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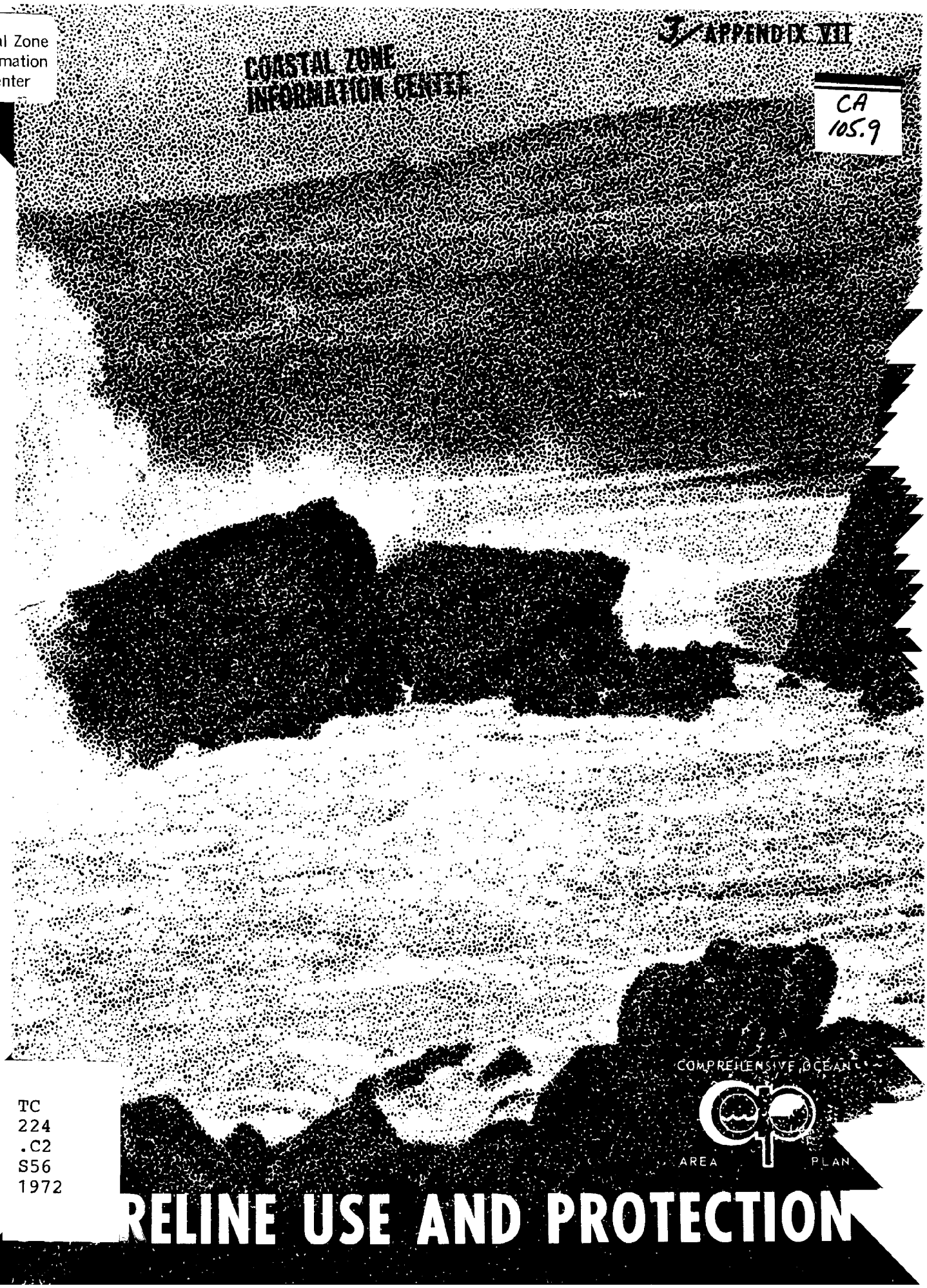

COMPREHENSIVE OCEAN
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RELINE USE AND PROTECTION

This appendix has been prepared as a contribution to the California Comprehensive Ocean Area Plan (COAP).

The subject matter herein has been developed following discussions with COAP staff, however the content remains the responsibility of the contributing agencies

DEPARTMENT OF NAVIGATION AND OCEAN DEVELOPMENT

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2/ SHORELINE USE AND PROTECTION

Prepared For The

COMPREHENSIVE OCEAN AREA PLAN

PART I

BEACH EROSION CONTROL PROGRAM

Prepared By

DEPARTMENT OF NAVIGATION AND OCEAN DEVELOPMENT

MARCH 1971

PART II

ROAD TRANSPORTATION

Prepared By

DEPARTMENT OF PUBLIC WORKS

MARCH 1972

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CONTENTS

PART I. SHORELINE PROTECTION

		Page
I.	Introduction	
	Objective	2
	Scope of Investigation	2
II.	Natural Shoreline Processes	4
III.	Technology of Shoreline Protection	
	Beaches	7
	Cliffs and Bluffs	10
	Non-Structural Measures	10
IV.	Governmental Programs for Protection	
	Federal Programs	12
	State Programs	15
V.	Critical Areas of Erosion in California	20
VI.	Economics of Shoreline Protection	47
	Costs and Benefits	
	Costs of Inaction	
	Financial Aspects	
VII.	Means to Satisfy Needs for Protection	
	Planning	51
	Framework Study	53
	National Shoreline Study	55
	Conservation of Sand	58
	Structural Measures	60
	Development of New Technology	
	Coordination with Other Interests	61
VIII.	Summary and Conclusions	62
IX.	Recommendations	67
	Legislative Action	68
	Administrative Action	69
	Bibliography	72

PART II. Road Transportation

		Page
I.	Past and Emerging Approaches to Transportation Issues	75
II.	Existing Road Systems	
	A. Administration	75
	B. Classification as to Purpose or Function	77
III.	The Planning Process	
	A. General	78
	B. Cooperative, Comprehensive, Continuous Transportation Planning	
	1. Organization	79
	2. Process	80
	C. Adjusting Policy	82
	1. The Transportation Corridor Policy	82
	D. Procedures in Freeway Route Planning Studies	86
	E. Specific Design Phase	88
IV.	Major State Laws Authorizing Road Transportation in the Coastal Zone	89
V.	Existing and Emerging Goals for Transportation	91
	A. Needs and Goals in Road Transportation	92
	B. More Comprehensive Participation in Highway Projects	94
	C. Community and Environmental Factors in the Highway Planning and Development Process	95
	D. Three Laws on Environmental Concerns	97
	E. Reduction of Traffic-Generated Noise -- A Policy and Approach	98
VI.	The Coastal Zone Policy of the State in Transportation	100

PART 1

INTRODUCTION

The State of California has over 1,100 miles of coastline comprising wide, sandy beaches, scenic bluff areas, and spectacular rocky headlands that meet the sea. This shoreline environment provides many opportunities for a variety of uses. Recreation, residential, commercial, agricultural, industrial, and military facilities, all compete for this prime land. California, probably more than any other state, recognizes just how important this shoreline is to the economy, the livelihood, and the well-being of its more than 20 million citizens.

The entire coastline is exposed to continuous wave action causing a wearing away of the State's valuable land resources. This erosion can be extremely rapid during storms. In areas of extensive land use and urbanization, the erosion causes serious problems of loss of badly needed recreation areas, restricted use, and eventual damage to property and improvements.

Our beaches have always been subjected to erosion, but there existed, during earlier days, a compensating element for natural beach replenishment by virtue of stream-borne sediment transported to the shoreline from the many rivers and creeks draining the coastal watersheds. Today this natural replenishment process has been upset by both nature and man through drought conditions, water development, flood control development, and harbor and marina construction, resulting in an imbalance in the stability of the shoreline.

To date, much of the work in planning for beach erosion control has been of a defensive nature. Emphasis has been placed on correcting the damage after it is

done and protecting the shoreline from further erosion. In the future, California cannot be satisfied with maintaining the status quo; but must look toward the future in order to achieve a rational balance between the economic development and conservation needs associated with beach and shoreline resources.

The concepts presented in this chapter are just a beginning. It has taken the people of the State a long time to discover that the coastal zone, especially its shores and beaches, is a unique area which should be studied with a view towards arriving at solutions to the many varied complex problems. An expanded program is encouraged by the State to devise permanent solutions to the protection and enhancement of our beaches and shoreline areas to meet the recreational and other social needs of our generation and those of the future.

Objectives

The objectives of this chapter are threefold: 1) identify the natural processes of erosion and the role of man in contributing to and combating its deleterious effects; 2) identify areas of the coastline subject to rapid rates of erosion; and 3) conclusions will be drawn leading to recommendations concerning the role and conduct of shore protection programs in the future.

Scope of Investigation

This chapter has been developed from the review and analysis of existing data. No new data were collected nor were field investigations or measurements made specifically for the purposes of this chapter.

Sources of information include reports, investigations, and other written information from Federal, State and local government agencies and the personal

observations and opinions of the author and his working associates in the shoreline protection field.

Those sources of written information referred to in the report and those which play an important role in shoreline protection are listed in the Bibliography.

NATURAL SHORELINE PROCESSES

There are two general shore types: the hard-rock type and the soft unconsolidated sandy type. The latter is subject to rapid change in appearance and configuration and, consequently, is the most important for economic and recreational reasons.

Sandy beaches have formed along much of California's coastline. On the rocky northern and central coasts, relatively short beaches known as pocket beaches are found. In much of the southern part of the State, sandy beaches may be found fronting bluffs or plains which slope gradually to the sea. Such beaches are usually long and continuous.

The major sources of beach-building material are the natural processes of weathering and the transport of sediment by streams draining to the ocean. The natural sand supply from drainage basins is dependent on the rate of upland erosion and on the ability of streams to transport material. Many factors affect the sand supply; for instance, cyclical dry spells result in insufficient runoff to carry material to the ocean. Urbanization has an adverse effect on the natural sand supply through reducing the areas subject to erosion and trapping sediment in storm drains, flood-control channels, debris basins, and dams.

Once beach-building material has reached the littoral zone, it is acted upon by wave action and is sorted and formed into a beach. Beach sand is moved onshore or offshore, usually seasonally, by the uprush and backwash of the waves; and can also be moved along parallel to shore by the littoral current.

The littoral current results when ocean waves strike the shoreline at an angle. The impinging waves have an energy and wave motion component parallel to the shoreline. This motion, the littoral current, is responsible for the movement of beach sand (littoral drift) along the coast. The littoral current may change seasonally from upcoast to downcoast, as waves approach from different directions. When more material is moved downcoast than upcoast during a year, the direction of net littoral transport is said to be downcoast.

Another source of beach-building material results from the erosion of coastal formations (bluffs and cliffs) by the sea. This source is comparatively unimportant, because coastal formations contain varying proportions of beach-building material and frequently are composed mostly of material too fine to remain on the beach.

The three main natural sources of material to any specific beach segment are: (1) material moving into the area by littoral transport from adjacent beach areas; (2) contributions by streams; and (3) contributions through erosion of coastal formations other than beaches exposed to wave attack. Considering coasts as a whole, maintenance of beaches by natural processes must be attained at the expense of erosion of the land mass.

Losses of beach material from a specific area result primarily from: (1) movement of material laterally out of the area; (2) movement of material offshore into water so deep that the material is lost to the littoral supply; (3) loss of material into submarine canyons; and (4) loss of material by deflation (e.g., wind blown). Loss of material by abrasion of sand has been found of

slight importance. In areas with relatively low, narrow barrier beaches, significant amounts of littoral material may be washed over the dunes during storms and deposited on the backshore or in the lagoon.

Along a given stretch of beach, one of three conditions exists: (1) the supply of sediments to the beach from all sources is in excess of that removed by natural forces, and the beach is aggrading; (2) losses exceed the material supplied and the beach is eroding; or (3) the shoreline is stable and neither erosion nor accretion predominates. In normal circumstances, only the second condition is of importance because it is this condition that leads to the disappearance of natural protective beaches and the possible destruction of property.

For any individual segment of beach, the largest source of material moving into the area is generally littoral drift eroded from the adjoining updrift segment; unless some major sediment-bearing stream enters the segment in question, or cliff or dune erosion is sufficiently rapid to provide appreciable supply. The various procedures for beach stabilization or construction require consideration of the littoral currents and frequently include structures to modify the currents' transporting capability. Any intrusion into the littoral current will cause some degree of interruption of the down-current sand movement, as well as decreasing the local eroding ability of the ocean wave energy.

TECHNOLOGY OF SHORELINE PROTECTION

Beaches: The term "beach" can be applied to any shoreline formation of sorted rock fragments. These fragments may be boulders, cobbles, gravels, sands, silts or clays. The slope of the beach foreshore and the erodibility of the beach are functions of the type of material comprising the beach. Boulders will stand on a steeper slope than sand and will, therefore, require greater wave energy to be displaced.

The sandy beaches have received most of the attention because they represent the most-used recreational beaches and because they are most vulnerable to erosion.

Beach areas can be maintained by continuing the supply or by minimizing the loss of sand. When the supply is deficient, it can be augmented by artificial means. This replenishment can be accomplished by depositing sand either directly on the area of interest or into the littoral stream and allowing it to be naturally transported to the area. The source of sand can be an upland excavation, an offshore underwater deposit, coastal sand dunes, or accretions formed by a littoral barrier such as a breakwater. The process of moving littoral accretion around a barrier and back into the littoral stream is termed bypassing. Shoreline improvements that include structures such as harbor breakwaters will normally require provisions for sand bypassing at regular intervals, ranging from one to several years, depending on the quantity of accretion and the severity of downdrift erosion.

As long as there is an adequate beach to dissipate the wave energy, the upland areas and improvements are protected, and space for recreation is available

on the beach. In areas where replenishment is not feasible, structures must be used to retain the beach. The problem then becomes one of design, where, through analysis of the wave forces in the littoral zone and the littoral transport characteristics, the proper type and configuration of structures can be selected.

The two major methods of dealing with beach erosion problems are stabilizing beaches with groins and periodic replenishment of beach material. A groin is a barrier-type structure designed to trap or retard passing littoral drift. Groins are usually built perpendicular to the shore, and extend from a point landward of possible shoreline recession into the water a sufficient distance to stabilize the shoreline. Depending on the desired results and the existing conditions, the length of the groin can be from less than 100 feet long to over 700 feet long. As material accumulates on the updrift side of the groin, supply to the downdrift shore is reduced and the downdrift shore recedes.

