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E C L A C

Economic Commission for Latin America and the Caribbean

BASIC PLAN FOR THE ENVIRONMENTAL MANAGEMENT OF THE DISTRICT OF CARTAGENA, COLOMBIA

This study was prepared by the Joint ECLAC/UNEP Development and Environment Unit of the Environment and Human Settlements Division on the basis of the background paper prepared by José Henrique Rizo, consultant. It contains the main conclusions of the ZOPP Seminar "Programmes and policies for control and supervision of urban and industrial pollution of the City of Cartagena" (Cartagena, Colombia, 6-8 August 1991), and the study conducted by professional staff members of various institutions in Cartagena, especially the National Institute for Renewable Natural Resources and the Environment (INDERENA). The views expressed in this document, which has not been formally edited, are the sole responsibility of the authors and may not coincide with those of the Organization.

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I. FOREWORD

This document is a summary of a study that has been carried out primarily by professional staff and government authorities in Cartagena, with the support and assistance of ECLAC in the context of the ECLAC/UNEP project on "Technical cooperation for planning and environmental management in Latin America and the Caribbean".

It examines one aspect of the diagnosis and identification of the main environmental problems affecting Cartagena, the determination of a set of objectives for the environmental management of the city in the context of its development, and the establishment of a series of project profiles that should be carried out in the relatively short term to implement that management.

In terms of diagnosis, the document incorporates an existing background paper on the environmental situation in Cartagena prepared by José Henrique Rizo Pombo, in addition to a fruitful discussion at a ZOPP Seminar that took place in Cartagena in August 1991, precisely on the problem of urban and industrial pollution in that city, among high-level officials, professional staff and technicians directly or indirectly involved with the pollution problem.

On the basis of the diagnostic study and the outline of priorities set forth at the seminar, as expressed in a planning matrix which contains objectives, findings and major activities planned, certain progress was made in defining a series of nine project profiles designed to undertake the most urgent types of action required for the environmental management of Cartagena. This definition was crafted by the institutions and professional staff involved, with the technical assistance of ECLAC.

II. BACKGROUND

Cartagena is located on the bay of the same name on the Colombian coast of the Caribbean Sea. (See figures 2.1, p. 3, and 2.2, p. 4).

Its climate is hot and humid, with an annual average temperature of 28° C. and an average rainfall of 920 mm per year. The rainy season runs from April to June and from late July to late November, with strong, frequent rains in October. During the rainy season, temperatures are the highest and winds are light and variable. During the dry season, when temperatures are lower, stronger trade winds from the north predominate, mainly from December to March.

The city was founded on 1 June 1533 by Pedro de Heredia on an indigenous settlement known as Calamarí or Caraimarí. Cartagena later became one of the most important cities in the Spanish colonies.

The military installations and religious and civilian buildings of the era constitute the largest urban colonial settlement in Latin America, which explains why Cartagena was declared by UNESCO in 1985 to be part of the Historical and Cultural Heritage of Mankind.

The opening of the Canal del Dique in 1650 linked Cartagena to the Magdalena River, making it the main river port in the country, handling slightly less than 80% of the freight on the Magdalena.

Table 2.1
LAND USE IN URBAN CARTAGENA (1987)

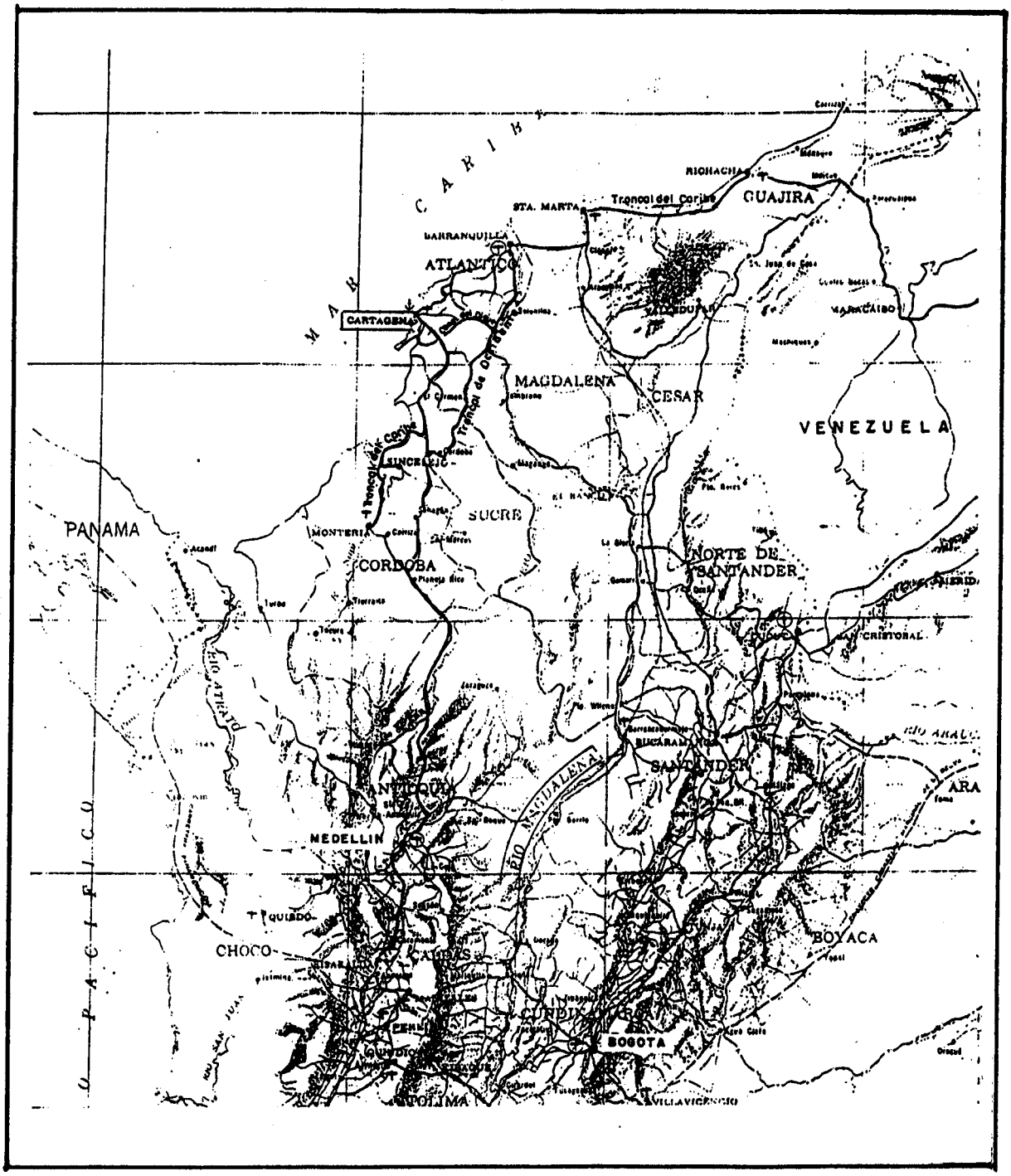
Use	Hectares
Residential	2,510
Commercial	52
Institutional	222
Industrial : Mamonal	2,500
Other	425
Ecological reserve	530
Open areas	1,790
	8,029

Table 2.2
SURFACE AREA OF CARTAGENA'S BODIES OF WATER

	Hectares
Virgin's Marsh	2,200
Waterways and lakes	152
Inland Bay	408
Total inland waters	2,760
Outer Bay	82,000

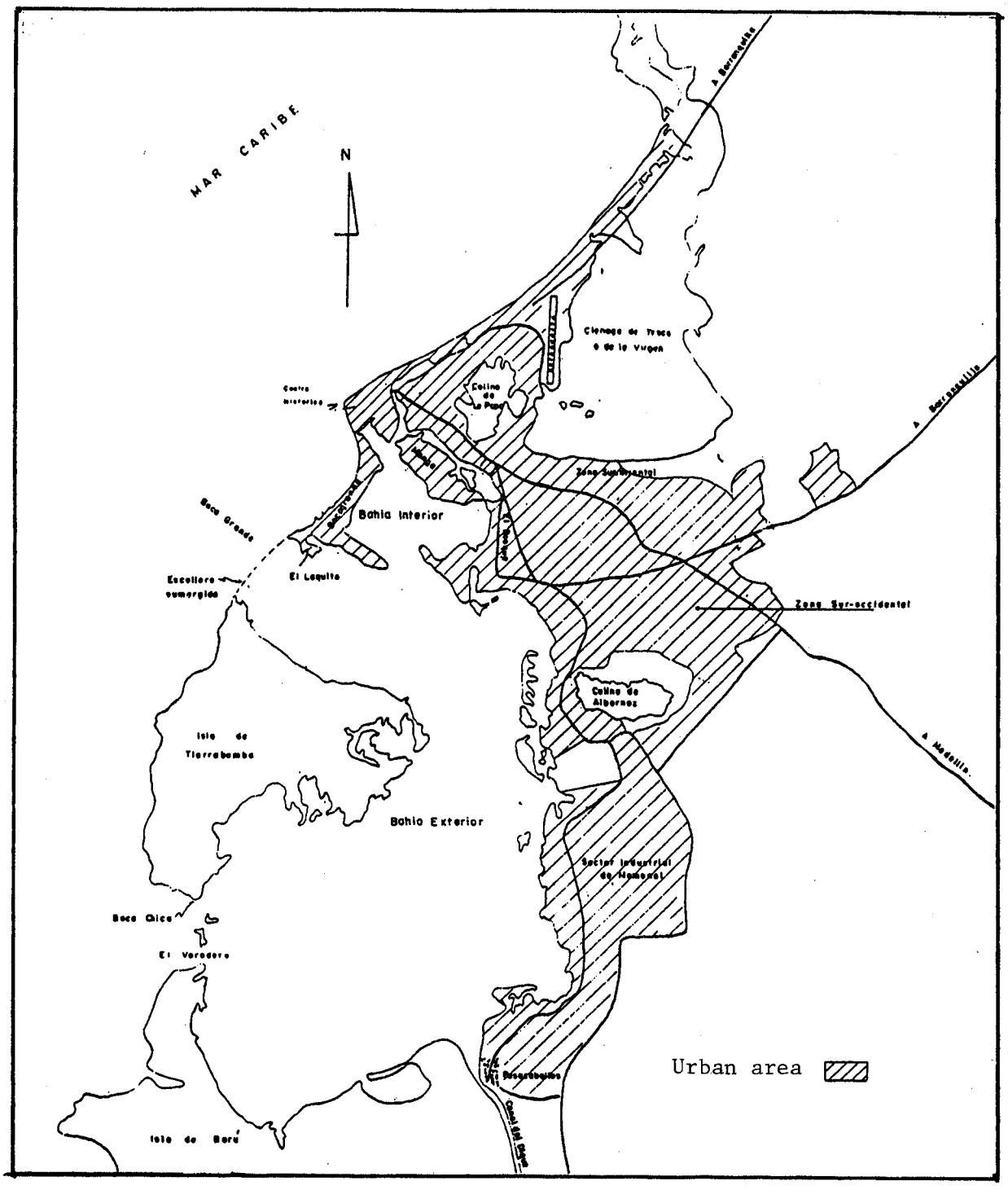
Cartagena is the fifth largest city in Colombia, with a population of 620,000 in an urban area covering 8,000 hectares, distributed as shown in table 2.1. As table 2.2 shows, water has considerable influence on the layout of Cartagena.

Figure 2.1
CARTAGENA: LOCATION AND ROAD LINKS



The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Figure 2.2
CARTAGENA: URBAN AREA AND BODIES OF WATER



Cartagena is Colombia's main tourist attraction, with hotel facilities for 8,000 people. It is also the country's main seaport and handles close to 60% of its international and coastal cargo. The city's industrial sector is already quite large and growing. Industry produces 52% of Cartagena's gross domestic product, while tourism (hotels and restaurants) produces 3.5%.

Cartagena is linked by land with the interior of the country and with other Caribbean and Venezuelan ports by the Caribbean highway, which connects with the western and Magdalena highways.

Migrations have produced a highly unbalanced population, with 85% in low-income groups, 20% of whom are in extreme poverty, and a high-income stratum of slightly less than 4%, and a middle class of barely 11%.

Legislative Act N° 1 of 1989 endowed Cartagena with the status of tourist and cultural district, with special characteristics within the territorial system of Colombia. The new Constitution, promulgated on 5 July 1991, confirmed the act.

As a district, Cartagena shares in the nation's income (leading to a rise of 17% in the city's income in 1992). It also grants legal benefits to its economic activity.

Looking to the future, it should also be mentioned that in the last four years new industries were either enlarged or constructed in the city, mainly petrochemical or related industries, for a total of US$500 million, and another US$1.28 billion in investments is planned over the next five to seven years.

The customs-free tourist zone of Barú was set up to develop some 600 hectares on the island; important economic groups have expressed interest in the project. Tourist facilities and lodging are also under construction along the coast between Cartagena and Barranquilla, especially the section between Cartagena and Galerazamba. Investors have renewed interest in constructing hotels in the little space still available in the tourist sector of Boca Grande. Construction of other hotels to the north and close to the airport is also planned.

III. THE ENVIRONMENTAL PROBLEMATIC OF CARTAGENA

Historic and more recent development in Cartagena have produced a variety of environmental problems, many of which are critical and demand systematic and decisive action by national and district authorities.

Without a doubt, as in practically all the urban centres of Latin America and the Caribbean, one of the most critical problems in Cartagena is the impairment of the habitat of the marginal population, with the well-known consequences of crime, alcoholism, promiscuity and overcrowding, poor health, etc. From a purely physical viewpoint and taking into consideration the links with the above-mentioned problematic, pollution from garbage is one of the main environmental problems facing the city of Cartagena at this time.

Figures 3.1 (p. 7) and 3.2 (p. 8) show in schematic fashion Cartagena's various pollution problems. This is the result of the analysis made in the seminar Programme of policies to monitor and control urban and industrial pollution in the city of Cartagena, held in Cartagena 6-8 August 1991, with participants from government, municipal, university and private sectors.

Even though air and soil pollution might be becoming more or less serious in certain limited areas, the worst problem is clearly water pollution. Besides the direct impact it has on the health of the population, water pollution is beginning to threaten the sustainability of economic activities with enormous development potential to benefit the population, such as tourism, which depends mainly on natural resources of the coast that have to be conserved by avoiding pollution and impairment.

For every concrete case of water, air and soil pollution there is a variety of immediate causes that must be taken into account in designing the strategy and basic plan for the environmental management of Cartagena.

The following pages will present a detailed analysis of the problems identified in numerous studies.

Figure 3.1
PROBLEMS: GENERAL CAUSES AND AIR- AND SOIL-RELATED CAUSES

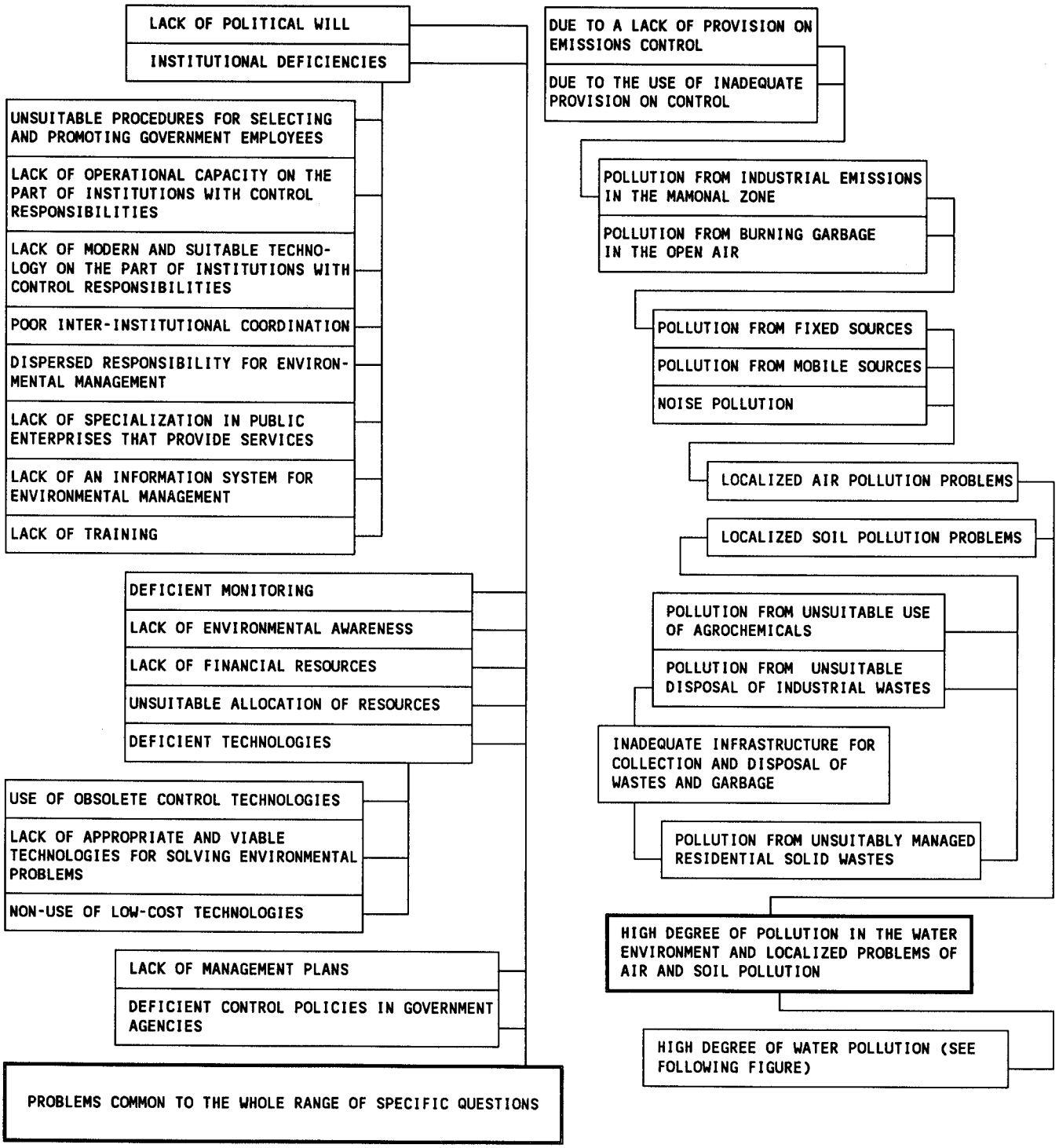
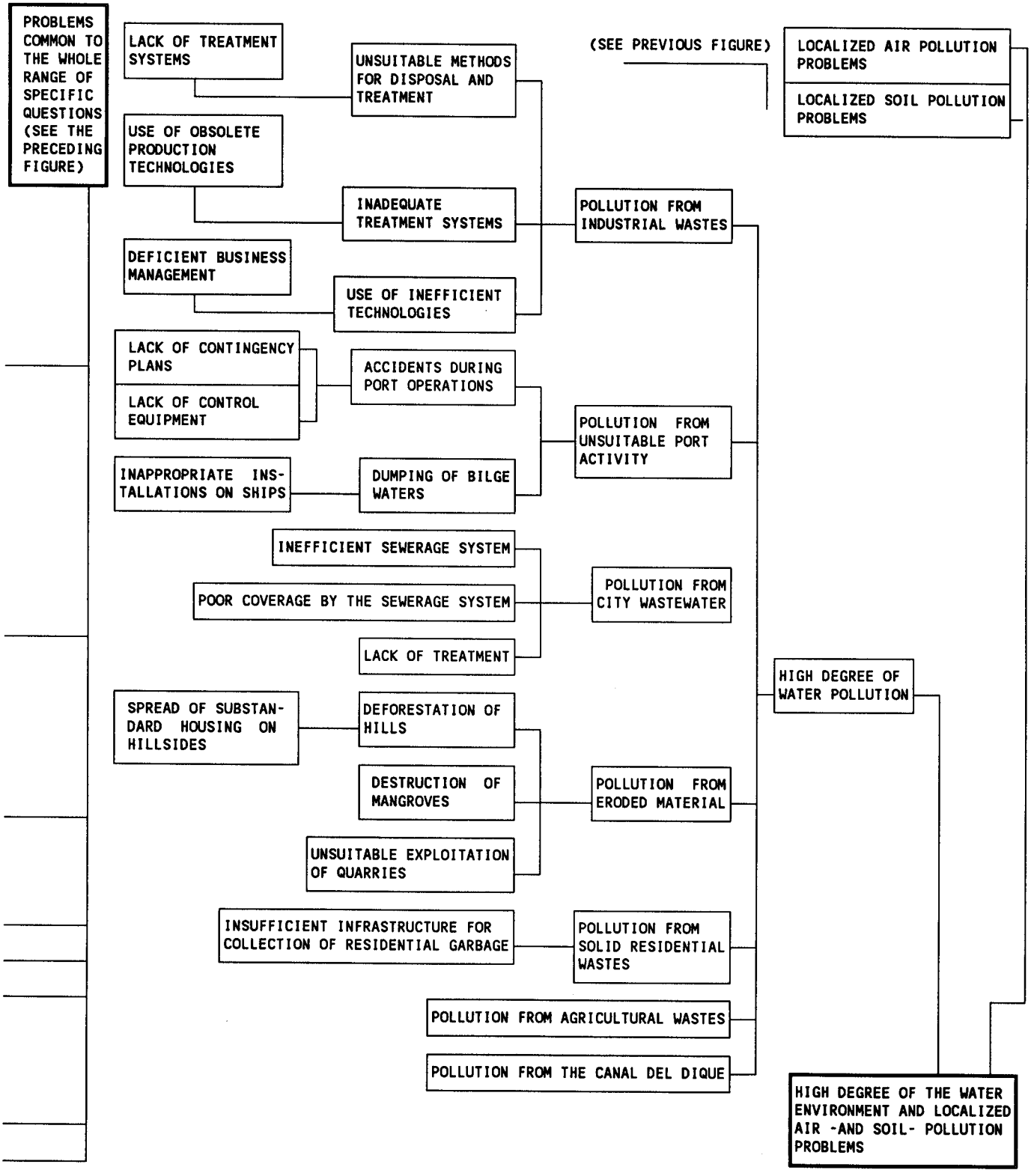


Figure 3.2
PROBLEMS CAUSED BY WATER POLLUTION



A. WATER POLLUTION

Water pollution in Cartagena can be schematized, as in table 3.1, according to the source of the release and the receiving body of water.

Table 3.1
MAIN SOURCES OF EMISSIONS AND POLLUTION-RECEIVING BODIES OF WATER IN CARTAGENA

RECEIVING BODIES OF WATER	VIRGIN'S MARSH	URBAN WATERWAYS AND LAKES	BAY OF CARTAGENA	OPEN SEA
SOURCES OF EMISSIONS				
1. Industrial dumping			XXXX	**
2. Wastewater	XXXX	XXXX	XXXX	**
3. Canal del Dique			XXXX	**
4. Spills from ships and dock operations		X	XXXX	X***
5. Agrochemical run-off	X		X	
6. Solid wastes	XX	XXX	X	
7. Leachate from solid wastes	X	XXX	XXX	

X Direct dumping
* Indirect impact through water circulation

Several studies have been made on water pollution in Cartagena.[1/]

Given the difficulty of summarizing all the aspects of this situation, a systematic picture of available information is given here, with comments on its main conclusions, listing in order of priority possible actions and pointing out the areas where information, policies and actions are lacking.[2/]

1. Sources of releases

a) Industrial dumping

According to 1990 data from the Cartagena Chamber of Commerce, the city has some 620 industries.[3/] INDERENA (1990) estimates that close to 50 of them produce significant volumes of liquid effluents. All of these industries are located on the east coast of the Bay of Cartagena, into which they therefore dump 100% of their industrial effluents, after treating them in some cases. Especially important in this group are the large enterprises in the Mamonal industrial zone. Besides Mamonal, another important source of discharges is the Bolivar Liquor Company (INDULIBOL) in El Bosque. This area also contains a number of small industries (mechanics, paint shops, furniture, soft drinks, etc.) whose

dumpings are not measured but might be considerable. Figure 3.3 (p. 12) gives the main industrial areas and enterprises.

Monitoring of industrial dumping by large enterprises in Cartagena has greatly increased over the last decade. In the last two years, the number of enterprises monitored went from two to 22 (see table 3.2, p. 13). A number of these were treating their liquid effluents when their releases were measured (see table 3.4, p. 14), therefore the figures represent effective releases after treatment by each enterprise.

All the data is not in yet,[4/] but the information provided in table 3.3 was obtained from the data by INDERENA on 12 enterprises in the area.

