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A SURVEY OF INTEGRATED COASTAL ZONE MANAGEMENT EXPERIENCES

(Extracted from: Preparing to meet the coastal challenges of the 21st century; Conference report: World Coast Conference 1993)

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Introduction

Coastal problems that stem from human activities are almost always rooted in resource use conflicts. Since the majority of the world's population lives in coastal areas, such conflicts can only be expected to increase. As population growth continues, the pressure to develop coastal areas for housing, industry, tourism, aquaculture, fisheries, and other uses, will intensify these conflicts. Furthermore, these developments take place in a dynamic natural coastal environment where the hazardous conditions caused by climate variability and climate change will impose additional stresses.

The main objective of any government policy is, basically, to encourage changes in human behaviour in order to achieve desired goals. In this process, the main purpose of management is to provide the conditions that will facilitate development and stimulate progress. In general, the goals are specified targets related to the desired mix of goods, services and values to be produced, consumed, or conserved. ICZM is such a management process, which can anticipate and respond to the needs of the coastal society. Public participation in the planning and implementation of ICZM is there-fore essential.

The management procedure generally comprises a set of related tasks, all of which must be carried out to achieve a desired set of objectives. The basis steps involved in the management cycle are: problem recognition, analysis and planning, implementation of measures, operation and maintenance, and monitoring and evaluation of the effectiveness of the measures in relation to the stated objectives. The way in which this process is executed will depend to a large extend on cultural, political, economic and historical conditions, and its success will therefore depend on the degree of public endorsement achieved.

The Elements

There are many definitions of ICZM. The WCC'93 Conference Statement defines the frame of ICZM as follows:

> *Integrated coastal zone management involves the comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses; it is a continuous and evolutionary process for achieving sustainable development.*

During the WCC'93 many elements of ICZM have been identified. A comprehensive list of elements is presented in the conference statement. Some of these elements are discussed here in more detail.

A national ICZM programme should facilitate integrated decision making through a continu-

ous and evolutionary process for cooperation and coordination among sectors. Sectoral-based approaches have proven unable to meet the management challenges posed by resource use conflicts because from the perspective of one sector it is difficult to make efficient trade-offs that best utilize coastal resources. In such cases, the question of how best to utilize coastal resources sometimes reduces to one of how best to resolve an inter-agency power struggle. Consequently, decisions are often made to settle immediate, politically motivated conflicts, rather than how to address long-term, socio-economically based conflicts.

Integration in coastal zone management is basically cooperation between all responsible actors. The incentives for cooperation are the common needs to achieve objectives related to the coastal zone, resulting in "win-win" situations. This context ICZM involves the integration of:

- the responsibilities of agencies at different levels of government ("vertical integration");
- the responsibilities of different government sectors ("horizontal integration");
- the responsibilities of government and local groups;
- policies across sectors of the economy; and
- economic, technical/scientific, and legal approaches to coastal problems.

ICZM is performed in a dynamic context which often features changes in: (i) demographic and socio-economic conditions, including social preferences and the changing demands on the coastal resources; (ii) natural coastal systems such as morphological processes and periodic climate variability, such as the El Niño/Southern Oscillation (ENSO); and (iii) long-term conditions, such as global climate change.
Consequently, ICZM involves decision making under uncertainty, where uncertainty includes economic, ecological, physical and technological conditions. Consequently ICZM is a cyclic process. Through evaluation and feedback the goals can be adjusted and the management arrangements changed.

Because of the time lag involved, it will be necessary to expand the planning horizon from the typical five-year plan to include longer time horizons. It is possible to harmonize both long- and short-term goals, so that in implementing a short-term plan, long-term goals are also approached. ICZM may provide the necessary link between the two time scales. The implementation of ICZM is economically justified in the short term. In addition to enhancing the sustainable use of coastal resources, the implementation of ICZM also reduces vulnerability to sea level rise and other expected impacts of climate change. It may thus provide an effective framework for long-term strategies that would not normally be justified, given current discount rates.

A basic element of an ICZM programme is the arrangement of management responsibilities. Management arrangements comprise institutional arrangements and management instruments. Institutional arrangements provide the framework within which the management tasks are carried out and the management instruments applied. This framework encompasses:

- the structure of government and non-governmental organizations, including mechanisms for linking responsible agencies and organizations;
- the set of laws, conventions, decrees and standards for environmental quality; and
- the set of traditions and social norms such as customary laws.

Each of the responsible agencies has a set of management instruments in the form of structural, regulatory and incentive-based measures. These instruments need to be supported by legislation or other types of authorization. Examples of structural measures are beach nourishment, protection infrastructure, and land use plans; examples of regulatory measures are licences and fines; and examples of incentive-based measures are tradable permits, taxes and subsidies.

Decision making under uncertainty can be facilitated by formal and consistent evaluations, incorporating cost-benefit analyses, resource and land use and environmental impact analyses. Such a framework of analysis, encompassing the agents of change, can assist decision makers to choose rationally and objectively among alternative courses of action. It is important that the development of such a framework is tailored to the variety of different situations (social, economic, cultural) and to the differences between natural conditions.

Experiences

In preparation of the WCC'93, each country was requested to prepare a document on the status of ICZM in their particular situation, focusing on the management arrangements applied and the bottlenecks encountered during implementation. The observations in this section are based on a survey of the 23 ICZM case studies. As "snapshots" in time, the case studies depict ICZM efforts initiated by various nations, in various stages of implementation. Although limited in number and scope, the case studies can offer useful insights. For instance, if a nation with no ICZM programme is interested in initiating one, the analysis here may help to elucidate what type of programme is most appropriate. Also, the information gleaned from such analyses can help to pinpoint ways to improve existing ICZM programmes. Further evaluation will be possible in the future, as the practice of ICZM spreads to more nations, and the larger number of available case studies will facilitate more rigorous and complete analysis.

At the WCC'93 it was concluded that the quest for a unique "recipe" for ICZM was misguided, and that efforts to define one should be reoriented. As soon as it was suggested that "top-down", central government-driven approach was most effective, national experiences to the contrary were held up. As soon as certain technologies were proposed as the most useful, experiences favouring other technologies were cited.
Gradually, it became evident that the most important lessons to be learned about ICZM arise from the differences between successful approaches. It was noted that the most fruitful use of available resources would be to understand the underlying factors that may have led to the differences, rather than try to homogenize national experiences to distil a unique "recipe" (which at best would only apply in certain circumstances). In this way, certain circumstances might be recognized as "indicators" which flag the possible success of a given approach.

Although the literature on the design and practice of coastal zone management is diverse, some essential prerequisites can be identified. The first of these is the need for initial leadership for the planning process. For effective ICZM, institutional responsibility must be distributed intersectorally and hierarchically, both within the government, and between government and local groups. Thus, the second necessary element of ICZM is the provision of institutional arrangements. This may involve creating new institutions, but will more

commonly involve improving horizontal and vertical linkages between existing ones. Third, technical capacity (both technological and human capacities) is necessary for compiling inventories in the planning phase, during the implementation of the programme, and for monitoring the changes. This may include simple methods for crop rotation, field surveying, or resource conservation. At the other end of the spectrum, sophisticated technologies such as remote sensing, computerized databases, and model simulations may be used. The final necessary element of ICZM is management instruments. These include tools ranging from command-and-control to incentive-based, all with the aim of encouraging stakeholders to comply with the ICZM plan.

Steps in the ICZM process

The planning process for ICZM typically involves:

- *identifying issues and problems, and establishing corresponding objectives and criteria;*
- *delimiting the spatial, temporal and substantive scope of the planning effort;*
- *identifying stakeholders, and ensuring their participation in the management process;*
- *analyzing existing planning programmes, institutional arrangements and management instruments to determine whether they may be useful in addressing the issues;*
- *formulating a set of actions that systematically relate the set of objectives to the current state of the coastal system;*
- *collecting and analyzing existing data and evaluating the need for further research and information;*
- *establishing monitoring systems and integrated databases; and*
- *supplying information for programme evaluation to policy makers.*

The implementation process of ICZM typically involves:

- *ensuring concordance between the plan structure and its implementation;*
- *designing, constructing, operating g and maintaining physical structures;*
- *applying and modifying regulatory measures such as physical planning;*
- *applying and modifying standards relating to, for example, water quality;*
- *enforcing strategies, regulations and standards through a formal legal process or through persuasion, education and traditional community controls;*
- *providing for participation of private entities and the public;*
- *identifying and contracting sources of funding for the implementation process;*
- *conducting ongoing measurements and monitoring of coastal processes and their interaction with human actions; and*
- *monitoring and evaluation the level of put of the ICZMplan.*

Source: WCC'93 Organizing Committee (1993c)

Although it is possible to identify several prerequisites for ICZM, as discussed above, it is important to recognize that each element has a range of implementation possibilities. For instance, by identifying leadership as an essential element of ICZM, no attempt is made to prescribe which approach is most suitable. In practice, the leadership initiative for ICZM may consist primarily of a central government-led, "top-down" approach, or something in between. Similarly, the other ICZM elements (institutional coordination, technical capacity, and management instruments) also show ranges of possibilities. Institutional structures

range from being horizontally integrated to vertically integrated. Technologies range from the highly sophisticated to the rudimentary. Management instruments range from command-and-control to incentive-based.

The discussion below represents a preliminary analysis of the available case studies, focusing on how the underlying conditions (geographic, demographic, cultural, economic and political) relate to the prerequisites for ICZM (initial leadership, institutional arrangements, technical capacity and management instruments).

Initial leadership

The extent of the involvement of government and local groups in providing the initial leadership for ICZM differs widely among nations. In the 23 cases examined, the majority were initiated by a top-down approach. This was true for both urban and rural settings, and for areas characterized by both traditional and modern cultural practices. All of the areas with market economies featured top-down approaches. Of the areas with subsistence economies, both top-down approaches bottom-up approaches can be found. This suggests that local groups are most willing to act, as they do in subsistence economies, when they perceive themselves to be direct stakeholders. A key to involving local groups in ICZM planning and implementation thus appears to be to enhance their awareness of the benefits of cooperation.

In general, the degree of government involvement in initiating ICZM appears to depend on the extent to which the resources being managed are viewed as public goods. Access to fresh water, for example, is often viewed as a personal right by farmers and city dwellers alike, and thus tends to elicit more personal involvement from citizens. This was demonstrated in Egypt and in Chile. Access to fisheries tends to be seen as a collective right, and thus appears more naturally to involve central government leadership. This was demonstrated in the Philippines and Indonesia. An example in which the roles of government agencies and private parties were relatively balanced is the USA. Interestingly, pollution control, which necessarily requires the involvement of both public and private sectors, served as the catalyst of ICZM in this case. As suggested by the case of The Netherlands, programmes with long histories tend to show an increasing balance between government and local leadership as they evolve, regardless of how they are initiated.

Applying the same reasoning, Bangladesh, where special interest groups can be easily identified in the river basins of concern, a grassroots-driven programme would seem warranted. But this has not been the case. A central government-led approach to flood control, largely financed by international donors, has resulted in the construction of dikes, at great expense. In some cases, these dikes have been destroyed by farmers who were note consulted prior to construction, illustrating the lack of support of local people for the programme. This, and other cases, suggests that outside funding of national programmes may encourage approaches that fail to adequately involve local groups.

The geographic setting also seemed to have some relationship to whether initiation was top-down or bottom-up. All of the island nations examined in the case studies featured a top-down approach, although the first initiative could have been provided by local groups. In Barbados, for example, the local initiative, inspired by concerns about beach erosion and coral reef degradation, was taken over by the central government who initiated formal ICZM

efforts. The government borrowed from an international development bank to finance the development and implementation of ICZM in the interest of preserving future economic development options. It is interesting to note that in such cases, where the national population is very small, the government may be approached by local advocate groups.

Of the continental shore cases and in the deltaic countries, a majority followed the same top-down pattern. This may be partially attributed to the pressure from international agencies to initiate ICZM efforts, since these pressures are usually applied to central governments. For example, in Indonesia and Bangladesh, major ICZM projects undertaken over the last two years have been partially funded by international donors and have principally been driven by the national governments, with citizen participation solicited after the programme was initiated.

In general, the distribution of coastal resources appears to play a role in determining the level of government involvement. Issues involving local resources are more commonly taken on by local groups, who perceive greater direct benefits than they do for resources that benefit society at large. Resources that are widely and evenly distributed tend to elicit a central government-driven management approach. In Indonesia, a country having a wide natural resource base that is distributed throughout the country, has employed a top-down, central government approach.

In this case, since no one portion of the population can expect to gain substantially more than the rest by promoting conservation, and since extensive actions were required, government leadership initiated ICZM.

Institutional arrangements

Certain sectoral issues appear to have good potential to catalyze intersectoral cooperation and thus evolve into ICZM. Among these are tourism, fisheries and water management. As examined in the previous section, the specific catalyst for ICZM has much to do with which agency or group provides the initial leadership. Before planning, implementation and evaluation efforts are under way, however, institutional coordination is required. ICZM requires horizontally and vertically integration of the responsibilities of institutions. The discussion below is perhaps most applicable to large, extensive governments with numerous sectoral ministries and agencies. But is should be noted that although the need for integration may be greater in very extensive governments, it also exists in small governments.