Periodic replenishment involved adding new sand to the beach to replace material lost by erosive processes. The new sand may be brought from inland sources or from offshore sources. Inland sources may be sand deposits with suitable characteristics or dune fields; however, dune fields presently or prospectively providing secondary defense against overtopping by storm waves should not be considered a source of replenishment material. Offshore sources are deposits of beach material lying in depths of water that permit dredging of the material. Another localized source of material is littoral material accidently or intentionally trapped by harbor structures. Some small craft harbors have incorporated "sand traps" to deliberately collect littoral drift before it shoals the navigation channels. The material collected in the sand trap can be pumped

to the downdrift beaches for nourishment. The offshore breakwaters used to form these sand traps are probably the most effective means of completely intercepting the littoral material and are usually positioned in water significantly deeper than the seaward ends of groins. This makes it possible for them to control a wider zone of littoral transport than structures tied to the shore. Because littoral transport is the direct result of wave action, the extent to which the breakwater intercepts the littoral drift is directly proportional to the extent of wave interception by the breakwater. As the wave energy is dissipated on the breakwater, sand is deposited on the shore in a convex seaward formation. This then acts as a natural groin which further impounds the littoral drift.

Some economic considerations affecting the selection of shore protection structures warrant discussion. When large quantities of sand are available within an economically practical distance from the eroding beach, replenishment is a desirable structural measure. At present, sand deposits in up to 70 feet of water can be dredged economically. In 1968, an offshore borrow area was used as a source for 1,400,000 cubic yards of sand to replenish Redondo Beach. The material was dredged from a depth of 40 to 70 feet, and was pumped a distance of one-half mile to the project beach through a pipeline.

In general, the cost per cubic yard of beach material varies inversely with the quantity and directly with the distance and the difficulty of the work. Future economic limits will probably change as new technology for offshore dredging develops and as the need for beach material increases.

When sand is not available nearby, more reliance must be placed on stabilization through construction of groins. In California, groins are most generally constructed of rock, because rock is relatively cheap, durable, and is easier to work with than alternative materials. For these reasons, rock is also used for most revetments while seawalls are, generally, rather uncommonly used in California. The size of the rock varies from 5 pounds to 25 tons and has an average price of about $9.00 a ton in place. The economic life of groins and revetments are usually taken at 50 years, although rock groins, if properly constructed and maintained, will last indefinitely.

Cliffs and Bluffs: Most of California's coastline consists of high cliffs and mountains or low lying bluffs in the process of being cut by wave erosion.

In most of these areas, erosion is so slow and development so sparse that the natural process results in no adverse effect upon man. However, in developed areas where man has built houses, roads, and etc., erosion does adversely affect man. Either these areas must be protected or improvements must be abandoned.

When it is determined to be economically feasible or socially desirable to protect land or improvements, the usual means is to construct rock structures such as dikes or revetments. Seawalls and bulkheads can also be constructed in some circumstances.

Non-Structural Measures: The use of structural measures to control erosion everywhere that it occurs is neither feasible nor desirable. The scenery

of the shoreline is often created by erosion and, as previously discussed, this erosion is one source of beach material. Erosion control structures are not the only measures that may be taken to mitigate damages. Dune stabilization and sand conservation measures are also available. The open lands in the shoreline zone may be controlled through regulatory and management programs to minimize developments adversely affected by erosion damage. Such non-structural measures reduce erosion damages to the shoreline and structures and contribute to preservation of the scenic beauty of the shoreline environment.

GOVERNMENT PROGRAMS FOR PROTECTION

Beach and shore erosion is one of California's pressing problems. The number of people using the shoreline is steadily increasing. Unrelenting pressures, generated by this growing population, have created a demand for shoreline land for homes, industries, transportation terminals, recreation and marine food resulting in concern for the protection and restoration of beaches and shoreline areas. At the federal level, this interest and concern has led to increasing involvement in shore protection. The increasing federal interest has been paralleled by expanding interest on the part of the coastal states.

Federal Programs

By various legislative actions, the Congress has authorized the U. S. Corps of Engineers to carry out the policies and programs established to protect and restore the Nation's shorelines.

Under these legislative authorities, the Corps of Engineers researches the causes of beach erosion; investigates and studies specific beach erosion problems; and constructs — or, in certain cases, reimburses local and state governments for constructing — shore protection and beach restoration projects. These authorities are contained in Title 33, United States Codes.

Shore protection and beach restoration projects are initiated by requests by local governmental agencies. Eroded publicly-owned shores and shores eroded because of federal navigation works are eligible for federal assistance; privately-owned shores may be eligible for federal assistance if there is public

benefit such as that arising from public use.

Beach erosion studies for the regular project program must be individually authorized by the Congress. The study authorization is granted by a resolution approved by the Public Works Committee of either the Senate or the House of Representatives, or is included in a River and Harbor Act adopted by the Congress and approved by the President. The District or Division Engineer will begin the study as soon as the necessary authorization and funds are provided.

The investigation and study are intended to determine whether a federal project is justified and, if so, whether its construction is feasible.

If comparisons of the costs of construction and the benefits resulting from the construction show the project to be a sound and prudent investment, and if the local sponsoring agency affirms willingness and ability to provide the required cooperation, the report on the study recommends adoption of the project. Before the report is submitted to the Congress, it is reviewed by the Board of Engineers for Rivers and Harbors, the Chief of Engineers, the Governors of affected states, and all interested federal departments.

When funds are provided, the responsible District Engineer carries out the detailed engineering work essential to construction and prepares construction drawings and specifications, and supervises construction. Upon completion, the protective works are turned over to the sponsoring local interests for operation and maintenance in accordance with the authorizing legislation.

Under the provisions of Section 103 of the River and Harbor Act of 1962, the Corps of Engineers may construct certain small beach erosion control projects

without specific authorization by Congress. These projects are subject to the same requirements of feasibility and economic justification as projects requiring congressional authorization and must be coordinated with the local interests concerned. However, the number of small beach erosion control projects is limited by the availability of funds, which are provided annually by Congress on a lump-sum, nationwide basis. The total allotment for small beach erosion control projects may not exceed $10,000,000 for any one year, and not more than $500,000 may be allotted for the construction of a project at any single locality. Each small beach erosion control project must be complete in itself and not commit the Federal Government to additional improvement to insure effective operation.

The legislation establishing the federal shore protection and beach restoration programs declares it to be "the policy of the United States to assist in the construction, but not the maintenance, of works for the improvement and protection against erosion by waves and currents of the shores of the United States, its territories and possessions". In its present form, the legislation spells out the conditions for, and the extent of, federal participation. Basically, it relates federal participation to public benefit and requires the active participation of the sponsoring local interests. Under this concept, federal participation is greatest where the protected shore areas are publicly owned and appropriate facilities to encourage full public use are provided. As much as 70 percent of the construction cost can be borne by the Federal Government in such cases. At the opposite end of the scale, where the protected shore area is privately owned and there is no public use, no federal

funds can be provided. The remaining costs are borne by the sponsoring local interests. Additionally, local interests are normally required to provide all necessary lands, easements, and rights-of-way; hold and save the United States free from claims and damages; prevent water pollution which would affect the health of bathers, maintain the completed works, and assure continued public use of the protected area. Other legislation provides that the Federal Government bear the entire cost of protecting federally owned shore areas and of mitigating or preventing shore damages attributable to federal navigation works.

Other federal agencies which have an interest in beach erosion are the Geological Survey, the Atomic Energy Commission, the Fish and Wildlife Service, and the Coast and Geodetic Survey. The U. S. Geological Survey is interested in the geology and topography of the shoreline and the composition of the materials on the beaches; the Atomic Energy Commission has some littoral drift studies underway using radioactive sands; Fish and Wildlife's interest lies with the living resources along the coast; and the U. S. Coast and Geodetic Survey in the mapping of the shoreline. The federal agencies cooperate well among themselves and will assist the State in joint ventures when requested and authorized.

State Programs

The State's authorities in beach erosion control are contained in the Harbors and Navigation Code and are administered by the Department of Navigation and Ocean Development.

The objectives of the State program are to, independently or in cooperation with any person or governmental agency, study and report upon problems of beach erosion and means for the stabilization of beaches and shoreline areas, prepare plans and specifications, and construct such works as its studies and investigations indicate to be necessary. The State may act in an advisory capacity on beach erosion control when requested by any public agency.

In July 1946, the State signed an agreement with the Corps of Engineers calling for a cooperative study of the problems of beach erosion and shore protection along the coast of California. The agreement called for the State and Federal Governments to each contribute 50% of the cost of the study. The original agreement and appendices thereto have been pursued on an annual basis since 1946 and have resulted in a number of Congressional authorizations of greatly needed beach erosion control projects.

The most important authority the State has with regard to its beach erosion control activities is the provision that the State financially aid local governmental agencies participating in federal projects. Section 65.5 of the Harbors and Navigation Code states in part, "...it shall be the policy of the State to bear one-half the costs of local participation required by the authorizing federal legislation...".

Since July 1959, the State has participated in federally sponsored beach erosion control projects in the following areas: Imperial Beach, San Diego, Oceanside, La Jolla, Seal Beach, Doheny Beach, Newport Beach, Surfside-Sunset Beaches, Redondo Beach, Ventura-Pierpont Beach and the City of Santa Cruz. The

Department of Water Resources and the Department of Parks and Recreation, when acting as local sponsor, contributed approximately $3,400,000 to these projects during the time period. The total first cost of the projects during the period for Federal, State and local governmental agencies was approximately $12,500,000. It is estimated that more than $50,000,000 worth of benefits will be derived from these projects.

In addition, the State spent nearly $1,000,000 contributing to cooperative research and investigations pursuant to the original agreement drafted in 1946, pursuing its own investigations, and administering the funds contributed by the State for the federal projects. Investigations consist mainly of the collection of data required for the evaluation and design of beach erosion control measures.

In addition to research and data collection, the State has participated in the research and development by the Corps of Engineers of a program designed to use radioactive isotopes in tracing the movement of sand along the shoreline. The research phase of the Radioisotopic Sand Tracer Study (RIST) will have been substantially completed at the end of the 1970-71 Fiscal Year and will have reached the operational stage with the capacity of determining the volumes of material transported in the littoral zone.

In 1965, the State undertook a study of beach nourishment along the Southern California coastline with a view towards determining the amount of beach building material transported annually to the beaches and towards formulation of a plan of beach nourishment and shoreline protection. An interim progress report, dated July 1969, concluded the following:

1. There is a relationship between sediment production and watershed development for the small coastal watersheds with areas of 160 square miles and less.

2. Abundant inland sand sources that could provide an economical source of material for artificial beach nourishment have been identified.

3. With future development, many of the inland sand sources may not be available for beach nourishment and emphasis may change to developing offshore sites.

In light of conclusion No. 3 above, the State should explore the possibility of the Corps of Engineers' expanding its Sand Inventory Program to include California's offshore areas. The program, now operating exclusively on the East Coast seeks to find and delineate offshore deposits of sand suitable for beach restoration and stabilization.

The Division of State Lands, which owns most of the submerged lands of the State, becomes involved in beach erosion when State lands may be affected by coastal structures to be constructed on its property. In a number of instances, the only way of preventing beach erosion problems from occurring from man-made structures has been to deny a State Lands permit to construct a project. State Lands does not have the staff capability to handle all the technical questions which arise and, therefore, relies upon other agencies for analysis.

The University of California, particularly at the Berkeley campus, does research in coastal engineering and offers a Masters Degree in the subject. The Berkeley campus has a good laboratory for wave and model studies. A number of research

projects are financed by the Corps of Engineers. The program has varied from year to year so that at times its full capabilities are not realized.

The State of California owns 200 miles of coastline, consisting of many valuable beaches. The Department of Parks and Recreation is probably more directly affected financially than any other State agency when a beach erosion problem arises.

The Boating Facilities Program of the Department of Navigation and Ocean Development also has a vital interest in beach erosion problems and their relation to harbors. Many harbor entrance structures upset the natural shoreline balance and affect the adjacent coastline; therefore, harbor design must give full consideration to these aspects. Although boating facilities projects are usually not directly related to State beaches, its staff has endeavored to follow the progress of studies and projects relating to State beaches and beach erosion in order to keep abreast of techniques and results.

The Department of Fish and Game is, of course, concerned with the living resources of the coastline and any modifications to the coastline affect the marine life.

CRITICAL AREAS OF EROSION IN CALIFORNIA

This chapter consists of narrative descriptions of the more critically eroding areas of the State. Critically eroding areas are those which are having or will have in the foreseeable future a significantly adverse effect on man by resulting in damage to public and private improvements.

San Diego County

Imperial Beach: The shoreline at Imperial Beach consists of a sandy beach varying from 0 to 150 feet which is backed by highly erodible bluffs and rock and rubble revetments protecting private improvements shoreward of the beach.

The upland area adjacent to the beach is primarily in private ownership with street ends and vacant lots presently used for access to the public beach. A number of two-story apartment houses and single family dwellings have been built on the low-lying bluff areas adjacent to the beach. Because of the erodibility of the native material, many of the private property owners have constructed revetments at their own cost to protect their property and improvements. Lots which have not been protected continue to erode and, in some cases, erosion on unprotected property outflanks protective revetments constructed on adjacent property.

Pursuant to federal authorization, two groins were constructed near the upcoast limits of Imperial Beach in 1959 and 1961. The Corps and other observers expected the compartments created by the groins to fill during the ensuing years; however they never did fill as anticipated. The Corps of Engineers has an

authorized investigation which it has been unable to begin because of lack of funding and uncertainties with regard to the construction of jetties and the placement of fills with regard to the Tijuana River Flood Control Project, the second entrance to San Diego Bay, and a proposed marina development within the City of Imperial Beach. There is a definite need for widening the beach to provide increased recreational facilities and protection of public and private property adjacent to the beach.

Sunset Cliffs, City of San Diego: The Sunset Cliffs area of the City of San Diego lies in the area north of the Point Loma peninsula and south of the San Diego River. The shoreline in this area consists of erodible bluffs which in some areas erode up to three feet per year. In the area south of Adair Street, Sunset Cliffs Boulevard traverses the top of the cliffs. The City of San Diego has been forced to dump rubble and other material adjacent to the road in order to protect it and, in some areas, has been forced to relocate the road. In the area north of Adair Street, the cliffs are primarily in private ownership with some street ends providing access. A number of the private owners in the area have been forced to dump rock and rubble in order to reduce damage to their homes and further loss of property. There is a definite need to provide protection to public and private property in the area and to restore and provide public beach areas. An authorized federal project calls for the construction of revetments, dikes, and cave closures in the area south of Osprey Street. This area of the project is referred to as Segment B. In addition, the authorization calls for the creation of a public beach north of Osprey Street beyond the present high tide line. Segment B construction was completed in early 1971 at

a cost of $320,000. Funds have not as yet been appropriated for Segment A primarily because the City of San Diego is faced with substantial local opposition to the project from those people whose homes are adjacent to the shoreline but are not endangered. These people object to the creation of a public beach seaward of the present high tide line. Additional opposition comes from people whose property is not adjacent to the shoreline and object to being assessed.