Table 3.3
INDUSTRIAL LIQUID EFFLUENTS, ESTIMATED FOR 1988

Volume of effluents	70,400 m^3/day
BOD	11.13 metric tons/day
Nitrogen	4.52 metric tons/day
Phosphorous	0.23 metric tons/day
Solids in suspension	7.86 metric tons/day
Oils and grease	30.78 metric tons/day

Source: INDERENA (1988)

According to a study by INDERENA (1990), 32% of the organic matter dumped into the Bay of Cartagena, 25% of the nutrients, a good part of fuel and fertilizer residues, and most of the typical industrial discharges, such sodium carbonate, ammonia, phenols, heated water, etc. come from industry.[5/]

New enterprises are being built in the Mamonal industrial zone and several of those already there are enlarging their operations. The Government's policy to promote exports and liberalize the economy will probably reinforce this trend, which will make new environmental demands on the Bay of Cartagena and require monitoring the enterprises. The study of the Mamonal Foundation (1989) gives a list of the projects under way and their requirements for environmental monitoring.

b) Urban wastewater

Cartagena's wastewater reaches a volume of 200,000 cubic metres a day, and between 5% and 60% of it is dumped into the Virgin's Marsh (or the Tesca Marsh) through a number of underground pipes and open drainage canals south and south-east of the Marsh. Another 35% to 40%, approximately, is discharged into the Bay of Cartagena, mainly through an underwater pipe 800 metres long opposite Manzanillo Island. Another amount, difficult to estimate, probably between 5% and 15%, finds its way to the city's system of waterways and lakes. A good part, unquantified, of these dumpings are produced by the supposedly emergency discharges of numerous sewerage pumping stations, which are frequent, and in some cases constant, since their pumping capacity is insufficient (see figure 3.3, p. 12).

The impact of these completely untreated discharges represents a pollution load which is detailed in table 3.5.[6/]

Table 3.5
DISCHARGE OF URBAN WASTEWATER

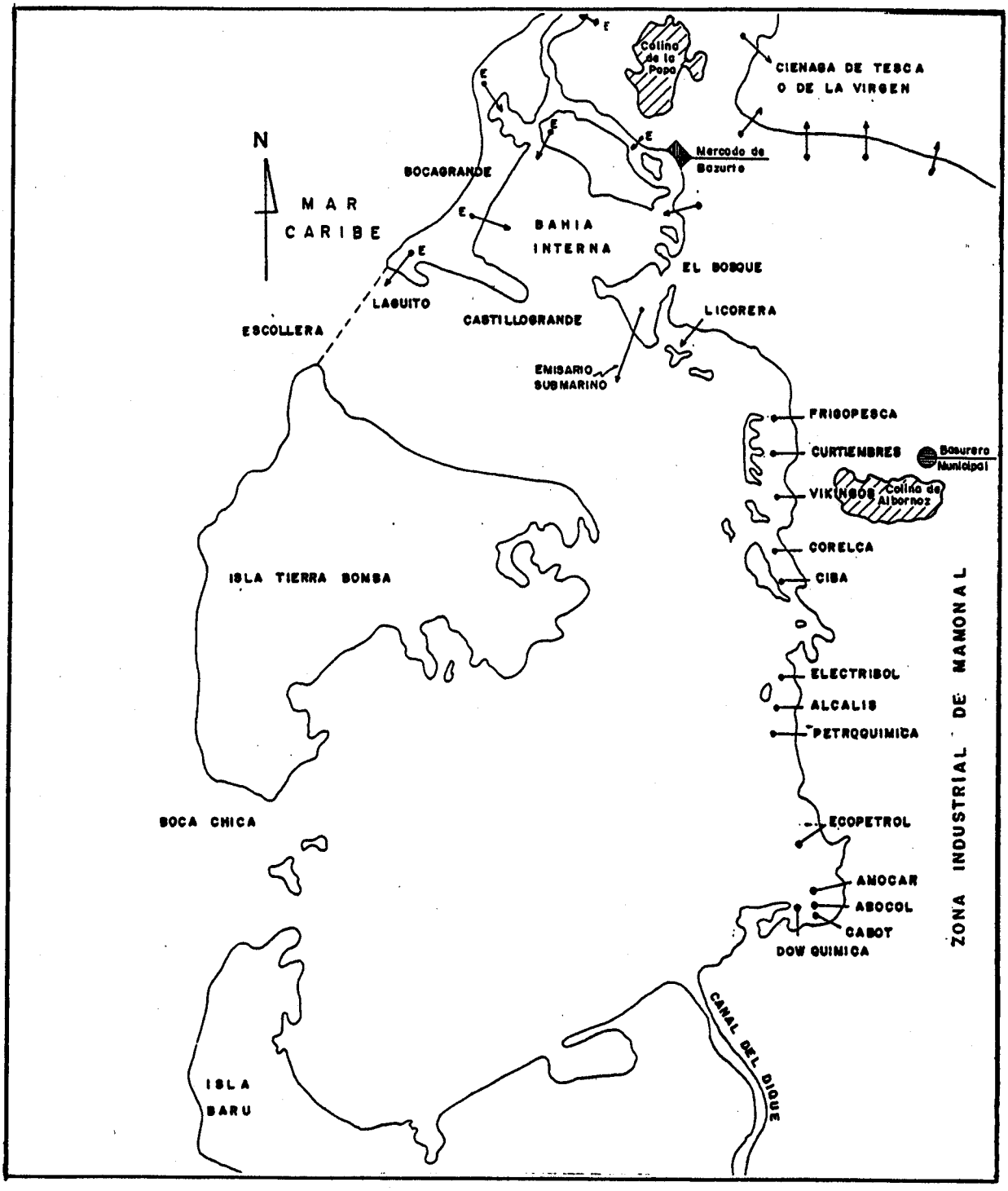
Estimated volume	200,000 m^3/day
Organic matter	27 metric tons/day
Total solids (suspended and dissolved)	69 metric tons/day
Total nitrogen	0.6 metric tons/day
Phosphorous	0.2 metric tons/day
Oil and grease	6.6 metric tons/day

Source: INDERENA (1988)

The impact of these discharges on the city's bodies of water has been devastating, leading to their eutrophication, high levels of bacterial pollution, accelerated sediment build-up and overall environmental impairment.

Its larger size and active interchange with the open ocean has diminished the impact of wastewater discharges on the Bay of Cartagena; nevertheless, today they are considered by many specialists to the main cause of pollution in this body of water.

Figure 3.3
LOCATION OF MAIN DISCHARGES



KEY

Industrial discharges ——•
Sewerage collector discharges ——•→
Emergency pumping stations E——•→

Table 3.2
INDUSTRIAL LIQUIDS DUMPED INTO THE BAY OF CARTAGENA, MARCH 1989, kg PER DAY

ENTERPRISE	VOLUME (m^3/day)	TSS	BOD	COD	NH4+	NO2-	NO3-	NT	PO4
ABONOS DE COLOMBIA-ABOCOL	831.1	71.7	1.6	8.1	452.4	2.7	249.8	883.6	29.5
ALCALIS DE COLOMBIA	49 464.0	91 775.7	608.4	1 004.1	474.9	6.9	291.8	619.5	
	5 685.1	26 626.3	133.6	231.4	35.3	18.2	110.3	337.7	
AMOCAR	986.7	289.0	15.8	37.2	100.0	1.0	20.4	205.6	
CABOT COLOMBIANA S.A.	33.5	0.8	1.2	1.5	0.3	3E-3	3E-2	0.7	15E-3
CIBA GEIBY COLOMBIANA S.A.	20.0	6E-4	16E-2	4.4	3E-4	6E-5	7E-3	756E-5	1E-4
COAPESCA	20.0	5.0	0.9	1.2	5E-3	1E-3	1E-3	15E-2	0.2
CODEGAN	25.2	22.2	30.2	37.8	14E-3	0.6			
CURTIEMBRES	19.6	140.7	34.4	42.8	8.3	-	9.7	23.4	
DOW QUIMICA OF COLOMBIA	69.1	25.9	46E-2	1.3	13E-2	1E-4	39E-4	13E-2	1E-3
DOW COLOMBIANA S.A.	1.1	13E-2	7E-3	24E-3	6E-3	-	4E-5	2E-3	2E-4
ECOPETROL	223 500.0	1 129.0	3 487.0	3 487.0					
ESSO COMBUSTIBLE	17.3	1E-2	19E-2	6E-2	6E-2			8E-2	
ESSO LUBRICANTE	17.3	13E-2	24E-2	34E-2	22E-3	-		4E-2	
FRIGOPESCA	181.4	22.5	24.6	36.3	6.5		16.4		
INDUSTRIA ROMAN S.A.	144.6	12.3	12.3	21.7	33E-2	16E-2	-	49E-2	5E-2
IND. LICORERA DE BOLIVAR	284.3	273.8	4 339.5	5 779.9	3.6	-	-	74.9	
INDUPOLLO	52.2	6.0	10.2	17.3	-			3.3	
MONTEMAR HELADOS	1.7	86E-2	1.8	2.9					
PETROQUIMICA COL.	1 728.0	172.1	103.7	140.9	1.6			18.5	
OCEANOS S.A.	19.2	1.3	10.3	13.9	53E-3	1E-3	1E-3	51E-2	48E-3
POSTOBON	117.1	35.5	107.4	175.6					
PROCESADORA DE LECHE DEL CARIBE	62.6	238.3	111.4	158.5	0.6	7E-2	41E-2	1.3	
VIKINGOS DE COLOMBIA S.A.	230.0	14.7	14.8	73.6	58E-2			1.2	
TOTAL ACCORDING TO SOURCE	283 500.0	96 842.9	9 050.0	11 277.0	1 048.8	29.1	698.8	9 671.9	29.8
CORRECTED TOTAL	283 518.0	120 863.9	9 050.0	11 278.0	1 048.6	29.1	698.8	2 171.5	29.8

ENTERPRISE	VOLUME (LT/DAY)	PT	Cr	Zn	A and G	HAT	Phenol	Ba	TensAc	PCB	MVC	Cn-
ABONOS DE COLOMBIA-ABOCOL	838.1	54.7	16E-2	0.10	0.6							
ALCALIS DE COLOMBIA	49 464.0											
	5 685.1											
AMOCAR	986.7	1.0	1.7		10.0							
CABOT COLOMBIANA S.A.	33.5	24E-3	-	-	0.1	3E-4	-	-	1.3	-		
CIBA GEIGY COLOMBIANA S.A.	20.0	1E-3							15E-2			
COAPESCA	20.0	25E-2			4.0							
CODEGAN	25.2	27E-2			14.1							
CURTIEMBRES	19.6	4E-2	27E-2		36.5							
DOW CHEMICAL OF COLOMBIA	69.1	14E-3			17E-2				21E-2			
DOW COLOMBIANA S.A.	1.1	7E-4			7E-3				8E-3			
ECOPETROL	223 500.0		4.6	27.0	42E+2	1.4	168.0					1.7
ESSO FUELS	17.3	-			1.1		-					
ESSO LUBRICANTS	17.3	3E-2			72E-2		-					
FRIGOPESCA	181.4	4.2			77.1							
INDUSTRIA ROMAN S.A.	144.6	9E-2			-		-					
INDUSTRIAS LICORERA DE BOLÍVAR	284.3	2.3										
INDUPOLLO	52.2											
MONTEMAR HELADOS	1.7	7E-4			25E-2				14E-2			
PETROQUÍMICA COL.	1 728.0	91E-2									6E-3	
OCEANOS S.A.	19.2	7E-2			24E-2							
POSTOBON	117.1				-				1.0			
PROCESADORA DE LECHE DEL CARIBE	62.6	87E-2			1.1							
VIKINGOS DE COLOMBIA S.A.	230.0	26E-3			2.8							
TOTAL ACCORDING TO SOURCE	283 500.0	64.7	6.7	27.1	4 339.7	1.4	168.0		2.8		6E-3	1.7
CORRECTED TOTAL	283 518.0	64.8	6.7	27.1	4 348.7	1.4	168.0		2.8		6E-3	1.7

Source: INDERENA (Total values have been corrected for this report).

Table 3.4

WATER TREATMENT SYSTEMS IN SOME INDUSTRIAL ENTERPRISES IN CARTAGENA

ENTERPRISE	ACTIVITY	TREATMENT SYSTEMS
Abolcol	Chemical fertilizers	Sedimentation basin; changes in processes.
Amocar	Ammonia, nitric acid	Sedimentation basin; API separator; neutralization tank.
Alco	Sodium carbonate, caustic soda	Sedimentation basins; changes in processes.
Bavaria	Malt factory (under construction)	Anaerobic sludge digestor (under construction).
Cabot	Carbon black	Settler, anaerobic digestor, separator and collector of oils and fats.
Colclinker	Cement and clinker	Not reported.
Corelca	Electric plant	Neutralization and cooling tanks.
Dexton, S.A.	Polystyrenes	API-type separator.
Dow Chemical	Biocides	Not reported.
ECOPETROL	Oil refinery, Dock for crude and hydrocarbons	API separator. Skimming basins for for bilge; pollutants removed are bio-stabilized by mixing with soil.
Frigopesca	Cold storage	Filtration; anaerobic basins; chlorination.
Hoechst	Surface-active agents	Septic tank; incinerator.
Indubol	Liquors	Not reported.
Purina	Animal feed	Not reported.
Postobón	Gases	None.

Source: INDERENA, Environmental Unit, 20 June 1991

c) The Canal del Dique

The Canal del Dique runs through a variety of marshes and old beds of the Magdalena River to reach the south side of the Bay of Cartagena, beginning in Calamar, 115 km away. Before it reaches the Bay of Cartagena, it partially empties into the Bay of Barbacoa through several canals (see figures 2.1, p. 3, and 2.2, p. 4).

The volume of water in the Canal del Dique is closely related to the dry and rainy seasons that affect the Magdalena River, normally at its highest from May to June and October to November and its lowest from February to March and August to September.

The Canal del Dique has greatly affected the whole water system of the Bay of Cartagena, changing it from a bay of coral reefs with clear water to an estuary with a high volume of fresh water and suspended matter which, depending on the season, alter the salinity, oxygenation and numerous physical and biological parameters in the Bay. The Canal's average inputs into the Bay are quantified in table 3.6. Among other effects, higher turbidity and lower salinity have killed the coral reefs, reduced the primary production of the Bay and notably narrowed the areas that can be used for recreation and swimming.

Table 3.6
DISCHARGES FROM THE CANAL DEL DIQUE

	INDERENA 1990	CRPDNB[a/] 1983
Volume	7 344.0 [b/]	7 340.0 [b/]
BOD	5.9 [c/]	58.7 [c/]
Nitrogen	1.8 [c/]	2.5 [c/]
Phosphorous	0.1 [c/]	0.4 [c/]
Suspended solids	1 836.0 [c/]	1 688.0 [c/]

a/ CRPDNB = Regional Council for Planning and Development of Northern Bolívar.
b/ Thousands of cubic metres per day
c/ Metric tons/day

The Canal del Dique is the only source of fresh water for Cartagena and numerous communities along its banks. It also regulates and is regulated by the wetlands on both sides of the Canal, which have been affected by works to straighten and dredge the Canal. Many of these marshes have become smaller and fishing in them has been substantially reduced. Some benefit has been obtained --although not proportional to what was lost-- for stock raising and agriculture. In recent years, land along the Canal and the Bay of Barbacoas has been converted into shrimp and babilla farms, with excellent results.

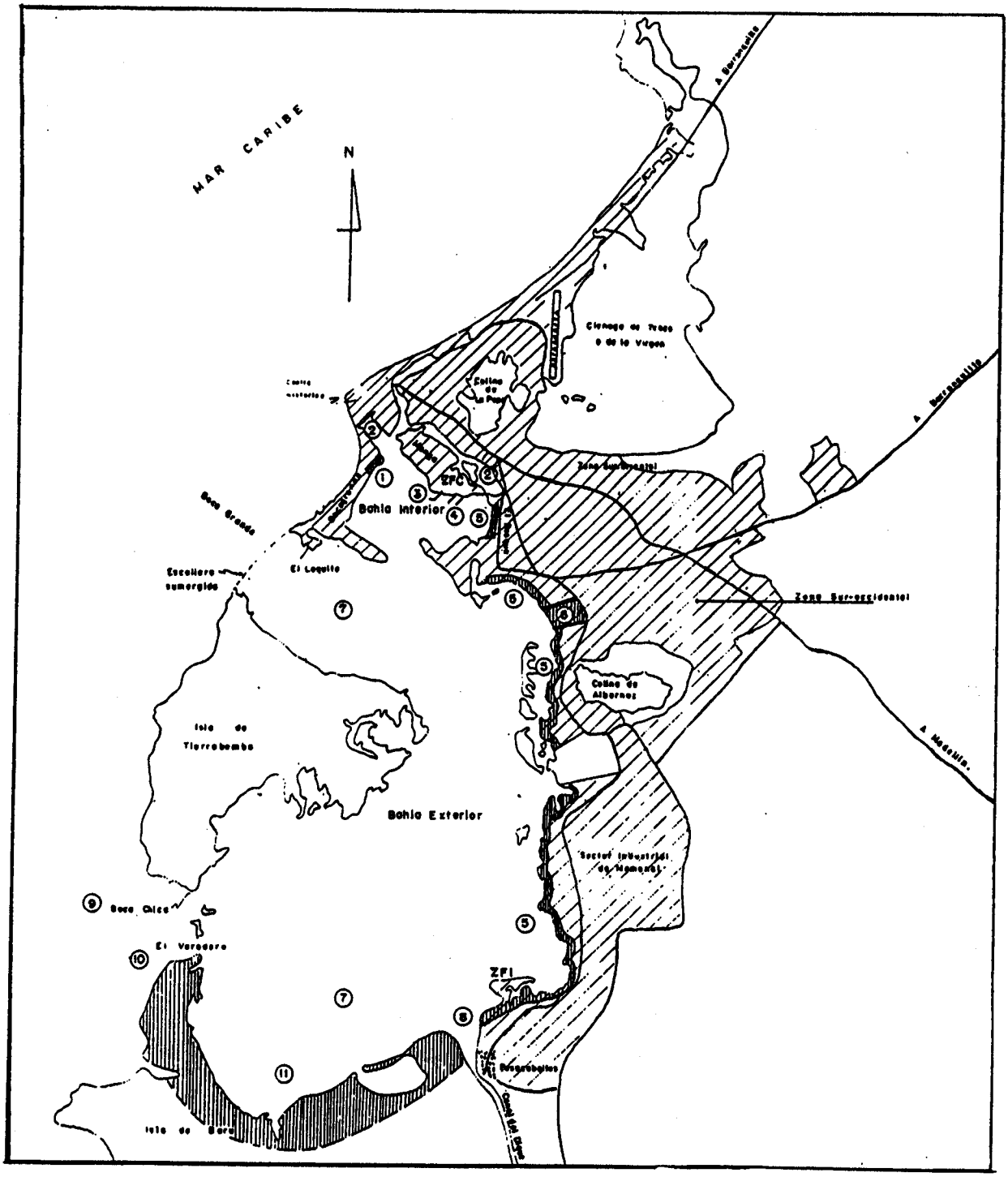
d) Spillage from ships and dock operations

Cartagena is Colombia's main port. Besides the marine and river terminal of the Colombian Port Authority (COLPUERTOS) and the tourist dock of the Bolívar Urban Development Enterprise (EDURBE), a number of industries in the Mamonal zone operate their own docks, with facilities to onload and offload fuels and chemical products. The major oil and fisheries enterprises also have their own docks and depots. In all, there are 22 of these docks, known as "private docks", although several belong to government agencies.

A container dock, which will be the largest in the country, is presently under construction.

Cartagena is also the headquarters of the Atlantic fleet of the Colombian navy. It also has several shipyards that can handle ships up to 10,000 tons in dry dock. Figure 3.4 (p. 16) shows the location of Cartagena's port facilities. It does not show the many marinas and sport and recreational landings the city also has.

Figure 3.4
CARTAGENA: PORT FACILITIES



K E Y

Urban area ///

1 Navy base
2 Coasting trade and/or tourist docks
3 Tourist dock
4 Colpuertos maritime and river
5 Industrial docks area (22)
6 Container port of Flota Mercante Grancolombiana (under construction)
7 Anchorage
8 Mouth of the Canal del Dique
9 Ship channel
10 Deep-draught channel
11 Area for port expansion
ZFC Free trade zone
ZFI Free industrial zone

With that much maritime traffic, it is to be expected that ship and dock operations cause pollution problems, due to a) faulty onloading and offloading of ships; b) inadequate port facilities for the reception of ballast and effluents from ships; c) wilful or unwilful dumping of bilge water and other wastes from ships at dock or under way in the Bay.

Hydrocarbons in the Bay have been reported repeatedly from visual sightings near the docks of petrochemical enterprises in the Mamonal zone and the port facilities. Oil has also been found in a number of samples taken from different points in the Bay (see Pagliardini, et al., 1982; Garay Tinoco, 1986, 1987).

There have been no major dumpings from ships and docks into the Bay in the recent past, although small spills constantly take place. This situation is improving, however, due to the collaboration of the enterprises and inspections by the authorities.[7/] The following are problems that still exist:

i) Deficient port infrastructure. Practically no Caribbean port outside the United States is equipped to receive and treat effluents from ships as stipulated in the international conventions (such as the International Convention for the Prevention of Pollution from Ships (MARPOL, 1978) and the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region). Therefore, the ships dump their wastes at sea (at the risk of polluting beaches and living resources) or at dockside and in surrounding areas.[8/]

ii) With the exception of Ecopetrol, no industry in the Cartagena area has port facilities to dispose of or treat bilge water from ships, tanker washing, wastewater, ballast, effluents from harmful liquid substances transported in bulk or fuels and lubricants.

The reasons for this are:

- The high cost of such facilities;
- A reduced volume of wastes and debris;
- A lack of an authority to enforce standards;
- Rampant impunity owing to the authorities' inefficiency and a lack of sanctions, which makes it cheaper to dump than to suitably dispose of wastes.

iii) Resources to environmentally police the port are very limited, particularly for spillage from ships, which requires daily monitoring, often from the air, in order to detect and apprehend offenders.

The Maritime and Port Authority (DIMAR), aware of this problem, elaborated a national contingency plan in 1990 for hydrocarbon spills and six plans for critical areas in ports and

zones with a high risk of hydrocarbon pollution, among them Cartagena. The plan is consistent with the guidelines of the International Maritime Organization (IMO) and the Action Plan for the Wider Caribbean, in the case of Cartagena. Institutional blocks have prevented the Plan from being executed.

DIMAR has also required enterprises that handle hydrocarbons to have their own limited contingency plan for local spills from accidents occurring in loading operations at their docks.

e) Other sources of water pollution

There are several other smaller sources of pollution in the Cartagena area. Agricultural chemical wastes reach the east side of the Virgin's Marsh and the Bay through a series of canals and streams than run through agricultural areas. The Canal del Dique also brings a significant amount of agricultural chemicals into the Bay of Cartagena.

Solid wastes thrown into the water and leachates from numerous dumps in the urban area are a serious source of pollution for canals and urban lakes and the Virgin's Marsh. Leachates from the municipal dump must also discharge into the Bay of Cartagena, although this has not been officially confirmed.

2. The condition of receiving bodies of water

Although there is no ongoing programme to monitor water quality in Cartagena, many studies have been done over the last 15 years containing a variety of measurements in one or more of the three main components of Cartagena's water system: 1) the Bay, 2) the Virgin's Marsh (also known as the Tesca Marsh) and 3) the system of urban waterways and lakes.

a) Pollution in the Bay of Cartagena

The Bay of Cartagena covers approximately 82 square kilometres, is 30 metres deep at the deepest spot and has an average depth of 16 metres, a volume of 1.23 billion cubic metres, and has an active history of morphological changes, part of which were due to natural causes but the majority due to human action.

According to most of the studies and technicians consulted, the main sources of pollution in the Bay, by order of importance, are:

i) Dumping of the city's wastewater;
ii) Sediment, nutrients and other pollutants from the Canal del Dique;

iii) Discharges from the Mamonal industrial zone;
iv) Ship and dock operations in the port;
v) Various run-offs.

Even though continuous monitoring of pollution in the Bay is not done, there are many highly detailed and well-documented studies available.[9/]

It is difficult to summarize the overall picture. Most of the measurements taken show a worrisome level of pollution in the Bay of Cartagena. Virtually every parameter of environmental impairment that was studied is found in the samples taken.[10/] Many of the parameters studied showed values significantly higher than the basic concentrations found in unpolluted sea water, port and industrial areas and exceeded recommended values for human use (direct contact, fishing).

