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FINAL REPORT
Wetland Enhancement Plan for the
Moss Landing Marine Laboratories Earthquake Reconstruction

October 1995

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1. INTRODUCTION

1.1. Overview

The salt marsh wetland below and west of the new marine lab project site is not being considered for development, but will be set aside under a resource conservation easement for preservation. The conservation area includes the entire salt marsh on the Peterson property and an approximately 100 foot buffer zone from the marsh up the hillside (Figures 1, 2, and 3), a total area of approximately 7.4 acres. The buffer zone includes steep sandy slopes covered with native vegetation. The marsh, in contrast, is quite flat and exposed to tidal action (Figures 3 and 4).

The marsh and adjacent upland habitat in the conservation parcel contain relatively well developed natural communities which do not require a major restoration plan (Figures 3 and 5). The present plan contains measures/alternatives for the enhancement of the existing habitat values of the wetland and outlines some of the past, present, and future problems and the best solutions for wetland management in the Old Salinas River. Future management strategies may involve wetland restoration or greater enhancement, but they depend on the development of a more regional approach to wetland management in the Old Salinas River and adjacent wetland systems. Therefore, the present wetland enhancement plan is limited in scope and designed to permit a number of likely and desirable future options. It is a first step in the development of a more compete regional plan for the Old Salinas River wetlands and other important natural resources within the Moss Landing Harbor District vicinity.

The hillside buffer zone is the least disturbed plant community (Figures 5 and 6). The conservation parcel will prevent access and insure preservation of these slopes while the marine lab restoration plan will restore a large area of degraded back and foredune communities located just north of the conservation parcel (see ABA Consultants 1995b).

1.2. Philosophy

The best model for restoration of wetlands and other native habitats is the historical setting on the site. Potentially restorable sites are usually highly degraded or modified, and historical conditions sometimes cannot be inferred from the present plant and animal communities. Often, however, there are adjacent habitats which are less disturbed and provide insight into what once covered the larger habitat area. Sometimes it is necessary to visit a number of other, less disturbed habitats to help expand a restoration model for a highly degraded area. The historical perspective can be extended through time by coring sediment from representative wetlands. Fortunately there is an excellent geological and ecological history of the wetland systems in the Elkhorn Slough and surrounding wetland systems obtained from deep sediment cores (Schwartz et al. 1986, Hornberger 1990).

The best historical model may not be appropriate for a particular site because of other constraints on restoration. For example, many local sites were once covered with extensive freshwater marshes, but there are no longer any sources of freshwater to these sites. Therefore, the historical model simply cannot be realized under this hydrographic constraint.

The history of human activities in local and regional watersheds provide some of the most significant constraints to restoration models. Consider the natural and human history of Elkhorn Slough. During the last century, the Salinas and Pajaro Rivers both flowed behind the sand dunes and entered Monterey Bay at Moss Landing. Freshwater abounded. Over the last 100 years freshwater has been channeled and diverted through the watershed by agricultural reclamation projects and flood control programs. Since the 1940's, coastal aquifers were severely lowered by well pumping. Salt water intrusion is common to depths of 400 feet. Tremendous areas of wetlands were dried. In 1947, the Moss Landing Harbor was opened. The entrance is at the mouth of Elkhorn Slough, which was previously a shallow estuary with little tidal flow and no intertidal habitats. The estuary was surrounded by freshwater

tributaries, including the Pajaro and Salinas Rivers and many small creeks and springs.

New tidal action created extensive mudflats in the slough and eroded every major wetland habitat. The erosion was accelerated during the 1980's by breaking dikes, which increased the tidal prism. The slough is now a deep water marine lagoon, bathed by strong tidal currents. It is no longer part of an extensive mosaic of wetland habitats extending into the Salinas and Pajaro Valleys. It is isolated from both rivers, which are highly channelized. Local creeks and springs are dry, especially during the recent drought. Elkhorn Slough is highly modified and still changing (Gordon 1979, Schwartz et al. 1986, ABA Consultants 1989, Malzone and Kvitek, 1994).

Increasing the flow of freshwater and/or decreasing tidal erosion are highly desirable for Elkhorn Slough. Since large areas of freshwater marsh, eel grass bed, and pickleweed marsh were lost and are presently threatened, these rank high for restoration and should be considered for mitigation. Nevertheless, the restoration plan for any particular site within the slough must work within the local site constraints. These constraints are often highly restrictive and simply cannot directly help the regional needs for habitat restoration. The most important habitat values of a particular site must be recognized and restored as much as possible within local constraints (ABA Consultants 1989). The resulting restoration plan should not aggravate the regional problems.

2. OLD SALINAS RIVER WETLAND MANAGEMENT PLAN

Any wetland restoration planned for the proposed MLML site should conform to quidelines set out in regional wetland management plans. Two such plans exist for the wetland environments in the Moss Landing vicinity, the Elkhorn Slough (ABA Consultants 1989), and the Moro Cojo Slough Management Plan, in the final stages of completion by John Gilchrest and Associates. The Elkhorn Slough Wetland Management Plan provides a thorough history of the slough's wetlands, establishes the best regional and

local habitat values, and guides future wetland restoration. Neither plan covers the Old Salinas River channel.

The best plan for the Old Salinas River habitats is to restore the degraded pickleweed marshes. Nature constructed lush vegetated marshes along the channel of the old river, this is the obvious habitat to restore and enhance. We are losing this vegetated habitat at astounding rates throughout the slough (Malzone and Kvitek, 1994). Any plan to remove marsh soil here is against natural history: that is the natural model for habitat restoration. If this model is not followed, there must be compelling reasons such as severe physical constraints or the conflicting needs of an endangered species and so on.