Horizontal integration means that several agencies at the same government level work together. Horizontally integrated efforts are often referred to as "intersectoral". Vertical integration means that agencies at different levels of government coordinate their programmes. An ICZM effort that begins with an intersectoral task force making a national ICZM plan, and culminates in the implementation of permitting and monitoring programmes by specific government agencies, would be said to be first horizontally and then vertically integrated. If an NGO directly implements some aspect of the ICZM plan (e.g. coordinating data collection or training activities with overseeing government agencies), its involvement would be considered an example of vertical integration with the private sector. It is important to note that ICZM institutions are often cyclical in nature, at times being predominantly horizontally integrated, and at others predominantly vertically integrated.

The degree of horizontal versus vertical integration necessary may change over time, as the ICZM effort evolves from planning to implementation. An effort that begins with a high-level, horizontally integrated planning effort, may evolve into a predominantly vertically integrated implementation programme. In the interests of efficient implementation, it may be critical to clearly define sectoral responsibilities for issuing permits, monitoring, and education. The opposite may also be true; a programme that begins as a vertically integrated approach may evolve to include more horizontal integration. This was the case in the USA, where provisions for public involvement were extended throughout the planning and implementation processes.

The degree of horizontal versus integration of a ICZM programme should be adjusted in time, to insure that all concerned groups are consulted at each particular phase from planning to implementation. In cases where major groups are likely to be impacted by ICZM, the planning process should be integrated in a way which encourages and facilitates the involvement of local groups, taking into account their cultural and behaviour norms.

The extent of the participation of "major groups", as defined in Agenda 21, varies widely among the case studies. In Mexico, indigenous peoples and local groups (such as fishermen's farmers' and women's groups) led the planning and implementation of ICZM. In Chile, the efforts that directly involved local people were most successful.

It is difficult to relate the actual structure of ICZM institutions to the underlying conditions. The cases examined showed virtually no preference for vertical versus horizontal integration. The only exception is that three out of four of the cases with traditional cultural practices favoured vertically integrated institutions. In general, the strongest conclusion that can be drawn from the survey is that existing ICZM approaches rely on neither horizontal nor vertical integration more than the other. Both forms of integration appear to be equally important overall, although their relative importance may vary in time, as an ICZM programme evolves from planning to implementation.

Technical capacity

"Technical capacity" encompasses hardware, practices and human skills. The most widely used technologies in the cases studied were related to resource inventories, analysis, and monitoring. Almost every case a database some sort was used, and many also used a Geographical Information System (GIS). The Netherlands has developed sophisticated computer models for resource allocation. Although such technologies are not yet widely used in other countries, the response to model demonstrations at the WCC'93 was positive, and their use may increase. Only a few case studies reported the use of remotely sensed data, such as satellite images, for inventories and monitoring. It is important to note that skilled human resources were necessary for the utilization of all of these technologies.

The level of sophistication of technologies used in ICZM varies significantly among nations. It appears that the level of sophistication of ICZM technologies is partially determined by available funds and human resources, and by the scale of the coastal problems being addressed. It seems that the use of more expensive, sophisticated technologies can easily be justified in cases where funds are available. In island nations such as Indonesia and Barbados, both of which are implementing top-down programmes funded by development banks, remote sensing and GIS data are being used for inventories and for monitoring resources. On the other hand, it appears that much can be done using "low-tech" methods if funds are limited. In a bottom-up, NGO-supported project in Mexico, for example, low-

tech erosion mitigation techniques, crop and fishing rotation schedules were employed. Unfortunately, no information is available on the cost effectiveness of particular technologies.

Several underlying conditions appear to be related to the level of technological sophistication employed. Case studies in urban areas always featured the use of highly sophisticated technologies, while those in rural areas showed no preference between high- and low-tech approaches. This suggests that where natural and human interactions are more concentrated, more advanced technical capacity is required to understand and monitor them. It may also indicate a bias toward dedicating resources to solving urban problems.
Three out of four of the case studies characterized as having traditional cultural systems used low-tech approaches, while those with modern cultural systems were evenly split. This suggest that, in some cases, traditional knowledge of indigenous cultures may be deemed sufficient understanding of the critical linkages between human and natural systems. Consensus-based political systems usually supported high-tech approaches, while hierarchical political systems showed no preference. However, this is probably simply a result of including several high-income industrialized nations in the first political category.

Whether or not advanced technologies can be justified and purchased, the availability of human resources defines the practical realm of technological choices. Almost all of the low-income nations surveyed cited underdeveloped human resources as a major obstacle to the successful management of the their coastal zones. Many nations also noted that past and present technical efforts have been motivated and implemented by international consultants. As noted in the case of Bangladesh, this has created a dependency on foreign technical assistance, a situation that is becoming increasingly common in low-income nations. Such dependency might be avoided if emphasis were to be placed on training and the transfer of appropriate technologies.

Management instruments

Management instruments include command-and-control measures (enforcement) such as licences and fines, and incentive-based (market) measures, such as tradable permits, taxes and subsidies. Analysis of the case studies suggested that the type of management instruments used was most closely related to geographical and political variables.

The geographic setting appears to be closely related to the type of management instruments used. Of the continental shore cases examined, the majority featured predominantly enforcement mechanisms. This may simply reflect the fact that highly industrialized nations such as the USA and Germany were included in this category. Experimentation with incentive-based instruments in other areas of pollution control, notably air pollution, may also eventually prove fruitful for coastal pollution control. Interestingly, of the four deltaic areas examined, three favoured incentive-based instruments, perhaps reflecting the fact that such instruments are easier to use for watershed management. The island nations appear to be evenly split between command-and-control and incentive-based instruments, although enforcement is slightly more common. Enforcement in island states is logistically difficult, given the geographic isolation of the islands within a nation, so the predominant use of command-and-control regulations in island programmes may be problematic.
Political traditions also appear to be related to the type of management instruments utilized. Political systems rooted in a tradition of consensus decision making seem to favour the use of incentive-based instruments. Those systems more typically involving

hierarchical decision making favoured the use of enforcement mechanisms. Unfortunately, no information is available as to the relative effectiveness of these measures. Although cultures classified as traditional and modern showed no difference in the type of management instruments used, some management instruments, particularly those that are market-based, are obviously illsuited for traditional cultures that rely on subsistence.

Indeed, it might be expected that incentive-based instruments would be more commonly implemented in nations with market economies than in those with subsistence-based economies. But this is not supported by the empirical analysis; in fact, there appears to be no difference. Of the cases examined, three out of four featured market economies. But whether the economy was market- or subsistence-based, command-and-control management instruments were more common. Although this is consistent with the observation that the majority of ICZM efforts were initiated by top-down government-led efforts, it suggest that market-based instruments for ICZM are not widely used.

Synthesis

The synthesis presented here is based on the limited number of ICZM case studies as analyzed in the previous section. The conclusions should be considered in light of the small sample of experiences available to this stage.

- ICZM can be initiated by local groups or national governments
  Among the case studies, there were differences both in the starting points for the initiation of ICZM, and in the degree of integration of institutions involved in implementing the evolutionary process. In The Netherlands, the initial call for ICZM was led by local groups concerned with localized issues, and evolved, bottom-up, towards higher administrative and political levels. Proceeding from the recognition of the problem to the development of a plan, the effort expanded to include other impacted and related sectors. Conversely, political awareness at the level of the national government may expand, top-down, to include local political, administrative and societal groups. For instance, Indonesia fits his pattern, with an ICZM effort initiated by national government, and seeking to increase the involvement of impacted local groups.

- ICZM requires vertical and horizontal institutional integration over time
  ICZM typically addresses multiple issues in the coastal region from an holistic viewpoint, with interest groups in different sectors and at different societal, administrative and political levels. The management process initiated to tackle these issues involves the planning, implementation and evaluation phases, generally performed as an iterative and cyclic process. It is found that for the successful establishment of ICZM we have thus to distinguish three dimensions along which integration and iteration will take place: (i) vertically between societal, administrative and political levels; (ii) horizontally between geographic, socio-economic, administrative and political sectors; and (iii) in time between problem recognition, planning, implementation and evaluation. The dominance of either horizontal or vertical integration will vary over time. ICZM offers a valuable framework for the management of long-term risk associated with potential climate change. However, existing ICZM activities tend to focus on short-term problems.
  Additional efforts are required to encourage the inclusion of mechanisms for dealing with longer-term challenges, such as adaptation to climate change.

- Technical capacities, encompassing hardware, practices and human skills, appear to be crucial for organizing information
  Resource inventories and monitoring exercises provide a basis for a framework for analysis. The availability of human resources to utilize these technologies defines the practical realm of technological choices. Underdeveloped human resources is a major obstacle to the successful management of the coastal zones of most lost-income nations.

- ICZM can be implemented through many different institutional structures.
  While no single approach for the integrative and iterative process towards ICZM can be derived from the case studies, successful approaches generally take social, economic and political variables into account in the design of both the overall programme, and the institutional structures to implement and evaluate the programme. As discussed above, the analysis of the case studies suggest that an understanding of the interplay between underlying geographic, demographic, cultural, economic and political conditions can greatly assist in developing a suitable approach for a given country of area.

- Specific lessons derived from the case study experiences include:
  - in many cases the ICZM process can be initiated by concerns over sectoral (e.g. Thailand) or regional (e.g. The Netherlands) issues;
  - whether the institutional arrangements are such that either one or more agencies are responsible for ICZM, the critical condition is the existence of a linking mechanism (e.g. Bangladesh and Indonesia);
  - ICZM is found to be a long, iterative and cyclical process, which may be more apparent in bottom-up approaches (as in the Philippines, Malaysia and The Netherlands), but equally exists in top-down approaches (e.g. USA);
  - ICZM is most effective when conducted in the context of national/regional planning (e.g. Sri Lanka);
  - a critical element in the implementation of institutional arrangements is the building of human capabilities through training and education (e.g. Eqypt);
  - wherever two or more countries are closely related, ICZM in one country can be affected by decisions made in another country, calling for international mechanisms (e.g. the UNEP Regional Seas Programmes for the South Pacific Caribbean and the Mediterranean.

- ICZM can address climate change, population growth and other long-term issues
  While many of today's major concerns dominate the need for ICZM, every coastal state has concerns about the long-term potential impacts of climate change, particularly accelerated sea level rise, and generally recognizes the need to begin to address these issues within the context of ICZM planning. Within the array of possible impacts of climate change, sea level rise may not be the only issue for some coastal states: droughts, changes in storm patterns and increased storm surges, for example, could also have serious impacts on human settlements and economic systems.

- ICZM can facilitate sustainable development of coastal resources
  Many of the areas described by the case studies include low-lying lands, some of which are heavily populated and are widely used for subsistence. In addition, tourism, which is often dependent on the health of coastal ecosystems, is an increasingly important component of many international economies. Consequently,

the emphasis on ICZM through different forums such as the UN Commission on Sustainable Development, the Global Conference on Sustainable Development in Small Island Developing States, the UN Framework Convention on Climate Change or through the IPCC, should remain a top priority in the basic call to action for coastal states to begin the long and challenging process of ICZM programme development as soon as possible.

The Obstacles

What general conditions could improve the performance of the implementation of ICZM, or in other words which obstacles have to be overcome? The obstacles and the needs subsequently identified are discussed below under two broad categories: "institutional strengthening" and "technologies and skills".

Institutional strengthening

In the national ICZM case studies, one of the most widely cited obstacles to ICZM was the lack of adequate institutional arrangements. In the case studies examined, there was generally need for enhancing: (i) inter-agency integration; (ii) citizen participation and awareness, and (iii) the legal and financial bases for management. Inter-agency coordination is needed both within and between government agencies. In several case studies, projects funded by development banks had some initial success in promoting coordination by establishing inter-agency task forces. Education programmes and public hearings were utilized to raise awareness and encourage public involvement, but appear to have been inadequate in many cases. An enhanced legal framework is necessary in some cases to establish ICZM as a priority, and to set up the mechanisms for inter-agency coordination.

In many of the case studies, government structures were claimed to be poorly integrated, characterized by national-level-overcentralization, the lack of lead agencies, overly complex bureaucracies, and weak inter-agency coordination. One basic characteristic of the administrative structures was the structural absence of an adequate relationship between hierarchically organized executing agencies in the central government and the consensus-based participation mechanisms at all levels of ICZM. In the worst cases, a strict top-down arrangement vested control of all aspects of the programme at the central level, minimizing the opportunity for input by stakeholders. The questionnaire survey findings seem to suggest stronger horizontal (i.e. sectoral) linkages than could be inferred from the case studies alone, but in most cases these linkages appear to be weak or informal.