La Jolla, Vicinity of Bird Rock: The shoreline in this area is composed of highly erodible bluffs. Most of the area adjacent to the shoreline is in private ownership with occasional street ends and very limited access. At high tide, there is essentially no beach in the area and waves are constantly working on the toe of the bluffs. In 1966, the Corps of Engineers placed revetments along a one-half mile segment up and downcoast from Bird Rock. This provided substantial incidental benefits to private properties in the area. Although there is a need for further protection in the area, the Corps of Engineers is precluded from participating because of the extent of private ownership adjacent to the beach. There is presently no authorized federal investigation for this area.

Oceanside: The erosion problem in the Oceanside-Carlsbad area has been aggravated by the construction of jetties associated with the Del Mar Boat Basin, Oceanside Small Craft Harbor, and a flood control jetty on the north side of San Luis Rey River. The beach is quite wide in the area between the south harbor jetty and the flood control jetty to the south. South of the

river, however, the beach is presently composed almost entirely of cobbles. When the Oceanside area was constructed in 1963, dredged spoil material from the harbor was placed on the beach. It was discovered a number of years later that the material contained a very large percentage of cobbles. The littoral drift which is predominantly southward has carried the sand and other erodible material downcoast leaving the cobbles. There is a need to reestablish the recreational beaches in the area to meet the demand for recreation. The Corps of Engineers is conducting a joint beach erosion--navigation investigation which is scheduled to be completed in 1974.

Orange County

Capistrano and San Clemente Beaches: Erosion is occurring along the shoreline of nearly the entire area. Much of the upland area is in private ownership; however, except for only small portions, the beaches are in public use and are quite accessible.

As a result of the overall erosion of the beaches, protective measures are required. The Corps of Engineers studied the area pursuant to the Orange County, California, Appendix V Phase I, Beach Erosion Control Study, which was authorized in 1960. At that time, local interests expressed a desire to maintain the shoreline approximately as established by a survey in 1949. Some of the owners of privately owned beaches in this segment expressed reluctance to assume the financial burden in participating in any shore protection project and, in general, indicated their belief that rebuilding their beaches would interfere with existing recreational use. However, local interests indicate a desire for shore protection measures at publicly owned beaches in the segment. Because of the predominance of privately-owned shoreline and the reluctance of private interests to participate in the costs, the Corps of Engineers was unable at that time to participate in the construction of a project.

Doheny State Beach: Doheny State Beach is located at the mouth of San Juan Creek. The condition of the beach is dependent upon the amount of material transported down the creek. The beach is presently in good condition because the flood of January-February 1969 formed a delta containing approximately 1.5 million cubic yards at the mouth of San Juan Creek.

The Corps of Engineers completed a project in 1966 consisting of the construction of a groin and a placement of sand fill. The project plan calls for periodic artificial nourishment at an annual rate of 23,000 cubic yards per year. Artificial replenishment has been unnecessary in recent years because of the large amount of sediment discharged in San Juan Creek.

San Gabriel River to Newport Beach: This segment of shoreline consists entirely of wide sandy beaches most of which are in public use or ownership and are backed by private beach front housing. Beaches included in this reach of shoreline include those of Surfside Colony, Sunset Beach, Bolsa Chica State Beach, Huntington City Beach, Huntington State Beach, and Newport Beach. The beaches of the entire segment are in excellent condition and provide one of the most highly used recreational beach areas of the State. Because upstream developments on the Los Angeles, San Gabriel, and Santa Ana Rivers have greatly reduced the flow of sediment to the area and flood control and harbor jetties north of the segment have cut off littoral movement from the north, the area requires almost constant artificial placement of sand. To this end, five stages of construction have been completed pursuant to the federal authorization in 1962. Stage I consisted of the placement of sand fill at Surfside-Sunset Beaches in 1964. Because of predominant littoral movement to the south, sand placed at the Surfside-Sunset area feeds the beaches downcoast. Stages II and III consisted of the construction of groins and the placement of sand fill at Newport Beach in 1968-69. Stage IV consisted of the replacement of sand fill at the Surfside area and the construction of more groins and the placement of more fill in Newport Beach. This work was completed in 1971.

Stage V presently under construction will complete the construction of groins in the Newport Beach area which should result in a high degree of stabilization of the beaches.

Los Angeles County

Royal Palms State Beach: This beach, located near the most southerly area of the Palos Verdes Peninsula, is rocky and is backed by high erodible cliffs. The City of Los Angeles, responsible for the operation of the beach, has requested that the Corps of Engineers investigate the possibilities of creating a sand beach in this area. Rock and rubble revetments have been constructed mainly for the purpose of maintaining parking and picnic areas at the foot of the cliffs. The Corps is investigating the possibility of creating a surfing reef offshore for the purpose of enhancing the surfing of the area. It is questionable from an environmental standpoint whether a sand beach should be created in this area. It is extremely beautiful and unique by virtue of the ruggedness of the area.

Las Tunas State Beach: This beach lies in the reach of coastline between Sunset Boulevard and Malibu and is operated by the County. It has suffered erosion to an extent that it is now only usable by a small number of people at one time. The narrow beach is backed by the Highway I road embankment which is also in a state of erosion at times. The beach is readily accessible; however, there are inadequate parking facilities in the area. A badly deteriorated groin system exists which is completely ineffective in compartmentalizing sand. The County of Los Angeles requested the Corps of Engineers to investigate the beach erosion control problem with a view towards a small project authorization. The Corps' tentative plan of improvement includes the construction of two rubble-mound groins and the installation of sand fill. It is anticipated that construction of this project will be completed in Fiscal Year 1971-72.

Point Mugu to San Pedro Breakwater: This area includes some of the most highly used recreational beach areas in the State. Specific beaches included in the area are: Leo Carillo State Beach, Point Dume State Park, Corral Beach, Las Tunas State Beach, Will Rogers State Beach, Santa Monica State Beach, Venice Beach, Dockweiler State Beach, El Porto Beach, Manhattan State Beach, Hermosa Beach, and Redondo State Beach.

The Corps of Engineers is conducting an investigation of specific areas within this reach of coastline. Present plans of the Corps call for limiting the scope of its survey report to the lesser reach between Sequit Point on the north and Flat Rock on the south. The entire shoreline in the reach is subject to seasonal change and to temporary shoreline recessions caused by storm action. These recessions hold a great potential for damage to existing beaches and public and private improvements.

Following is a description of the beaches, associated problems, and tentative solutions. The Corps' study is scheduled for completion in July 1972.

Point Dume Beach State Park - It is desired that the beach be widened to accommodate new park facilities and to provide additional area for recreation and protection for landside facilities. As proposed by the County, this would be accomplished by constructing a groin at the downcoast end of the beach and placing approximately 310,000 cubic yards of suitable material. This would result in widening the beach an average of 100 feet. This amount is considered sufficient to make the desired width of beach and allow the normal rate of littoral drift to continue.

Corral Beach - Much of the narrower portion of this beach is unusable at high tide and the Pacific Coast Highway is being endangered by continued erosion. The beach should be widened to provide protection for the highway as well as to give the public a usable recreation area. The solution proposed by the County is to construct groins at the downcoast end and at the approximate midpoint of the beach and to fill the groin compartments with approximately 442,000 cubic yards of material. Average additional beach width would be 100 feet. Two existing storm drains at Solstice and Corral Canyons would be extended through the new fill.

Las Tunas State Beach - Prior to February 1970, Las Tunas State Beach was being considered for improvement as a part of the main Point Mugu to San Pedro Study. It is now being studied separately as a small beach erosion control project at the request of Los Angeles County. The problem is mainly one of improving and protecting a beach area that has suffered erosion to the extent that it is now barely usable by a small number of people at one time. Six existing sheet steel pile groins are greatly deteriorated and relatively ineffective for retaining the beach. The proposed solution is to construct one or two groins and place approximately 200,000 cubic yards of sand fill. Two of the existing groins would be removed prior to this operation. The remaining groins will be buried within the new rock groins or covered by the sand fill.

Will Rogers State Beach - This beach is fairly stable due to a system of 13 groins of 100 to 175 feet in length. Though no serious erosion problems exist at this time, seasonal and storm encroachments are beginning to endanger

some of the existing parking areas and at certain points, the Pacific Coast Highway. The State and the City of Los Angeles want this section studied to obtain information on beach stability, wave action and possible improvements or protective features.

Santa Monica Beach State Park - From 1933 through 1948, this beach was accreting at a rate estimated at 200,000 to 260,000 cubic yards per year. Accretion is caused by a 2000-foot long detached breakwater constructed by the City of Santa Monica in 1933. The original intent of the breakwater was to provide protected waters for a small craft harbor. It has effectively acted as a sand trap that has resulted in a seaward advance of the shoreline amounting to 850 feet behind the breakwater and as much as 200 feet, 1.5 miles upcoast. Deterioration of the breakwater has greatly reduced its effectiveness to provide protected water for small craft, but it still functions as a partial littoral barrier. Increasing wave action behind the deteriorating breakwater has lessened the rate of accretion, and the beach is now approaching equilibrium. It is requested by the State and the City that rehabilitation of the breakwater be investigated in this study.

Venice Beach - The area of beach south of the groin at 26th Street, approximately 4,000 feet to Mast Street, has been experiencing accelerating erosion. Prior to the construction of the Marina del Rey entrance jetties and breakwater, some material was returned to the beach during the seasonal reversal of the littoral currents. This material is now blocked from its upcoast travel.

The predominant downcoast littoral drift accretes against the northerly entrance jetty to the marina and results in interruption of supply to the more southerly beaches.

The City of Los Angeles proposes that a groin be built in the area of Mast Street to stabilize the beach northerly thereof, and that a method of sand bypassing be instigated to transport the accretion north of the Marina del Rey entrance to Dockweiler Beach to the south.

The stretch of beach southerly of the Marina del Rey entrance to Redondo Beach Harbor (King Harbor), includes Dockweiler Beach State Park, El Porto Beach, Manhattan Beach State Park, and Hermosa Beach. This reach is a 8.1 mile littoral compartment between complete littoral barriers. In 1958 and 1961, a total of 5,500,000 cubic yards of sand were deposited on the upper end of Dockweiler Beach. Since that time, under the effect of the predominant downcoast currents, this reach has been rotating with erosion at the northerly end and accretion at the southerly end against the King Harbor breakwater. Seasonal reversal of the littoral current and waves refracted by the Marina del Rey breakwater causes some upcoast drifting. The City of Los Angeles suggests the construction of a groin south of Ballona Creek to stop this upcoast drift.

South of King Harbor are Redondo Beach State Park, Clifton Beach, and Torrance County Beach, which compose a 2.4 mile littoral compartment between the south jetty of King Harbor and the Palos Verdes headland. As a result of previous studies 1.4 million cubic yards of sand were deposited on the 1.5 mile portion of this stretch of beach from Topaz Street toward Malaga Cove. A

stabilizing groin at Topaz Street was completed in September 1970. This groin is to stop the northerly movement of sand into the harbor and the loss of sand into the Redondo marine canyon. This project was sponsored by the Los Angeles County Department of Parks and Recreation.

Ventura County

The shoreline of Ventura County consists of two distinct types. North of the Ventura River, the beaches are quite narrow and rocky. South of the Ventura River, for the most part, the shoreline consists of wide sandy beaches which have been in especially good condition since the floods of 1969.

Rincon Point Area: Immediately downcoast of Rincon Point, there is about one mile of highway revetment with about five to ten feet of beach at the toe of the revetment in the surf zone. The only source of sand for the area appears to be Rincon Creek which empties near Rincon Point. This beach probably could be developed but, in addition to the importing of sand, would require the construction of parking facilities which would be quite expensive.

Punta Gorda: The County has plans to develop this very rocky beach in the future.

Hoffman Park: This County park is in a badly eroded state. The surf zone consists entirely of exposed rocks and is completely unsuitable for bathing. However, the park is to be taken by the Division of Highways for the Highway 1 Freeway, and development of the area cannot be considered until after the Division of Highways has completed the freeway.

Hobson Park: This beach is also degraded and has a completely rocky surf zone. The County plans on refurbishing it in the future, but it is not of a very high priority.

Hobson Park to Faria Park: In this reach of shoreline, the County plans to develop a large park when the State abandons the present highway after the freeway is constructed. It has historically been in relatively good shape and experiences seasonal onshore-offshore movement of sand.

Faria Park: Faria Park is similar to most of the beaches in Ventura County north of the Ventura River. It has a rocky surf zone and is badly degraded. The County Parks Department had originally planned the refurbishment and development of this park in 1970-71. However, the County Executive's Office vetoed the proposal, and it is presently being planned for inclusion in the County's 1971-72 budget. The development would consist of a parking area supported by a seawall and a sand beach.

Emma Wood State Beach: This is a relatively undeveloped State beach with no shower facilities or water and has only chemical toilets and undeveloped parking areas. The beach is rocky in most places but does have some stretches of sandy beach.

San Buenaventura State Beach: The high flows of early 1969 in the Ventura River resulted in the filling of the compartments of the Pierpont Bay beach erosion control project between the Ventura pier and the north breakwater of Ventura Harbor. The beach is relatively wide and, except for the presence of small cobbles in the surf zone, is in excellent shape.

Ventura County Fairgrounds: The fairgrounds lie immediately downcoast of and adjacent to the mouth of the Ventura River. The fairgrounds have not been developed out towards the beach, and the area is extremely unsightly and in a

bad state of disrepair.

Ventura City Beach: This beach lies on both sides of the entrance to the Ventura Marina between the State beach to the north and the Santa Clara River to the south. The beach is in excellent shape at this time but is undeveloped.

McGrath State Beach: This beach is in good shape with the camping area basically protected by a ridge of sand dunes along its entire reach.

Oxnard Shores (Mandalay Beach): This beach, owned by the City of Oxnard, has been recently developed into a residential area. The houses have been built out to the surf zone. Annual onshore-offshore movement of sand has resulted in some damage to the homes adjacent to the beach. When the developer leveled the sand dunes, he eliminated the natural protection of the areas further away from the surf zone.

Hollywood Beach: This beach, immediately upcoast of the north jetty of Channel Islands Harbor, is in very good shape and is well maintained by the County. The houses in this area are built back a considerable distance from the shoreline resulting in much less of a problem than the Oxnard shores area.

Silver Strand Beach: This beach, immediately downcoast of the south jetty of Channel Islands Harbor, is in very good shape and is experiencing no problems.

