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Municipal Coastal Hazard Planning: Los Angeles and Orange County City Responses, California

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ABSTRACT

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This paper describes results of two surveys of southern California municipal planners to determine their degree of emphasis given to coastal hazards within their jurisdictions. With growing property losses associated with the coastal zones of southern California, the studies were undertaken to assess the role of planning for hazards in coastal land use decisions. The findings show that while planners are gaining knowledge of their coastal zones, they still tend to view the coastal zone as just one element in the overall planning process. Their emphasis on day-to-day development permitting overshadows a proactive stance on strategic planning for coastal hazards.

ADDITIONAL INDEX WORDS: *Coastal hazards, local planning, southern California.*

INTRODUCTION

Coastal population growth with its concomitant development is a leading source of stress on the coastal environment (COATES, 1989). Nowhere is this force more apparent than in the southern California coastal zone with its increasing traffic congestion and lack of parking at local beaches, frequent sewage spills and beach closures, infilling and expansion of existing coastal developments, and continuing property losses from coastal erosion. A fifty year description of past and projected population growth shows the tremendous growth experienced by the California coastal zone; indeed, California has the largest total population in coastal counties in the United States (WARREN *et al.,* 1977).

Los Angeles and Orange Counties comprise more than 100 miles of the total 1100 mile California shoreline and account for the popular image of California scenic beach areas. These two counties also contribute the majority of coastal residents and have an intense infilling of their coastal zones. Coastal municipalities are inundated with new residents seeking housing, as well as tourists seeking places to stay. Older, smaller houses are replaced by mansions, condos and hotels. More residents and tourists demand more services and new businesses are opened to meet the need. Additional municipal services are required alike by residents, tourists and businesses.

Such growth impacts negatively on the environment, but the mere presence of this population and infrastructure bears impacts from the coastal zone as well. Coastal hazards are many in southern California. Winter storms along with torrential rains interacting with erosive soils have generated cliff slumping, mud slides and beach loss along with whatever structures were associated with these areas. For example, rains caused landslides, subsidence, and debris in Orange County resulting in a loss of homes, highway, railroad and municipal services for a total of $75 million in 1993 (WALKER and BERG, 1993). The City of Malibu suffered floods and mudslides from winter rains at an estimated cost of $22 million in 1995 (POOL, 1995). The City of Redondo Beach was hit three times by winter storms in 1988, resulting in a loss of structures with 18 businesses destroyed for a total of $32 million lost (FISCHER, 1990). These costs involve direct losses and do not include the costs of loss of business, litigation and additional protective works to mitigate future storm damage. California suffers an average of $10 million in property losses annually due to winter storms (GRIGGS *et al.,* 1992).

Not only are there recurring hazards of high probability, such as winter storms, but hazards of lower probability also exist. These hazards include tsunamis, earthquakes and sea level rise. Given the loosely consolidated soils underlying coastal bluffs and comprising beaches in southern California, these hazards can be termed significant, especially in conjunction with winter storms. Since tsunamis and earthquakes have hit southern California's immediate coastal zone in historic times, they can occur again. The recent quake in Kobe, Japan, with the epicenter in the coastal zone resulted in widespread loss of life, property and infrastructure (REID, 1995).

Sea level rise is a "rising" hazard of immense scope. The expected national coastal property loss just in wetlands has been compared to the loss of the entire state of Massachusetts (TITUS, 1991). While California losses are estimated to be less than elsewhere in the United States, such losses will be major and impact on the entire economy, the state's water re-

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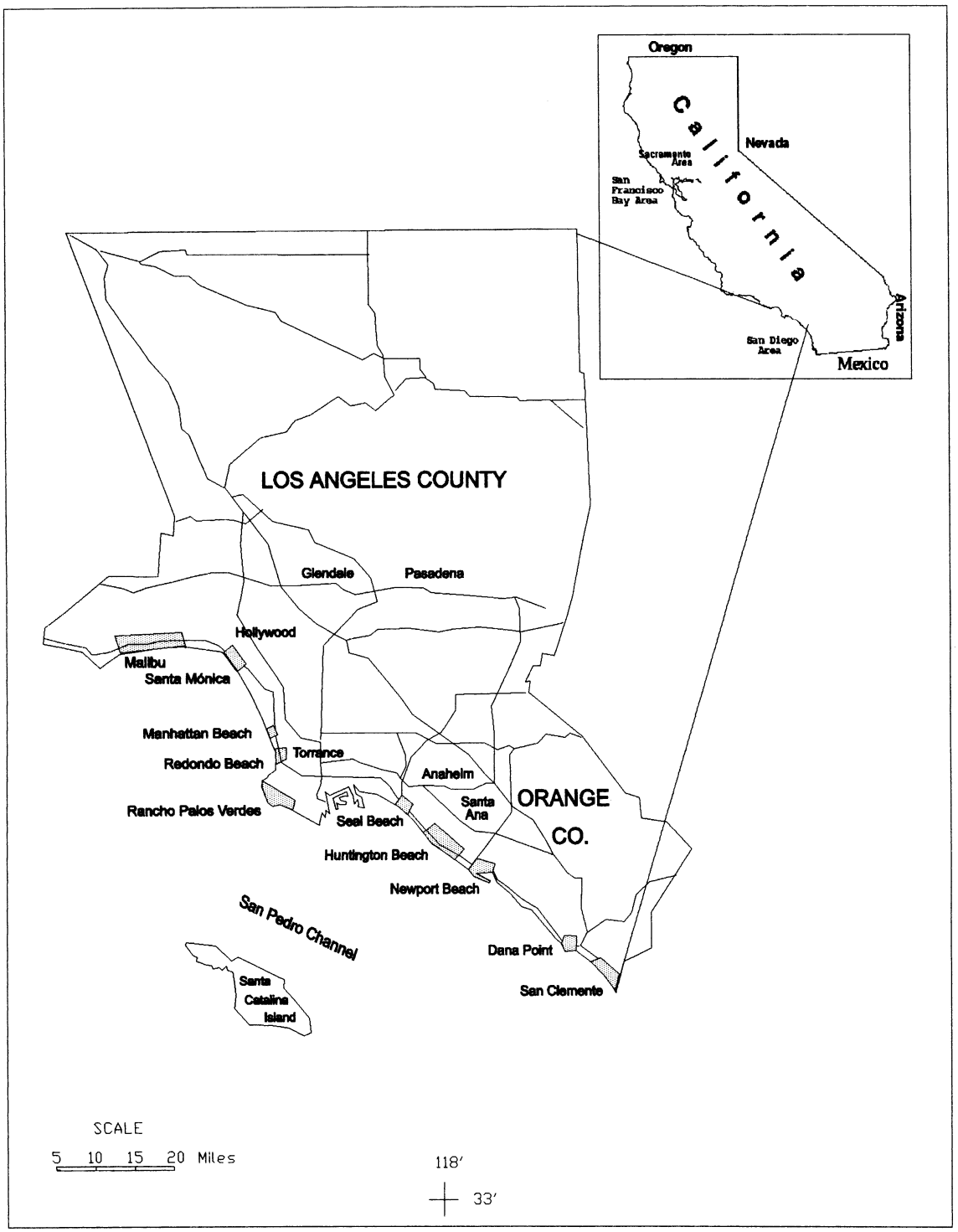

