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DRAFT COUNTRY REPORTS ON POLLUTION HOT SPOTS AND SENSITIVE AREAS

In collaboration with:

WHO

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INTRODUCTION

Late in 1996 the Global Environment Facility (GEF) approved a proposal made by the Secretariat of the Mediterranean Action Plan for the formulation of a Strategic Action Programme for the Mediterranean to address pollution from land-based activities.

The Strategic Action Programme (SAP) was prepared, based on a comprehensive Transboundary Diagnostic Analysis which also included the identification and assessment of problems and causes related to pollution hot spots and sensitive areas. Therefore, the starting point for the preparation of the SAP was the issue of hot spots and sensitive areas.

In this context, the WHO Office of the Coordinating Unit of MAP, within the framework of the Mediterranean Action Plan and, in particular, within the MED POL Programme, was given the responsibility to carry out the activities specifically related to the issue of "identification of pollution hot spots and sensitive areas".

The aim of the identification of pollution hot spots and sensitive areas was:

- to identify potential Mediterranean pollution hot spots in each Mediterranean country, based on the assessment of contaminants reaching the Mediterranean Sea from (a) coastal cities or urban coastal agglomerates with a population above 10,000 inhabitants (which of course depended on the country itself, taking into consideration the population, the number of large coastal cities and the particular problems that may also arise from a city with, for example, 80,000 inhabitants); (b) from main industries discharging directly into the sea; and (c) from selected rivers;

- to prepare a list of national priority hot spots which should have national priority for intervention in order to control or eliminate pollution in those hot spots;

- to propose national interventions required to address the problems and assess, wherever possible, their costs;

- to identify areas in each Mediterranean country which are particularly sensitive to damage from land-based activities.

More specifically, and based on the above, each country prepared a country report consisting of:

1. A proposed number of hot spots (an indicative number is around 5-6) which, judging from experience and knowledge, could be defined as such;

2. the collection of existing data on pollution loads from the proposed hot spots, in order to clearly indicate and justify their designation as hot spots. This was done by completing questionnaires specifically prepared for this purpose;

3. the preparation of a priority list of the hot spots using a ranking system, and the identification of the causes and remedial actions required to control or eliminate pollution;

4. the undertaking of similar tasks for the sensitive areas as outlined in 1, 2 and 3 above, but in a simplified yet informative manner;

5. the collection of existing data on pollution loads of some important rivers in the country.

The country reports containing the above-mentioned information presented in this document have been prepared by national teams headed by the government-designated national coordinator for the implementation of the Strategic Action Programme in each country. These national teams were supported by consultants whenever necessary.

The country reports were discussed at length and edited during a meeting attended by national coordinators and consultants. However, the versions contained in this document were finalized subsequent to comments and corrections received from the national coordinators.

In order to continue with the second phase of the GEF Project (i.e. the preparation of the pre-investment studies for rehabilitation of pollution hot spots), the country reports will be used as background information following revision and updating of the information contained therein.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

ALBANIA

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Prepared by: Mr Ante Barić

1. INTRODUCTION

Albania is a small country covering 28,748 km² and has approximately 3.3 million inhabitants. It is mostly mountainous with hills and mountains accounting for 2/3 of the territory. The coastal area opens to the Adriatic and Ionian Seas. The total length of the coastline is 476 km, of which 200 km in the north are on a coastal plain up to 50 km wide. All Albania's rivers belong to the Mediterranean watershed. The population of the wider coastal area is approximately 1.3 million, and two towns on the coast have more than 100,000 inhabitants: Durres in the northern part, and Vlora in the south, where the Adriatic and Ionian Seas meet. In the north, the town of Lezhe has around 50,000 inhabitants, and in the far south the town of Saranda has some 25,000 inhabitants.

From the end of World War II until 1990, Albania was virtually isolated from the rest of the world, which resulted in severe economic underdevelopment despite considerable natural resources. The social transformation that started in 1990 brought about economic changes. Practically all industries, which had been large-scale polluters, were closed down, but some of the dumping sites created earlier are still active and remain significant sources of pollution. However, the principal source of the coastal sea pollution is the urban wastewater discharged directly into the sea without any treatment, mostly through open canals and numerous outlets, as well as by the rivers.