Port Hueneme Beach: This beach, south of the Port Hueneme Harbor entrance, is wide and well maintained and is experiencing no problems at this time.

Ormond Beach and Adjacent Area: This beach, owned by the City of Oxnard, is essentially a continuation of Port Hueneme Beach. It is moderately wide and almost completely undeveloped. At the present time, there is very limited access to it except along the beach from Port Hueneme. There is a Southern California Edison Company Steam Plant being constructed in the area. Because of the construction of this steam plant, access is presently limited. However, upon the completion of the plant, it is anticipated the area will develop and that the access will improve.

Point Mugu State Beach: This beach in southern Ventura County is undeveloped, relatively secluded, and has a rocky surf zone.

The Corps of Engineers has an authorized investigation which has been funded for a start in Fiscal Year 1971-72. Although the study was earmarked specifically for the Point Mugu-Oxnard area, it is anticipated that the Corps will investigate the entire Ventura County area.

Santa Barbara County

Rincon Point: The County has a proposal for the development of a park immediately upcoast of Rincon Point. The area consists of steep cliffs about 150 feet high with a sand beach about 30-50 feet wide. Future plans are to widen the beach but current plans are only to develop the area for recreational use.

Carpinteria State Beach: This beach is moderately sloping and about 200 feet wide. It is clean and well maintained and experiences some onshore-offshore seasonal movement.

Sandy Land Cove District: This is an area where private homes must be protected from the surf. A local home owners association has recently constructed a revetment and seawall. The County does not contribute funds for the construction or maintenance of the area but has contributed engineering and other advisory services to the association.

The Santa Claus Area: Along this reach of coastline, the railroad comes quite close to the shore, and there is a rock revetment protecting it with essentially no beach.

Upper Sandy Land Cove (Padero Lane) and Beach Club Road Area: In this vicinity, the homes along the beach are protected by rock revetment with the beach about 20 feet wide. The beach disappears completely during the winter and at high tide. There is essentially no public access in the area.

Summerland (Lookout Beach Park): This is an area of cliffs 100-150 feet high with a beach below it which averages 75-150 feet in width. The beach is in fairly good condition with some scattered cobbles in the surf zone.

Montecito (Miramar Beach): This is an area of private homes built right down onto the beach. The beach varies from 50-200 feet depending on the time of the year. There is little or no public access.

Montecito - Biltmore Hotel Area: This is an area of public beach which varies between 150-300 feet wide. There is a concrete seawall shoreward of the beach which protects this area along Channel Drive.

East Beach (City of Santa Barbara): This beach is up to 400 feet in width in places and is well maintained by the City.

Cabrillo Beach (City of Santa Barbara): This beach is approximately 200 feet wide and is also well maintained by the City. It is immediately downcoast from the Santa Barbara Harbor and is nourished by the dredging of the harbor.

Leadbetter Beach: This beach, immediately upcoast of the harbor breakwater, is in very good shape, is quite well developed, and is well maintained by the City.

Shoreline Park to Goleta Slough: This is an area of high cliffs with many pocket beaches. The area has not been developed by the City partly because of the limited stability of the cliffs and limited public access.

Royal Burro Beach State Park: This beach, at the mouth of a small creek, is about 100 feet at its widest point. During the winter, the beach almost

completely disappears.

Goleta Beach State Park: This beach, seaward of Goleta Slough, is in excellent shape and is well maintained by the County.

University of California at Santa Barbara: The area along the shore of the University consists almost entirely of high cliffs with essentially no beach development.

Isle Vista County Beach: This is basically an area of low cliffs approximately 30-50 feet high with a small frontage beach at the toe of the cliffs. The beach varies up to 20 feet in width in places. It is relatively undeveloped at the present time.

The Corps of Engineers has just begun an investigation for the Santa Barbara coastline south of the north boundary of the City of Santa Barbara.

Santa Cruz County

City of Santa Cruz: Except for the beach area at the mouth of the San Lorenzo River, the coastline of the City of Santa Cruz consists entirely of highly erodible cliffs. A major roadway adjacent to the cliffs (East Cliff Drive and West Cliff Drive) had to be abandoned in some locations and required extensive maintenance in others. In 1964, the Corps of Engineers constructed a series of rock revetments in the most serious areas to retard the erosion. The project is highly successful, although there are still some areas adjacent to the roadway which require continual maintenance by the City.

City of Capitola: Capitola Beach lies at the mouth of Soquel Creek. Prior to 1970, the beach was in a severe state of erosion. The State Department of Parks and Recreation, in cooperation with the City of Capitola, constructed a rubble-mound groin and installed a sand fill in order to provide an adequate recreational beach for the area. The Corps of Engineers completed a small project investigation for the area in June 1971. The results of that study were that

San Mateo County

Half Moon Bay and Vicinity: In the Half Moon Bay area, shoreline and beach erosion has occurred at El Granada, Vallejo, and Miramar Beaches. The beaches are located just north of the City of Half Moon Bay immediately west of the Village of El Granada and downcoast from Half Moon Bay Harbor. The historical rate of shore erosion was about four feet per year during the years 1914 through 1959. This rapid rate of erosion will continue until the beaches reach a state of equilibrium which is compatible with wave action and the availability of material for beach nourishment. This area has been subjected to shoreline and beach erosion from wave action for many years. The construction of the Half Moon Bay Harbor about nine years ago has contributed to the erosion because of the breakwater acting as a groin and resulting in reduction of replenishment sand to the beach.

Possible Solutions - The beach erosion problems in the vicinity of Half Moon Bay have been investigated by the U. S. Army Corps of Engineers, and several alternative plans for improvement of the shoreline erosion have been developed and were presented to the County Board of Supervisors at a public meeting on September 16, 1970. To date, the County Board of Supervisors and the various San Mateo County agencies and groups directly affected by the beach erosion in this area have not selected any of the alternatives presented.

Pacifica and Vicinity: Bluff and beach erosion has occurred on the shoreline in the areas of the City of Pacifica between Mussel Rock and Devil's Slide. The beach is backed by bluffs 30 to 40 feet high at the north end and gradually

decreases in height to 10 to 15 feet at the southern end. Major bluff erosion has taken place along the shoreline in the Pacific Manor and Sharp Park portions of the coastline. This erosive action has accelerated during the past seven to eight years. Sand from these beaches apparently is moving downcoast and no replenishment is occurring. The loss of sand on the foreshore has allowed heavy seas and extremely high wind driven tides to erode the backshore portion of the beach as well as the low bluffs and terraces along the shoreline.

Possible Solutions - The entire northern shoreline of the City of Pacifica has suffered beach and bluff erosion. There are two districts within the City which are in need of immediate relief from bluff erosion, Pacific Manor and Sharp Park. The north-south coastline within these two areas comprises approximately 9,000 feet of narrow beach backed by 40-60 foot high bluffs along the northern portion and a wider beach and lower bluffs at the southerly end. The coastal end within this stretch is highly developed with single-family homes and apartments which back up to the edge of the bluffs. The progressive undercutting of the bluffs and subsequent loss of large pieces of the entire bluff face have endangered numerous homes and apartments. To date, no major damage has occurred; but, if the natural erosion is not abated in the near future, several homes will be lost and numerous others will be structurally damaged.

Construction of rubble-mound seawalls along the toe of the eroding bluffs in the Pacific Manor and Sharp Park districts would prevent many of the bluff failures. A project to construct remedial works to stabilize the bluff face is engineeringly feasible. Along much of the bluff area, erosion has progressed

across public property to privately-owned bluff areas landward of the beach which would necessitate protective works for private property. Federal funds cannot be used to construct protective works for private property until the part of the beach front property needed for construction is obtained by the County or City in fee or by a deeded easement from the private property owners.

Thus, only about 2,400 feet of publicly-owned property located at the southerly end of this stretch of coastline could receive a federal contribution for seawall construction. The Corps of Engineers, San Francisco District, has completed a survey report for this portion of the Sharp Park district and has estimated a capital expenditure of $1,500,000 for construction along the publicly-owned property which starts at Paloma Avenue and runs downcoast to Claredon Road. The final report will be submitted to the County Board of Supervisors during February 1971. Construction costs for the remainder of the Edgemar, Pacific Manor, and Sharp Park districts of Pacifica not included in the federal project have been estimated to be approximately $4,000,000. These costs would include a rubble-mound seawall and imported sand fill material to the areas where the bluff has receded further landward than the proposed alignment of the seawall.

San Francisco County

Ocean Beach: Ocean Beach is located approximately between the Cliff House on the north and the San Mateo County boundary on the south. It consists of a long rather narrow beach backed by erodible bluffs in the southern area and a massive concrete seawall on the north. The bluffs in the southern portion are subject to erosion, and the City has dumped concrete and other rubble in the worst areas. In addition, accumulation of beach sand along the ocean side of the Great Highway causes sand to drift across the highway.

Lands End and Fort Funston Areas: Land slides are causing the loss of material from these very rugged and rocky areas of coastline.

James Phelan State Beach: This beach located just west of the Golden Gate Bridge has been eroding in recent years. There is a need for the development and protection of greater sand areas for the beach.

The U. S. Corps of Engineers is studying all of these areas pursuant to an authorized investigation. The study began during the 1971-72 Fiscal Year.

Alameda County

Alameda Memorial State Beach: This beach, adjacent to Shoreline Drive in the City of Alameda, has undergone considerable erosion in recent years. The easterly end of the south shore has eroded so as to endanger houses along the shore and to remove usable recreational beaches. The U. S. Corps of Engineers is in the process of conducting a small beach erosion control investigation for this area. Consideration is being given to the restoration of the eroded beach area on the east side of the lagoon and the construction of a rubble-mound groin extending in a north-western direction from the southern end of the lagoon to protect the restored beach. Measures are also being considered to protect and restore that portion of the beach adjacent to Shoreline Drive.

Marin County

Bolinas Cliffs Area: This area of the coastline consists of high erodible bluffs which are constantly subjected to erosion from waves, ground water seepage, and surface water drainage. Waves are eroding the toe of the cliffs to the extent that roadways and homes at the top are endangered. The Corps of Engineers originally studied this area under its small project authority and formulated a project costing about $4.5 million which would consist of a groin field and beach replenishment program for a 1.3 mile stretch of shoreline. Since local authorities could not fund the $4 million local participation required, the Corps has since received authority to study the area under its major project authorities.

Further narrative descriptions of the shoreline are available in other parts of this report, the Shoreline Protection and Development Appendix of the Framework Study, and the California Regional Inventory of the National Shoreline Study.

ECONOMICS OF SHORELINE PROTECTION

Because of the general erosive condition of the shoreline in California, the State must expect the need for beach and shore protection to continue indefinitely. Since the late 1940's, governments at all levels have caused millions of yards of sand to be placed on the Southern California beaches for the purposes of shoreline protection and public recreation. At a number of sites, beaches must be replenished periodically because of the loss of sand through natural processes. As long as it is considered desirable to maintain beaches for public recreational use, the State is committed to the periodic artificial replenishment of those beaches and the costs associated therewith.

In addition to beach erosion, many of the cliff areas along the coast are subject to continuing erosion. In a number of places, especially in Southern California, public and private improvements have been constructed adjacent to the edge of the cliffs primarily because of the desirable view provided by the cliffs. Some of these areas have eroded to the extent that public facilities and private improvements are endangered. There is an extremely high cost associated with protecting these cliff areas.

Magnitude of Expenditures for Beach and Shoreline Protection: Between Fiscal Year 1959-60 and 1970-71, Federal, State and local governmental entities spent approximately 13.3 million dollars on the construction of beach and shoreline protection projects. This averages 1.1 million dollars over the 12-year period. In addition, funds were spent by the several levels of government for planning,

research and data collection, operation and maintenance, purchase of beach land for the State Park System, and administration. The magnitude of the funds expended for these purposes is not known.

The Framework Study estimates that between the period 1965 and 2020, $187 million will be required for structural and non-structural means of protecting property and improvements and purchasing land for recreation and scenic shoreline purposes. Of the $187 million, $145 million is estimated to be required for structural measures. The National Shoreline Study has estimated that for the period 1970 through 2020, $140 million will be required for structural measures. Both of these studies assume an increasing rate of development to meet the needs for an increasing population and some sort of coastal zone management program limiting development immediately adjacent to the shoreline. On an annual basis, both studies estimate that the cost for structural measures will be about 2½ times what they have been during the 12-year period 1959-60 and 1970-71 and, if non-structural alternatives are considered, the ratio could increase to as high as three times the present expenditure rate.

Economic Justification: Federal legislation requires that beach and shore protection projects participated in by the Corps of Engineers must be economically justified. This means that the benefits derived from the project must exceed the cost associated with its design, construction, operation and maintenance.

It is relatively easy to economically justify projects for the restoration of recreational beaches because of the high use associated with beaches and the high value assigned beach use by economists. Conversely, it is generally difficult to economically justify the construction of projects designed to protect cliff

areas. Usually, the only benefits derived from this type of project are those associated with the protection of land and improvements.

Governmental Financing: In order for the Federal Government to participate in a beach or shore protection project, the local cooperating governmental agency (usually the city or county) must agree to fund one-half of the costs of the project. With the State contributing one-half of the local government's share, this reduces the local share to 25% in a normal project. In spite of this, it is becoming increasingly more difficult for local governmental agencies to fund their share of projects. This is due, in part, to the increasing lack of availability of funds to all levels of government. Beach and shore protection works are by their very nature extremely expensive and, except in emergency situations, are of a relatively low priority to local governmental agencies. In addition to the local government's decreasing financial ability, funds at the Federal and State levels especially in the public works field have been severely cut back and are at times not expended even when appropriated as fiscal devises to combat inflation.

The Protection of Private Property: Federal law prohibits the Corps of Engineers from protecting land which is not in public ownership or in public use. Although there is no statutory policy with regard to the protection of private property on the part of the State, the State has in the past generally followed the federal policy of only protecting property which is in public use or ownership. The result of this policy has, in a number of cases, led to a general degradation of shoreline areas because of the private owners' inability to finance shoreline protection. This makes a good case for precluding the construction of private

development immediately adjacent to the shoreline. Any development, public or private, constructed adjacent to the shoreline creates a liability for future maintenance. Because of the high costs associated with the maintenance of the shoreline, either land is protected at very high cost or it is not protected at all. The result to the people of the State is one of either higher tax bills or a degraded coastal environment.

The Littoral Environment Observation Program described earlier in this chapter was substantially reduced in scope by the State Department of Parks and Recreation on January 1, 1971. Many people in the coastal engineering field feel that the program should be continued at a greater level than it now is. However, with the reduction of staff for the operation and maintenance of the State Parks System, it will be difficult to restore the program to its original level.