The wetland restoration proposed for the MLML site is consistent with the guidelines that will be established within a future Old Salinas River Wetland Management Plan. Since it is fairly obvious from the natural history what types of restoration should be done, the restoration planned for the MLML site can be used as a model for future restoration projects in the area. The present plan only enhances obvious aspects of the existing Peterson wetland, points up the more serious local and regional problems, and prepares for more comprehensive restoration of the entire Old Salinas River system.

3. FLOOD CONTROL DIKES

One of the most conspicuous physical features on the eastern side of the Old Salinas River channel is the dike. This was installed in the last century for a narrow gauge railroad which carried farm produce between the Salinas and Pajaro Valleys (Gordon 1979, Lydon 1985). The dike had a secondary function for flood control and has been periodically maintained for this purpose even during the last decade. Some of the old dike was removed during the mitigation project done by the harbor next to Sandholdt Road. As a result, Monterey County Water Resources Agency (MCWRA) has proposed a new dike at the back of the marshes (eastern side) to protect the town of Moss

Landing from flooding. Planning for this dike has been going on since at least 1987 and is still in the works, although little action is being taken.

This dike can be linked to a visitor access and education path on the new marine lab parcel and to a regional coastal walk from Sandholdt to Potrero Road which is described in the Visitor Access and Education Plan for the new marine lab. The site of the proposed Flood Control District berm is between Sandholdt Road and Potrero Road on the east side of the Old Salinas River Channel in the town of Moss Landing (Figures 2-4). The property north of the site is owned by the Moss Landing Harbor District and the property to the east is owned by North Monterey County School District. The majority of the berm will be constructed on property owned by Louise Rubis, and the district has obtained an easement from her. The southern terminus of the dike is on the new marine lab parcel. The site is in the floodplain of the Old Salinas River, and is flooded at times of high water.

The present railroad berm is the only flood control structure between the Old Salinas River and the business district of Moss Landing. The railroad berm is quite old and was not originally constructed as a flood control structure. The railroad berm failed in the winter of 1982-83 which resulted in the flooding of central Moss Landing. It currently has several places in need of maintenance. Because of its small size and deteriorating condition vehicles cannot drive along the top of the railroad berm. Currently, it can only be repaired by driving heavy equipment across the adjacent salt marsh, a practice which has caused substantial, although temporary, damage to the salt marsh (such as in 1987). Should repairs be required during emergency flooding conditions, potentially serious damage to the salt marsh could result. During the heavy rains of 1995, which caused substantial damage in the Salinas Valley, despite its deteriorating condition the railroad berm proved adequate to protect the town of Moss Landing from flooding.

4. PRELIMINARY ALTERNATIVES

This plan does not describe restoration alternatives for the site, but only considers several enhancement options which do not require additional site preparation and permit the greatest potential for integration with a future comprehensive wetland and resource management plan for Old Salinas River. The primary enhancement options, discussed in detail below, are 1) to link the flood control dike and habitats with the restored wetlands, 2) to enhance bird nesting and other uses of the old railroad dike along the west side of the Peterson marsh, to limit public access to the southern Peterson marsh and old dune habitats south of the new marine lab, 3) to construct a visitor causeway over the marsh and link it with the marine lab visitor pathways and overlooks, 4) to establish a program to monitor the marsh habitats and communities with marine lab students in preparation for future restoration work.

5. SITE DESIGN AND PREPARATION

5.1. Proposed Flood Control Dike

The proposed MCWRA flood control berm must fill the gap between the lab hill and the berm built as part of the Harbor District Mitigation Plan (Figure 4). The berm must be 3 feet tall to provide adequate flood control, but it can be expected to subside so it will be constructed 3.5 feet tall to provide a safety margin. In order to allow vehicle and heavy equipment traffic, the berm must be 10 feet wide at the top. With a 3:1 slope on the side, the berm will be 31 feet at the base.

This construction is not part of the marine lab development, but should be closely coordinated between the lab and the Water Resources Agency. It requires no site preparation by the marine lab.

5.2. Hillside Drainage

Drainage water from the new marine lab building will be directed down the west slopes and into two flat areas above the salt marsh (see see ABA Consultants, 1995c). These will develop a rich freshwater plant community similar to those found around natural springs or small riparian areas. These wet areas will also attract a unique wildlife. The main building roof will be drained to the southwest and northwest ends of the building and into rock leach lines with perforated pipes which run to the base of the hill and into natural wet areas. The drainage system will be sized to peak flows from the roofs. The south end of the building is next to a natural swale where blackberry and mugwort bushes growth thick to the hill bottom. The slope grades gradually into the salt marsh. The north end fans into a relatively large flat area above the salt marsh where there is more moisture and a vegetation adapted to near wetland soils. This directed water will spread into the flat areas at the hill base and produce even denser growths of plants requiring greater inputs of fresh water. This will have a positive impact on the salt marsh habitats and wildlife surrounding the west side of the parcel (see ABA Consultants, 1995b).

6. VEGETATION PLAN

6.1. Vegetation

The existing vegetation in the wetland and the surrounding buffer zone is described in the Biological Assessment (ABA Consultants, 1995a), and is shown in the habitat map (Figure 5), the vegetation map (Figure 6), and the conceptual cross section through the marsh (Figure 7). The low marsh area is primarily covered with pickleweed and is presently in good ecological condition, except for the potential erosion of salt marsh habitat which will be monitored to determine the extent of the problem into the future and the best solution if necessary (see Section 8).

The area of the greatest revegetation potential is within the wetland fringe which includes a narrow zone within the delineated wetland (the Old Salinas River) as well as a contiguous band along the lower dune. This wetland fringe is now primarily covered with non-native invasive weeds which dominate the plant cover (primarily poison hemlock and wild radish). Essentially no native plants can be seen within the areas where this weed community remains undisturbed. Over the last several years, the weeds have been mowed and removed by hand from the northern end of the wetland fringe, resulting in significant recovery of the native plants as described in the Biological Assessment and in later sections of this report (Section 11).

