolia, Cakile maritima, Poa douglasii. (negligible cover.)

APPENDIX IV-B: Acronyms used in the field notes and releve samples.

ABLA	Abronia latifolia
ABUM	A. umbellata
ACBO	Achillea borealis spp. arenicola
AGAP	Agoseris apargioides
AMCH	Ambrosia chamissonis
AMSP	Amsinkia sp
ARMA	Armeria maritima
ARPY	Artemisia pycnocephala
ATCA	Atriplex californica
ATLE	A. leucophylla
BRPU	Brodiea pulchella
BRDI	Bromus diandrus
CAMA	Cakile maritima
CASO	Calystegia soldanella
CACH	Camissonia cheiranthifolia
CARA	Cardionema rammosissimum
CAAQ	Carpobrotus aquilateralis
CAED	C. edule
CALA	Castilleja latifolia
CHCU	Chorizanthe cuspidata
CHDI	Chorizanthe diffusa
CHCU/PU	Chorizanthe cuspidata x (?) pungens
CHPU	Chorizanthe pungens var pungens
COLE	Corethrogyne leucophylla
DW	Dead wood
DISP	Distichlis spicata
Dodder	Cuscuta salina
DUFA	Dudleya farinosa
ERER	Ericameria ericoides
ERLA	Eriognum latifolium
ERPA	E. parvifolium
ERST	Eriophyllum staechadifolium
ERAM	Erysimum ammophilum
ERME	E. menziesii
ESCA	Eschscholzia californica
FEOC	Festuca octoflora
GNsp	Gnaphalium sp.
GITE	Gilia tenuiflora ssp. arenaria
LICA	Linaria canadensis
LOHE	Lotus heermannii
LOSC	Lotus scoparius
LUCH	Lupinus chamissonis
MAFA	Marah fabaceus
MEsp	Melica sp.
MOPE	Montia perfoliata
Moss	moss spp
ORGR	Orobanche grayana var. nelsonii
PHRA	Phacelia rammosissima
PODO	Poa douglasii
POPA	Polygonum paronychia
RHDI	Rhus diversiloba
SECA	Senecio californicus
TIER	Tillea erecta

FIGURE IV-1
VEGETATION



EXISTING COMMUNITIES

- SAMPLING LOCATIONS
- STRAND VEGETATION
- RECENT BLUFF SCRUB
- DISTURBED (LIMITED VEGETATION)
- DISTURBED (NON-NATIVE VEGETATION)
- MESIC SWALE SCRUB
- FLANDRIAN DUNE SCRUB
- PRE-FLANDRIAN OAK WODLAND
- RECENT DUNE SCRUB

CITY OF MARINA

MARINA DUNES PLAN

COASTAL ZONE PLANNING TASK FORCE

THOMAS REID ASSOCIATES
PLANNING COLLABORATIVE

AND SUPPORTING CONSULTANTS

1 acre
4 acres
north

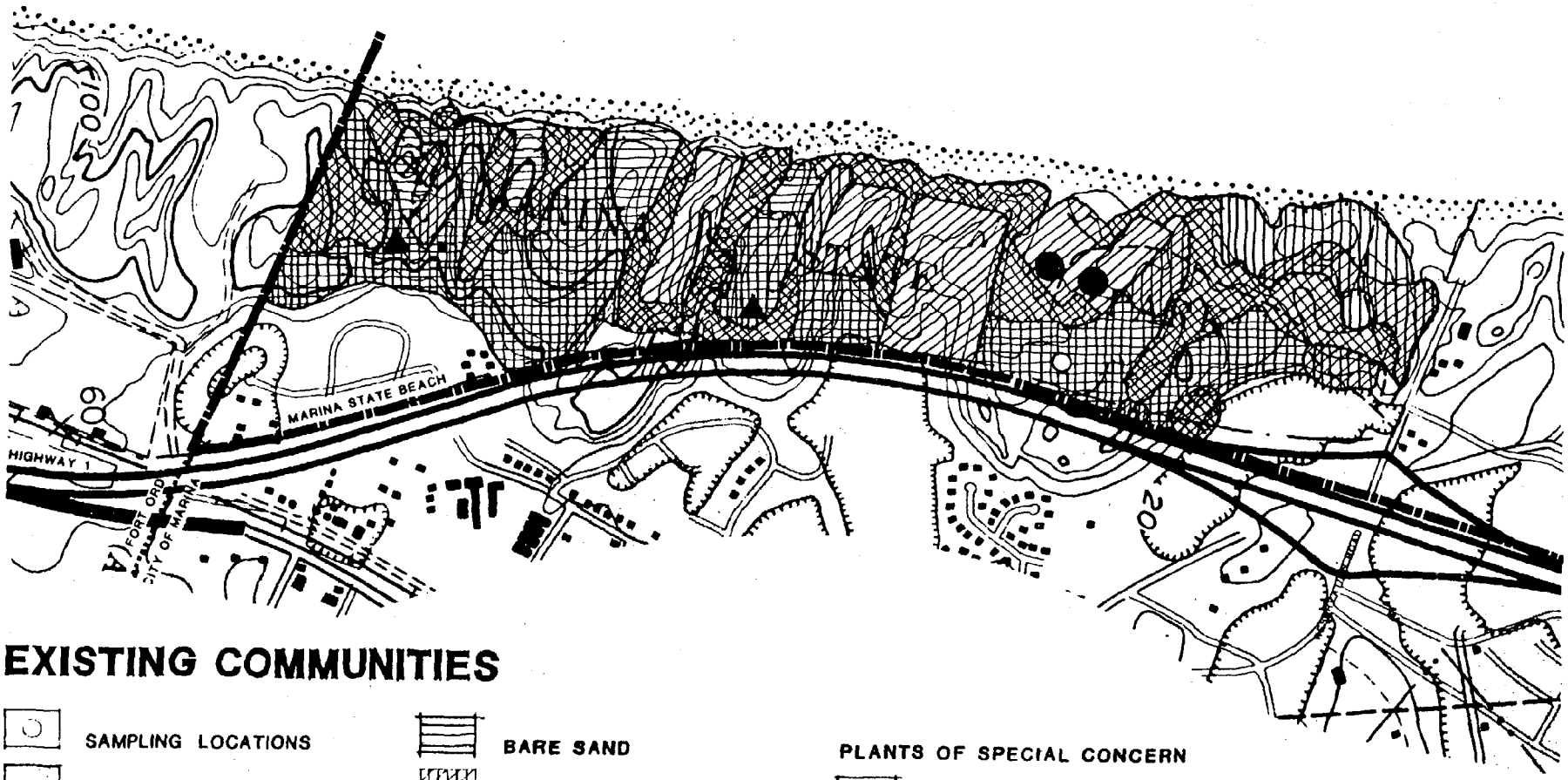
0 200 500 1000

LAPIS ROAD

HIGHWAY 1

SALINAS RIVER

MONTEREY BAY



EXISTING COMMUNITIES

- SAMPLING LOCATIONS
- STRAND VEGETATION
- RECENT BLUFF SCRUB
- REVEGETATED AREAS
- BARE SAND
- STRAW
- ICEPLANT
- FLANDRIAN DUNE SCRUB

PLANTS OF SPECIAL CONCERN

- GITE
- ERME

CITY OF MARINA

MARINA DUNES PLAN

COASTAL ZONE PLANNING TASK FORCE

THOMAS REID ASSOCIATES
PLANNING COLLABORATIVE

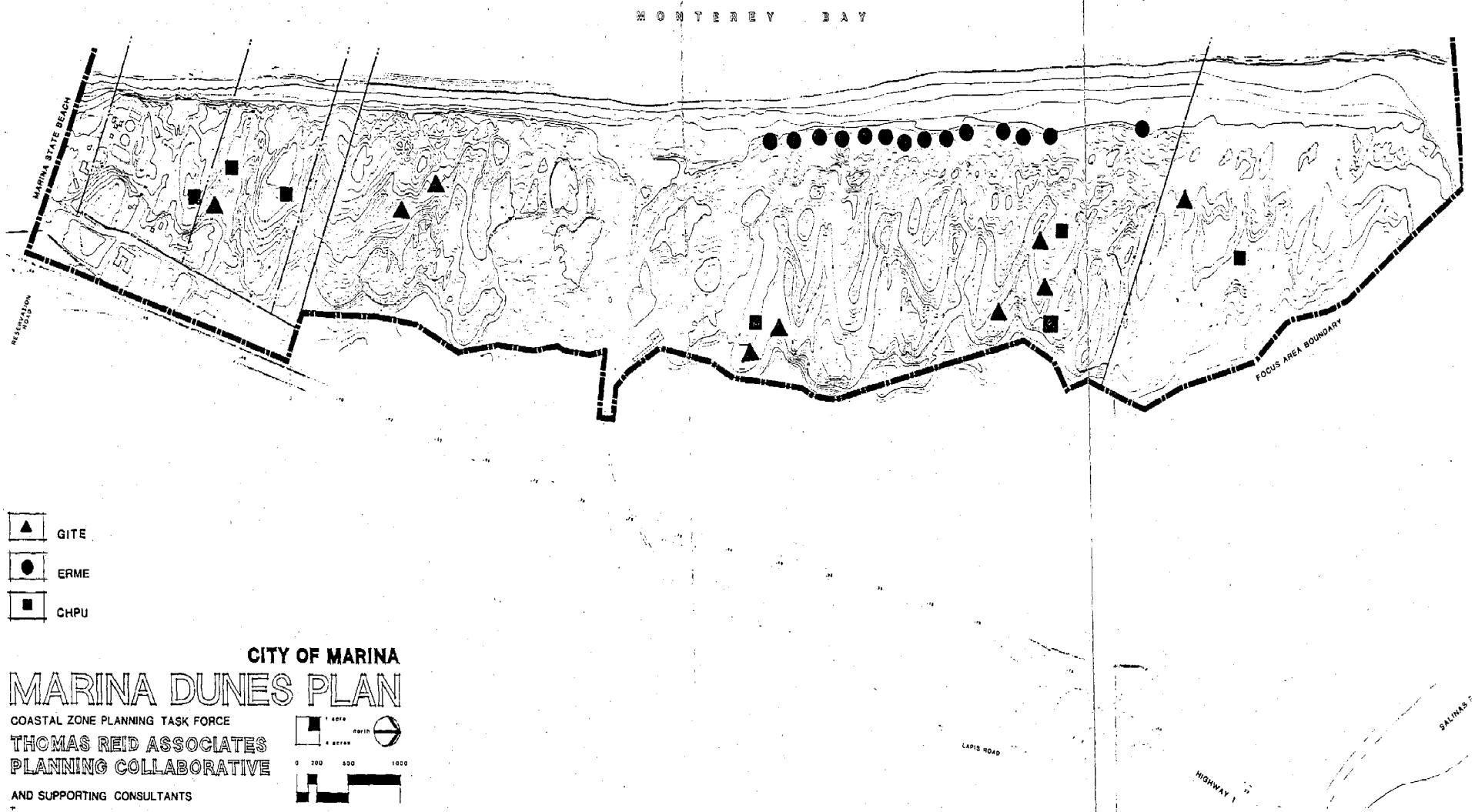
AND SUPPORTING CONSULTANTS

1 acre
4 acres
north

0 200 500 1000

FIGURE IV-2
VEGETATION AND PLANTS OF CONCERN -- MARINA STATE BEACH

FIGURE IV-3
PLANTS OF SPECIAL CONCERN



V. Revegetation and Exotic Species Control

V. REVEGETATION AND EXOTIC SPECIES CONTROL

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Thomas Reid Associates

November 1987

A. INTRODUCTION

This issue paper constitutes a revegetation study of Marina Dunes, a portion of the Monterey Bay dune system on the central California coast in the City of Marina, California. It is intended to give an overview of the landscape character and native vegetation of the site and to outline methods and techniques to restore this vegetation in the event of man-made or in some instances, natural disturbances to the landscape. Findings and recommendations contained in this paper will be used in the formulation of a Habitat Conservation Plan for Marina Dunes.

Some areas of the dunes contain extensive areas of non native plant species, primarily Ice Plant, which has been increasing rapidly over the past several years. The spread of Ice Plant degrades the natural vegetation and reduces the quality of habitat for the rare and endangered species found at the dunes. This paper includes a discussion of known exotic species control methods for the species found at the Dunes and recommendations for implementing an exotics control program.

PART I -- REVEGETATION

B. EXISTING CONDITIONS

The Marina Dunes are unique in several respects. For instance, there is a great deal of variation with regard to man's influence on the local ecology. There are virtually pristine areas of strand and dune plant communities as well as disturbed landscapes with little or no native vegetation and greatly altered landforms (see Figure V-1) in the Rare Plant paper). In addition, portions of the dunes are habitat for several rare, threatened and endangered species of plants and animals including the Smith's Blue Butterfly, the Black Legless Lizard and the Menzies' Wallflower.

1. Project Objectives

The objectives of the revegetation study are as follows:

A. To catalog and identify those native plant species from the study area that will be potentially useful in dune and strand restoration; explain characteristics of selected species.

B. To describe a process by which a revegetation program can be established that makes use of the site's existing resources.

C. To outline a strategy that includes methods and techniques that can be used to restore areas disturbed in the course of man's activities in the dunes and ways to maintain the restored dunes.

These issues are addressed in sequence in the revegetation study. It concludes with the information summarized in a matrix and a checklist, in the final two pages.

2. Study Methodology

In order to develop a plant pallette for revegetation at Marina Dunes it was necessary to:

1) Examine existing environmental documents to determine the extent of the known flora of the site.

2) Survey the site on foot, especially in areas of concern, to look for additional native species that may be useful for revegetation purposes.

3) List additional species that are found in nearby dune environments that have desirable revegetation characteristics.

4) Review the information and select from the lists those species which are best suited to the purposes of restoring the dunes.

The following criteria were taken into account in the selection of the plants proposed for use in the revegetation program.

- Species that are known to be native to the site or nearby environs.
- Specific plants that provide habitat for the animal species of concern.
- Plants that are designated as rare, threatened or endangered on site.
- Plants that are known to establish well from past experience.
- Pioneer species with good stabilizing and erosion control qualities.
- Species that can be propagated under nursery conditions without great difficulty.
- Species that seed can be gathered from economically, and in sufficient quantity.
- Plants that are visually characteristic of coastal dune and strand environments.

3. Suggested Plant Pallette

The following list represents a variety of plant species that were selected for having one or more of the above characteristics. It includes forty seven species of annuals and perennials that may be used in a number of different combinations to enhance or restore specific plant associations known to occur in Marina Dunes. The list is broken down into three categories, and includes both the proper species name as well as the generally accepted common name. Though seemingly ambitious, the proposed plant pallette is indicative of the complexity of the dune ecosystem.

Plant pallette derived from environmental documents.

Abronia latifolia	YELLOW SAND VERBENA
Abronia umbellata	PINK SAND VERBENA
Armeria maritima	THRIFT
Artemesia pycnocephala	DUNE SAGEBRUSH
Astragalus nuttalli	BEACH LOCOWEED
Baccharis pilularius pil.	COYOTE BRUSH
Calystegia soldanella	BEACH MORNING GLORY
Camissonia cheiranthifolia	BEACH PRIMROSE
Castilleja latifolia	INDIAN PAINTBRUSH
Chorizanthe pungens	NCN
Corethrogyne californica	BEACH ASTER
Croton californicus	CROTON
Dudleya caespitosa	LIVE FOREVER
Erigeron glaucus	SEASIDE DAISY
Eriogonum latifolium	BUCKWHEAT
Eriogonum parvifolium	DUNE BUCKWHEAT
Eriophyllum staechadifolium	LIZARDTAIL
Erysimum ammophilum	BEACH WALLFLOWER
Erysimum menziesii	MENZIES WALLFLOWER
Eschscholzia calif. var maritima	CALIFORNIA POPPY
Franseria chamissonis	SILVER BEACHWEED
Gilia tenuiflora spp. arenaria	DUNE GILIA
Happlopappus ericoides	MOCK HEATHER
Lotus scoparius	DEERWEED
Lupinus arboreus	BUSH LUPINE
Lupinus chamissonis	DUNE LUPINE
Poa douglasii	DUNE BLUEGRASS
Polygonum paronychia	DUNE KNOTWEED

Additions to plant pallette based on field survey.

Achillea borealis var arenicola	YARROW
Acaena californica	NCN
Arctostaphylos pumila	SANDMAT MANZANITA
Atriplex leucophylla	DUNE SALTBUSH
Ceanothus rigidus	WILD LILAC
Cryptantha leiocarpa	POPCORN FLOWER
Elymus mollis	DUNE RYEGRASS
Eriophyllum multicaule	NCN
Helianthemum scoparium	SUNROSE
Lathyrus littoralis	BEACH PEA

Layia platyglossa	TIDY TIPS
Lupinus bicolor	ANNUAL LUPINE
Orthocarpus purpurescens	OWL'S CLOVER
Phacelia ramosissima var montereyensis	NCN
Rhamnus californica	CALIFORNIA COFFEEBERRY

Additional locally native species recommended.

Fragaria chiloensis	BEACH STRAWBERRY
Grindelia stricta venulosa	SHORE GUMPLANT
Lasthenia glabrata	GOLDFIELDS
Myrica californica	CALIFORNIA WAX MYRTLE
Plantago maritima	COAST PLANTAIN

Descriptions of selected plant species

Artemesia pycnocephala DUNE SAGEBRUSH	A small shrub with attractive, silvery foliage that is very common and characteristic of the northern California dunes. It establishes well from seed and small containers. It is also a nectar source for the Smith's Blue butterfly. The seed is easily obtained and the plant grows readily from cuttings.
Eriogonum latifolium BUCKWHEAT	A small evergreen shrub with clusters of white flowers in the spring and early summer. Common on the dunes at Marina and very important as both larval host and nectar source for the Smith's Blue. Establishes well from seed and containers.
Eriogonum parvifolium DUNE BUCKWHEAT	A larger, prostrate, evergreen shrub found only on dunes and another larval host to the Blue. Establishes well and the seed is abundant in places. Deep rooted and a good dune stabilizer.
Abronia umbellata & Abronia latifolia SAND VERBENAS	Attractive flowering perennial groundcover plants of the strand and adjacent foredunes. Best established from seed. Abronia umbellata is a nectar source for the Blue.
Lupinus chamissonis & Lupinus arboreus LUPINES	Medium to large flowering shrubs that are easily established from seed. Good for dune stabilization, they are legumes of the Pea family that have nitrogen fixing nodules on the roots that enrich the surrounding soil. L. chamissonis is a nectar source for the Blue.
Eriophyllum staechadifolium LIZARDTAIL	Another nectar source, this medium sized shrub has attractive yellow flowers and is easy to establish from seed or containers. Very common on the dunes at Marina.
Arctostaphylos pumila SANDMAT MANZANITA	A very attractive native groundcover of the Heath family. Rare and found only in the backdunes. Slow growing, and can only be propagated from cuttings.

Ceanothus rigidus WILD LILAC	Another attractive, native evergreen shrub with blue or white flowers in spring. Found in the same habitat as the manzanita, and both were probably much more common before Marina was developed. It can be grown from cuttings and established best from one gallon containers.
Dudleya caespitosa LIVE FOREVER	A succulent that is quite common on the dunes that is also a nectar source for the Smith's Blue butterfly. Grown easily from cuttings or divisions and a good candidate for salvaging from development areas.
Rhamnus californica COFFEEBERRY	A medium to large evergreen shrub that is found only in the backdunes. Established from seed or containers. Berries are good wildlife food and attract many birds.
Lotus scoparius DEERWEED	Another attractive legume that establishes readily from easy to collect seed. A pioneer species that has a natural tendency to invade disturbed areas. A possible nectar source as well. A deep rooted good dune stablilizer.
Poa douglasii DUNE BLUEGRASS	A native grass that is an excellent dune stabilization plant that may be difficult to establish but worth the effort. Should be tried from both seed and containers. May propagate well from stolons at the proper time of year. Another nectar source as well.
Erysimum menziesii MENZIES WALLFLOWER	An attractive flowering herbaceous species that is considered an RTE plant (Rare threatened or endangered) and included for this reason. Perhaps its habitat can be enhanced and its numbers increased through revegetation.
Fragaria chiloensis BEACH STRAWBERRY	A hardy groundcover native to the coastal dunes and excellent for erosion control. Established from containers at 3' on center, and spreads rapidly by runners.
Grindelia stricta var. venulosa SHORE GUMPLANT	A large perennial groundcover that forms dense mats of foliage and attractive yellow flower clusters in the summer months. It establishes well from seed or containers and is not difficult to collect seed from. Native to sand dunes from Monterey County north
Myrica californica WAX MYRTLE	An attractive native evergreen shrub with lush, glossy leaves that is fast growing and establishes well from containers. Native to coastal California in sandy locations.

Plantego maritima COAST PLANTAIN	A small, succulent perennial herb that grows prolifically from seed and is native to the immediate coast of central and northern California. Would make a useful, fast germinating nurse crop for hydroseeding purposes.

4. Revegetation Strategy

This section of the study examines a number of suggested program elements and a sequence of events that, when followed, will lead to a successful revegetation effort at Marina Dunes. In effect, the program has already begun with the commitment to undertake the writing of these issue papers and the HCP.

Define the Native Revegetation Program Boundaries. Not all disturbed areas of the dunes should be subject to the native revegetation program. Areas designated for urban uses should be excluded from the native plant revegetation requirement. Property owners should be allowed to landscape the interior portions of a particular development area with appropriate non native species as prescribed by their landscape architect. However, the use of invasive non native species, such as broom, Ice Plant, or eucalyptus, should be prohibited. Portions of an urban project area which are to be used as habitat corridors, however, should contain native plant species.

Set Goals. The program should begin with an analysis of the goals that are to be accomplished, and any special circumstances involved. Since there are specific habitats to be recreated and mitigation measures to consider, due to endangered species present on the site, pertinent biological data must be obtained and studied to determine the critical plant species for inclusion in the reclamation plans.

Allow Time for Planning. A time schedule must be developed early in the process in order to allow enough lead time to set up the program properly. After maps, site plans and other documents have been obtained and examined, a thorough field survey must be undertaken to become familiar with the landscape and begin assessing the vegetative resources that are available. This is also the time to be observant regarding invasive, exotic plant species that may be present on the site. Eradication of these is often necessary for a successful revegetation effort. Consideration should also be given to examining the feasibility of salvaging plant material from the site before disturbance occurs.

Prepare Reclamation Plans. After reviewing the accumulated documents and field notes taken on site, the revegetation strategy and working plant pallette can be written, leading to a reclamation plan which will likely be submitted for review by local authorities. When approved, it becomes time to begin implementing programs to make needed plant material and seed available when needed. This usually involves custom seed collecting and plant propagation since many native species are not commonly grown in the nursery trade. In addition, the use of site-specific material is preferred among revegetation professionals for practical and ecological reasons.

Test Materials and Techniques. Time should be designated for

establishing test plots in order to experiment with materials and techniques. Likewise, it is important to coordinate needed suppliers, contractors and equipment early in the program so that things progress in a timely and organized manner.

Supervision. When the time comes to implement the program it should be done under careful supervision. Sensitive areas may need to be fenced off and/or posted with appropriate signage. Plant material, seeds and equipment should be inspected to be sure they conform to the specifications. All treated areas should be carefully inspected to be sure a thorough and proper job has been done as most contractors are not familiar with the sensitivity and degree of precision required by revegetation as compared to conventional landscaping.

Monitoring. A period of monitoring to document the progress of the restoration is invaluable in determining the need for follow up maintenance, weed and pest control, re-planting, etc. and to evaluate the success of the project for future reference.

Maintenance. Native vegetation requires little maintenance once it has been established, however, there will be a need to remove any invading (or re-invading) exotic species from the revegetation areas. Seedlings of undesirable plants are easy to remove by hand if they are caught early. Once they are well established it becomes more difficult to removed them without damaging desirable species. Also the sites should be checked for signs of instability. Some recontouring or additional plantings in unstable areas may be required to avoid the start of blow out conditions.

5. Suggested Revegetation Methods and Techniques

The Marina Dunes revegetation work should involve the following elements as part of the long term program. Experience has proven that each is an important and interrelated part of the overall effort.

1) Develop specific reclamation plans for each individual project. Each site where disturbance will occur should be studied in detail and documented with photographs and a plant species inventory before any grading or clearing occurs. The reclamation plan should be tailored to each project site and specific habitat issues addressed.

2) All seed and plant material for revegetation work should be collected from Marina Dunes or nearby environments. Because of endangered species issues and the need to preserve the genetic identity of the species native to the dunes, it is important to initiate custom seed collecting and plant propagation programs. Collecting should be particularly encouraged in the development locations and away from sensitive areas such as known habitat.

3) Initiate a program to control invasive exotic plants (see below). Without such measures being taken it is futile to attempt to restore native landscapes to reasonably pristine conditions. Ice plant, pampas grass, and broom, among others, have caused problems Monterey County. Physical and chemical methods of control have proven effective in many cases and should be included in Marina Dunes revegetation program.

4) Whenever possible, salvage valuable or hard to replace plant material from the sites before the disturbance occurs. Entire plants can sometimes be saved as well as small seedlings and propagules (seed and cuttings) for custom growing at the nursery. Since many plants are resistant to transplanting, this technique maybe be limited to a small number of species.

5) Production planting/growing for increase. The limited availability and the need for large quantities of seed may be offset by growing certain important and hard to collect species as row crops for seed production. Experience has shown that the best results are obtained by using available land on site for this purpose. In time, the unit cost for seed may decrease as a result of this technique.

6) Planting methods should include hydroseeding, hand-broadcasting of seed, and container planting. Again, experience has shown that all these methods or any combination of the three may be needed to solve a particular site planting situation. Hydroseeding with specific seedmixes, tailored to each individual site, will typically be the best and most economical method for large areas. Container grown specimens are used to augment the planting and for those species that do not establish well by hydroseeding. Hand-broadcasting of a seedmix may prove to be a more effective and economical method in areas of limited size, and by broadcasting the seed of a single species, a pure stand can be established of a desired species.