In general, planning and management regimes should seek to involve local populations which often have primary responsibility for management of coastal resources, and in some cases depend on them for subsistence. The importance of recognizing traditions and social norms in order to ensure public participation is noteworthy. In some cases, institutions and management instruments inadequately integrate modern and traditional values. For instance, some modern land management regimes fail to incorporate traditional land tenure or management systems. The value of sensitivity to the cultural norms of major groups is well demonstrated by the crisis over land tenure in the South Pacific. In several Pacific island nations, attempts at ICZM have been frustrated by landowners who perceive ICZM as

a threat to their basic rights. In the Marshall Islands, the adoption of Western-style regulations for coastal resource usage failed. If the involvement of the traditional leaders had been solicited in the enforcement and education processes, the outcome may have been quite different.

In many cases an inadequate legal framework may underlie institutional weaknesses. Legal weaknesses pointed out by several nations include: (i) administrative rather than legal bases for planning agencies; (ii) resource laws that are strongly sectoral in nature; (iii) the absence of a legal authority to integrate and coordinate endeavours; (iv) the lack of stringent enforcement procedures; and (v) the fragmentation of statutory authority when it does exist. It is important to note, however, that while an adequate legal framework may be considered a necessary condition for ICZM, this in itself is no guarantee of the successful implementation of a programme. Examples abound of nations with legal frameworks for ICZM, where no ICZM is conducted. In practice, political will, based on awareness among the public and government officials, is crucial. Also, technical and financial shortcomings sometimes prohibit institutions from carrying out their legal obligations. The importance of training as an effective vehicle for capacity building has become increasingly apparent, as nations proceed from traditional sector-oriented marine resource management practices, toward the development of new, political, administrative, and technical schemes for ICZM. The need for dedicated funds is also crucial to the continuous implementation of ICZM.

Despite the recognition of their overwhelming importance, institutional arrangements for intersectoral and public-private sector linkages are too often poorly articulated, ineffective and inefficient. In addressing this problem, it is necessary to recognize that different contexts require different mechanisms and structures. The challenge is to design and implement institutional arrangements that are compatible with existing customs and traditions. These arrangements by nature will then strengthen the control and enforcement procedures and provide a legal framework for management.

Technologies and skills

Among the other widely cited obstacles to ICZM is the lack of adequate resources, from human resources to investment capital. A shortage of trained personnel and collective expertise tops the list, followed by inadequate financial resources, data and information. Related to these deficiencies, as well as to the inadequacy or absence of legal bases, is a general lack of administrative capacity for enforcement programmes will increase if they are able to generate their own revenues and recover costs, perhaps through the granting of permits and licenses, or through direct receipt of special taxes. The case studies reviewed revealed that technical support may be helpful in designing market instruments for enforcement, as well as regimes for environmental monitoring and database management.

Other obstacles mentioned in the case studies and questionnaires often receive comparatively little attention, but significant among these in the near term, are deficient monitoring of resource conditions, and the lack of feedback necessary for evaluation and programme revision. In general, a strategic dimension, which would facilitate the identification of long-term problems (such as climate change and sea level rise) and the design of mitigating actions in the context of day-to-day ICZM, is often lacking. In developing national programmes for ICZM, it is necessary to establish ongoing monitoring and evaluation programmes. Specifically, flexible tools need to be developed for use in: (i) monitoring the quality and

distribution of coastal resources; (ii) monitoring development activities and resource usage, and (iii) managing coastal data to facilitate meaningful policy analysis.

Since many coastal nations are facing similar problems, it should be possible to develop technical tools that will have wide application. In low-income nations, the baseline data and institutional structure needed for assessments and inventories is often lacking. The urgency of coastal problems, calls for quick and efficient methods for overcoming these constraints. It is imperative that the techniques developed make maximal use of existing data, and that they can be readily updated as new information becomes available. The cost of initiating much-needed monitoring and assessment networks could be minimized by adapting the approaches used in one area for use in similar areas. For instance, an environmental assessment programme developed in one island nation, while specific to that nation, could be adapted at relatively low cost for use by another island nation. With wide application to coastal states, tools developed could be disseminated via regional technical assistance and institution.

Conclusions

Based on the ICZM case studies discussed, and other materials submitted to the WCC'93, it was concluded that:

> *"Integrated coastal zone management involves the comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses; it is a continuous and evolutionary process for achieving sustainable development".*

Recognizing the difficulties that coastal states face in initiating ICZM, WCC'93 concluded:

> *"Coastal states that are in the process of defining and implementing a national programme for integrated coastal zone management have encountered obstacles that constrain the effective development of national programmes".*

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MEDITERRANEAN BEACH MANAGEMENT WORKSHOP

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Shoreline management "Costa Oceanica": A case study

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FOREWORD

This lecture contribution to the MEDITERRANEAN BEACH MANAGEMENT WORKSHOP presents a Coastal Zone Management approach based on a real life shoreline management problem, viz. along the Costa Atlantica south of the Rio de La Plata in Argentina. The physical shoreline management problems are real, but the institutional management problems are partly imaginary. For this reason we have named the case Costa Oceanica. We emphasize that this case should not be referenced as a true real case.

Shoreline management "Costa Oceanica": A case study

1. Introduction

The Costa Oceanica shore under consideration concerns a coastal stretch of some 70 km, consisting of a relatively narrow barrier and dune ridge, backed by a lowlying, near the Rio Plata Bay wetlandlike, hinterland (see Figure 1). The coastal strip, which locates nine municipalities of small to moderate size, is important for recreational and touristic purposes and has been exploited as such. Due to its favourable location and climate it has a high development potential, but local erosion and unguided planning have resulted in a number of problems.

The physical problem

The primary physical problems concern a particular stretch of 25 km along which long term erosion has created the loss of beaches. Combined with unrestricted development in the foredunes also the primary dune row has been severely affected and this creates a flooding problem for the coastal zone.
A secondary physical problem concerns the need to provide hinterland drainage, which is necessary during and after storms and heavy rainfall.

The management problem

Most of the nine municipalities along the Costa Oceanica suffer from the physical detoriation of the coastal zone. However, nor from national, provincial or local level there exists a well-based development planning, integrating the different sectoral needs in relation to a sustainable coastal resources exploitation. Also, proper institutional arrangements are lacking, to provide a framework within which management measures and tasks may be carried out and management instruments may be applied.

A first approach towards integrated shoreline management

Obviously, the Costa Oceanica problems require that an integrated management approach is sought. In the following a first step towards such an approach is suggested. In acknowledgement of the fact that the development of Integrated Coastal Zone Management involves the comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses and that it is a continuous and evolutionary process for achieving sustainable development, we propose a three phase approach, as follows:

Phase 1: Short term planning, to result in a short term action plan for the first one to three years, relieving the immediate local problems;
Phase 2: Medium term planning with a time horizon of five to ten years, integrating the resource exploitation for the whole of the Costa Oceanica;
Phase 3: Long term planning with a time horizon longer than twenty-five years, matching the regional development with that of the nation and taking the possible impacts of climate change into account.

These phases or at least Phases 1 and 2 should be initiated as soon as possible. Phase 1 could result in management measures to be implemented on a very short time scale. The lead time for management measures resulting from Phase 2 could take from one to two years. For Phases 1 and 2 concrete suggestions are given, while for Phase 3 an approach is formulated.

2. Initial problem analysis

2.1 Present situation

Condition of the beach

The coastal reach under discussion is located at the most eastern edge of the province of Buenos Aires and has a length of 69 kilometres. Its orientation is almost north-south. From south to north the following towns can be found: Mar de Ajó, San Bernardo, La Lucilla del Mar, Aguas Verdes, Costa del Este, Mar del Tuyú, Santa Teresíta, Las Toninas and San Clemente del Tuyú. Towards the north the beach ends in a large sand spit, called Punta Rasa, in the Bahia Samborombon at the entrance of the Rio Plata. At a distance of 14 kilometres south of Mar de Ajó, at Punta Médanos, the north-south orientation of the beach ends. There the orientation of the beach changes, as it continues in a more south-western direction. An overview of the beach and the towns located along the beach is shown in Figure 1.

Beach erosion problems are experienced from Mar de Ajo to Santa Teresíta along a stretch of beach of 25 kilometres length. Beach erosion has been going on for years leading to the almost total disappearance of a dry beach surface. The beach is narrow and low. At high tide almost no dry beach area is left and the sea reaches the dune foot, at the locations where dunes are still present. The continuing shoreline regression is evident from the presence of buildings on the beach, which used to be located in the dunes. North of Santa Teresíta, at Las Toninas a certain amount of erosion occurs, be it at much lesser extent. Due to wave attack during south-eastern storms, and the low beach levels, structures along the beach such as buildings roads and jetties have been badly damaged or destroyed. The situation along the affected stretch of coast keeps on deteriorating as the erosion process is structural. With only a very small available dry beach surface and the presence of destroyed buildings and structures, the beach becomes less attractive to tourists.

At Punta Médanos and south of Punta Médanos a wide and beautiful beach is present which shows no signs of erosion at all. In fact the beach at Punta Médanos has been accreting. The lighthouse there was built close tot he contempory shoreline, nowadays it is located almost 1 km from the present shoreline. Offshore of Punta Médanos two large sand banks are located on which waves break and which provide a sheltered anchorage.

At the northern end of the coastal stretch, at Punta Rasa, also accretion occurs. Punta Rasa is a long sand spit of approximately 5 kilometres length, extending 2.5 kilometres north of the lighthouse. Large quantities of sand are deposited here, this can also be seen from the presence of extensive shoals north of Punta Rasa. As sand is deposited here no erosion problems exist. In fact, the whole shoreline north of Las Toninas to Punta Rasa shows no erosion problems.

No groynes or offshore breakwaters have been constructed along the shoreline from Punta

Médanos to Punta Rasa, except for one groyne located just north of Santa Teresíta. This groyne however shows little effect, no significant accretion or erosion has occurred at that location.

Locally, a kind of seawall structures have been constructed in front of private properties. A lot of these "seawalls" have already been severely damaged.

Condition of the dunes

Along some parts of this shoreline a row of dunes in good condition, complete with vegetation, is still present. Especially in between some towns good quality dunes can be found. However, in front of several of the aforementioned towns the dunes have almost disappeared. Only at San Clemente del Tuyú, where no erosion problems occur, a solid row of primary dunes complete with vegetation is located between the beach and the town. At several locations no vegetation is present on the dunes, and therefore dune erosion by wind occurs. The dune sand is blown inland by the wind, preventing the build up of dunes of significant height. At many locations the absence of vegetation is caused by men. The primary row of dunes is in many cases used as a source of sand for construction purposes elsewhere, and for various types of structures in the primary dunes themselves. Furthermore, peoplee drive through the primary row of dunes with trucks, cars and motorcycles. Most of the dunes are freely accessible, people wander through the dunes, and because of all these activities the vegetation suffers severely.

2.2 Beach erosion mechanisms

Wave climate and littoral drift

Grossly speaking, the littoral drift (also called longshore transport) along the shoreline of the Costa Atlantica is going north as may be observed from the spit at the north. The wave climate which governs the littoral drift at the Costa Atlantica is complicated. Not only wind waves are present but also swell coming from the South Atlantic ocean.

Let us consider the beach eroded stretch between Mar de Ajó and Santa Teresíta, and the beautiful and wide beach south of Punta Médanos. The erosion as experienced at this 25 kilometer stretch is structural erosion, the beaches do not recover after storm wave attack, and erosion continues. To be able to explain this erosion, a gradient in the longshore transport must be present. This means that less sand is supplied through longshore transport to the eroding beaches than is taken away.

Starting point in the considerations is the geomorphological situation at Punta Médanos. Figure 2 shows the shorelines and sea bed in the vicinity of Punta Médanos. The sand banks along the shoreline from Villa Gesell to Punta Médanos are clearly visible. The sand banks are a quite regular feature, in fact with their length of over 10 km and their width of 2.5 km they can be considered as a kind of mega ripples. The "wave height" of these sand banks is in the order of 5 metres. The presence of these sand banks was explained above as being due to a reduction in the longshore littoral drift.

The reason that the beaches at Punta Médanos are wide, and that large sand banks are present offshore, is that the sand transported northwards along the beaches near Pinamar is deposted at Punta Médanos. Because of the deposition of sand there the shoreline has

accreted and sand banks have been formed.

The longshore transport along the beach from Mar de Ajó to Santa Teresíta is less than the longshore transport along the beach of Pinamar, south of Punta Médanos. This is due to the different orientation of the shoreline north of Punta Médanos the southern swell has less impact on the longshore transport while the impact of NE wind waves increases.

As the beach from Mar de Ajó to Santa Teresíta is eroding, less sand is deposited there than is taken away by the longshore transport. This can be explained by looking at the wave climate just north of Punta Médanos. At Punta Médanos the swell from southern directions, which generates the northward longshore drift, is blocked by the sand banks. In this shadow zone, the waves from north-eastern directions prevail, effectively blocking the longshore drift to the north at that location.