Hot spots and sensitive areas were identified on the basis of analyses of available data, completed questionnaires, and direct contacts with the representatives of the Committee for Environmental Protection (CEP) and the SAP Focal Point during the visit to Tirana. Unfortunately, the amount of data available was rather limited. Moreover, those that were available do not usually reflect the actual situation as in the last few years considerable changes have occurred with regard to sources of pollution.

2. PROCEDURE FOLLOWED IN IDENTIFYING HOT SPOTS AND SENSITIVE AREAS

In order to identify hot spots, the given criteria were used, and the towns of Durres and Vlora, with more than 100,000 inhabitants each, were selected, together with the rivers of Drini, Mati, Semani and Shkumbini, with average flows greater than 30 m³/s. In addition, two locations in the vicinity of Durres and Vlora that had been used in the past for depositing toxic industrial waste were selected, as they represented a constant threat to the coastal sea.

Four lagoons (Kuna, Vain, Karavasta and Narta) of particular ecological interest (biodiversity, natural reserves, fishing) that could be threatened by possible future activities in their wider area were selected as sensitive areas.

3. CONTRIBUTION OF DIFFERENT SOURCES TO DEFINED HOT SPOTS OR SENSITIVE AREAS

Hot spots	Main sources of pollution	Principal supporting data extracted from the questionnaires
Durres	- Domestic	- BOD 2,864 t/y - N_{tot} 477 t/y - P_{tot} 95.5 t/y - TSS 4,300 t/y - FC 10^9col/100 ml
Vlora	- Domestic	- BOD 2,628 t/y- N_{tot} 438 t/y- P_{tot} 87.6 t/y- TSS 3,942 t/y- FC 10^9col/100 ml
Drini river	- Domestic - Industrial	- TSS 3,900 t/y
ex PVC factory in Vlora	Leakage from chloralkaline plant	Area of approximately 11 ha contaminated by elemental mercury
ex chemical factory, Lalzi Bay, Durres	Industrial solid waste	Deposit of approximately 20,000 t of solid waste containing 4-5% of hexavalent chromium

Sensitive areas	Main sources of pollution	Principal supporting data extracted from the questionnaires
Kuna-Vain lagoons	- Domestic - Industrial	
Karavasta lagoon	- Domestic	
Narta lagoon	- Agriculture runoff- water extraction	

4. PRIORITY HOT SPOTS AND SENSITIVE AREAS

The priority hot spots and sensitive areas are shown in the following table.

The town of Durres is located in the central section of the northern part of the Albanian coast. Owing to its geographical position, it has developed into the most important harbour in Albania. Long sand beaches spread south to the town and along them there are numerous houses, once used as holiday homes by State officials and now permanently populated by immigrants from inland. North of the town there are a number of industrial plants, most of which have ceased production, probably permanently. Most domestic wastewaters are collected by a sewerage system and discharged through an open canal into Lalzi Bay north of the town. The canal is also used to receive untreated industrial wastewaters A small amount of domestic wastewaters from some of the houses located along the beach is discharged without any treatment directly onto the beach through numerous small outlets.

Several kilometres north of the town there was a chemical factory that produced chromium salts and other products. The solid wastes were deposited within the factory premises so today there is a contaminated area of approximately 5 ha covered by some 20,000 t of waste containing 4-5 per cent of hexavalent chromium salts. In places the depth of the layer reaches up to 2 m. Rains wash away the chromium salts and transport them into the nearby sewer, and thus the chrome reaches the sea.