7) Establish a maintenance program to assure the long term success of the revegetation sites.

Although fertilizers and irrigation are not normally recommended for native plant revegetation, discrete short-term use of fertilizers can be beneficial for increasing seed germination and the survival rate of seedlings and outplanted container plants in a dune environment. Under some circumstances (low rainfall years or when unseasonal planting is done) a temporary irrigation system may be needed to help ensure successful plant establishment. However, care must be taken not to create an artificial dependency on supplemental water. If an irrigation is used, it should be discontinued as soon as possible after the plants have become established.

The timing of all planting is of utmost importance. It must be scheduled during wet fall and winter months. October through February are generally considered the 'window of opportunity' for conducting revegetation work.

The preceding methods and techniques are recommended for inclusion in revegetation specifications for Marina Dunes. All have been used successfully in past revegetation projects in coastal northern California.

Summary/Recommended Plant Pallette for Marina Dunes revegetation. Species list by plant type (annual (an) or perennial (per)), characteristics, micro-environment, and best methods of establishment (seed or containers).

Species	An/Per	Strand & Foredune	Middune	Backdune	Seed/Container	
LARGE SHRUBS						
Arcto pumila	*			*		*
Cean rigidus	*			*		*
Erioph staech	*		*	*	*	*
Lupinus arbor	*	*	*	*	*	
Lupinus chamis	*		*	*	*	*
Myrica calif	*			*		*
Rhamnus calif	*		*	*	*	*
SMALL SHRUBS						
Artemesia pyc	*		*	*	*	
Astrag nuttal	*		*		*	*
Atriplex leuc	*	*			*	*
Baccharis pil	*			*	*	*
Camissonia cheir	*	*	*	*	*	*
Castilleja lat	*	*	*	*	*	
Croton calif	*		*	*	*	
Erigeron glauc	*		*	*	*	*
Eriogonum lat	*		*	*	*	*
Eriogonum parv	*		*	*	*	*
Franseria cham	*	*	*		*	
Grindelia strict	*	*	*	*	*	*
Happlopappus eri	*		*	*	*	
Helianthemum scop	*			*	*	*
Lotus scop	*		*	*	*	
Phacelia ramos	*		*	*	*	
Polygonum paron	*		*	*	*	*
HERBACEOUS PLANTS, GRASSES AND WILDFLOWERS						
Abronia latif	*	*	*		*	
Abronia umbel	*	*	*		*	
Achillea boreal	*			*	*	*
Acaena calif	*		*	*	*	*
Armeria marit	*		*	*	*	*
Calystegia sol	*	*			*	
Chorizanthe pun	*		*		*	
Corethrogyne cal	*		*		*	*
Cryptantha lei	*		*	*	*	
Dudleya caespit	*		*	*		*
Elymus mollis	*	*	*	*		*
Eriophyllum mult	*		*	*	*	
Erysimum ammoph	*	*	*		*	
Erysimum menzie	*	*	*		*	*
Esch calif marit	*	*	*	*	*	
Fragaria chil	*	*	*	*		*
Lasthenia glab	*			*	*	
Lathyrus littor	*	*			*	*
Layia platy	*			*	*	

Lupinus bicol	*		*	*	*	
Orthocarpus pur	*			*	*	
Plantago marit	*	*	*	*	*	*
Poa douglasii	*		*	*	*	*

Summary of revegetation program elements and sequence of events.

Step 1: Establish goals of program and determine the anticipated construction schedule time frame.

Step 2: Investigate project through maps, documents and site plans.

Step 3: Conduct a thorough on-site analysis with regards to site development plans and vegetative resources available.

Step 4: Develop a working plant pallette and restoration strategy based on all the above.

Step 5: Produce a reclamation plan for review by local authorities.

Step 6: Upon approval, establish programs to make needed plant material and seed available at the appropriate time.

Step 7: Plan for test plots if time allows or develop sequence of priority areas to be planted during implementation.

Step 8: Coordinate needed suppliers, contractors and equipment needed to execute program in an organized and timely manner.

Step 9: Implement the revegetation plan under careful supervision.

Step 10: Monitor and document the progress of the restored landscape through photographs and periodic written reports.

Step 11: Determine necessary follow-up maintenance with regards to weed and pest control, re-planting if needed, etc.

PART II -- EXOTIC SPECIES CONTROL

The above discussion of revegetation provided recommendations for revegetating both restored dunes and dunes where exotic plants have been eliminated. This section of the paper describes known control methods for some of the invasive exotic species found at Marina Dunes, particularly ice plant, as well as recommendations for implementing an exotics control program at the Dunes.

B. EXISTING CONDITIONS

There are three invasive exotic plant species found at Marina Dunes which threatened habitat of rare and endangered species: Ice Plant (Carpobrotus aequilateralis, and C. edulis, (also known as Mesembryanthemum)), Eucalyptus trees (Eucalyptus spp.), and introduced beach grass (Ammophila arenaria).

1. Ice Plant

Ice Plant, also known as Hottentot-fig or Sea fig, is the most extensive and invasive exotic plant at Marina Dunes. It is found almost throughout the dunes except in active mining areas or blow outs.

The two species of Ice Plant at Marina Dunes are perennial species, originally from South Africa. Populations of Carpobrotus aequilateralis have become naturalized in some areas and are not as invasive as C. edulis. As a result of this, it is often thought of as being native. According to Jim Hickman, of the U.C. Berkeley Jepson Herbarium, the plant is from South Africa, and is not being considered for native status.

Ice Plant is a succulent which is hardy, requires little watering, provides a good ground cover, is effective for controlling erosion and has showy flowers in the the spring and summer. As such it is frequently used by Caltrans to revegetate cut and fill slopes along highways. Caltrans maintains over 6,000 acres of Ice Plant along highways in California, and as many acres exist on other private and public lands in the State (Washburn and Frankie, 1985). Much of the Ice Plant found at Marina Dunes probably came from stands which were planted along Highway 1 in the late 1960's or from Fort Ord where the U.S. Army planted it extensively to stablize disturbed dunes.

Ice Plant spreads both vegetatively and by seed. Seeds germinate well in disturbed soils. Due to its faster germination and growing rate relative to native plants, Ice Plant outcompetes natives in disturbed areas. At the Dunes it is crowding out both the host plants of the Smith's blue butterfly (Eriogonum spp.) and rare plant species.

Ice Plant has an extensive root system which holds soil well. However such a root system prevents sand dwelling creatures, such as the black legless lizard, from active dispersal. Thus it is unsuitable habitat for these creatures.

Ice Plant control is a relatively new phenomenon. Although the plant is on the California Native Plant Society list of undesirable exotic

species, it is not on the California Department of Food and Agriculture (CDFA) target list of undesirable weeds. In fact the CDFA supports efforts being made by Caltrans to prevent the spread of a scale insect which is killing Ice Plant along freeways (see below).

Several Ice Plant control projects are taking place along the coast of California by both State and Federal Resource Agencies, including Bodega Head, Point Reyes National Seashore, Golden Gate National Recreation Area, Sunset State Beach, Marina State Beach, and Asilomar, to name a few. A discussion of some of the results of Ice Plant control work going on at these locations is included below.

Chemical Control

Chemical control of Ice Plant has three major advantages:

- The growth form of Ice Plant (low and in dense mats) makes chemical spraying fairly easy,
- for large areas it is considerably less expensive than labor intensive hand control,
- after the herbicide kills the plant, the roots and dead "mulch material" provide effective erosion control, and
- the presence of dead "mulch material" over the bare soil/sand prevents the germination of Ice Plant seedlings.

The major disadvantages of chemical control are:

- the dead mulch material also prevents other native plants from germinating,
- the presence of dead Ice Plant is not particularly aestheticly pleasing,
- some people are adverse to the use of pesticides in any form, and
- the available herbicides are non-selective; where native species are intermixed with Ice Plant, pesticide treatment of the Ice Plant may result in destruction of the native vegetation.

There are several herbicides on the market which are effective in controlling Ice Plants including 2,4-D (Weedar 64, Weedone), picloram (Tordon), amino triazole (Amitrol-T), and glyphosate (Roundup). Some of these are restricted by the California Department of Food and Agriculture and require special use permits.

Roundup is the most widely used herbicide for Ice Plant because it does not require a restricted materials permit, is relatively non toxic, and is effective in killing Ice Plant, However, Roundup is also the most expensive of the herbicides. Amitrol-T, which is less costly than Roundup and is not restricted will also kill Ice Plant. However, most of the Amitrol-T control work has been aimed at killing grasses growing in ice plant landscapes; the Ice Plant kill being unintentional and undesirable (San Mateo Co. Dept. of Agriculture).

At Bodega Head State Beach in 1985, approximately 20 acres of Ice Plant were sprayed with a solution of 1.5% Roundup and 1% surfactant. Due to the extent of the Ice Plant cover, all spraying was done by truck rather than using backpack sprayers. Over 85% of the Ice Plant was killed. The

remaining Ice Plant not killed was sprayed in 1986. Two years later (1987) there are fairly thick patches of dead Ice Plant on the site. Over time, the dead Ice Plant dries up and becomes more compacted on the ground. At present, the Ice Plant "mulch" is too thick to allow native plants to germinate under it. Fortunately, Ice Plant seedlings cannot germinate under the "mulch" either.

According to the Plant Ecologist for Bodega Head, Marla Hastings, the Ice Plant control program has been successful. Ice Plant is no longer spreading, the dead Ice Plant holds the soil well and prevents large scale erosion, and except in areas where Ice Plant was removed, there are very few seedlings sprouting. A revegetation program was instigated at Bodega Head in 1986. The program seeks to re-establish native plants in areas where large extensive Ice Plant patches were found. According to Ms. Hastings, the revegetation program, although ongoing, has been successful to date.

At Asilomar, Plant Ecologist Tom Moss, has been working on controlling Ice Plant with Roundup. He uses a 2% Roundup solution which he feels is not necessarily more effective in killing the plant, but makes it unnecessary to have complete coverage and provides for a quicker kill.

Whenever chemical control of Ice Plant is proposed, it should be preceded by sight-specific surveys for sensitive native species.

Hand Control

Ice Plant can also be controlled by manually removing the plant from the soil in which it is growing. The plant "rips out" of the ground relatively easily by pulling up the stems. This method also removes the roots of the plant which hold the soil. When using a hand control method, the ice plant can either be totally removed from the site, (i.e dumped at a landfill), which can be quite costly, or can be left on site to dry out and later be used as mulch material.

At Asilomar, Tom Moss prefers reuse of the dead Ice Plant material. There they spread it out to dry and then use it as a surface mulch. They have had some success direct seeding desirable species in the mulch material. In fact the germination rate of native plants has been higher in the Ice Plant mulch, than in bare sand.

Hand control of Ice Plant is effective where there are fairly small areas of the plant, or where it is so intermixed with desirable plants such that chemical spraying would kill both the target species (Ice Plant) and the desirable plants.

However, hand control is very labor intensive and could be costly unless volunteer labor is available. It is not recommended for large areas on steeper slopes, since removal of Ice Plant will result in exposing large areas of loose soil, creating an erosion problem.

Biological Control

In 1971, two species of scale insects (*Pulvinariella mesembryanthemi* and *P. delottoi*) were discovered feeding on Ice Plant in the San Francisco Bay Area (Washburn and Frankie, 1985). The scale, which has a high

reproductive potential and is easily dispersed by wind, quickly spread throughout the State, and assigned pest status by the CDFA.

Caltrans, which maintains extensive areas of Ice Plant along California highways, has funded studies to determine methods of controlling the insect. One study prepared by Washburn and Frankie in 1985 states: "Interestingly, under some conditions Ice Plants are considered pest species. In many coastal plant communities of California aggressive Aizoaceous (Carpet-weed) species have displaced native vegetation. In these instances Ice Plant scales have been considered for use as biological control agents to reduce Ice Plant populations."

The use of the scale insect for control of Ice Plant is not recommended at Marina Dunes for two reasons: 1) it is unlikely that the State Department of Food and Agriculture would allow the introduction and/or spread of a designated pest species anywhere in the State, and 2) the scale insect has been known to colonize a native Dudleya species, which is a relatively common native plant found at Marina Dunes.

Recommended Control Methods for Particular Ice Plant Growing Conditions

FOR: Large patches as are found at the Marina State Beach and on the Graniterock and Marina Beach Co. property.
USE: Chemical control, using a spray wand that can avoid larger native plants found growing in the dense patches of Ice Plant. Truck spraying is recommended in areas accessible by roads, backpack sprayers in more remote areas. Roundup is recommended, although experimentation with Amitrol-T on a small scale is suggested to possibly cut costs.

FOR: Smaller patches as are found on the Southern Lone Star property.
USE: Chemical control, with a spray wand that can avoid larger native plants found growing in the dense patches of Ice Plant. Truck spraying is recommended in areas accessible by access roads; backpack sprayers in more remote areas.

FOR: Invading patches as are found in the Flandrian dune habitat in the North Lone Star property and Martin dunes.
USE: Either hand control where removal is critical to the survival of rare and endangered species, or chemical treatment. Determine appropriate method on a site specific basis.

2. Eucalyptus Trees and Introduced Beach Grass

Fortunately both Eucalyptus and introduced beach grass have a limited distribution at Marina Dunes.

Eucalyptus trees are found in small clumps at the Marina State Beach. They are native to Australia and are often used in the landscaping trade due to their fast growth and ability to provide visual and wind screens. Unlike Ice Plant, which has seeds which disperse easily in the wind, Eucalyptus trees have seeds which are heavy and fall to the ground near the parent tree. As such, Eucalyptus trees typically spread by expanding out from established stands. Expansion of existing stands can be controlled by pulling out seedlings or cutting down small trees which are found outside

the existing periphery of the stand.

The Eucalyptus stands at Marina Dunes, if contained to their present area by periodic seedling removal, do not pose a major threat to the habitat of the rare and endangered species.

Beach grass (Ammophila arenaria) is an introduced grass which has been widely used for dune erosion control purposes by state and local public works agencies. As with Ice Plant it is an aggressive invasive species which outcompetes native plants in dune habitats. Fortunately there are only two small areas of introduced beach grass at Marina Dunes, one is near the State Beach visitor parking lot off of Reservation Road, the other is near the beach about 1/3 mile south of the parking lot.

Pavlik and Zoger in their Rare Plant Study for Marina Dunes (1986) note that Marina Dunes "have the distinction of being practically free of Ammophila arenaria, an introduced beach grass that invades and degrades native strand and dune communities along the Pacific coast" and "it is rare to find dune vegetation today in California that is not slowly, or not so slowly, being destroyed by this exotic grass. They stressed the importance of controlling and eventually eliminating the small area of beach grass that exists at the dunes so that it does not invade nearby areas.

Hand pulling individual beach grass clumps can be time consuming and ineffective. Because the infestation area at the Dunes is easily accessible by vehicle, and does not contain rare or endangered species, chemical treatment is recommended for control.

C. EXISTING CONDITIONS

The existing laws and policies relevant to revegetation are contained in a separate background paper. See Section VIII. Biological Resources -- Existing Laws and Policies.

D. SUGGESTED PLANNING GUIDELINES

I. REVEGETATION

1) Allow dune reshaping in all sites disturbed by mining or off road vehicles use as development occurs.

2) Use only California native plant species indigenous to Marina Dunes for revegetation work within designated conserved habitat areas. Collect seeds and plant material from Marina Dunes or nearby environs.

3) Allow the use of non native non invasive species in designated development areas.

4) Whenever possible, salvage valuable or hard to replace plant material from the sites before the disturbance occurs.

5) Develop specific reclamation plans for each individual restoration

area. The reclamation plan should include provision for erosion control. Seed mixtures or container plants specified in the Reclamation Plans should be comprised of species that are representative of the habitat type or micro-environment that is being revegetated.

6) More than one planting method may be needed in any given area. Planting methods should include hydroseeding, hand-broadcasting of seed, and container planting. All of these methods or any combination of the three may be needed to successfully revegetate and maintain a particular site.

7) Establish a native plant nursery in the project area or vicinity. Some plants can be propagated on site; plants not grown on site can be hardened at the nursery before planting. In addition it is suggested that if there is a need for large quantities of some species, a species specific seed production plot be established on site.

8) Seeding and planting should occur in the fall and winter months so as to avoid or minimize the need for artificial irrigation. Revegetation work can also be conducted during all seasons when water is available from irrigation. Discrete, short-term use of fertilizer and irrigation can be beneficial in increasing seed germination and the survival rates of seedlings, thereby ensuring revegetation success.

9) Progress toward revegetation of disturbed areas and the health of preserved areas should be systematically observed and evaluated. Periodic surveys should be conducted and status reports prepared by a qualified dune botanist to assess plant establishment, relative abundance, species composition, and revegetation success. Damage to vegetation from human use of the dunes, inclement weather, and animals and the success of measures to control and eradicate exotic plants should be documented. Recommendations for meeting management goals should be identified. Permanent transects should be established as part of a long-term scientific monitoring program.

II. EXOTIC SPECIES CONTROL

1) Determine a funding source for the exotics control program.

2) Prepare an exotics species control priority list which based on the degree of threat t sensitive native plant and animal species. Eradication of exotics should receive the highest priority in areas where exotics are competing directly with rare and endangered plants, the host plants of Smith's Blue Butterfly and areas of good and excellent habitat for the Black Legless Lizard. Key the list to a map which shows specific areas and timing of control (i.e. immediate, near future, far future) For example, the top priority may be to hand remove Ice Plant growing close to or around stands of Erysimum menzesii or Gilia tenuiflora and to chemically treat the area of introduced beach grass. The next priority may be to work on eliminating small "invading" patches found on the North Lone Star and Martin Dunes property; a lower priority may be to kill the large extensive patches of Ice Plant because they have already removed native habitat and are

not as immediate a threat to the rare and endangered species and to remove Eucalyptus trees in areas that are to be managed for preservation of natural values.

3) Prepare an ongoing exotics control work program. In this program define goals, scope of work methods to be used, and estimated annual budget; include any follow up work which may be necessary. Make sure the exotics control program is coordinated with dune restoration and revegetation programs and is incorporated into a permanent dune vegetation maintenance program.

4) During implementation of the program, use persons who are knowledgeable on the particular control methods being used, are sensitive to the native resources on the site, and are cost competitive.

5) Prevent the use of invasive exotic species in landscaping plans for projects taking place at Marina Dunes.

6) Since Carpobrotus edulis is more aggressive and therefore more of a threat to native species than C. aequilateralis, Ice Plant control efforts should be focused on C. edulis.

VI. Smith's Blue Butterfly

VI. SMITH'S BLUE BUTTERFLY

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A. INTRODUCTION

Smith's Blue butterfly is listed as an endangered species by the United States Fish and Wildlife Service. Because Smith's Blue is found at Marina Dunes, Marina Dunes Coastal Zone Planning Task Force required information on the ecology and population distribution of this butterfly prior to the preparation of a Habitat Conservation Plan.

The information presented here is based on field work by Robert Langston, Dennis Murphy and Raymond White for Thomas Reid Associates in 1987 and 1986 and on the work of others as reported in the published literature.

B. EXISTING CONDITIONS

1. Summary

Smith's Blue butterfly is found along the coastal dunes of Monterey County, where the larvae (caterpillar form) feed on two species of buckwheat: the seacliff buckwheat, Eriogonum parvifolium, used to the south, and the coast buckwheat, Eriogonum latifolium, used in the north. While the overall distribution of Smith's Blue is smaller than the geographic range of its larval food plants, Marina Dunes is clearly within the present range of the butterfly and thus there is a high probability of finding the Smith's Blue wherever the buckwheats occur. At the dunes the butterfly is seen in low to moderate densities (several dozen per acre) throughout areas of native dune vegetation, with patches of high density in concentrations of buckwheat on the sheltered lee side of the Dunes.

Smith's Blue adults are found close to its larval host plants, which also serve as adult nectar sources as well as egg-laying sites for females. The close relationship between the butterfly and its food plant allows Smith's Blue to colonize and maintain populations on habitat areas as small as a few acres. Such small populations may frequently go extinct, however, and can only be reestablished by migrants from more persistent colonies.

2. Taxonomy

a. Description of the Butterfly

Smith's Blue is a small lycaenid butterfly. The adults have a 1 inch wingspan. The wing has a pale grey underside speckled with black dots and a reddish-orange band on the hind-wing border. The topside of the male is a lustrous blue, the female has a brown topside with a band of orange bordering the hind wing (1984 SB Recovery Plan). Larvae are slug-shaped and vary in color from cream to pale yellow or rose, depending on the color of the flowerhead on which they are feeding.

b. Subspecies Relationships

The species Euphilotes enoptes comprises nine described subspecies, including Smith's Blue (Euphilotes enoptes smithi). The following paragraph is a general introduction to the species biology adapted from Langston (1975).

The species group distribution is restricted to western North America, Western Canada and Baja California. Adults are closely associated with their host plants, several species of wild buckwheat, Eriogonum (Polygonaceae). Eggs are deposited on late buds or early flower heads of the buckwheat plants. Young larvae feed solely on the flowerheads of the plant. Each subspecies is generally restricted to one or a few closely related host species of buckwheat. There is only one generation per year. Depending upon subspecies, the adults may fly in early-late spring, early summer, mid-summer or early fall.

Smith's Blue (Euphilotes enoptes smithi) was originally described in 1954 by R.H.T. Mattoni from specimens collected at Burns Creek, State Highway 1, Monterey County, California. Robert Langston discovered a colony at Marina Dunes in 1962. In 1975, Langston described the butterfly as inhabiting the sand dunes of north Monterey County southward through Big Sur.

The most recent distribution of SB is described in the U.S. Fish and Wildlife Service (USFWS) Smith's Blue Butterfly Recovery Plan (1984). Figure VI-1 (taken from the Recovery Plan) shows the known collection locations of Smith's Blue through 1983. Note that the Santa Cruz and San Mateo County locations are not considered to be assignable to Euphilotes enoptes smithi.

Robert Langston and Dennis Murphy, Ph.D. (Thomas Reid Associates) conducted a survey of Euphilotes enoptes in 1986 in inland Santa Cruz County for the USFWS to determine the taxonomic status of the insect and its distribution. That study concluded that Euphilotes enoptes found in inland Santa Cruz Co. and San Mateo County are phenotypically intermediate between E. e. smithi and E. e. tildeni.

Two other subspecies of Euphilotes enoptes are found in the greater San Francisco Bay Area. E. e. bayensis is found in the northern San Francisco Bay area: including Marin, Contra Costa, and Solano Counties, ranging northward in Sonoma, Mendocino and Humboldt Counties. E. e. tildeni is also more widespread than smithi: it occurs in the inner coast range foothills

and mountains in Santa Clara, Stanislaus, San Benito, Monterey, San Luis Obispo, Kern and Ventura Counties.

2. Ecology

a. Life Cycle

The following is summarized from the Smith's Blue Recovery Plan (USFWS 1984). Smith's Blue butterflies are univoltine -- there is only a single generation per year. The butterflies overwinter as pupae, emerging as adults in the late spring or early summer. The males emerge a few days to a week ahead of the females. Once the females emerge, they are quickly mated. All courtship and mating behavior takes place around the buckwheat plants.

The females lay their eggs singly on flower heads of the plants. The larvae hatch in about a week. After hatching the larvae begin eating the flowering heads of the buckwheat. As larvae grow they molt, passing through 5 growing stages (or instars). Following the fifth instar stage the larvae pupate (August - November), and then overwinter in the leaf litter at the base of the plants. Some pupae have been found to overwinter in the dried flower heads of the plant.

b. Larval Food Plants

The Smith's Blue is known to use two buckwheat species as larval food plants: seacliff or dune buckwheat, Eriogonum parvifolium, and coast buckwheat, Eriogonum latifolium. In California, Eriogonum parvifolium is found in dunes and hillsides along the California coast from Monterey County south to San Diego County (Abrams, 1944). The Marina Dunes is near the northern range limit for Eriogonum parvifolium and the butterfly. The dune buckwheat is a low spreading shrub with slender leafy branches (Figure VI-5). It has a single inflorescence; the flower is a pale rose color. Eriogonum latifolium is found in bluffs and dunes along the coast from Oregon south to San Luis Obispo (Munz 1968). It has mostly basal oval leaves (Figure VI-5), and also has a single white or pale rose inflorescence.

The distributions of both buckwheat species were determined in 1986 and in 1987. Figure VI-6 shows the distribution of Eriogonum latifolium and Eriogonum parvifolium at Marina Dunes. Eriogonum latifolium is distributed widely over most of the Dunes. Eriogonum parvifolium has been restricted to the coastal strand where, due to continual surf and wind induced erosion, there is little competition from invading Ice Plant. Elsewhere in its range, E. parvifolium is more common in sheltered areas; its exclusion from the aft dunes at Marina may show the role of competition in establishing its northern range limit.

Smith's Blue at Marina Dunes uses E. latifolium. Smith's Blue has been known to use both species of Eriogonum at the same location in Sand City (Langston, unpublished data for 1987), but dual host use at Marina was not observed in 1987. Long term fluctuations in conditions may effect shifts in the north-south demarcation of host plant utilization such that increasing E. parvifolium populations at Marina Dunes would be followed by Smith's Blue use once again.

c. Oviposition Suitability

Female butterflies lay their eggs singly on the buds and newly opened flowering heads of buckwheat. Because the plants bloom earlier in the more sheltered aft dunes, the earliest emerging adults are found flying in these locations. The adults subsequently emerge in the mid dunes, and ultimately in the more exposed areas of the fore dunes.

d. Nectaring

Adult Smith's Blue butterflies nectar (feed) almost exclusively on buckwheat flowers. Under inclement weather conditions when butterflies do not get sufficient warmth from sunlight to allow flight, adult feeding is also curtailed.

e. Interaction with Other Animal Species

There are several species of lepidoptera which also feed on buckwheat species at Marina Dunes: the mormon metalmark (Apodemia mormo), the green hairstreak (Callophrys viridis), the acmon blue (Plebejus acmon), and the common hairstreak (Strymon melinus pudica). These species overlap in flight period with Smith's Blue. The extent of larval competition among these species is not known, however, due to the abundance of buckwheat at the Dunes, competitive exclusion among the species is not likely to occur across large portions of the habitat.