Since 1966, the State in cooperation with the U. S. Geological Survey collected data on the transport of sediment in coastal draining streams. State funds for this program were also terminated on July 1, 1971. It would be desirable if funds for at least a partial funding of this program could be restored in the future.

Project Planning: The Corps of Engineers is continuing to conduct investigations at a number of sites along the coastline with a view towards eventually constructing physical works to retard shoreline erosion. These investigations are funded totally by the Federal Government. Local governments are encouraged to make requests for investigations by the Corps as soon as it appears that a beach erosion problem is beginning to occur. The earlier a request is made, the greater the chance of avoiding serious damage to property and improvements.

The State does not participate in project planning although it has the authority to do so. Funds for State sponsored projects have seldom been approved by the Legislature and the Governor. The State should adopt a policy of funding

small beach erosion control projects in areas in which the Corps of Engineers cannot respond on a timely basis.

Critical Areas of Erosion in California

Comprehensive Planning: There are a number of studies and investigations available in which an attempt has been made to identify areas of the coastline subjected to varying degrees of erosion. The most comprehensive of these are the Shoreline Protection and Development Appendix of the Framework Study, prepared under the direction of the Water Resources Council and the California Regional Inventory of the National Shoreline Study, prepared by the Corps of Engineers.

Framework Study: Appendix XVI, Shoreline Protection and Development, of the Comprehensive Framework Study concerning the California region was prepared by the California Region Framework Study Committee for the Pacific Southwest Interagency Committee of the Water Resources Council. The Appendix concerns itself with the needs for protection and development of the shoreline zone. For the purposes of the study, the shoreline zone is considered to include the area subject to erosion from sea action and the closely adjoining landward area. It comprises a strip generally not exceeding 500 feet in width. The California region is divided into four subregions: North Coastal, San Francisco Bay, Central Coastal, and South Coastal. For the region and each subregion, the following types of information are presented: description of the region or subregion; existing conditions in the shoreline zone; future needs in the shoreline zone; and means to satisfy future needs in the shoreline zone.

The shoreline is classified into three categories of erosion: Non-erodible shoreline comprises shoreline composed of resistant rock or that which is protected by harbor structures, beach erosion control improvements, or is stable or accreting; Non-critical shoreline erosion includes uninhabited areas except where the loss of recreational swimming beaches is involved; Critical shoreline comprises erosion that threatens shoreline resources and urban or public facilities and requires structural or non-structural measures for protection.

For the region and each subregion, the basic information and findings are presented in four tables. Table I presents in miles by time-frame and county the number of miles of beach stabilization, seawalls, beach replenishment, and beach development required. Table II presents information by county and time-frame of the estimated average annual shoreline erosion damages and damage reduction resulting from the recommended program. Table III also by county and time-frame tabulates the required swimming beach, non-swimming beach, and scenic shoreline in miles. Table IV gives the estimated cost of the shoreline protection program in terms of first and annual costs and structural and non-structural measures by county and time-frame.

The report concludes that if measures are not taken to reduce property damage due to erosion, erosion damage will increase from approximately $10,000,000 per year in 1965 to approximately $50,000,000 per year in 2020. The structural and non-structural measures set forth in the report would reduce erosion damages from $50,000,000 to $4.5 million per year by 2020. The report also concludes that the estimated cost for the structural and non-structural

measures amount to approximately $187,000,000 including the costs of protecting 95 miles of shoreline through the construction of 54 miles of beach stabilization, 23 miles of seawall, and 18 miles of beach replenishment. The costs also include construction of 30 miles of new beach and the preservation of 330 miles of scenic shoreline.

California Regional Inventory, National Shoreline Study: This report was prepared pursuant to Section 106 of Public Law 90-483. It authorizes the Corps of Engineers to: (1) determine areas along the coastline where significant erosion occurs; (2) identify areas where erosion presents a serious problem because of a high rate of erosion; (3) describe the most suitable type of remedial action; (4) estimate costs for the remedial action; (5) recommend priorities among serious problem areas; (6) provide information to State and local authorities concerning shoreline erosion problems; (7) develop guidelines for land use regulation; (8) identify coastal areas where title uncertainty exists.

The Corps of Engineers, in determining areas along the coast "where erosion presents a serious problem because the rate of erosion, considered in conjunction with economic, industrial, recreational, agricultural, navigational, demographic, ecological, and other relevant factors," indicated that action to halt such erosion may be justified, initially considered that each mile of the shoreline of the California coast would be evaluated with reference to all the factors given above. However, discussions with State and other Federal agencies indicated that insufficient data were available on many important factors to quantify this decision, and that major studies which would be beyond the scope

of the National Shoreline Study authority would be required if definitive answers were to be obtained.

It was determined that the coastline would be categorized into three basic classes of historical shore changes: (1) critical erosion; (2) non-critical erosion; (3) areas of stability or accretion.

In evaluating these terms, the Corps of Engineers found that no definite rules or quantifiable planning matrix could be developed. Existing critical conditions were determined from requests for shoreline protection investigations by local governmental agencies, direct communication with concerned citizens, and examination of aerial photographs. The bulk of this information and the information on historical shoreline changes was obtained from review of existing Corps of Engineers reports and materials on file in the Los Angeles and San Francisco Districts of the Corps of Engineers, generally developed in conjunction with project investigations. The coastal aerial photographs used had been previously obtained largely through cooperative beach erosion studies of the State of California and the Corps of Engineers.

The study also indicates the areas that may be critical in the year 2020. For this determination, the population projections furnished by the Department of Water Resources entitled "California State-Federal Interagency Group, Type I Framework Studies, 2020 Population Projection of California Counties and Hydrologic Study Area," dated April 24, 1968, were used as a general index of development of the coastal counties. Areas which would be similar to areas considered critical in 1970 were thus selected for identification under the

table of critical erosion.

In this report, non-structural alternatives have not been quantified in the actual cost summaries. Conceptually, however, management, zoning, or acquisition of a federal easement along the coastline not already in public ownership appear to the Corps of Engineers to provide a practicable solution. As a concensus regarding the width of this easement or on the indirect costs and desirability of zoning or management could be obtained, no costs could be fixed for these alternatives. However, the study states that non-structural alternatives should be given further study at the earliest practicable date, as they appear to be a logical means of protecting the coastline from future generation of critical areas. The report presents a series of plates showing the entire coastline of California.
The following types of information are depicted on these plates:

A. Ownership: federal, non-federal, private, uncertain;

B. Land Use: public recreational, private recreational, non-recreational development, undeveloped;

C. Historical Shore Changes: critical erosion, non-critical erosion, non-eroding;

D. Effective Beach (Type of Beach): sand, gravel and cobbles, silt and clay;

E. Without Effective Beach (Areas Other Than Beaches): rock, marsh, other;

F. Backshore (Upland Physical Characteristics): dunes, cliffs, swamps, etc., other;

G. Parks: federal, state, county, city

H. Existing Protection: seawalls, levees, groins and/or beach fill, other;

I. Suitable Protection: seawalls, levees, groins and/or beach fill, non-structural, other.

In addition to the plates, all of the above information is presented in tabular form. The report also presents a cost summary of conceptual plans for the entire time period 1970 through 2020. The information is presented by county and indicates the miles of suitable protection required and the associated cost. The report estimates that the total cost of all the conceptual plans through 2020 will be $140,200,000 and will provide protection for 70.2 miles of coastline. The report also discusses shoreline areas recommended for further study and segragates them into the following categories: (1) areas of erosion under study or authorized for study for the Corps of Engineers; (2) areas needing study of erosion problems; (3) areas needing study to determine the suitability of creating or enlarging recreational beaches to accommodate the increased use from the growing population by the year 2020.

Conservation of Sand: Sand, in dunes, beaches and nearshore areas, is the principal material nature has provided to protect our seacoasts. Where sand is available in abundant quantities, protective measures are greatly simplified and reduced in cost. When dunes and broad, gently sloping beaches can no longer be provided, it is necessary to resort to massive structures; and the recreational attraction of the seashore is lost or greatly diminished.

Sand is a rapidly diminishing natural resource. Once carried to our shores in abundant supply by streams, rivers and glaciers, geological processes have

progressed to a stage where large areas of our coast receive no supply from this source. All development by man in inland areas tends to further reduce erosion of the upland, resulting in a reduction of the sand supply to the shore. It thus becomes apparent that consideration must be given to conservation of sand to the utmost practicable extent. This does not mean local hoarding of beach sand at the expense of adjoining areas, but rather the elimination of wasteful practices and the prevention of losses whenever feasible.

Mechanical bypassing of sand at coastal inlets is one means of conservation which will come into increasing practice. Removal of beach sand for building purposes, formerly a common procedure, is rapidly being reduced as coastal communities learn the need for regulating this practice. Modern hopper dredges, used for channel maintenance in coastal inlets, are being equipped with pump-out capability so that their loads can be discharged on the shore instead of being dumped at sea; and it is expected that this source of loss will ultimately be eliminated. On the California coast, where large volumes of sand are lost into deep submarine canyons near the shore, facilities are being provided to trap the sand before it reaches the canyon and transport it mechanically to a point where it can resume normal beach transport. Dune planting with appropriate grasses and shrubs reduces windborne losses landward and aids in dune preservation.

The Sand Inventory Program of the Corps of Engineers, now operating on the East Coast of the United States, has identified substantial volumes of sand lying offshore out of the littoral stream which could be used for commercial purposes. It appears desirable that a similar program be initiated very soon along the California coastline.

Structural Measures

The protection of developed beach and cliff areas by structural measures has been the traditional method of counteracting erosion. Although structural measures are not necessarily required in undeveloped areas, they will nearly always be necessary for the protection of land, private improvements, and public facilities in developed areas. In undeveloped areas, regulation of land use through zoning and other means will probably be the most effective means of "protection". Basically, the physical means of protection have been developed and are available for use by public agencies and private individuals. However, in many cases, they are prohibitive because of their excessive costs. Because of the costs and for environmental reasons, structural measures will probably be relied upon less and less in the future. The maintenance of beach erosion control projects constructed by the Federal Government is and will continue to be a local responsibility. Local governments must consider the responsibility and the need for maintenance when they agree to participate in a federal project.

Coordination with Other Interests

Beach protection interests should coordinate their planning, design, construction, and maintenance activities with the following other interests: harbors and navigation, flood control, and water conservation and recreation. These interests have an effect upon the amount of sand available for beach building purposes. When a harbor is constructed, many times the material dredged out from the harbor can be placed on adjacent beaches. Flood control and water conservation projects tend to reduce the total amount of beach building material available to an area. However, when floods do occur, deltas can be formed at the mouths

of the rivers and, in some cases, the rivers themselves are filled with material which can be used on the beach. When planning for a beach erosion control project for the purpose of protection of land and improvements, the recreation purpose can in some cases be added to the project helping to provide economic justification for the project.

Regulation of Permits

A number of agencies have a considerable amount of control over development in the coastal zone through permit powers: specifically, the Corps of Engineers, State Lands Commission, Water Resources Control Board, the Coastal Zone Authority, local planning commissions, city councils, and boards of supervisors. Systems of coordination between these various entities must be developed and implemented in order to reduce the time required for gaining approval to construct beach erosion control and other environmentally desirable projects.

SUMMARY AND CONCLUSIONS

Natural Processes

The shoreline of the State is in a constant condition of erosion both in the areas composed of cliffs and those made up of sand and rock beaches. The primary source of sand supplied to the beaches consists of sediment discharged by coastal draining streams and the erosion of coastal cliffs and bluffs. The littoral forces from waves result in an overall movement of sand southerly along the California coastline with seasonal variations in the direction and a few exceptions in specific areas. Rocky headlands at various locations along the coastline tend to compartmentalize sand and prevent or retard its movement. A considerable amount of sand especially in the Southern California area is lost into submarine canyons and cannot be recovered. Southern California is experiencing a dry weather cycle which results in less flooding and a reduction in beach building materials transported to the coast. Large winter waves tend to pull sand offshore away from the beaches resulting in a narrowing of beaches and, at times, a complete elimination of protective beaches which front cliff areas in many parts of the State. The smaller summer waves tend to push the sand back shoreward thus recreating the beaches previously lost. However, these processes result in a net loss of sand to the beaches over a period of years.

Technical Considerations

The Coastal Engineering Research Center of the U. S. Corps of Engineers has a number of continuing programs of basic research and data collection of coastal

phenomena. The research and data collection programs conducted over the years provide the basic source material which has led to the shore protection planning and design policy carried on by the Corps of Engineers. A number of physical means of protecting the coastline have been developed over the years including the construction of protective beaches and groins and seawalls, dikes, revetments, bulkheads, and other structures designed to withstand the force of waves.

The Effects of Urban Development

Urban development in the coastal zone has resulted in a need for protection of cliff and beach areas against erosion. Since the shoreline will continue to erode in the future, decisions will have to be made to either protect or abandon land and improvements threatened by erosion. Future developments in the coastal zone will create the need for protective works in the future. Because of the desirability of beach oriented recreation, society has already committed itself to the continuous artificial replenishment and constant maintenance of beach areas. There is a duel benefit derived from limiting urban development and the building of structures in erodible portions of the coast; those being: a) the foregoing of future maintenance and protection costs; and b) reserving the areas for recreational uses. Urbanization of the coastal flood plains has greatly reduced the amount of beach building material which is transported to the coast.

Economic Considerations

In order for Federal and State Governments to participate in beach and shoreline erosion control projects, there must be a showing that the benefits derived

from the project exceed the cost thereof. There usually is no problem in justifying the creation of recreational beaches from an economic standpoint because of the high economic value attributable to recreation. However, it is extremely difficult to economically justify the protection of cliff and bluff areas solely on benefits derived from the protection of land and improvements. Many times, the protective works themselves cost more than the value of the land and improvements to be protected. Since governmental agencies cannot participate in projects which costs exceed benefits, the burden of protection remains with the local property owner who usually cannot afford the cost involved. Because of the limited resources available to local governmental agencies adjacent to the coastline, many times the prospective cooperating agency is unable to fund its share of a federal project which is usually 25% of the costs of construction when the State also participates. Because of the federal and State requirements for local sharing in shoreline protection projects, some projects which might be desirable cannot be built. This leaves local governmental agencies and private property owners with the remaining option which is to allow the land to continue to erode and eventually require the rebuilding, relocation, condemnation, or abandonment of improvements.