The freshwater drains from the new marine lab building will create small springs at the base of the hill. Native wetland plants may be planted here, but are likely to volunteer without an active planting strategy. These freshwater wetlands will add important local habitat diversity where relatively rare, at least locally, animals can pass back and forth between the salt and freshwater environments.

6.2. Fauna

The salt marsh fauna in the wetland is also described in the Biological Assessment. Removal of non-native plants will increase habitat for a number of these species, especially along the wetland fringe. This area is used by mice and other small mammals, insects, and several benthic invertebrates. If the railroad dike, which runs along the west side of the marsh (Figures 4-8), continues to erode and fragment, the resulting dike islands could be developed into potentially important areas for bird nesting and roosting. These islands could be protected from ground predators by small gaps of salt water and with small fences at key crossings. Increased bird use along the dike could be observed from visitor access paths and overlooks. If animals nest as well, interpretive displays may inform about the positive impacts of thoughtful human intervention in highly modified natural systems.

Finally, there may be significant changes in the fauna living in the tidal channels through the slat marsh, if the habitat erodes at increasing rates like those in Elkhorn Slough and Moss Landing Harbor (see the next section).

7. EROSION PROBLEMS

Although periodic flooding is a major problem around Old Salinas River, the most important environmental problem within the main Elkhorn Slough system is erosion of wetlands. The slough erosion problem is briefly summarized to indicate potential problems along the Old Salinas River. The primary erosion in Elkhorn Slough was caused by the construction of Moss Landing Harbor and the maintenance of the harbor entrance at the slough's mouth since 1947. The pre-harbor slough was a shallow estuarine embayment with mild tidal currents and no intertidal flats (Gordon 1979, Schwartz et al. 1986, Malzone and Kvitek, 1994). The harbor opening exposed large areas of intertidal mudflats. It scoured the slough with strong tidal currents (over 50 cm/sec, Clark 1972, Smith 1973) eroding every major sedimentary habitat. The main tidal channel increased from less than 7 m in width to 125 m, and from about 1 m in depth to over 8m. Tidal creeks in the marshes increased in width an average of 72% from 1931 to 1980, when the cover of salt marsh plants decreased from an average of 92% to 69% (Malzone and Kvitek, 1994).

Rates of erosion increased during the present decade with the breakage of dikes surrounding five former wetlands (pastures and salt ponds). The diked areas added 2.8 km^2 of new wetland to the slough, and almost doubled the total volume of water in the slough at a high tide. Tidal creeks draining natural marshes increased in size by 18% from 1980 to 1987; and increased 74% in creeks draining habitats with broken dikes. During the same time, the cover of vegetated salt marsh decreased by 8%. The rate of wetland loss from 1980 to 1987 was significantly greater than the rate from 1931 to 1980. Dike breakage was a planned and unplanned strategy for restoring salt marshes, which unfortunately accelerated habitat loss. These dramatic patterns of erosion caused important changes in biological communities. Extensive eel grass beds were eroded; freshwater vegetation and anadromous fishes

disappeared; and native bird, fish, and invertebrate communities were replaced by more marine assemblages (Gordon 1977, Nybakken et al. 1977, Malzone and Kvitek, 1994).

The removal of dikes and the excavation of channels and mudflat are likely to increase the tidal prism and thus tidal currents and erosion in the Old Salinas River, as they have in Elkhorn Slough. This has certainly been the case at the harbor mitigation site next to Sandholdt Road (Figure 4: the area of open water in the marsh north of the Peterson marsh).

8. DIKE REMOVAL

The entire railroad berm or dike along the west side of the Peterson marsh could be removed. This would result in increased tidal circulation in the surrounding wetlands. However, as discussed in the last section, there are numerous unanswered questions about the effects of increased circulation on erosion rates of wetlands. Breaking berms in Elkhorn Slough has increased the tidal prism, greatly increasing erosion rates of salt marsh habitat throughout the slough (ABA Consultants 1989). This problem has not been examined at the Old Salinas River, but could result in the destruction of the habitat which should be preserved. In addition, removal of the entire berm would require a significant amount of construction activity in the marsh.

The railroad berm already supports a mature community with wetland vegetation, and will gradually erode over time. As the berm erodes, islands will be created. The 'islands' will be high spots with a different mixture of vegetation, providing increased habitat heterogeneity, surrounded by pickleweed marsh. If erosion proceeds, or water levels rise, they will become islands surrounded by water. Such islands attract resting and feeding birds. The adjacent Harbor District mitigation site has an island that is being used by many coastal birds ranging from California Brown Pelicans to Western Sanderlings. There is no compelling reason to remove the railroad berm, while the unanswered erosion questions and potential construction disruption are strong counter-arguments to berm removal.

9. VISITOR ACCESS AND EDUCATION

The plan for visitor access and education is a separate planning document and describes the visitor trail, path, and overlook that permit visitors to enjoy and learn about the local and regional natural history as they walk around the marine lab facilities. These plans include a path to the marsh, a boardwalk across the marsh to the main channel of Old Salinas River, and a path north of the site to Sandholdt Road. This potential loop trail may provide public access to wetland habitats along the east side of the river as part of the County trails planning. On the other hand, the path and boardwalk make an outstanding public access and education setting where there will be minimal impacts to wildlife and none to vegetation and habitats. The low impacts along the path and boardwalk will be enforced by the presence of the marine lab and their personnel as well as by the design and location of the trail and by the interpretive displays.