As with other lycaenids, Smith's Blue larvae appear to be tended by ants during later instars (Arnold 1980). Arnold also observed predation by spiders and occasionally heavy parasitism by wasps. The role of other species in Smith's Blue population dynamics is unknown.

f. Dispersal and Barriers to Movement

Smith's Blue is a weak flying species and long distance dispersal is certainly extremely rare. Mark-release-recapture (MRR) studies are required to demonstrate actual movement of individuals and were not done for the 1986-1987 Marina Dunes study. Arnold (1983) examined Smith's Blue at Fort Ord and at the Marina State Beach (1986), reporting common dispersal of distances of a few hundred yards. Absence of observations of long distance movement from Arnold's study does not mean that the butterfly does not or is incapable of long distance dispersal -- Arnold's MRR study focused on several colonies and would not have detected dispersal outside of the area being sampled. However, the butterfly's behavior corroborates the limited movement described by Arnold. Flight usually occurs within one or two meters above the ground. Observations of extended flight -- more than a few minutes for an individual butterfly -- are rare.

Since the Smith's Blue spends the majority of its time in short flights within patches of buckwheat, any area of non-habitat, such as active mining areas, large blow-out, or extensive dense patches of vegetation which does not contain buckwheat (such as Ice Plant), will act as some barrier to dispersal. Where there is no visual continuity of habitat, as with areas of urban development or plantings of shrubs or trees, the barrier is likely to be significant. Some dispersal may be passive, by the wind, but the typical response of adults under high wind conditions is to avoid flight altogether.

3. Smith's Blue Populations at Marina Dunes

a. Host Plant Utilization and Population Distribution

Host Plant Utilization

Prior to construction of Highway 1 through Marina in late 1960's, the seacliff buckwheat, Eriogonum parvifolium, was widespread in aft dunes areas, away from the shore. At that time E. parvifolium was the only known host of the butterfly and Langston found Smith's Blue at Marina Dunes associated with E. parvifolium. After construction of Highway 1, African ice plant used to revegetate open sand spread onto undisturbed dunes. Competition with Ice Plant resulted in a drastic decrease in the distribution of E. parvifolium at Marina Dunes, and caused a concomitant decline in the population of the butterfly. This loss of habitat was a major factor in the decision to list the butterfly as an Endangered Species in 1974.

The coast buckwheat, Eriogonum latifolium, was also found in the Dunes in the 1960's, but it did not appear at that time to be used by Smith's blue. Apparently the decline of the E. parvifolium population caused the butterfly to oviposit on E. latifolium, which was more widespread in the Dunes and which appears to better withstand competition from alien Ice Plant. Smith's Blue was first observed using E. latifolium at Marina Dunes in 1978 by Langston.

E. latifolium blooms in June and July; E. parvifolium blooms from July through September. Because E. latifolium blooms earlier than E. parvifolium and because the larvae feed on the flowerheads, Smith's Blue began to exhibit an earlier adult flight period. Where Smith's Blue is associated with E. latifolium, the butterfly flies in June and early July, and where associated with E. parvifolium, the butterfly flies from July to September. Morphologically, the adults fall within the same range of variation from either host.

Smith's Blue now can be found essentially anywhere Eriogonum latifolium is found at Marina Dunes. This buckwheat is scattered in relatively high density over much of the Dunes, except where there has been substantial disturbance, such as in quarried areas or where major blowouts or vehicle damage have occurred. The greater local numbers of Smith's Blue invariably correspond with denser patches of Eriogonum latifolium.

The declining relative abundance of Eriogonum parvifolium on the Marina Dunes, and increased association of butterflies there with E. latifolium suggests that a population-wide shift in larval host plant use is occuring. At least two explanations for this phenomenon are plausible. First, is that two "host races" or "ecotypes" with distinct preferences for, and adaptations to, each of the Eriogonum species always have co-occured at Marina Dunes. With the decline in abundance of E. parvifolium has come a decline in abundance of the ecotype utilizing that host. This seems unlikely because the formation of host races or ecotypes demands a rather complete barrier to gene exchange between the individuals exhibiting the distinct host preferences. The partially overlapping flowering times of the two Eriogonum species and overlapping flight periods of the butterflies using the two

hosts would make the "two ecotypes" scenario difficult to support.

The more likely explanation is that a capability of using both hosts is manifested in most individuals in the population (or populations). The loss of one host has caused a measurable temporal shift in the flight period of the population. As in the case above, historical records indicating exclusive use of E. parvifolium undoubtedly overlooked use of E. latifolium which was also occuring.

The "plasticity" in host choice that the latter explanation implies, would be an important adaptation in a rapidly changing environment and, should be considered in the conservation of the butterfly. The recent disappearance of Eriogonum parvifolium and the concomitant narrowing of the butterfly flight window may reduce the ability of Marina Dunes Smith's blue population to respond to environmental variation, particularly the vicissitudes of climate. Outplanting of E. parvifolium is highly recommended to aid in sustaining variation in host plant use in the butterfly population.

Population Distribution

Marina Dunes is the northern limit of the confirmed range for Smith's blue butterfly. Because of the relatively poor representation of E. parvifolium there in the recent past, Marina Dunes had been considered "marginal" habitat for the butterfly. Now, because of the butterfly's clear association with E. latifolium, the Dunes are considered prime habitat.

The survey methods used do not support quantitative population estimates. Clearly, Smith's Blue are numerous along the natural dunes in the study area. Over a thousand sightings were made in 1987 and there were undoubtedly thousands of adults at the Dunes in 1987. The colony as a whole has populations well above levels where theory would suggest inbreeding or other population viability limitations.

The general distribution of the butterfly was determined based on the transect surveys of 1986 and 1987 and on extensive habitat mapping (Figure VI-2). The shading on the distribution map indicates the relative density of Smith's Blue. In all, there is good habitat for the insect on about two-thirds of the study site.

b. **Smith's Blue Survey**

A survey of adult Smith' Blue Butterfly was performed in July 1986 for the Marina Dune Coastal Zone Planning Task Force. By the time that contract was let, however, the flight season for the butterfly at Marina Dunes was effectively passed and the full scope of biological studies required for the preparation of a Habitat Conservation Plan could not be performed. As a result, a subsequent survey was performed in June and July, 1987.

The results of the 1986 study are discussed in a report entitled "Marina Dunes Smith's Blue Survey -- 1986, Final Report, January 1987" prepared by Thomas Reid Associates and Dennis D. Murphy, PhD. The results of the 1987 study are reported below.

In 1987, over 40 person hours were spent in the field in transect

studies of Smith's Blue at Marina Dunes with a total of 1080 butterfly sightings. For this survey an effort was made to cover the entirety of Marina Dunes, including the State Beach area to the south. The actual census, that is individual observations, are shown in Figure VI-3. Because the insect is scattered at low to medium density over a wide area of varied terrain, some areas were not covered by the walking transects. Also, some areas may have been covered, but no butterflies were observed due to poor weather conditions on that particular day. Although inclement weather (including rain, strong winds, or heavy fog) restricts flight by the butterflies, the insects can be observed while perched on the buckwheat flower heads. Thus, even under poor weather conditions, transect monitoring could proceed, but with less efficiency and with somewhat less reliability.

Note that no mark-release-recapture work was done by Thomas Reid Associates in either 1986 or 1987. Such a study technique is needed to get quantitative population and dispersion estimates. Because of the availability of population parameter data from the work of Arnold and because of the close dependency of the Smith's Blue on the larval host plant distribution, mark-release was judged to be unnecessary for this study. Handling during mark-release has a distinct adverse impact on a fragile butterfly such as Smith's Blue. Mark-release also requires a level of effort at least 10 to 20 fold greater than do transect methods for the same area studied.

c. **Demographic Centers**

Presence of Smith's Blue butterfly generally corresponds with areas of undisturbed habitat surrounded by areas of disturbance and areas in which non-native plants occur. The boundaries between population concentrations should not be viewed as strict demarcation lines, only as demographic centers which may vary somewhat from year to year.

Although the demographic centers are separated by areas of non-habitat it is the authors' belief that those barriers at present do not significantly fragment the Marina Dunes population. The Marina Dunes population is probably genetically contiguous and there is probably adequate dispersal between centers so that each is consistently occupied by the butterfly.

Based on the transect surveys performed in 1987, four Smith's Blue sub-colonies or demographic centers were identified (Figure VI-4). The largest is the North Lone Star-Martin Dunes-Salinas National Wildlife Refuge population, north of Lone Star's active mining area. The second largest demographic center is that on Lone Star property south of the active mining area and lands of the Marina Beach Company, and of Granite Rock. A small sub-colony is found north of Reservation Road, near the State Beach headquarters building and just south of Reservation Road in the State Beach. Scattered observations across the dune restoration areas of the State Beach separate that small center from fairly concentrated habitat on the lee side of the dunes on the south end of the State Beach.

4. Habitat Requirements for Preserve Design

a. Objectives

Conservation planning for Marina Dunes area deals with only a part of the known range for Smith's Blue. As such, whatever conservation is achieved at Marina Dunes will affect and be affected by conservation efforts elsewhere in the butterfly's range. With minor updating for recent studies, the US Fish and Wildlife Recover Plan is a good guide to the sort of range-wide protection that would be appropriate to maximize the long term survival of Smith's Blue.

In considering habitat requirements for preserve design, we consider first the need to preserve areas of adequate size, integrity and resource quality to maximize the long term survival of a colony at Marina Dunes. Second we consider the proximity to other colonies (primarily to the south).

b. Resource Quality Within Colonies

The quality of habitat, including host plant availability, for Smith's Blue varies over Marina Dunes study area. The larval food plants, buckwheat, are most abundant in the flandrian dune scrub vegetation and in lesser abundance in the recent dune and mesic swale scrub communities (see Pavlik and Zoger survey on Rare Plants, June 1987). The denser stands of Eriogonum latifolium range in size from 1/2 acre to several acres and may support a correspondingly denser local concentrations of Smith's Blue.

Adult Smith's Blue can find basic requirements (mating, nectaring, egg-laying) within a very small area (less than an acre), but the buckwheat resource can vary location from year-to-year, and thus local butterfly densities may vary as well. Within the densest stands of buckwheat, habitat quality also varies with the mean ages of individuals plants and due to competition from other species. Thus, Smith's Blue "hotspots" may shift over a period of years -- partially in response to declining buckwheat quality (Arnold, 1980, 1986). The shift in population density following ice plant invasion is unmistakable.

The strong on-shore wind is attenuated on the lee side of prominent dunes creating a distinct microclimate gradient from foreshore to aft dunes. The warmer conditions in more sheltered aft dune areas seem to have a consistent influence on both the activity and population density of Smith's blue: the butterflies are scarce along the fore dune, scattered throughout the mid-dune area, and widely found and dense in patches along the aft dune. Part of the spatial difference in distribution can be explained by the greater host plant density in more sheltered locations, but the role of the butterfly's thermal ecology is probably most significant. As with most butterflies, Smith's Blue undoubtedly needs some warmth to be active. In sheltered areas, butterflies can spend more time in feeding, mating, and oviposition (egg-laying), which allows greater utilization of the host plant resources present.

c. Conservation Strategies and Species Survival

The butterfly probably has a stepping-stone dispersal pattern, (Murphy 1986). Although few individuals travel substantial distances, individuals

do leave colonies and disperse into adjacent unpopulated areas throughout the range of the butterfly. Surveys of Smith's Blue habitat around Marina Dunes (Salinas State Beach to the north and Fort Ord and Sand City to the south) in 1987 suggest that gene flow may be realized across the entirety of the butterfly's distribution along the coast of Monterey Bay.

Large, continuous habitat areas with high resource density are the areas of greatest habitat value. Small isolated areas, even with high resource density, may be unable to support Smith's Blue butterflies in the long term. Even with high buckwheat density, small areas may not be able to support enough butterflies to avoid extinction due to random fluctuations in population size. While it is plausible that sufficient long-range dispersal (on the order of a mile) could accomplish recolonization and gene flow through the stepping stone model, the rate of recolonization may be too low to functionally sustain colonies at many of the isolated habitat patches noted along the dunes at Fort Ord, for example.

Large areas with low resource density may continue to support colonies of Smith's Blue if the resource density is above some critical value (not now known explicitly). Results from this study and others (Arnold, 1980, 1986) indicate that the flight behavior of Smith's Blue is well adapted to exploit a host plant of moderate density with a patchy distribution on a small scale and which shifts in density and distribution over time.

The ability of Smith's Blue to respond to environmental variation is greatly enhanced by maximizing the physical area and topographic diversity of the core habitat conserved. As in all conservation prescriptions -- all else being equal -- the largest and most heterogeneous habitat patches will support the greatest biological diversity, and the resident species will persist there the longest.

There is virtually no practical data on the design of corridors to enhance interpatch dispersal by endangered species. However, our understanding of butterflies closely related to the Smith's Blue, observations of Smith's Blue at the Dunes, and common sense, can give some evidence. Any corridor to effect dispersal in this highly habitat-specific species certainly will have to both act as habitat itself and as a flyway. All observations of Euphilotes flight behavior suggests that "intrinsic barriers" to dispersal limit movement in this sedentary species; that is, the butterfly tends not to leave its habitat even in an absence of physical barriers. How wide gaps in habitat corridors must be before they become barriers to dispersal is also unknown, but certainly any gap larger than a one lane road may become a barrier to many potential dispersants. How wide the corridor must be to support butterflies as habitat is also not known. One population of the closely related El Segundo Blue, however, has survived for many years with some habitat modification on just two acres.

Restoration of disturbed areas with host plants of Smith's Blue can help mitigate habitat losses due to development. Several successful revegetation and habitat enhancement projects have been done in the recent past for this species and related species. Restoration of a reconstructed dune at Spanish Bay on the Monterey Peninsula resulted in the successful establishment of a native plant community which contained Eriogonum latifolium. Dr. Rudy Mattoni has successfully outplanted several acres of Eriogonum spp., for use by the El Segundo Blue butterfly, Euphilotes

battoides alleni at the Los Angeles Airport (Liona Mattoni, pers. comm. 10/87). This revegetation project has not only resulted in the increase in habitat area but also an increase in the quality of habitat through the control of exotic species.

With adequate conservation planning, Marina Dunes should be able to sustain a major Smith's Blue colony -- and by far the most significant colony using E. latifolium as the larval host plant. Certainly the habitat disturbance in the middle and southern portions of the dune system (Fort Ord, Sand City) show that Marina Dunes should be viewed as important to the long term persistence of the subspecies.

With Marina Dunes as one element of a system of coastal dune conservation, the objectives of the USFWS Recovery Plan for the Smith's Blue could be realized.

C. EXISTING POLICIES

The existing laws and policies relevant to Smith's Blue are contained in a separate background paper. See section VIII. Biological Resources -- Existing Laws and Policies

D. SUGGESTED PLANNING GUIDELINES

These suggested planning guidelines are specific to Smith's Blue butterfly and are in addition to those described for overall biological resources (see Section VIII).

1) Minimize the overall reduction of the habitat (area of host plant) of the Smith's Blue butterfly at Marina Dunes resulting from the designation of non-habitat use areas.

2) Taking of the Smith's Blue butterfly resulting from the implementation of a Habitat Conservation Plan should be incidental, and not appreciable to reduce the likelihood of the survival and recovery of the species in the wild (Endangered Species Act, Section 10(a) B.).

3) To the maximum extent practicable, minimize and mitigate the impacts of taking (Endangered Species Act, Section 10(a) B.).

4) Provide adequate funding for the Habitat Conservation Plan (Endangered Species Act, Section 10(a) B.).

5) Preserved/conserved habitat areas should be contiguous or be joined by habitat corridors to allow adequate dispersal between butterfly demographic centers. Optimal corridors between preserved/conserved habitat areas should be at least 50 feet in width. The corridors should be maintained in the sheltered aft dunes as well as the more exposed fore dunes (Fore dune corridors would be also maintained through the erosion setbacks). Provision should be made to maintain/provide corridors with Smith's Blue habitat north and south of the study area.

6) Outplanting of both E. parvifolium and E. latifolium is recommended in disturbed areas to mitigated habitat loss due to development.

7) Monitor the adult population of Smith's Blue butterfly each year during the early phases of the implementation of the conservation plan to determine the effects of management programs. Use transect surveys rather than mark-recapture surveys to reduce damage to the butterflies caused by excessive handling.