Local and Administrative Restraints

Under present federal statutes, the Corps of Engineers may not provide protection to private property unless it is subject to public use or protection of the private property would be only incidental to the protection of adjacent public property. Legislation introduced during the 92nd Congress proposes that this policy be changed so that private property could be protected. If such

legislation were passed, it would be possible under present State authorities for a group of private property owners to obtain State and federal assistance up to 75% of the costs of the beach or shoreline protection project with no obligation on their part to allow the public to use the protected or restored area. The Corps of Engineers is authorized only to restore beach and shoreline areas to previous conditions but is precluded from creating new beaches either for the purpose of protection or recreation. Federal administrative processes are extremely slow. The average response time between an initial request of the Federal Government to commence an investigation and the first stage of construction has been approximately 12 years. Current Resources Agency policy precludes the State from constructing beach and shore protection projects unless the Federal Government also participates.

The Relationship Between Shoreline Protection and Other Interests

Harbors and Navigation: When dredging harbors initially during construction or during periodic maintenance operations, suitable dredging spoils should always be made available for use on adjacent beaches. The construction of harbor jetties and offshore breakwaters stop or reduce movement of sand in the littoral stream. In the past, this has resulted in the erosion of downcoast beaches. At harbor facilities where bypassing is provided, navigation channels can be maintained while downcoast beaches are protected.

Reservoirs: Reservoirs constructed for the purposes of flood control, water conservation, recreation, power production, and other purposes tend to impound sediment and reduce downstream flows and velocities both of which prevent

beach building material from being transported to the coastline.

Urban Development: Development of the flood plains also reduces the amount of beach building material transported to the coastline.

Sand and Gravel Mining: The mining of material for construction purposes in streams, sand dunes, or beach areas reduces the overall amount of sand available in littoral streams.

Environmental Considerations

Recent legislation at the State and federal levels regarding the environmental impacts of projects will also have an effect upon beach and shore protection. In the past, it has been assumed that if a project is engineeringly, economically, and financially feasible, it should be built. However, effects on the ecology and the esthetics of a given area are now also to be considered. This will probably lead towards a greater use of non-structural means of dealing with the problems of coastal erosion. These non-structural measures will probably include the following: land management, building permits, land use control through zoning, and acquisition by public agencies. Another environmental consideration is determination of the most desirable type of structural protection for a given area. For example, seawall and revetments, although effective in combating wave forces, are not very esthetic. Sand fill projects, although more desirable in most cases, are extremely expensive because of the need for stabilizing groins or long-term maintenance required for replenishment of sand. Environmental effects of such structural measures as offshore breakwaters, surfing reefs, and perched beaches are complex and provide no easy answers.

RECOMMENDATIONS

Federal Government Action

1. The federal statutes should be amended to allow the Corps of Engineers to participate in the development of new recreational beaches.

2. The Corps of Engineers should have emergency funds at its disposal for the use of beach and shoreline protection and restoration when emergency conditions arise.

3. Reevaluation of the extent of federal participation in beach and shore protection projects should be initiated with a view towards increasing the allowable federal contribution.

4. The Corps of Engineers should be authorized and encouraged to give greater consideration to environmental values and non-structural measures in the development of beach and shoreline protection projects.

5. Studies should be initiated with a view towards finding a means for the Corps of Engineers to react to requests for local projects on a more timely basis. The average time period between the initial request and the completion of the first stage of construction of nine major projects in California was 12 years.

6. The Corps of Engineers should continue and, if possible, expand its present efforts of research into surfing reefs, perched beaches, and submarine canyons.

In addition, consideration should be given to commencing a sand inventory along the coast of California, similar to the one being conducted on the East Coast.

7. Provision should be made for the construction or purchase of sand bypassing facilities upon the completion of construction of new harbor facilities to prevent problems in the future with regard to coastal erosion such as accompanied the construction of Santa Cruz and Santa Barbara Harbors.

State Government Action

1. Legislation should be prepared to allow the Department of Navigation and Ocean Development to control any modification of the coast or shoreline below the ordinary high water line. Such modifications should include jetties; breakwaters; sand traps, groins; fills; the dumping of rubble for cliff, bluff and embankment protection; and sand and gravel extraction operations.

2. The State should have emergency funds at its disposal for the purposes of beach and shoreline protection and restoration when emergency conditions arise.

3. The State should reestablish the funding for cooperative research and basic data collection with the Corps of Engineers and the U. S. Geological Survey.

4. The State should initiate a program of joint State-local funding of small beach erosion control projects so that coastline erosion problems can be responded to on a more timely basis than occurs now.

5. Provision should be made for the construction or purchase of sand bypassing facilities upon the completion of construction of new harbor facilities to prevent problems in the future with regard to coastal erosion such as accompanied the construction of Santa Cruz and Santa Barbara Harbors.

6. The State should consider the possibility of funding non-structural alternatives to beach erosion control projects including the purchase of recreational land in lieu of structural measures.

7. State personnel involved in shoreline protection should continue to familiarize themselves with emerging methods of coastal construction especially the more modern techniques presently being used in Europe and other parts of the world.

8. The State's Beach Erosion Control Program budget should include funds for out-of-state travel and specialized training.

Local Government Agency Actions

1. Local agencies should encourage the public use and ensure public access to the shoreline.

2. Local agencies should discourage the construction of improvements to land which will probably require protection in the foreseeable future.

3. If new developments adjacent to the coastline must be built, the coastline should be fronted by a road, parking lot, green area, or some other type of open public improvement. This would tend to decrease the ultimate cost of

protection and also allow federal and State participation.

4. Local governmental agencies should take the necessary steps to secure agreements with private landowners which provide for the public use or ownership of shoreline areas which are in need of protection. This would then allow the State and Federal Governments to aid financially in the protection of those areas.

5. Because of the prohibitive costs associated with the protection of the shoreline from erosion, local governmental agencies should consider adopting policies that prohibit the construction of subdivisions in areas which are subject to erosion in the foreseeable future and encourage uses such as recreation and agriculture which rely more on the use of open space than on the use of structures.

6. Local governmental agencies should support joint State-local funding of beach erosion control projects.

7. Non-structural alternatives such as zoning, building permits, and purchase of land should be exercised whenever possible in lieu of structural measures.

8. Give full support to flood plain policies and proposals that would promote rather than inhibit river sand replenishment of the shoreline.

9. Local agencies should be required to contribute financially to research and basic data collection programs conducted in their area of jurisdiction by federal and State agencies.

Private Interests

1. Private interests should be encouraged to deed easements for public use on land lying between private improvements and the high tide line so that governmental entities can participate in the protection of the property and more effectively control land use.

2. Private interests should be encouraged to form shoreline protection districts so that the design and construction of protective works can be coordinated among all parties in a given area.

3. Land developers should be required to deed a public easement between the high tide line and private properties in order that public access can be maintained and State and federal agencies can participate in the protection of the shoreline area if required.

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PART 2

THE CALIFORNIA COMPREHENSIVE OCEAN AREA PLAN
ROAD TRANSPORTATION

I. Past and Emerging Approaches to Transportation Issues

In the past, transportation facilities were developed primarily to serve the traveler's desire to move from one place to another in a fast, safe, convenient, comfortable and economical manner. While this desire still remains an important goal in transportation planning, to it has been added the ever increasing desire that these facilities enhance and conserve environmental qualities and complement community planning. Urban growth and complexity and the tremendous increase in individual mobility, brought about today by the almost universal availability of the motor vehicle, has compounded the problems involved in planning transportation systems that will provide mobility and reflect rapidly changing community values.

To meet the demands of the rapidly changing values, the Department of Public Works encourages extensive local involvement to provide an active partnership in planning that affects land use development and total transportation needs. An example is the Department's policy on highway transportation in the coastal zone which has special conservation and development significance. This policy endeavors to provide coastal zone transportation service consistent with local and regional total planning with the objective of conserving the natural coastal resource.

The future role of transportation systems in such areas will, to a large extent, be shaped by the level of success achieved by these State/local planning parternships.

II. Existing Road Systems

A. Administration

There are approximately 164,000 miles of public highways, roads, and streets in California. Various levels of government are concerned with development and administration of these facilities. The Department of Public Works, Division of Highways, is responsible for a system of highways which amounts to nine percent of the total highway, road, and street mileage and has 51 percent of the total travel. The Federal Government retains

administrative responsibility for those roads in National Forests, National Parks, and military establishments which amount to 21 percent of the total mileage and have 0.5 percent of the total travel.

City and county governments are responsible for the remainder of the public highway, roads, and streets within their respective jurisdictions.

The Federal-Aid Systems are composed of portions of the facilities under jurisdiction of the State and of county and city governments. The facilities on these systems are designated by the Federal Government in cooperation with the State and local jurisdiction involved.

The area of responsibility for the given level of government includes planning, design, right-of-way acquisition, construction, maintenance, and operation. Such work by the State, counties, and cities is financed primarily with funds from the State Highway Users' Tax Fund plus Federal-aid apportionments for facilities on the Federal-Aid Systems from the National Highway Trust Fund. These funds are apportioned for use by the counties and cities and for financing the State Highway System by State law. In addition, counties and cities obtain some financing for facilities under their jurisdiction from local tax sources. Residential streets and some local streets are primarily initially developed by residential and commercial developers to standards set by cities and counties.

In addition to these public road systems, there exists some private and institutional road systems which are under the jurisdiction of the particular land owner or institution. Integration of these private systems with the public road systems is, for the most part, accomplished by local traffic engineering and planning agencies. This is done by responsible governmental agencies through cooperative planning and development, land use restrictions, taxation, etc.

B. Classification As to Purpose or Function

Transportation exists to permit the social and economic activities of people, and almost every human activity requires a transportation element. As living becomes more complicated, so must our transportation facilities. Comprehensive transportation planning involves providing a transportation system of all modes to serve the activities of people. Through this planning process, it is determined what part of the total movement of people and goods should be carried on streets and highways, and what part of those streets and highways should be a State, city, or county responsibility.

Individual roads do not serve travel independently in any major way. Travel involves movement through a network of roads. Functional classification is a way of describing the purpose of each road or street in the network in accommodating travel. The predominant purpose or function of highways, streets, and roads must include such considerations as connecting major population and economic centers of the State, providing the continuity of travel into or through and around urban areas, providing areawide service along major traffic corridors within urban areas, and serving major recreation areas.

The Department of Public Works, in cooperation with the cities and counties of this State, have completed a functional classification study of all highways, streets, and roads. The total system was divided into functional levels in accordance with their degree of mobility or land access.

Roads act in varying degrees as arterials, collectors, or local roads. Arterials on the one end emphasize a high degree of mobility for through movement. A freeway is an example of a road which exists primarily to provide mobility. Local roads are at the other end and emphasize a high degree of land access. A residential subdivision street is an example of a road which exists primarily for the purpose of providing access to abutting property. The collector roads in the middle offer

a balance between land access and mobility. These classifications were also divided into rural and urban groups, because travel characteristics in rural and urban areas are quite different.

This comprehensive analysis of all highways, roads, and streets has been made, using a common and uniform criteria, regardless of present jurisdiction. It is a cooperatively developed plan as seen by State and local governments and represents today's best estimate of the highway, road, and street system, which would be responsive to the desires of the people of California for the next 20 years. This plan cannot be static, valid only at one point in time. In order to provide a flexible and current plan, responsive to and reflecting important changes in land use and travel and new developments in transportation, functional classification is being conducted on a continuous basis in California.

III. The Planning Process

A. General

Planning for road systems within the California Ocean Area Plan zone is carried on by various private, institutional, and governmental jurisdictions. Two types of planning activities can be distinguished: (1) That type of activity which can be considered under the category of single element planning, such as route or transportation corridor planning; and (2) That planning activity which can be grouped or classified under comprehensive or area planning. Ideally, in a fully integrated planning situation, single element planning would be done within the framework of comprehensive planning which would include broad transportation planning. By including route planning within the scope of comprehensive transportation planning, the road network can be developed in accordance with broader transportation needs serving not only the immediate needs of road traffic but the needs of community development and regional growth. Historically, route planning and the development of the road network has been a most effective approach to providing for the transportation needs of the coastal zone. However, with the

advent of California's changing needs, specifically the changing of life styles, greater disposable incomes, and the flexibility and mobility provided by availability of the automobile, the need for comprehensive planning and development has become evident.

B. Cooperative, Comprehensive, Continuing Transportation Planning

1. Organization

To meet the transportation planning needs of California, and to comply with the 1962 Federal-Aid Highway Act, the planning process was established in each of the urbanized areas over 50,000 population. In contrast to earlier practice, overall guidance of these efforts was vested in policy committees of elected officials. Technical committees continued in a subordinate role to oversee the technical aspects of the work.

The typical study is generally organized under a cooperative agreement between the State Business and Transportation Agency and either the regional voluntary planning agency or the constituent local governments signing individually. Policy direction is given by a planning policy committee consisting of elected local officials and a representative of the State. Technical studies and recommendations to the policy group are by one or more committees of the planning and engineering staffs of the participating organizations. Representation on the Technical Coordinating Committee by local public transportation, airport, and port facilities is urged.

In the coastal zone, continuing studies are presently under way in the San Diego metropolitan area, Los Angeles regional area, Santa Barbara urbanized area, the Salinas-Monterey area, and the San Francisco Bay area nine-county region. A similar study is also under way in the Sacramento regional area at the upper end of the Sacramento River Delta.

Transportation planning in urban areas of less than 50,000 population is carried on in similar fashion. The Eureka area has had a transportation study which is currently being reevaluated in connection with studies of Highway 101; and Santa Cruz County is presently formulating a proposal for a cooperative transportation planning study.

The local agencies are generally responsible for providing the base-year inventories of transportation and terminal facilities, land use, population, and economic resources, as well as the projections of these factors to the future study years. The State's participation is through the Division of Highways which collects travel data, provides computer services, and performs analyses of travel characteristics, transportation facilities, and land use which serve as a basis for predicting future travel demands.

The continuing process provides data essential to the planning of the statewide highway system, establishing highway routes, and determining project design. Local governments benefit similarly from the process, with planning data for present and future development of the local street and public transportation systems.

2. Process

The planning process includes the operational procedures and working arrangements by which highway and transportation plans are soundly conceived and developed, and continuously evaluated in a manner that will:

a. Assist governing bodies and official agencies in determining courses of action and in formulating attainable capital improvement programs in anticipation of community needs.

b. Guide private individuals and groups in their planning decisions which can be important factors in the pattern of future development.

Transportation planning is concerned with all facilities used for the movement of persons and goods, including terminal facilities and traffic control systems. The process is based on the collection, analysis, and interpretation of pertinent data concerning existing conditions and historical growth; the establishment of community goals and objectives; and the forecasting of future urban development and future travel demands. It includes not only the initial preparation and evaluation of a transportation plan through an appraisal of practicable alternatives, but also continuing review and modification to meet changing conditions. In addition, it includes the preparation and dissemination of information needed by official agencies in their consideration of planning proposals and improvement programs, and information suitable for the encouragement of public understanding and support. The planning process also includes the preparation of recommendations concerning scheduling and financing of highway improvements, coordination with other urban development programs, revision of ordinances and regulations, and additional legislation, if necessary.