Further north, at Mar de Ajó, the southern swell is able to reach the beach without being blocked by the sand banks, and the nett littoral drift is going northward again. As no sand is supplied from the Punta Médanos area to the beaches to the north and still sand is carried away towards Punta Rasa by the longshore transport erosion occurs.

This explains the structural erosion problems experienced along these beaches. The littoral drift and erosion mechanisms are indicated in Figure 2.

Non-structural beach erosion

The erosion experienced along the Costa Atlantica is structural, as explained above. Because a positive gradient in the longshore transport exists in the area north of Punta Médanos the beaches between Mar de Ajó and Santa Teresíta are literally "starved" of sand. As the structural erosion process has continued for a long time, the situation has become quite alarming.

During winter storm, the "sudestas", sand is taken from the beach top and deposited on the foreshore by cross-shore transport. Because at many locations dunes are no longer present, no buffer capacity exists to cope with this cross-shore erosion, and the beach level drops significantly. Normally this cross-shore erosion during storms can be considered as non structural, non structural, erosion, as sand will be returned to the top of the beach during calm periods. However as along this eroding coast the beach levels are so low that the beach stays permanently wet, beach recuperation will not take place. The wind is unable to transport the wet sand to the top of the beach and to the remaining dunes.

2.3 Drainage problem

Apart from the beach erosion problems related to the sea, also erosion occurs due to drainage problems. At some locations the storm water drainage is discharged on the beach, where during torrential rain sand is taken away by the drainage outflow. The outflow structures are in itself vulnerable to the erosion caused by wave action. At some locations outfall structures have been swept away by storm waves.

2.4 Socio-economic requirements

The situation along the affected stretch of coast keeps on deteriorating as the erosion process is structural. With only a very small available dry beach surface and the presence of destroyed buildings and structures, the beach becomes less attractive to tourists. As the beach is a recreational facility which is of paramount importance to the local economy, a solution which leads to the recuperation of the beach has to be implemented.

On somewhat longer term recreational developments may be stimulated through offering more than just beach recreation. One of the options that has been suggested is the construction of marinas for recreational water sports.

3. Short and medium term shoreline management strategies: Phases 1 and 2

3.1 Short term measures and alternative medium term options

Restoring the integrity of the shoreline

The detoriation of the beaches from Mar de Ajo to Santa Teresita is such that the integrity of the coast is at stake. Without going into a comprehensive decision and policy analysis process, a simple cost-benefit analysis to be executed in Phase 1 will show that a beach of sufficient height and width is required from an economic viewpoint, with regard to tourism and recreation, referring both to beach capacity and attractiveness of the beach.

In anticipation of the result of Phase 1 analysis, an initial and minimal beach nourishment is proposed along the affected 25 km coastal stretch. A possible borrow site location is offered by the sand banks at Punta Medanos. After this nourishment the necessity for maintenance with hard or soft defence options can be evaluated. This is discussed below.

Beach replenishment/coastal defense structures

At this moment implementation of a beach replenishment has the highest priority for the affected beaches. The initial beach restoration by replenishment will solve the existing problems associated with the structural beach erosion. However, after implementation of this beach restoration it has to be decided whether coastal defense structures will be built or whether the beach will be maintained by future replenishments. The advantages and disadvantages of both options (local and global, short term and long term, physical and non physical) will have to be studied. On a decision making level it has to be decided which option is the most favourable. This decision is part of Phase 2 of the integrated shoreline management approach.

Basically there are five alternatives which all require beach restoration to be implemented first. These five alternatives are:

1 Beach restoration + periodic beach suppletion
2 Beach restoration + groynes + extra suppletion + maintenance
3 Beach restoration + T-groynes + extra suppletion + limited maintenance of the groynes
4 Beach restoration + parallel breakwaters + extra suppletion (forming a tombolo) + limited maintenance of the breakwaters

5 As 4, + extra suppletion forming a salient.

After the initial beach restoration has been implemented the restored beach will have to be monitored to establish the behaviour and erosion rates. Meanwhile (and as part of Phase 2) the alternatives as given above can be evaluated, considering all advantages and disadvantages, and a decision on the most favourable options can be made.
It is possible that alternative 1, with periodic maintenance by beach suppletion is economically favourable.

An overview of the alternatives is given in Figure 3, also showing the necessity of having an extra sand suppletion with the construction of breakwaters and groynes.

Dune restoration

Another part of the shoreline management planning is the rehabilitation of the dunes. As the dunes are an important aspect of the coastal zone in providing a sand buffer and retaining sweet water, they will have to be restored. Dune restoration should coincide with beach replenishment. Part of the dredged sand can be used for this dune restoration.

Dune restoration comprises rebuilding of the dunes by adding sand, replanting of the dunes with native vegetation and protecting the dunes from man induced damage. This means that no new buildings should be built in the existing primary row of dunes, special access corridors should be made connecting the boulevard with the beach and it also implies that people and motorvehicles should not be allowed to travel through the dunes freely. The existing hotels and restaurants will not have to move, but no new hotels and restaurants should be built in the dune zone. In fact this has already been achieved at San Clemente del Tuyú. There a beautiful and well protected row of dunes exist with abundant vegetation. Access to the beach is through a limited amount of paved corridors. Figure 4 gives an overview of some regulatory aspects which have to be considered.

Storm water drainage

Storm water drainage is also part of the shoreline management planning. In many towns along the shoreline under discussion, storm water outfalls are located on the beach. Most of these outfalls discharge on the beach instead of directly into the sea. With torrential rainfall, large quantities of rain flow through these outfalls over the beach, eroding the beachs and and moving it offshore. As the beach itself is receding, these storm water drains are undermined and damaged during storms.

The possibility to drain the rain water through drainage channels to the Bahia Samborombón should be studied. By draining the rain water at the back side of the coastal zone, the beach will not suffer from the eroding effect of the storm water flow. Also no ocean outfalls, which are vulnerable to extreme environmental conditions, will be required. When after beach replenishment the decision is made to construct coastal defense structures, then the storm water outfalls can be combined with these structures.

When a beach replenishment is implemented, and the storm water drainage is not diverted to the backside of the coastal zone, then the existing outfalls certainly need modification. These outfalls then will need lengthening and strengthening, as the beach will become wider and higher.

Recreational facilities

Apart from the decisions which have to be taken in the view of the beach erosion problems, also recreational facilities can be considered as part of the further development of an integrated shoreline management approach.

When a beach replenishment is implemented to restore the integrity of the coastal zone, and to rehabilitate the beaches for the tourists, then also the construction of marinas can be considered. These marinas can of course also be combinated with small fishing ports. If after replenishment of the beaches coastal defense structures such as parallel breakwaters and T-groynes are implemented, then these structures can also be used in the development of marinas to provide protection.

Another possibility is to combine the implementation of improved drainage at the backside of the coastal zone with the construction of a marina at Punta Rasa. The combination could take place in the form of an artificial laguna. Both options are outlined in Figure 5.

3.2 Elements for short and medium term management development

A basic element required, even for short term planning and management, concerns an integration over involved sectors and responsible authorities. In these phases it would be at least necessary to integrate the interests of the involved nine municipalities. The Costa Oceanica shoreline and direct hinterland of 70 km alongshore length forms the coupled physical system, which is impacted. The planning elements involve beach restoration, dune restoration, drainage facilities and anticipation on further socio-economic developments and planning.

Initial leadership to set into motion an integrated approach could logically lie with the most affected municipalities, although provincial authorities may also consider a top-down approach. The required institutional arrangements at this stage could be limited to a creating an intermunicipality committee with the assignment to develop a short term planning and implementation of management measures and to initiate the development of the medium term planning. Technological capacity as present may be sufficient for Phase 1, but will need upgrading for the following phases.

For Phase 2 the responsible authorities or provincial/national agency has to define and implement a set of management instruments in the form of structural, regulatory and incentive-based measures. These instruments need to be supported by legislation or other types of authorization. Examples of structural measures are beach nourishment, protection infrastructure, and land use plans; examples of regulatory measures are licences and fines; and examples of incentive-based measures are tradable permits, taxes and subsidies.

3.3 Actions and recommendations

1 The coastal erosion problems experienced at the Costa Atlantica, from Mar de Ajó to Santa Teresíta, can be solved by constructing with nature through the implementation of a beach replenishment, leading to beach restoration. This beach replenishment is vital to the integrity of the coast, as presently this coast is very vulnerable to extreme environmental conditions. Even when coastal defense

structures such as parallel breakwaters and T-groynes are considered, then still a beach replenishment has to be implemented first. Beach restoration is very attractive from an environmental viewpoint. Furthermore, it can be a cost effective solution.

2 What is required is an Integrated Shoreline Management Plan (Phase 2). This should be carried out and implemented by all the relevant local and regional authorities, varying from the Municipalidad de la Costa to the Provincia de Buenos Aires. The interests of the local population should always be taken into account. By means of this plan the decision can be made if after the implementation of a beach replenishment coastal defense structures will be built or future maintenance replenishments will be carried out. The advantages and disadvantages of both options (local and global, short term and long term, physical and non physical) will have to be studied.

3 Part of the regulatory measures to be considered for Phase 2 (Integrated Shoreline Management Plan) is the restoration of the dunes. As the dunes are very important in providing a protective buffer zone, the restoration of the dunes should coincide with the beach replenishment. Sand should be added to the dune zone, and the dunes should be revegetated where necessary. After this has been accomplished, the dunes should be protected. This implies that no new buildings should be built in the primary row of dunes, and that access to the dunes to be restricted. Special corridors have to be provided for the tourists and certain service sectors to make it possible for them to reach the beach without inflicting damage to the primary row of dunes and their vegetation.

4 Another part of the regulatory measures to be considered for Phase 2 (Integrated Shoreline Management Plan) is the improvement of storm water drainage works, as these have presently a detrimental effect on the beach. Rerouting and integration with coastal defense structures should be considered.

4. Long term integrated coastal zone management: Phase 3

It is advisable to consider also the broader context and therewith longer planning scales of regional coastal zone developments. This includes anticipating climate change impacts. Generically, the approach, suggested by IPCC, may be as follows.

Framework for analysis for ICZM

The changes imposed on a coastal system may result from three types of agents of change:

- demand-driven changes;
- natural processes;
- climate change factors.

A key issue in ICZM is the determination of the relative importance of the agents of change in relation to the vulnerability and sustainable development of the coastal system. The sustainable use of the coastal system is defined as "the maintenance of a desired mix of outputs from a coastal system generated through the use of natural resources over time,

subject to maintaining a prescribed environmental quality". The combination of uncertainty and the possibility of irreversible decisions emphasizes the importance of risk-averse behaviour if a goal of society is to achieve sustainable development. This leads to the recommendation that a precautionary approach for environmental management should be adopted, and that long-term changes should be properly accounted for, including a special focus on the impacts of climate change.

Analysis for ICZM

There are a number of more or less common approaches for the analysis for ICZM. The steps which are regarded as "common" to the analysis for ICZM apply to time horizons of the order of 10-25 years, and are referred to as the short-term analysis for ICZM:

1 specification of the conditions and execution of the analysis;
2 assessment of present, past and future situations within the coastal system;
3 analysis of the coastal system;
4 formulation and analysis of integrated coastal zone management (ICZM) strategies;
5 evaluation of coastal zone management strategies;
6 presentation of results to the decision process.

The first three steps comprise the preparatory phase of analysis, including the specification of the contents of the analysis and operationalization of the tools and data. The last three steps pertain to the actual execution of the analysis. The first step, i.e. the specification of analysis conditions and analysis execution, requires detailed knowledge of the relevant problems and characteristics of the coastal system. Therefore, the usual procedure is to have a first round of analysis, involving the rough execution of analysis steps 2 and 3. This will enable the detailed formulation of step 1, thereby ensuring a realistic specification of the tasks and resources required.

In addition to the above steps, specific attention should be paid to broadening short-term analysis to include the long-term impacts of climate change. In principle, the short-term analysis steps are quite adequate for dealing with the impacts of climate change; the question is which climate change factors to include. The addition of such factors will broaden the scope of the analysis, in that order mechanisms will need to be considered, other relationships will need to be specified, and other data will need to be collected. Consequently, additional tools and techniques may be needed.

Preferences for coastal zone managements plans may differ in view of the possible long-term impacts of climate change in terms of vulnerability and sustainability. In order to account for the latter impacts, a long-term analysis step is added to the procedure, which will produce a number of additional indicators expressing the relative vulnerability of alternative ICZM strategies based on a rough assessment of the impacts of long-term climate changes. In specifying the scope of the analysis, a crucial question is which agents of change need to be considered. The answer to this question depends on the relative importance of the various agents of change, particularly climate change factors. The relative importance should be evaluated from the perspectives of both short- and long-term developments and decisions. The outcome of this evaluation will determine which agents of change are to be included in the short- or long-term analysis, or in both.