FIGURE VI-1
KNOWN LOCATIONS OF SMITH'S BLUE BUTTERFLY THROUGH 1983

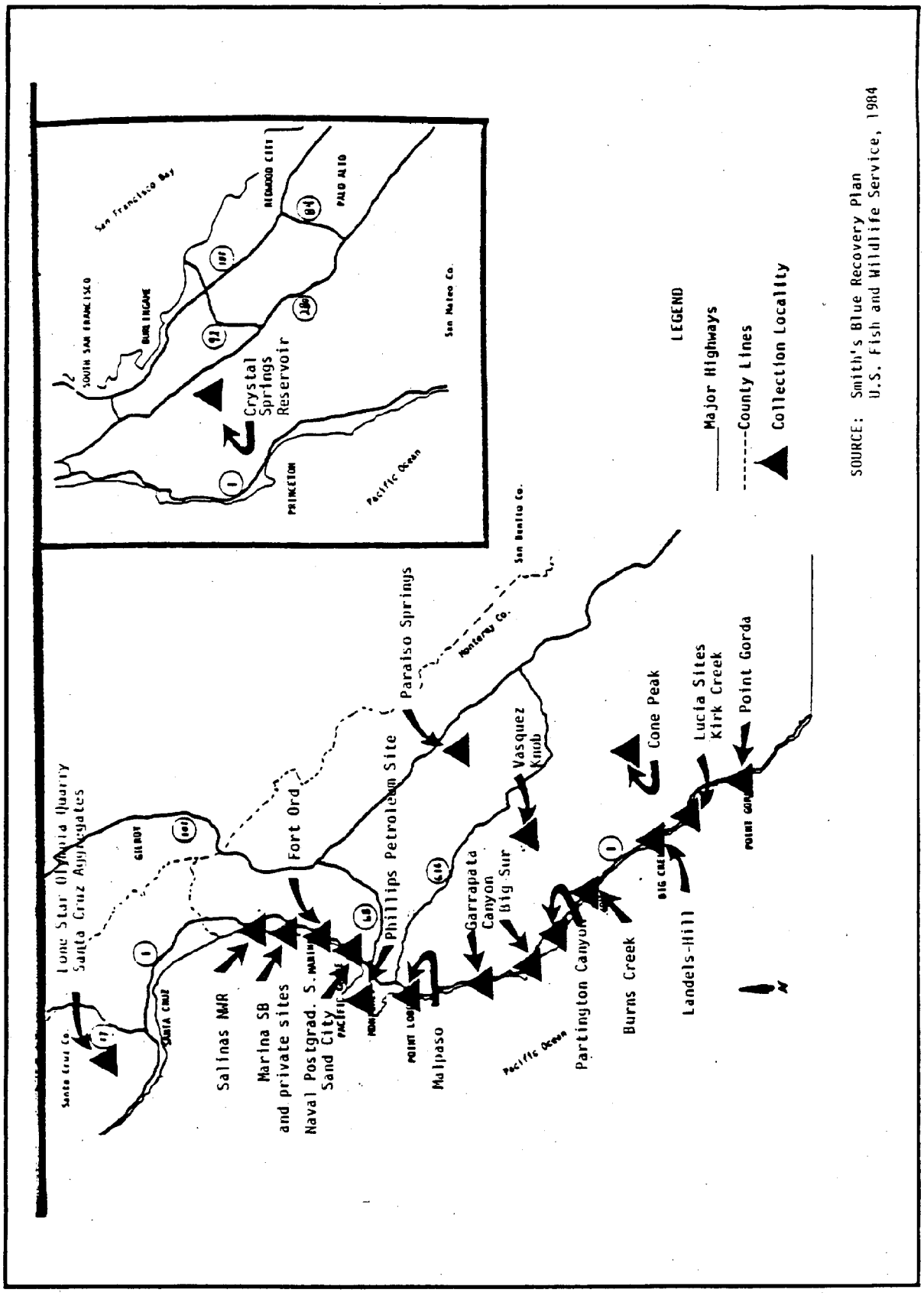


FIGURE VI-2
GENERAL POPULATION AND HABITAT DISTRIBUTION 1987 -- SMITH'S BLUE

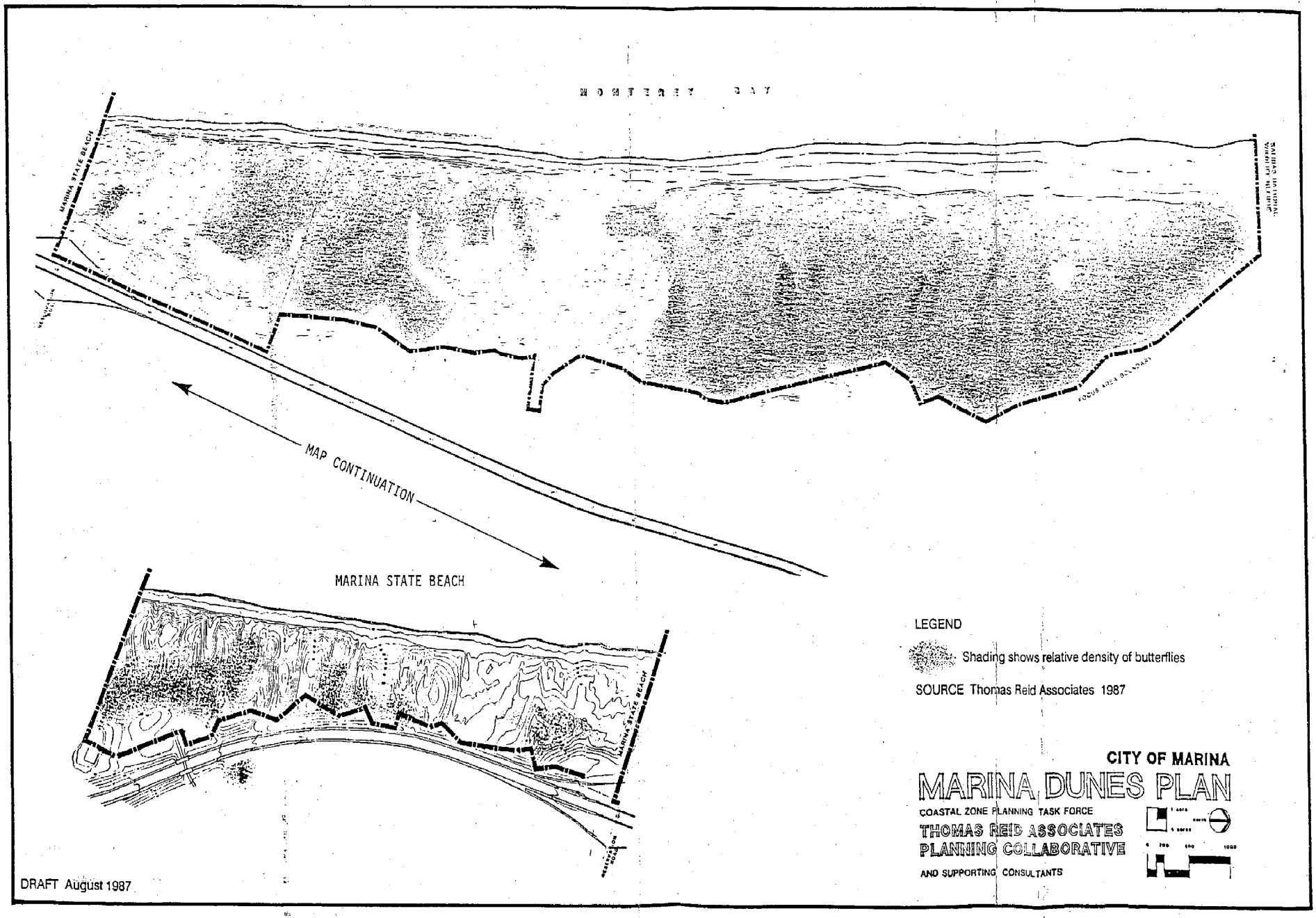


FIGURE VI-3
1987 CENSUS, LOCATION OF ADULT OBSERVATIONS

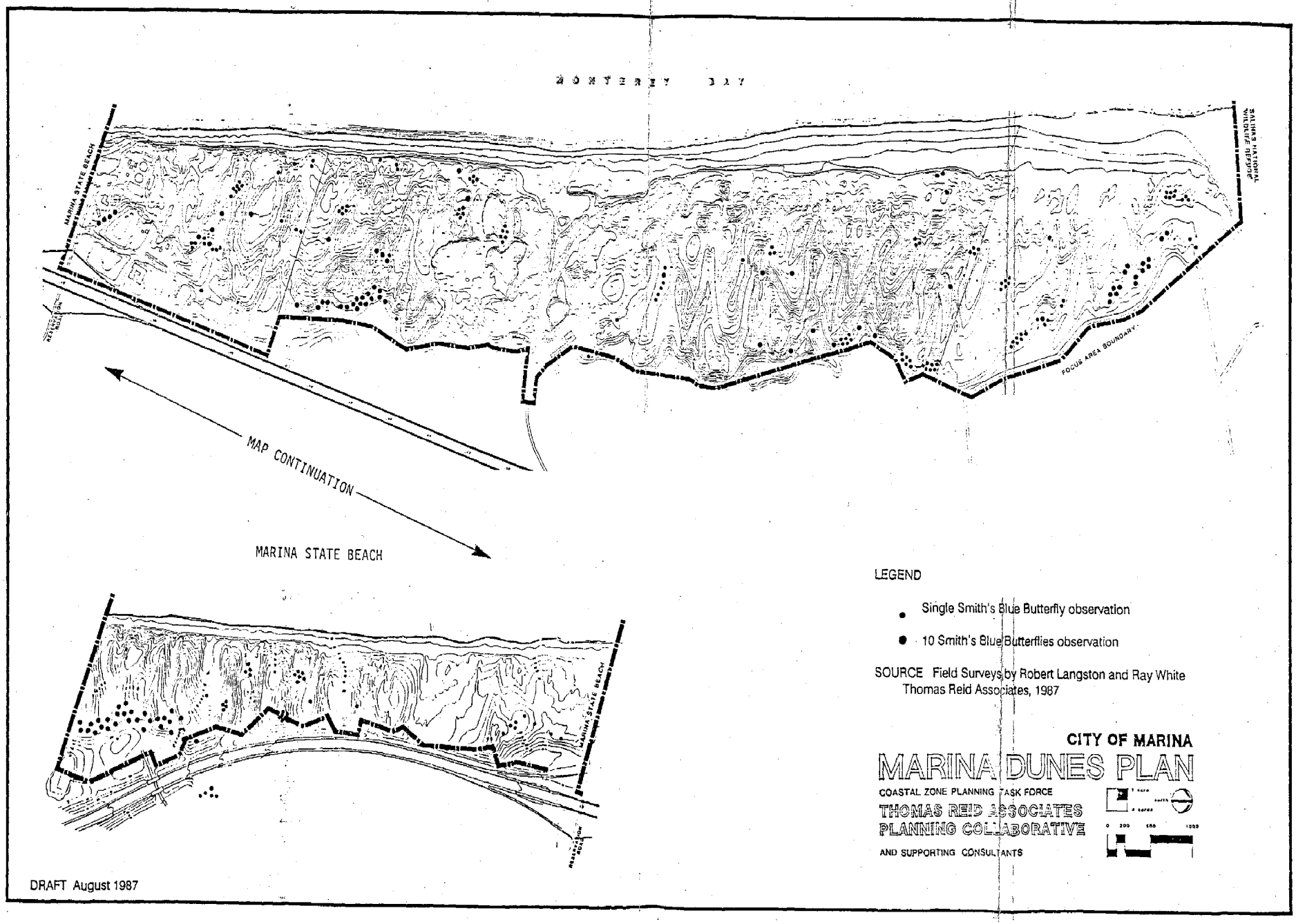


FIGURE VI-4
SMITH'S BLUE DEMOGRAPHIC CENTERS

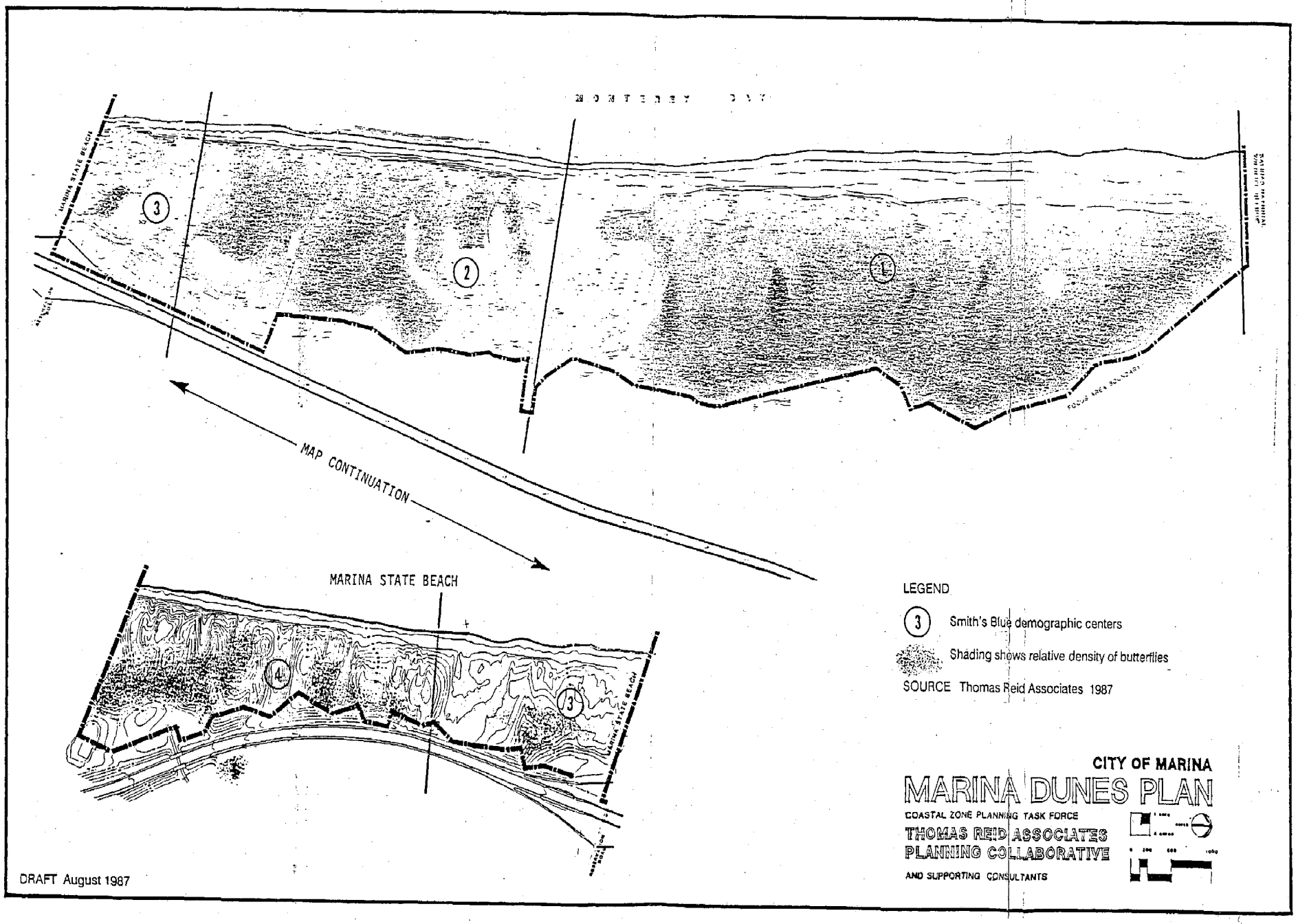
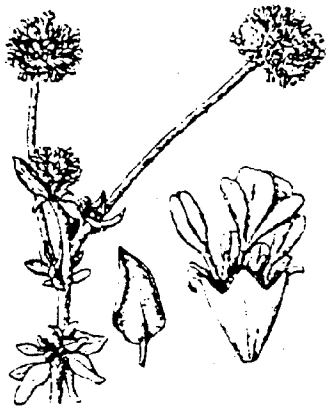


FIGURE VI-5
ILLUSTRATIONS OF ERIOGONUM HOST PLANTS

PLANTS OF CONCERN



Eriogonum parvifolium

75. Eriogonum parvifòlium Smith. Dune Eriogonum. Fig. 1423.

Eriogonum parvifolium Smith in Rees, Cycl. 13: No. 2. 1809.
Eriogonum parvifolium subsp. *lucidum* Howell ex Stokes, Gen. Eriog. 87. 1936.

Low spreading shrub, 3–10 dm. high, with slender densely leafy branches, thinly floccose. Leaves fasciculate at the nodes, round-ovate to oblong-lanceolate, 8–12 mm. long, short-petioled, thick, revolute on the margins, densely white-tomentose beneath, dark green and shining above; heads solitary or racemosely disposed on a simple or umbellately branched peduncle; involucres 4 mm. long, glabrate outside, woolly on the throat within; calyx white or tinged with rose, glabrous, 3–4 mm. long, the lobes obovate; filaments sparsely hairy.

Dunes and hillsides along the coast, mainly Upper Sonoran Zone; Monterey Bay to San Diego County, California. Type locality: California (Menzies), probably Monterey. June–Dec.

Eriogonum latifolium

70. Eriogonum latifòlium Smith. Coast Eriogonum, Tibinagua. Fig. 1418.

Eriogonum latifolium Smith in Rees, Cycl. 13: No. 3. 1809.

Leaves persistent, densely clothing the branches of the low woody caudex, ovate or ovate-oblong, rounded or cordate at base, densely white-woolly beneath, lanate or glabrate above, 2.5–4 cm. long, the margins plane or somewhat crisped; flowering stems leafless, floccose-tomentose, stout, 2–6 dm. high, simple or 2–4-forked, the forks simple or again forked; involucres congested forming a large terminal head or in the forms with forked stems the heads more reduced and occurring in the forks as well as the ends of the branches, shallowly 5-toothed, tomentose, 4 mm. long; calyx white or pale rose, glabrous, 3 mm. long, the lobes obovate, rounded at apex; filaments densely villous at base.

Bluffs and dunes along the coast, Humid Transition Zone; Cape Blanco, Oregon, to Monterey County, California. Type locality: California (Menzies). June–Dec.

Source: Illustrated Flora of the Pacific States, Leroy Abrams, 1974

FIGURE VI-6
DISTRIBUTION OF ERIOGONUM LATIFOLIUM AND ERIOGONUM PARVIFOLIUM

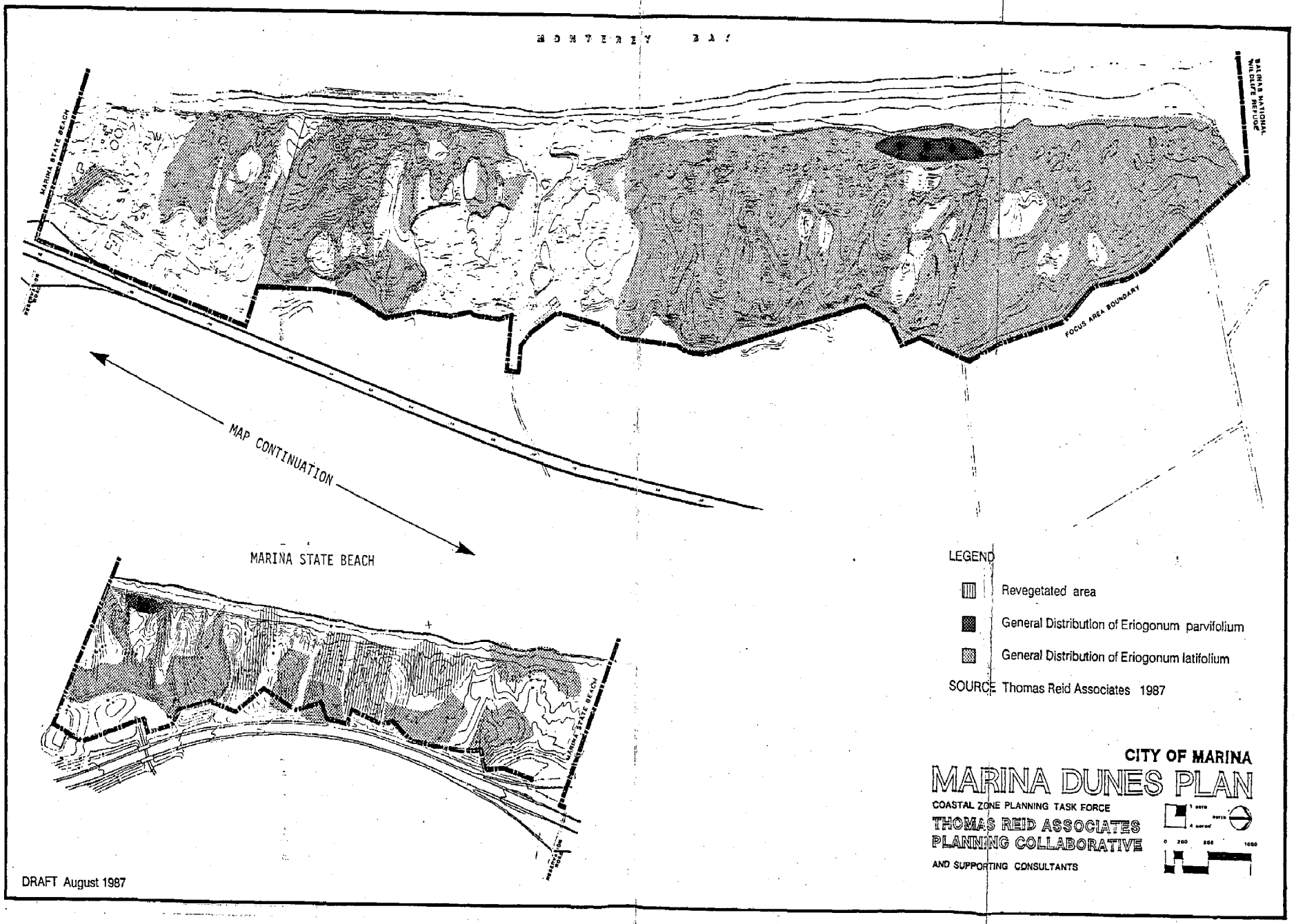
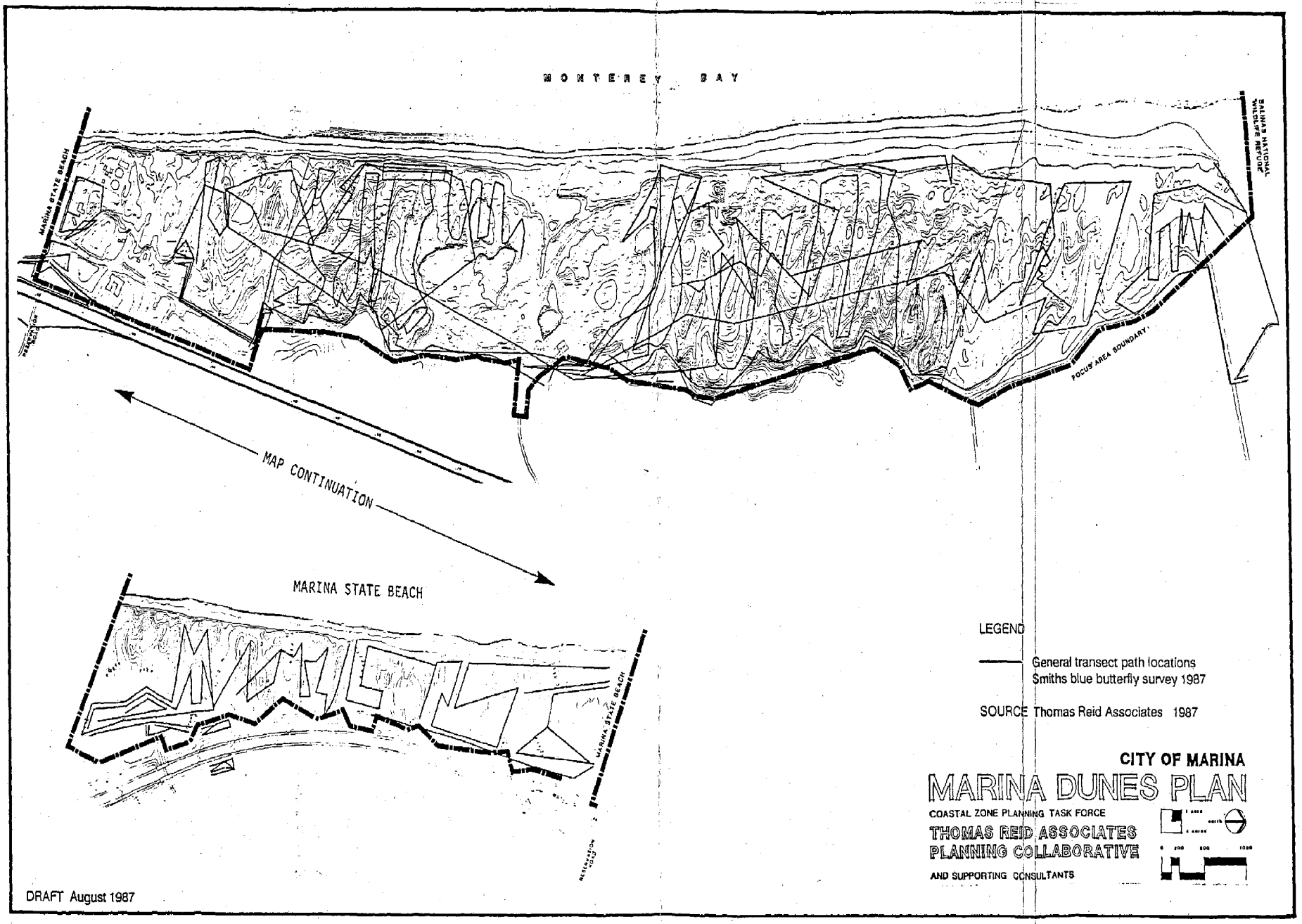


FIGURE VI-7
TRANSECT PATH LOCATIONS FOR SMITH'S BLUE BUTTERFLY



VII. Black Legless Lizard

VII. BLACK LEGLESS LIZARD

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Thomas Reid Associates

November 1987

A. INTRODUCTION

Although the Black Legless Lizard was known from Marina Dunes, its distribution there was not well known. The purpose of the study was to verify Black Legless Lizard presence and delineate the habitat quality throughout the study area. The findings and recommendations contained in this paper will be used in the preparation of the Marina Dunes Habitat Conservation Plan.

B. EXISTING CONDITIONS

1. Background

The Black Legless Lizard (Anniella pulchra nigra) is a Federal Candidate Species, Category 2. This is a listing for species which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking (California Department of Fish and Game Natural Diversity Data Base April, 1986).

The Black Legless Lizard has a limited range. According to Stebbins (1966), it is found only on the Monterey Peninsula and on adjacent coastal sand dunes along the southern part of Monterey Bay. Intergrades between the Black and Silver Legless Lizard (Anniella pulchra pulchra) occur along Monterey Bay north of the Salinas River just into Santa Cruz County (Miller, 1943). Dark individuals from coastal San Luis Obispo County have in the past been tentatively referred to as intergrades (Stebbins, 1954). However, recent biochemical studies conducted at the University of California at Berkeley indicate that these populations are most closely related to the normal Silver Legless Lizards that occur in other parts of central and southern California (William Rainey, pers. comm.). The dark coloration of the San Luis Obispo Co. population has evolved independently from Silver Legless Lizards and has no relation to Black Legless Lizards in Monterey County.

Historically, the Black Legless Lizard had a continuous distribution along coastal sand dunes from the Salinas River to the Carmel River. However, habitat has been greatly reduced and fragmented by human activities. This habitat reduction is caused by urban development, vegetation destruction through human trampling and off-road vehicle use, sand mining, and the introduction of Ice Plant that forms large mats under

which Black Legless Lizards are not able to live (Bury, 1985).

Black Legless Lizards occur throughout the coastal dune system from above high tide line to the dune crests. They burrow in the sand and are found by raking in the leaf litter under native vegetation such as Sagewort, Lupine, and Mock Heather. Bury (1985) reported that 71% of the lizards he found were in association with Mock Heather and Lupine. However, in 1985 at Spanish Bay on the Monterey Peninsula, 70% were found under sagewort. At this site Mock Heather and Lupine were not common.

Black Legless Lizards are relatively sedentary and populations occur even in small patches of natural habitat. Miller (1944) found 62 lizards on a small islet off Point Pinos on the Monterey Peninsula. This islet was cut off from the Mainland by tidal action and the 62 lizards were found in an area approximately one hundred feet on a side. The lizards were marked and ten were recaptured two months later. The marked lizards recaptured two months later had moved as little as 2 feet and no more than 28 feet from their place of original capture.

A status report prepared for the Office of Endangered Species stated that the Black Legless Lizard was probably threatened (Bury, 1985). The report recommended that further studies were needed to determine the extent of remaining habitat, to assess threats at each site, to determine appropriate protective measures, to find means to restore habitat, and to monitor populations over time. The report listed the Marina Dunes area between Salinas River National Wildlife Refuge and Marina State Beach as potential critical habitat. However, the species was not yet recorded here.

2. **Results of Marina Dunes Study**

The site was surveyed from the southern border of Marina State Beach to the northern extent of dunes on the Salinas National Wildlife Refuge. About 90 man-hours were spent in the field doing walking transects. Each property was covered in a criss-cross manner. Areas of suitable habitat were mapped in the field based on the distribution of natural or only slightly disturbed dunes.

Specimens were previously known from both Marina State Beach and the Salinas National Wildlife Refuge, so a search for individual lizards was concentrated between the above two known localities. Lizards were found by digging with a rake under vegetation at random locations on each property. Since this method has an adverse effect on the plants, no attempt was made to locate large numbers of Black Legless Lizards. The specific location of each lizard observation was mapped in the field.

Eight hours were spent uprooting ice plant on the Marina State Beach property in an attempt to located the lizards. No lizards were found during this activity.

During the initial search for Black Legless Lizards, several sites were found between Marina State Beach and Salinas National Wildlife Refuge (Figure VII-1). Three were found on Graniterock Property, four on Lone Star Property south of the plant, one on Lone Star north of the plant, and one on Martin Dunes.

Habitat types are shown on Figure VII-1 and discussed for each property below. Suitable habitat consists of all types of vegetated dune above high tide line. The only areas unsuitable are those completely altered by sand mining, extensive off-road vehicle use, and construction of buildings. Habitat was rated according to the following categories:

UNSUITABLE. Areas with buildings or extensive sand mining. Large blow outs are also considered unsuitable habitat, however, small trails caused by off-road vehicle activity was not extensive enough to completely eliminate areas of habitat in the Marina Dunes.

OPEN UNVEGETATED DUNE. These areas, often caused by off-road vehicle use and blow outs, are presently unsuitable for Black Legless Lizards. Usually they are quite small areas and will naturally vegetate if ice plant is not allowed to grow.

ICE PLANT. Large areas of introduced ice plant provide poor habitat. Black Legless Lizards are not able to bury in the sand under the patches because of the thick root system. They can be found under the edges of large clumps and under small plants.

GOOD HABITAT. Areas that are mostly covered with natural vegetation. Patches of ice plant may be present and/or off-road vehicle use has damaged some of the habitat.

EXCELLENT HABITAT. Areas primarily covered with natural vegetation. Off-road vehicle damage is minimal and ice plant is limited or absent.

HABITAT TYPES ON EACH PROPERTY

MARINA STATE BEACH. Most of the property has been impacted in the past by Off-road vehicle use and the extensive growth of ice plant. This site is presently being restored by the removal of ice plant and the planting of native vegetation. This type of restoration will benefit Black Legless Lizards.

WATER DISTRICT. Most of this site is occupied by a sewage treatment plant. There is a small area of good habitat on the south slope above the lower sediment pond.

MONTEREY SAND. Due to extensive sand mining, this property does not provide suitable habitat for Black Legless Lizards.

GRANITEROCK INC. Extensive areas of good habitat are found on the property as well as some large dense patches of ice plant. Three Black Legless Lizards were found in the good habitat during the survey.

MARINA BEACH CO. This site has been degraded by ice plant, off-road vehicle use, and sand mining. However an extensive area of good habitat is present.

LONE STAR. Most of the area south of the plant is rated good or excellent. The area directly south and directly west of the plant is unsuitable due to extensive sand mining. North of the plant is an area of excellent habitat.

MARTIN DUNES. The entire property is rated as excellent habitat.

SALINAS NATIONAL WILDLIFE REFUGE. Excellent habitat extends from the Martin Dunes onto the refuge dunes.

3. **Conservation Strategies**

1. **Feasibility of Salvage and Relocation to Restored Habitat**

Areas of unsuitable habitat restored to natural conditions will be able to support legless lizard populations. Restoration might take place in areas where extensive mats of ice plant have been removed, in areas of bare sand caused by blow outs or in areas where the sand has been removed by mining or off road vehicle activity.

It is not difficult to salvage large numbers of legless lizards by digging up the native vegetation and searching for lizards in the root systems and litter. This is a destructive technique to plants and naturally should only be attempted where development is certain to take place. The salvage and relocation activities should take place during the spring and summer months when the lizards are near the ground surface. Relocation to previously disturbed areas would only be successful if the degraded areas have been successfully restored and contains well established vegetation. The lizards need the native vegetation for shelter and the invertebrate food supply that lives in association with the plants and leaf litter.

In poor, unsuitable, or ice plant habitat areas few or no legless lizards would be killed by development, thus salvage efforts would be unnecessary in these areas.

Lizards found in good or excellent habitat could be relocated to restored habitat. This would not only prevent the death of individual animals but would add an important species to the restored dune community. It is not practical to move salvaged legless lizards to already existing natural habitats where the species is already found, because a natural population density is already established there. If salvage and relocation is necessary before any restoration is done in the project area, the lizards should be moved to existing restoration sites found at the Marina State Beach.

In May and June 1985 a relocation project for the Black Legless Lizard was done at Spanish Bay (Monterey County). For this project 125 legless lizards were moved to a reconstructed sand dune. The dune contained well established vegetation during the time of relocation. Unfortunately, no follow up surveys have been conducted at the dune since the relocation effort was made. One lizard sighting was made in the summer of 1986 by a casual observer on the site.

2. **The Effects of Barriers and Provision for Habitat Corridors**

a. **Barriers**

Paved roads, buildings, and areas of bare earth where all sand has been removed are absolute barriers to the movement of black legless lizards. Small areas of suitable substrate, without habitat, such as open sand

and patches of ice plant certainly limit movement. Even a single paved road cutting across an area will prevent dispersal.

b. **Corridors**

The Black Legless Lizard is not known to travel long distances, however there is a need to maintain contiguous areas of good and excellent habitat to assure gene flow. Corridors of natural habitat connecting preserved habitats will allow for gene flow between areas. A continual gene flow between populations prevents the "bottle neck effect" of tiny population size with low genetic variability that may lead to eventual extinction.

A corridor through the unsuitable habitat in the Lone Star active mining area is recommended to connect the northern and southern lizard populations found in the good and excellent habitat. An erosion setback area along the beach would provide an adequate corridor between contiguous areas of good and excellent habitat.