Figure 1. Location of study area.

Table 1. *Selected southern California municipalities.*

Municipality	Population	Coastal Population	Coastal Length (Miles)	Persons Per Coastal Mile
Malibu	11,500	8,000	27.00	296
Santa Monica	89,902	10,000	3.50	2,857
Manhattan Beach	33,000	8,000	2.10	3,809
Redondo Beach	60,500	15,000	2.75	5,454
Rancho Palos Verdes	41,000	6,000	7.50	800
Seal Beach	26,000	10,000	2.00	5,000
Huntington Beach	181,000	25,000	8.00	3,125
Newport Beach	70,000	40,000	9.00	4,444
Dana Point	34,000	28,000	8.00	3,500
San Clemente	41,000	23,500	3.50	6,714
Total	588,002	173,500	73.35	2,378

Table 2. *Type of shoreline (miles).*

Municipality	Cliff	Beach	Wetland	Harbor	Totals
Malibu	10.00	27.0	1.00		38.00
Santa Monica	0.40	3.50			3.90
Manhattan Beach		2.10			2.10
Redondo Beach	0.25	1.75		1.00	3.00
R. Palos Verdes	5.10	2.25			7.35
Seal Beach		2.00			2.00
Hunt. Beach		8.00	4.00		12.00
Newport Beach		5.50		3.50	9.00
Dana Point	1.00	6.00		1.00	8.00
San Clemente	3.00	0.50			3.50
Total	19.75	58.60	5.00	5.50	88.85*

* Some beach areas backed by cliff, wetland or harbor creating an overlap.

sources, wetland habitats, fisheries, endangered species, coastal bluffs and beaches, and coastal properties (CEC, 1989). San Francisco Bay would be irrevocably changed through the necessity of having to build seawalls and levees at an estimated cost of $1 billion with an annual maintenance of $100 million (STEIN, 1990). Coastal beach retreat in southern California has been estimated to be between 30–200 feet by the year 2050 with an even greater risk inland from winter storms and wave run-up (GUSTAITUS, 1989).

With the southern California population attracted to coastal activities in spite of coastal hazards; a planning and regulatory framework was created to account for impacts of coastal use and development (Act, 1988). The general policies of the California Coastal Act include:

(1) Providing for maximum public access to and recreational use of the coast, consistent with private rights and environmental protection.
(2) Protecting marine and land resources, including wetlands, rare and endangered habitat areas, environmentally sensitive areas, tidepools, and stream channels.
(3) Maintaining productive coastal agricultural lands.
(4) Directing new housing and other development to urbanized areas with adequate services rather than allowing a scattered, sprawling pattern of subdivision.
(5) Protecting the scenic beauty of the coastal landscape.
(6) Locating any needed coastal energy and industrial facilities where they will have the least adverse impact.

It should be noted that coastal hazards do not appear as a general policy goal in the Coastal Act. The Act does not recognize coastal hazards; as only one section notes that developments shall, "minimize risk to life in areas of high geologic, flood and fire hazard" (section 30253). No coastal hazard requirements are set forth in either the Coastal Act or its implementing guidelines. Thus, local governments which must implement the California Coastal Act can be expected to have a wide variety of responses to coastal hazards.

Each coastal city is required to prepare and maintain a local coastal plan (LCP). The LCP incorporates the policies outlined in the Coastal Act and must be approved by the California Coastal Commission. A LCP is the city's specific, long-term coastal management plan which includes a land use plan, zoning ordinances and other implementing actions. LCP's are drafted by coastal cities, submitted to the Coastal Commission for approval and, upon approval, are formally adopted by the City Council of the authorizing city (CCC, 1981).

Because municipal governments bear the brunt of planning for hazard impacts, this paper focuses on this level of government. The objective is to identify the extent to which coastal municipalities in southern California plan for coastal hazards and what mitigation measures, if any, are used or being considered. A further objective is to assess the level of knowledge city officials have concerning coastal problems, resources and hazards, and what features are incorporated, if any, into their local coastal plans.

SELECTED PREVIOUS STUDIES

Information about the role of local government in coastal planning is scarce. Recent case studies about California coastal cities are scant because most studies are conducted statewide. One such state-sponsored study focused on the coastal policies of local governments in the Los Angeles area before and after the passage of the California Coastal Act of 1976 (WARREN *et al.,* 1977). The study looked at development patterns and the coastal residential permit process. For example, before the Coastal Act, Redondo Beach allowed extensive coastal development which transformed the City from a small, "local only" beach community to a larger municipality with King Harbor and an urban redevelopment project. After passage of the Coastal Act, the new permit process halted many proposed projects in Redondo Beach, including some projects with tremendous citizen support. The authors of this study concluded that the California Coastal Commission (CCC) should not make decisions based on universal principles, but rather should take time to review local government policies which reflect the historical patterns and preferences of local citizenry.