The planning process provides a basis for policy making and program management and is organized with the objectives of achieving agreement on interrelated action programs founded on factual information.

Basic elements for which inventories and analyses are required are as follows:

a. Economic factors affecting development

b. Population

c. Land use

d. Transportation facilities, including those for mass transportation

e. Travel patterns

f. Terminal and transfer facilities

g. Traffic control features

h. Zoning ordinances, subdivision regulations, building codes, etc.

i. Financial resources

j. Social and community-value factors

The scope of the inventories and the extent to which the various analyses need to be carried will, of course, vary depending upon such factors as city size, age, and growth potential.

Given the broad and complex conservational and developmental requirements in the coastal zone, these continuing processes should make it easier to adjust transportation to environmental demands.

C. Adjusting Policy

Within the State Government framework, a series of policies have been derived to take into consideration the impact of freeways and highways on the overall environment of communities, including community development and goals, land use planning, and the desire for mobility. Among other things, such policies provide the opportunity for local and State agencies to formally participate together in freeway route planning studies. The following is one such recent policy which articulates this intent.

The Transportation Corridor Policy
(Departmental Directive 71-20)

"Purpose:

"The purpose is to revise and update the Department's policy for conducting freeway route planning studies.

"Philosophy:

"Because of the importance of State freeways to the overall environment of communities including their development goals, land use planning, and the mobility of people and goods, the planning of such freeways should be based on a process that:

". provides the opportunity for local and State agencies to formally participate in such a process,

". includes provision for evaluating the need for a freeway as the appropriate solution to a transportation problem,

". includes environmental studies as established in Departmental Directive No. 71-10, dated February 11, 1971, as an integral part of the route or corridor study process.

"Policy:

"Route planning for all freeways will be conducted within the framework of the California Highway Commission's procedural resolution.

"Freeway routes will be planned on the basis of a formal cooperative agreement with the affected local governmental agencies and, if appropriate, regional planning agencies and transportation districts. Such cooperative agreements shall provide for either a freeway route study or a transportation corridor study. In general "freeway route studies" will be conducted in rural areas and "transportation corridor studies" will be conducted in urban areas.

"In transportation corridor studies, the Department's primary responsibility will be to address the issues of whether a State highway facility would be an appropriate part of the solution to a transportation corridor problem, and if so, what that facility should be, where it might be located, and how it should fit in with other transportation

"and community facilities and overall environmental concerns. Others will be expected to address the issues of local or regional development and environmental goals, land use planning, and local or regional transportation facilities including how a transportation need should be met if a State highway facility is not appropriate or is a partial solution only.

"The result of a cooperative freeway route or transportation corridor study could be that no transportation improvement is justified; or it could be a transportation plan involving a freeway, conventional roads or streets, transit, or combinations of these. The results of these studies will be reflected in subsequent Section 256 reports recommending additions and deletions to the State Highway System and the Freeway and Expressway System. Local agencies will be encouraged to update the transportation element of their general plans to reflect the results of these cooperative studies.

"Each agreement will, wherever possible, use the organizational structure of the ongoing cooperative urban transportation planning study, and will treat the freeway route or transportation corridor study as a subregion of the overall study. Flexibility will be exercised in the negotiations of cooperative agreements to fit the circumstances of each freeway route or transportation corridor study. Subjects that will be considered when negotiating such agreements include: scope, schedule, techniques, study organization including policy, technical and advisory committees, responsibilities and contribution of each agency, use of consultants, and conduct of public hearings.

"Exceptions to the above noted cooperative agreement procedures may be made by the Director for Routes of Statewide Significance or in other unusual cases and will be considered on an individual basis."

The ramification of the overall policy is expected to be substantial to the transportation and environmental concerns. Objectives of such a policy would aid in strengthening State-local governmental relationships by creating a partnership role in local areas in orderly freeway and route development. Further, the policy is expected to provide a means of reacting to a growing awareness of individuals and communities of the need to broaden transportation planning approaches to social problems and to broaden the frame of reference to solutions. More specifically, to continue to solve transportation problems by including "no development" as an alternative. If a State highway facility is not the "total solution" to a transportation problem, then the issue of what facilities are and where they should be located can be considered.

Thus, such a requirement would bring forth issues of the overall planning and development of an area and would provide incentives to constant reevaluation of the developmental goals and objectives of a particular area. Finally, the intent of the policy is to meet and improve the freeway planning process by broadening the options available to those involved in the process at the State and local levels. Such an approach may well provide a tool that is useful in resolving major controversies by allowing highway planners to step back from the traditional posture of "a freeway is the answer, the question is where should we put it" to a new philosophy of "let us see if a freeway is appropriate here. If not, we would like to help determine how else this transportation need might be met".

Cooperative studies serve to standardize various aspects of the transportation planning processes by providing for better anticipation of emerging issues and problems in respective areas by involved agencies. Better identification of emerging issues and problems in the social environment will tend to generate more applicable and stable plans, programs with fewer revisions, and projects that would not be stopped by action of special groups.

Nearly all types of studies will require cooperative agreements. Cities and counties have for many years contributed to the freeway route studies by furnishing land use data plus information regarding parks,

schools and other facilities. With the evolving complexity of California's social system, there has been an increasing need for local agencies to define their environmental and developmental goals. Such freeway route or transportation corridor studies appear to provide the opportunity of presenting the community with an active set of planning issues and the need to make a decision. The formal agreement policy allows the community to look to its local governing body as a tool for more meaningful participation and a way to influence its own quality of life.

D. Procedures in Freeway Route Planning Studies

Statutes enacted by the Legislature describe the content of the State Highway System by prescribing general termini of each route and, where applicable, the general corridor through which the route is to pass by specifying that the route will pass near or via cities, towns, or other geographical locations. Likewise, the Legislature, through enactment of specifid statutes, prescribes the State highway routes, or portions of routes, which comprise the California Freeway and Expressway System. Determination of the specific location of each State highway route, including freeways, is delegated to the California Highway Commission.

The California Highway Commission is authorized to adopt specific locations for all State highways to declare specific routes, or portions of routes, to be freeways, and to allocate money for State highway purposes in accordance with certain legislative formulae. The Director of the State Department of Public Works and the State Highway Engineer make recommendations to the Commission on these subjects.

Future route location studies in urban areas will generally be initiated as a result of a need determined through the transportation corridor studies described in the previous subsection. In rural areas, highway needs will generally lead directly to route location studies.

When route location studies are initiated, the Division of Highways publicly announces the start of these studies. A publicized meeting with affected governmental bodies (cities and counties) and their technical and planning staffs is required prior to the formal initiation of studies. The purpose of the meeting is to discuss and receive the recommendations of the local governing bodies on time schedules, study limits, and whether an advisory committee should be appointed to work with the Division of Highways in developing the studies. This meeting will also be used to define study objectives to be included in the cooperative study agreement. Following the meeting, official notice of the start of studies is published and individual letters are sent to a distribution list of about sixty agencies that may be affected.

During the course of the study, often over a time span of two years or more, the study team is in continuous contact with the appropriate units of local government and members of the public at large. A study involves gathering of engineering, economic, social, and environmental data and other special information that may be considered significant for the study. This information is evaluated and assembled for presentation to the local governing bodies and to the public. As a part of the study, a draft environmental statement is prepared in consultation with other agencies that have environmental responsibilities in the study area. This draft is circulated for review by the affected agencies prior to public hearings.

Various types of publicity are used to inform the public of the meetings and for formal public hearings. Letters are sent to all concerned county supervisors, city councilmen, State assemblymen and senators, and to a distribution list of some 60 local, regional, State, and Federal agencies, private groups and individuals depending on the location and type of the project. News releases are sent to all local newspapers. In the case of formal public hearings, paid notices are published in all local newspapers. Such notices include a map showing the alternate routes to be discussed.

At all formal public hearings, major effort is made to permit the expression of opinion so, in effect, public hearings become an important vehicle for assessing the opinion of groups and individuals, and the overall climate of these opinions. Opinions and evidence are solicited from both expert and nonexpert members of the public. Those who are unable to attend and wish to make written statements may do so for up to a period of 30 days for a location hearing and 10 days for a design hearing. A copy of these statements and other relevant material are included in the hearing transcript which is available for public review.

Many local, regional, State, and Federal agencies are notified of the studies. Included are the following members of the Interagency Council for Ocean Resources: Department of Agriculture, Air Resources Board, Department of Conservation, Department of Fish and Game, Department of Navigation and Ocean Development, Department of Parks and Recreation, State Lands Commission, and the Department of Water Resources.

After the public hearing record is complete, the State Highway Engineer makes a routing recommendation to the Director of Public Works. The Director, in turn, furnishes that recommendation to various State and local agencies for comments prior to making his recommendation to the California Highway Commission. Upon receiving the Director's recommendation, the Commission considers the entire project record and makes a decision on the final route location.

E. Specific Design Phase

After a route has been selected by the California Highway Commission, the Division of Highways continues to work cooperatively with the local agencies to designate the special features of the highway within the adopted route. At this stage, city and county streets and highways master plans are consulted for detailed location of interchanges and circulation features.

When the basic major design features, as well as appropriate alternate features have been determined, a route is ready for a design hearing. The Division of Highways advertises the scheduling of the local hearing in local newspapers and in addition to the advertisement, government agencies are also given notices as well as many other local groups.

At the design hearing, members of the public have the opportunity to comment upon such features as the type of facility; number of lanes; right-of-way; general grade line (whether at grade, elevated, or depressed); streets to be closed, separated, or connected; local streets to be substantially altered; pedestrian and railroad separations; frontage roads; and any other pertinent features. Prior to the hearing, an environmental report will have been prepared. This will also be brought to the public's attention and offered for discussion. The cost to citizens who must relocate is explained as well as governmental regulations providing financial assistance for the relocation of homeowners, renters, and businesses. Further, timetables of right-of-way appraisal and purchase of property are shown and explained.

A design report, based on the information developed at the design hearing is prepared for the project and appropriate design features are selected. For projects on one of the Federal-aid systems, a request is made to the U. S. Department of Transportation, Federal Highway Administration, for design approval. Upon approval,detailed design begins.

IV. Major State Laws Authorizing Road Transportation in the Coastal Zone

The Constitution of California vests in the State the power to establish, construct, and maintain the State Highway System, to enact necessary legislation to affect this and to aid in the construction and maintenance of county highways. Various portions of the Streets and Highways Code establish the organizational responsibility and authority for accomplishing the objective of the law. Other portions create various special funds for distribution of Highway Users' Taxes to local governments and for direct development of State highways and freeways.

At the State level, the Business and Transportation Agency, including the Department of Public Works and its Division of Highways, have general planning and management responsibility for the State highways.

Various responsibilities are assigned to cities and counties regarding State highways. Agreements with city councils or boards of supervisors are required to close local streets, to improve streets leading to State highways, to develop roadside parks along State highways, etc. Cities and counties are involved in advance planning for highways through mapped highways procedure. In such a procedure, maps of proposed highways are sent to county planning commissions which review them and adopt plans controlling development in rights-of-way and provide suggestions for development to the Division.

In the development of local roads systems, responsibility resides with the particular local jurisdiction. Specifically, authority for the location and development of county highways is vested within the given county board of supervisors. The particular board of supervisors is given, by law, the powers of planning, management and control of county highways. The Streets and Highways Code also gives the cities authority for developing streets and imposes the duties on cities of exercising more general powers. As an example, the pedestrian mall act provides authority and financial procedures through a special assessment to enable communities to close streets to traffic and to develop pedestrian malls. This opportunity for downtown center development remains open for urban areas in the coastal zone and provides the oppoltunity for local governing bodies to more properly integrate their commercial centers with their conservation zones.

The State Scenic Highway System is designated in the Streets and Highways Code. The Code provides for developing a program of scenic corridors including the defining, identification, and acquisition necessary for developing rights-of-way by the given proper agency. Parkways have also been authorized by the Legislature since 1965. In that year, the Legislature approved the establishment of such a system of roads which were to be designed for pleasure travel, rest and turnouts, pedestrian, equestrian, and other leisure travel. The concept of the parkway has traditionally been the matching of mobility

and pleasure. The parkway may be considered as a park for pleasure and leisure driving. The parkway may be distinguished from the scenic highway in that the scenic highway may be considered as a transportation channel within a corridor of aesthetic and visual value, which is intended to be preserved.

V. Existing and Emerging Goals for Transportation

In its most simple form, transportation planning is the development of transportation goals and deriving the processes and means to reach these goals. Goals can be discussed in the perspective of problems and needs. Unfortunately, no comprehensive statement on transportation needs for the coastal zone has ever been made in the State of California. Thus, no explicit direction is presently set for the development of transportation in the coastal zone. Nevertheless, there has developed in the last few years certain implicit guidelines for transportation planning, development, and management. For one thing, needs for transportation in coastal areas must be identified by considering, as much as possible, the total development and conservation objectives for the coastal zone, insofar as these are capable of being analyzed, understood, and described. The derivation of transportation needs within the coastal zone will continue to come about through the interaction of diverse groups in the private and public sectors.

At the present time, measurement of need is against an acceptable or tolerable condition rather than a utopian or completely adequate condition. The cost of correcting the deficiencies once a project has been judged to be deficient is, however, based on a geometric standard which would generally provide an adequate facility for approximately 20 years beyond the date of construction. Needs can be classified, generally, into those types of deficiencies resulting from traffic demand (including elimination of congestion where traffic service has dropped below a minimum tolerable level, increasing safety, providing new routes in corridors where there are no existing State facilities, etc.) and those needs dealing with minimum acceptable geometric and structural levels. Other factors, such as continuity of travel, community desires, and effect of the proposed development on the surrounding area play an important part in the determination of transportation needs.

A. Needs and Goals in Road Transportation

A statement of transportation needs implies necessity of a comprehensive statement of goals and objectives for transportation planning in the State. In recent years, the policy of the Business and Transportation Agency has been to expand the base upon which transportation needs are determined. The process for determining needs from broader and more comprehensive bases, must, of necessity, include nontransportation considerations, such as might be obtained through inputs from other agencies in State government, county and local areas, community groups, institutions, and a variety of other groups within the State. In fact, the Federal Government itself has a major role to play in the determination of statewide transportation.

The State has been moving toward expanding the field of consideration by which needs are determined. For example, in a statement to the Assembly Committee on Transportation during a hearing on October 1, 1969, an Agency representive said, in speaking about public transportation, "it is our opinion that needs for public transportation in urban areas should be defined to include consideration of the total urban environment". This statement about public transportation appears to be basically sound for all types of transportation.