It is possible that large culverts partially filled with sand could allow lizard movement beneath roads. Alternatively a long term habitat monitoring program could routinely move a few individuals between isolated habitat areas.

C. EXISTING POLICIES

The existing laws and policies relevant to the Black Legless Lizard are contained in a separate background paper. See Section VIII. Biological Resources -- Existing Laws and Policies.

D. SUGGESTED PLANNING GUIDELINES

These suggested planning guidelines are specific to the Black Legless Lizard and are considered in addition to those described for overall biological resources (See Section VIII).

1) Minimize the overall reduction of excellent and good Black Legless Lizard habitat resulting from its designation for non-habitat uses.

2) Instigate a relocation program for the Black Legless Lizard prior to disturbance of any existing good and excellent Black Legless Lizard habitat. This would minimize the destruction of individual Black Legless Lizards.

3) Perform an annual status survey of the population of the Black Legless Lizard at the Marina Dunes during the initial years of implementation of the Habitat Conservation Plan.

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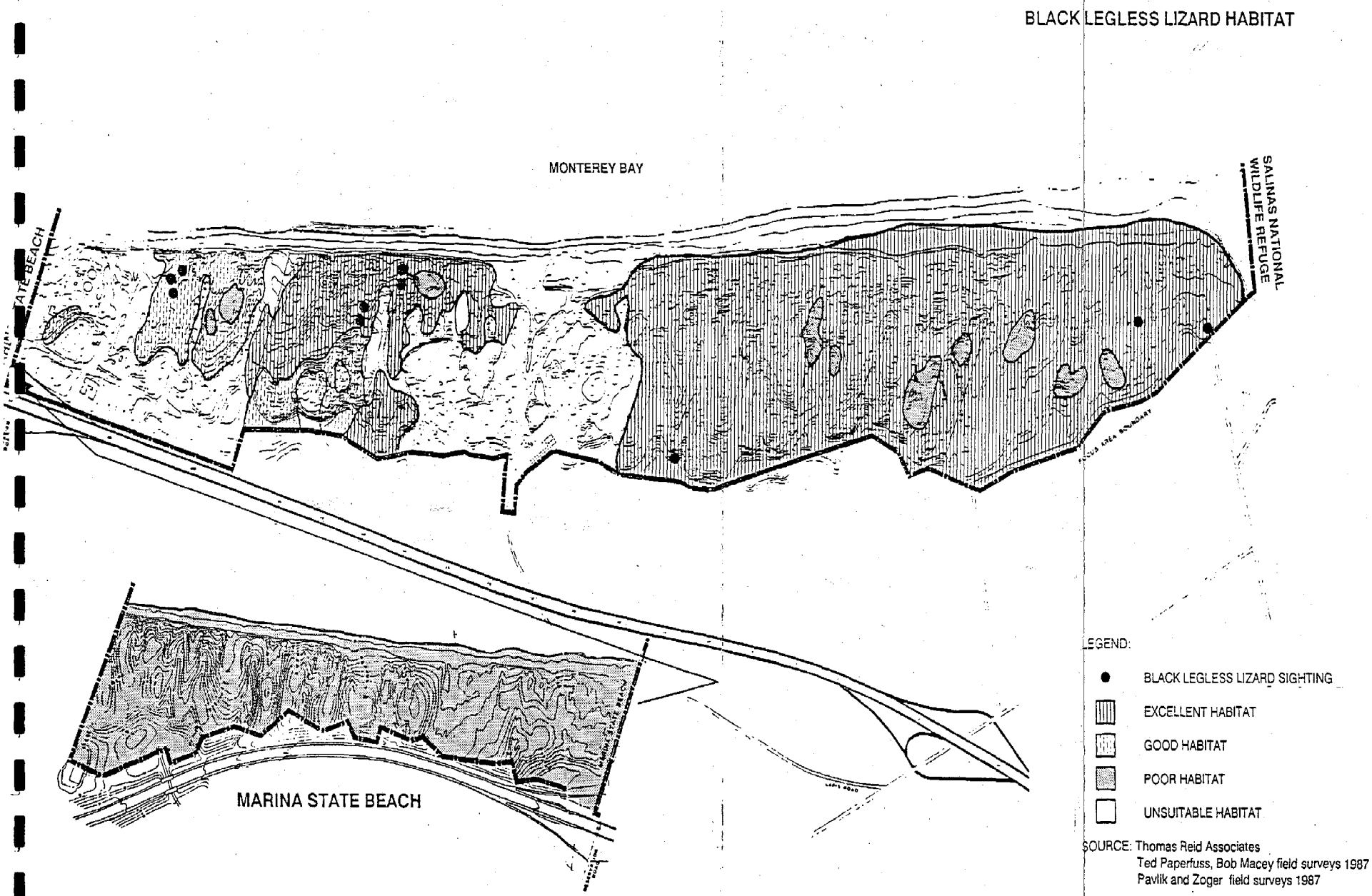
FIGURE VII-1
BLACK LEGLESS LIZARD HABITAT



SOURCE: Thomas Reid Associates
Ted Paperfuss, Bob Macey field surveys 1987
Pavlik and Zoger field surveys 1987

VIII. Biological Resource Policies and Guidelines

VIII. BIOLOGICAL RESOURCES -- EXISTING LAWS AND POLICIES AND SUGGESTED PLANNING GUIDELINES

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November 1987

A. INTRODUCTION

Existing laws and policies pertaining to the biological resources found at Marina Dunes particularly endangered species, are set forth in this paper. Marina Dunes is habitat of one Federally listed endangered species, Smith's Blue butterfly, one California State listed endangered species, Menzies' Wallflower, two Federal Candidate species, the Black Legless Lizard and the Dune Gilia, and one California Native Plant Society rare species, Chorizanthe.

Following the existing laws and policies portion of the paper is a section on suggested planning guidelines for the overall biological resources. Although the HCP is being prepared as a result of the presence of the Smith's Blue butterfly, the HCP will address all rare and endangered species and provide for conservation of the entire dune ecosystem.

Specific suggested planning guidelines for Smith's Blue, the Black Legless Lizard, and the rare plants are included in individual issue papers for those resources.

PART I -- EXISTING LAWS AND POLICIES FOR BIOLOGICAL RESOURCES

A. FEDERAL

1. Endangered Species Act (16 USC 1531 et seq)

The purposes of the Federal Endangered Species Act (ESA) are to "provide a means whereby the ecosystem upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species...".

For the most part, the ESA is administered by the U.S. Fish and Wildlife Service, an agency within the Department of the Interior. The administering office for Marina Dunes, is the Sacramento Office of Endangered Species. The Regional Office in Portland Oregon will ultimately review and comment on the HCP and related documents. The Office of the Regional Solicitor will review and comment on environmental documentation and legal agreements with respect to the HCP.

RELEVANT SECTIONS OF THE ESA WHICH APPLY TO THE MARINA DUNES PLAN

Section 4 -- Determination of Endangered and Threatened Species

Summary of Policy: The Secretary of the Interior determines which species are endangered or threatened and designates critical habitat based on the best scientific and commercial data available. This list of species and critical habitat is published in the Federal Register. The Secretary reviews the list at least once every five years and individuals can petition for changes. For any species listed as threatened, the Secretary issues regulations to provide for the conservation of such species and in this way, essentially all protection for endangered species established by the Act has been provided for threatened species as well.

The Secretary of the Interior develops and implements recovery plans for the conservation and survival of threatened and endangered species.

Relevance to Marina Dunes: The Smith's Blue butterfly (SBB) (Euphilotes enoptes smithi) is a Federally listed endangered species. It was listed on June 1, 1976 (41 Federal Register 22043-22044). Critical habitat has not been defined for this butterfly.

The Black Legless Lizard (Anniella pulchra) is a Federal Candidate species. It was nominated for listing on September 18, 1985 (50 Federal Register 37962). It is presently a Category 2 Candidate which means there is enough scientific information on hand to warrant its being nominated for listing, however, supplemental information is required prior to the preparation of a formal listing petition packet and the publication of such petition in the Federal Register.

A Smith's Blue Butterfly Recovery Plan (SBBRP) was approved by the U.S. Fish and Wildlife Service in 1984. The objective of the Recovery Plan is to "prevent the extinction of the Smith's Blue butterfly and to improve and maintain its status at a point where it can be safely delisted." The known distribution of the SBB at the time of its listing in 1976 included the Marina State Beach and private sites within Marina Dunes.

The primary SBBRP objective would be reached when either 1) the 18 identified known sites of of the SBB have been made secure, or 2) an equivalent number of SBB colonies have been made secure as comparable alternative sites to insure its continued existence. According to the Plan "a colony will be considered secure when viable, self sustaining populations have been maintained for a period of ten consecutive years and no foreseeable threats to the future survival of the colony exist".

Both the Marina State Beach and the private land within the Marina Dunes are among the 18 sites which require "securing" prior to the delisting of the butterfly.

The SBBRP lists specific measures for the Marina State Beach property and the private property within Marina Dunes. These measures are as follows:

- Develop and implement management and land protection plans for the Marina State Beach and Marina sites within these areas:

1) identify colonies and area necessary for maintenance of the SBB,
2) control hang-glider use (at Marina State Beach),
3) control off-road vehicle use of dunes,
4) revegetate existing blow-out areas with native plants,
5) control foot traffic on dunes by constructing boardwalks for beach access, and
6) remove exotic plants and replace with native plants.

Other policies of the SBBRP which are applicable to Marina Dunes include:

- Determine ecological needs of the butterfly (i.e. host plant preference, quality, size, symbiosis with ants, etc.) and apply results to habitat management.

- Determine taxonomic and/or ecotypic variation among colonies found in each type of habitat and apply results to management of Smith's Blue butterfly.

- Determine current population status of the SBB colonies, identify potential threats to habitat, and determine priorities for securing habitats.

- Investigate and implement restoration techniques for native vegetation, including revegetation and exotic species control.

- Develop public awareness of the SBB.

Section 6 -- Cooperation with States

Summary of Policy: The Secretary of the Interior must cooperate with the States concerned before acquiring land or water or interest, for the purpose of conserving any threatened or endangered species. The Secretary is authorized to enter into an agreement with the State which establishes and maintains an adequate and active program for the conservation of threatened and endangered species.

Relevance to Marina Dunes: The State agencies involved with the Marina Dunes Plan will ultimately be party to the HCP and HCP Agreement. Such an action would fulfill this policy of the ESA.

Section 7 -- Interagency Cooperation

Summary of Policy: All federal agencies must, in consultation with and with the assistance of the Secretary, use their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of endangered species and threatened species. Each federal agency must insure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary to be critical, unless granted an exemption.

The Fish and Wildlife Service performs the consultation duties for the Secretary. At the conclusion of the consultation, the Secretary provides to

the Federal agency and the applicant a written statement setting forth the opinion, and a summary of the information on which the opinion is based, detailing how the agency action affects the species or its critical habitat. If jeopardy or adverse modifications is found, the Fish and Wildlife Service suggests reasonable and prudent alternatives which would reduce jeopardy.

Relevance to Marina Dunes: There are no permits involved with actions now going on at Marina Dunes, therefore Section 7 is not immediately relevant. However, the HCP itself and the action of the Interior in granting a permit under Section 10(a) will be subject to a Section 7 consultation.

Section 9(a) -- Prohibited Acts

Summary of Policy: It is unlawful for any person subject to the jurisdiction of the United States to take any endangered fish or wildlife species within the United States or the territorial sea of the United States. The term take means to "harass, harm, pursue, hunt, shoot wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

Relevance to Marina Dunes: Habitat of the federally listed endangered Smith's Blue butterfly is found throughout the Dunes . Except in existing disturbed areas of the dunes, (i.e areas devoid of vegetation), any activity which results in the disturbance of dune vegetation containing the larval food plants of the Smith's Blue butterfly (Eriogonum latifolium and E. parvifolium) could result in a violation of Section 9 of the ESA.

Section 10(a) -- Exceptions

Summary of Policy: The Secretary may permit any act prohibited in Section 9 for scientific purposes. The Secretary may also permit any taking of fish or wildlife if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

The Secretary cannot issue a permit under Section 10(a) unless the applicant submits a conservation plan that specifies 1)the impact resulting from the taking, 2)mitigation measures which will minimize the impact, 3) funding to implement the mitigation, 4)alternative actions considered and 5) reasons for not utilizing them.

The Secretary can revoke or suspend a permit issued under Section 10(a) if the permittee is not complying with the terms and conditions of the permit.

Relevance to Marina Dunes: The Marina Dunes Coastal Zone Planning Task Force intends to submit an application to the Secretary of the Interior for a Section 10(a) Permit to allow the incidental taking of the Smith's Blue butterfly in conjunction with the implementation of a Habitat Conservation Plan for Marina Dunes. The Task Force is presently overseeing the preparation of the Habitat Conservation Plan.

Section 11 (a) -- Penalties and Enforcement

Summary of Policy: Any person who knowingly violates Section 9 of the ESA will, upon conviction, be fined not more than $20,000 or imprisoned for not more than one year, or both.

2. National Environmental Policy Act (NEPA) -- Council on Environmental Quality, Implementation of Procedural Provisions; Final Regulations, November 29, 1978.

The U.S. Fish and Wildlife Service as a Federal Agency must comply with the provisions of NEPA. Since the goal of Marina Dunes Coastal Zone Planning Task Force is to submit an application for a ESA Section 10(a) Permit along with a supporting HCP to the US FWS, the US FWS will be in the position of having to prepare, or have prepared, environmental documentation on the issuance of the 10(a) Permit and the implementation of Marina Dunes HCP. Such a document would be in the form of an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) depending primarily on the impacts of the action, and the degree of controversy surrounding the project.

Although NEPA does not specifically mention endangered species, it requires thorough documentation of the proposed project's impacts on the natural environment, and the identification of conflicts with the goals and policies of other governmental agencies.

The following are relevant sections of the NEPA as they relate to the rare and endangered species.

Section 1502.10 -- Recommended Format for an EIS

a) An EIS should rigorously explore and objectively evaluate all reasonable alternatives. Each alternative will be considered in detail including the proposed action so that reviewers may evaluate their comparative merits. For alternatives which were eliminated from detailed study, the EIS should briefly discuss the reasons for their elimination.

   The EIS will identify the agency's preferred alternative or alternatives, if one or more exists, in the draft and final statement unless another law prohibits the expression of such a preference.

b) The EIS will succinctly describe the environment of the areas to be affected or created by the alternatives under consideration. Data and analyses in a statement will be comensurate with the impact.

c) The EIS will include a section on the environmental consequences of the act. This section will include:

   1) Environmental impacts of the alternatives including the proposed action either direct or indirect, and their significance

   2) Any adverse environmental effects which cannot be avoided should the proposal be implemented

3) Possible conflicts between the proposed action and the objectives of Federal, regional, State and local land use plans, policies and controls for the area concerned.

4) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.

5) Means to mitigate adverse environmental impacts.

6) Any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented.

An Environmental Assessment (EA) should briefly provide sufficient evidence and analysis for determining whether to prepare an EIS or a finding of no significant impact. It would aid in the compliance of NEPA when an EIS is not considered necessary. An EA should include brief discussions of the need for the proposal, of alternatives, the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted.

B. CALIFORNIA STATE

1. California Endangered Species Act (Fish and Game Code 2050 et seq)

The California Endangered Species Act (CESA) is focused on the conservation of all state listed threatened or endangered species. The California Native Plant Protection Act specifically pertains to the protection of rare and endangered native plants (see below).

At Marina Dunes there is one State listed endangered plant species, the Menzies' Wallflower (Erysimum menziesii) and one State listed threatened plant, the Slender-flowered Gilia (Gilia tenuiflora var. arenaria). There are no State listed threatened or endangered animals at the Dunes .

Section 2052 -- Protection of Species -- Land Acquisition

Summary of Policy: It is the policy of the State of California to "conserve, protect, restore, and enhance any threatened or endangered species and its habitat and it is the intent of the Legislature, consistent with conserving the species, to acquire lands for habitat for these species".

Relevance to Marina Dunes: At one point, the State Conservation Board was negotiating for the purchase of the Martin Dunes from a private landowner due to their value for rare and endangered species and proximity to the Salinas National Wildlife Refuge (adjacent to the north). Although it is the general intention of the landowner to sell the property to a public agency for the purpose of preserving the land, no agreement was reached on the appraised value for the land.

Section 2053 -- Alternatives Available Consistent with Conservation

Summary of Policy: State agencies should not approve projects as proposed which would jeopardize the continued existence of any endangered or

threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species, if there are reasonable and prudent alternatives available consistent the conserving the species or its habitat which would prevent jeopardy.

Relevance to Marina Dunes: During the process of preparing the MDP, the Task Force will be presented several alternative concept plans for development and conservation of the dunes. The Task Force should consider this policy when deciding on the ultimate final plan for the dunes.

Section 2055 -- Conservation Efforts

Summary of Policy: All state agencies, boards, and commissions will seek to conserve endangered and threatened species.

Relevance to Marina Dunes: All State Agencies involved in the Marina Dunes project, including the California Coastal Commission and the California Department of Parks and Recreation will consider the need to protect and conserve endangered species when reviewing plans for Marina Dunes.

Section 2056 -- Cooperation with owners of the land

Summary of Policy: "The cooperation of the owners of the land which is identified as habitat for threatened and endangered species is essential for the conservation of those species and that it is the policy of this state to foster and encourage such cooperation ..."

Relevance to Marina Dunes: It is the intention of all parties involved in Marina Dunes plan to foster cooperation in choosing a plan which has a goal of conserving the habitat of rare and endangered species.

Section 2080 -- Prohibiting the import or export of endangered species

Summary of Policy: No person will take any endangered or threatened species except as otherwise provided in the Native Plant Protection Act.

Relevance to Marina Dunes: There are no State listed animal species at the Dunes . Refer to the section below on the California Native Plan Protection Act for policy implications on the listed plant species.

Section 2081 -- Endangered Species; exceptions

Summary of Policy: Through permits or memorandums of understanding (MOU), the DFG may authorize individuals or public agencies to take or possess any endangered, threatened, or candidate species for scientific, educational, or management purposes.

Relevance to Marina Dunes: Depending on the final Marina Dunes Plan chosen by the Task Force, a permit or Memorandum Of Understanding from CDFG may be required before the State would allow taking of any of the State listed plants.

Section 2090 -- State Agency Consultation

Summary of Policy: Whenever the CDFG consults with a state lead agency the department issues a written finding based on its determination of whether a proposed project would jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of the species. The written finding includes the Department's determination of whether a proposed project would result in any taking of an endangered species or a threatened species incidental to the proposed project. The determination is based on the best existing scientific information.

Relevance to Marina Dunes: Because the Dunes support habitat of both federal and state listed species, the USFWS and CDFG are jointly involved with Marina Dunes project. In conjunction with the USFWS, the CDFG will provide biological consultation to the Task Force, the City of Marina, the California Coastal Commission and the California Dept of Parks and Recreation.

Section 2095 -- Coordination with State and Federal Agencies

Summary of Policy: If a project may affect species that are listed as threatened or endangered under both this chapter and the federal Endangered Species Act the CDFG will 1) participate to the greatest extent practicable in the federal consultation and 2) request the Fish and Wildlife Service to initiate consultation pursuant to the federal Endangered Species Act.

Relevance to Marina Dunes: see under Section 2090 above

2. Native Plant Protection Act (NPPA) (Fish and Game Code sec. 1911 et seq)

As mentioned above there are two state listed plant species found at Marina Dunes , the Menzies' Wallflower and the Slender-Flowered Gilia. There is also a CNPS designated rare plant, the Monterey Spine-flower (Chorizanthe pugens var. pugens).

Section 1900 -- Intent and Purpose

Summary of Policy: The intent of the NPPA is to preserve, protect and enhance endangered or rare native plants of the State. Many species and subspecies of native plants are endangered because their habitats are threatened with destruction, drastic modification, or severe curtailment.

Section 1911 -- Endangered Plant conservation programs

Summary of Policy: All state departments and agencies must consult with the CDFG to use their authority in furtherance of the purposes of the Native Plant Protection Act by carrying out programs for the conservation of endangered or rare native plants. Such programs include the identification, delineation and protection of habitat critical to the continued survival of endangered or rare native plants.

Section 1907 -- Regulations

Summary of Policy: The Fish and Game Commission may adopt regulations

governing the taking, possession, and propagation of any endangered or rare native plants. Persons who perform such activities should maintain written records and obtain permits from the DFG..

Relevance to Marina Dunes: Although the main goal of the MDP should be to preserve all of the existing habitat of the endangered Menzies' Wallflower due to its limited distribution, it may be desirable to obtain permits from the CDF to inorder to propagate the plant and thus expand its distribution within the Dunes .

3. California Environmental Quality Act (CEQA)

Policies related to Vegetation/Wildlife:

Section 15065

Where a state or local governmental agency is the primary permitting or decision making body, it is designated the lead agency for the purposes of complying with CEQA. A Lead Agency will require an EIR to be prepared for any project which "has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory."

Section 21104.2

The Lead Agency must consult with and obtain written findings from the California Department of Fish and Game in preparing an environmental impact report regarding project impacts upon endangered or threatened species.

Section 15091-15092

A public agency will not approve or carry out a project which is found to significantly effect the population size, range or habitat of rare or endangered species unless 1) the public agency makes written findings that changes have been required or incorporated into the project which avoid or substantially lessen the significant impact or 2) that economic, social, or other considerations make infeasible the mitigation measures or project alternatives identified in the final EIR.

Relevance to Marina Dunes : The City will require that an Environmental Impact Report be prepared for Marina Dunes Plan and the Local Coastal Plan Amendment. The EIR will address the impacts on the rare and endangered species.

4. California Coastal Act

The California Coastal Act requires that local land use agencies set forth specific policies related to the protection and conservation of rare and endangered species in their Local Coastal Plan. The specific local policies should reflect the following general California Coastal Plan

policies relating to environmentally sensitive areas. These policies provide for a more comprehensive approach to protection of habitat resources in the coastal zone than may be required by those of other agencies.

Section 30240.

(a) Environmentally sensitive habitat areas will be protected against any significant disruption of habitat values, and only uses dependent on such resources will be allowed within such areas.

(b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas will be sited and designed to prevent impacts which would significantly degrade such areas, and will be compatible with the continuance of such habitat areas.

Section 30107.5

"Environmentally sensitive area" means any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.

5. California Department of Parks and Recreation

Marina State Beach Resource Element July 1985

The Marina State Beach is governed by directives approved by the Director of the California Department of Parks and Recreation (CDPR). Based on these directives, policies on development and management of Marina State Beach have been set forth. The following are the policies pertaining to the conservation of plants and animals at the State Beach.

General Vegetation Management Policies: The primary objective of vegetation management is management toward a natural condition with minimum disruption to natural processes. The secondary objective is to restore and perpetuate the native plant communities that prevailed in the area prior to Euroamerican influences.

Dune Management Policies: In recognition of Marina Dunes' value to rare and endangered species, the dune system within Marina State Beach is being considered for designation as a Natural Preserve.

CDPR will work with other public agencies, private organizations, and individuals to assure that every effort is made to maintain suitable habitat for rare and endangered species within Marina State Beach.

Specific management action will be undertaken to expand the local population of Menzies's Wallflower. Collection of seed, propagation, and planting will be undertaken if deemed necessary to assure the continued existence of this species within Marina State Beach.

Revegetation Policies: Destabilized dune areas within Marina State Beach will be revegetated. In order to maintain the genetic integrity and diversity of the native California communities, seeding or transplanting

will be done only with native plants from local populations.

Human activities within the dunes will be regulated and controlled so as to prevent destruction and allow for rehabilitation of the natural dune environment. Hiking, horseback riding, hang gliding, and other recreational uses will be restricted to designated areas and routes. Construction of walkways and/or sand ladders should be considered.

Rare and Endangered Plant Policies: Rare and endangered plants found within the Marina State Beach boundaries will be protected and managed for their protection.

Systematic surveys for rare and endangered plants will be made throughout the project. When located, all populations will be mapped and management plans developed or their protection and perpetuation.

Prior to any site-specific development or heavy use activities, additional surveys will be made in the areas that will be impacted for rare or endangered plants.

The known locations of Erysimum menziesii will receive no more than the lowest intensity use. Population monitoring will be done on an annual basis in order to detect any adverse factors affecting the plant. Enclosures should be considered as a means of protection for all existing E. menziesii within the project.

Landscaping Policies: Landscaping in developed areas should consist of species indigenous to the park. If exotic species are used, these will be species which are incapable of naturalizing in the wild and which would not require a permanent irrigation system.

C. LOCAL

1. City of Marina Local Coastal Program Land Use Plan

Policies on Rare and Endangered Species

General Policies related to Vegetation/Wildlife:

19. Promote restoration and protection of native dune habitat and vegetation

24. To protect and encourage the restoration of the vernal ponds to their original state and allow only those uses adjacent which will reinforce and conserve the unique habitat qualities of these ponds.

25. To protect the habitat of recognized rare and endangered species found in the Coastal dune area.

26. To regulate development in areas adjacent to recognized rare and endangered species or their habitats so that they will not threaten continuation of the species or its habitat.

Specific Policies related to Vegetation/Wildlife:

Habitat Protection Policies:

- Before any use or change in use, areas identified as potential habitat for rare and endangered plant or animal species will be investigated by a qualified biologist to determine the physical extent of the primary habitat areas for the specific rare and endangered plants and animals on that site.

- Primary habitat should be protected and preserved. All development must be sited and designed so as not to interfere with the natural functions of such habitat areas. Management and enhancement opportunities should be incorporated into use or development proposals; potential impacts should be mitigated.

- Potential secondary or support habitat areas to the primary habitats identified on the site should also be defined. Secondary habitat investigation should include identification of the role and importance of the secondary area to the primary habitat area and should stress the impact of use or development in the secondary area on the primary habitat. All development in this area must be designed to prevent significant adverse impacts on the primary habitat areas.