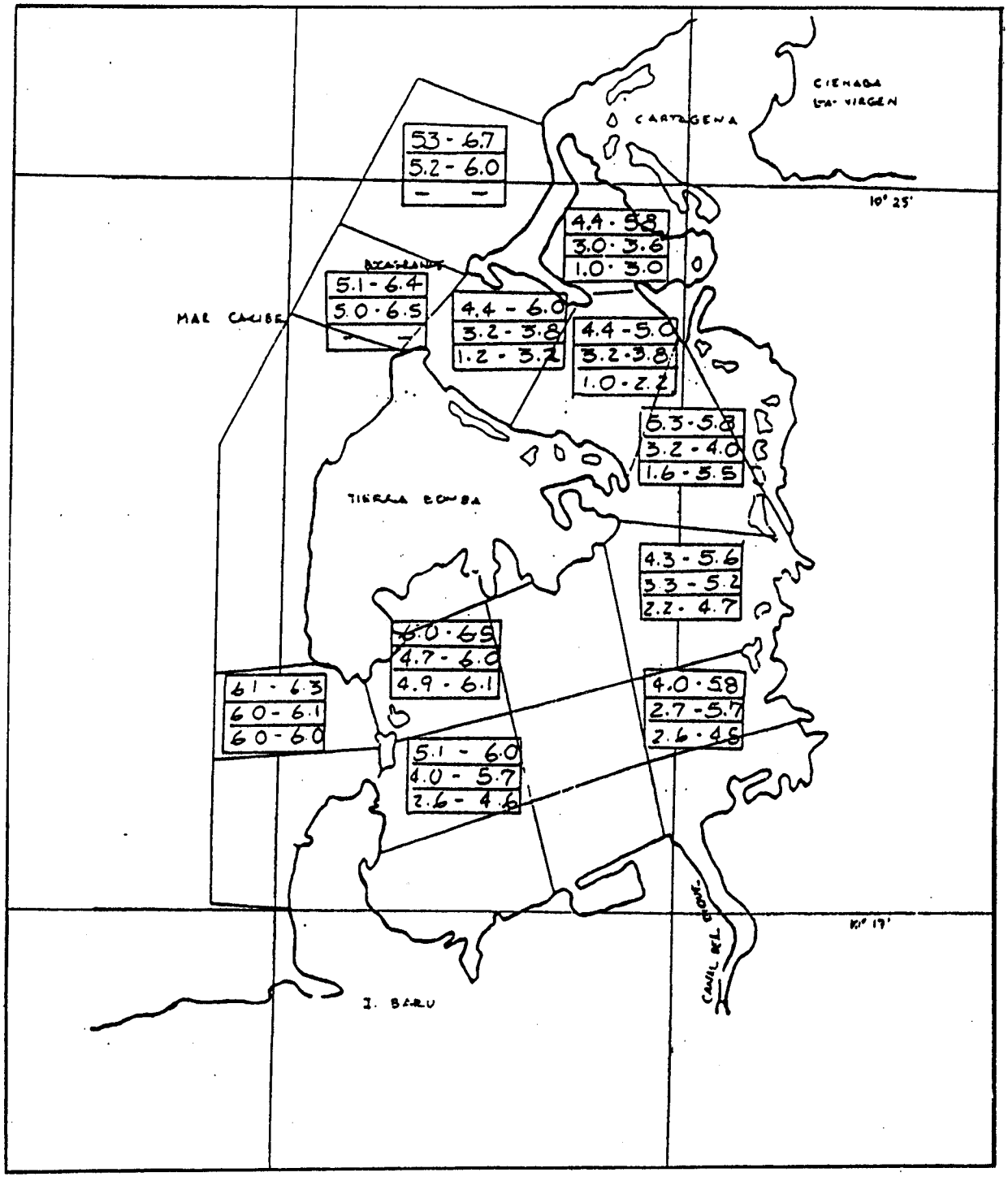
Table 3.7 shows the results of several studies done in the early 1980s and compares them with the maximum values established by Colombian law for the quality of sea water and estuaries and recreational uses involving primary and secondary contact. It does not give numerical values, due to the huge differences in records and the number of figures presented in each study.[11/] [12/]

Table 3.7
POLLUTION LEVELS FOUND IN THE BAY OF CARTAGENA IN TESTS IN THE EARLY 1980s

PARAMETER MEASURED	COMPARISON WITH COLOMBIA'S QUALITY STANDARD (Decree 1.954 of 1984)	
	SEA WATER	RE-CREATION WITH CONTACT
- Dissolved oxygen	Acceptable up to four metres deep; very low at deeper levels	Same
- Fats and oils	Far above standard in several parts of the Bay	
- pH	Acceptable	Acceptable
- Mercury	Far above standard	
- Copper	Acceptable	
- Iron	Acceptable	
- Arsenic	Acceptable	
- Lead	Barely meets standard	
- Zinc	Above standard	
- Pesticides	Above standard in some parts of the Bay	
- Total coliforms (times)		Up to 500 times the standard in some areas
- Fecal coliforms (times)		Up to 500 times the standard in some areas
	COMPARISON WITH QUALITY STANDARDS PROPOSED BY CRPDNB* (1983)	
Chlorophyll "a"	Above recommended values	
Transparency		
Nitrogen		
Suspended solids	Far above recommended values	
Phosphorous	Slightly above recommended values	

* *CRPDNB = Regional Council for Planning and Development of Northern Bolívar.*

Figure 3.5
CONCENTRATION OF DISSOLVED OXYGEN IN THE BAY OF CARTAGENA
(Measured in 1982)
set value: 4 mg/l



Concentration of dissolved oxygen

Depth

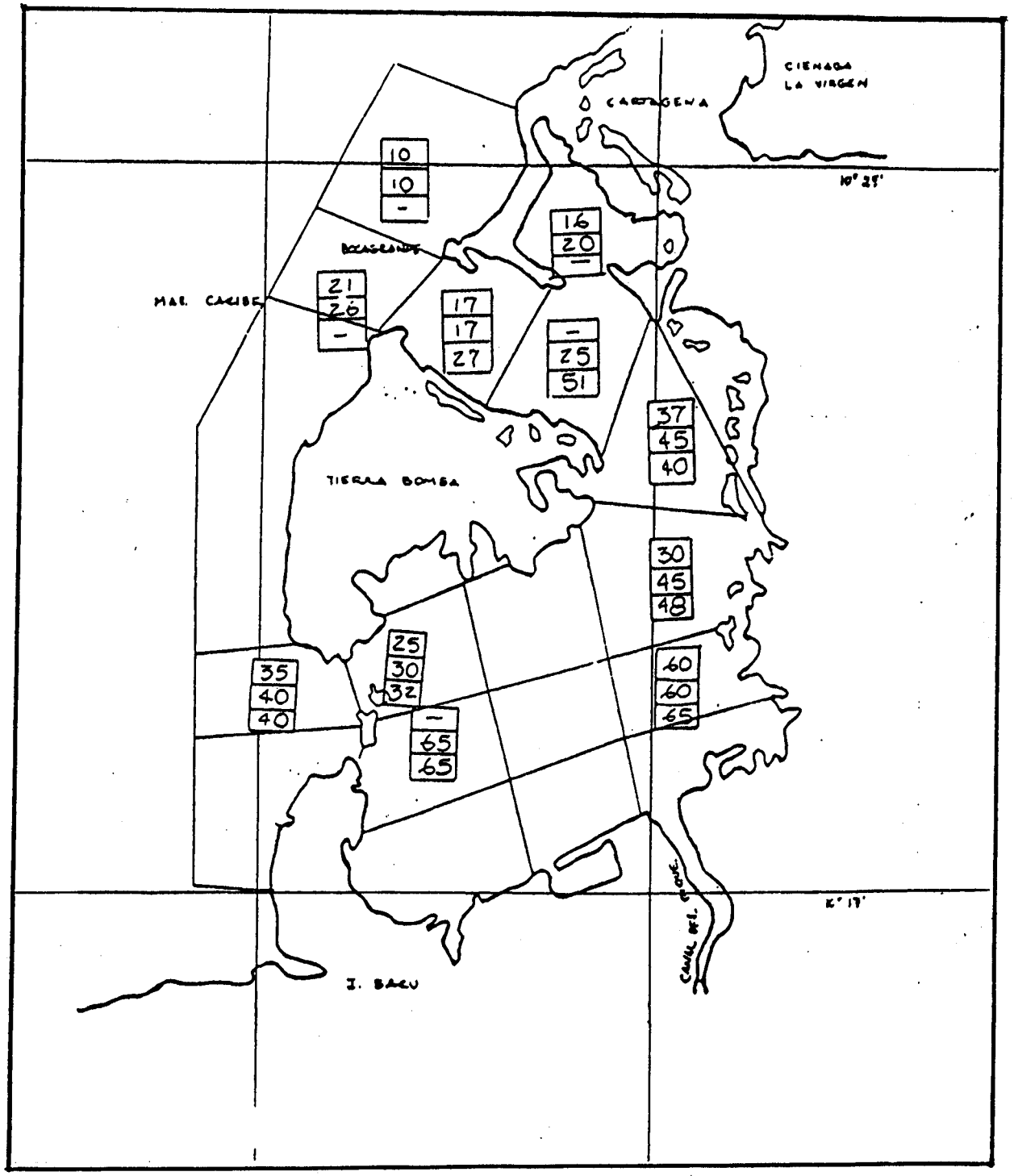
0-4 metres

4-20 metres

20 metres-bottom

Source: CRPDU (1983)

Figure 3.6
CONCENTRATIONS OF SOLIDS SUSPENDED IN THE BAY OF CARTAGENA
(Measured in 1982)
set value: 5 mg/l - 11 mg/l



Concentration (mg/l)

Depth

0-4 metres

4-20 metres

20 metres-bottom

Source: CRPDU (1983)

For example, during the transition between the rainy and dry seasons, deep currents of sea water force their way into the Bay and remove the organic material from the bottom of the Bay. This causes the level of dissolved oxygen to drop abruptly and organic pollution to increase, which has killed fish in the past. Likewise, measurements of total coliforms in various beaches in the Bay fluctuate throughout the year by more than 100 times, from 3,600 to 460,000 nmp/100ml.[13/]

Changes and degradation of the Bay have economic and social consequences in terms of: 1) the health of the population; 2) loss of recreational resources; 3) loss of fisheries resources; 4) loss of tourist, historical and cultural resources. None of these costs has been evaluated to date.

It should also be mentioned that most of the studies were begun in the early 1980s and are now partially out of date due to changes in the volumes and kinds of dumping and processes proper to the water dynamics of the Bay.

b) Pollution in the Virgin's Marsh

The Virgin's Marsh, north of Cartagena, covers an area of approximately 22 square kilometres and has an average depth of 1.2 metres. It drains the waters of a small local basin of some 500 square kilometres. Originally, the Marsh emptied its excess water in the rainy season into the sea through several openings which closed during the dry season.

With its abundant mangroves and wildlife, the Marsh was traditionally home to fishermen and a recreation spot for the citizens of Cartagena up to the beginning of the century. At present, several factors have seriously impaired it:

i) Discharge of 60% of city's sewerage system;
ii) The growth of marginal neighbourhoods built on landfills on the southern edge of the Marsh, which discharge their liquid and solid wastes into it;
iii) The partial cut-off of a link to the sea by the new Barranquilla highway, known as the Ring Road, which will become part of the Caribbean highway;
iv) The damming of outflows by farmers on the eastern edge and biocide run-off from these agricultural areas.

All of the measurements and studies[14/] find the Virgin's Marsh completely eutrophicated, with dissolved oxygen up to three times the saturation point. Benthic demand is particularly high, fluctuating between 5 grams and 13 grams of oxygen per square metre per day. Orthophosphate and ammonium levels are high throughout the Marsh.

These parameters taken together cause sharp drops in dissolved oxygen when sunny days alternate with cloudy days, which kills fish. Measurements of total coliforms and faecal matter taken in 1983 were systematically above acceptable limits, especially in the area where wastewater is discharged at the southern end of the Marsh. Biocide levels, however, are not high.

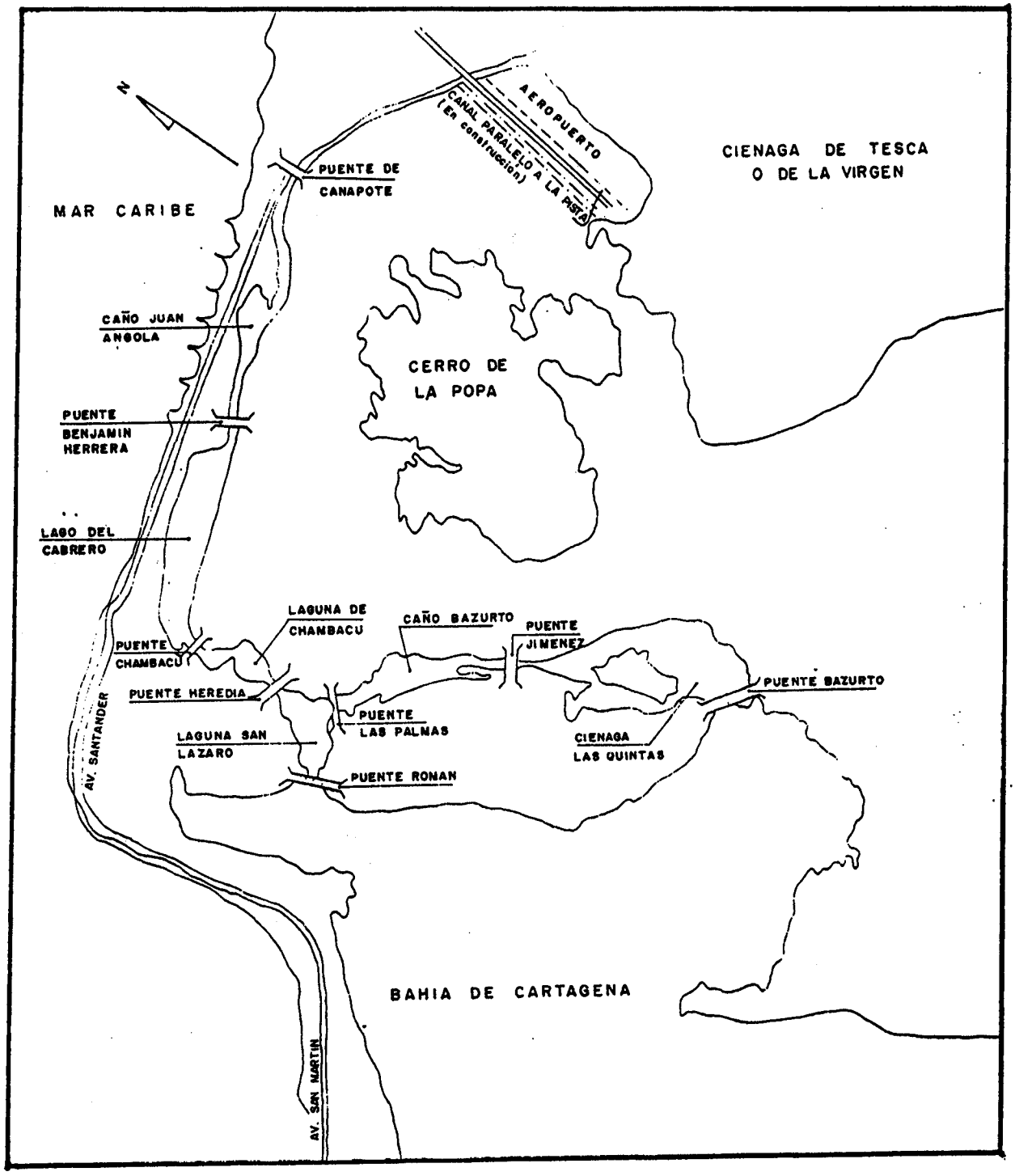
Traditional uses of the Marsh, such as fishing and recreation, are incompatible with present pollution levels. Even if dumping from the sewerage system of Cartagena were ended, it could take years for the Marsh to recuperate biologically, according to several of the studies done.

c) Pollution in waterways and lakes

The waterways and lakes of Cartagena form an interconnected system nine kilometres long that includes: Las Quintas Marsh, Bazurto Canal, Lake San Lázaro, Lake Chambacú, Lake Cabrero and the Juan Angola Canal. The system empties into the Bay through Lake San Lázaro at the Román bridge and the Las Quintas Marsh at the Bazurto bridge. It was previously also connected with the Virgin's Marsh through the Juan Angola Canal, but that link was reduced to two culverts when the runway of the city's airport was enlarged. A canal is currently being dug parallel to the runway to re-establish the link (see figure 3.7, p. 24).

The location of these waters in the midst of an urban area, a high percentage of the population along the shore living in extreme poverty, limited coverage of urban sewerage and sanitation services and emergency discharges from sewerage pumping stations are all factors working against the conservation of the system of waterways and lakes. The main sources of pollution are wastewater dumping (10,000-15,000 cubic metres a day), garbage (50 tons a day) and rain run-off, which are considerable for bodies of water of this size. The felling of mangroves and illegal landfills[15/] must also be added to these factors. All this generates deplorable environmental conditions, which are reflected, for example, in the fact that total coliforms fluctuate between 23 and 46 times the acceptable levels and faecal matter between 6 and 30 times acceptable levels in all sampling stations at any time of the year.

Figure 3.7
WATERWAYS AND LAKES OF CARTAGENA



B. AIR POLLUTION

Cartagena is a flat, coastal city with strong sea breezes during most of the year. The strongest winds come from the north and north-west during 41% of the year, mostly during the dry season. Winds blow from the south during only 5% of the year, in the rainy season. The air is still during 20% of the year.[16/]

Air pollution in the urban area is produced mainly by:

i) Fuel consumption in automotive vehicles (transport vehicles of all types);
ii) Fuel consumption in fixed sources (generating plants, industrial boilers);
iii) Emissions of gases from industrial processes;
iv) Particulate emissions from industrial processes, construction, earth-moving, quarries, open-air dumps, etc.

Given the city's flatness and wind patterns, air pollution from vehicles does not significantly affect air quality in the urban area.

Cartagena at present has two electricity generating plants (Electrificadora de Bolívar, S.A. (ELECTRIBOL) and CORELCA) with a joint capacity of 250 MW. They burn natural gas, which is the least polluting fuel used in thermoelectric plants (some emission figures are given in table 3.8).

Table 3.8
ESTIMATED EMISSIONS IN THE MAMONAL INDUSTRIAL ZONE

Emission of	Potential emission with no control system	Emission with control system a/
Particles	1,000 metric tons/day	5 metric tons/day
SO_x	40 metric tons/day	"
NO_x	31 metric tons/day	"
Ammonia (NH_4)	5 metric tons/day	"

a/ Theoretical data, based on systems proposed by the enterprises, since there are no measurements available to quantify the efficiency of control systems installed by the industries.

Source: Mamonal Foundation (1989)

Industrial emissions are concentrated in the heavy industry of Mamonal. Based on the fuels they use and their industrial processes, the following emissions can be expected:

- Nitrogen oxides - hydrocarbons
- Carbon
- Carbonates
- Different kinds of dust in suspension
- Sulphur oxides
- Carbon oxides
- Fertilizers in suspension
- Particulate emissions from the cement industry

Using information from the Environmental Sanitation Office of the Ministry of Health in Bogotá, the Mamonal Foundation study (1989) estimated the theoretical emissions with and without monitoring systems in the Mamonal industrial zone as presented in table 3.8.

Table 3.9 (also taken from the Mamonal Foundation 1989 study) (p. 27) estimates theoretical emissions and those actually reported by several of the major industries in the zone.

Given the characteristics of the winds, urban zoning laws and the location of the Momonal zone in relation to the city, it is improbable that these emissions reach the rest of Cartagena. They are strongest in the Mamonal zone itself and in the nearby neighbourhoods of Pasacaballos to the south and Arroz Barato and Membrillal next to the zone, as well as settlements from land invasions such as Policarpa Salavarrieta. It should be mentioned, however, that air pollution is not routinely measured in Cartagena.

C. SOLID WASTE POLLUTION

Urban solid wastes are produced mainly by: a) residential and commercial activities, b) street cleaning, c) industrial activities, d) construction materials, demolitions and the like, e) different objects left in public thoroughfares (old boats in waterways, scrap in streets, etc.), f) solid wastes from systems to control gas and liquid pollution (dust and slurry), g) prunings and plant wastes from parks, green areas, yards and gardens.

Table 3.10
SOLID WASTE PRODUCTION IN CARTAGENA
ESTIMATED FOR 1991 (in metric tons/day)

- Residential garbage	310
- Streets and public places	50
- Bazurto food market	10
- Commercial and industrial	150
- Building and demolition material	100
- Wastes from pollution control	!
- Abandoned vehicles and other objects	!
DAILY TOTAL	620

Source: Municipality of Cartagena (1991)

Only partial information exists on volumes of garbage produced in the urban area of Cartagena, mainly in reference to the generation of domestic garbage.[17/] Table 3.10 shows the approximate daily production, according to the most recent estimates.

Table 3.9

DISCHARGES INTO THE ENVIRONMENT FROM 13 ENTERPRISES IN MAMONAL, ESTIMATED FOR 1988

	DISCHARGES INTO THE ENVIRONMENT. CALCULATED WITHOUT CONTROLS						TOTAL DISCHARGES - PARTICLES			TOTAL DISCHARGES-GASES		
	FROM FUEL CONSUMPTION			FROM PRODUCTION PROCESS			TOTAL (1)	CURRENT (2)	PERMISSIBLE (3)	CALCULATED (4)		
INDUSTRIA	Particles	Gases		Particles	Gases					SOx	NOx	H_4, Other
	grams/sec	grams/sec	Type	grams/sec	grams/sec	Type	grams/sec	grams/sec	grams/sec	grams/sec	grams/sec	grams/sec
PETROQUIM. COL	9E-4 6E-2	8E-4 1.2E-2 3.0E-3 0.85	SOx NOx SOx NOx	23.2	11.3	Clode	23.2	0.0	4.7	3.7E-3	0.858	11.27
ABOCOL.	3E-2	1.5E-3 0.42	SOx NOx	28.1	0.118	NOx	28.1	9.7	10.6	2.3	64.5	28.5
AMOCAR	0.61	2.9E-2 8.42	SOx NOx	0.61	44.4	NOx #	0.6				52.8	
ALCALIS	0.56	3.0E-2 7.68	SOx NOx	17.4	20.3	NH_4	17.9	1.2E-2	8.5	3.0E-2	7.7	20.3
DOW QUIMICA	2.4E-3 5.7E-4	2.3E-3 3.4E-2 2.8E-5 7.9E-3	SOx NOx SOx NOx	0.45	0.2 0.1	NO_3 NH_4	0.45	1.5E-2	0.4	2.3E-3	0.235	0.1
CIBA-GEIGY	3.2E-3	3.0E-3 4.5E-2	SOx NOx	1.00	0.4 0.2	NO_3 NH_4	1.04	4.4E-3	1.3	3.0E-3	0.489	0.2
FRIGOPESCA	8.7 7.0	8.1 22.0 57.0 70.0	SOx NOx SOx NOx	0.024			35.5	30.0	0.4	336.0	191.0	---
CABOT COL.	5.1E-3	2.4E-4 7.0E-2	SOx NOx	0.291	---		0.3	0.0	1.3	2.0E-4	0.070	---

(continued)

Table 3.9 (cont.)

DISCHARGES INTO THE ENVIRONMENT FROM 13 ENTERPRISES IN MAMONAL, ESTIMATED FOR 1988

	DISCHARGES INTO THE ENVIRONMENT. CALCULATED WITHOUT CONTROLS						TOTAL DISCHARGES - PARTICLES			TOTAL DISCHARGES-GASES		
	FROM FUEL CONSUMPTION			FROM PRODUCTION PROCESS			TOTAL (1)	CURRENT (2)	PERMISSIBLE (3)	CALCULATED (4)		
INDUSTRIA	Particles	Gases		Particles	Gases					SOx	NOx	H_4, Other
	grams/sec	grams/sec	Type	grams/sec	grams/sec	Type	grams/sec	grams/sec	grams/sec	grams/sec	grams/sec	grams/sec
COLCLINKER	---	---		3 439.0	103.0 26.0	SO_2 NOx	12 381.0	0.104	47.0	103.0	26.0	---
CURTIEMBRE MATTEUCCI	---	---										
ELECTRO-BOLIVAR	0.93	4.0E-2 12.8	SOx NOx				0.93	0.192		>0.04	>12.8	---
CORELCA	1.59	8.0E-2 21.9	SOx NOx				1.59	1.27		>0.08	>21.9	---
ECOPETROL	0.99	5.0E-2 13.7	SOx NOx				0.99	30.0		>0.05	>13.7	---
				TOTAL IN GRAMS/SECOND TOTAL IN METRIC TONS/DAY			12 492.0 1 079.0	71.0 6.0		471.0 41.0	361.0 31.0	60.0 5.0

Notes:

(-) Ministry of Health, Environmental Sanitation Office. Register of Sources of Discharges into the Environment. Bogotá.
(#) Current discharge, Martínez - ABOCOL. Letter to A. Piñeres - National Association of Industrialists (ANDI), Cartagena, 14 July 1989.

(1) Calculated without control equipment.
(2) Reported with control equipment.
(3) Discharge standard, articles 70 and 48, decree 02, Ministry of Health, 1982.
(4) Without control equipment.