Research focusing on coastal hazards based on surveys of municipal planners are growing in number. One of the earliest efforts was on the response of coastal municipalities to coastal flood hazards (BURTON *et al.,* 1969). This research reported on the adaptions municipalities were making to coastal storm experiences in order to reduce the associated losses of life, property and local revenues. The study area

Table 3. *Existing coastal development.*

Municipality	Pier	Marina	Tourist Facilities	Housing	Commerical	Parking	City Services	Other	Total
Malibu	X			X					2
Santa Monica	X		X	X	X	X	X		6
Manhattan Beach	X			X	X	X			4
Redondo Beach	X	X	X	X	X	X		X	7
R. Palos Verdes			X	X	X	X	X	X	6
Seal Beach	X		X	X	X	X	X		6
Hunt. Beach	X		X	X	X	X		X	6
Newport Beach	X	X		X	X	X			5
Dana Point	X	X		X	X	X		X	6
San Clemente	X		X	X	X	X	X	X	7
Total	9	3	6	10	9	9	4	5	55

Other: electric plant, churches, agriculture, interpretive center, recreation, county parks, railroad station

covered the eastern U.S. coast from Maine through North Carolina from which 15 municipalities were selected as case studies. A major finding was that zoning is best left to local government, since their regulations of land use recognize flood hazard planning on the basis of the degree of hazard faced in each location. In this way, the type of use and construction can be adjusted to fit the degree of hazard involved.

A survey of all coastal counties in Florida having a sandy beachfront focused on local officials' perceptions and responses to shoreline erosion (FISCHER *et al.,* 1986). Detailed questionnaires sought information on local coastal objectives, physical beach trends, beachfront land uses and planning, erosion control measures favored, and coastal issues encountered in beach management. Results showed that coastal county officials were on the whole responding to beach erosion and developing measures for reducing dune and beach losses in their general plans. In addition, the economic and policy issues associated with shoreline erosion were enumerated in FISCHER (1990).

One study tracked the "American Trader" oil spill in Huntington Beach (FISCHER, 1993). The problem which surfaced during this accident was the lack of coordination between local governments that were affected by the spill. There was little communication between and among the five immediately affected cities and the 49 other federal, state and local agencies involved in the clean-up efforts. This study stressed the importance of local governments taking an "all hazards" approach in their coastal planning.

Two other studies concerning coastal hazards focused on increased coastal erosion resulting from sea level rise. The first study, conducted in Ocean Breach, California, near San Francisco, stated that by the year 2100, sea level rise will generate increased erosion (WILCOXEN, 1986). In Ocean Beach, a Sewer Transport Project located in the coastal zone was approved by the California Coastal Commission and the participating cities without full knowledge of the effects sea level rise would have on the completed project. This study showed that erosion caused by sea level rise would undermine the approved sewer transport project. The second study on sea level rise focused on planning for this hazard. The author stated that, "planning for global (warming) is made difficult not only as a result of the diversity of agencies involved in producing country assessments and/or recommendations of actions, but also because such assessments have been undertaken in an uncoordinated manner, as a crisis response to current concerns, and without clear definition of spatial and temporal boundaries". This study concluded that many, "local, regional and national studies have failed to define precisely the changed conditions or the time frame under which projected scenarios will occur and have often been based on general rather than theoretical reviews of broad ar-

Table 4. *Parts of coastal zone legally protected by municipalities.*

	Natural Features Protected													
Municipality	A	B	C	D	E	F	G	H	I	J	K	M	N	O
Malibu													X	
Santa Monica													X	
Rancho Palos Verdes		X		X	X		X		X			X		X
Manhattan Beach		X							X					
Redondo Beach													X	
Seal Beach		X	X		X						X	X		
Huntington Beach	X	X	X	X	X	X	X	X	X	X	X	X		
Newport Beach	X	X	X		X		X				X	X		X
Dana Point		X	X	X			X		X	X		X		
San Clemente		X		X	X		X	X	X			X		
Total Number	2	7	4	4	5	1	5	2	5	2	3	6	3	2

A: dunes, B: beaches, C: wetlands, D: cliff tops, E: fauna, F: farms, G: open spaces, H: old buildings, I: hazardous areas, J: rivers, K: bays, M: vegetation, N: no responses, O: other

Table 5. *Hazards officially recognized by ten municipalities.*

Municipality	S	F	CS	LM	BE	SL	T	W	WF	P	AS	E	O	N	NP
Malibu															X
Santa Monica															X
Rancho Palos Verdes	X	X	X	X	X		X		X	X			X		
Manhattan Beach										X	X				
Redondo Beach	X	X			X	X	X	X		X					
Seal Beach	X	X			X						X		X		
Huntington Beach	X	X	X	X	X	X	X	X	X	X	X	X			
Newport Beach	X	X	X	X	X		X		X	X	X	X	X		
Dana Point	X	X	X	X	X	X	X		X	X	X				
San Clemente			X		X					X					
Total Number	6	6	5	4	7	3	5	2	4	7	5	2	3	0	2

S: storms, F: floods, CS: cliff slumping, LM: landslides/mudflows, BE: beach erosion, SL: sea level rise, T: tsunamis, W: winds, WF: wildfires, P: pollution, AS: accidental spills, E: explosion, O: others, N: none, NP: no response

eas of impact which may or may not occur in any given location" (PERNETTA and ELDER, 1992).

The Santa Monica Bay Restoration Project (SMBRP), a non-profit organization, developed a plan in 1994 for restoring Santa Monica Bay to a more pristine condition (SMBRP, 1994). This plan takes into account the stressors put on the Bay from the high level of growth and development in the Los Angeles County area. The Senior Planning Manager at SMBRP stated that beach erosion was not accounted for in the restoration plan (MARIANNE YAMAGUCHI, 1995). The plan examined the pollution factors and the natural resources of the Bay for developing a comprehensive bay restoration plan. She indicated that while beach erosion was an issue, information was not readily available.