- Development in wetlands will be prohibited.

- Areas damaged by illegal use or negligence will be considered restorable and eligible for restoration.

- Where habitats of rare and endangered species are located on any parcel, owners and/or operators will, at such time that development is proposed, develop and execute a Management Plan which will protect identified rare and endangered plant and animal communities. Each plan should be drawn up by a qualified biologist in co-operation with the property owner/developer.

Wetlands Protection: The Marina LCP identifies a Vernal Pond at the Marina Dunes . It is located on the eastern portion of the Monterey Sand property and is referred to as #4 within the City of Marina. The following are the policies related to the pond.

- Because of their fragile geology, no new structures will be allowed within the Vernal Pond itself. The only new structure allowed in the wetland area should be those designated for public access for nature observation. No access structure should be allowed without thorough investigation by a qualified biologist and geologist. Design should include mitigation for all impacts identified by these specialists.

- New development within the drainage areas of natural Vernal Ponds should be approved without investigation by a qualified biologist as well as other necessary specialists. Grading setbacks, reduction of impervious surface coverage, siltation basins, and other appropriate measures will be employed to protect the ponds and their wetlands.

- A 100 foot riparian setback will be established from the edge of all wetlands.

- The City should encourage State participation in the preservation and restoration of the historic Vernal Ponds and their wetlands.

Exhibit A of the LCP LUP defines primary habitat as all of the environmentally sensitive areas including:

"1. Habitat for all identified plant and animal species which are rare, endangered, threatened, or are necessary for the survival of an endangered species. These species will be collectively referred to as 'rare and endangered'.

2. Vernal ponds and their associated wetland vegetation. The State-Wide Interpretive Guideline for Wetlands and Other Wet Environmentally Sensitive Habitat Areas (California Coastal Commission, February 14, 1981) contains technical criteria for establishing the inland boundary of wetland vegetation.

3. All native dune vegetation, where such vegetation is extensive enough to perform the special role of stabilizing Marina's natural sand dune formations."

2. Monterey County North County Local Coastal Program Land Use Plan -- 1982

The Martin Dunes and a portion of the Salinas National Wildlife Refuge to the north of the Lone Star property are unincorporated lands within the County of Monterey. Monterey County is aware of the presence of rare and endangered species within their jurisdictional boundaries and the need to preserve environmentally sensitive habitats within the County. The County has several policies on rare species and the presence of sensitive habitats, such as dunes. The following is a list of the most relevant.

Environmentally Sensitive Habitat Policies

- With the exception of resource dependent uses, all development, including vegetation removal, excavation, grading, filling and the construction of roads and structures, will be prohibited in environmentally sensitive habitats including dunes. Resource dependent uses will be allowed within environmentally sensitive habitats only if such uses will not cause significant disruption of habitat values.

- Existing land uses and new development adjacent to locations of environmentally sensitive habitats will be compatible with the long-term maintenance of the resource. New land uses will be considered compatible only where they incorporate all site planning and design features needed to prevent habitat impacts, upon habitat values and where they do not establish a precedent for continued land development which, on a cumulative basis, could degrade the resource.

- To protect environmentally sensitive habitats and the high wildlife values associated with large areas of undisturbed habitat, the County will maintain significant and, where possible, contiguous areas of undisturbed land for low intensity recreation, education, or resource conservation use.

- Where private or public development is proposed in documented or potential locations or environmentally sensitive habitats, field surveys by qualified individuals or agencies will be required in order to determine precise locations and to recommend mitigating measures to ensure protection of any sensitive habitat present. The required survey will document that the proposed development complies with all applicable environmentally sensitive habitat policies.

- The County will ensure the protection of environmentally sensitive habitats through deed restrictions or dedications of permanent conservation easements.

- Where public access exists or is permitted in areas of environmentally sensitive habitats, it will be limited to low intensity recreation, scientific or education uses such as nature study and observation, education programs in which collecting is restricted, photography, and hiking. Access in such locations will be confined to appropriate areas on designated trails and paths.

- Where development is permitted in or adjacent to environmentally sensitive habitat areas, the County will restrict the removal of indigenous vegetation and land disturbance to the minimum amount necessary for structural improvements.

- The County will require the use of non-native plant species in proposed landscaping and should encourage the use of appropriate native species or species that are compatible with native plants.

Terrestrial Plant and Habitat Policies:

- Public access to areas of rare, endangered and sensitive plants should be actively discouraged and directed to less sensitive areas. Where allowed, public access should be strictly managed. Otherwise the area should be closed.

- Coastal dune habitats in areas shown as Resource Conservation on the plan map (including the Martin Dunes) will be preserved and protected. Appropriate uses in such areas will be limited to scientific, education and low intensity recreational uses.

- The dune area between the City of Marina and the Salinas River along Monterey Bay should be acquired by the U.S. Fish and Wildlife Service or the State Department of Fish and Game and managed as a wildlife reserve.

PART II -- SUGGESTED PLANNING GUIDELINES FOR BIOLOGICAL RESOURCES

The following are a list of suggested planning guidelines for the biological resources at Marina Dunes to be used as the basis of preparing the Habitat Conservation Plan. In most cases they reflect existing policies of resources agencies, the California Coastal Commission, the City of Marina and Monterey County. There are also specific suggested planning guidelines for rare plants, revegetation, exotic species control, Smith's Blue butterfly, and the Black Legless Lizard in each of the issue papers for those particular issues.

1) Maintain large, continuous areas of preserved/conserved habitat to provide for adequate habitat diversity at Marina Dunes . The preserved/conserved areas should include portions of the various vegetation communities, and areas within the fore dunes, mid dunes, and aft dunes. Vegetation communities are defined and mapped in the Pavlik-Zoger report.

2) Eliminate off road vehicle access to preserved/conserved areas.

3) Control heavy foot traffic in particularly sensitive areas.

4) Develop a program for controlling invasive non-native iceplant and other exotic species (manually and using herbicides).

5) Stabilize blow outs and off road vehicle scars within the preserved/conserved areas and reestablish these areas with typical native dune stabilizing plants such as Yellow Sand Verbena, Beach Sagewort, Beach Bur, and others. Where appropriate, the host plants of the Smith' blue butterfly, and appropriate rare, threatened, and endangered (RTE) plants, should be included in the reclamation plans for these areas.

6) Less intensive land uses such as hiking and nature trails may be allowed in designated habitat conservation areas.

7) Encourage researchers from local colleges and universities to study the biology of the rare plants, (particularly the Dune Gilia, of which little is know of its habitat requirements) the Smith's Blue, its habitat, and other species of interest, to provide a more extensive data base for future decision making.

8) Protect preserved/conserved habitat areas from activities taking place in adjacent non-habitat areas through the use of fences and/or signs.

9) Establish buffer zones around preserved/conserved habitat areas. A zone of 20 to 30 feet in most cases should suffice.

10) Obtain the necessary permits from resource agencies in order to perform and carry out scientific studies on each of the species of concern. Assure that any biological consultants and scientists used in developing and implementing the conservation plan have obtained necessary permits.

11) Protect and encourage the restoration and protection of vernal ponds to their original state and allow only those uses adjacent which will reinforce and conserve the unique habitat qualities of these ponds.

IX. Slope Analysis

IX. SLOPE ANALYSIS

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November 1987

A. INTRODUCTION

This brief issue paper summarizes the conditions of slope and terrain within Marina Dunes for purposes of further planning efforts.

B. EXISTING CONDITIONS

Slope is typically a major constraint in land planning for any type of developed use. In unconsolidated sand dunes, the constraint would appear to be less rigid, since, with relatively inexpensive excavation and grading, the dunes can be reshaped to eliminate steep slopes. However, several factors suggest that slope should remain a major consideration in establishing land use areas:

- Coastal Act policy discourages any alteration of topography.
- Over much of the Study Area, the stable dunes support the most valuable Flandarian dune scrub vegetation community. Altering slopes would damage this valuable community and require reestablishing the vegetative cover.
- Although all of the dunes exist in a dynamic condition, relatively stable slopes which have been wind-sculpted and are now fully vegetated protect areas leeward from further movement.

To map the Study Area, four slope categories were selected: 0-10 percent, 10-30 percent, 30-50 percent and over 50 percent. The initial category (0-10%) was used in response to Coastal Act policy. In these relatively level areas, developed uses could be sited with minimal, if any, land form alteration.

Typically, sand dunes with the grain size distribution and constituency of Marina Dunes maintain an angle of repose of 48-57 percent - that is, they will naturally stabilize at an angle of approximately 2:1 (50 percent). In the event of earth movement, ground shaking can cause these slopes to fail. Based on a simplified model of ground acceleration* and slope stability, the natural dunes at any slope greater than 30 percent are likely to fail to approximately 30 percent - 31 percent slope. This concept is illustrated in the diagram on Figure IX-1.

As Figure IX-2 illustrates, flatter slopes (0-30 percent) are concentrated in the southern end of the Study Area, at the Lone Star mining site and

blow-out, near the beach edge and on the Martin property. The steepest slopes occur on the leeward edge of the back dunes and along some of the east-west trending side slopes throughout the Study Area. Also, there are narrow bands of steep slope in mined areas which have resulted from sand stockpiling. These are generally unstable sands in constant use as mining continues.

Looked at solely from the perspective of slope and terrain, slopes of 0-10 percent could support developed uses with minor amounts of grading and dune reshaping. Slopes of 10-30 percent would require moderate to high amounts of grading and reshaping (i.e. land form alteration) to support developed uses. Slopes of 30-50 percent would not support development without considerable grading and dune reconfiguration. Road construction in these steeper slopes would also require major grading to ensure stable side slopes. These statements do not account for any other project area constraints such as visual or biological.

C. EXISTING POLICIES

The following policy guidance is available for the issue of slope and terrain. It should be noted that the Coastal Act considerations are generalized and not oriented specifically to a sand dune environment.

1. State

Section 30253 of the Coastal Act states, in part, "New development shall: (1) Minimize risks to life and property in areas of high geologic, flood, and fire hazard. (2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs."

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* Note: A 0.25G high repeatable ground acceleration was assumed. A "reasonable" seismic event in relatively close proximity or a major seismic event some distance away could produce such acceleration.

2. Local

The following policies are contained in the City's LCP:

1) Because of the fragile character of the dune vegetation, new development in this area shall be restricted to already-disturbed areas. Development in areas where the natural dune remains shall not alter the basic configuration of the natural dune landform, and shall not provide for site reclamation.

2) Before development is permitted in the Coastal Zone, a geotechnical report shall be prepared for that development in the dues or in the vicinity of any vernal pond. The report shall include at least geologic and seismic stability, liquefaction potential, identification of an appropriate hazard setback to protect the economic life of structures, and specific recommendations on drainage, irrigation and

mitigation of identified problems. Report contents shall comply with guidelines of the California Division of Mines and Geology.

D. SUGGESTED PLANNING GUIDELINES

The potential guidelines and ultimate policies for slope and landform protection and alteration must be integrated with other policies regarding visual resources, biological resources and other issues.

The trade-offs between such issues, some of them conflicting, are discussed in the Development Issues Paper.

For purposes of continuing to develop and refine the Habitat Conservation Plan and Local Coastal Program amendment, the following planning guidelines have been suggested.

1) General Landform Alteration. In general, landform alteration throughout the dunes area should be minimized in providing for any existing or future land uses.

2) Steep Slopes. Developed uses should be discouraged on slopes greater than 30 percent because of the extensive grading and landform alteration requirements. Exceptions could be made in those areas where sand mining has created steeply-sloping stockpiles of sand which contain no vegetation or habitat.

3) Moderate Slopes. Within the 10-30 percent slope range, developed uses may be allowed, provided that dunes which are disturbed are reshaped to a naturalized topographic form and that there are no other substantial impacts to native vegetation, habitat and visual resources.

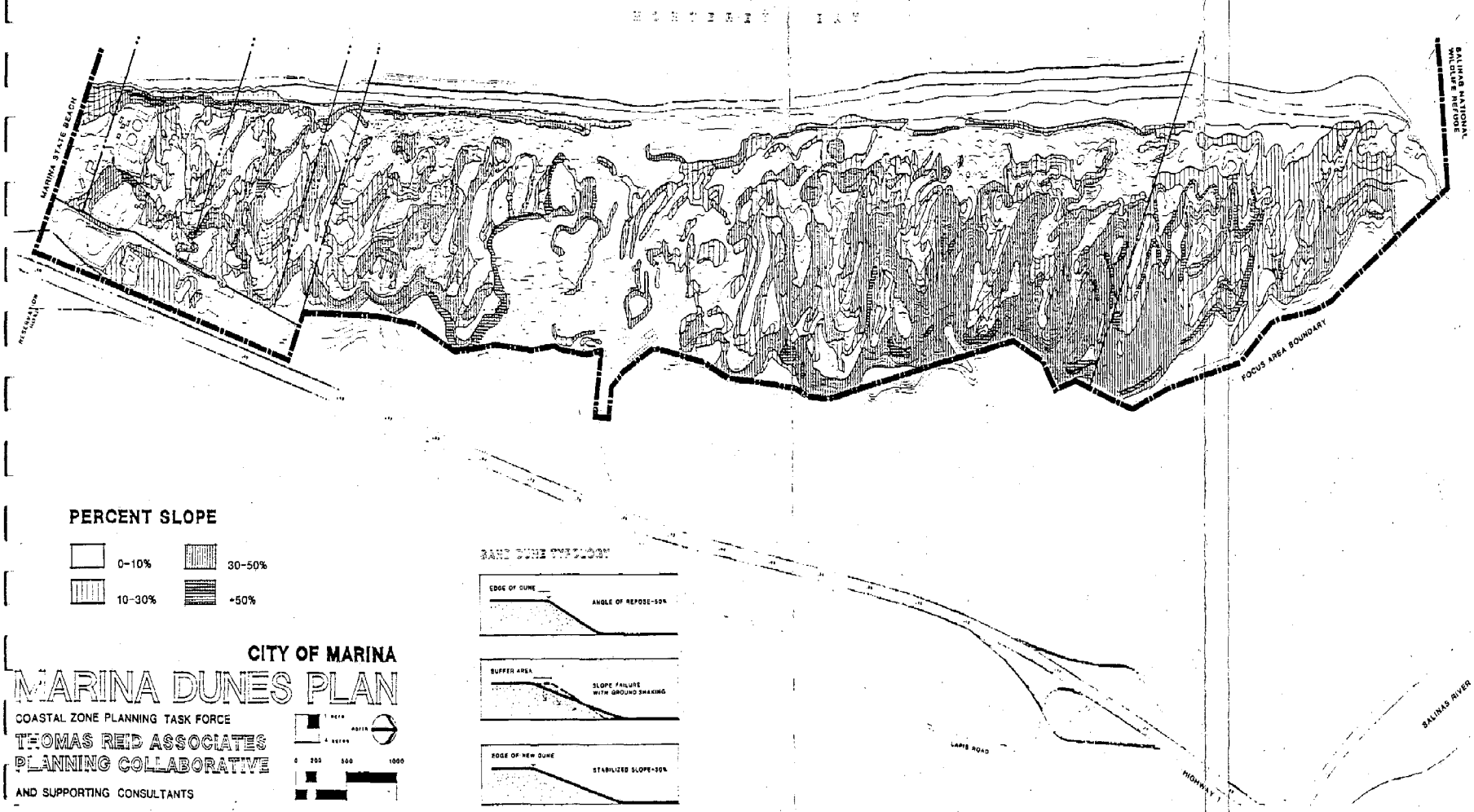
4) Revegetation. Dune slopes should be revegetated with native dune plants to improve stability and provide adequate habitat.

5) Lower Slopes. In areas of 0-10 percent slope, developed uses are permitted provided that other constraints do not preclude them.

6) Geotechnical Reports. All proposed developments in the dunes will require geotechnical investigations of seismic risks, liquefaction potential, slope stability and other potential impacts. All structures should have adequately engineered foundations, designed to UBC Standards to withstand moderate ground shaking activity.

7) Set backs. All structures should be set back from the edges of dune slopes (as shown in Figure IX-1) to prevent undercutting of the slope. Set back distances should generally reflect the "Buffer Area" concept shown on Figure IX-1.

FIGURE IX-1
SLOPE ANALYSIS



X. Shoreline Recession Study

X. SHORELINE RECESSION STUDY

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November 1987

A. INTRODUCTION

The shoreline of Monterey Bay has been receding due to coastal erosion and the Marina Dunes Habitat Conservation Plan and Local Coastal Plan Amendment must take into account continuing shoreline recession. A 50 (year 2037) and 100 (year 2087) year erosion setback line were projected based on the average erosion rate of the past 50 years.

The study includes a discussion of factors which may affect the future erosion rates including the effects of accelerated sea level rise resulting from the "greenhouse effect". Although some scenarios of accelerated sea level rise may significantly increase future erosion rates, the current projections of the rate at which the sea level may rise is not generally known, although theories exist. For purposes of this study, the planning period (50 years) is such that accelerated sea level rise would probably not be significant enough in that time frame to warrant special consideration now. The effects of accelerated sea level rise, however, should be considered in the long term.

B. EXISTING CONDITIONS

1. Geology

The Marina Dunes area encompasses a three long by one-half mile wide strip of dunes between the Marina State Beach to the south and the Salinas National Wildlife Refuge to the north.

The dunes vary in height from about 60 to 100 feet with the lower elevations at the northern portion of the study area.

Steep to near-vertical bluffs, approximately 40 feet high have been incised into the dunes at the back of the beach in the southern part of the study area, indicating that rapid erosion has taken place in this area. Towards the north, the topography has been significantly modified by sand mining in the vicinity of the Monterey Sand Company property and the Lone Star Company Lapis property. In the Martin Dunes Area, adjacent to the Salinas National Wildlife Refuge, there is at present no distinct scarp incised into the dunes.

The Monterey Dune Complex covers about 42 square miles and borders Monterey Bay between the Salinas River Valley and Del Monte (Cooper, 1967).

The dunes in the study area are "Recent", Flandrian and pre-Flandrian in age (Figure X-1). The "Recent" dunes form a narrow (maximum 400-foot wide) coastal strip that fringe the coastline from the Graniterock property northward. The Flandrian Dunes are a strip of parabolic dunes up to 100 feet thick and 2300 feet wide. The pre-Flandrian dunes are older and are of lower relief than the Flandrian dunes; they lie adjacent to Highway 1 and are mostly outside the limits of the study area.

All the dunes within the study area are composed entirely of unconsolidated, uncemented, cohesionless, generally well-sorted, highly erodible sand.

The Flandrian dunes were formed as a belt of active dunes that moved inland during and following the Flandrian transgression (roughly from 15,000 to 5,000 years ago). The dune sand was derived largely from destruction of pre-Flandrian dune masses by coastal longshore drift erosion; additional sand was added by longshore drift (Cooper, 1967).

South of the Salinas River, there is a narrow triangular-shaped patch of recent dunes and/or beach ridges (Figure X-1). The landward edge of this triangle is bounded by an erosional scarp incised into the Flandrian dunes. This sequence of younger deposits seaward of a large erosional scarp is evidence of a prograding (seaward moving) shoreline adjusting to erosional events that occurred sometime during the past 5,000 years. The significance of the large erosional scarp is worth noting. This scarp may have formed from a single gigantic storm or a series of huge storms that cut back the dune field several hundred feet sometime during the past 5,000 years.

2. Historical Frequency of Storms Causing Coastal Erosion

The recent historic record of storm damage is perhaps the most useful data for estimating the frequency or magnitude of major storms. Three separate compilations of storm data (U.S. Army Corps of Engineers, 1958; Bixby, 1962; California Coastal Commission, 1978) were initially investigated; these compilations are summarized in Table X-1.

The available storm data show: 1) the number of major storms affecting the central California coast is large, and 2) waves which damage one section of coastline may cause little or no damage elsewhere. Other important variables affecting coastal erosion are the orientation of the coastline, the location of wave generation and approach direction, the water depth, the wave height and wave length, offshore topography, persistence of wave attack (i.e., the number of storms per season), and presence or absence of a protective beach or offshore bar.

During the winter of 1982-83, the Marina area suffered substantial damage to the beach itself and to the bluffs behind the beach. Much of the beach, which provides a buffer against wave attack, was removed by a series of storms which left the bluffs unprotected from wave attack. In addition, heavy rainfall resulted in copious amounts of groundwater. This groundwater weakened the earth materials, rendering them more susceptible to surf and subaerial erosion.

3. Aerial Photograph Analysis

Various techniques have been employed to determine historical rates of cliff recession. Comparison of topographic maps, aerial photographs and profile surveys are the primary methods used. Commonly, researchers will determine significantly different cliff recession rates in identical field areas. For example, erosion rates from previous studies of Marina Dunes range from 1.25 to 6.8 feet per year.

A detailed analysis of seven sets of stereoscopic aerial photographs that cover the time period between 1937 and 1986 was performed for this study. The rate of coastal recession was analyzed along seven transects.

Since the coastal landscape is constantly evolving, it is often difficult to find an identified feature which can be followed through time. Individual researchers will select different features to measure cliff recession which they believe to be the most characteristic and/or accurate. The most commonly used features are the top or the base of the seacliff, but in many cases the shape of the coast profile is more complex and often changes form over time.

The rates of coastal recession were measured using a Topcon Mirror Stereoscope and a Finescale Magnifying Comparator (see Appendix X-A for a description of the methodology used to obtain the data and tables listing specific data).

For the 1937-1986 time period, rates of coastal recession within the study area averaged 4.2 feet/year, $\pm$ 0.7 feet/year, and ranged between 3.6 and 7.3 feet/year.

Figure X-2 shows average rates of coastal recession between 1937 and 1986. High rates of coastal recession occurred in the late 1930's, the early 1940's, the late 1970's, and especially in the early 1980's. These data show that coastal erosion is highly episodic and is usually associated with large oceanic storms.

A variety of shoreline features were used to make the measurements of coastal recession. The most preferred feature was the top of the coastal bluff or scarp. In areas where the top of the bluff was irregular (non-linear), the base of the bluff or scarp was used if it was more linear. If there was no bluff or scarp, the seaward edge of dune vegetation was used based on the reasoning that significant dune erosion typically undermines and strips the surficial vegetation without necessarily creating a scarp visible on the air photos. The measurement points for each transect are noted in Appendix X-A.

4. Factors Affecting Rates of Coastal Recession

Projections bases on historical recession rates must assume that past rates will continue into the future. However, changing conditions will effect coastal recession rates.

<u>Dam construction</u> has decreased the sediment yield of the Salinas River, a major source of beach sediment to beaches in the study area (Dorman, 1968;

Arnal, 1973; Oradiwie, 1986).

Sand mining from the beach and surf zone in the study area also contributes to disequilibrium in the longshore drift system. It is the opinion of the author that coastal sand mining significantly contributes to longshore drift disequilibrium and sediment budget deficits in the study area. Sand mining unequivocally increases the rate of coastal recession. To what degree it causes increased bluff recession is difficult to define.

The response of the beach profile to: 1) rising sea level and 2) longshore littoral drift disequilibrium has, to the author's knowledge, not been adequately quantified. Because of this lack of knowledge regarding changes in the beach profile, future rates of recession are not amenable to precise prediction.

5. Sea Level Rise

There is very little published literature on sea level rise which sets out to forecast sea level rise scenarios for the next 100 years. The Environmental Protection Agency (EPA) published a report in 1983 entitled "Projecting Sea Level Rise; Methodology, Estimates to the Year 2100 and Research Needs". This document is the most commonly used published document on sea level rise scenarios. Some experts believe it to be true and its findings credible, others, who dispute the "greenhouse effect", disbelieve the report's conclusions. The EPA's average estimate of rise in global sea level within the next 50 and 100 years is 1.5 and 4.75 feet, respectively (Environmental Protection Agency, 1983). Global warming and the greenhouse effect are predicted to cause melting of a portion of the polar ice caps engendering this sea level rise (a total melting of the polar ice caps would result in a 315-foot rise in sea level; Bruun, 1962).

In Fall of 1987 the National Research Council published a book entitled "Responding to Changes in Sea Level Rise, Engineering Implications". The book was prepared by the Committee on Engineering Implications of Changes in Relative Mean Sea Level. The report based its conclusions on three plausible variations in sea level rise to the year 2100: 50, 100, and 150 cm. These rates of rise would be greater in the distant future than in the next decade and would be increased relative to the present. The following conclusions taken from the book may be relevant to the Marina Dunes Study:

> "6. Monitoring of relative mean sea level behavior is at present inadequate for measuring the possible global result of future climate warming due to rising greenhouse gases.
>
> 8. The risk of accelerated mean sea level rise is sufficiently established to warrant consideration in the planning and design of coastal facilities. Although there is substantial local variability and statistical uncertainty, average relative sea level over the past century appears to have risen about 30 cm relative to the East Coast of the United States and 11 cm along the West Coast, excluding Alaska where, glacial rebound has resulted in a lowering of relative sea level."

The primary recommendation of the report is as follows:

> "1. The prognosis for sea level rise should not be a cause for alarm or complacency. Present decisions should not be based on a particular sea level rise scenario. Rather, those charged with planning or design responsibilities in the coastal zone should be aware of and sensitized to the probabilities of and quantitative uncertainties related to future sea level rise. Options should be kept open to enable the most appropriate response to future changes in the rate of sea level rise. Long-term planning and policy development should explicitly consider the high probability of future increased sea level rise."

A key factor in evaluating the severity of future coastal erosion and bluff recession relates to what impact sea level rise will have on rates of erosion. Flick and Cayan (1984) evaluated yearly mean sea levels in San Diego between 1906 and 1983. This data shows an increase of 0.7 feet/century.