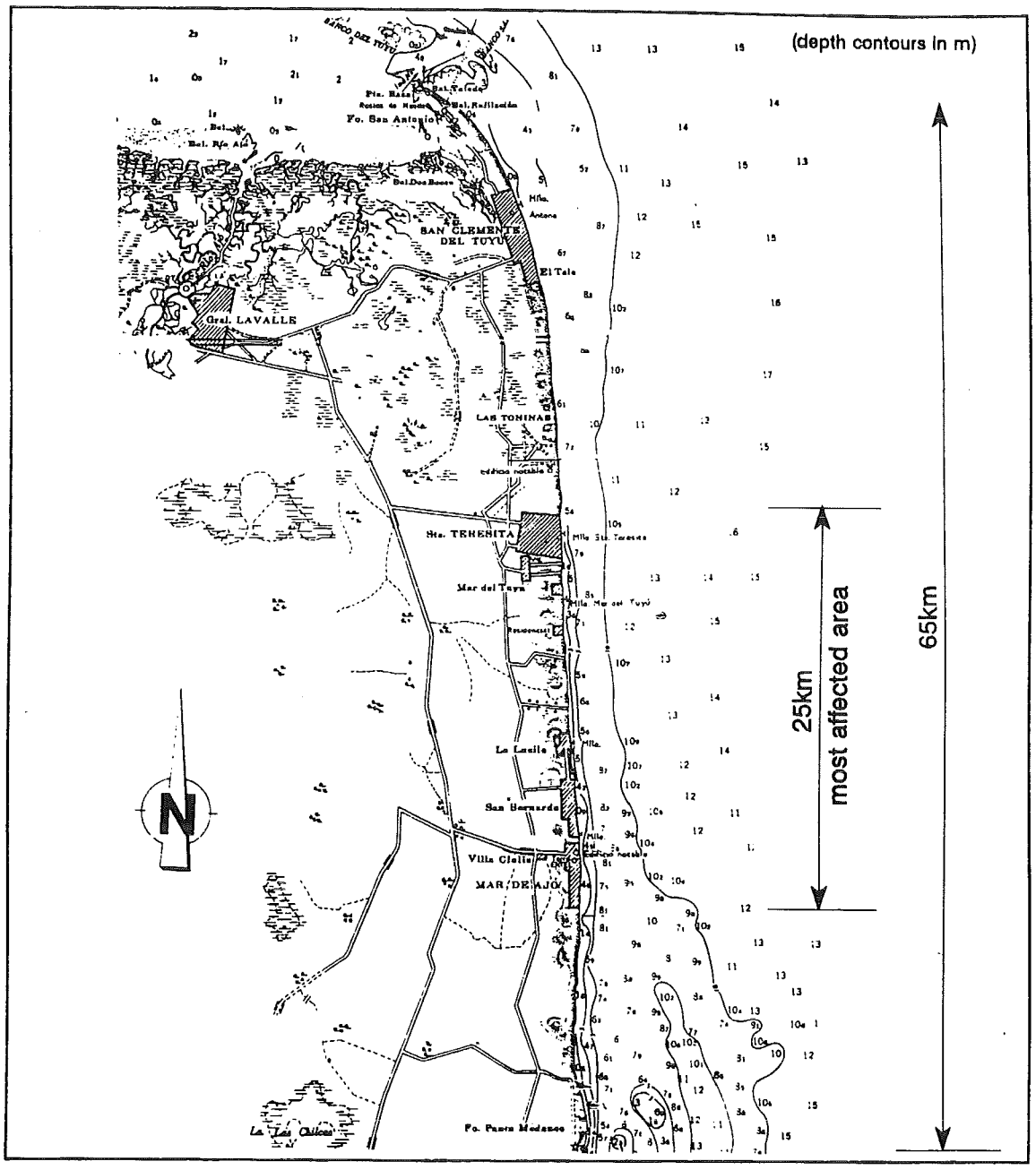


Figure 1 Costa Oceanica

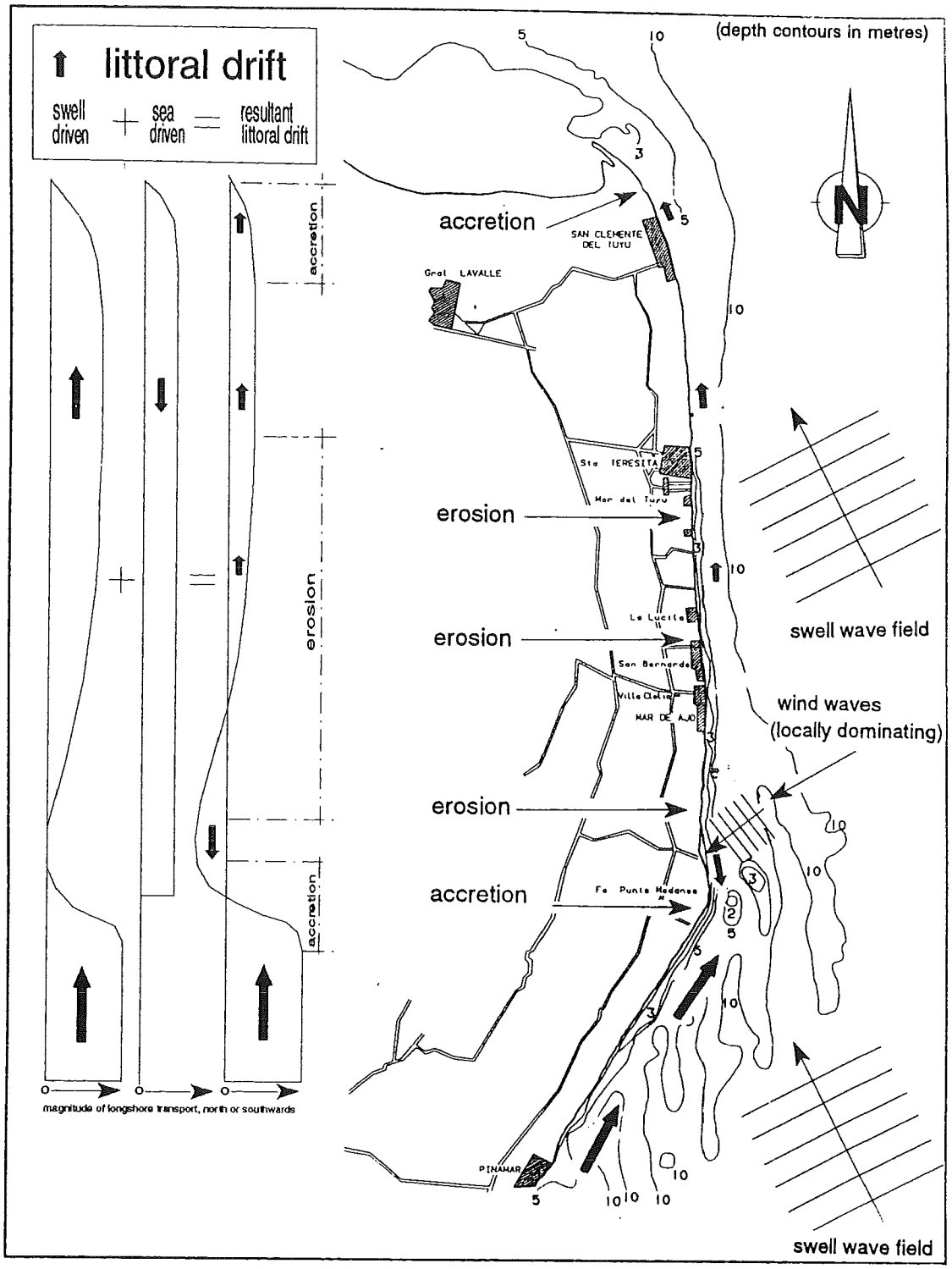


Figure 2 Littoral drift (longshore transport) and erosion mechanisms

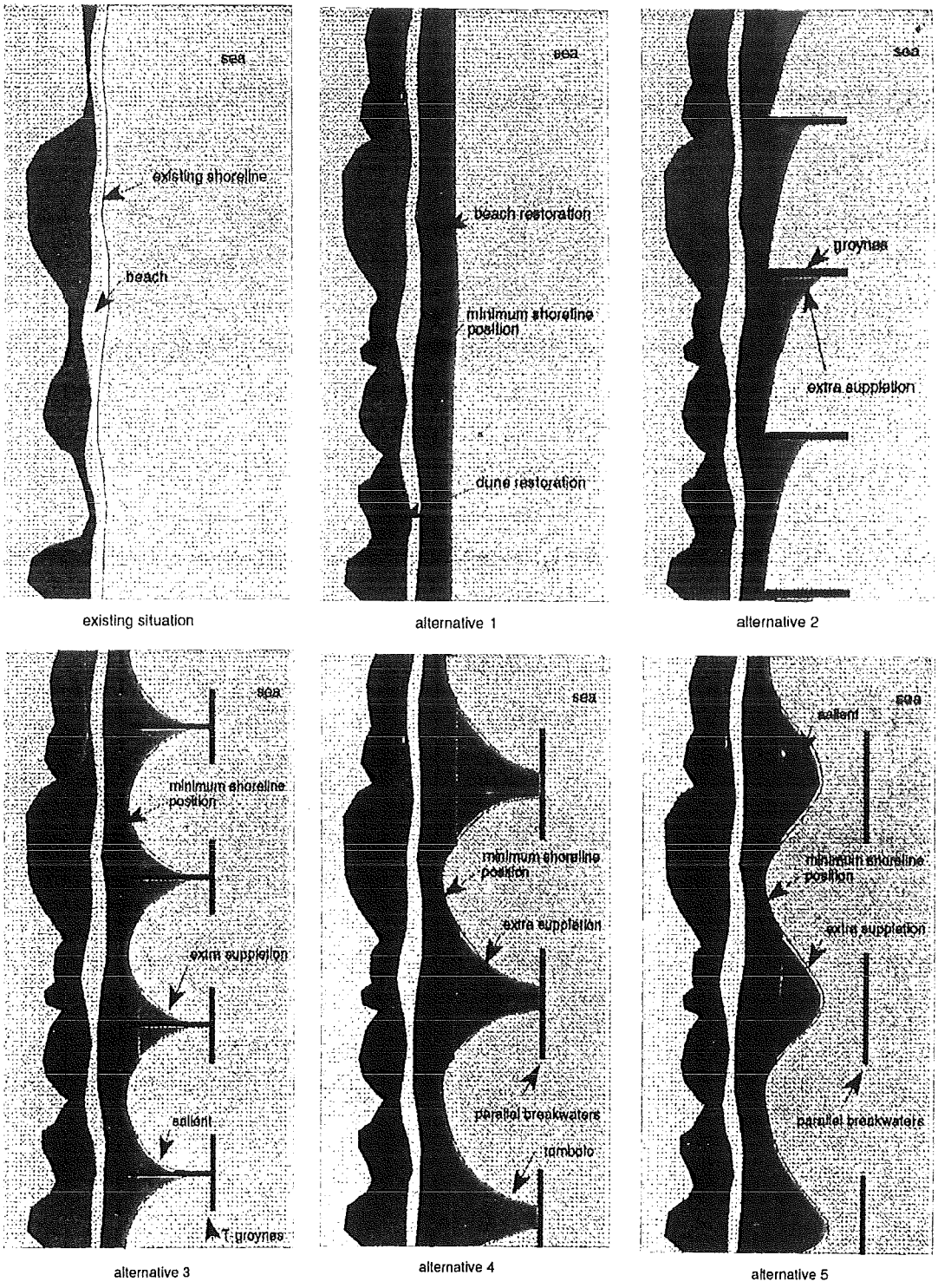


Figure 3 Alternative management measures