The U.S. Corps of Engineers developed a report in 1992 establishing a five year study on the state of the Orange County coast (COE, 1992). The purpose of this study was to develop a data base for improving planning and management of this coastal zone. The study is a comprehensive effort geared toward the assessment, evaluation and analysis of southern California coastal processes.

Two local government responses to coastal hazard based on surveys were recently completed. The first concentrated on California municipal efforts to develop and protect their coastal zones through municipal ordinances and regulations (GRIGGS *et al.,* 1992). This study used questionnaires and interviews as a basis to describe local government requirements and regulations for seawalls, setback lines, and other erosion control measures. The second study used a telephone survey to determine views of Louisiana coastal residents and local officials on the impact of sea level rise (LASCHA and EMMER, 1992). The California and Louisiana surveys showed the need for clearer policies from state governments to assist local land use planning in potentially hazardous coastal areas. Coastal hazard information was deemed lacking as well as the regulatory measures needed to reduce development in threatened areas. Surprisingly, only four out of the 48 California local governments surveyed had a specific ordinance dealing with geologic hazards. Even though the Louisiana study dealt with sea level rise and the California study dealt with coastal erosion and flooding, both studies showed that local officials felt they lacked the regulatory measures to address these problems effectively. While no official wanted to restrict development in response to coastal hazard, local governments seemed increasingly aware of the conflicts they faced between public and private concerns.

Table 6. *Existing shoreline protection.*

Municipality	Groins	Jetties	Riprap	Break-water	Sea-walls	Total
Malibu	X		X		X	3
Santa Monica	X			X g		2
Manhattan Beach	X a					1
Redondo Beach	X b					1
R. Palos Verdes						0
Seal Beach	X c	X d		X		3
Hunt. Beach	X a					1
Newport Beach		X e				1
Dana Point				X h		1
San Clemente			X f			1
Total	6	2	2	3	1	14*

* Some beach areas backed by cliff, wetland or harbor creating an overlap. a = Pier, b = 2 (0.75, 0.20 mi), c = 1200 ft, d = 2 (1600, 2500 ft), e = 8 (COE), f = 1.5 mi, g = 2000 ft, h = 2 (1.1, 0.25 mi)

A survey study by the authors was conducted among northern Spanish coastal municipalities. It showed that local officials tend to rely on personal observations, legal requirements and tourist demands for making coastal land use decisions (FISCHER, *et al.,* 1995). Scientific information in the form of expert studies had not played a role in planning decisions. The views of these officials with respect to the need for coastal protection and hazard avoidance were at variance with scientific studies conducted in the same region.

The three survey studies in California, Louisiana and Cantabria show that coastal planners desire clearer policies and regulatory measures from the next higher level of government to assist them in planning for coastal protection and hazard avoidance. These studies illustrate a discrepancy between what is known scientifically and what is being implemented locally by municipalities (RIVAS, *et al.,* 1994).

METHODOLOGY

The data for this study were obtained through two surveys administered in 1995 and 1997, the latter with a more restricted focus on erosion. In Los Angeles Country, the cities

Table 7. *Coastal problems experienced in ten cities in southern California.*

Coastal Problems Experienced	Erosion		Cliff Slumping		Flooding		Channel Silting		Increasing Urbaniz.	
	1995	1997	1995	1997	1995	1997	1995	1997	1995	1997
Malibu		X			X		X			
Santa Monica		X	X	X					X	
Manhattan Beach								X	X	
Redondo Beach						X		X		
Rancho Palos Verdes	X		X	X						
Seal Beach	X	X				X				X
Huntington Beach		X	X	X		X				
Newport Beach	X	X	X		X					
Dana Point		X	X	X						
San Clemente	X	X	X	X						
Total	4	7	6	5	2	3	1	2	2	1

of Malibu, Santa Monica, Rancho Palos Verdes, Manhattan Beach and Redondo Brach were contacted. In Orange County, the cities of Seal Beach, Huntington Beach, Newport Beach, Dana Point and San Clemente were contacted. The two large cities of Long Beach and Los Angeles were excluded because of their size relative to all other coastal cities and their breakwater protected shoreline. Table 1 describes these municipalities, and Figure 1 maps them.

Of the cities surveyed, approximately 30% of their population lives within one mile of the shoreline along the southern California coast. The population density within one mile of the shoreline and for each mile along the coast is shown in Table I.

It is recognized that coastal planning is influenced by national, regional and local levels of government as well as nongovernment organizations and the general public. However, this study focused on local government because it is this level of government where coastal plans are forged, interpreted and implemented. Local government officials seek to integrate the requirements of other government levels with demands from their constituents in an effort to create the plans that shape the development of their respective coastal zones.

An advance copy of the questions was sent to the planning director of each municipality included in the study together with a cover letter requesting that the questions be given to the municipal planner with responsibility for technical coastal considerations prior to the interview. Once the name was known each individual involved was contacted for a convenient interview time. During the interview each was asked the pre-determined, multiple-option questions in the order presented in the questionnaire and their responses were recorded by the interviewer. Five medium sized cities in Los Angeles and in Orange Counties were included for a total of nearly 75% of their respective shorelines (Table I).

The questions asked included the nature of coastal problems being experienced, what coastal features were protected, what coastal hazards were acknowledged, the respondent's knowledge of sea level rise, planning response to conflicts involving coastal protection and development, and the respondent's use of scientific information. The questions used were drawn from the California, Louisiana and Spanish studies previously described.

Since the focus of the study was centered on ten coastal cities, the data from the questions were subjected to a qualitative analysis. For each question the number of municipalities responding to that element were counted, totaled and placed into a table that grouped similar questions and responses.