The priority hot spots and sensitive areas are shown in the table below:

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
HOT SPOTS													
Albania	Durres	Domestic	4	1	3	4	3	1	13.3	100	WWTP + reconstruction of a sewerage system	P, L, H	48 million
Albania	Vlora	Domestic	4	1	3	4	3	1	13.3	98	WWTP + reconstruction of a sewerage system	P, L, H	48 million
Albania	Drini river	Domestic Industrial	2	1	3	4	2	2	11.2		Study of pollution sources in the river basin	B, F	500,000
Albania	ex PVC factory - Vlora	Industrial	4	1	2	1	1	2	9.3	80	Sanitation of mercury-spoiled soil (See Chapter 6)	P	2 million
Albania	ex chemical factory - Durres	Industrial	4	1	5	1	1	2	11.4		Sanitation of toxic solid waste dumping site (See Chapter 6)	F, B, P	2-3 million

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
SENSITIVE AREAS													
Albania	Kuna - Vain lagoons	Domestic Industrial	2	1	4	1	1	2	7.7		WWTP + construction of a sewerage system with establishment of proper management	B, F	25 million 1 million
Albania	Karavasta lagoon	Domestic	2	1	3	1	1	2	8.0		Establishment of proper management with appropriate monitoring program	B, F	1-2 million
Albania	Narta lagoon	Agriculture water extraction	2	1	2	1	1	2	7.3		Dredging of outlet channel + establishment of proper management with appropriate monitoring programme	B, F	3-5 million

The town of Vlora is situated in the southern part of the country, on the coast of Vlora Bay. North of the town there are many industrial plants, most of which are not operational, while to the south there is a sandy beach. The urban wastewaters are collected by a separate sewerage system, and some 2/3 are discharged into the sea north of the town through an open canal, while 1/3 ends up into the sea south of the town through several outlets at the beach.

Vlora Bay is a semi-enclosed basin framed on the outside by the Karaburmi peninsula, while the opening is further reduced by the small island of Sazan. The bottom of the bay, between the town of Vlora in the east and Cape Galloveci in the west, is covered by *Posidonia oceanica* seagrass meadows, the most important in the country. Vlora Bay and its *Posidonia oceanica* seagrass meadows could be classified as a protected seascape, and part of it as a fishery reserve. The bay is threatened by the urban wastewaters of the population of approximately 200,000 living around it, especially since these are discharged into the bay without any treatment. Potentially, the bay could be further threatened by the effluents of industries that might develop in the area of Vlora town.

North of the town of Vlora, some 300 m from the sea, there was a PVC plant utilizing *inter alia* chloralcaline electrolysis with mercury as the cathode. During the period of operation, approximately 60 t of mercury were lost. Small quantities reached the sea, but most of it ended up in the soil, so that at present, elemental mercury can be found at depths of up to 1.5 m over a contaminated area of some 10 ha. In the immediate vicinity of the coast, the sea often becomes white in colour in patches of approximately 300x50 m, probably as a result of alkali leakage.

All Albanian rivers receive the urban wastewaters of the areas through which they flow without any treatment. Previously, they were also polluted by industrial wastewaters, but industrial pollution has now all but disappeared since industries have largely ceased production and there is little probability that production will be re-launched with the same equipment and technology used up until now. It is very important to point out that Albanian rivers have a significant impact on the ecology of the Southern Adriatic.

In the area between the mouths of the rivers Drini and Mati there are numerous lagoons. The best known are the Kuna and Vaini lagoons, with a surface area of approximately 15 km² and depth of up to 0.9 m. Both lagoons are protected as nature or hunting reserves, and represent the most important nesting grounds for birds in Albania. They are also of great importance for fishing. The lagoons are threatened by the urban wastewaters of the town of Lezha (some 50,000 inhabitants) and the surrounding rural settlements, as well as by industrial wastewaters, especially from the paper factory and copper smelter situated upstream, along the Drini river.

The Karavasta lagoon is situated between the rivers Shkumbini and Mbledhesi. It covers a surface of 43.3 km² and has a maximum depth of 1.5 m. It is considered the most important coastal wetland of Albania, and is one of the biologically richest lagoons of the Mediterranean area. It is also important for fishing. There is a proposal that the whole lagoon be given the status of a national park and included in the Ramsar Convention List. The lagoon is threatened by the urban wastewaters of the neighbouring settlements.