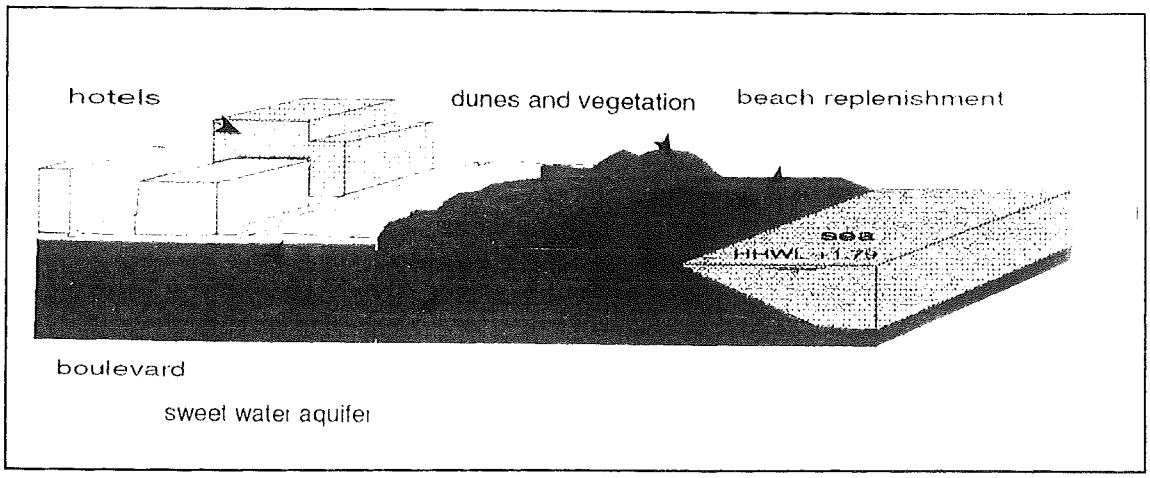


Figure 4 Shoreline zonation

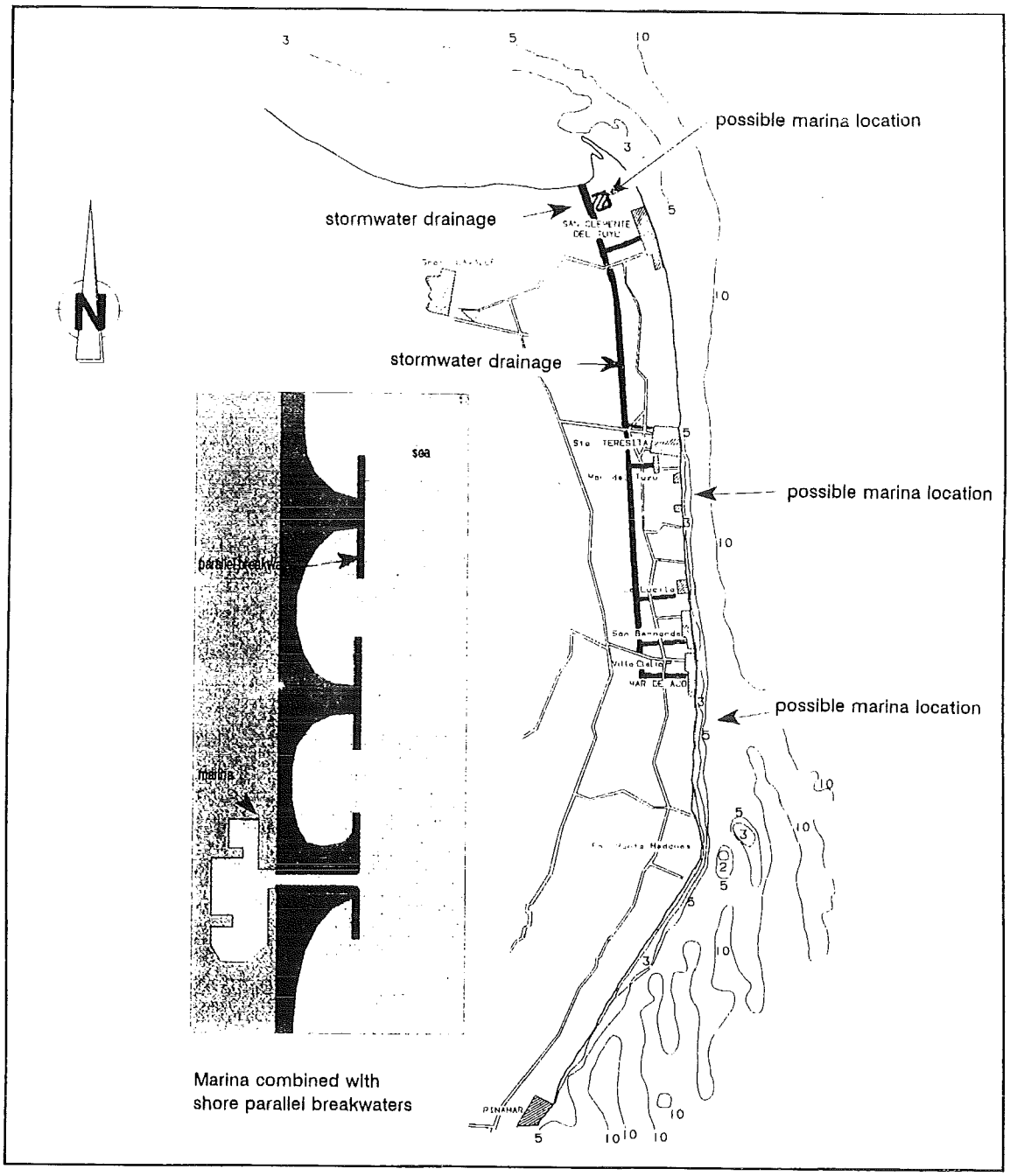


Figure 5 Possible locations of marinas and storm water drainage

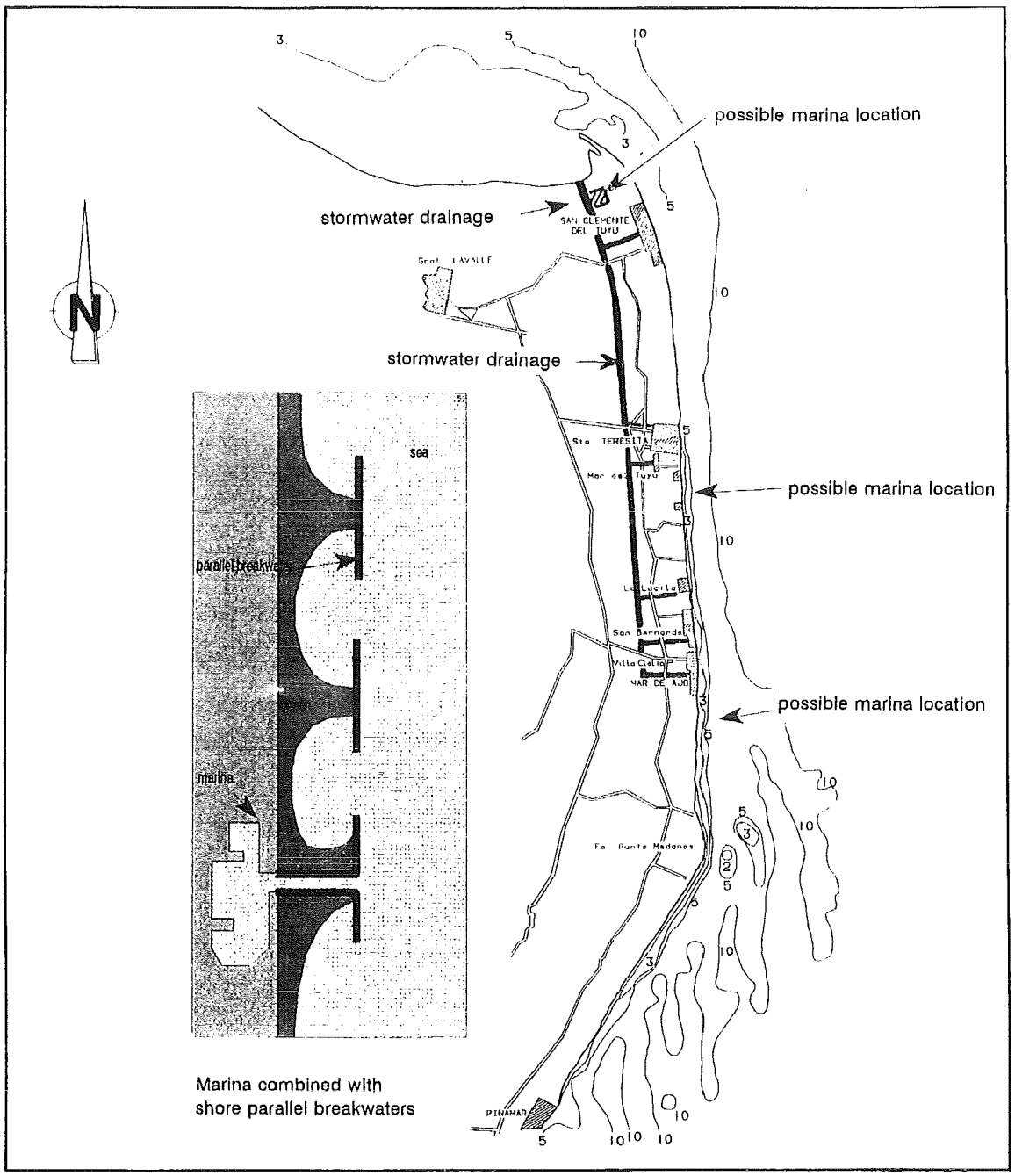
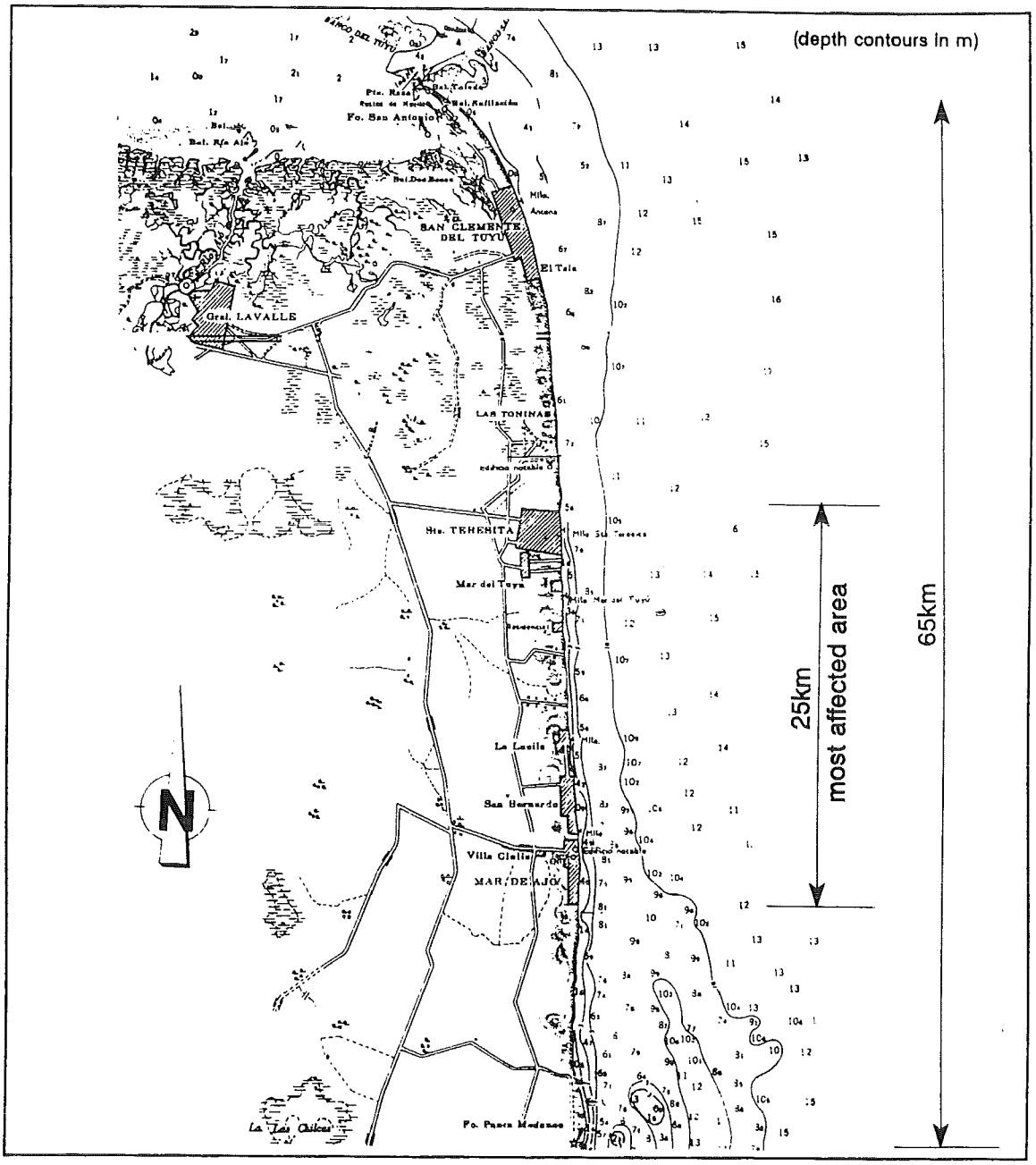