SURVEY RESULTS AND DISCUSSION

Table II shows approximately 90 miles of shoreline affected by exposure to the ocean. The percentage of various shoreline features is as follows: 66% is beach, 22% is cliff, 6% is wetland, and 6% is harbor. The coast of southern California is predominantly sandy beach exposed to erosion. Erosion of

Table 8. *Reasons for coastal problems in ten cities in southern California.*

Reasons for Coastal Problems	Incr. Urbaniz.		Nature		Lack of Local Authority		Lack of Funding	
	1995	1997	1995	1997	1995	1997	1995	1997
Malibu		X	X				X	X
Santa Monica	X		X	X				
Manhattan Beach	X	X		X		X		X
Redondo Beach		X		X		X		X
Rancho Palos Verdes	X			X	X		X	
Seal Beach	X	X		X		X	X	X
Huntington Beach				X				X
Newport Beach	X	X	X					X
Dana Point		X						X
San Clemente				X			X	X
Total	5	6	3	7	1	3	4	8

Table 9. *Loss of shoreline due to erosion (perceived, 1997).*

Municipality	Much	Some	None
Malibu		X	
Santa Monica		X	
Manhattan Beach			X
Redondo Beach			X
R. Palos Verdes		X	
Seal Beach		X	
Hunt. Beach		X	
Newport Beach	X		
Dana Point		X	
San Clemente		X	
Total	1	7	2

Table 10. *Development caused degeneration of the shoreline.*

Municipality	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
Malibu		X			
Santa Monica		X			
Manhattan Beach		X			
Redondo Beach		X			
R. Palos Verdes				X	
Seal Beach	X				
Hunt. Beach				X	
Newport Beach		X			
Dana Point			X		
San Clemente			X		
Total	1	5	2	2	0

cliffs is apparent when there is little vegetation to hold the soil. Wetlands usually are protected by the beach, but both experience the effects of erosion through the absence of sediment from riverways.

The characteristics of coastal development for the cities are shown in Table III: 100% have housing, 90% have piers, commercial property/businesses and parking facilities, and 60% have tourist facilities. All cities surveyed have housing located within the coastal zone corresponding to the number of people located along the coast. The property value in Orange County is estimated at over $150 billion, with ocean front property carrying the highest assessment. Only the City of San Clemente reported the availability of substantial amounts of vacant coastal land for future development.

The commercial business base in the coastal zone provides vital services to the local population, but more importantly to the tourists. Tourism is very important to the southern California economy contributing $7.1 million directly to Los Angeles County in 1991 (SMBRP, 1994). The parking facilities support the huge inland resident population as well as visitors to the coastal area.

These structures are threatened when beach erosion is significant. This is illustrated by losses from the 1982 and 1983 storms, amounting to $40.1 million in damages (COE, 1992). The 1988 storms resulted in $32 million in damages, especially King Harbor in Redondo Beach. Homes in Seal Beach were flooded in both 1983 and 1988 because of beach erosion. Piers destroyed in Redondo Beach, Manhattan Beach, Seal Beach, Malibu and Huntington Beach have been rebuilt since these storms.

Table IV shows the specific types of natural coastal features protected by each municipality. The table indicates that a majority of the municipalities actively protect beaches and open spaces while few cities protect dunes, farms and rivers. The table also indicates the measures employed by municipalities to protect these natural features. Frequently-used protection measures include regulations, buffer zones, special use plans/zones, building codes and engineering structures. None of the municipalities reported buying-out owners as a coastal protection measure. As shown in Table III, this may be due to lack of funding. Few municipalities reported banning activities or lowering taxes as coastal protection methods.

Table V shows the coastal hazards officially recognized in LCPs. Beach erosion and pollution stand out as the hazard most frequently recognized, followed by storms and floods. No city ignored coastal hazards, although two cities did not respond to this question.

The cities surveyed have reported the following shoreline protection devices (Table VI): 60% use groins, 30% use breakwaters; 20% use jetties, 20% use riprap; and 10% use seawalls. These structures are built to prevent movement of sediment away from or into an area, improving navigation of harbors, flood relief, and protection of property from storm waves. In Newport Beach there are eight groins protecting the coast causing the shoreline to be irregular and inhibiting the movement of longshore sediment. South of this groin field, Laguna, Dana Point and San Clemente suffer the loss of beach width. Jetties at Alamitos Bay and Anaheim Bay eliminate sand transport to Surfside, Sunset and Huntington Beach. The Huntington Beach Pier acts as a permeable groin reducing longshore current and slowing the travel of sediment. In Malibu riprap protecting housing structures has diminished the amount of sediment down shore. In Santa Monica the 2,000 foot breakwater has deteriorated from the 1982–1983 storms causing the beaches to become narrower. However, the sand is no longer trapped allowing sand to replenish beaches to the south (COE, 1992).

Table VII shows the coastal zone problems being experienced by each of the municipalities. In 1995 six cities reported problems with cliff slumping and four noted coastal erosion. The 1997 survey showed erosion was reported by 7 out of the 10 cities and cliff slumping declined from six to five cities. Other than the addition of the three cities noting erosion problems (a rise of 57%) in 1997, the types of coastal problems varied only by one city between 1995 and 1997.

Table VIII shows the reasons cited by the respondents for their coastal problems. Municipalities viewed urbanization pressures, "nature" and lack of funding as the reasons behind their coastal problems. The dramatic change between 1995 and 1997 was the increase in the number of cities noting nature and lack of funding as primary reasons for their coastal problems. A lack of funding would likely discourage cities from developing strategies against beach erosion and cliff slumping. Nature as a reason for erosion could have come from the increased media coverage of "El Niño" expectations.

According to Table IX, the cities have observed erosion as follows: one city felt it had much erosion, 7 indicated some erosion, and two claimed no loss of shoreline due to erosion.