10. IMPLEMENTATION PLAN AND SCHEDULE

The implementation plan concerns three distinct habitats: the wetland fringe along the steep sand dune habitat, the wetland fringe at the extreme north end of the property, and the tidal creeks within the salt marsh. As discussed above, the wetland fringe is covered with invasive non-native plants. Hemlock and radish form a tall, dense canopy excluding almost all native species. The major restoration plan here is to remove the weeds. This is done by mowing or hand removal. Mowing should be done during late flower development when seeds are not mature and will not mature on cuttings spread over the ground. This period is well defined for hemlock and wild radish. Mowing is preferred for larger stands and where natives are not present. Hand removal can be done at any time as long as the roots are pulled. This is preferred next to native species or when there are only a few weeds left, for example after mowing. Since these weeds are highly invasive, even a few plants can become a major problem at least until the native cover is restored. As described in the Biological Assessment, weeding has been done along the northern end of the wetland fringe for the last two years. As a result

the cover of wetland species has increased and spread further from the wetland. The most common natives that are colonizing the wetland fringe and live here naturally in other locations are alkali rye grass, salt grass, alkali heath and fat hen. The success of implementing the weeding in the northern section of the wetland fringe contrasts dramatically with conditions in the central and southern habitats, which are still dominated by hemlock and especially radish.

The extreme northern part of the wetland fringe was also weeded over the last two years with the same result. However, this habitat is flat and grades much more gradually into the adjacent salt marsh. It is part of a large level marsh area extending onto the Rubis property well beyond the northern end of the Peterson property. This large flat marsh is only well developed directly next to the existing salt marsh, but has the potential for considerable expansion since the heavy alien cover along the Rubis parcel has also been weeded for the last two years. In fact, the major weeding effort was actually on the Rubis site and was only extended to the Peterson property at their request to conform with weed control efforts on the Rubis site. In contrast to the broad, flat habitat of the extreme northern wetland fringe, the hillside fringe is narrow and steep. Here, the wetland species meet the characteristic dune vegetation only a few meters up the hill. The broad, flat habitat at the extreme northern end of the Peterson property and into the Rubis site is historical salt marsh, which has been covered with non-natives aliens for decades. This large area has considerable habitat value, especially as the restoration of the two properties are linked.

Finally, the tidal creeks in the existing salt marsh are likely to continue to erode and expand in the future. This erosion is a focus of the restoration monitoring, and may lead to significant changes in the animals using the tidal creeks. Although there is no plan to change the pattern of erosion at present, the proposed monitoring program may lead to the development of such a plan in the future. The marine lab staff and students have been studying the erosion of wetland habitats in the Elkhorn Slough for many

years and are eager to extend these investigations into the Old Salinas River; and to protect the surviving habitats from future erosion if desirable and necessary.

11. CONSERVATION AND MAINTENANCE

The entire salt marsh and a 100 foot buffer area into the adjacent uplands, 7.4 acres total, will be protected in a conservation easement which will be held by the San Jose State University Foundation. They, along with Moss Landing Marine Labs, will be responsible for any maintenance on the parcel.

12. PERFORMANCE STANDARDS

At this juncture in the plan, the only important performance standards concern the removal of non-native weeds and the colonization or recovery of the natives species in the wetland fringe. These standards apply to the steep, narrow fringe as well as the broad, flat wetland fringe. The invasive weeds should be reduced to less than 10% cover at peak periods of community biomass accumulation, within three years. Preliminary weeding in the wetland fringe indicates that the 10% target can be reached within two years, but a third year will allow for unforeseen problems. Also within three years, at least 70% cover of native wetland or dune vegetation within the wetland fringe should be reached. The other 30% of the area can be relatively open for annual species such as fat hen, gilia and spine flower.

Performance criteria for the tidal creeks will be developed if the monitoring program indicates the need for restoration or enhancement plans in the future.

13. MONITORING PROGRAM

The monitoring program for the wetland enhancement or restoration should be qualitative and implemented by naturalists with experience in these systems. It will include at least yearly aerial or balloon photographs of large-scale habitat and landscape patterns and changes; seasonal walks on the site

for discovering and qualitatively mapping rare and endangered plant and animal species and any other biological pattern that the monitoring team thinks is ecologically significant–such as areas of erosion, trampling by unwanted access, and so on. Ground photographs should also be taken from fixed locations which reveal important community patterns and permit periodic re-photographing of the same site to document restoration success, failure, or other interesting phenomena. The interval between photographs should be determined by the monitoring group depending on the pattern or process of interest.

Erosion of the tidal creeks can also be documented by aerial, balloon, or ground photographs as well as by direct measurements from reference stakes placed along the creeks and adjacent marshes. These measurements are presently made throughout the slough system by marine lab staff and students. Although changes in the tidal creek animals can also by documented by qualitative surveys of benthic invertebrates and fishes, the marine lab programs will focus on likely problems and develop more quantitative sampling as the monitoring program develops.

These qualitative observations will be summarized in a yearly letter report to agencies with juisdiction over these aspects of the project. The report may also include recommendations for changes in the restoration activities or monitoring design.

14. RESEARCH VALUES

One of the major functions of the marine lab is marine, estuarine and coastal research. The faculty, staff and students have over 25 years of experience in exploring wetland and other coastal environments in the Moss Landing area. The access paths, boardwalk, and presence of the new marine lab facilities insure that students and faculty will work in the wetlands below the lab. There are many opportunities for long and short term research projects which are of major value to a marine lab and the scientific community at large.

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Table 1. Munsell soil color and notation of soil samples taken from the new Moss Landing Marine Laboratories site. Site locations shown in Figure 8. Code letters and numbers refer to Munsell soil color charts (produced by Munsell Color, Kollmorgen Instruments Corp., Baltimore, MD). Colors at sites 1 and 6 indicate wetland.