Source: Mamonal Foundation (1989)

1. Composition and disposal

There is no published information on the composition of industrial garbage and wastes from pollution control generated in the Mamonal industrial zone.[18/] The average garbage produced in homes, commerce and light industry in the urban area is composed of 55% organic matter, 18% inert matter, 10% paper, 10% glass and less than 7% metals, plastic, wood, bones (Ministry of Public Health-Pan American Health Organization (PAHO)-Municipal Public Enterprises of Cartagena, 1979). It is disposed of in the following ways:

i) Wastes from the Mamonal industrial zone, including those from pollution control systems, are collected and disposed of by the industries themselves, directly or through contracted services. They are recycled, sold, buried at the plants themselves or burned. An undisclosed amount is thrown into the municipal dump.

ii) Debris from construction and demolition, if a small amount, is normally transported by wheelbarrow and dumped on the nearest shore. If the quantity is large enough to require hiring a lorry to remove it from the site, the owner of the vehicle is responsible for its final destiny. In most cases it is sold to landfills, which in some cases are illegal.

iii) An estimated 280 to 320 tons of garbage (between 54% and 62% of the total) is collected daily by the garbage collection service, managed by the Municipal Public Enterprises of Cartagena, and brought to the municipal dump located near the neighbourhood of Henequén (see figure 3.3, p.12).

iv) Approximately another 200 tons of garbage (around 40%) a day is not collected in the urban area. It winds up in bodies of water, on shores and in some 100 informal dumps spread throughout the city, including the centre of town and residential neighbourhoods. Garbage poorly disposed of, due to a lack of facilities, adequate collection and the decisions of users also affects the beaches and water in Cartagena's tourist areas.

2. Collection and disposal

Whereas at the national level the Ministry of Health is in charge of setting standards for the management and disposal of solid wastes, regulation and provision of sanitation services belongs to municipal government. In Cartagena, Municipal Public Enterprises are responsible for collecting and disposing of the city's solid wastes. The following information was given by technicians of Municipal Public Enterprises:[19/]

i) Municipal Public Enterprises has 10 garbage trucks, of which three or four are normally out of service because of mechanical problems. Most residential neighbourhoods in Cartagena have daily garbage collection, twice a day in the Bazurto market and sporadically in the marginal neighbourhoods where the trucks have a difficult time manoeuvering. According to some experts, Cartagena today needs 21 garbage trucks.

ii) The collection routes are not organized to facilitate the classification and differential treatment of wastes. The same vehicle collects garbage from all the homes, restaurants, hotels, markets and hospitals on its route.

iii) All the garbage collected, like a good part of the industrial wastes from Mamonal, is brought to the municipal dump, with no distinction made for the different kinds of wastes. It is an open-air dump. Municipal Public Enterprises has no scale and there is only one tractor to distribute and level the discharges of wastes.

iv) Some 300 persons work in the dump recovering and recycling wastes. According to a 1979 study, approximately 50 of them were living in the dump, with no control, support or protection to avoid accidents or diseases.[20/]

There are several causes of Cartagena's garbage and solid wastes problem. Among them are: a) a lack of roads for garbage trucks to enter marginal neighbourhoods; c) a lack of resources in Municipal Public Enterprises, c) a lack of environmental awareness on the part of the general population.

D. HAZARDOUS TOXIC SUBSTANCES AND ENVIRONMENTAL ACCIDENTS

No particular group of wastes is designated as toxic or hazardous in Colombian law, but article 74 of decree 1594/84 gives a list of "substances of concern for sanitation", which corresponds to what is normally called toxic or hazardous wastes. The list is relatively short (25 substances) and deals exclusively with liquid effluents (see table 3.11). There is no toxic or hazardous wastes management in Colombia today and, in the best of cases, the only thing done is that certain major producers are required to treat their wastes.

1. Current hazardous toxic waste management in Cartagena

The situation in Cartagena is similar to that in the rest of the country. The city has no specific criteria for toxic or hazardous wastes management. The total lack of protection against solid wastes is particularly worrisome. There is more monitoring of

liquid releases, where INDERENA enforces laws concerning effluents from large enterprises. The situation with respect to gases is between these two, since there is less capacity to enforce legislation.[21/] However, there is no monitoring of waste disposal from depollution systems.

Table 3.11
SUBSTANCES NAMED IN COLOMBIAN ENVIRONMENTAL LEGISLATION AS AFFECTING SANITATION
(Decree 1594 of 1989, article 74)

Substance	Expressed as	Concentration (mg/l)
Arsenic	As	0.5
Barium	Ba	5.0
Cadmium	Cd	0.1
Copper	Cu	3.0
Chromium	Cr+6	0.5
Phenolic compounds	Phenol	0.2
Mercury	Hg	0.02
Nickel	Ni	0.2
Silver	Ag	0.5
Lead	Pb	0.5
Selenium	Se	0.5
Cyanide	CN-	1.0
Polychlorinated diphenyl	Concentration of active agent	Undetectable
Organic mercury	Hg	Undetectable
Trichloroethylene	Trichloroethylene	1.0
Chloroform	Charcoal extract chloroform	1.0
Carbon tetrachloride	Carbon tetrachloride	1.0
Dichloroethylene	Dichloroethylene	1.0
Carbon oxygen sulfide	Carbon oxygen sulfide	1.0
Other organochlorine compounds (each type)	Concentration of active agent	0.05
Other organophosphorus compounds	Concentration of active agent	0.1
Carbonates	--	0.1

a) Municipal solid waste

This is undoubtedly the least protected area. There is no monitoring of urban garbage collection nor of the municipal dump. Potentially toxic or hazardous wastes and most of the solid wastes from heavy industry end up in the municipal dump with no specific management whatsoever.

b) Municipal wastewater

All of the city's wastewater at present is dumped into the Virgin's Marsh, the Bay of Cartagena and other bodies of water in the city, totally untreated.

The many chemical and bacteriological measurements of urban effluents taken in Cartagena were limited to assessing the most traditional parameters (biochemical oxygen demand (B.O.D)., solids, nitrogen, coliforms and grease); substances of concern for sanitation or other toxic or hazardous wastes (heavy metals, pesticides, etc.) were not analysed.[22/]

Although there are no analyses of urban effluents in terms of toxic or hazardous wastes, a worrisome indicator is that most of the measurements of heavy metals taken in the Bay of Cartagena (see above) found three points of concentration: near the mouth of the Canal del Dique, near the Mamonal industrial zone and near the spot where urban wastewater is discharged. This indirect evidence leads to the conclusion that besides the organic and bacterial loads typical of wastewater, Cartagena's sewerage system is also discharging an indeterminate volume of toxic or hazardous wastes.

c) Hazardous toxic industrial wastes

Given the high number of petroleum, petrochemical and chemical enterprises in Cartagena's industrial sector (see the list of enterprises in Annex I), it is easy to deduce that many of them are large producers of toxic or hazardous wastes. Unfortunately, there is no information available to form a complete picture of the industrial sector's production of toxic or hazardous wastes and their current treatment systems.

Few of the enterprises listed in Annex 2 include production of toxic or hazardous wastes. This is partially due to the fact that the larger petroleum and petrochemical enterprises are not listed. As mentioned above, it is also notable that:

i) Enterprises report that they meet the dumping requirements of Colombian law regarding liquid wastes;

ii) The same claim is made for gas emissions, but several of the enterprises admit that they have never analysed the emissions of several effluents or measured the real efficiency of their installed systems; and

iii) Greater dispersion is found in solid waste management. Despite the fact that enterprises need an authorization from the Ministry of Health for solid waste management, monitoring is minimum, in part because there is always the possibility of dumping anything in the municipal dump.[23/]

d) Hazardous toxic waste in Cartagena

There are no studies on concentrations of toxic or hazardous wastes in the air, soil or surface or groundwater of Cartagena. Nor has an environmental study of the municipal or other dumps been made.

However, in some environmental studies of the Bay of Cartagena, several toxic or hazardous wastes were included in the parameters studied.

The Regional Council for Planning and Development of Northern Bolívar (CRPDNB) study (1983) looked for oils and fats, mercury, copper, chromium, arsenic and lead. The Centre for Oceanographic and Hydrographic Research studied mercury, copper, zinc, organochloride pesticides, and hydrocarbons. Most of the measurements were taken in the early 1980s.

Hydrocarbon spills were dealt with above. Mercury and hydrocarbons in the Bay of Cartagena will be treated below. Table 3.12 gives the range of results from other measurements.

Table 3.12
MEASUREMENTS OF TOXIC AND HAZARDOUS WASTE IN THE BAY OF CARTAGENA (mg/l)

Pollutant	CRPDNB (1983)	CIOH (1982/1983)
- Cooper	0.001-0.003	0.001-0.054
- Chromium	0	---
- Arsenic	0-0.1	---
- Lead	0.01-0.06	---
- Zinc	---	0.01-0.6
- Organochloride pesticides	---	0-0.322

CRPDNB: *Regional Council for Planning and Development of Northern Bolívar.*

CIOH: *Centre for Oceanographic and Hydrographic Research.*

The results for heavy metals are well below acceptable limits. Organochloride pesticides are high in some measurements, but the dispersion is large and the high results are only found in a few sampling stations (see the detailed report in Annex 3). Except for chromium, which was not found in any of the samples, the results for heavy metals were low but still above those naturally found, which leads to the conclusion that these toxic or hazardous wastes were being dumped into the Bay, but in relatively insignificant amounts in the early 1980s.

e) Management of liquid harmful substances in bulk

Harmful liquid substances are those substances assessed and classified by the Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), comprised of specialists from different agencies of the United Nations system, and included in the list of the International Maritime Organization.

They are classified in seven large groups:

- Acids and inorganic bases
- Petroleum-based chemical products
- Alcohols and alicoles
- Coal and tar derivatives

- Vegetable and animal oils and fats
- Lubricant additives
- Molasses

Many of the industries in the Momonal zone import these substances as raw materials for their processes.

i) Unlike hydrocarbon management, the enterprises have no specific contingency plan for managing harmful liquid substances. They intend simply to use fire extinguishing equipment to handle any emergency arising from a spill of some substance.

ii) The enterprises claim that there have been no accidental spills during onloading and offloading operations in port. Reality belies the claim.

iii) DIMAR assigns inspectors to oversee each shipment of these substances, but they are not specialized in managing harmful liquid substances in bulk. Sometimes they lack facilities, either aboard ship or on land, which they need to adequately do their job.

iv) Colombia has no facilities to receive, eliminate or treat wastes from these substances.

v) DIMAR does not have the capacity to adequately fulfill its functions, especially personnel.

f) Management of harmful substances in packages or containers.

In this case the substances are brought to a warehouse in the terminal of the Colombian Port Authority, or remain in two yards chosen for that purpose without much technical criteria, making this a highly dangerous area with no concrete solutions at this time.

2. Environmental accidents

Environmental accidents involving these substances are an especially important aspect of managing toxic or hazardous wastes. Several have taken place in Cartagena, and much of what has been learned or done about pollution control was in reaction to accidents that alarmed public opinion.

a) The 1976 mercury spill

In 1976, the general public learned that the enterprise Alcalis de Colombia, located in the Mamonal zone, was operating an obsolete chloroalkane plant, which between 1973 and 1975 discharged into the Bay of Cartagena (through a natural drainage canal in the Casimiro area) between 11 and 15 tons of mercury.

In 1976 the plant was closed, small-scale fishing in the Bay was prohibited (with only partial compliance) and a number of studies were done by Colombian institutions, several of them with support from PAHO, World Health Organization (WHO) and the Food and Agriculture Organization (FAO) and the collaboration of research centres in the United States and Sweden.

Measurements taken between 1977 and 1982 showed that mercury levels in the Bay of Cartagena were significantly higher than those recommended for sea water, seabeds and marine biota. The samples record a broad dispersion of results that fluctuated between 0 and 4.2 mg/l. The recommended maximum is 0.3 mg/l. Measurements taken in sludge varied between 0 to 124.6 parts per million, whereas unpolluted seabeds have 0.05 ppm. In the beginning, the largest concentrations were found in the mouth of the Casimiro waterway, but later they were found near the Momonal zone and the mouth of the Canal del Dique.

From 1978 to 1980, the National Institute of Health studied 630 people who were considered high risk, since they lived in fishing communities near the dumping areas. The study found high levels of mercury absorption in the hair and blood of almost 40% of the cases and dangerous levels in 7% of the cases. Organomercurial intoxication was not diagnosed in any the cases and later measurements showed a slow decline in the number of cases of high and dangerous absorption.

b) Oil and agricultural chemical spills

In past decades, oil spills in the Bay of Cartagena, either from ships or industries, were constantly denounced as an endemic problem. In 1984, a Greek tanker spilled approximately 5,000 barrels of oil, covering virtually the whole Bay and killing a tremendous number of fish.

Periodical measurements have evaluated dissolved hydrocarbons in the Bay, finding concentrations of aromatics between 5 and 65 mg/l, 0.018 mg/g in sediment and up to 0.235 mg/g in certain varieties of commercial fish. The highest results are found in the northern and southern extremes of the Bay and in the ship lanes. Successive measurements seem to indicate a slow improvement. In any case, the results found are high in relation to nationally and internationally recommended standards, although they are less than half of those found in other coastal areas with dense shipping and industrial traffic, such as New York, the Bay of California or the Gulf of Mexico.

In another environmental accident that took place in 1989 in Dow Chemical of Colombia in the Mamonal zone, the control systems failed, producing a sizeable spill of phosphorus pesticides into the Bay, which killed fish in a wide surrounding area. In response

to the claims of small-scale fishermen, the enterprise offered to buy all the fish brought to the plant, which it then buried on its land.[24/]

E. OTHER ENVIRONMENTAL PROBLEMS IN CARTAGENA

This section refers briefly to other environmental problems that have made more or less of an impact on public opinion in Cartagena.

1. Mangrove impairment

South of the Bay of Cartagena, the shorelines of the waterways, lakes, marshes and islands, particularly around the Virgin's Marsh, were traditionally areas with large mangroves swamps.

Today, those wetlands have been drastically reduced, owing to exploitation of the mangrove trees, urbanization on landfills, tourist and industrial developments and pollution of the waters and shorelines. Those that remain are in extremely poor phytosanitary condition. Some recent studies --Prada (1989) and particularly Bardi (1990)-- have examined the situation of this resource in detail and have presented proposals for their rehabilitation, based on: 1) protective zoning of existing mangroves, and 2) the environmental rehabilitation of the surrounding areas.

2. Impairment of ecological reserves

The Colina de la Popa was declared an ecological reserve in the 1978 development plan for Cartagena. Despite that fact, it has undergone an increasing environmental impairment as a result of: 1) being used to build marginal neighbourhoods; 2) illegal quarries, and 3) gradual cutting of its vegetation (see INDERENA, 1988).

Besides the environmental impairment of the Colina itself, the erosion produces a good part of the particles that have been detected in measurements of the city's air and is a source of matter found in rainfall run-offs into surrounding bodies of water.

3. The Cartagena airport and noise pollution

The Rafael Núñez airport of Cartagena is located in the neighbourhood of Crespo, north of the city and on the south-east edge of the Virgin's Marsh (see figure 2.2, p.4).

Short studies have been made containing some measurements of noise levels, but they have not been analysed nor have physical measures been designed to lower the noise or to effectively monitor pilots and airlines to prevent them from making more noise than necessary.

IV. LEGAL AND INSTITUTIONAL FRAMEWORK OF ENVIRONMENTAL MANAGEMENT

A. THE LEGAL FRAMEWORK OF ENVIRONMENTAL MANAGEMENT

The legal framework of environmental management in Cartagena is comprised on a variety of laws, decrees and regulations that govern the different areas in which environmental management takes place: natural renewable and mining resources; health and sanitation condition of the population; marine environment and maritime and port activities; historical and cultural patrimony and urban ordinances.

In general, this legal framework provides government authorities in charge of directing and orienting environmental management a number of tools for executing policies to conserve and improve the environment for sustainable development. Without prejudice to necessary processes of legislative adjustment, updating and improvement, the legal framework for environmental management presents no lacunae or deficiencies that could paralyze that management. Annex 4 gives a list of the components of this legal framework in the areas mentioned.

Of particular note is decree 1741 of 1978 by the President of the country, creating the Special Management Area of the Canal del Dique and the Bay of Cartagena, in order to provide an integral environmental management and administration of the natural resources in the area of jurisdiction, given the importance of the Bay for the city and the country and the complex factors at play in the hydric and environmental dynamic of the bodies of water surrounding the city.

The object of the Special Management Area is to protect the environment by regulating activities to control and correct pollution, conserve existing habitats, especially coral and mangrove ecosystems, conserve and protect species in danger of extinction, promote aquaculture, plan the use of areas for the National Parks System and develop integrated models for the management of renewable natural resources.

B. ENVIRONMENTAL MANAGEMENT INSTITUTIONS

Environmental management in the city of Cartagena is the responsibility of four national institutions: the National Institute for Renewable Natural Resources and the Environment (INDERENA), for soil and water; Sectional Health Service of Bolívar, a branch of the Ministry of Health, for the air, and the Maritime and Port Authority (DIMAR) for the marine environment. Locally, the Municipal Public Enterprises of Cartagena is responsible for the water supply, basic sanitation, rainfall drainage, garbage collection and other services, and the Bolívar Urban Development Enterprise (EDURBE) for the environmental sanitation of the bodies of water and the city. Annex 5 gives details on these and other agencies related to environmental management in Cartagena.

1. The National Institute for Renewable Natural Resources and the Environment (INDERENA)

INDERENA was established by decree-law 2420 of 1968 and has a regional office in Cartagena for the Department of Bolívar, under a regional director.

This office houses the Environmental Research and Management Unit, in charge of environmental management of the whole Department of Bolívar. The Environmental Unit grants environmental permits, pursuant to decree 2811 of 1974.

With regards dumping into bodies of water, if the conditions of the effluent are such that a permit cannot be granted, INDERENA requires the user to present a plan to comply with pollution control in stages (see Annex 6).

2. Sectional Health Service of Bolívar

The Sectional Health Services are operational branches of the Ministry of Health at the Department level, which is the country's administrative unit. The Service for the Department of Bolívar is headquartered in Cartagena.

When environmental impact studies are presented to INDERENA, the Environmental Unit will not certify that the project is environmentally feasible unless it is also has sanitation authorizations regarding water and air from the Sectional Health Services of Bolívar. These authorizations are called for by decree 1594/84, but the Sectional Health Services of Bolívar must clear any authorization it gives through the Ministry in Bogotá.

3. The Maritime and Port Authority (DIMAR)

DIMAR was established by decree 2349 of 1971 and restructured by decree 2324 of 1984 and, with respect to ports, law 1 of 1991. The local office for exercising maritime and port authority and enforcing the laws and provisions related to maritime and port activities is the Cartagena Port Authority, with technical and scientific support from the Centre for Oceanographic and Hydrographic Research (CIOH).

The Port Authority is in charge of environmental policy along the coastline, port areas and beaches and enforces Colombian law and international agreements regarding pollution control in ships, port operations and coastal discharges (law 10 of 1978 and law 12 of 1981).

CIOH is an agency of the Colombian Navy and comes under DIMAR. It was established by resolution 6238 of 1975 of the Navy command. It is responsible for basic and applied research in diverse disciplines needed by the Navy to fulfill its mission and of interest to the country for coming to know and develop its marine resources.

CIOH researches Colombia's seas both in the Caribbean and the Pacific and provides marine support services for marine pollution control, maintenance of oceanographic equipment, nautical cartography and the purveyance of oceanographic ships.

4. The Oceanographic Commission of Colombia (OCC)

This is a standing body, headquartered in Bogotá, that advises the Government on oceanographic policies and scientific and technical aspects dealing with the sea. It also coordinates the work done along these lines by the scientific community in Colombia. It was established by decree 763 of 1969 and restructured by decrees 413 of 1981 and 415 of 1983.

Its agencies are the National Oceanographic Council (NCO), General Secretariat and standing technical committees dealing with specific aspects. The NCO directs the overall activities of the OCC and particularly the Special Project for the Promotion and Development of Ocean-Related Sciences and Technologies (FONDEMAR).

The functions of the OCC are to plan, programme, coordinate, promote and direct activities related to ocean-related sciences and technologies in the country and serve as advisor and consultant to the national Government in this area and in national and international policies related to the sea. As such, it is the focal point in Colombia for the agencies, agreements and international conferences that deal with the sea.

5. Institute for Research in Earth Sciences, Mining and Chemistry (INGEOMINAS)

INGEOMINAS was originally established as the National Institute for Geological and Mining Research by decree 3161 of 1968 and reformed by decrees 441 of 1969 and 587 of 1991. It is of interest for environmental management at the national level and for Cartagena because of its research in geophysics, marine and environmental regional geology, non-renewable natural resources, groundwater and natural threats, among many other areas it is responsible for.

6. Bolívar Urban Development Enterprise (EDURBE)

EDURBE was founded in December 1981 as a national-level public establishment under the Ministry of Development, associated with the Department of Bolívar, Territorial Credit Institute (INSCREDIAL) and the Municipal Public Enterprises of Cartagena.

Later, on the basis of laws 11 and 12 of 1986 on administrative decentralization, INSCREDIAL moved its operations to 32 municipalities of Bolívar and EDURBE was converted into a private corporation.

EDURBE increased its capital in 1990. The Municipality of Cartagena bought shares which, added to those of Municipal Public Enterprises, made it the major stockholder.

Decree 7 of 1984 gave EDURBE the competency and responsibility for carrying out programmes for the environmental sanitation of Cartagena's lakes, waterways and marshes, and gave to other agencies related works or activities, for example, the sanitation of the Virgin's Marsh to the Ministry of Public Works and Transport.

7. Municipal Public Enterprises of Cartagena

The Municipal Public Enterprises comprise a decentralized municipal agency established by agreement 12 of 1961 of the Cartagena City Council to provide the public services of water supply, sewerage, urban garbage collection, markets, parks, tree planting and fire fighting.

It is run by a board of directors, presided over by the Mayor of Cartagena, with three representatives of the City Council, three of the District Administration (the special rank of the Municipality of Cartagena), including the Magistrate and three of the users of the services.

8. Ministry of Public Works and Transport

The Ministry of Public Works and Transport is responsible throughout the country for everything related to national roads and rivers. Since 1989, it is also responsible for the technical direction of drinking water supply systems and basic sanitation, but municipalities are responsible for providing these services. The Ministry established an Office of Drinking Water and Basic Sanitation to carry out this function.

The Ministry of Public Works and Transport includes the Colombian Port Authority (COLPUERTOS), which operates Cartagena's maritime and river terminal. The law created the Superintendency of Ports, already functioning, to plan and supervise port operations.

As part of its functions, the Ministry was placed in charge of maintenance for the Canal del Dique, and was given responsibility by decree 7 of 1989 for the sanitation of the Virgin's Marsh.

9. The Special Management Area of the Canal del Dique and the Bay of Cartagena

The Special Management Area has an Advisory Council composed of the Governor of the Department of Bolívar, commander of the Navy's Atlantic fleet, two delegates from the office of the President of the country, representatives of the Ministry of Health, INDERENA, DIMAR, Colombian Institute of Hydrology, Meteorology and Land Development (HIMAT) and the Cartagena Chamber of Commerce. The Special Management Area should have a director named by the general manager of INDERENA. The post was in the plans ever since the Area was established, but no operational support nor resources to fulfill the functions called for by the decree were provided. In practice, the importance the national Government wanted to give to environmental management in Cartagena by establishing the Special Management Area has been lost. Of the attributes granted to the Special Management Area by decree 1741/78, INDERENA uses those related to the marine environment to intervene in measurements and monitoring of industrial dumping, since effective monitoring belongs legally to DIMAR.

10. International organizations

In virtue of the international agreements mentioned above in paragraph 3.1.4., Colombia is a member of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the IOC Association for the Caribbean and Adjacent Regions (IOCARIBE), which has been headquartered in Cartagena since 1988.

V. PROGRAMMES AND ACTIONS OF ENVIRONMENTAL MANAGEMENT

Based on the analysis presented above, the seminar on the Programme of policies for the control and monitoring of urban and industrial pollution in Cartagena, held in August 1991, established a set of objectives for an environmental management programme for Cartagena. Figures 5.1 (p. 43) and 5.2 (p. 44) give a diagram of those objectives.

A. THE PLANNING MATRIX

On the basis of the objectives and the general results given in the above figures, a planning matrix was drawn up which specifies in depth both the objective of the programme and the results it is expected to achieve. That involves determining the indicators that make it possible to verify that the result has been achieved and, therefore, to quantify and establish time limits for achieving that result. For each result, activities are specified that have to be carried out in order to ensure that it is achieved.

Table 5.1 (p. 45) presents the planning matrix drawn up by the seminar.

The elements contained in the matrix constitute the starting point for designing a variety of project profiles or projects that make it possible to move towards the execution phases as rapidly as possible.