Table 11. *Municipal preferences for new coastal zone projects and planning measures.*

	If Had $25 Million Dollars/If Had To Match By 50%															
Municipality	RC	NP	P	MA	PC	HM	RP	M	ST	WP	ES	O	N	P	YM	NM
Malibu						X	X			X						X
Santa Monica			X				X					X			X	
R. Palos Verdes						X					X					X
Manhattan Beach		X	X				X									X
Redondo Beach				X		X										X
Seal Beach											X	X				X
Huntington Beach		X		X						X	X				X	
Newport Beach												X			X	
Dana Point			X	X	X										X	
San Clemente		X			X										X	
Total Number	0	3	3	3	2	3	3	0	0	2	3	3	0	0	5	5

If Had $25 Mill Dollars: RC = New roads to coast, NP = New parking lots on coast, P = View parks in city, MA = Museum/aquarium, PC = Promenade along coast, HM = Hazard mitigation on coast, RP = Recreation pier, M = Public marina on coast, ST = Enhanced sewage treatment, WP = Wetland protection, ES = Engineering structures, O = Other, N = None, P = No response
If Had to Match by 50%: YM = Yes, would match funding by 50%, NM = No, would not match funding by 50%

In Malibu Las Tunas Beach has experienced significant erosion creating an unstable beach face. During the last 16 years, Los Angeles County had about three million cubic yards of sand placed on beaches. In 1968 the Army Corps of Engineers (COE) engaged in a beach nourishment program in Redondo Beach which makes up most of that beach today. Santa Monica has experienced a loss of beach width resulting from the deterioration of a breakwater.

In Orange County, Seal Beach, Sunset, Surfside, Newport Beach, Dana Point (Doheny State Beach) and San Clemente have experienced loss of beach width from erosion. Every five to six years, between 1–2 million cubic yards of sand are placed on beaches in Newport Beach from an offshore dredging program. In 1983–84 approximately 250,000 cubic yards of sand were used to replenish Seal Beach from the Naval Weapons Station (COE, 1992). Eroded sand either shoals offshore creating shallower depths or is lost in the longshore current. Shoaling of sand is important for navigational purposes as oil tankers service the Huntington Beach oil field and one tanker recently grounded there. All the area's beaches experience a seasonal shift in positioning of lifeguard towers.

The replenishment programs cited above are important because they reflect significant erosion and the inability of the respective beaches to replenish naturally. According to the planners interviewed, the losses of beaches are affected by sediment loss from channelization and flood control measures to protect inland areas from flooding. The upstream dams and concrete spillways practically eliminate the inland as a sediment source. However, the shoreline erosion control structures contribute to this loss as well since they trap sand in some places and cause more extensive erosion in other places.

Table 12. *Types of natural and technological hazards studies undertaken.*

Municipality	E	G	UP	VA	SE	O	N	P
Malibu								X
Santa Monica	X	X	X	X	X			
R. Palos Verdes			X		X			
Manhattan Beach						X		
Redondo Beach	X		X					
Seal Beach	X							
Huntington Beach					X			
Newport Beach	X	X	X					
Dana Point	X	X	X					
San Clemente	X	X	X		X			
Total Number	6	4	6	1	4	1	0	1

Hazards Studies Undertaken: E = Engineering, G = Geological, UP = Urban Planning, VA = Vegetation assessment, SE = Socio-economic, O = Other, N = None, P = No response

Cliffsides also have been experiencing a degree of noticeable erosion. In Rancho Palos Verdes, the U.S. Coast Guard Point Vicente Lighthouse has been moved once to prevent its destruction from the eroding cliff. In Huntington Beach there has been loss of cliff due to erosion, and Santa Monica, Dana Point and San Clemente also have experienced cliff losses.

The responses in Table X reflect the opinion that coastal development does cause degeneration (erosion) of the shoreline. The responses were as follows: one city strongly agreed, five agreed, while two cities did not believe development resulted in erosion. Only two cities had no opinion. The planners emphasized how the channelization of the riverways to prevent floods has significantly contributed to the erosion process. This channelization is a direct result of the enormous population found in southern California and the development pressure caused by the resulting population density. This pressure has resulted in expansion of public infrastructure and flood control. Sand delivery has been reduced in the Los Angeles, San Gabriel and Santa Ana Rivers as a result of sediment impoundment in reservoirs and greatly changed land uses. Urbanization has brought a reduction in sediment as erodible surfaces are made impermeable. Within this study area there are seven channelized riverways which transport water and little sediment to the ocean, thereby adversely affecting adjacent beaches.

The flood control measures prevent materials from reaching the ocean for most of the year due to the long dry season. The beach lost during the winter months is generally not replaced during the dry summer months, leaving the shoreline vulnerable. Also, shoreline protection measures result in a

Table 13. *Types of measures used to avoid coastal hazards.*

Municipality	BA	PS	BC	EP	RL	BO	DH	ES	HI	EP	LU	BZ	O	N	P
Malibu															X
Santa Monica	X	X	X	X	X	X	X	X	X	X	X	X			
R. Palos Verdes			X				X				X	X			
Manhattan Beach													X		
Redondo Beach			X					X			X				
Seal Beach			X	X				X	X	X	X		X		
Huntington Beach			X				X	X			X				
Newport Beach			X				X	X		X	X	X			
Dana Point		X		X				X		X	X	X			
San Clemente	X	X	X				X			X	X	X			
Total Number	2	3	7	3	1	1	5	6	2	5	8	5	2	0	1

Measures Used to Avoid Hazard: BA = Ban Activity, PS = Performance Standards, BC = Building Code, EP = Educational Program, RL = Reimbursement for Loss, BO = Buy-out Owner(s), DH = Designation of Hazard Zones, ES = Engineering Structures, HI = Require Hazard Insurance, EP = Evacuation Plan, LU = Land Use Planning, BZ = Buffer Zone, O = Other, N = None, P = No Response

reduced longshore sediment transport. This loss of beach has reduced recreational beach areas which combined with structural protection is increasing the risk from further storm damage.

Table XI shows preferences for new projects and is based on the hypothetical question of how each municipality would spend $25 million dollars. Coastal and non-coastal choices were included in the list of spending alternatives. There was little agreement among the municipalities about the most desirable new projects. Preferences were offered for hazard mitigation and new parks followed by new parking lots, a museum or aquarium, a recreational pier and engineering structures. No municipalities favored new roads to the coast, a new public marina or upgrading existing sewage treatment. Most municipalities would recommend the same expenditures if their municipality had to provide 50% of the matching funds for the new projects, particularly for hazard mitigation. Orange County cities appear more willing to provide matching funds than Los Angeles County cities.