Figure 5 Possible locations of marinas and storm water drainage



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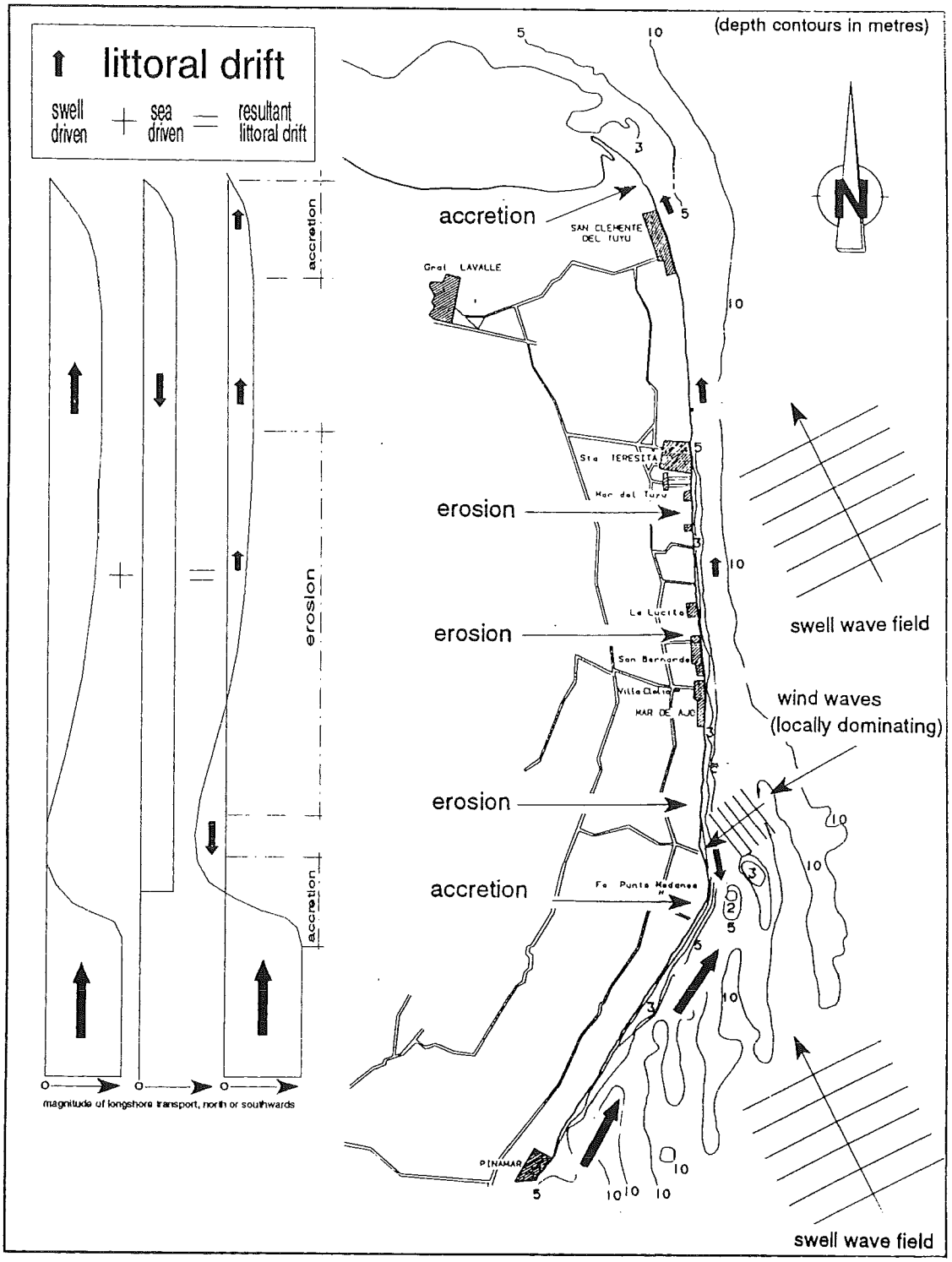
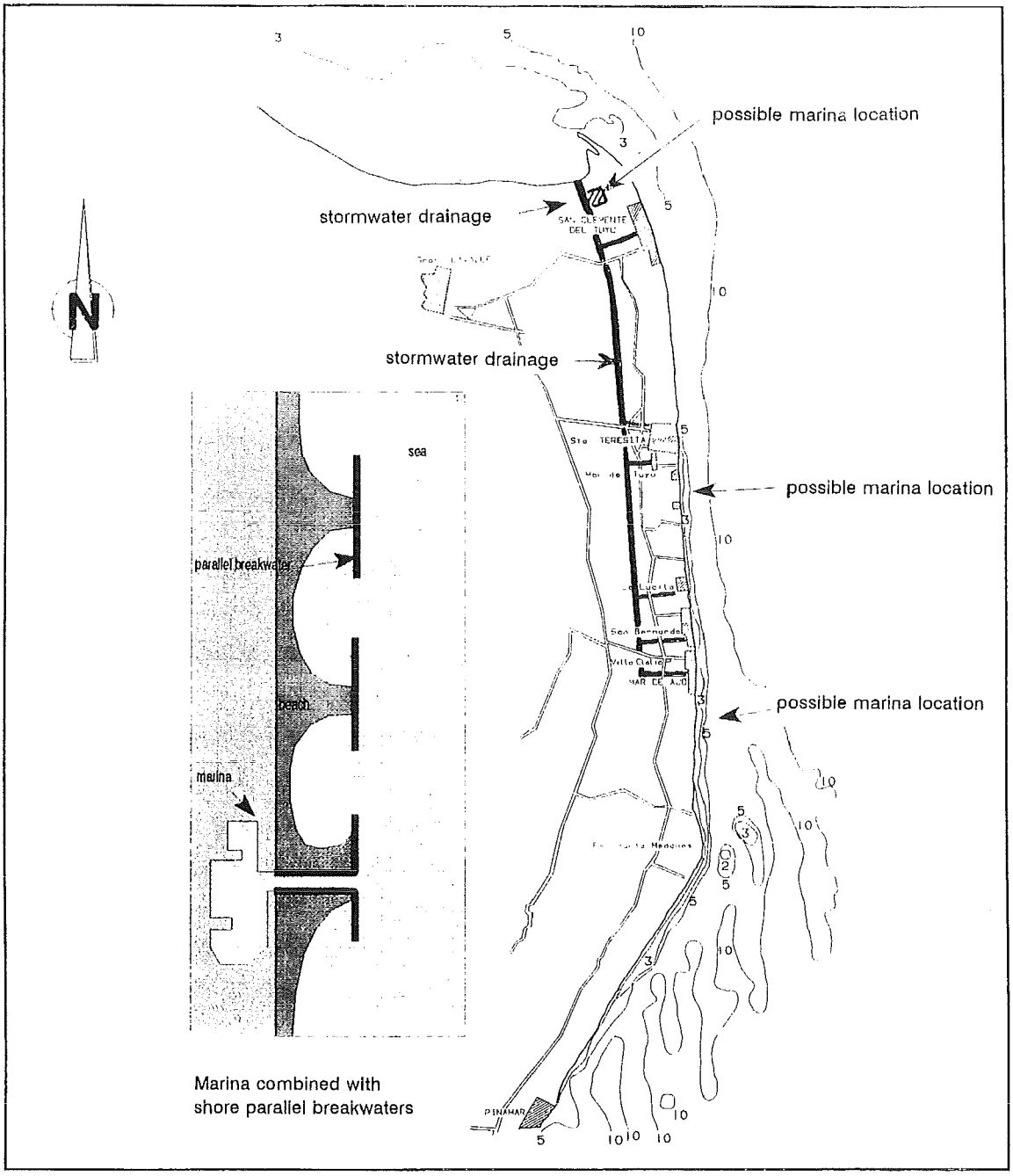


Figure 2 Littoral drift (longshore transport) and erosion mechanisms



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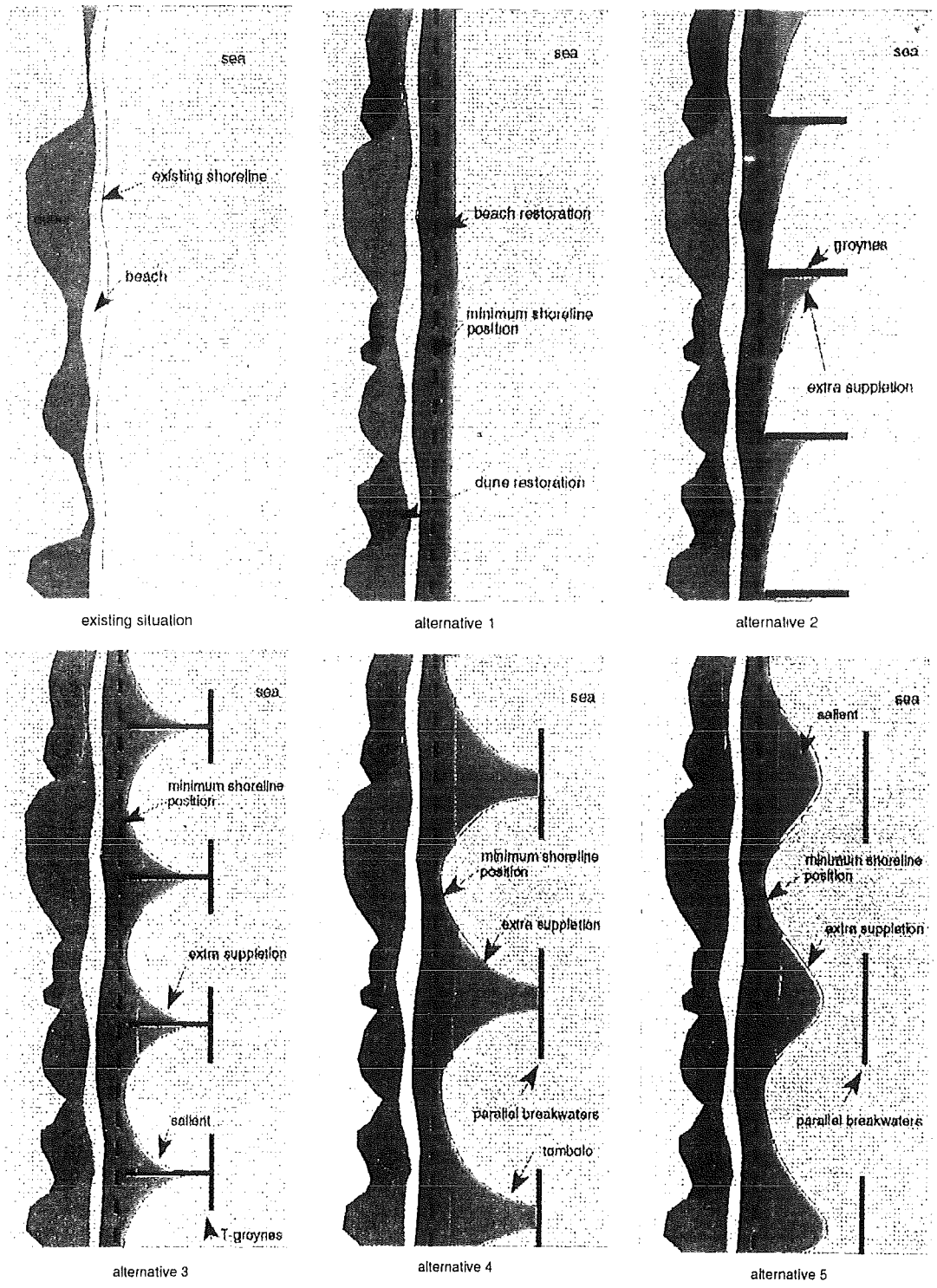