Excerpts from the publication "Sea Level Variations for the United States", published by the Tides and Water Levels branch of the National Oceano Survey in 1983 indicates that average sea level rise at the San Francisco tide guage station from 1855 to 1981 was 1.2 mm/year and from 1940 to 1981 was 1.5 mm/yr. This means that sea level rose about 0.5 feet in San Francisco Bay between 1855 and 1981 and the average rate of rise has slightly accelerated in recent decades. This is slightly different than in San Diego where yearly sea level has risen about 0.6 feet since 1905.

Information from the Monterey tide guage suggests that sea level has risen in Monterey at a rate of .009 ft/yr from 1975 to 1985. The short (13-year) record from the Monterey guage is inadequate to use to predict sea level rise for the next 100 years. Short-term effects (El Nino, etc.) make the Monterey tide guage records difficult to interpret. Review of these data provides substantial information on historical sea level rise and validates the current trends line presented by the EPA.

Sea level has probably risen about 0.25 feet in Monterey Bay in the last 50 years. If global warming over the next 50 years equals the global warming of the last 50 years, sea level will probably rise the same amount (about 0.25 feet) in Monterey Bay in the next 50 years. However, the rate of global warming appears to be accelerating, causing a corresponding acceleration in the rate of sea level rise.

A rapidly rising sea level can significantly affect the amount of sediment that low-gradient rivers supply to the coast because their lower reaches become depositional environments, trapping sand that otherwise would reach the littoral zone.

Future sea level rise is a controversial issue. There is considerable uncertainty in all estimates of future sea level rise. There is a general agreement in the scientific community that significant changes in global climate will occur due to the accumulation of "greenhouse" gases in the atmosphere such as carbon dioxide, methane and chlorofluorocarbons. Some scientists now predict average temperature increases of 2-6 degrees Centigrade in the next 50 to 100 years. This would cause thermal expansion

of sea water and melting of glacial and polar ice, both of which would cause a substantial rise in sea level.

6. Coastal Recession Analysis

Coastal recession has been taking place in the Marina Dunes area since at least 1919 (Arnal, et.al., 1973). Extreme narrowing of the Flandrian dune belt opposite Fort Ord (south of the study area) is evidence of long-term coastal and dune erosion (Cooper, 1967). In this region the heights of the dunes imply that a much broader belt should exist (Smith, 1983).

Thompson (1984) indicates that the maximum rates of coastal bluff recession in the southern Monterey Bay area are in the "Fort Ord Sector", based on his analysis of various locations in southern Monterey Bay. Coastal recession decreases downcoast to Monterey Harbor and upcoast to Marina and beyond. Smith (1983) estimates average annual long-term coastal recession rates at Ford Ord to be six to seven feet per year.

Cleary Consultants (1983) analyzed air photos from 25 October 1937 to 3 February 1983, and determined that rates of coastal recession at the proposed Gullwing Inn site were about 2.2 feet per year. Because of extreme erosion of dunes that took place in February and March 1983, this may be an underestimate of the actual long-term rate of recession.

Ken Harrington of the U.S. Army Corps of Engineers estimated coastal recession at the Marina County Water District wastewater treatment plant to be 4 foot/year. Mr. Harrington derived his data from a combination of topographic maps (1"=50' and 1'=200' scale) and survey data from the period 1968 to 1983. This data indicates that the top of the cliff receded 60 feet in fifteen years. Aerial photographs indicate that the base of the cliff receded at a greater rate. This differential recession caused the cliff opinion, recession of the base of the cliff is the more accurate recession estimate, because the top of the cliff is unstable and will naturally retreat until the face of the cliff reaches the equilibrium angle of repose (about 30 to 35 degrees).

Historical data to estimate the recurrence interval of the 1983 winter storms is lacking and therefore the extent of these storms' impact on rates of calculated recession in the study area cannot be judged. On the average, slightly more than half the total bluff recession observed in the 1937 to 1984 time period occurred between May 1978 and April 1984.

Jones (1983) utilized air photos and field measurements to measure rates of coastal recession between 1937 and July 1983. His rates of recession varied from 5.7 to 6.8 feet per year within the Marina area.

McGee (1986) investigated the average rates of bluff recession for a 0.8-mile stretch of coast in the vicinity of Marina by applying precise photogrammetric techniques to analyze air photos from 1940 through 1984. He reports average rates of bluff recession of 1.25 feet per year during this time period, including 7.6 feet per year of "anomalous" accretion between 1970 and 1980. McGee analyzed recession of the crest of the most seaward sand dune in areas lacking coastal bluffs, which may account for this anomalous accretion.

The average historical rates of coastal recession between 1937 and 1986 have been extrapolated, and the projected position of the bluff in the years 2036 and 2086 has been plotted based on those projections (see Figure X-3). This technique assumes that rates of coastal recession remain constant.

The increasing amount of eroded material as bluff recession continues landward could potentially reduce the long-term rate of recession. Figure X-4 is a schematic profile in the vicinity of the Marina County Water District facilities. A parallax Bar was used to make measurements of the height of the coastal bluff shown on the 1937 and 1986 aerial photos. This figure illustrates that the amount of earth materials eroded in the next 50 years would have to increase by about 25% over the amount eroded in the past 50 years if the same rate of recession were to be maintained. An accelerated sea level rise and increasing longshore littoral drift disequilibrium will probably nullify this effect and, in fact, may cause accelerated retreat.

As mentioned above the rates of coastal recession may increase because of rising sea level and possible increasing longshore drift disequilibrium. Using the EPA significant and extreme sea level rise scenarios (EPA, 1983) and the Bruun Rule (refer to P. Bruun, 1962) a projection of the possible future sea level rise can be made. Average estimates using the significant sea level rise scenario are 1.5 feet in 50 years and 4.75 feet in 100 years). Average estimates using the extreme values of sea level rise are 2.6 feet for 50 years, and 8.6+ feet in 100 years. Refer to Appendix B for calculations. Based on this, if EPA projections are correct, the average rates of coastal recession in the study area may increase by 20% to 60% over the next 50 years and by 60% to 108% over the next 100 years.

7. Summary of Conclusions

Coastal recession has affected the Marina Dunes area since 1916 or earlier. Major erosion occurs when heavy storm wave action reaches the base of the bluffs, above the level of the beach. As such, erosion is deemed "episodic", that is, occurring in episodes, during large storms.

The episodic nature of erosion here makes it difficult to forecast future erosion. Analysis of a series of air photos from 1937 to 1986 enabled RJA to measure the <u>average</u> rate of historic erosion -- 4.2 feet $\pm$ 0.7 feet per year. However, a few large storms in only a few days account for most of the loss during the fifty year period. So, the observed rate of erosion depends on the number and severity of storms during the period of observation. In particular, the winter of 1982-83 caused major erosion at Marina such that the annual recession rate measured from the 1978 photo to the 1984 photo was 16.7 feet/year while the rate for the previous period, 1970 to 1978, was only 4.8 feet/year.

Thus, projection of historic rates to future conditions is subject to uncertainty: 1) How representative is the period of historic observations? 2) What is the recurrence frequency of very large storms? 3) What other conditions affect erosion rates that may change in the future?

One factor identified for future change is the rising sea level. Most scientific sources now agree that global warming trends are resulting in melting of polar ice caps and a concomitant rise in sea level. There is disagreement on how <u>fast</u> the level will rise, with estimates cited by the US

Environmental Protection Agency ranging to as much as 2.6 feet for the next 50 years and to as much as 8.6 feet for the next 100 years.

Sea level rise will increase shoreline recession through increased erosion rates of the bluffs above the shore. In low-lieing areas, sea level rise would result in inundation -- the shore would recede as the water level advanced up a shallow slope. Along the coast, recession from inundation due to sea level rise is minor compared to the effect of erosion resulting from the higher water level increasing the reach of storm waves and increasing the amount of time storm waves break against the bluffs.

The analysis presents estimates for the approximate shoreline location at 50 and 100 years hence under two scenarios. One scenario assumes a static sea level with no increase in the erosion rate which has been observed historically, during a period of essentially no net rise in sea level. These are shown in Figure X-3. The second scenario examines the effect of sea level rise, with the forecast reflecting a range of effects from a rise equal to the average US EPA projection and from a rise equal to the maximum US EPA projection and resulting in a band rather than a single line. These are discussed in Appendix X-B.

In making use of the recession map, it is important to bear in mind that the lines are only estimates of future processes and that they are only meant to indicate the approximate extent of shoreline recession that may be experienced in the Marina Dunes area over the next 50 to 100 years. Because the lines are estimates, future events will not follow exactly: the shoreline will not recede at exactly 4.2 feet each year -- as in the past, recession will be governed by episodes of major storms. Moreover, projections based on history necessarily assume that natural forces acting during the period of historical observations will continue to operate during the period of forecast. The imposition of a sea level rise scenario illustrates the sensitivity of the shoreline system to changing conditions.

The following are a list of the major conclusions of this study.

1. The study area is composed of dunes of three ages, pre-Flandrian, Flandrian and Recent.

2. The dune deposits are unconsolidated, cohesionless sands with very little resistance to coastal erosion.

3. Geologic and historical evidence indicates long-term coastal recession has taken place in the study area.

4. The average rate of coastal recession in the study area between 1937 and 1986 was about 4.2 feet $\pm$ 0.7 feet per year and ranged from 3.6 to 7.3 feet per year.

5. Significant but unquantified increasing longshore drift disequilibrium probably exists in the study area. Ceasing sand mining in the study area may decrease longshore drift disequilibrium.

6. An accelerated rate of sea level rise caused by world wide global warming associated with the "greenhouse effect" may increase the rate of sea level rise and thus effect the future recession rate.

C. EXISTING APPLICABLE POLICIES

The Current City of Marina Local Coastal Program Land Use Plan policy regarding erosion setback is as follows: no development is allowed seaward of a 50 year erosion setback line. The erosion rate at which to base the 50 year setback must be determined by the project Applicant at the time of project submittal.

D. SUGGESTED PLANNING GUIDELINES

Shoreline recession affects the Marina Dunes Plan by reducing the land area available for either development or conservation. The value of the shoreline recession study is to show the reasonably probable range of recession that may be experienced over the intermediate term of the plan. Because we cannot know today what storms will come tomorrow or how much the sea will rise, there is uncertainty in the recession estimates. Because of the prospect of land loss there is an element of risk that is to be reflected in Task Force policy.

Shoreline erosion is well documented. Despite the episodic nature of recession, the present trend is clear. So the question is not, whether the shoreline will recede, rather it is, how fast? Generally, the less extreme recession lines in the study are more likely to be equalled or exceeded than are the more extreme lines and represent a greater risk of loss.

The result of different time-frames for forecast and of different scenarios for sea level rise is a wide range of projected shoreline recession. The Task Force may use different shoreline projections as a basis for different policy needs.

One policy need is for an exclusion zone to guard against placing structures in immanent risk of damage from coastal erosion. This is the basic intent of coastal cities establishing a 50 year erosion setback: the cities do not want to place structures where a series of large storms could precipitate a crisis requiring protection or abandonment of the buildings.

A second need is to delineate the longer term threat to land, to identify that area of intermediate risk where structures would not be immediately jeopardized yet where advance planning may be required to anticipate changing conditions.

A third need is for a definition of worst case land loss to be used for assessing Plan impact on coastal access, public safety, and species of concern. Clearly, the Plan must be considered not only in the context of the present day, but also in the forseeable future to ensure that adequate protections have been afforded during a reasonable planning horizon.

Finally, erosion estimates can be used for landowner planning to protect private property. That need will not be filled by the Task Force. This shoreline recession study is not intended to guide individual property owners or developers in facility design. Only complete project-specific engineering is adequate to design and site a structure to ensure its security from coastal erosion over its economic lifetime.

SHORELINE RECESSION

The following are list of the suggested planning guidelines for shoreline recession.

1) The fifty year erosion set back line shown in Figure X-3, which is based on an average recession rate of 4.2 foot per year, should be used as the basis for making land use planning decisions at the Marina Dunes until such time further information becomes available.

2) No permanent structures should be allowed seaward of the 50 year erosion setback line.

3) Non-permanent structures should be allowed between the 50 and 75 year erosion set back line.

4) Any permanent structures with an estimated economic lifetime of less than 50 years should be allowed in the 50 to 75 year erosion set back zone.

5) A specific 50 year setback line should be determined for each structure as it comes forward for development. If available, new site-specific data should be used as the basis for setting the 50 year line.

6) Long-term (50-100 years) planning and policy development for the dunes should consider the high probability of future increased sea level rise.

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APPENDIX X-A
MARINA DUNES AERIAL PHOTO ANALYSIS DATA

Analysis by P. Crenna 5-7-87

*All distances in feet
*Recession rates in feet per year
*Uncertainties derived from largest variation from the mean in photograph scale determinations

Transect	1937	1940	1949	1970	1978	1984	1986
A	966±9	952±4	949±3	869±5	873±7	766±3	718±3
Rate		4.7	0.3	3.8	+0.5	17.8	24
Avg. rate	5.1±0.6						
B	957±9	952±4	916±3	867±5	797±6	613±2	598±2
Rate		1.7	4	2.3	8.7	30.7	7.5
Avg. rate	7.3±0.5 **						
C	-	695±3	701±2	653±4	621±5	516±2	513±2
Rate			0.7	2.3	4	17.5	1.5
Avg. rate	4.0±0.3						
D	692±7	673±3	655±2	604±3	482±4	476±1	479±2
Rate		6.3	2	2.4	15.2	1	+1.5
Avg. rate	4.3±0.4						
E	1836±18	1793±7	1766±5	1757±10	1737±13	1652±5	1652±7
Rate		14.3	3	0.42	2.5	14.2	0
Avg. rate	3.7±1.3						

** Measured recession rate is anomalously high. Rate of 4.55±0.5 is probable. See Transect Recession Summary, Appendix A.

Transect	1937	1940	1949	1970	1978	1984	1986
F		652	627				
F1	1319	1210	1191				
F2					478±4	363±1	
F3	1292±13	1274±5	1282±4	1255±7			
F4				351±2	336±3		
Rate		6	+0.9	1.3	2	19.2	
Avg. rate	3.6±0.8						
G		453±2	376±1				
G1	1291±13	1287±5	1254±4	1257±7	1242±9	1145±4	
Rate		1.6	8.5	+0.1	1.9	16.2	
Avg. rate	4.0±0.8						

	1937-40	1940-49	1949-70	1970-78	1978-84	1984-86
Avg. Coastal Recession rate for all transects	5.8	2.5	1.8	4.8	16.7	6.3

Mean Coastal Recession Rate for all Transects 4.2±0.7 feet/year

TRANSECT EROSION SUMMARY

Transect A -

Measurement datum point: Intersection of break in slope with drainage

Coastal recession point: Dune vegetation line

Seaward dune strip significantly eroded on 1937 photos. Subsequently, seaward dune strip totally eroded and inland dune strip partially eroded. Pre-1937 data would most probably show significant erosion of the seaward dune strip on transect A just prior to 1937.

Transect B -

Measurement datum point: Dirt road intersection

Coastal recession point: Dune vegetation line

Seaward dune strip relatively intact on 1937 photos (partially eroded on transect A). Subsequent erosion totally removes seaward dune strip, and erosional scarp migrates inland. Intact seaward dune strip on 1937 photos results in anomalously high long term recession rate. Actual long term recession rate is probably similar to those of transects A and C.

Transect C -

Measurement datum point: Intersection of dirt road and drainage

Coastal recession point: Dune vegetation line

Seaward dune strip scarp migrated to the base of the inland dune strip scarp.

Transect D -

Measurement datum point: Dirt road intersection (intersection of dirt road and characteristic break in slope on photos 1937, 1940, 1949)

Coastal recession point: Dune vegetation line on 1937, 1940, 1949, 1970 photos; top of erosional scarp on 1978, 1984, 1986 photos

Seaward and inland dune strips removed completely; active erosional scarp established. Sand mining may have increased the

recession rate on this transect. Increased eolian erosion due to mining and unnatural sand removal appears to have caused retreat of the erosional scarp around the edges of the sand mining operation. This artificial setback of the erosional scarp would make this area less susceptible to wave erosion in the 1978 and 1983 storm events. This may explain the anomalously low recession rate of 1 ft/yr between 1978 and 1984.

Transect E -

Measurement datum point: Center of small group of trees

Coastal recession point: Dune vegetation line on the 1937, 1940, 1949 photos; Base of erosional scarp on the 1970,1978,1984,1986 photos

An erosional scarp formed, undercutting the dunes on the 1970 photos, and migrated inland. Since the measurement datum is approximately 1800 feet from the shoreline, significant error may be present (See error estimates on transect measurements). The 1986 base of scarp plotted to far inland by about 45 feet on the 1986 topographic map. We shifted the datum to the topographic base of scarp and projected the erosion rates from that point to compensate for this disagreement.

Transect F -

Measurement datum point:

F - Seaward corner of building

F1 - Inland corner of square pattern of tanks

F2 - Center of inland water tank at the sewage treatment plant

F3 - Intersection of tree rows

F4 - Center of seaward water tank at the sewage treatment plant

Coastal recession point: Base of the cliff

Due to the lack of stable datum points from 1937 to 1986, measurements were made from five separate datum points. The coastal recession point for transects F and F1 is geomorphically different than that for transects F2, F3, and F4. Transects F2, F3, and F4 measured cliff retreat, while transects F and F1 measured recession within the depression between two dune ridges. Inspection of the data shows that coastal recession was excessive at transects F and F1 from 1937 to 1949; hence, we declined to combine this data with data from transects F2, F3, and F4. We added each successive change between transects F2, F3, and F4 to calculate an average rate. We note that the erosion was greater

at the coastal recession point for F and F1.

Transect G -

Measurement datum point:

G - Dirt road intersection on ridge

G1 - Center of most seaward tree of a three tree group

Coastal recession point: Top of cliff

We measured cliff retreat. Active dunes adjacent to cliff indicate that eolian erosion may contribute significantly to the transects recession rate. Measurements were made on two transects, G and G1. Transect G was preferred in determination of the recession rate between 1940 and 1949 due to the shorter measuring distance which reduces potential error.

AERIAL PHOTOGRAPH SCALE DETERMINATION

Exact photograph scales were determined by measuring the distance between two landmarks, and then measuring the same distance on the U.S.G.S. 7.5 minute Marina Quadrangle. Using the known scale of the Quadrangle map, we calculated the scale of each set of photographs. This procedure was repeated several times on each set of photographs to confirm the scale, and to determine the uncertainty present in measurements taken from the photographs. We chose to use the largest deviation from the mean as the uncertainty associated with photograph measurements. Measurements were made between numerous landmarks and in all areas of the photographs to account for radial distortion. Additional confirmation of the photograph scales was performed by comparing measured distances between identical landmarks on each set of photos, converting these distances to actual distances with the appropriate scale conversion, and checking for reasonable agreement of the actual distances.

Supplement to Appendix X-A.

Some of the datum points used on the transects may be considered "moving targets". Due to the lack of structural landmarks in close proximity to the coast, drainages, trees and bushes were used as some datum points. In most instances, structural landmarks were simply not present. In other cases, the error induced by measuring long distances from structural landmarks outweighed the error induced from using potentially unstable landmarks. Throughout the analysis procedure, careful judgement was used in choosing the best datum points possible. The report indicates an average uncertainty in the rates of coastal recession of $\pm$ 0.7 feet per year.

APPENDIX X-B
PROJECTION OF EROSION RATES BASED ON EPA SEA LEVEL RISE SCENARIOS

Dean (1987) discusses two methods of predicting future shoreline retreat associated with sea level rise. The first method considers past retreat and past sea level rise and predicts future retreat proportionally based on predicted future sea level rise. Dean notes this approach is oversimplified. If applied in the study area, it would predict a six to 12-fold increase in rated of bluff recession in the next century, assuming sea levels rise six to 12 times more in the next century compared to the last century.

The second method relies on the disputed "Bruun Rule" developed by P. Bruun (1962). The "Bruun Rule" predicts that: (a) there is a shoreward shift in the beach profile as the upper beach is eroded; (b) the material eroded from the upper beach is equal in volume to the material deposited on the nearshore bottom; and (c) the rise of the nearshore bottom as a result of this deposition is equal to the rise in sea level, thus maintaining a constant nearshore water depth in that area.

Strictly applying the Bruun model to Monterey Bay beach profiles does not work. This theory indicates that on the "nearshore bottom" of tectonically stable areas of the world an onlapping sequence of 330 feet of deposits less than 15,000 years old corresponding to the Flandrian rise in sea level should be seen. If historical sea level rise was the sole cause of historical coastal recession in the study area, the Bruun Rule predicts that we would have had about an order of magnitude less coastal recession than has actually occurred. Dean and Maurmeyer (1984) note that the Bruun Rule does not include the effects of longshore drift disequilibrium which can significantly affect the model. They note that the gradient of longshore transport is not usually well enough known to adjust the Bruun model for longshore drift conditions.

Despite the difficulties in analyzing the effect of rising sea level and possible increasing longshore drift disequilibrium, a worst case model has been developed that approximates the increase in rates of bluff recession in the study area. This model is based on modification of the "Bruun Rule" and the Lima Blanco and Sklavidis (1985) bluff recession model.

<u>Model approximating increased bluff recession rates due to sea level rise and possible increased longshore drift disequilibrium</u>.

$$RR = K \left[\frac{WT + SWL - BTE}{BS} \right]$$

$$\frac{RR_F}{RR_H} = \frac{WR_F + SWL_F - BTE_F}{WR_H + SWL_H - BTE_H}$$

NOTES:
- RR = Recession Rate (RR_F=future, RR_H=historical).
- K = 0.000096 (Lima Blanco & Sklavidis, 1985).
- WR = Wave Runup (WR_F=future, WR_H=historical).
- SWL = Stillwater Level (SWL_F=future, SWL_H=historical).
- BTE = Bluff to Elevation (BTE_F=future, BTE_H=historical).
- BS = Tan B (Beach Slope).

The conceptual basis and assumptions incorporated in this model are as follows:

Conceptual basis and assumptions incorporated in determining worst case approximate increased cliff recession rates due to sea level rise and possible increased longshore drift disequilibrium in the Marina Dunes area

1. The coastal profile contains three segments: the bluff, the beach and the nearshore ocean bottom.

2. The average increase in sea level during the next 50 years based on mean and extreme EPA estimates is 0.6 feet to 1.8 feet.

   The average increase in sea level during the next 100 years based on mean and extreme EPA estimates is 1.2 feet to 3.3 feet.

3. Wave runup that causes coastal recession typically results from waves that initiate breaking on the beach rather than on the nearshore ocean floor. Waves that initiate breaking on the nearshore ocean floor will break. reform and break again on the beach.

4. The rate of coastal recession is proportional to the amount of time wave runup impacts the coastal bluffs.

5. Under a rising sea level, the amount of time that wave runup impacts the coastal bluffs with different sea level conditions is proportional to the distance above the toe of the bluff that maximum wave runup attains under different sea level conditions.

6. The elevation of the nearshore ocean floor at the toe of the beach will not change with a rise in sea level. The elevation at the toe of the beach will not rise with increasing sea level because of a combination of the following conditions: A) the toe of the beach is in an erosional area landward of the inflection point in Bruun's model and B) longshore drift disequilibrium in the area prevents significant nearshore bottom deposition from affecting the elevation of the toe of the beach.

7. Wave runup will increase with increasing sea level because larger waves will break at the toe of the beach.

8. Rates of coastal recession will increase because increasing sea level will result in higher wave runup impacting the coastal bluff more frequently.

This rough model predicts that coastal recession rates, on the average, will increase 20% to 60% during the next 50 years and 60% to 108% during the next 100 years. The zones showing the possible position of the coastal bluffs in years 2037 and 2087 are shown on the map and on Figure X-3.

Conclusions

1. The study area is composed of dunes of three ages, pre-Flandrian, Flandrian and Recent.

2. The dune deposits are unconsolidated, cohesionless sands with very little resistance to coastal erosion.

3. Geologic and historical evidence indicates long-term coastal recession has taken place in the study area.

4. The average rate of coastal recession in the study area between 1937 and 1986 was about 4.2 feet $\pm$ 0.7 feet per year and ranged from 3.6 to 7.3 feet per year.

6. Significant but unquantified increasing longshore drift disequilibrium probably exists in the study area. Ceasing sand mining in the study area may decrease longshore drift disequilibrium.

7. Rates of coastal recession may increase because of rising sea level and possible increasing longshore drift disequilibrium. Average rates of coastal recession may increase by 20% to 60% over the next 50 years and by 60% to 108% over the next 100 years in the study area.

TABLE X-1
STORM HISTORY OF MONTEREY COUNTY AND THE CENTRAL COAST

(Compiled from U.S. Army Corps of Engineers, 1958; Bixby, 1962; Calif. Coastal Com., 1978; Santa Cruz Sentinel, Watsonville Register-Pajaronian, and the Monterey Peninsula Herald.)