Table XII describes the types of hazard studies prepared by planners to assess and mitigate coastal hazards. Most municipalities identified storm and beach erosion hazards, but interestingly, the majority of municipalities reported using urban planning as a means to assess and mitigate hazards. Urban planning alone cannot solve the problems that arise from beach erosion and storms, but in combination with engineering studies, coastal management may contribute to reducing the impact of these problems. Santa Monica is the only municipality that uses all the types of studies identified in the survey to assess and mitigate identified coastal hazards.

Table XIII illustrates the measures used by municipalities to avoid coastal hazards. Again, Santa Monica used all studies/measures noted in the survey. Most of the municipalities use land-use planning measures because the California Coastal Commission requires municipalities to include a land use element in their local coastal plan. The City of Malibu is the only survey municipality that does not have a local coastal plan and could not respond to this section of the survey.

Table XIV describes hazard avoidance measures that municipalities are willing to adopt. Most of the municipalities were willing to engage in erosion setback lines and land-use planning based on hazard potential and post storm/flood reconstruction restrictions. A lesser number of cities would use educational programs, redesign infrastructure, create special hazard study zones and require hazard insurance of residents in the coastal zone. None of the municipalities were willing to pay part of the cost of residential relocatation or purchase

Table 14. *Types of measures willing to consider to avoid hazards.*

Municipality	ES	EP	LU	RI	PR	BZ	SL	DR	DS	BS	DB	RI	CR	HZ	BH	RI	BN	O	P
Malibu	X		X		X	X								X		X			
Santa Monica	X	X	X		X	X	X		X			X		X		X			
R. Palos Verdes	X			X						X		X		X					
Manhattan Beach		X										X							
Redondo Beach											X								
Seal Beach			X		X					X							X		
Huntington Beach		X	X		X											X			
Newport Beach																		X	
Dana Point	X	X	X	X	X					X	X	X		X		X	X		
San Clemente	X									X	X								
Total Number	5	4	5	2	5	2	1	0	1	4	3	4	0	4	0	4	3	1	0

Measures to Consider: ES = Erosion Setback, EP = Educational Program, LU = Land-use Planning based on Hazard Potential, RI = Remodel Infrastructure, PR = Post Storm/Flood Reconstruction Restrictions, BZ = Buffer Zone around Hazardous Areas, SL = Stop Leasing Public Land, DR = Dune Revegetation, DS = Destroy sea walls/groins, BS = Build sea walls/groins, DB = Development Plan, RI = Restrict New Public Infrastructure, CR = Pay Part of Costs to Relocate, HZ = Create Special Hazard Study Zones, BH = Buy Hazardous Lots, RI = Require Hazard Insurance, BN = Beach Nourishment, O = Other, P = No response

Table 15. *Expected sea level rise to affect areas in municipalities.*

Municipality	NE	F	LB	NB	FW	SC	LI	LH	DK	O
Malibu		X	X	X	X	X		X		
Santa Monica		X	X	X		X		X		
Rancho Palos Verdes		X	X			X	X	X		X
Manhattan Beach			X							X
Redondo Beach		X	X							
Seal Beach		X	X	X	X		X	X		
Huntington Beach		X	X	X	X	X		X		
Newport Beach		X	X	X	X		X	X		
Dana Point	X									
San Clemente			X			X	X	X		X
Total Number	1	7	9	5	4	5	4	7	0	3

NE: no effect, F: flooding of inhabited areas, LB: loss of beaches, NB: narrowing of beaches, FW: flooding of wetlands, SC: slumping of cliffs, LI: loss of infrastructure, LH: loss of housing, DK: don't know, O: other

of hazardous areas as hazard avoidance measures. These results are similar to a survey of coastal municipalities done in North Carolina (GODSCHALK, *et al.*, 1989).

Finally, Table XV shows that sea level rise impacts are expected by local planners. Loss of beaches and housing are the effects most expected as a result of increased flooding.

CONCLUSION

The results of this study confirm that local planners increasingly are aware of existing and potential coastal hazards in their municipalities. Furthermore, they are exploring these issues in accordance with prescribed mandates and their own perceptions of the magnitude of these problems in relationship to other city issues. One problem that is not unique to the surveyed coastal municipalities is the inherent difficulty in dealing with coastal zone issues separately from non-coastal zone issues. Although many coastal problems really need special use review and planning, the magnitude of the coastal planning equation in relation to the entire municipal planning process is often lost or denied. Although only one survey municipality, Manhattan Beach, reported employing a planner dedicated to coastal issues, most cities reported that all of their planners deal with coastal issues as part of their daily activities. Perhaps this lack of specialization illustrates the municipal perspective on coastal zone issues as being just part of the usual mix of planning issues in general. However, each municipality with a coastal zone is responsible for a unique natural resource/hazard area.

Some coastal problems may receive less than proactive attention because of the lack of coastal information and professional expertise. None of the surveyed municipalities indicated that they would be willing to seek expert advice about coastal issues. This may be based on the assumption that expert advice must be purchased and coastal issues are not considered a priority in this era of downsizing and continuing lack of funding. Municipalities could, however, have access to experts conducting scientific research on coastal problems whose findings could assist them in identifying and mitigating potential coastal hazards. Often such research is conducted by local universities and is free to those interested in the information.

Given the unique planning and mitigation issues associated with the coastal zone, the prevailing lack of information about the zone and the municipal fiscal scarcity hampering the creation of such valuable information, perhaps it should be recognized that the coastal zone has a very special, untapped resource at its disposal . . . its wealthier-than-average residents. Coastal municipalities in southern California generally have a large population of upper and upper-middle class residents. As an example, few surveyed municipalities were willing to require hazard insurance or consider the leasing of public lands. Such revenue streams could help pay for coastal hazard identification and mitigation as well as fund other coastline preservation activities. The concept of having hazard zone residents bear the brunt of the cost of living in that hazard zone is not new, but must be revisited as sea level rise increases. This new era is characterized by a better understanding and acceptance of the unique short and long term issues and remedies associated with the coastal zone and the real costs of inhabiting, maintaining and preserving this unique area.