Site	Soil color	Soil Notation
1	black	5Y 2.5/1
2	black	10YR 2/1
3	black	10YR 2/1
4	black	10YR 2/1
5	very dark greyish brown	10YR 3/2
6	black	10YR 3/1

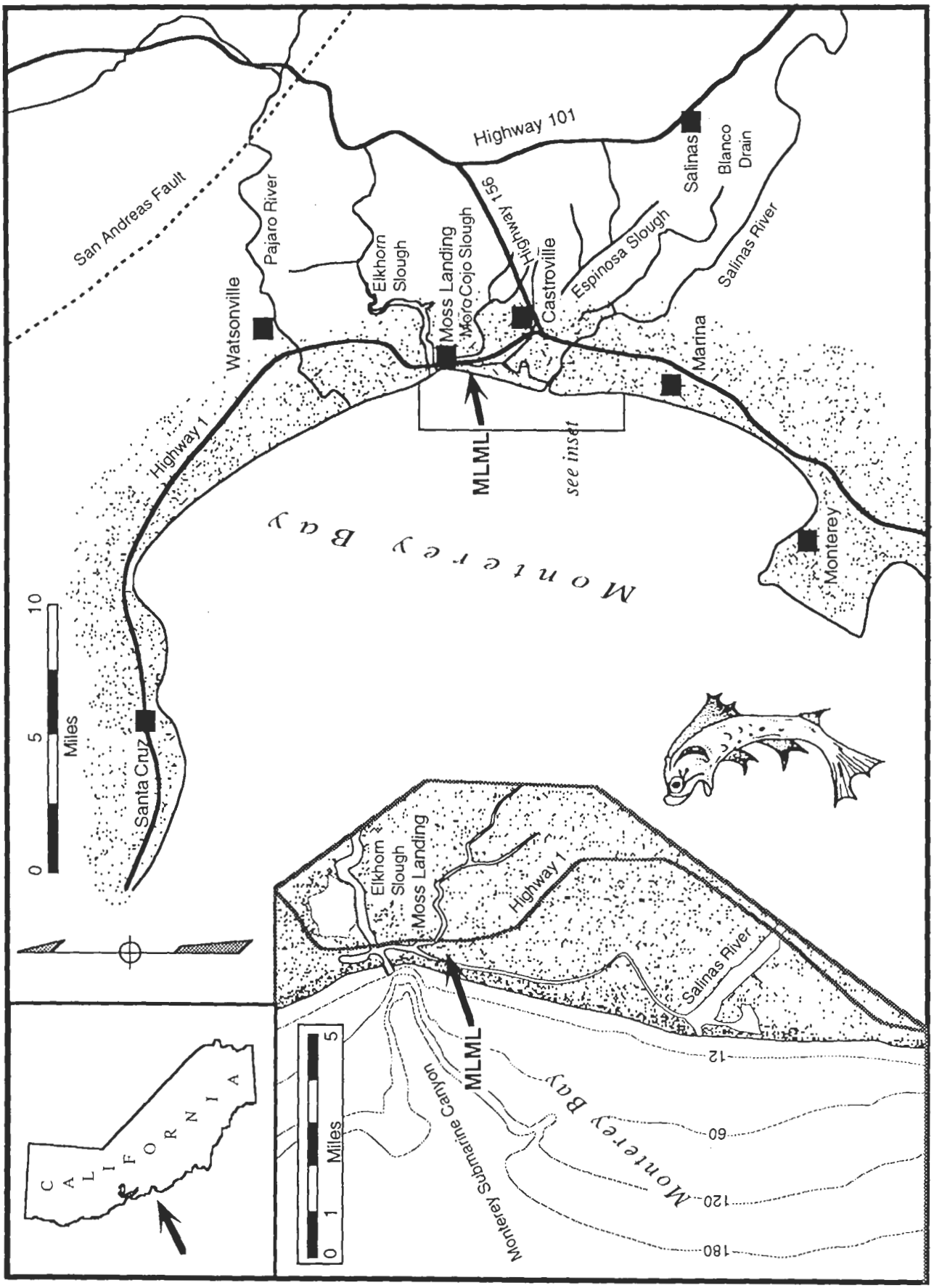

Figure 1: Maps showing proposed location of Moss Landing Marine Labs (MLML) on Monterey Bay in central California. Inset shows closeup of Moss Landing vicinity. Bathymetric contours are in feet.