At the present time, three sections of the law require studies which develop perspectives on needs. Section 188.8 of the Streets and Highways Code requires preparation every four years of an estimate of existing highway construction needs. This is to be used in determining percentages for computing minimum expenditures for each State Highway District. The estimate of existing construction needs is a result of the study of all State highway routes on a project-by-project basis, and represents the combined efforts of the several Highway Districts and Headquarters Office of the Division of Highways.

Section 256 of the Code requires the Department to review the California Freeway and Expressway System and the entire State Highway System and to report to the Legislature periodically, usually every four

years. This report is to include progress made in developing the systems and revisions that should be made in the systems. Such studies are to be made without regard to whether particular routes are included in either system. In past studies, criteria were developed and recommended to the Legislature for defining the State Highway System and for use in making revisions to the System. Legislation, however, was not enacted to implement these recommendations.

In a recent study conducted in response to Section 256 of the Streets and Highways Code and in conjunction with the functional classification studies, criteria based on the classification of the facility were developed for defining the State Highway System. Legislative endorsement of these criteria is being recommended in the current Section 256 Study report.

Section 2156 of the Streets and Highways Code requires that, at four-year intervals, each city and county transmit a report to the Department of Public Works, setting forth what progress it has made on the improvement of its road and street system and its estimate of road or street needs or deficiencies for the next five and ten years. The report must be in the detail required by the Department of Public Works, and the Department of Public Works is instructed to review, audit, and combine the information and estimates, and submit the combined report to the Legislature through such interim committee or committees as may be designated by the Legislature. Further, relative to defining road systems, the Department has undertaken a functional classification study in conjunction with the National Transportation Planning Study (to be reported to Congress in 1972), and as directed by SR 49 (1969 Legislative Session).

This Functional Classification Study has two basic objectives: to provide Congress with the facts to help them determine the size and character of future Federal-aid systems and programs, and to provide the Legislature with the facts that will assist in the determination of criteria for defining the role of the State Highway System.

The considerations and eventual determinations which may be made by the California Legislature, based on California's continuing functional classification studies, will have impact on all coastal road systems in the State. The study is considering, for the first time, the function and needs of all roads regardless of jurisdiction. The intent is that the study will be helpful as a tool in future transportation planning.

B. More Comprehensive Participation in Highway Projects

The recognition of the interlocking relationship of transportation and land use has brought about attempts by the Federal Government to develop procedures that maximize the cooperation of all agencies involved in road planning and in urban development. In conformance to the Model Cities Act, certain highway projects must be submitted for review by the Department of Public Works to the designated areawide agencies. The Department of Public Works has established the policy that the following types of highway projects should be submitted by the Districts to the appropriate areawide review agency: (1) Major freeways, including addition of lanes to existing freeways if additional right-of-way is required; (2) the conventional highways on any new locations; (3) the widening of conventional streets and highways which result in an increased number of lanes or would require additional right-of-way; (4) any additional interchanges or major revisions to existing interchanges involving additional right-of-way; and (5) the acquisition of scenic areas.

In general, maintenance, landscape, and safety improvement type projects need not be submitted for review, but those projects that somehow require changing major traffic patterns and acquiring of additional right-of-way would be submitted for review. The procedure affects those coastal areas which fall under the jurisdiction of the areawide review agency and guarantees that such agencies, if properly staffed and represented, shall have substantial influence in the planning and development of the Federal-Aid Road System, which, incidentally, applies to the major portion of the overall highway system.

C. Community and Environmental Factors in the Highway Planning and Development Process

A primary goal of the State Highway Program is to provide highway facilities which, in their location and design as well as in their transportation functions, reflect or support the environmental values in community planning objectives of the areas through which they are proposed. These planning considerations are being weighed increasingly more heavily by the State Highway Commission in its route selection decisions, by the Federal Government, and its review of project proposals, and by the general public in its appraisal of the agencies, departments, and divisions planning the highway program. Thus, the accurate assessment of the community and environmental implications of proposed highways and improvements is the major responsibility for the Department.

Community environmental factors encompass the considerations underlying the Streets and Highways Code reference to community values. Simply expressed, community and environmental factors are the social, political, economic, aesthetic, conservational, and natural resource values of the environment through which a highway improvement is proposed and which may be sensitive to the location and design of a highway project. The emphasis on values in this definition is intended to stress the fact that environmental features or facilities are to be examined not only as to their existing or apparent utility, but also in terms of their relationship to the plans and prospects of the larger community of which they are a part. These relationships may be political, e.g., in terms of conservation and development policies at various levels of government, or they may be economic, e.g., in terms of industrial structure of commercial patterns, or sociological, e.g., in terms of a neighborhood organization or cultural continuity.

The emphasis on sensitivities is intended to stress potentially positive as well as negative effects of a proposed highway. Sensitivities might include the possibility of detrimental effects to ecology,

to natural or historical resources, or to the social structure. But sensitivity also suggests opportunities for development or redevelopment potential, or commercial recreational benefits or the desirability of special situations for utilizing such planning tools as relocation housing development, multiple use of rights-of-way, and joint development. Such terminology is intended to reflect the view that comprehensive consideration of community and environmental factors includes not only avoiding problem areas but also seeking opportunities to make positive, extra transportation contributions to local environments.

In recognition of the importance of such considerations in the highway planning process, there has been created within the Department (Division of Highways) the Community Environmental Factors Unit (CEFU). Its primary mission has been to develop activities which will promote the comprehensive consideration of community and environmental factors in highway planning.

In order to more correctly describe the overall approach to Community Environmental Studies, it is helpful at this point to explain the role of CEFU.

The Headquarters CEFU has been created to assist in the development and expansion of highway planning activities, which relate to the community function and influences of highway improvements. The basic objective of the Unit is to expand the contribution of potential social, economic, and environmental analysis to the highway planning process. It does this by performing contracting for basic research, by developing study methodologies and standards, by developing planning tools especially with interest in joint development and multiple use and relocation assistance, and by promoting earlier and wider application of techniques and knowledge which are developed.

Another objective is to provide expertise in social, economic, and environmental disciplines to assist the Districts to expand their capability for evaluating community environmental factors. Still another

objective is to promote a greater awareness, among other governmental bodies and the general public, of the Department's concern with community and environmental factors.

D. Three Laws on Environmental Concern

The State Environmental Quality Act of 1970, which became effective November 23, 1970, requires that all State agencies, boards, and commissions include a detailed environmental statement in any report on any project which could have a significant effect on the environment of the State. It provides that no State agency, board, or commission is to request funds or authorize such funds for expenditure for any project except for planning purposes, which would have a significant effect on the environment, unless each request or authorization is accompanied by a detailed statement setting forth the following: (a) the environmental impact of the proposed action, (b) any adverse environmental effects which cannot be avoided if the proposal is implemented, (c) mitigation measures proposed to minimize the impact, (d) alternatives to the proposed action, (e) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, (f) any irreversible environmental changes which would be involved in the proposed action.

Section 102.2(c) of the National Environmental Policy Act requires that all agencies in the Federal Government shall include a similar statement in every recommendation report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment.

Section 4(f) of the U. S. Department of Transportation Act directs that "the Secretary shall not approve any program or project which requires the use of any publicly owned land from the public park, recreation area, or wildlife or waterfowl refuge of national, State, or local significance as determined by Federal, State, and local officials having jurisdiction thereof; or of any land from a historic site of national, State, or local significance as so determined by such officials unless (1) there is no

feasible alternative to the use of such land, and (2) such programming uses all possible planning to minimize requirement of such parks, recreational area, wildlife and waterfowl refuge or historical site resulting from such use". To meet the requirements of this act, either an environmental statement or an evaluation that a project has no significant impact are required of all projects unless regular right-of-way funds or construction funds were budgeted prior to Novemger 23, 1970. Major projects, that is projects on new location or major reconstruction projects on a definite route, that have advanced beyond the regular right-of-way funding stage may be reviewed to determine if the proposed design minimizes adverse environmental consequences and to examine the highway planning to insure that these environmental consequences have been thoroughly considered. The law requires that these projects be modified, to the extent practical, to include additional elements or features identified and considered necessary to minimize environmental effects.

It is expected that the above laws will continue to grow in importance respective to natural and wildlife areas. In the coastal zone area, their importance appears substantial.

E. <u>The Reduction of Traffic-Generated Noise - A Policy and Approach</u>

Another area of environmental concern, where interest has been mounting recently, is noise reduction.

The California Environmental Quality Study Council and the Federal Council on Environmental Quality have identified noise pollution created by motor vehicles as part of the range of environmental concerns to which public agencies must be responsive. Steps necessary to alleviate present noise problems and reduce adverse impacts from future construction are in order to protect and enhance California's environment.

Even though it is clear that no State liability exists in this field, the Department feels responsibility for involvement. Extensive noise research has been carried out by the Division of Highways and additional

studies are under way. Noise impacts on the community are considered explicitly in highway location and design studies. Means of resolving noise problems are proposed in the environmental impact reports prepared for each project with noise barriers and other methods of noise reduction being incorporated into new construction projects as appropriate.

A systemic approach -- attacking the noise problem with its interrelated aspects from several directions -- is being developed by the Department. The Department is concentrating on three aspects of the problem:

a. Reducing noise at the source -- the motor vehicle.

b. Encouraging the location of compatible land uses and appropriate building standards adjacent to freeways within the area affected by traffic noise.

c. Decreasing the traffic noise reaching adjacent areas through freeway design techniques.

The concern of the Directive is primarily related to noise problems associated with freeway traffic. This is not to imply that serious noise problems are not found along conventional (nonfreeway) highways, including State, county, and city facilities. It is recognized that noise is as much a problem along heavily-traveled conventional roadways, with stop-and-go traffic, as near freeways.

The most practical approach to alleviating the noise problem seriously affecting many homes, schools, and other noise sensitive uses adjacent to conventional highways is to reduce the noise from the source. This further emphasizes the need for the Department to give high priority to efforts aimed at quieting vehicles.

VI. The Coastal Zone Policy of the State in Transportation

One of the most recent and significant advances in considering transportation as an integral part of the social and physical environment became manifest in the articulation of the "Coastal Zone Policy" by the Department of Public Works, in respect to transportation. The policy is as follows:

A. Philosophy

The California coastal zone is a unique and irreplaceable natural resource with a limited capacity for use and development. The permanent protection of the natural and scenic resources of the California coastal zone is of paramount concern to present and future residents of the State and Nation.

B. Zone Definition

The coastal zone is defined, for transportation planning purposes, as an area of variable width abutting the Pacific Ocean and extending inland to the highest elevation of the nearest coastal mountain range. Where coastal plains lie adjacent to the ocean, the zone generally will be considered as one-half mile in width.

C. Policy

It is the policy of the Department of Public Works to help provide the coastal zone with optimal transportation service consistent with local and regional total planning and with the objective of conserving the coastal resource. Various modes of transportation, means of access and levels of service will be considered in balance with coastal capacities to preserve and enhance the coastal resource.

D. Planning Concepts

1. Significant portions of the coastal zone may not be suitable as the location of a major north-south transportation corridor. Consideration will be given to linking coastal destination points by lower standard highway facilities, by alternative routings, or recommending other modes of transportation, if appropriate.

Understanding that both business and recreational drivers have a legitimate interest in access to the coastal zone, creative approaches to serving these interests will be encouraged within the framework of this policy.

2. Traffic which is not specifically oriented toward use of the coastal zone will be encouraged to use other nearby traffic corridors.

3. Coastal highways will generally function as arterials, providing variable levels of service with mixed operating conditions, and furnishing appropriate land access.

4. Transportation facilities within the zone will be planned in cooperation with local and regional agencies to:

   a. Encourage and support human uses which are dependent on the coastal zone's natural resources.

   b. Enhance and conserve environmental qualities or amenities while minimizing disruption to stable ecological systems and harmonizing, as nearly as possible, with natural land forms.

   c. Maintain the widest number of options possible for future generations.

   d. Assist in preserving unique scientific, educational, and recreational opportunities.

   e. Emphasize safe business and recreational driver enjoyment of the coastal resource rather than speed of vehicular movement.

5. When the State and local agencies agree that, for compelling reasons, freeways or broad arterials are necessary in the coastal zone, special planning and design criteria within the context of this policy will be utilized.

It is the intent of the policy that the State undertake only minimal freeway construction along what has been designated in the policy as a "coastal zone". The policy's definition of the coastal zone is essentially the same as COAP's, but may vary slightly with other definitions. Any variations reflect divergence in the missions and responsibilities of different agencies.

In recent years, it has become clear that certain areas of the State have a limited absorptive capacity for people and their activities, and it would appear that in many of these portions of the State, the growth of the population is challenging the resources which can support a healthful existence. Further, it has become clear that certain areas of the State are of such interest to all of the people of the State that they demand special consideration by development of specific policies, criteria, and legal safeguards. Such areas include the coastline and certain mountain, forest, desert, and prime agricultural zones, as well as specific segments of the State's urbanized areas. The coastal zone, then, becomes the first area of emphatic conservational concern in State transportation planning.

On a continuous basis, the planning process for transportation corridors will recognize that the California shoreline and its beaches are a priceless resource to the people of the entire State, and, of course, the Nation. The transportation planning process will recognize that the coastal-marine zone exists as an interdependent, physical, and biological system in delicate ecological balance. Although the shoreline and its beaches can be used by the residents of the State for a variety of purposes, the beaches, estuaries, marshlands, and other integral parts of the coastal life zone are especially susceptible to disruption and destruction by man. Thus, the intent of the policy is that transportation shall encourage human activity that is compatible with nonhuman processes. Therefore, transportation planning and development will vary between coastal areas. Where it might be completely feasible to suggest a form of rail mass transit in a highly congested area, such a mode would not be considered in a sparsely populated area that might best

be served by a two-lane conventional highway. On the other hand, where transportation can obviously not accommodate development plans, then local agencies will have the opportunity, through their local planning efforts, of reassessing anticipated densities of population.

The State and local areas have been involved in comprehensive transportation planning in various portions of the coastal zone for several years and the anticipated effect of the new policy will be to make such transportation planning more conducive to the best interests of the people of the State. For example, there will be some modifications in procedures previously followed in highway planning. In the past, because of traffic demand, it was almost a foregone conclusion that any planning study would result in a recommendation for freeway construction. Now, insofar as the coastal zone is concerned, the highway planners will have to first establish not only the overriding need for such construction before it will be considered, but also the project's compatibility with the goal of conserving the coastal environment. On the other hand, the policy does not place excessive restrictions on planning and development possibilities in the coastal zone. It encourages planning on a broader scope. It could curtail some planning and development by making it clear that a particular freeway or highway will not be built close to the coast, but as with transportation planning, other possibilities may be opened up in a given situation.

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