Date - Year	Damage - Description	Direction/ Type of Storm
21 March 1910	Heavy storm off coast, mountainous seas. No damage.	-
22 Nov. 1910	Monterey Bay was very rough and surf was running high. No ships able to enter or leave Monterey harbor. No damage.	-
13 Feb. 1911	Mountainous waves reported along the beach north of Monterey. No damage.	-
4-11 Oct. 1912	Strong northwest wind and heavy swell. Several wharves at Monterey damaged and boats beached. Heavy surf.	-
December 1912	Heaviest seas in history of Monterey Bay.	-
29-30 Apr. 1915	Heavy surf and strong winds. Considerable damage to structures and boats.	-
26 Nov. 1915	Large and powerful waves breaking over wharves at Monterey. No damage.	-
27 Jan. 1916	Southwest gale, tremendous swells.	"southwest gale"
29 Nov.-1 Dec. 1923	Northeast gale, heavy seas.	"northeast gale"
11-15 Feb. 1926	Southerly gale winds and wave damage all along California coast. High tide and waves.	"southerly gale"
25 Oct. 1925	Heavy swells running into Monterey Bay.	-
8-9 Dec. 1926	Heavy swells washed one boat ashore at Monterey. No significant damage.	-

Table " (cont'd)

Date - Year	Damage - Direction	Direction/ Type of Storm
14-16 Feb. 1927	At the time reported to be most violent storm in history of Pacific coast.	"heavy south-westerner"
4 Oct. 1927	Hugh breakers reported along Central California Coast. No damage reported.	-
30 Dec. 1928	Powerful surges in Monterey harbor causing damage to freighter attempting to moor.	-
3 Jan. 1931	Heavy southwest swell.	-
4 Feb. 1931	High breakers and ground swells, waves reached 14 to 20 feet above mean lower low water.	-
20 Feb. 1931	North winds of gale intensity. Several small boats wrecked.	north winds
20-21 Nov. 1931	Strong winds and heavy seas beached numerous small boats at Monterey.	northwest gale
23-29 Dec. 1931	Violent storm. Entire coastal area affected. Large quantities of sand eroded. Beaches littered with debris brought down by storms. Waves reached 20 feet above mean lower low water. Considerable damage.	winds first from southwest, then northwest
20-21 Dec. 1932	Very rough on bay and waves breaking over breakwater under construction at Monterey.	winds from north-west
19 Dec. 1935	Very heavy surf. Giant breakers.	-
10-11 Dec. 1937	Southwest winds.	-
9-10 Dec. 1939	High waves. Breakers and high tide combined to flood many areas. Deep water wave height hindcast at 20 feet.	southwest wind waves

Table (cont'd)

Date - Year	Damage - Description	Direction/ Type of Storm
26-28 Feb. 1940	Beaches eroded and littered with logs. Hindcasted waves of 25 feet height.	southwest wind, waves and swell
26-27 Dec. 1940	Highway 1 closed after 800 feet of roadway washed away north of Santa Cruz from high seas. Logs up to 10 feet were tossed onto road. Monterey Bay houses damaged.	-
8-13 Jan. 1941	Beach eroded to bedrock in areas.	waves and swell from southwest; crests +20 feet above mean lower low water
11-13 Feb. 1941	Large waves in Monterey Bay.	-
26-28 Feb. 1941	Heavy winds, gigantic waves, hindcast wave height at 22 feet.	south-southwest and southwest wind waves and swell
24-25 Dec. 1942	North winds and high surf.	north winds
22 Jan. 1943	High surf reported but no wave damage.	southwest winds
8-9 Dec. 1943	Very strong northeast winds wrecked 40 fishing boats, piers and pilings in Monterey harbor.	northeast wind
1-2 Feb. 1945	Southerly winds and heavy seas. No damage reported.	southerly winds
4 March 1946	North winds up to 40 knots.	north winds
28 Jan. 1947	Northerly gale force winds; 43-foot fishing boat capsized and beached; 80-foot section of dike holding dredge spoil washed out in Monterey.	northerly gale
4 April 1947	Strong northerly winds with high surf in bay.	northerly winds

Table (cont'd)

Date - Year	Damage - Description	Direction/ Type of Storm
23 Feb. 1948	Northwest winds up to 50 mph. Some boats beached in Monterey. Damage light.	northwest winds
2-3 Jan. 1949	High winds and seas. Several boats adrift and one lost in Monterey.	-
27-29 Oct. 1950	Northerly gale winds accompanied by gigantic waves pounded Monterey Peninsula. Considerable shoreline erosion. Waves were 10-15 feet high.	northerly gale
2 Dec. 1951	Southerly winds up to 40 mph. High surf but no damage.	southerly winds
23 Feb. 1953	Northeast gale winds up to 60 mph drive 7 large fishing boats ashore in Monterey.	northeast winds
13 Nov. 1953	Southerly winds. Monterey Bay beaches eroded. 14-foot waves.	southerly winds
7 Oct. 1954	Foreshore of beaches in Monterey Bay lowered; 3 to 5-foot scarp in area.	heavy ground swells from southwest
9-10 Feb. 1960	Southerly winds to 45 mph with gigantic waves. (Destruction of Stillwater pier)	southerly and westerly winds
27 Oct. 1974	10-foot waves, 30 mph winds, power outages on Monterey Pen.; two large fishing boats driven ashore at Del Monte Beach.	
4 Dec. 1974	3.69 inches rain in 24 hours at Big Sur; 8000 PG&E customers without power overnight; 38 mph winds in Monterey.	
29 Dec. 1974	Storm coincides with high tide in Monterey harbor; breaks boats moorings; high surf flood harbor parking lot; damages harbor restaurant.	
26 March 1975	50 mph winds in Monterey; sand dunes close roads.	

Table 1 (cont'd)

Date - Year	Damage - Description	Direction/ Type of Storm
Winter 1978	California coastline attacked by severe storms. These storms had the greatest effect on west and southwest-facing beaches. Private and public property sustained at least $13 million in damage. Extensive damage in Monterey Bay. In Carmel, a seawall at Cook's Cove parallel to Scenic Drive was damaged. At one point, 175 feet of seawall was lost and another 80 feet were damaged. Another portion of the wall required slope stabilization and storm drain repairs.	-
9 Jan. 1978	Surf breaks windows of Cannery Row restaurant; Capitola Wharf damaged; southwest-facing beaches damaged most.	
21 Jan. 1978	Santa Cruz County declared in state of emergency, extensive damage from flooding, slides and surf.	
2 Oct. 1979	High surf damages restaurant in Monterey; Four sailboats break moorings and go aground in Capitola; 12-foot waves.	
24 Dec. 1979	Major windstorm causes extensive power outages; tree falls in Carmel, hit homes; high surf damages small boat in moorings; power out in Carmel for three days.	
16 Feb. 1980	High winds up to 55 mph in Monterey; surf destroys adobe wall in historic Pebble Beach home.	Southerly winds
22 Jan. 1981	12 to 20-foot waves; 50 mph winds; no major damage reported.	

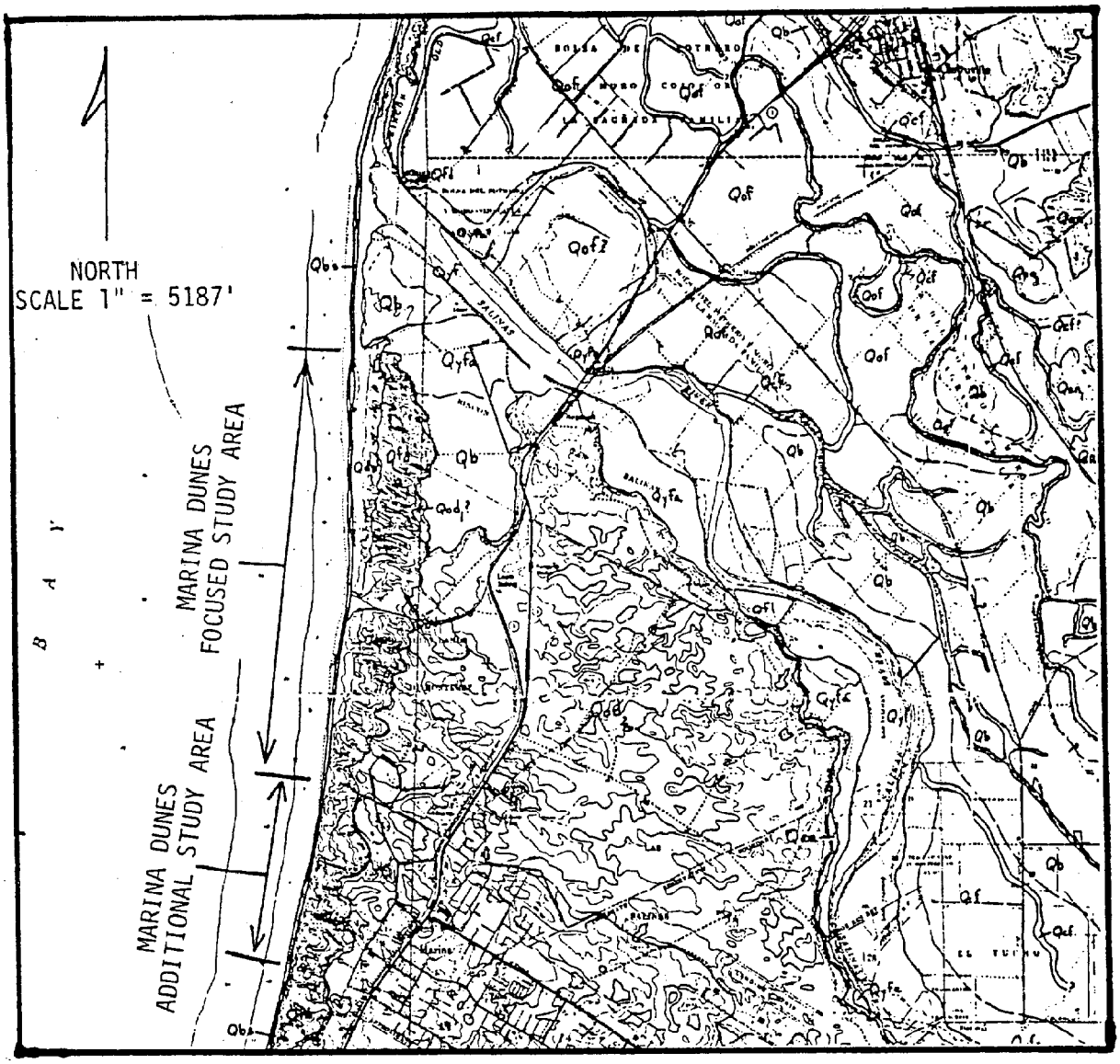
Table : (cont'd)

Date - Year	Damage - Description	Direction/ Type of Storm
5 Jan. 1982	Major storm strikes Monterey Bay; 70 mph winds and heavy rain from west measured in Monterey. Evacuation of downtown Soquel due to 4 to 6-foot deep flood waters. Large logjam formed in Soquel Creek. Experts call this "most devastating Pacific storm in a quarter century"; extensive mudslides and flooding in Santa Cruz County; 16 fatalities; thousands of homes damaged; state of emergency declared in Santa Cruz and four other counties; estimated $100 million damage in Santa Cruz County alone; extensive coastal erosion in Monterey Bay from gigantic waves.	from west
21 Jan. 1982	Rain and hailstorm in Monterey Bay; minor damage.	
1 Dec. 1982	Storm with high winds and driving rain; California coast affected from San Diego to San Francisco; scattered mudslides and power outages; Monterey Harbor seawall and restaurants badly damaged by storm runoff and high surf; extensive coastal erosion in Monterey Bay.	northwesterly storm
23 Dec. 1982	Thunderstorms and high winds in Monterey with flooding in Monterey and Carmel; extensive power outages; emergency coastal protection placed at Monterey Holiday Inn and Oceanhouse Apartments, Monterey.	
25 Jan. 1983	High winds and rain in Monterey.	

Table cont'd

Date - Year	Damage - Description	Direction/ Type of Storm
28 Jan 1983 1 Mar 1983	Huge surf destroys restaurants, shops, and homes in Capitola; beaches in Aptos, Capitola, Santa Cruz and Marina severely eroded; Rio Del Mar beachfront homes severely damaged by 18-foot surf on top of 6.6-foot high tide; damage estimated at $13.3 million in Santa Cruz County.	

FIGURE X-1
MARINA DUNES GEOLOGIC MAP



From DUPRE (1980)

DESCRIPTION OF GEOLOGIC UNITS

Qbs — BEACH SAND--Unconsolidated, well-sorted, medium- to coarse-grained sand. Local layers of pebbles and cobbles. Thin discontinuous lenses of silt relatively common in back-beach areas. Thickness variable, in part due to seasonal changes in wave energy; commonly less than 6 m thick. May interfinger with either well-sorted dune sand or, where adjacent to coastal cliff, poorly sorted colluvial deposits. Iron- and magnesium-rich heavy minerals locally form placers as much as 60 cm thick. High porosity and permeability. High susceptibility to coastal flooding, moderate to high liquefaction susceptibility

DUNE DEPOSITS--Divided into:

Qds — Dune sand--Unconsolidated, well-sorted, fine- to medium-grained sand, deposited as linear strip of coastal dunes. May be as much as 25 m thick. High porosity and permeability; well drained. Low susceptibility to flooding. Moderate to high liquefaction susceptibility depending on depth to water table. Soils poorly developed or absent. Accelerated erosion likely in areas where vegetation disturbed or removed

Qfd — Flandrian dune deposits of Cooper (1967)--Unconsolidated well-sorted sand as much as to 30 m thick, deposited in a belt of parabolic dunes up to 700 m wide. The dunes are presently stabilized, but accelerated erosion may occur where the vegetation is disturbed. Their physical characteristics are similar to those of younger dune sand. Liquefaction potential ranges from moderate to low, depending on the location of the water table

FIGURE X-2
AVERAGE COASTAL RECESSION RATES FROM 1937 TO 1986

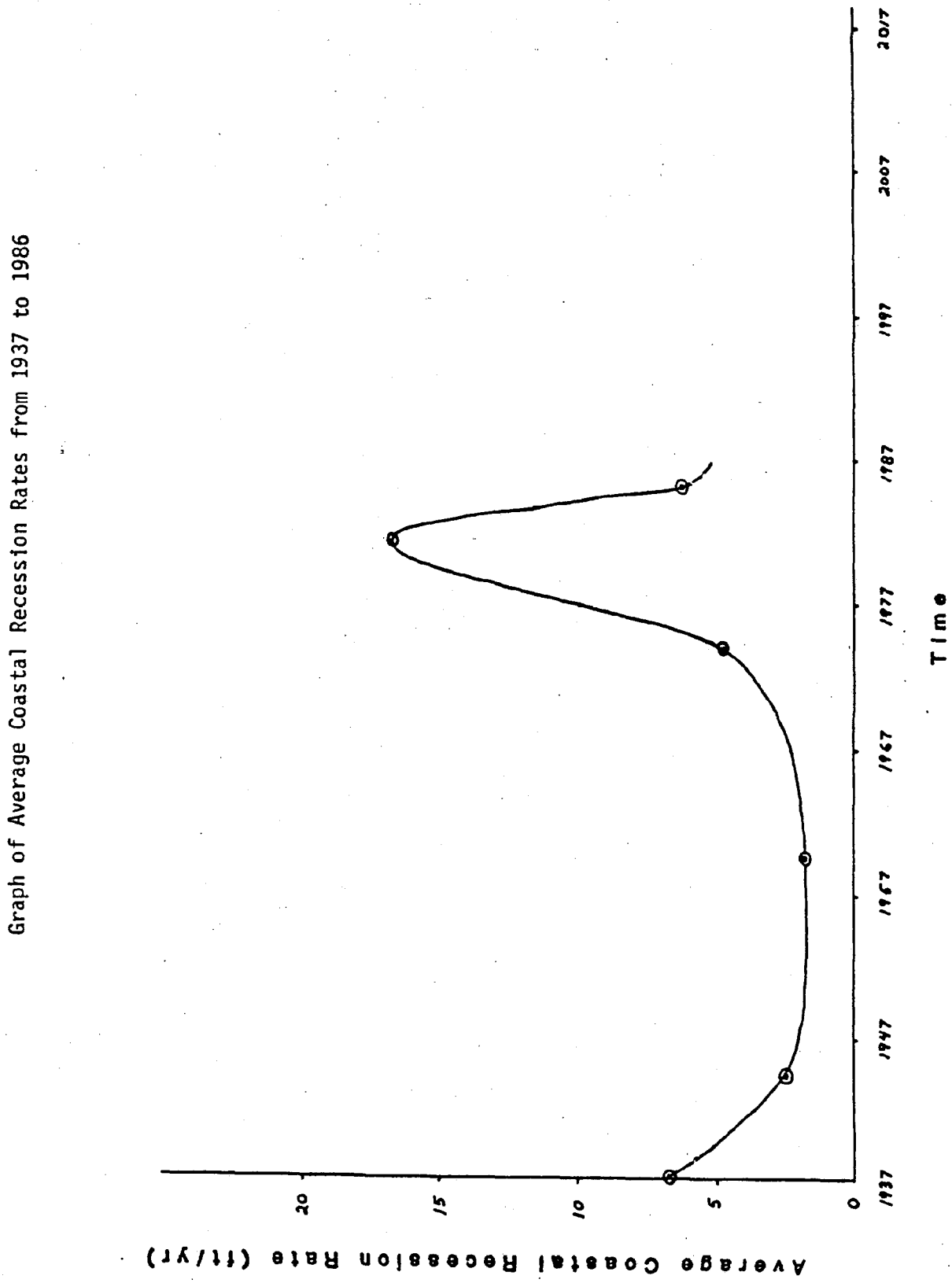
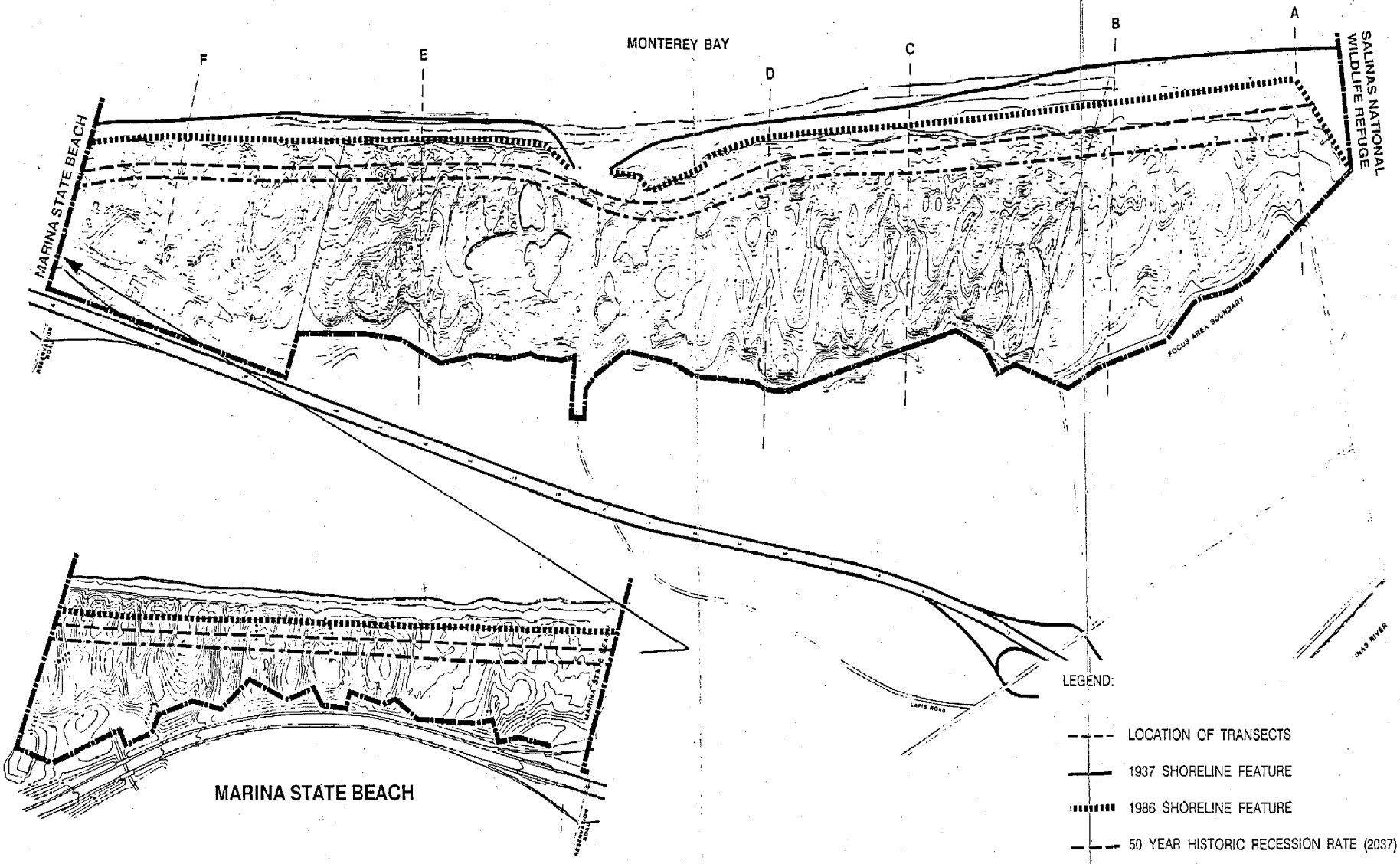


FIGURE X-3
SHORELINE RECESSION



LEGEND:

- - - - LOCATION OF TRANSECTS

——— 1937 SHORELINE FEATURE

▪▪▪▪▪▪ 1986 SHORELINE FEATURE

— — — 50 YEAR HISTORIC RECESSION RATE (2037)

—·—·— 100 YEAR HISTORIC RECESSION RATE (2087)

SOURCE: Thomas Reid Associates
Rogers Johnson and Associates
Geotechnical Engineers

MAP KEY
EXPLANATION

1937	-	Location of characteristic shoreline feature in 1937.*
1986	-	Location of characteristic shoreline feature in 1986.*
50 Year	-	Location of characteristic shoreline feature in the year 2037 based on extrapolation of historical rates of recession between 1937 and 1986.
100 Year	-	Location of characteristic shoreline feature in the year 2087 based on extrapolation of historical rates of recession between 1937 and 1986.

The following characteristic shoreline features were used in our aerial photograph analysis:

(DVL) - Dune Vegetation Line
(BOC) - Base of Scarp or Cliff
(TOC) - Top of Scarp or Cliff

NOTES

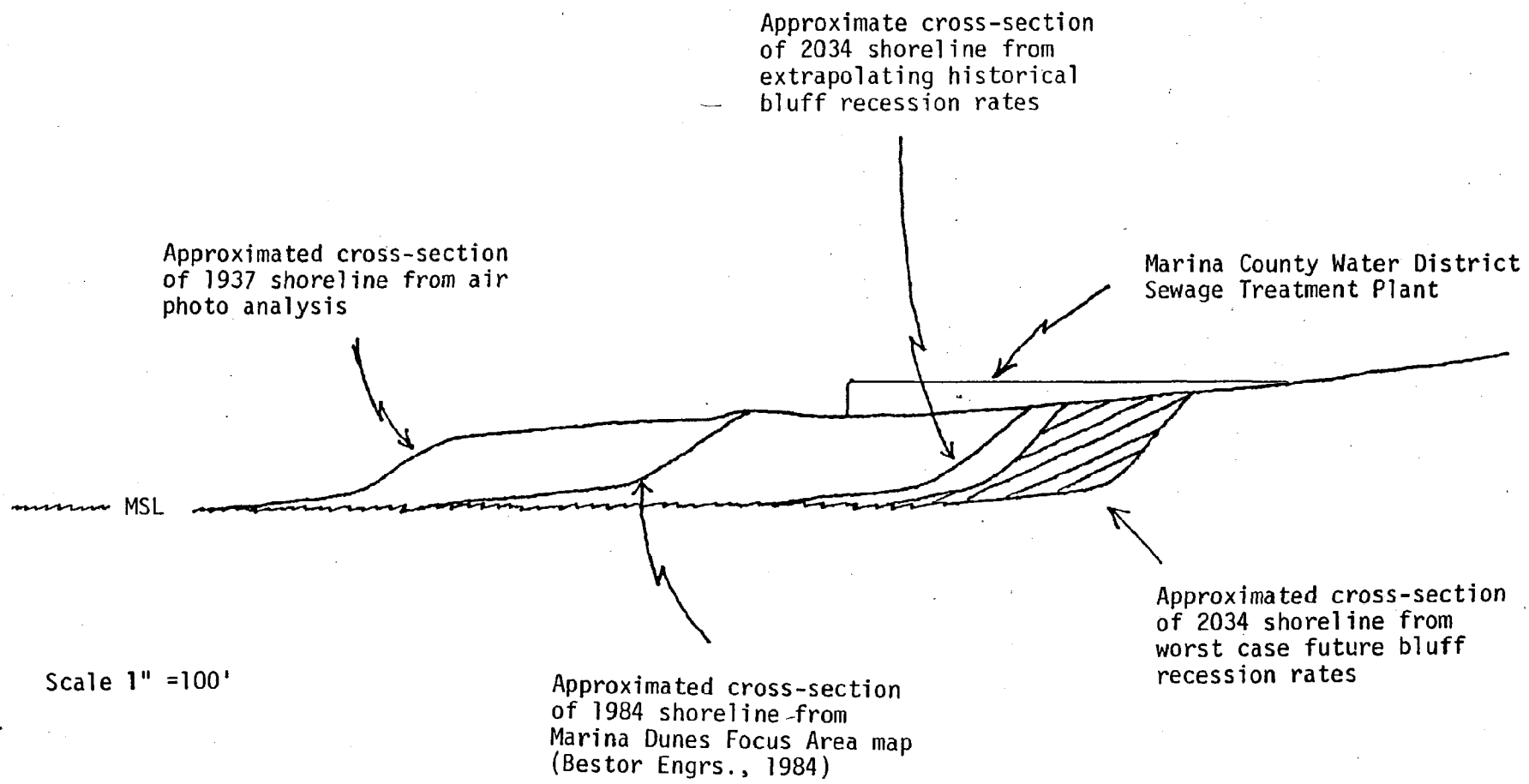
* All measurements are based on interpretation of vertical stereo aerial photographs.

** Predicted rates of recession derived from a modification of Sklavidis and Blanco's cliff recession model (1985).

*** We were unable to predict rates of recession in the vicinity of the Lone Star sand mining operation due to:
1) Unknown quantities of future sand removal;
2) Alteration of the shoreline profile;
3) Inability of the cliff recession model to predict erosion rates in the mining area.

Our recession projections in the vicinity of the sand mining areas are based on qualitative interpretation. These areas are designated by dashed and/or queried erosion projection lines.

FIGURE X-4
TIME SEQUENCE CROSS-SECTION THROUGH
THE MARINA COUNTY WATER DISTRICT TREATMENT PLANT



MARINA DUNES
Time Sequence Cross-section Through the Marina County Water District Treatment Plant

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