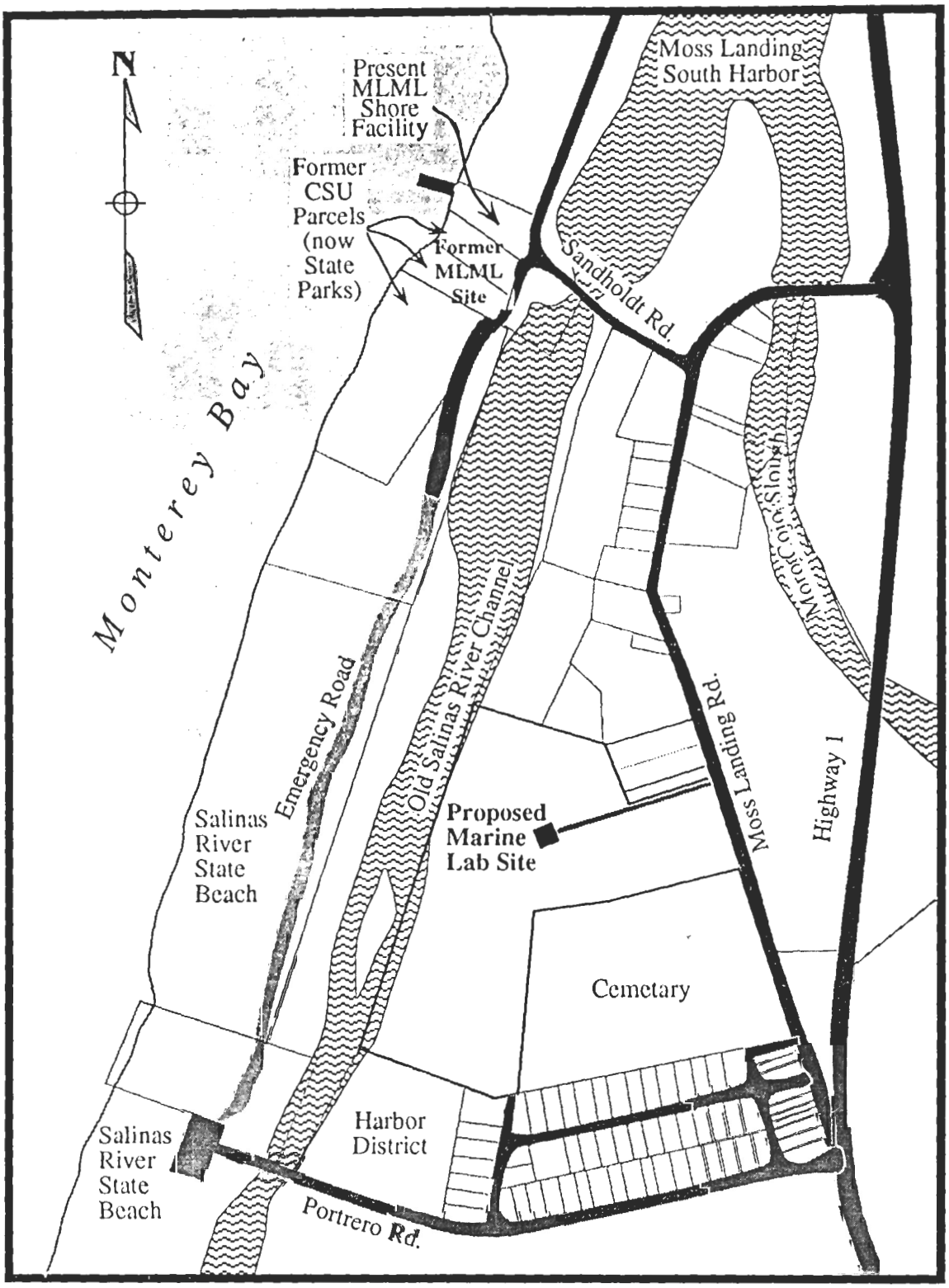

Figure 2: Map of Moss Landing vicinity showing pertinent parcels and proposed site of Moss Landing Marine Labs.

Present Setting

Figure 3:

Aerial photograph of present setting of project site with topographic contours superimposed. Project area is outlined by dashed line. Contour interval is 2 feet.

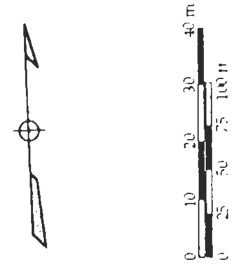

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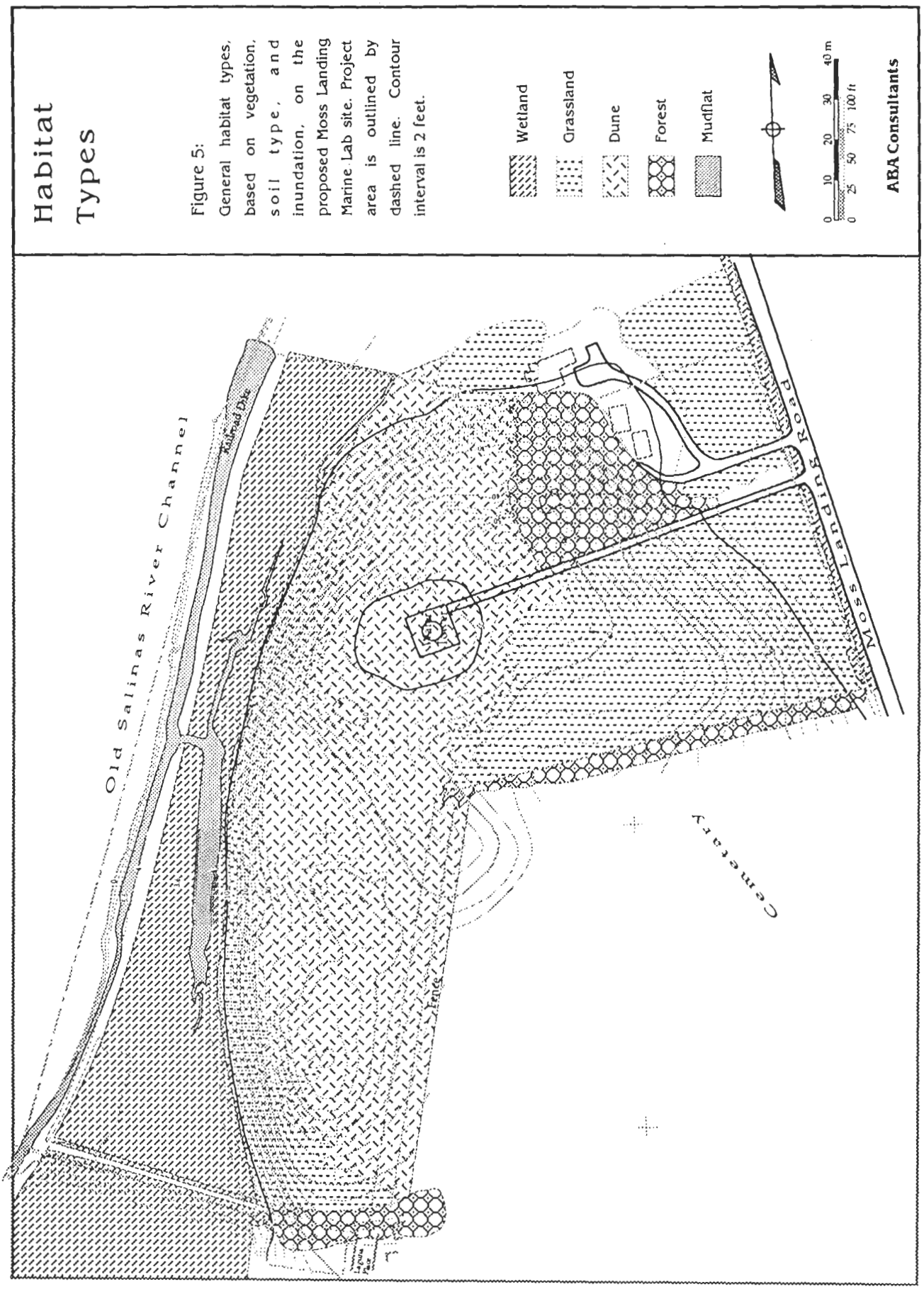
Figure 4. Color infra-red aerial photograph of the Old Salinas River from May 9, 1992. Note the marsh at the south end of the Peterson wetland next to Potrero Road and the excavated marsh at the north end (harbor mitigation site).