Although the California Coastal Commission (CCC) works with local governments to protect the coastal zone, they do not appear to help local governments prepare for future, long term hazard prevention. The CCC is largely responsible for the permit process in the coastal zone by granting and denying developers the right to build on certain coastal properties, even though it lacks local knowledge of municipal preferences. This permit process has become the focal point between the state and local coastal municipalities rather than the state contributing to a larger picture of identification and mitigation of coastal hazards within municipal juridictions.

Currently, governance of coastal hazards is administrated reactively, ultimately costing more and achieving less per dollar expended than if a proactive governance approach were used. Generally, the region's storm damage was far more expensive when compared to the cost of implementing storm and flood mitigation measures. A shift in the perception of planners within coastal municipalities is important, especially moving the primary focus away from individual development and shoreline protection projects and toward coastal zone management.

It is evident from the general results of this survey that not nearly enough is being done to protect the southern Cal-

ifornia coastline by the municipalities. Survey results indicate that coastal municipalities are inconsistent in their approaches to local coastal planning and protection. Municipalities should redirect their efforts toward greater coastal hazard identification and mitigation. Local governments must be empowered to identify coastal problems and mitigation strategies and work in concert with the California Coastal Commission to review those strategies from a regional perspective. The small, minor, more local, coastal development issues should be left solely to the municipalities. This shift in governance and perspective, when combined with financial and legislative support for coastal hazard planning, would provide a true foundation for cost-effective, long term, coordinated coastal zone management.

LITERATURE CITED

BROWN, D.L., 1964. *Tsunami Activity Accompanying the Alaskan Earthquake of 27 March 1964.* Anchorage U.S. Army Engineer District,

BURTON, I.; KATES R., and SNEED, R., 1969. *The Human Ecology of Coastal Flood Hazard in Megalopolis.* (Chicago: University of Chicago Press).

CALIFORNIA COASTAL ACT of 1976, 1988. Public Resources Code, Division 20 (San Francisco).

CALIFORNIA COASTAL COMMISSION (CCC), 1981. *Statewide Interpretive Guidelines* (San Francisco).

CALIFORNIA ENERGY COMMISSION (CEC), 1989. *The Impacts of Global Warming on California.* Sacramento: California Intergovernmental Relations Committee.

COATES, J.F., 1989. Factors Shaping and Shaped by the Environment: 1990–2010. *Futures Research Ouarterly,* 7, 1–51.

FISCHER, D.W., 1990. Local Coastal Storm Responses: The 1988 Redondo Beach Exprience. *International Journal of Mass Emergencies and Disasters,* 8, 49–59.

FISCHER, D.W. and MARTINET, L., 1993. Local Government Response to the *American Trader* Oil Spill of 1990 *Ocean and Coastal Management,* 19, 59–73.

FISCHER, D.W.; STONE, G.; MORGAN, J., and HENNINGSEN, D., 1986. Integrated Multi-Disciplinary Information for Coastal Management, Florida. *Journal of Coastal Research,* 2, 437–447.

FISCHER, D.W.; RIVAS, V., and CENDRERO, A., 1995. Local Government Planning for Coastal Protection: A Case Study of Cantabrian Municipalities, Spain. *Journal of Coastal Research,* 11, 135–152.

FISCHER, D.W., 1990. Public Policy Aspects of Beach Erosion Control, *American Journal of Economics and Sociology,* 49, 185–197.

GODSCHALK, D.R.; BROWER D.J., and BEATLEY, T., 1989. *Catastrophic Coastal Storms: Hazard Mitigations and Development Manegement,* Duke University Press, Durham, N.C.

GRIGGS, G.B.; PEPPER J.E., and JORDAN, M.E., 1992. California Coastal Hazards: A Critical Assessment of Existing Land Use Policies *California Policy Seminar Report* University of California, Berkeley.

GUSTAITUS, R., 1989. Cliffs and Beaches Will Go. *California Waterfront Age,* 5, 29.

LASCHA, S. and EMMER, R., 1992. *Resident and Public Official Perceptions of the Effects of Coastal Erosion and Sea Level rise on Coastal Louisiana.* Environmental Social Science Research Institute, University of New Orleans.

PERNETTA, J.C. and ELDER, D.L., 1992. Climate, Sea Level Rise and the Coastal Zone: Maganement and Planning for Global Changes. *Ocean and Coastal Management,* 18, 113–160.

POOL, B., 1995. The Slide Toward the Tide. *Los Angeles Times,* B1 (February 9).

REID, T.R., 1995. Kobe Wakes to a Nightmare. *National Geographic,* 188, 112–136.

RIVAS, V.; FISCHER, D.W., and CENDRERO, A., 1994. Perception of Indicators of Coastal Environmental Quality by Municipal Officials in Northern Spain. *International Journal of Environmental Studies,* 45, 217–225.

SANTA MONICA BAY RESTORATION PROJECT (SMBRP), 1994. *Public Summary of the Santa Monica Bay Restoration Plan.* Sacramento: Georges and Shapiro.

STEIN, M.A., 1990. Havoc to San Francisco Bay Possible Due to Big Rise in Sea. *Los Angeles Times,* A3 (April 16).

TITUS, J.G., 1991. Greenhouse Effects and Coastal Wetland Policy: How America Could Abandon an Area the Size of Massachusetts at Minimum Cost. *Environmental Management,* 15, 39–58.

U.S. ARMY CORPS OF ENGINEERS (COE), 1992. *Existing State of Orange County Coast.* Coast of California Storm and Tidal Waves Study, Los Angeles, October.

WALKER, T. and BERG, T., 1993. Storm Damage Estimate Rises. *Orange County Register* 3 (March 2).

WARREN, R.; WESCHLER, L.F., and ROSENTRAUB, M.S., 1977. Local-Regional Interaction in the Development of Coastal Land Use Policies. A Case Study of Metropolitan Los Angeles. *Coastal Zone Management,* 3, 331–360.

WILCOXEN, P.J., 1986. Coastal Erosion and Sea Level Rise: Application for Ocean Beach *Coastal Zone Management Journal,* 14, 173–185.

YAMAGUCHI, M., 1995. Personal interview.