Figure 5.1
OBJECTIVES CONCERNING GENERAL PROBLEMS AND AIR AND SOIL POLLUTION

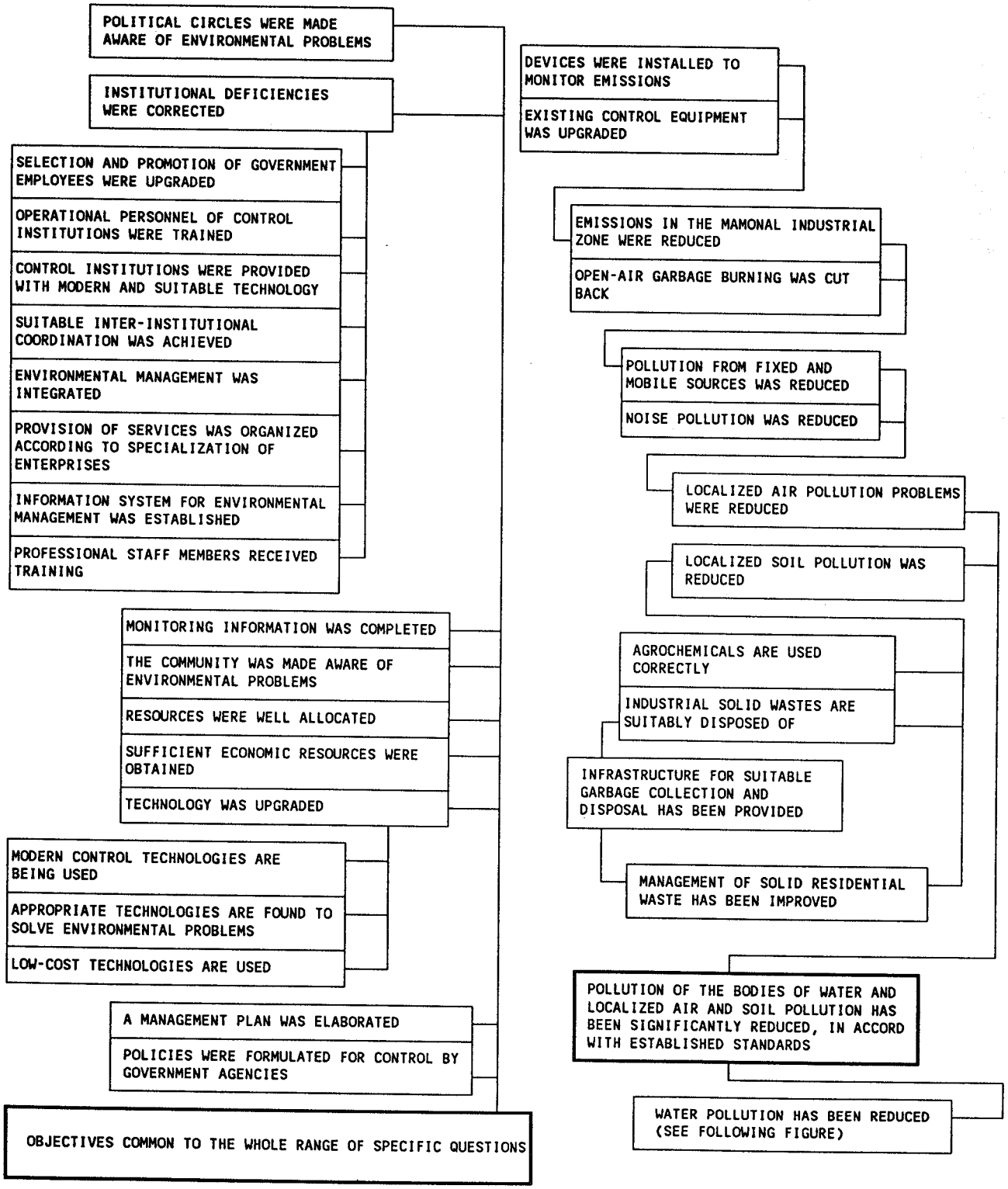


Figure 5.2
OBJECTIVES CONCERNING WATER POLLUTION

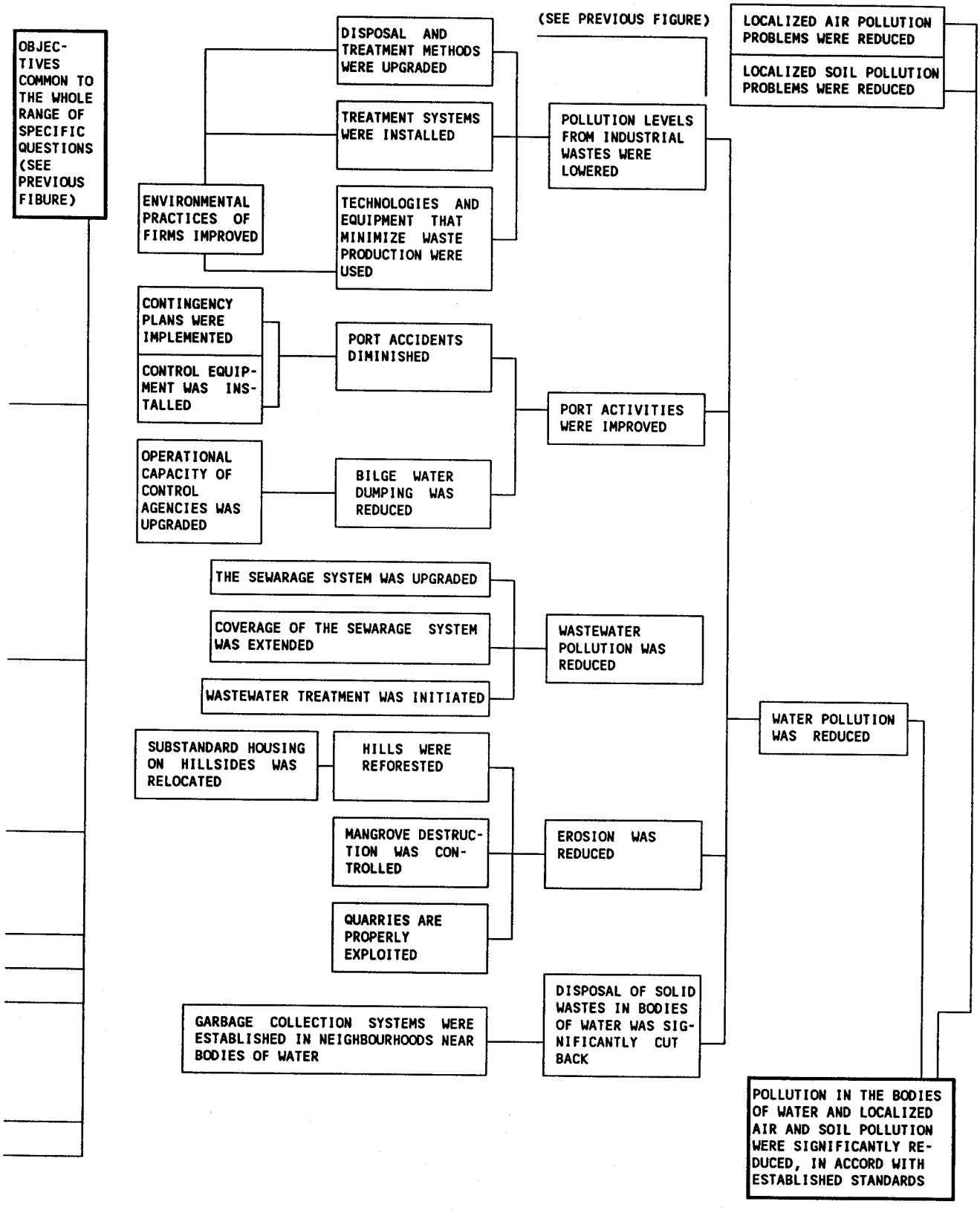


Table 5.1

PLANNING MATRIX

	INDICATORS	SOURCES OF VERIFICATION	KEY PRESUPPOSITIONS
GENERAL OBJECTIVE: THE POPULATION'S QUALITY OF LIFE WAS IMPROVED THROUGH SUSTAINED DEVELOPMENT			
OBJECTIVE OF THE PROJECT: WATER POLLUTION WAS SIGNIFICANTLY REDUCED AND AIR AND SOIL POLLUTION WERE LOCALIZED IN ACCORD WITH ESTABLISHED STANDARDS	BY DECEMBER 1996, CHEMICAL AND BIOLOGICAL PARAMETERS MEET ESTABLISHED STANDARDS	PARTICIPATING AGENTS: PUBLIC ENTERPRISES, CIOH, INDERENA, L.E.H., UNIVERSITY OF CARTAGENA, MINISTRY OF PUBLIC HEALTH	
RESULTS/PRODUCTS			AUTHENTIC SUPERVISION EXISTS PEOPLE LIVING ON THE HILLS WERE RELOCATED ADEQUATE RESOURCES ARE AVAILABLE THE ENVIRONMENTAL MANAGEMENT PLAN FOR CARTAGENA WAS ADOPTED THE COMMUNITY WAS MADE AWARE OF ENVIRONMENTAL PROBLEMS POLITICAL WILL EXISTS THE FLOW OF SEDIMENT INTO INLAND WATERS HAS BEEN CONTROLLED BUSINESSES COLLABORATE STANDARDS HAVE BEEN SPELLED OUT AS RULES CONDITIONS IN THE CANAL DEL DIQUE HAVE BEEN IMPROVED
1. UNPOLLUTED RECEIVING WATERS	BY 1997, WATER QUALITY MEETS ESTABLISHED STANDARDS	INDERENA	
2. TOXIC AND HAZARDOUS SUBSTANCES CONTROLLED	BY 1997, LIQUID WASTES MEET ESTABLISHED STANDARDS BY 1997, SPILLS OF TOXIC AND HAZARDOUS SUBSTANCES WILL BE REDUCED BY 90%	SECTIONAL HEALTH SERVICE, INDERENA DIMAR	
3. IMPROVED COLLECTION AND SUITABLE DISPOSAL OF SOLID WASTES	BY 1997, 90% COVERAGE FOR COLLECTION AND SUITABLE DISPOSAL OF RESIDENTIAL AND HOSPITAL SOLID WASTES BY 1997, SUITABLE DISPOSAL OF 95% OF INDUSTRIAL SOLID WASTES	SECTIONAL HEALTH SERVICE	
4. UNPOLLUTED AIR	BY 1997, AIR QUALITY IN THE MAMONAL INDUSTRIAL ZONE MEETS ESTABLISHED STANDARDS	SECTIONAL HEALTH SERVICE	
5. CARTAGENA'S INSTITUTIONAL CAPACITY FOR ENVIRONMENTAL MANAGEMENT WAS STRENGTHENED			
6. A MORE ENVIRONMENTALLY AWARE AND EDUCATED POPULATION IN CARTAGENA			
7. IMPROVED RESOURCES FOR TOURISM			
8. A HEALTHIER POPULATION			

Table 5.1 (cont.)

PLANNING MATRIX

ACTIVITIES

OBJECTIVE 1: UNPOLLUTED RECEIVING WATERS
1.1: DIMINISH THE FLOW OF POLLUTANTS FROM THE CANAL DEL DIQUE
1.2: GATHER AND DISSEMINATE INFORMATION ON EXISTING PROJECTS, EITHER IN THE PLANNING OR EXECUTION PHASE
1.3: DESIGN THE EXPANSION OF THE SEWERAGE SYSTEM IN OVERCROWDED AREAS
1.4: EXPAND THE SEWERAGE SYSTEM IN OVERCROWDED AREAS
1.5: PROMOTE THE IMPROVEMENT OF INDUSTRIAL PROCESSES THAT GENERATE LARGE QUANTITIES OF LIQUID WASTES
1.6: EXECUTE THE SEWERAGE SYSTEM MASTER PLAN (SEWERS, COLLECTORS AND STABILIZATION LAGOONS) 1.6.1) CONSTRUCT STABILIZATION LAGOONS TO TREAT CARTAGENA'S WASTEWATER 1.6.2) CONSTRUCT THE NETWORK OF MAIN COLLECTORS, PUMPING STATIONS AND FINAL OUTFALL, FOR THE POPULATION OF THE YEAR 2010 1.6.3) CONSTRUCT THE A.S.AS. IN THE SOUTH-EASTERN ZONE AS A WASTEWATER COLLECTION SYSTEM
1.7: EXECUTE THE PROJECT FOR IMPROVING THE WATERWAYS, LAKES AND MARSHES OF CARTAGENA 1.7.1) CARRY OUT DREDGING AND FILLING 1.7.2) CONSTRUCT BRIDGES AND ROADS 1.7.3) PROTECT SHORELINES 1.7.4) CARRY OUT RELATED WORKS (RELOCATE HOMES AND INFRASTRUCTURE)
1.8: FORMULATE PROJECT TO CLEAN UP THE VIRGIN'S MARSH
1.9: ELABORATE A PLAN FOR MANAGING THE BODIES OF WATER
1.10: DECIDE ON A PROGRAMME FOR A SUITALBE EXPLOITATION OF QUARRIES
1.11: DETERMINE THE ASSIMILATION CAPACITY OF THE BODIES OF WATER
1.12: DESIGN AND INSTALL A SYSTEM FOR MONITORING WATER QUALITY
1.13: STRENGTHEN THE FINANCIAL SITUATION OF AGENCIES RESPONSIBLE FOR CARRYING OUT THE PLANS, SO THAT THEY CAN ACQUIRE THE NECESSARY RESOURCES
1.14: REDUCE SOLID WASTE DISPOSAL IN THE BODIES OF WATER
1.15: REMOVE SUBSTANDARD HOUSING FROM HILLSIDES
1.16: REFOREST THE HILLS
1.17: INSTALL MORE SYSTEMS FOR THE TREATMENT OF INDUSTRIAL LIQUID WASTES AND IMPROVE THOSE ALREADY IN EXISTENCE

Table 5.1 (cont.)

PLANNING MATRIX

ACTIVITIES

OBJECTIVE 2: TOXIC AND HAZARDOUS SUBSTANCES CONTROLLED
2.1: UPGRADE THE LIST OF SOURCES OF TOXIC AND HAZARDOUS SUBSTANCES
2.2: UPDATE AND CARRY OUT STUDIES OF THE ENVIRONMENTAL IMPACT (ON HUMAN HEALTH, FLORA AND FAUNA) OF TOXIC AND HAZARDOUS WASTES
2.3: ASSESS SOLUTIONS FOR THE CENTRALIZED MANAGEMENT OF TOXIC AND HAZARDOUS WASTES
2.4: IMPROVE THE SURVEILLANCE CAPACITY OF CONTROL INSTITUTIONS
2.5: IMPROVE THE CAPACITY OF ENTERPRISES TO MANAGE TOXIC AND HAZARDOUS WASTES
2.6: FORMULATE A PLAN FOR SMALL AND MEDIUM-SIZED INDUSTRIAL ENTERPRISES TO CONTROL TOXIC AND HAZARDOUS WASTES
2.7: REDUCE POLLUTION FROM PORT ACTIVITIES 2.7.1) STRENGTHEN SURVEILLANCE TO AVOID DUMPING FROM SHIPS AND PORT ACTIVITIES 2.7.2) INSTALL FACILITIES TO RECEIVE AND TREAT WASTES FROM SHIPS 2.7.3) IMPLEMENT CONTINGENCY PLANS FOR SPILLS OF TOXIC AND HAZARDOUS SUBSTANCES
2.8: FORMULATE WAYS TO ELIMINATE PATHOGENIC WASTES FROM HOSPITALS
OBJECTIVE 3: IMPROVED COLLECTION SERVICE AND SUITABLE DISPOSAL OF SOLID WASTES
3.1: ELABORATE A PROJECT FOR COLLECTING AND SUITABLY DISPOSING OF RESIDENTIAL AND HOSPITAL SOLID WASTES 3.1.1) PROVIDE THE NECESSARY INFRASTRUCTURE FOR GARBAGE COLLECTION AND DISPOSAL 3.1.2) STUDY THE TECHNICAL AND ECONOMIC FEASIBILITY OF INDUSTRIAL AND COMMUNITY RECYCLING 3.1.3) EVALUATE THE USE OF APPROPRIATE TECHNOLOGIES FOR GARBAGE COLLECTION
3.2: IMPLEMENT SYSTEMS FOR THE SUITABLE DISPOSAL OF SOLID INDUSTRIAL WASTES
3.3: IMPROVE PROGRAMMES FOR EDUCATING ABOUT RECYCLING RESIDENTIAL WASTES
OBJECTIVE 4: CLEAN AIR
4.1: STUDY THE EFFECTS OF AIR POLLUTION ON THE HEALTH OF THOSE WHO LIVE NEAR THE MAMONAL INDUSTRIAL ZONE AND ON THE FLORA AND FAUNA OF THE IMPACT AREA
4.2: STUDY THE EFFECTS OF AIR POLLUTION IN THE MAMONAL AREA ON THE QUALITY OF THE WATER ENVIRONMENT
4.3: RELOCATE THOSE WHO LIVE IN THE INDUSTRIAL ZONE
4.4: FORMULATE A PROJECT FOR MONITORING AIR QUALITY
4.5: PROVIDE THE NECESSARY HUMAN AND PHYSICAL RESOURCES TO THE AGENCY RESPONSIBLE FOR MONITORING AIR QUALITY
4.6: ENTERPRISES INCREASE AND UPGRADE THEIR EQUIPMENT FOR CONTROLLING AND MEASURING THEIR EMISSIONS INTO THE ENVIRONMENT

Table 5.1 (cont.)

PLANNING MATRIX

ACTIVITIES

OBJECTIVE 5: CARTAGENA'S INSTITUTIONAL CAPACITY FOR ENVIRONMENTAL MANAGEMENT WAS STRENGTHENED
5.1: ELABORATE A PROJECT FOR INSTITUTIONAL STRENGTHENING THAT INCLUDES: 5.1.1) IMPROVE EXISTING LEGISLATION AND REGULATIONS 5.1.2) UPGRADE THE TECHNICAL INFRASTRUCTURE (EQUIPMENT, INSTALLATIONS, PERSONNEL) OF THE AGENCIES INVOLVED IN ENVIRONMENTAL MANAGEMENT 5.1.3) DESIGN AND IMPLEMENT AN ENVIRONMENTAL INFORMATION SYSTEM 5.1.4) ESTABLISH MECHANISMS FOR ONGOING COORDINATION AMONG INSTITUTIONS 5.1.5) TRAIN PUBLIC EMPLOYEES IN MODERN TECHNIQUES FOR ENVIRONMENTAL MANAGEMENT AND CONTROL 5.1.6) PROVIDE ADEQUATE WORKING CONDITIONS TO MAINTAIN A GOOD PROFESSIONAL LEVEL OF CONTROL PERSONNEL 5.2: FIND FINANCING FOR THE PROJECT FOR INSTITUTIONAL STRENGTHENING
OBJECTIVE 6: A MORE ENVIRONMENTALLY AWARE AND EDUCATED POPULATION IN CARTAGENA
6.1: ELABORATE AN EDUCATIONAL PROGRAMME THAT INCLUDES: 6.1.1) INCORPORATION OF ENVIRONMENTAL EDUCATION INTO THE CURRICULA OF PRIMARY AND SECONDARY EDUCATION 6.1.2) IMPROVEMENT OF TEXT BOOKS TO INCLUDE THE ENVIRONMENTAL DIMENSION 6.1.3) RAISE ENVIRONMENTAL AWARENESS THROUGH THE MASS MEDIA 6.1.3.1) GIVE COURSES OF ENVIRONMENTAL EDUCATION TO JOURNALISTS FROM THE LOCAL MEDIA 6.2: STUDY AND DESIGN A STRATEGY FOR FINANCING THE COMPONENTS OF THE ENVIRONMENTAL EDUCATION PROGRAMME

B. NEW PROJECTS

Several projects were chosen from among the different fields and lines of work identified in the planning matrix for immediate action to further define them and move to their execution.

In the context of the project sponsored by ECLAC, The United National Environment Programme (UNEP) and the Government of Colombia, with the participation of officials of diverse national agencies responsible for these respective areas and ECLAC experts, several project profiles in these fields were elaborated.

These profiles are presented here and refer to the following projects:

1. Regulatory plan for the Bay of Cartagena.

2. Monitoring of industrial liquid waste in the tourist district of Cartagena.

3. Establishment and maintenance of a network to monitor water quality in Cartagena.

4. A study to receive and adequately treat wastes in the Port of Cartagena.

5. Elimination of pathogenic wastes from Cartagena hospitals.

6. A study for a system of centralized final disposal of solid industrial wastes.

7. Relocation of inhabitants of high-risk areas and the rehabilitation of the Cerro de la Popa.

8. A study to establish a sanitary landfill for Cartagena's solid wastes.

9. Programme for the institutional reinforcement of environmental management in the tourist district of Cartagena.

1. Regulatory plan for the Bay of Cartagena

EXECUTING AGENCY: INDERENA

COLLABORATING AGENCIES: MUNICIPALITY OF CARTAGENA, EDURBE, DISTRICT PUBLIC ENTERPRISES

BACKGROUND:

1. In November 1991, the Cartagena District Council, in its agreement 58, adopted a plan for environmental development and sanitation for the year 2010, which has as one of its main objectives the environmental and sanitary rehabilitation of the city's bodies of water: the Bay, internal waterways and lakes and the Virgin's Marsh.

2. One activity that would be indispensable for effectively achieving a suitable management of those bodies of water is to draw up a regulatory plan from an environmental perspective, which would make it possible to clearly point out the relevant areas and determine what is most suitable for their use.

3. Many studies have been made about Cartagena's bodies of water. Therefore, valuable information is available. However, from the viewpoint of a regulatory plan, the problem is that much of this information is not systematically interlinked, therefore, is relatively useless for drawing up such a plan.

4. The project was drawn up on the basis of this background.

OBJECTIVE OF THE PROJECT:

To protect and optimize the use of Cartagena's bodies of water in function of the development of human settlements in the metropolitan area of Cartagena and the corresponding aquatic ecosystems.

RESULTS OF THE PROJECT:

1. Zoning the bodies of water with respect to their main uses;

2. Establishment of quality standards to be met in the different zones established, according to their use;

3. Assessment and determination of maximum emission standards presently in force for different known and/or controlled sources of effluents;

4. Assessment and improvement of existing instruments and proposal of other possible instruments to achieve and maintain quality standards according to the uses determined;

5. Determination of institutional adjustments required in order to execute and administer the regulatory plan defined.

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1.1: Updating of the inventory of sources and substances dumped into the different bodies of water;

1.2: Analysis and determination of the present uses being made of the different bodies of water;

1.3: Preliminary zoning;

1.4: Workshop with the participation of technicians and representatives of actors in the Cartagena community to determine final zoning.

RESULT 2:

2.1: Modeling of the hydrodynamic behaviour of the Bay of Cartagena and the bodies of water in the system;

2.2: Modeling of the system's assimilative capacity with its areas and components (mainly advection, dispersion and breakdown of pollutants;

2.3: Preliminary determination of water quality standards according to its use and interaction between contiguous or overlapping zones of use;

2.4: Realization of studies and tests of toxicity in order to determine the quality parameters of substances (hazardous or toxic) of sanitation interest.

RESULT 3:

3.1: Updating of information on domestic, industrial and agricultural releases. See the project on monitoring sources of industrial releases.

3.2: Review and updating of release standards for effluents, according to the uses of bodies of water and quality standards.

RESULT 4:

4.1: Review and updating of the territorial regulatory plan of shore areas, based on the planned use of bodies of water;

4.2: Evaluation of a retribution rate for the service of eliminating or controlling liquid dumping (decree 1594/84), as a pollution control instrument.

4.3: Workshop to analyse other possible instruments that provide more efficient ways to monitor dumping into bodies of water.

RESULT 5:

5.1: Identification and analysis of the functions and attributions of all State agencies that are directly or indirectly connected with the water environment of Cartagena;

5.2: A study and proposal of a number of alternative administrative and institutional solutions for the execution of the environmental regulatory plan for Cartagena's bodies of water;

5.3: Workshop with the participation of all concerned institutions to discuss and define a consensual administrative and institutional structure.

ESTIMATED BUDGET:

130 million pesos (US$200,000).

ESTIMATED COMPLETION TIME:

18 months.

2. Monitoring of industrial liquid waste in the tourist district of Cartagena

EXECUTING AGENCY: INDERENA

COLLABORATING AGENCIES: MAMONAL FOUNDATION (Private sector)

BACKGROUND:

1. According to 1990 data from the Cartagena Chamber of Commerce, there are 620 industrial establishments. INDERENA (1990) estimates that 50 of them (less than 10%) produce liquid effluents in significant volumes.

2. All of these establishments are located on the east coast of the Bay of Cartagena, into which they dump 100% of their industrial effluents, in some cases after treatment by the enterprise itself. The large enterprises in the Mamonal

industrial zone belong to this group. Outside the Mamonal area, the Industria Licorera de Bolívar (INDULIBOL), located in El Bosque, has large discharges. In the El Bosque area, next to the centre of the city, there are a considerable number of small industries (workshops, paint shops, furniture factories, soft drink plants, etc.) whose discharges are not known but could nonetheless be large.