Habitat Types
Figure 5:
General habitat types, based on vegetation, soil type, and inundation, on the proposed Moss Landing Marine Lab site. Project area is outlined by dashed line. Contour interval is 2 feet.
Wetland
Grassland
Dune
Forest
Mudflat
0 10 20 30 40 m
0 25 50 75 100 ft
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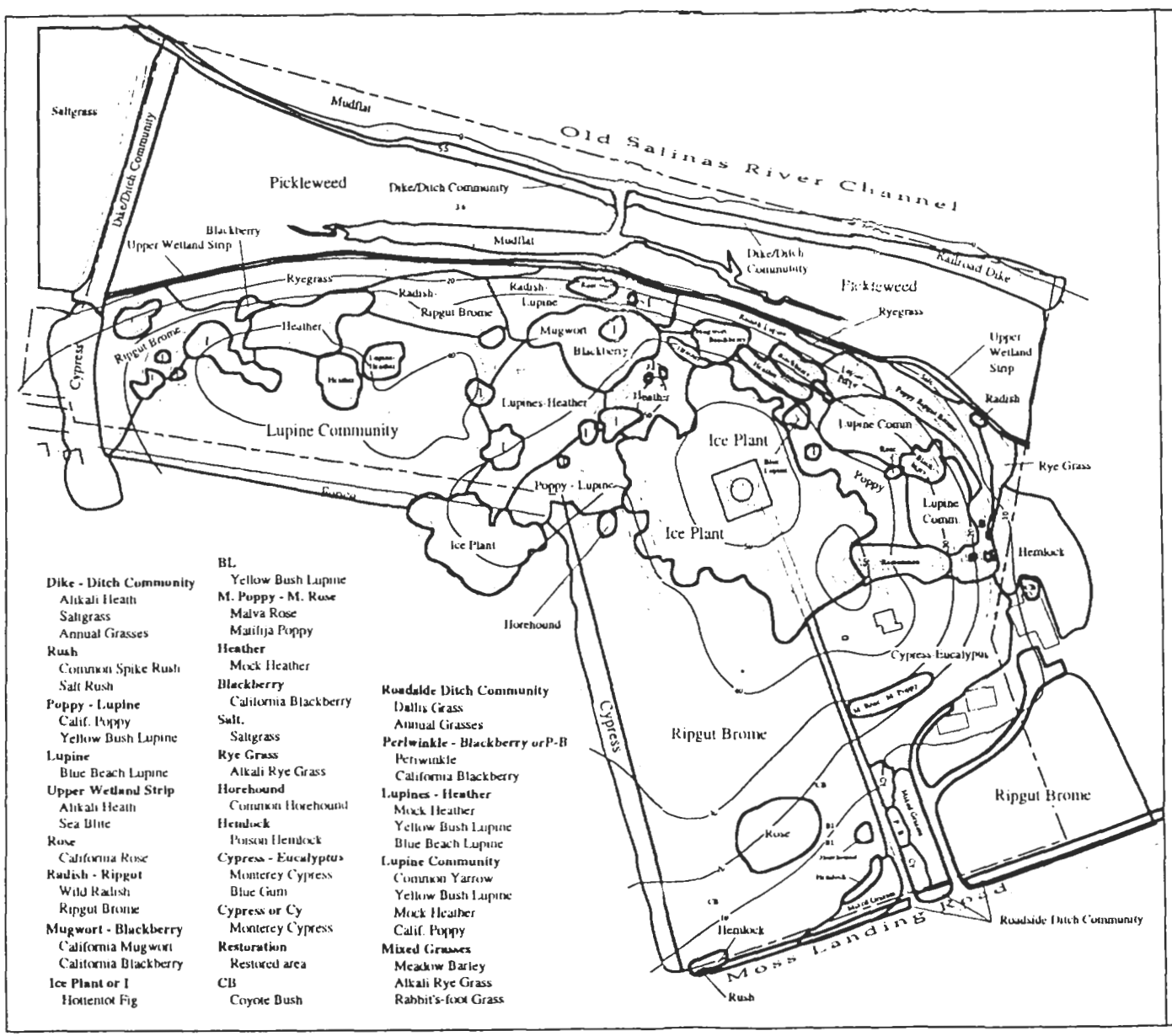
Old Salinas River Channel
Railroad Dike
Moss Landing Road
Cemetery