Figure 3 Alternative management measures

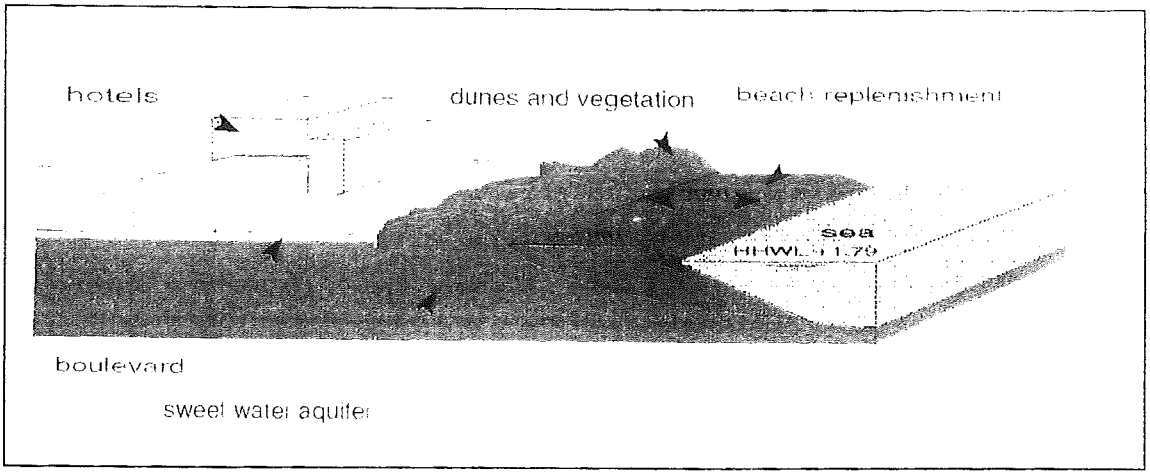

Figure 4 Shoreline zonation

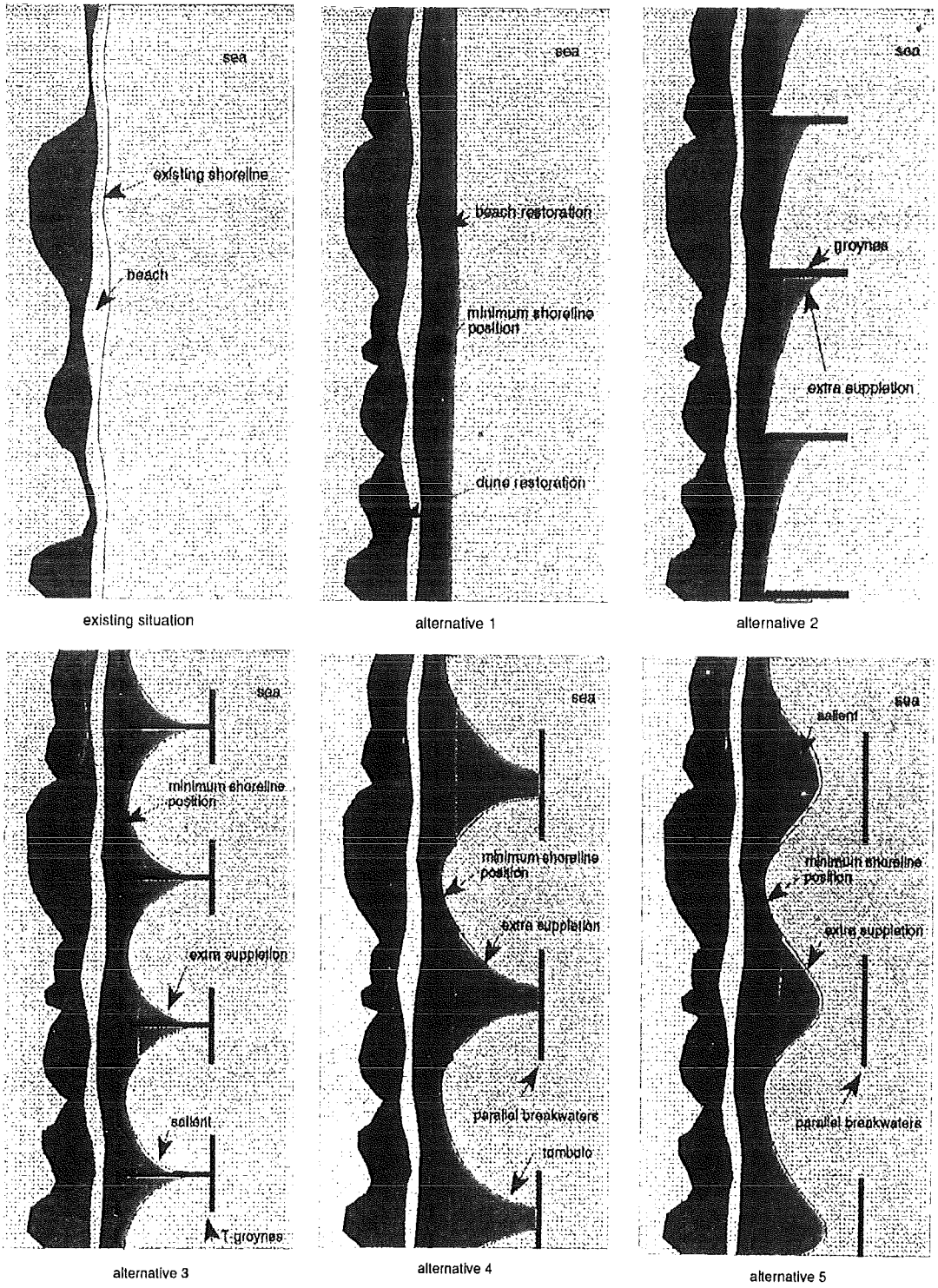

Figure 3 Alternative management measures

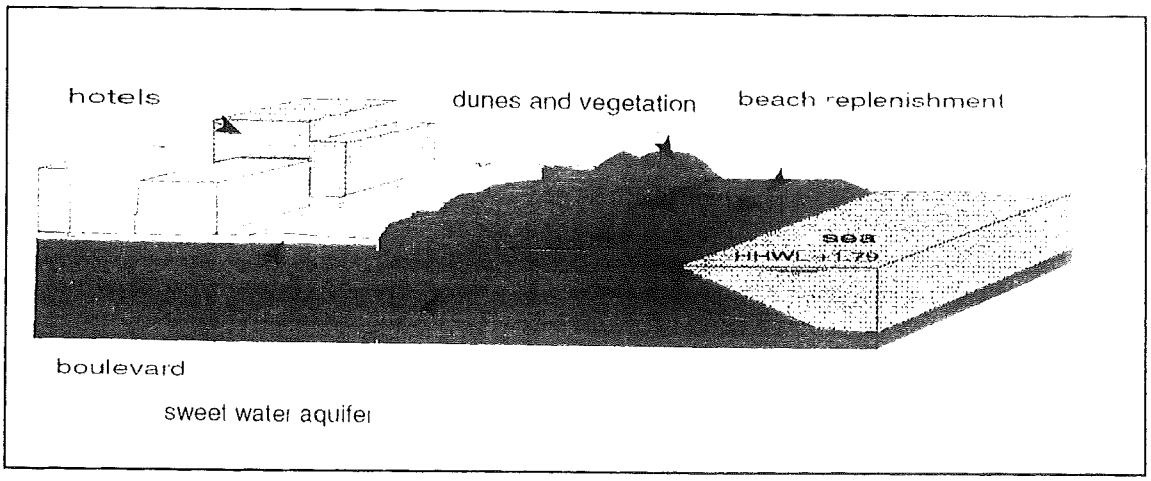

Figure 4 Shoreline zonation

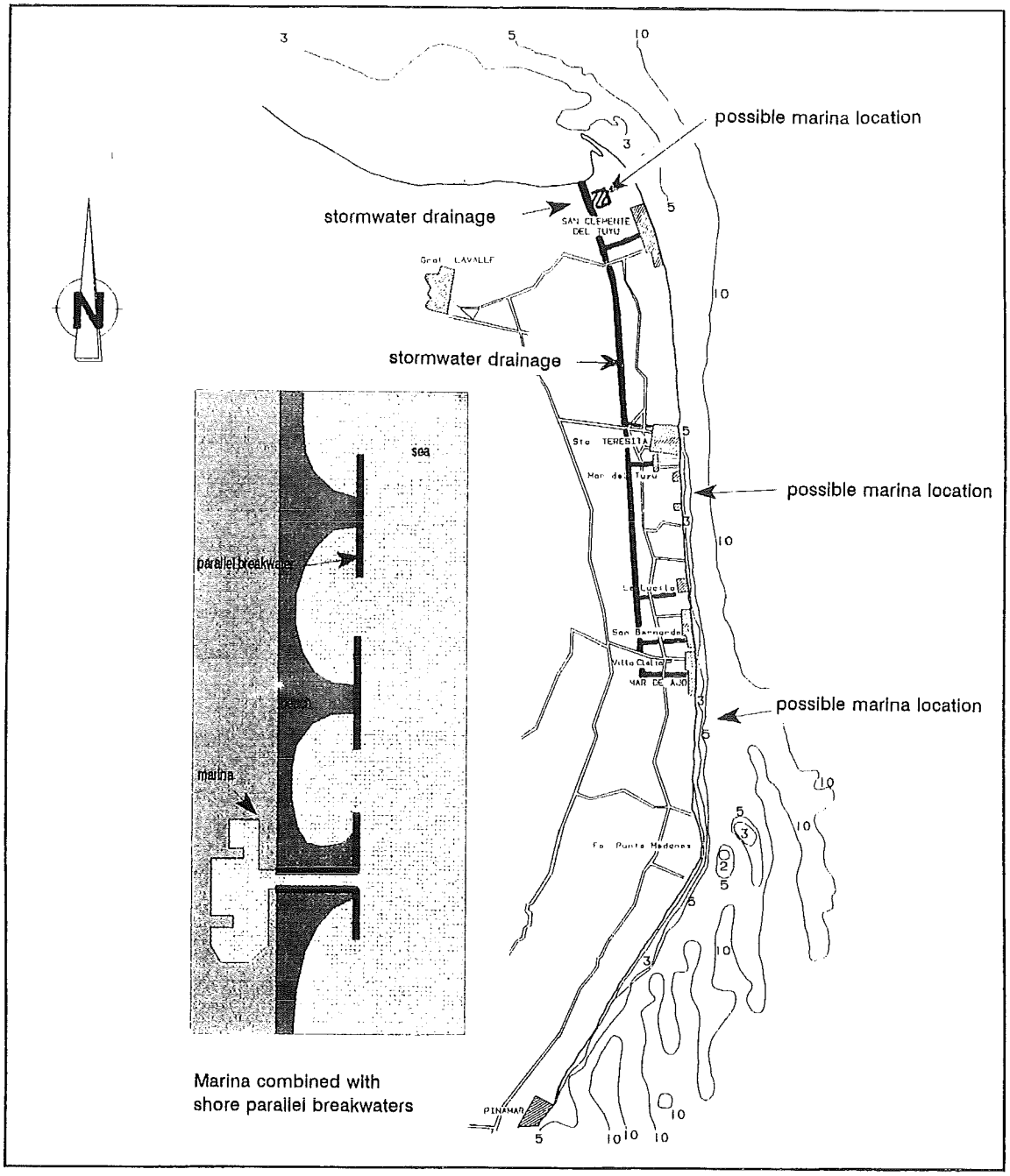

Figure 5 Possible locations of marinas and storm water drainage

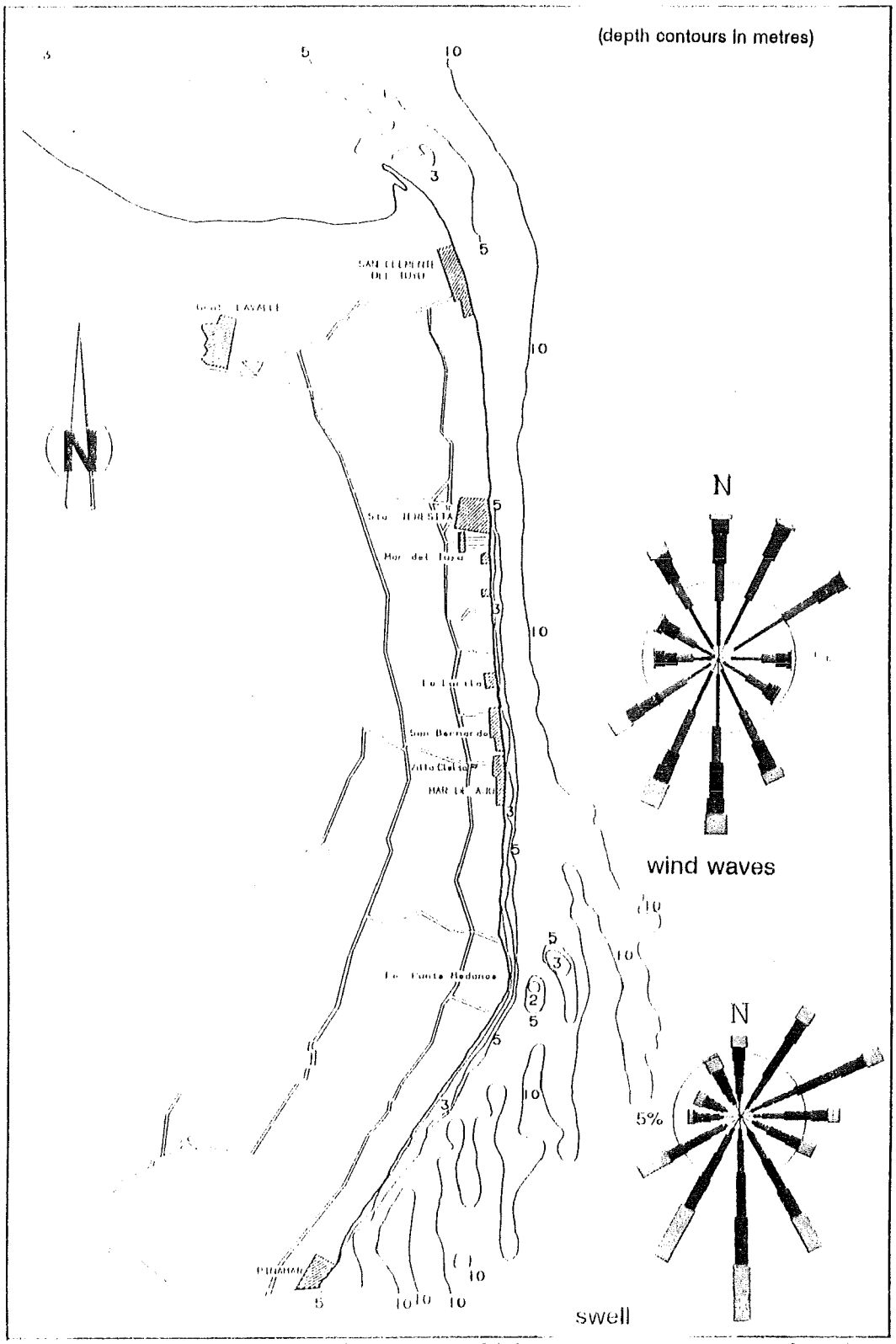

Figure 4.1 Wind and swell waves offshore of the Costa Atlantica

Note; 5%: read as 5% of time