3. INDERENA has detailed information for 13 enterprises whose effluents it monitorings, many of which have treatment systems for their liquid effluents. Of the relatively large enterprises that generate liquid waste, 18 should be incorporated into compliance plans and have yet to do so.
4. Available information also shows that it very important that a complete register of industrial activities be established (including small and medium-sized enterprises), which would undoubtedly make it possible to know where liquid wastes are generated, what their characteristics are, where they are presently be disposed of and what control should be demanded of different enterprises.

5. If adequate control over the dumping of liquid industrial wastes into Cartagena's waters is to be ensured, it is indispensable that a plan be established to constantly monitor the sources and the effluents generated.

OBJECTIVE OF THE PROJECT:

Reduce the amount of liquid industrial wastes being dumped into Cartagena's bodies of water.

RESULTS OF THE PROJECT:

1. The 18 industries that do not at present have plans for meeting dumping standards will draw up such plans;

2. The liquid dumping of 35 industries will be monitored (included the 18 mentioned above).

3. All the industries of Cartagena will be registered, identifying the effluents they generate and a programme to incorporate them into a plan of constant monitoring.

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1.1: Verification of the information presented by the enterprises by visiting each enterprise, monitoring sewage (one aggregate sample during production, taken on five successive days of normal functioning of each plant), and sample analysis;

1.2: Assessment of the characteristics of each enterprise to verify that current dumping standards are being met;

1.3: Analysis and assessment of each enterprise's plan to meet standards (activities 1.1 - 1.3 to be done in a six to nine month period).

RESULT 2:

2.1: Sampling on an average of every four months of the 35 enterprises in Cartagena that have plans to meet standards of liquid dumping;

2.2: Analysis of samples included in the assessment, in 50% of the cases, of the following parameters: Ph, conductivity, ammonium, nitrites, nitrates, NKT, total phosphorus, oils and fats, suspended solids, sedimentary solids, biochemical oxygen demand, biological oxygen demand, organic nitrogen and volume; for the other 50% of cases, analysis of specific parameters is added according to the industries in question: total polynuclear aromatic hydrocarbons, pesticides, heavy metals, phenolic compounds and other specific substances.

NOTE: The number of industries to be incorporated into the liquid waste control system will increase by 10% a year over the next three years included in the project.

RESULT 3:

3.1: Identification and registry of all small and medium-sized enterprises in Cartagena;

3.2: A survey of all those that generate liquid wastes, for their characterization;

3.3: Assessment of the situation of this sector and determination of its impact on Cartagena's water quality;

3.4: Incorporation as needed of enterprises into plans to meet dumping standards;

3.5: Determination of a monitoring plan for those enterprises who need one.

NOTE: Since the number of enterprises in this group that will eventually have to be incorporated into dumping control systems is unknown, their characterization and effective incorporation into a monitoring system are not considered in this project.

ESTIMATED BUDGET

172 million pesos (US$265,000)

ESTIMATED COMPLETION TIME

three years

NOTE: It should be emphasized that this is a programme of permanent monitoring, which will not end after three years. In this regard, and taking into consideration the 35 industries monitored, an annual cost of 50 million pesos should be considered for maintaining the programme.

3. Establishment and maintenance of a network to monitor water quality in Cartagena

EXECUTING AGENCY: INDERENA

COLLABORATING AGENCIES: Centre for Oceanographic and Hydrographic Research, University of Cartagena, Municipality of Cartagena.

BACKGROUND:

1. A considerable number of studies on pollution in the Bay of Cartagena, lakes and waterways have been made. Most of them, however, were done in the early 1980s. Therefore --despite their undeniable usefulness-- they are obsolete from the viewpoint of managing and protecting the bodies of water.

2. In any case, there is undoubtedly considerable pollution. More and better information, however, is needed, since the overall situation of Cartagena's waters is quite complex. For example, the complicated seasonal pattern of water circulation and rains leads to large seasonal variations in vertical gradients, with marked stratification in temperature, salinity and oxygenation that magnify the spatial differences in the distribution of pollution.

3. More recent studies are available on the Virgin's Marsh. Ten sampling stations were installed in 1990 and 10 relevant parameters were measured. However, the measurements are sporadic and do not provide the basis for an adequate assessment of trends, therefore making it more difficult to evaluate potential solutions.

4. The establishment of an environmental regulatory plan for Cartagena's bodies of water, as seen in the project mentioned above, calls for suitable models for understanding what takes

place in those waters. Such models depend on a continuous flow of information that can be provided only by an adequate monitoring system.

OBJECTIVE OF THE PROJECT:

Analyse on a constant basis the chemical, physical and biological quality of Cartagena's waters.

RESULTS OF THE PROJECT:

1. Measurements of the following parameters will be taken with sufficient frequency in Cartagena's waters: physical: pH, temperature, solids, turbidity (transparency) and salinity; chemical: nutrients, biological oxygen demand, dissolved oxygen, heavy metals, chlorophyll, hydrocarbons, pesticides and benthic demand; biological: phytozoa, meiobenthoses and microbiological (coliforms and streptococcus).

2. Pertinent indicators of the quality of Cartagena's waters.

3. Publication of a biannual report on the state of Cartagena's water environment.

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1:1 Water samples from three different depths taken every two weeks during the first year, once a month during the second year, and once every two months from the third year onward at 13 sampling points in the Bay, to measure the parameters mentioned above;

1:2 Water samples taken from one depth every two weeks during the first year, once a month during the second year, and once every two months from the third year onward at eight sampling points in the lakes and waterways and 10 sampling points in the Virgin's Marsh to measure the parameters mentioned above;

1:3 Bottom samples taken from the 31 points mentioned above once a week during the first year and once a year after that, to determine benthic demand;

1:4 Samples taken for meiobenthos analysis, once a month during the first year, every two months during the second year and every four months after that at five sampling points in the Bay, four points in the lakes and waterways and three points in the Virgin's Marsh;

1:5 Samples taken for phytozoological analysis with the same frequency and at the same points as in 1:4;

1:6 Water samples taken for microbiological analysis once a month at 10 points affecting the beaches of Cartagena;

1:7 Analysis of the samples taken to determine the measurements relevant to each case.

RESULT 2:

2:1 Design and implementation of a database to record the results of the analyses of the samples taken;

2:2 Establishment of water quality indicators on the basis of the parameters identified;

2:3 Generation of computer software to elaborate the quality indicators established;

2:4 Entry of the measurements of the aforementioned parameters taken from the analyses;

2:5 Calculation of the established indicators and dissemination of the results to interested users.

RESULT 3:

3:1 Statistical analyses of data obtained in each six-month period and previous six-month periods;

3:2 Assessment of the statistical results from the perspective of the environment and water quality;

3:3 Preparation, publication and distribution of reports on the water environment of Cartagena.

ESTIMATED BUDGET:

325 million pesos (US$500,000).

ESTIMATED COMPLETION TIME:

3 years.

NOTE: It should be emphasized that this is a programme of continuous monitoring. Therefore, the work will not stop at the end of three years. In this sense, an annual cost of 65 million pesos to maintain the programme should be planned.

4. A study to receive and adequately treat waste in the Port of Cartagena

EXECUTING AGENCIES: Maritime and Port Authority (DIMAR)/Centre for Oceanographic and Hydrographic Research (CIOH)

BACKGROUND:

1. The Maritime and Port Authority (DIMAR), pursuant to decree 2324/84, is responsible for seeing that Colombia complies with the maritime agreements that the country has signed.

2. Colombia approved, through law 12/81, the International Convention for the Prevention of Pollution from Ships of 1973 and its Protocol of 1978 and is presently developing the regulations of that convention.

3. Given the above, studies need to be made concerning the requirements for land-based installations for receiving hydrocarbons, chemicals, sewage and garbage from ships.

OBJECTIVE OF THE PROJECT:

Elaborate a proposal for improving Cartagena's port facilities for receiving and treating wastes from ships.

RESULTS OF THE PROJECT:

1. An up-to-date knowledge of the capacity of existing installations and of the movement of wastes at the different docks of the port.

2. A proposal for works to be done in the port to provide adequate reception and treatment of the wastes that arrive.

ACTIVITIES FOR TO ACHIEVE EACH RESULT:

RESULT 1:

1:1 Gathering of information on the present condition of existing installations on each of the 55 docks of the Port of Cartagena;

1:2 Gathering of information on the movement of wastes actually produced on existing docks, with respect to their characteristics, volume, frequency of reception, treatment given and final disposal:

1:3 On-site verification of the information gathered;

1:4 Gathering or elaboration of maps and plans that show the location of all the elements (installations and infrastructure) involved in the reception, treatment and final disposal of wastes.

RESULT 2:

2:1 Detailed assessment of existing installations, in function of the characteristics, volumes and frequency of arrival of wastes;

2:2 General indication of the minimum needs for improvement and modification of existing installations and for the construction of new installations. This indication includes the analysis of the repair or construction of shared installations serving more than one enterprise or dock, dealing with the same or similar kinds of wastes;

2:3 Determination of the technical specifications that reception and treatment installations have to meet to be improved, transformed or constructed according to the wastes they receive and the particular characteristics of each dock;

2:4 Proposal of a schedule of estimated minimum times needed to carry out project details and terminate the different works involved;

2:5 General estimate and estimate by type of waste of the approximate cost of minimum installations detected by the study.

ESTIMATE BUDGET:

26 million pesos (US$40,000).

NOTE: It is estimated that the implementation of this project will require the services of a specialized consulting firm that can carry out all the activities mentioned, which --in this case-- constitute the general terms of reference for the work to be contracted.

ESTIMATED COMPLETION TIME:

Eight months.

5. Elimination of pathogenic waste from Cartagena hospitals

EXECUTING AGENCIES: DISTRICT PUBLIC ENTERPRISES/SECTIONAL HEALTH SERVICE OF BOLIVAR

COLLABORATING AGENCIES: HOSPITALS WITH CREMATION FACILITIES

BACKGROUND:

1. At present, there are 16 hospitals and 30 medical centres in Cartagena that generate pathogenic or potentially pathogenic wastes. The total output of this kind of waste has not been adequately estimated.

2. There is also a lack of knowledge about the volume, composition and disposal of wastes from laboratories and centres for analysis.

3. However, it is known that existing waste disposal is inadequate, since wastes are thrown into sewers or the municipal dump without any monitoring whatsoever.

4. Four hospitals have crematoria which incinerate approximately 100 kg of pathogenic wastes per day. These hospitals have the capacity and are willing to incinerate all the pathogenic wastes that Cartagena is estimated to produce.

OBJECTIVE OF THE PROJECT:

Protect the health of Cartagena's population by collecting, transporting and securely disposing of pathogenic wastes from hospitals, clinics and laboratories.

RESULTS OF THE PROJECT:

1. Incineration of all pathogenic wastes from the aforementioned establishments;

2. A total of 100 workers from those establishments will be suitably trained to handle hazardous (pathogenic) wastes.

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT I:

1:1: Implementation of a complete inventory of all the health establishments in Cartagena that generate hazardous (pathogenic) wastes, indicating the approximate daily production of each on them;

1:2: Production and distribution to those establishments of especially designed and marked (e.g., red) bags for the disposal of hazardous wastes;

1:3: Organization of a special route to collect the wastes from the establishments identified to bring them to the closest hospital with an incinerator (daily);

1:4: Establishment of agreements between District Public Enterprises and hospitals equipped with incinerators so that the wastes collected can be burned. This includes setting a price for the service;

1:5: Establishment of a rate that District Public Enterprises will charge the users;

1:6: A study and evaluation of alternative ways to administer this service (e.g., by private-sector microenterprises).

RESULT 2:

2:1: Elaboration of a training programme and materials;

2:2: Promotion and dissemination of the training programme among participating health centres;

2:3: Selection of those who will participate in the programme;

2:4: Implementation of the training courses;

2:5: Monitoring of the achievement of training objectives.

ESTIMATED BUDGET:

19.5 million pesos (US$30,000).

ESTIMATED COMPLETION TIME:

Four months.

6. A study for a system of centralized final disposal of solid industrial waste

EXECUTING AGENCIES: MUNICIPALITY/PRIVATE SECTOR

BACKGROUND:

1 There is no published information on the composition of industrial waste and control wastes from liquid dumping in the Mamonal area.

2. Those wastes are generally collected and disposed of by the industries themselves, either directly or through contracted services. The wastes are recycled, sold, buried on the site of the plant or incinerated. Some of them, of unknown characteristics and volume, are disposed of in the municipal dump where they are treated like any other wastes.

3. No information is available on the characteristics, volumes or destination of industrial wastes from small and medium-sized enterprises.

4. At the national level, the Ministry of Public Health is in charge of regulating the management and disposal of solid wastes; municipal governments are responsible for regulating and providing sanitation services in their respective urban areas. In Cartagena, the District Public Enterprises collect and dispose of solid wastes.

5. With regards solid wastes of sanitation interest (toxic or hazardous), there is no suitable monitoring of their final disposal. That is true for some large enterprises and particularly so for small and medium-sized enterprises. Mixed in with common urban garbage are elements such as: pharmaceutical products, wood preservatives, pesticides, fat and other animal wastes and wastes from small industries that produce run-offs, paint, etc.

OBJECTIVE OF THE PROJECT:

Determine the desirability and feasibility of centralizing final disposal of solid wastes from a number of industries to be identified.

RESULTS OF THE PROJECT:

1. A detailed inventory of solid wastes produced by industries in Cartagena.

2. A feasibility study of centralized disposal for a series of solid wastes from different industries.

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1:1: A census of industries, recording --at least-- the following information connected with the generation of solid wastes:

a) Identification of solid wastes generated;

b) Source producing the waste (establishment);

c) The process that generates the waste;

d) Volume generated daily;

e) Frequency with which the waste is disposed of;

f) Physical characteristics of the waste (blocks, grains, dust, paste, sludge, etc.);

g) Chemical composition;

h) Reaction to temperatures (fusion, boiling and inflammation points of the waste);

i) Results of the standard leaching test;

j) Toxicity analysis;

k) Other risks linked to the waste (explosions, chemical reactions with other elements, emission of gases, etc.).

1:2: Analysis and processing of the information gathered.

RESULT 2:

2:1: Analysis and determination of recorded wastes that could be disposed of in a central facility, including details concerning any prior treatment needed. Determination of volumes per type of waste;

2:2: Selection of a site for centralized disposal and a detailed analysis of its characteristics;

2:3: Design of the construction of the site and detailed technical specifications for the different sections needed for the kinds of wastes to be received (systems for segregating them);

2:4: Design of a system for managing the wastes, with its corresponding manual for technical procedures;

2:5: Design of a contingency plan for each type of waste disposed of in case of accidents (leaks, breakages, fires, etc.) involving toxic or hazardous wastes;

2:6: Proposal for handling the site after it is no longer useful, together with technical specifications for its definitive closing;

2:7: Determination of investment and operational costs of the site and the setting of minimum rates to charge users; analysis of the feasibility of the project;

2:8: Analyses and proposals of alternatives for managing the site (mixed municipal/private enterprise); concession to a contractor; exclusive municipal administration, etc.).

ESTIMATED BUDGET:

26 million pesos (US$40,000).

NOTE: Some of the initial cost of the study could be recovered, depending on the management system chosen and the way it is awarded.

ESTIMATED COMPLETION TIME:

Eight months.

7. Relocation of inhabitants of high-risk areas and the rehabilitation of the Cerro de la Popa

EXECUTING AGENCIES: GOVERNMENT OF THE DISTRICT OF CARTAGENA (through the Housing Fund, Public Enterprises, Planning Department and the Secretariat of the Government) and INDERENA

COLLABORATING AGENCIES: NAVY (Naval Academy "Admiral Padilla") AND PRIVATE ENTERPRISES

OBJECTIVES OF THE PROJECT:

1. Improve the quality of life of the population living in the high-risk area on Cerro de la Popa;

2. Eliminate the erosion processes presently affecting Cerro de la Popa.

RESULTS OF THE PROJECT:

1. A total of 500 families relocated in basic housing by the end of the third year (1994);

2. x hectares reforested or in the process of being reforested by the end of the third year (1994).

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1:1: Population and household census in the high-risk areas of Cerro de la Popa;

1:2: Identification of the eventual receiving area, including a feasibility study of providing services in that area;

1:3: Implementation of a social work programme with the community to be relocated;

1:4: Analysis of the possibilities and alternatives for financing the proposed construction of dwellings;

1:5: Execution of the proposed construction;

1:6: Handing over of deeds of ownership to the families benefitted;

1:7: Transfer to and occupation of the dwellings by those families.

RESULT 2:

2:1: Topographical survey of areas to be reforested;

2:2: A study of civil works to be constructed to stabilize the hillside;

2:3: Construction of the civil works designed;

2:4: A study of a reforestation plan (density of plantation, method, species to plant, etc.) by area;

2:5: Acquisition of saplings to plant and other inputs;

2:6: Preparation of the terrain, including the installation of irrigation systems;

2:7: Plantation and maintenance;

2:8: Execution of a maintenance programme.

ESTIMATED BUDGET:

1.85 billion pesos for the relocation/housing component;

x billion pesos for the reforestation component.

ESTIMATED COMPLETION TIME:

Three years.

8. A study to establish a sanitary landfill for Cartagena's solid waste

EXECUTING AGENCY: MUNICIPALITY (through District Public Enterprises)

BACKGROUND:

1. An estimated 360 tons of garbage a day (around 60% of the total) is collected by the District Public Enterprises of Cartagena and brought to the municipal dump in the Henequén area.

2. No distinction is made in this open-air dump between different kinds of wastes.

3. Some 300 people work in the dump on an informal basis recovering and recycling wastes. According to a 1979 study, even then around 50 people were permanently living in the dump, with no type of control, support or protection for avoiding accidents or illnesses.

4. An absolutely clear point from a public-health as well as an economic perspective is that a city for which tourism is so important cannot continue to dispose of its wastes as it presently does; adequate solutions must be studied and implemented.

5. Undoubtedly, the problem of Cartagena's urban garbage also includes limitations in collecting it. However, given the different character of those activities, the present project only deals with final disposal.

OBJECTIVE OF THE PROJECT:

Define a project for the final disposal of solid wastes generated in Cartagena, so that public health and safety is not deteriorated or placed at risk; a project economically feasible and one that has secondary objectives, such as the production of biogas and land reclamation.

RESULTS OF THE PROJECT:

1. A sanitary landfill project, including engineering studies and assessment of economic and financial feasibility;

2. A proposal of alternatives for the management of the landfill and corresponding procedures;

3. Determination of a rate system to establish and set rates for at least for the first year of functioning;

4. A proposal for the use of the landfill once it has outlived its usefulness;

5. Analysis of disposing industrial solid wastes in the landfill (see the project specifically for this purpose).

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1:1: Updating of the characteristics and volumes of municipal and industrial solid wastes generated in Cartagena, with at least a 10-year projection into the future;

1:2: Selection of a landfill site (analysis of alternatives of sites currently available). Includes analysis of accessibility; physical capacity to receive wastes; ecological conditions and linkage to other ecosystems; availability of material to cover wastes; location in relation to present and future human settlements; current laws directly or indirectly related to landfills, and acquisition or opportunity (if a municipal site) cost.

1:3: Plane survey of the site chosen and other detailed studies, especially: soil (permeability, drainage and compactness); groundwater and surface water systems on the site and immediate surroundings; basic information on the climate of the zone and the microclimate of the area, and the availability and characteristics of material to prepare and cover the landfill;

1:4: Implementation of the basic project (at the level of pre-feasibility study);

1:5: Design of detailed projects for infrastructure (in and around the landfill); construction of the landfill itself and the different components (among them, those for the disposal of industrial wastes, including sanitation-sensitive substances or toxic or hazardous wastes: see the project that deals with these); facilities for reception, operation and management of the landfill;

treatment of liquid wastes generated by the landfill itself, and preparation for final disposal at the end of the useful life of the landfill;

1:6: Determination of investments and costs associated with the operation of the landfill, taking into account the normal items: installations, equipment and machinery (national and imported); personnel (professional, technical, administrative and unskilled manpower); different inputs; general expenditures and maintenance; insurance and financing costs, etc.;

1:7: A study and economic analysis of by-products generated by the landfill (especially gas and its eventual use by nearby industries and other users);

1:8: Determination of a financial programme for building and operating the landfill, plus a feasibility study.

RESULT 2

2:1: Gathering of information, analysis and evaluation of different forms of administration used in the country, in other countries of the region, and outside the region;

2:2: Specification of two or more viable alternatives for Cartagena's sanitary landfill, assessment of them in different scenarios and selection of the most suitable alternative;

2:3: Determination of the terms of reference for activating the administrative form chosen and design of procedures for implementing it.

RESULT 3:

3:1: Design of a rate schedule, taking into consideration the different users of the landfill, both for disposal services themselves and for the sale of by-products;

3:2: Based on the analyses done in the feasibility study of the project (Result 1), analysis and determination of rates to charge different users for disposal services (considering the municipal collection service as a user like any other) and for the sale of by-products (mainly gas).

RESULT 4:

4:1: In function of the location of the landfill, the urban development of the area, constraints inherent in the administrative system chosen, etc., different

alternatives of what to do with the landfill after its service life is over will be studied and assessed.

RESULT 5:

5:1: To the extent it is considered necessary, suitable and feasible, centralized final disposal of industrial wastes, a study will be made --as part of the corresponding project-- the integration of that centralized disposal into the landfill, conditions of integration, safeguards to be taken, participation of users in choosing an administrative system, etc.

ESTIMATED BUDGET:

32.5 million pesos (US$50,000).

ESTIMATED COMPLETION TIME:

Eight months.

9. Programme for the institutional reinforcement of environmental management in the tourist district of Cartagena

EXECUTING AGENCY: MUNICIPALITY OF CARTAGENA

COLLABORATING AGENCIES: ALL DISTRICT AND NATIONAL AGENCIES WITH OFFICES IN CARTAGENA

BACKGROUND:

1. Environmental management in the country is controlled by a broad spectrum of laws and decrees that determine actions and define responsibilities.

2. Environmental management in Cartagena operates on the basis of national and district institutions. The national institutions include INDERENA for the management of land and water environments; Sectional Health Service of Bolívar (Ministry of Health) for air quality and control of sanitation-sensitive substances; and DIMAR for the marine environment. Especially important at the district level are Public Enterprises, in charge of the water supply, basic sanitation, rainfall drainage, garbage collection and other services; and EDURBE, for the environmental clean-up of the city's bodies of water.

3. Given the essentially transsectoral character of the environmental problematic, constant communication, coordination and consensus-building between the aforementioned institutions are fundamental for good management. The

complexity of the task demands suitably trained personnel. Deficiencies in both areas call for measures to be taken.

OBJECTIVE OF THE PROJECT:

Improve regulatory and institutional capacities of the District of Cartagena for a more efficient and effective environmental management in the city's development process.

RESULTS OF THE PROJECT:

1. Up-to-date, systematic and modern norms and regulations for environmental management at the District level;

2. Better equipment, installations and personnel in the institutions active in environmental management;

3. A functioning system of environmental information;

4. An efficient and operational mechanism for inter-institutional coordination in environmental matters;

5. A group of public and municipal employees duly trained in different areas of environmental management.

ACTIVITIES TO ACHIEVE EACH RESULT:

RESULT 1:

1:1: A survey of current rules, regulations and laws concerning different aspects of the environment;

1:2: Analysis of the inventory taken and the determination of areas of contradiction, duplication, inconsistencies between existing regulations, as well as lacunae in the regulations;

1:3: Proposal of changes needed in the rules, regulations and laws and elaboration of new regulations where there are lacunae.

RESULT 2:

2:1: A study of the functions and attributions of all the institutions directly or indirectly concerned about environmental questions;

2:2: Assessments of staffs, equipment and installations in relation to the functions they are to fulfill; determination of quantitative and qualitative deficiencies;

2:3: Estimate of the cost of covering all the deficiencies recorded and elaboration of a plan for improvements in that regard, indicating possible sources of the resources needed.

RESULT 3:

3:1: Based on the environmental functions and attributions of the different institutions involved in environmental management, analysis of the minimum information needed for decision-making at different levels of each of those institutions;

3:2: Identification and design of essential indicators that should comprise the environmental information needed for efficient decision-making at each level in each institution;

3:3: Identification of the basic information needed to construct the indicators designed and identified as the sources that generate that information;

3:4: Determination of existing informational lacunae and an indication of research needed to overcome them;

3:5: Design and implementation of a system to exchange necessary information (instruments, procedures, mechanisms, agreements, etc.) so that it flows rapidly and is available when needed, including administrative aspects;

3:7: Analysis of the economic and financial feasibility of the proposed environmental information system;

3:8: Execution and start-up/evaluation.

RESULT 4:

4:1: Based on the analysis of the functions and attributions of the different institutions directly or indirectly involved in environmental management, determination of the critical areas of coordination (sequenced actions; authorizations; duplications; complementarity of equipment, experience or professional personnel, among other areas);

4:2: Design of mechanisms for coordination in general and for specific matters with critical areas (committees, work groups, temporary or standing; workshops, etc.);

4:3: Seminars and/or workshops to periodically analyse, test and evaluate the mechanisms designed, including an analysis of experiences in other cities or countries.