Dike - Ditch Community
Alkali Heath
Saltgrass
Annual Grasses
Rush
Common Spike Rush
Salt Rush
Poppy - Lupine
Calif. Poppy
Yellow Bush Lupine
Lupine
Blue Beach Lupine
Upper Wetland Strip
Alkali Heath
Sea Blite
Rose
California Rose
Radish - Ripgut
Wild Radish
Ripgut Brome
Mugwort - Blackberry
California Mugwort
California Blackberry
Ice Plant or I
Hottentot Fig

BL
Yellow Bush Lupine
M. Poppy - M. Rose
Malva Rose
Matilija Poppy
Heather
Mock Heather
Blackberry
California Blackberry
Salt.
Saltgrass
Rye Grass
Alkali Rye Grass
Horehound
Common Horehound
Hemlock
Poison Hemlock
Cypress - Eucalyptus
Monterey Cypress
Blue Gum
Cypress or Cy
Monterey Cypress
Restoration
Restored area
CB
Coyote Bush

Roadside Ditch Community
Dallis Grass
Annual Grasses
Periwinkle - Blackberry orP-B
Periwinkle
California Blackberry
Lupines - Heather
Mock Heather
Yellow Bush Lupine
Blue Beach Lupine
Lupine Community
Common Yarrow
Yellow Bush Lupine
Mock Heather
Calif. Poppy
Mixed Grasses
Meadow Barley
Alkali Rye Grass
Rabbit's-foot Grass

Vegetation Map

Present vegetation on proposed Moss Landing Marine Laboratories site with topographic contours superimposed. Project area is outlined by dashed line. Contour interval is 2 feet.

0 10 20 30 40 m
0 25 50 75 100 ft

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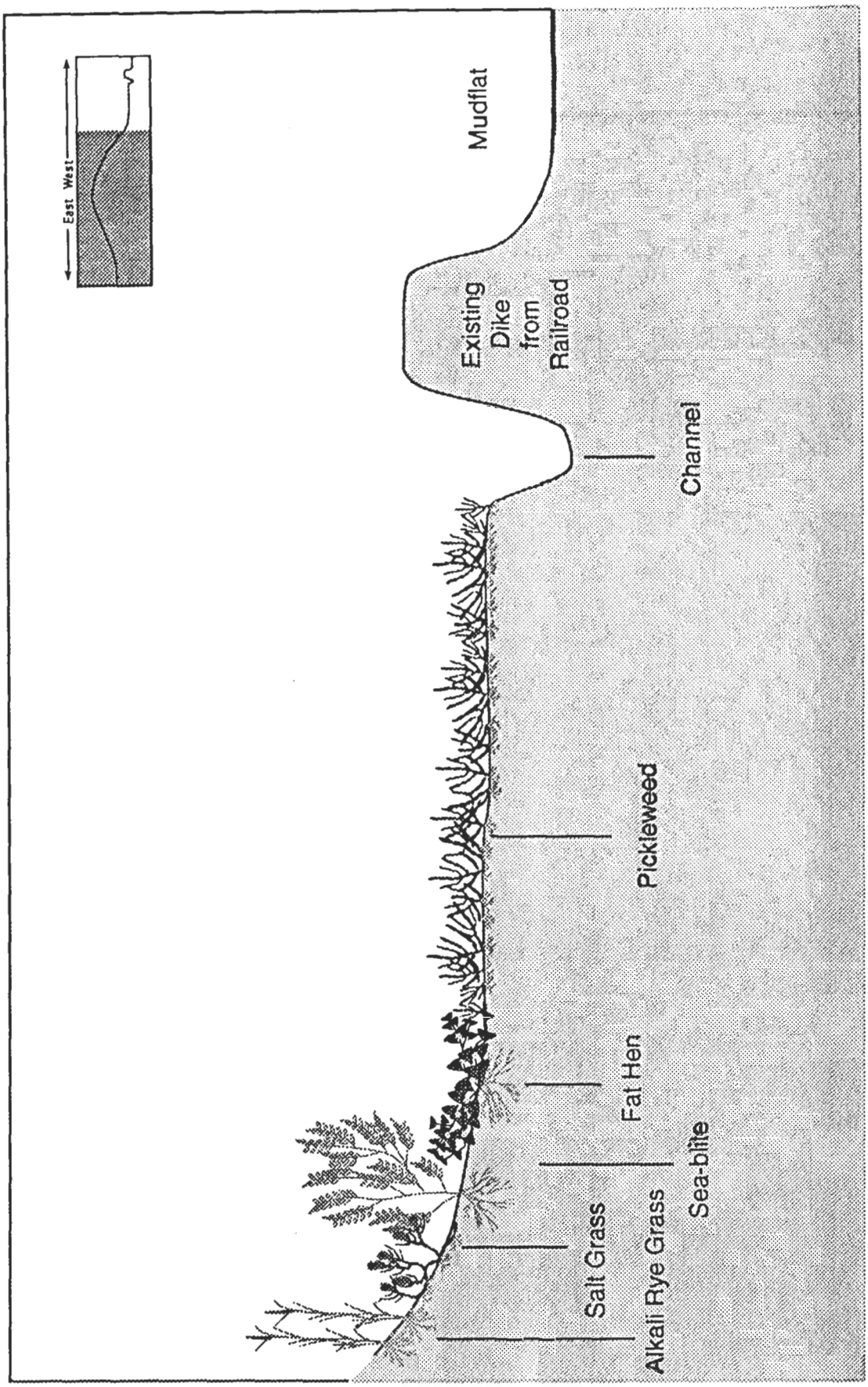

Figure 7: Cross section composite view of vegetation along the salt marsh wetland.

Wetland Delineation

Figure 8:
Areas of jurisdictional wetland, based on vegetation, soil type, and inundation history, on the proposed Moss Landing Marine Lab site. Locations of soil samples are shown by circled numbers (see Biological Assessment). Project area is outlined by dashed line. Contour interval is 2 feet.