RESULT 5:

5:1: In accord with the functions and attributions of the different institutions involved in environmental management, analysis and determination of training needs classified by subject matter and levels;

5:2 Identification of existing capacities in Cartagena and other places in the country, to carry out suitable training activities in the subject matter identified;

5:3: Agreements with training agencies and design of special programmes in those areas in which there is no training capacity and foreign or international groups or centres have to be used;

5:4: Supervision of the curriculum designed and accepted in each agreement;

5:5: Production and reproduction of teaching materials for the different training programmes;

5:6: Implementation of the programme;

5:7: Different follow-up activities to evaluate results.

ESTIMATE BUDGET:			TIME
RESULT 1:	9.75 million pesos	(US$15,000)	5 months
RESULT 2:	15.6 million pesos	(US$24,000)	8 months
RESULT 3:	78.0 million pesos	(US$120,000)	12 months
RESULT 4:	6.5 million pesos	(US$10,000)	8 months
RESULT 5:	65.0 million pesos	(US$100,000)	3 years
TOTAL:	174.85 million pesos	(US$269,000).	

C. PROGRAMMES AND PROJECTS UNDER WAY

1. Environmental and sanitation development plan for Cartagena to the year 2010

For the purpose of providing a suitable legal framework and guarantee the execution of the programmes and specific actions leading to the effective improvement of Cartagena's bodies of water, the District Council of Cartagena, through agreement no. 58 of 1991, adopted the environmental and sanitation development plan for Cartagena to the year 2010.

a) Basic objectives

The basic objectives of the plan are:

- Optimization of the existing watermain system and construction of a new additional system.

- The environmental and sanitary rehabilitation of the city's bodies of water: Bay, inland lakes and waterways and the Virgin's Marsh.

- Total coverage for the collection and treatment of sewage.

- Implementation of the master plan for the collection and final disposal of garbage.

- Management of the system of canals for rainfall and rainfall run-off, as called for by the master plan for rainfall drainage.

- Urban reorganization, as a result of the sanitation plan: infrastructure for public services, roads and streets, public spaces, landscaping, etc.

b) Programmes

The programmes of the agreement come under three sections:

Section I: Environmental and sanitary clean-up.
Section II: Watermains.
Section III: Urban garbage collection.

The first section includes three projects identified in the ZOPP seminar mentioned above, as top priority projects for dealing with Cartagena's environmental problematic. These projects are:

i) Improvement of Cartagena's waterways, lakes and marshes;
ii) Sewerage master plan;
iii) Sanitary and environmental clean-up of the Virgin's Marsh.

For almost 10 years, EDURBE has been promoting a programme to clean-up the waterways, lakes and marshes of Cartagena. The technical alternatives have been studied at the feasibility level (see National Development Projects Fund (FONADE), HIDROTEC, EDURBE, 1984, 8 volumes) and widely distributed to authorities, technicians and the general population. Several of the works in the study have been completed, such as the dredging and partial straightening of the Juan Angola waterway, the landscaping of one shore and the relocation of some of the people living on the other shore, the

beginning of the canal parallel to the runway at the airport and the replacement of the old Román bridge with another with more clearance and better lighting, at one of the links to the Bay system.

The main objective of the project to improve Cartagena's waterways, lakes and marshes is to clean up inland waters by ensuring their suitable hydraulic connection, within the context of present and future urban development of the areas directly linked to those waters and of the city itself.

Less important objectives are the improvement of the transport system by incorporating the bodies of water as additional river or lake shipping lanes; the development and reclamation of areas for human settlements and activities; and direct basic sanitation in the community living on the shorelines.

The main results of these activities are:

- dredging and filling of several canals, waterways and marshes and the protection of their shorelines;

- construction of bridges, vehicular and pedestrian, and the construction of perimeter roads;

- related activities associated with the acquisition of land and the relocation of watermain and sewerage infrastructure.

The main objective of the project for the sanitary and environmental clean-up of the Virgin's Marsh is to clean up the Virgin's Marsh, the most important inland body of water in the city's aquatic ecosystem. That involves, as more specific objectives, the re-establishment of the system's water balance and the elimination of accumulated organic wastes. To achieve such a clean-up, it is essential that the planned results of the previous objective be obtained, since the waterways and lakes are integral parts of the Marsh's water system. Also, rehabilitation will be permanent only if the dumping of human-related organic material is controlled, keeping it within the margins of the associated systems' capacity to assimilate it.

The results and activities to achieve them basically revolve around pumping out a to-be-specified percentage of liquified septic sludge that has accumulated on the bottom of the Marsh; the determination of its final disposal; the implementation of that disposal, dredging and protective and related works that make possible and ensure that the Marsh remains connected with the rest of the water system, including the Caribbean.

At present, a series of studies are under way, for the purpose of upgrading information on the hydrodynamic behaviour and the

quality of the waters, in order to define with precision and execute the engineering projects of the activities and works connected with the project and those of the previous project more directly linked to the objectives of this one (mainly, the dimensions of the canal parallel to the airport).

Finally, the main objective of the project dealing with sewage collection and treatment systems is to improve the basic sanitation of Cartagena and its bodies of water by reducing the impact of sewage from a population estimated to be around 540,000 by the year 2010.

The results and activities of this project include the construction of interceptors of sewage (sewerage and collector systems); construction of pumping stations; construction of a sludge-free sewerage system in an area of the water system with special characteristics; construction of a final outfall; construction of lagoons for the stabilization, maturation and removal of nutrients from the water to be treated.

The watermain programme includes the project, currently being designed, for another system at the Leticia site, over the Canal del Dique, to back up the systems in Gambote and Dolores, which also feed into the Canal.

The urban garbage collection programme is to evaluate the service and make recommendations for short-term emergency operations, in order to elaborate medium- and long-term proposals for defining a general plan for dealing with garbage, including the sanitary landfill.

c) Agencies in charge of works

The following is a summary of the works comprising the programme and the agencies responsible for carrying them out:

i) EDURBE

- Dredging of waterways and lakes; build-up of shores;
- Reconnection of the waterway system with the Virgin's Marsh;
- Raising of seven existing bridges.

ii) MINISTRY OF PUBLIC WORKS AND TRANSPORT (MOPT)

- Construction of the ring road;
- Stabilization of the link between the sea and the Virgin's Marsh;

- Clean-up of the Virgin's Marsh;
- Construction of the perimeter road to the south and east of the Virgin's Marsh.

iii) MUNICIPALITY OF CARTAGENA

- Construction of marginal roads to the bodies of water cleaned-up;
- Urban reorganization of land reclaimed in the clean-up of the water system, providing roads and public services.

iv) MUNICIPAL PUBLIC ENTERPRISES

- Improvement of the drinking water supply with construction in stages of the new Leticia watermain;
- Sewage collection and treatment;
- Rainfall drainage system. The city's rainfall drainage system is generally deficient, first, because Municipal Public Enterprises have no department specifically in charge of maintaining and improving the system and, second, the master plan for rainfall drainage, which was drawn up in 1983 and is currently the basis for programming works, did not take into account the city's growth; it needs to be updated with suitable projections into the future.
- Collection and management of solid wastes. The possibility is currently being studied of acquiring land next to the existing dump for a sanitary landfill, with the technical assistance of the sanitation firm from Medellín, which has had excellent results with its system.

The estimated cost of these projects is US$44 million, for which local government and EDURBE have to seek national and international financing, with the support and special interest of the national Government, particularly the President's office.

2. Programmes to control water pollution

The following initiatives deal with water pollution monitoring in Cartagena and the rationale behind it.

a) The Canal del Dique

The studies reviewed and the technical experts consulted are split on the question of whether the advantages of the Canal outweigh the environmental problems it causes to the Bay of

Cartagena, Barbacoas Bay and the Rosario islands. Some studies pinpoint it as the worst cause of environmental degradation in the area; others put it in third place, and others consider it to be still part of Cartagena's water system.

A number of engineering works have been proposed to reduce to volume of sediment that the Canal dumps into the Bay. It has also been pointed out that the environmental monitoring of mining and industrial dumping along the Magdalena River would benefit the Bay of Cartagena.

At present, no major works for the Canal are planned, but the Colombian Government has earmarked US$26 million to improve the navigability and environmental state of the Magdalena River and the Canal del Dique which, if carried out, could reduce the environmental impact in Cartagena.

b) The project of Cartagena Municipal Public Enterprises for the provision of drinking water

Plans are currently being drawn up to increase the drinking water supply for the year 2010 and for a total coverage of the urban population. At present, drinking water reaches 70%-80% of the population, frequently with problems of pressure; whole areas are not served.

3. Programmes and projects of environmental management agencies

The three agencies in charge of environmental management, INDERENA, Sectional Health Service of Bolívar, and the Maritime and Port Authority (DIMAR), are advancing their regular programmes that deal with their functions of surveillance and monitoring of water and air pollution in Cartagena, but with the limitations already noted.

The following is a list of their specific programmes that are or could be related to the environment in Cartagena, with associated agencies or agreements:

i) Environmental education (INDERENA, DISTRICT MUNICIPALITY, UNDP);

ii) Facilities for reception in the port and elimination of wastes (case study: Port of Cartagena) (INDERENA, UNEP, WHO, UNDP, WORLD BANK);

iii) Environmental management of highly-polluted bays in the Wider Caribbean (case study: Bay of Cartagena) (INDERENA, UNEP, PAC, UNDP, UNESCO);

iv) Monitoring of household, industrial and agricultural sources of pollution (case study: Caribbean coast of Colombia) (INDERENA, IOCARIBE, Marine Pollution Assessment and Control Programme for the Wider Caribbean Region (IOC CEPPOL programme);

v) Study of the basis for pesticide pollution and formulation of measures for monitoring it (case study: Virgin's Marsh);

vi) Surveillance and monitoring of the quality of coastal waters used for recreational purposes and shellfish farming (case study: recreational zones in the immediate Cartagena area and nearby) (INDERENA, CENTRE FOR OCEANOGRAPHIC AND HYDROGRAPHIC RESEARCH (CIOH), IOCARIBE, Marine Pollution Assessment and Control Programme for the Wider Caribbean Region (IOC CEPPOL programme)

vii) Elaboration of criteria for environmental quality (case study: estuarine ecosystems) (INDERENA, IOCARIBE, IOC CEPPOL programme);

viii) Programme for surveillance of oil pollution in the Wider Caribbean (CARIPOL Colombia) (DIMAR, CIOH, COLOMBIAN FUND FOR SCIENTIFIC RESEARCH AND SPECIAL PROJECTS (COLCIENCIAS), OAS, IOCARIBE);

ix) Project for monitoring floating solid wastes (garbage) in the Colombian Caribbean (DIMAR, CIOH, IOCARIBE);

x) Study of mangrove ecosystems for the Caribbean area (DIMAR, CIOH, IOCARIBE);

xi) Environmental study of the area of influence of the Bay of Cartagena (INDERENA, CIOH, UNIVERSITY OF CARTAGENA, INDUSTRIAL DEVELOPMENT INSTITUTE (IFI));

xii) Study of artificial reefs for the rehabilitation of coral ecosystems around the Rosario islands (CIOH, INDERENA, JORGE TADEO LOZANO UNIVERSITY, PUNTA DE BETIN INSTITUTE FOR MARINE RESEARCH (INVEMAR), COLCIENCIAS);

xiii) Studies of marine concretion (electrolytic depositing of carbonates on metallic surfaces) (CIOH, INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (IDRC), DIMAR);

xiv) National pilot programme for school recycling (INDERENA, PRESIDENT'S OFFICE).

Endnotes

1/ See Hinestrosa, 1982; Escobar and Astrálaga, 1981, INDERENA, 1988.

2/ Without attempting to review all the information available, the main water pollution problems in Cartagena can be summarized in 10 to 20 pages, as can be seen in Colombia's presentation in United Nations Environment Programme (UNEP) et al. (1990) or National Institute for Renewable Natural Resources and the Environment (INDERENA) (1988).

3/ Based on lists provided by the Cartagena Chamber of Commerce for this report.

4/ INDERENA should have complete information in its files, since large enterprises are legally obliged to report on their decontamination equipment and provide information quarterly on the volume of their discharges.

5/ Despite, or because of, the many studies done, there is still disagreement about how much each source contributes and what are the best solutions. Thus, in the study done by the Mamonal Foundation (1989), figures from INDERENA itself (op.cit., p.179) were used to state that industry is responsible for less than 5% of the organic matter and 6% of the nutrients dumped into the Bay of Cartagena.

6/ The volume of wastewater, and therefore of pollution loads, are less than that according to officials of the Municipal Public Enterprises of Cartagena.

7/ It is not clear how the person interviewed for this section considers the Dow episode of 1989 or that of the Greek ship in 1984. See the chapter on toxic and hazardous wastes.

8/ According to the Association for the Caribbean and Adjacent Regions of the Intergovernmental Oceanographic Commission (IOCARIBE), an international programme was recently established to assess this situation and provide the main Caribbean ports, including Cartagena, with an environmental-related infrastructure.

9/ The following should be mentioned: Pagliardini et al. (1982), "Proyecto Bahía de Cartagena"; the programme carried out in 1978 and 1979 by the Centre for Oceanographic and Hydrographic Research (CIOH); Regional Council for Planning and the Development of North Bolívar (CRPDNB) (1983), "Estudio Integral de Contaminación de la Bahía de Cartagena y su Area de Influencia"; F. Galeano et al. (1980), "Contaminación de la Bahía de Cartagena", Institute for Technological Research, Bogotá; Other more narrowly-focused or smaller studies are: CETIH (1987); INDERENA (1984); Garay Tinoco (1986,1987); National Institute of Health (1981); Barón Porras et al. (1984); Swedish Water and Air Pollution Research Institute (1978) and others listed in the bibliography at the end of this document.

10/ That is not true in every case. For example, the CRPDNB study (1983) found values for pH, copper, iron, arsenic and temperature which did not indicate the presence of pollution processes.

11/ Criteria for water quality are set in Colombia by Decree 1594 of 1984, in articles 42, 43 and 45.

12/ An annex to this report includes the pull-out of the Scientific Bulletin No.4 of CIOH, which gives the measurements taken in the Bay of Cartagena Project.

13/ A maximum of 1000 nmp/ml is recommended for direct contact.

14/ Besides the above-mentioned CRPDNB study, other studies that specifically analyse the environmental situation of the Marsh of the Virgin are: J.H. Rizo Pombo & Company, Ltda. (1982) "Estudio de Soluciones de Saneamiento de la Zona Sur-Oriental y el Corregimiento de Pasacaballos", two volumes; CHS, J.H. Rizo Pombo (1983), "Estudio Actual del Sistema Bahía Interna, Caños y Lagos y Ciénaga de Tesca. Orígen de su Deterioro y Alternativas de su Recuperación"; INDERENA, Centre for Environmental Research (1987), "Estudio del Impacto Ambiental por la Construcción del Anillo Vial de Cartagena sobre la Ciénaga de la Virgen", three volumes; CHS (1989), "Estudio Integral del Problema de Contaminación en la Bahía de Cartagena"; INDERENA-INGEMASTER, Ltda. (1990), "Evaluación ambiental y criterios sobre la modelación ambiental de la Ciénaga de la Virgen en Cartagena".

15/ Among the studies that have assessed the environmental situation of the canals, lakes and lagoons are: CRPDNB (op. cit.); FONADE-HIDROTEC-EDURBE (1984), "Proyecto para el Mejoramiento del Sistema de Caños, Lagunas y Ciénagas", six volumes; A. Barón Porras et al. (1985), "Estado Actual del Sistema Bahía Interna, Caños y Lagos y Ciénaga de Tesca. Orígen de su deterioro y Alternativas de su Recuperación", INDERENA.

16/ Meteorological data are from Estinco Ltda. (1988).

17/ See Ministry of Public Health-PAHO-Municipal Public Enterprises of Cartagena (1979); Bolívar Technological Corporation (1983); Meresco Ltda. (1985); Municipal Public Enterprises of Cartagena (1990), and Municipality of Cartagena (1991).

18/ INDERENA has disaggregate information for each of some 15 enterprises in Mamonal.

19/ Interview with Benjamín Alvarez and Orlando Jimenez, 5 June 1991.

20/ According to the Ministry of Health study (1979), income from selling recyclable materials came to one peso per day per capita, which was approximately equivalent to a minimum wage at that time.

21/ For example, the Mamonal Foundation study points out that, except for particular matter, in the Momonal industrial zone no measurements are taken to control the efficiency of the air pollution control systems installed in enterprises.

22/ Measurements of oils and grease in the sewerage system in the early 1980s showed 110 mg/l, CRPDNB (1983).

23/ The Mamonal Foundation study (1989) finds that 11 of 19 responding enterprises declare that they need no sanitation authorization to manage solid wastes; six state that they need no license for gas emissions and four for liquid wastes.

24/ In the following two years, Dow has carried on an active campaign for environmental control and communication, both within and outside its plant. In June 1991, the company organized a week of environmental education in the Mamonal zone and is preparing a programme of domestic sanitation in the neighbourhood of Pasacaballos.

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ANNEXES

Annex 1

MAIN ENTERPRISES IN CARTAGENA

1. Abonos de Colombia ABOCOL
2. Agafano
3. Aireco (air conditioning)
4. Alcalis de Colombia ALCO (chemicals)
5. Amoníacos del Caribe S.A. - AMOCAR
6. Astilleros Vikingos
7. Astilleros Cartagena
8. Bloques y Prefabricados Ltda.
9. Briths Caribbean Tradings (foodstuffs)
10. Cabarria y Cía.
11. Cabot Colombiana S.A. (carbon black)
12. Cartagena Shrimp Company (foodstuffs)
13. Cía. Industrial y Comercial de Polímeros S.A. (polyolefins
14. Ciba Geigy Colombiana S.A.
15. Colclinker (cement)
16. Coltimar del Caribe Ltda.
17. Conastil (shipyard)
18. Concretos del Caribe
19. Curtiembre Matteucci (tannery)
20. Dow Chemical of Colombia
21. Ecopetrol (oil refinery)
22. Electrificadora Bolívar S.A.
23. Empresas Municipales de Cartagena (public services)
24. Fantasy Internacional (imitation jewelry)
25. Ferrocem S.A. (transport material)
26. Frigopesca (food products)
27. Frigorífico Industrial de Cartagena
28. Frutexpo (foodstuffs)
29. Hielos Cartagena y Cial Ltda. - HIELOCAR
30. Industria de Grasas de la Costa S.A. (eatable oils) 31. Industria Harinera de Murra
32. Industrias Químicas Razanli Ltda.
33. Industrias Metálicas del Caribe - INMECAR (machinery)
34. Industrias Román S.A. (soft drinks)
35. Intecol (electricity)
36. Jabonería del Caribe S.A.
37. Jaime Ochoa (latex products)
38. Líquido Carbónico Colombiano S.A.
39. Mademac Ltda. (wood)
40. Mariquímica Ltda.
41. Marquímica chemicals, disinfectants and softeners)
42. Nukote (office supplies)
43. Océanos S.A.
44. Oxígeno Optimo 02 Ltda.
45. Pesquera Internacional Ltda.
46. PAAD
47. Petroquímica Colombiana S.A. (plastics)
48. Procesadora de Leche del Caribe
49. Perfumería Lemaitre
50. Polymer
51. Poyban (containers)
52. Société Forestière Multibois (wood)
53. Super Protel Pinturas
54. Tecnoají (foodstuffs)
55. Thermocar (refrigeration)
56. Van Leer Envases de Colombia S.A.
57. Vikingos de Colombia S.A.
58. Williams (diesel motors)

Annex 2

INFORMATION FROM 12 ENTERPRISES ON WASTE PRODUCTION AND TREATMENT
Source: INDERENA

USER: ABOCOL
ACTIVITY: Chemical fertilizers
RAW MATERIALS:

Nitric acid
Ammonia
Phosphoric rock
Ammoniacal phosphate

FINISHED PRODUCTS:

WASTES GENERATED DAILY:

		Quantity (Kg/day)
LIQUIDS:	Suspended solids	71.0
	Ammonium	42.0
	Nitrites	1.5
	Nitrates	10.0
	Soluble orthophosphates	7.0
	Total phosphate	13.1
	Biochemicalx oxygen demand (BDO 5)	2.6
	Chemical oxygen demand (COD)	9.9
	Fats and oils	0.3
SOLIDS:	Sawdust mixed with fertilizers	300
	Damaged packaging	

GASES: Emissions of gases and particles into the atmosphere and their sources are as follows:

Substances	Quantity (Kg/day)
In the smokestack of the reactors:	
Particles	106
Ammoniac	1,416
Nitrous gases	517.9
In the smokestack of granulator A: Particles	181.7
In the smokestack of granulator B: Particles	109.9
In the smokestack of the cooler: Particles	95.3

WASTE TREATMENT:

- Two cyclones in series at the discharge point of each of the granulators, designed for 85% to 95% efficiency.

- Two cyclones in series at the discharge point of of the cooler, with an efficiency rate of 85% to 95%.

- A gas scrubber for the emissions of the reactors.

- A system proportioning urea solution up to 30% in weight. The nitrogen oxides generated by reactor N° react with the urea solution to form nitrous acids that are later neutralized in the process.

USER: AMOCAR

ACTIVITY: Production of ammonia and nitric acid

RAW MATERIALS:

	Quantity
Natural gas	2,553,158 MMBTU/year
Water	1,531,000 m^3/year

FINISHED PRODUCTS:

	Quantity (Metric tons/year)
Ammonia	100,000
Nitric acid	36,000

WASTES GENERATED DAILY:

		Quantity (Kg/day)
LIQUIDS:	Suspended solids	113
	Ammonium	56
	Nitrites	2.1
	Nitrates	24.1
	NK	184.3
	Soluble orthophosphates	0.9
	Total phosphorous	2.5
	Total chromium	0.6
	Biochemical oxygen demand (BDO 5)	14.5
	Chemical oxygen demand (COD)	69
	Fats and oils	20
SOLIDS:	None	
GASES:	Nitrous gases	450

WASTE TREATMENT:

LIQUID: Three settling tanks
API separator
Pond for neutralizing acids and bases

GASES: Spray separator
Tower to absorb condensation of nitrous oxides

USER: CABOT

ACTIVITY: Production of carbon black

RAW MATERIALS:

	Quantity
Arotar	400 barrels/day
Natural gas	821 MMBTU/day

FINISHED PRODUCTS:

	Quantity
Carbon black	40 metric tons/day

WASTES GENERATED DAILY:

		Quantity (Kg/day)
LIQUIDS:	Suspended solids	1.84
	Total nitrogen	0.63
	Total phosphorous	0.001
	Biochemical oxygen demand (BDO 5)	1.4
	Chemical oxygen demand (COD)	2.06
	Fats and oils	2.45
	Surface-active agents	0.26
	Volume	52.2 m^3/day
SOLIDS:	Plastics	1,280 total
	Paper	
	Cardboard	
	Wood	
	Cloth	
	Carbon black sludge	20 kg/day
GASES:	Gases CO_2	4.5%
	CO	8.5%
	C_2H_2	0.5%
	CH_4	0.5%
	H_2	10.5%
	N_2	71.0%

WASTE TREATMENT:

LIQUID: Sedimentator
Anaerobic digestor
Separator and collector of oils and fats

GASES: Separator filters and vibrators for cleaning balls.

USER: ALCALIS DE COLOMBIA

ACTIVITY: Production of sodium carbonate, caustic soda, refined salt (iodized and fluoridated)

RAW MATERIALS:

	Quantity
Salt	
Chalk	
Liquid ammonia	
Sodium sulfide	
Carbon dioxide	

FINISHED PRODUCTS:

	Quantity (Metric tons/year)
Sodium carbonate	
Refined salt	
Caustic soda	

WASTES GENERATED DAILY:

	Quantity	
	Cospique	Casimiro
LIQUIDS:		
Total suspended solids (mg/l)	167	72.5
Settleable solids (g/l)	100.7	16.5
Chlorides (g/l)	46.4	10.4
NKT (mgN/l)	13.9	145.9
Total phosphorous (mgP/l)	0.16	0.32
Total hardness (mg $CaCO_3$)	42.5	1.9
Biochemical oxygen demand (BDO 5) (mg/l)	2.9	2.9
Calcium (mg/l)	16.9	773.0
Nitrites (mgN/l)	0.7	1.9
Nitrates (mgN/l)	0.8	0.5
Ammonium (mgN/l)	1.9	4.6

SOLIDS:

From the restaurant	450 kg/day
From the office and plant	2,000 kg/day
From the plants	variable

WASTE TREATMENT:

LIQUID: Settling tank

SOLIDS:
- Raw and processed material: sold to a contractor
- Paper, plastics, grass: disposed of in municipal dump
- Wastes from the plants: disposed of in company dump
- Scrap: placed in yard
- Fines and ballast: disposed of in the chalk wash bed

USER: DOW CHEMICAL OF COLOMBIA

ACTIVITY: Production of herbicides and pesticides

WASTES GENERATED DAILY:

LIQUIDS:

	Quantity (mg/l) Styron plant	Agrochemical plant
T.S.S.	4.8	12.4
Ammonium	0.22	1.11
Nitrite	0.018	0.052
Nitrate	0.038	0.189
NKT	2.55	4.87
Soluble orthophosphate	0.016	0.123
Total phosphorous	0.052	0.235
Oil and grease	19.9	14.4
Surface-active agents	7.87	5.84
Polynuclear aromatics	0.003	0.002
Mononuclear aromatics	0.0003	0.0002

SOLIDS:

	Metric tons/day
Cardboard	1.6
Wood	0.2
Metal	0.1
Plastic	0.03
Chemical wastes (hydrocarbons, agrochemicals, polyols, laboratory wastes)	1.06
Incinerator ashes	0.03

GASES:

	Kg/day
Carbon dioxide	120,819
Steam	99,072
Hydrocarbon aromatics (styrene)	
Ethylene and propylene oxides	

WASTE TREATMENT:

SOLIDS:

Office wastes: municipal garbage
Plant wastes: incinerator
Wood: recycled
Metal: Cleaned up and sent to foundry
Chemical wastes: incinerator

GASES:
Oxides: absorption scrubber

USER: DEXTON, S.A.

ACTIVITY: Production of polystyrenes

RAW MATERIALS:

	Quantity
Monomer styrenes (metric tons/day)	27
Ethyl benzol (metric tons/day)	0.007
Mineral oil (metric tons/day)	0.77
Blue tone L (kg/day)	0.4
Polybutadiene (metric tons/day)	2,041
Zinc stearate (kg/day)	20.48
Irganox (kg/day)	18

FINISHED PRODUCTS:

	Quantity (Metric tons/year)
High impact styrene	6,667
Common polystyrene	3,333

WASTES GENERATED DAILY:

LIQUIDS:

	Quantity	
Ph	8.14	
Temperature	31.0	
Settleable solids	6.6	mg/l
Biochemical oxygen demand (BDO 5)	11.6	mg/l
Chemical oxygen demand (COD)	17.4	mg/l
Ammonium	0.235	mg/l
Nitrite	0.029	mg/l
Nitrate	0.400	mg/l
NKT	6.37	mg/l
Oil and grease	9.2	mg/l
Volume	20	l/day

WASTE TREATMENT:

LIQUIDS:

API-type skimmer

USER: COLCLINKER

ACTIVITY: Production of cement and clinker

RAW MATERIALS:

	Quantity
Chalk	800,000 metric tons/year
Clay	200,000 metric tons/year
Gypsum	45,000 metric tons/year

FINISHED PRODUCTS:

	Quantity (Metric tons/year)
Cement	700,000
Clinker	600,000

WASTES GENERATED DAILY:

	Quantity (Kg/day)
SOLIDS:	
Paper	6
Wood	5
Metal	500
Dust (kg/ton of cement)	1.2

GASES:

	Furnace 1 and 2	Furnace 3
	(m^3/second)	
CO_2	21.8	22.5
Nitrogen	75.7	75.9
O_2	2.5	1.6

WASTE TREATMENT:

SOLIDS:

Paper: burned
Wood: burned
Metal: to foundry for recycling
Dust: electrostatic filter

USER: FRICOPESCA, S.A.

ACTIVITY: Slaughterhouse

RAW MATERIALS:

	Quantity
Cattle (head)	250
Beef (kg/day)	1,260
Fish (metric tons/day)	5

FINISHED PRODUCTS:

	Quantity (Metric tons/day)
Butchered beef	1.2
Fish (fillet and whole)	1.0
Unprocessed fish	3.33

WASTES GENERATED DAILY:

LIQUIDS:

	Quantity
Oil and grease (mg/l)	47.4
Volume (m^3/day)	404.8

WASTE TREATMENT:

LIQUIDS:

Filtering and pumping
Anaerobic tank
Chlorination tank

USER: CORELCA

ACTIVITY: Generation of electric energy

RAW MATERIALS:

	Quantity
Natural gas (cubic feet/day)	36×10^6

FINISHED PRODUCTS:

	Quantity
Kilowatts/hour/year	1×10^9

WASTES GENERATED DAILY:

	Quantity
LIQUIDS:	
Cooling water (m^3/day) Temperature 55°C	216
Volume (m^3/day)	216

WASTE TREATMENT:

LIQUIDS:

Neutralization basin

USER: INDUSTRIA LICORERA DE BOLIVAR

ACTIVITY: Production of liquors

RAW MATERIALS:

	Quantity
Unprocessed honey (metric tons/day)	40

FINISHED PRODUCTS:

	Quantity
Liquor (m^3/day)	30

WASTES GENERATED DAILY:

	Quantity (ml/l)
LIQUIDS:	
Suspended solids	963
Biochemical oxygen demand (BDO 5)	20,333
Chemical oxygen demand (COD)	15,266
Ammonium	12.62
NKT	251
Total nitrogen	263
Total phosphorous	8.09
Chlorides	319.1
Sulphates	552.7
Temperature	55°C
Volume (m^3/day)	284.3

WASTE TREATMENT:

USER: PURINA COLOMBIANA, S.A.

ACTIVITY: Production of concentrated animal feed

RAW MATERIALS:

	Quantity (Metric tons/day)
Grains	7
Flours	18
Cakes	9
Feed	0.2
Molasses	2.2
Minerals	12

FINISHED PRODUCTS:

	Quantity
Concentrates for animals (metric tons/day)	60

WASTES GENERATED DAILY:

	Quantity
LIQUIDS:	
Water from domestic use (lt/second)	0.6
Water from boilers and basement	
SOLIDS:	
Domestic refuse (metric tons/day)	1

WASTE TREATMENT:

USER: HOECHST COLOMBIANA, S.A.

ACTIVITY: Production of surface-active agents

RAW MATERIALS:

	Quantity (Metric tons/year)
Ethylene oxide	1,300
Propylene oxide	150
Nonene	280
Phenol	220
Lauryl alcohol	270
Castor oil	40
Xylole	130

FINISHED PRODUCTS:

	Quantity (Metric tons/year)
Etoxilated noniphenols	1,930
Etoxilated fatty alcohols	755
Block polymers	641
Nonilphenol	635
Merda products	200

WASTE GENERATED DAILY:

	Quantity (Metric tons/year)
LIQUIDS:	
Reactor wash water	0.020
Wastewater	0.020
SOLIDS:	
Packaging, cardboard, plastic	0.050
Chemicals	0.010
Ashes	0.030
GASES:	
Generated	0.005
Steam	0.020
CO_2 and steam	0.040

WASTE TREATMENT:

SOLIDS: Incinerator

LIQUIDS: Incinerator
Septic tank

GASES: Scrubber

Annex 3

HEAVY METALS AND ORGANOCHLORIDE PESTICIDES IN THE BAY OF CARTAGENA

A. HEAVY METALS

The study of heavy metals is very important for the whole problem of pollution, if we consider the toxic impact of some of these metals on organisms.

i) Total mercury in water: The normal level of mercury found in sea water is considered to be between 0.1 y 0.3μg Hg/l, generally in the form of a soluble complex anion $(HgCl_4)_2$, although it can also be found in organic form absorbed in particles of sediment.

Mercury can also accumulate in organisms in the form of methyl mercury, which is the organic form which metallic mercury can take in a marine environment.

During the dry season (December to April), the highest concentrations were found in the southern sector, especially station 37, with concentration levels of 2.0 μg Hg/l, and station 31, with concentrations of 1.4 μg Hg/l.

Observing the horizontal distribution during the rainy season (August-November), there are three large focal points of mercury dispersion in surface waters: the first and largest at station 3, with average levels of 1,455 μg Hg/l; the second at station 36, with 1,180 μg Hg/l and the third at station 40 at the mouth of the Canal del Dique.

It is important to note that the highest concentrations are found in the south-east part of the Bay, that is, in the Mamonal industrial zone and the Canal del Dique.

An analysis of a vertical cross section of the Bay from north to south shows that the Canal del Dique at this time is the main factor of mercury distribution, because of the large quantity of suspended particles in its waters. There is also movement from the bottom to the surface, that is, from sediment to water, especially in sites like station 33; this movement is greatly intensified by changes in the physical and chemical characteristics of the interphase between sediment and water.

ii) Copper in solution: Copper is indispensable for life, but in high concentrations it becomes a highly dangerous toxic for aquatic organisms. Normal levels can be below 0.05 mg/l for sea water (Mekee), which is the maximum allowable level, whereas the normal level is 0.0003 mg/l (Goldberg).

It can be precipitated as carbonate, causing the alkalinity in some cases to reach toxic levels.

During the dry season (December to April), concentrations increase considerably throughout the Bay. The highest values were found in the southern and south-eastern part of the Bay, at station 38 with 0.666 mg/l, and stations 35 and 36, with 0.051 and 0.054 mg/l, respectively, in the Mamonal area.

Generally, during the dry season the concentrations of copper are above normal, just passing the toxic level at the above-mentioned stations.

It can be observed in the vertical cross section that the largest source of copper is the Canal del Dique, with the highest concentrations being transported to the bottom by the currents, producing a slight dilution towards the centre of the Bay and a deposit of copper with particles of sediment (Turbiditas).

During the rainy season (August to November), the highest concentrations of copper are found at station 40 or at the mouth of the Canal del Dique, con 0.01 mg/l; the Pegasos dock, with concentrations of 0.016 mg/l, and the area at station 3 around the Navy base, with 0.0012 mg/l. Other heavy concentrations are found at stations 11 and 13, with 0.009 mg/l and 0.008 mg/l, respectively.

The vertical distribution of copper for this season shows the Canal del Dique with the highest quantity of copper in suspended particles, which tend to move to middle levels and the bottom. Other sources of copper exist at station 31, where concentrations of 0.0138 mg/l were found, with a distribution or dispersion towards the surface.

iii) Zinc in solution: Zinc salts are used in several industries and are highly soluble in water. Therefore, they can be expected to be found in industrial wastes.

The normal concentration in the oceans is 0.002 mg/l, and in rivers 0.02 mg/l.

During the dry season (December to April), the highest surface concentrations (0.5-o.6 mg/l) are found along the coast of Barú Island, from the Canal del Dique to the Boca Chica. The concentrations diminish further north, with the lowest (0.1 mg/l) near the entrance to Boca Grande.

At middle (10 metres) and deep (20 metres) levels, the distribution of the concentration tends to be similar to that at the surface. Also, near the mouth of the Canal del Dique, the concentration increases at deeper levels, but towards the north

side of the Bay, the concentration at the bottom begins to be equal to that at the surface.

During the rainy season (August to November), the highest concentrations at the surface are found at the mouth of the Canal del Dique (0.11-0.08 mg/l) and at the ARC Bolívar Navy base (0.09 mg/l). Concentrations tend to be unevenly distributed throughout the Bay, with the lowest (0.02 mg/l) in some areas of the east coast.

At middle (10 metres) and deep (20 metres) levels, the distribution of concentrations is rather irregular. Generally, the average concentration of zinc during the dry season is approximately five times that of the rainy season (0.04 mg/l).

iv) Iron in solution: The main source is corrosion. It can be found in industrial and domestic wastes. The normal levels recommended by International Standards (2328) allow for maximum concentrations for industrial wastes of 0.3 mg/l.

During the dry season (December to April), the highest concentrations at the surface level (>0.5 mg/l) are found at the mouth of the Canal del Dique. Concentrations weaken further north. The lowest concentrations (<0.05 mg/l) are found to the south of the inland Bay (Islas del Diablo and Manzanillo).

At the medium (10 metres) and deep (20 metres) levels, the distribution of concentrations tends to be irregular, especially at the bottom. An area of high concentration is station 38 (>1.5 mg/l).

During the rainy season (August to November), the highest concentrations at the surface (>0.02 mg/l) are around station 28. Concentrations diminish in the entrances to Boca Chica and Boca Grande, where they vary between 0.03 mg/l and 0.05 mg/l.

At the medium (10 metres) and deep (20 metres) levels, the distribution of concentrations is similar to that at the surface, with a slight tendency to increase in deeper water.

Normally, the average concentration of iron during the dry season is approximately twice as great as during the rainy season (0.1 mg/l).

B. ORGANOCHLORATED PESTICIDES IN THE BAY OF CARTAGENA

Organochlorated pesticides constitute an important type of marine pollutant. The use of these compounds as pesticides in agriculture and public health leaves traces of them in the air, crops and foodstuffs. Compounds like DDT, Aldrin and Heptachloro-Epoxide contain different chemicals in significant proportion that affect the marine ecosystem in different ways.

These substances are commonly used in Colombia in agriculture and sanitation. The most common means of application is crop dusting from aeroplanes. Some reaches the targeted area; the rest is dispersed in the air and is carried to the sea by floods, evaporation, winds, erosion, and rainfall run-off from rocks.

Of the pesticides analysed during the first sampling (October 1980, rainy season), concentrations were found of Aldrin, Heptachloro-Epoxide, Endrin, O.P'-DDT, OP'-DDE AND P.P'-DDE, in a range from 0.0005 to 0.302 ng/l (parts per trillion or nanograms per litre). Of the 11 stations studied, only five showed positive results, and an important observation is that four of them are at the northern end of the Bay and the other one in the Mamonal industrial zone. The highest concentrations of Heptachloro-Epoxide (0.302 ng/l) and Endrin (0.244 ng/l) were found at station 8 and that of Aldrin (0.133 ng/l) at station 5.

During the second sampling (January 1981, dry season), concentrations of O.P'-DDE, Endrin, O.P'-DDT and P.P'-DDT were found in a range of 0.020 to 0.322 ng/l, at stations 8 and 40 at the surface and at stations 5 and 37 at the bottom. The highest concentration was of Endrin (0.322 ng/l), detected a 0.5 metre at the mouth of the Canal del Dique (station 40) and O.P'-DDE and P.P'-DDD at eight stations in the Bay, in a range of 0.0002 to 0.020 ng/l. Only stations 2, 5 and 34 showed negative results. Concentrations for the different pesticides diminished significantly in relation to previous samplings. This is the time of year with the lowest concentrations.

Analysing the three seasons together, during the rainy season, the average high concentrations were detected and localized in the northern area of the Bay.

Annex 4

COMPONENTS OF THE LEGAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

1. Natural Resources Code - NRC

Issued by decree 2811 of 1974, based on the powers granted the President of the Republic by law 23 of 1973. The NRC is divided into two volumes.

Volume one establishes the elements that comprise the environment and overall environmental policy. The second volume refers to property and the use and environmental impact of renewable natural resources.

Surveillance, control and management of natural resources and the environment in the city of Cartagena and its rainfall and marine environment are carried out on the basis of certain regulatory decrees, the more important of which are the following:

- Decree 1449/77, which spells out the obligations of shoreline property owners with respect to the conservation, protection and use of water.

- Decree 1541/78, which regulates the use and management of non-maritime waters and sand and gravel.

- Decree 1741/78, which creates the Special Management Area of the Canal del Dique and the Bay of Cartagena.

- Decree 1594/84, which regulates the use of water and liquid wastes, and establishes criteria for surface, ground, marine and estuarine water quality, including wastewater. It also establishes which substances are important for sanitation, the methods for monitoring the disposal of those substances, admissible quality standards for disposal of the affected resource, the legal procedure for a user to obtain a dumping permit and sanitation authorizations, and sanctions and fines.

Decree 2811 of 1974 establishes in article 27 that every natural or juridical person, public or private, that plans to actually carries out a work or activity likely to impair the environment is obliged to declare the presumed danger resulting from the work or activity. Article 28 stipulates that a prior ecological and environmental study must be presented and a permit obtained.

2. National Sanitation Code - NSC

The National Sanitation Code was established by law 09 of 1979, especially the section on environmental protection, which has

provisions on sanitation monitoring of water uses; liquid wastes, solid wastes, sewage disposal, air emissions and receiving areas.

Some of the important regulations of this law are:

- Decree 1601/84, with provisions on port sanitation; the Ministry of Health is the responsible agency.

- Decree 2104/83, which regulates the management of solid wastes.

- Decree 2105/83, which deals with drinking water.

- Resolution 0821/83, which controls environmental noise.

3. National maritime legislation

The following regulations are contained in national maritime legislation:

- Decree 2349 of 1971, which creates the Maritime and Port Authority (DIMAR), with the objective, among others, of overseeing the country's maritime research.

Law 10 of 1978, which dictates rules on the territorial sea, exclusive economic zone, continental shelf and other provisions. This law was regulated by the following later decrees:

- Decree 1874/79, which establishes the Coast Guard and other provisions. Of interest here is its function mentioned in article 20, paragraph 5, which reads "protect the marine environment against pollution".

- Decree 1875/79, which provides rules on the prevention and monitoring of pollution of the marine environment and other provisions.

- Decree 1876/79, which adopts measures dealing with natural marine resources.

- Decree 1877/79, which regulates the integral use of the marine environment.

- Decreè 2324 of 1984, which reorganizes the Maritime and Port Authority (DIMAR), in charge of regulating and monitoring all maritime activities. These activities include the following with environmental significance: use, protection and conservation of shorelines; scientific marine research in all its disciplines; exploration, exploitation and prospection of natural resources in the marine environment; nautical sports and recreation; conservation, preservation and protection of

the marine environment, and ocean filling, dredging and engineering works.

On the basis of this decree, DIMAR issued resolution 438/86, which regulates the use of beaches in the Municipality of Cartagena.

Law 01 of 1991, the new maritime ports statute, established that the Maritime and Port Authority will from now on be called the Maritime Authority, and that all port activities will be the responsibility of the Port Authority. It also provides for environmental authorities to participate in the process of granting port licenses.

4. International agreements dealing with the sea

In 1972, Colombia signed the London Dumping Convention, still unratified, and through law 12 of 1981, approved the International Convention for the Prevention of Pollution from Ships, signed in London in 1973, and the corresponding protocol of 1978. That instrument has five annexes, which are currently be expressed as regulations by DIMAR consultants, namely:

- Annex 1: Rules to prevent oil pollution (standing inter-agency committee).
- Annex 2: Rules to prevent pollution by harmful liquid substances transported in bulk.
- Annex 3: Prevention of pollution by harmful substances transported in packages.
- Annex 4: Prevention of pollution from ships' wastewater.
- Annex 5: Prevention of pollution from ships' garbage.

In 1983, Colombia also signed in Cartagena the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region and the Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region, under the direction of the United Nations Environment Programme (UNEP), and signed the United Nations Convention on the Law of the Sea in Jamaica on 10 December 1982.

5. Mining Code

The Mining Code was issued through decrees 2655, 2656 and 2657 of 1989. In Section XXVI, entitled "Environmental conservation", the Ministry of Mining and Energy is given the role of overseeing and monitoring renewable natural and environmental resources involved in mining. With decree-law 501 of 1989, which restructured the Ministry of Agriculture, these functions were returned to INDERENA.

6. Anthropological and historical heritage

The Colombian Institute of Anthropology was given the functions of conserving and defending the nation's historical and artistic heritage and its public monuments, through a series of regulations, the most important of which are the following laws: 47 of 1920, 14 of 1936, 812 of 1961, 44 of 1967, 1118 of 1970 and 154 of 1976.

7. Application regulations

With decree-law 1333 of 1986, the national Government adopted a new code of municipal government (the previous one was based on law 4 of 1913), whose articles contained regulations on urban construction and plans to prevent the deterioration of the urban environment and guarantee the well-being of its citizens.

Law 9 of 1989, on urban reform, concretely spells out some environmental issues of decree-law 1333 that are worth mentioning:

- The aspects that should be included in the development plan of every municipality are defined. Zones should be included for environmental and ecological protection; areas of high risk for the population should be identified, and the population should be protected or relocated.

- The use of public areas is defined and regulated, including sites needed for the preservation and conservation of marine and river beaches, tidal areas, etc.

- Establishes community action as the means to defend public spaces and the environment.

- Regulates the acquisition or expropriation of sites for social projects and for the protection of the environment and water resources.

The Municipal Council passed agreements Nos. 44 and 45 of 26 December 1989, adopting the Cartagena Development Plan for 1989-2010, with the following articles:

- Articles 25 to 36: Areas are designated for ecological reserves and environmental management, and their management and development are regulated.

- Articles 37-42: High-risk areas are defined.

- Articles 43-54: Special regulations are made for Islas del Rosario.

- Article 449: A certificate of environmental sustainability from INDERENA is required for a permit to subdivide land in a municipality.

8. Sanitation law for the waterways, lakes and marshes of Cartagena

Through law 62 of 1937, the National Congress ordered the central Government to clean, channel and define the waterways of Cartagena and to build embankments and urbanize the shores of the waterways and bays.

Later, through decree 07 of 1984, an order was given to clean up those same bodies of water and EDURBE was named as the agency in charge of doing so. Other government agencies were also assigned tasks for the same purpose.

9. The national Constitution

This aspect deserves mention because of its implications for the environmental future of Cartagena and the country. The National Constitutional Assembly was called to change the national Constitution that was in effect since 1886. It gave special attention to ecological and environmental aspects and the management of nature, with close to 40 articles related to these issues, not only as a duty of the State and private citizens, but also as a basic right of those citizens.

In this regard, the Constitution enshrines citizen participation in decisions affecting nature and the obligation to repair damage caused, and defines property as a social function that entails obligations, as such, having an inherent ecological function. To that effect, it establishes real links between the economy, culture, ecology and society, by imposing conditions for the national development plan and ensuring financing for the preservation of the environment. It obliges regulatory and monitoring agencies of the executive branch to take into account the assessment of environmental costs and present to Congress an annual report on the state of natural resources and the environment. It even grants the executive branch the power to declare a state of emergency when events threaten to disturb the economic, social and ecological order of the country.

Annex 5

FURTHER BACKGROUND INFORMATION ON SOME OF THE MAIN INSTITUTIONS INVOLVED IN ENVIRONMENTAL MANAGEMENT IN CARTAGENA

National Institute for Renewable Resources and the Environment (INDERENA)

INDERENA has three laboratories: biology, chemistry and bioassays. Its permanent staff consists of five scientists and six technicians. Two scientists and an assistant are also on contract. The budget for 1991 was 91,244,000 pesos (around US$145,000 at the current exchange rate), covering five investment projects. Annex 7 provides more detailed information.

SECTIONAL HEALTH SERVICE OF BOLIVAR

The Sectional Health Service of Bolívar includes a section on environmental sanitation, with two staff members, one technician and an assistant. It has two instruments to measure particles in suspension, but they are not used due to a lack of personnel to install and operate them.

MARITIME AUTHORITY (DIMAR)

The Port Authority has very limited infrastructure for surveillance. There are four inspectors and one boat in poor condition for two patrols a week in its area of jurisdiction and to respond to complaints presented to the Port Authority. The Navy provides the means for one air patrol a week.

CENTRE FOR OCEANOGRAPHIC AND HYDROGRAPHIC RESEARCH (CIOH)

This centre has four oceanographic ships, laboratories and technical and scientific personnel to carry out its projects. Part of its organization is the division to monitor marine pollution.

NATIONAL OCEANOGRAPHIC COUNCIL (NOC)

The members of the NOC are:

- Two representatives of the President of the Republic, who alternate in the presidency of the council every six months.
- Director General of DIMAR.
- Managing Director of INDERENA.
- Director General of the Institute for Research in Earth Sciences, Mining and Chemistry (INGEOMINAS).

- Director General of the Colombian Fund for Scientific Research and Special Projects "Francisco José de Caldas" (COLCIENCIAS).

- Assistant Director of the National Planning Department.

- Under-Secretary for Agencies and International Conferences of the Ministry of Foreign Affairs.

- Director of the Special Project for the Promotion and Development of Ocean-Related Sciences and Technologies (FONDEMAR).

- Director of CIOH.

- Director of the Centre for Technological and Marine Research of the Pacific (CENIPACIFICO), of the Colombian Navy.

- Director General of the Colombian Institute of Hydrology, Meteorology and Land Development (HIMAT).

- Director of the Colombian Institute for the Development of Higher Education (ICFES).

- President of the National University of Colombia.

- Manager of the National Institute for Fisheries and Agriculture (INPA).

BOLIVAR URBAN DEVELOPMENT ENTERPRISE (EDURBE)

The meeting of shareholders names a board of directors, which in turn appoints a managing director, who runs EDURBE with the assistance of technical, administrative and financial departments and a general secretariat. The staff consists of 10 professional personnel plus support personnel to carry out, among other activities, the city's Integral Plan for Environmental Sanitation, at a cost of US$44 million, the urban reorganization project, a study of the city's transportation system, with the help of a Japanese technical mission, and the management and operation of the city's tourist dock.

Annex 6

TIMETABLE FOR THE CONSTRUCTION OF DUMPS CALLED FOR BY INDERENA

First stage: Elaboration of the engineering programme and the timetable of activities: 18 months.

Second stage: Construction: 30 months.

Third stage: Verification of compliance with regulations governing dumps: 6 months.