The Narta lagoon is situated between the mouth of the Vjosa river and the town of Vlora, covering a surface of 41.8 km², with an average depth of 0.8 m. Approximately 1/3 of the total surface is taken up by the Skrofotina salt pans, with an annual production of 120,000 t. In the north-eastern part, a fish farm has recently been established. The primary importance of the lagoon is for fishing, but also, potentially, for eco-tourism. Vine-growing is well developed in the surrounding areas and this might result in agricultural runoff. In the southern corner of the lagoon there is a basin that used to receive effluents from a PVC

factory. The factory is out of operation and it is highly improbable that it would be re-activated, but the sediment of the retention basin is heavily polluted by mercury. Narta lagoon is undergoing very rapid degradation due to extremely limited marine and fresh water input. This phenomenon first occurred some five years ago. During summer and early autumn almost half the lagoon is completely dry and the rest has a depth of only 10-20 cm.

5. IDENTIFICATION OF MAIN GAPS AND CONSTRAINTS

The basic problem in the identification of hot spots and sensitive areas is the lack of relevant information necessary to show precisely the pollution load and environmental state. This primarily means data on the water quality of the rivers that receive the untreated urban wastewaters of the areas through which they flow, as well as industrial wastewaters and runoff waters that flow over various waste disposal grounds. There are no data whatsoever on the water quality of the Viosa river, which is comparatively large (average annual flow amounting to 171 m^3/s). Similarly, there are very few data on sea water quality and the state of marine ecosystems. The situation is particularly bad with regard to the lagoons that have been selected as sensitive areas.

6. PROPOSED OPTIONS FOR REMEDIAL ACTION

The pollution problems caused by the urban wastewaters of Durres and Vlora will be resolved by the construction of separate sewerage systems complete with adequate wastewater treatment plants and submarine outfalls. All future industrial plants, or the present ones if re-activated - which is highly improbable - will have to treat their wastewaters, at least to the level of urban wastewaters, before they can be allowed to discharge into the urban sewerage systems. Particular attention will have to be paid to the elimination of toxic matter that could disturb the functioning of the treatment plants.

The Kuna and Vaini lagoons could be preserved through the implementation of an appropriate management programme. Protection against pollution by urban wastewaters could be achieved by the construction of a sewerage system with an appropriate treatment plant to serve the area of the town of Lezha. For the industries that discharge untreated wastewaters into the Drini river, treatment in the factories will be necessary before discharge into the urban sewerage system or the Drini river. Because of lack of data on industrial wastewaters, it is impossible to propose any funding for their treatment.

The Karavasta lagoon is, at present, threatened only to a limited degree by the domestic wastewaters from the surrounding settlements. To protect it against any future activities, it will be necessary to launch a monitoring programme and management plan.

In order to protect the Narta lagoon and provide sufficient quantities of water, dredging of the existing outlet channel is a top priority, together with the establishment of a long-term sustainable self-financing mechanism to cover the maintenance costs of such an activity. Since this lagoon is potentially threatened by accumulated industrial waste, it is necessary, first of all to assess the true risk of pollution from that source and then, if necessary, take appropriate measures.

The most appropriate solution to resolve the problem of solid waste containing chromium deposited in the Durres region has to be found as soon as possible. One option would be to find an appropriate place to dump the entire quantity, taking the necessary measures to protect it against action of runoff, surface and ground waters. Another

alternative could be chemical treatment of the entire waste material in order to remove the chromium or transform it into an insoluble or less toxic chromium (iii) salt.

An appropriate sanitation method has to be found for the area contaminated by mercury in the Vlora region. Probably the most suitable solution would be to remove the elemental mercury from the contaminated soil by a thermal method.

Support for capacity-building (including experts and institutions) will be necessary in order to improve the amount and quality of environmental data, as well as management of coastal zones. The amount is estimated at around US$155 million.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

ALGERIA

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1. INTRODUCTION

1.1 Present situation

Extending for almost 1,200 km., the Algerian coastline offers an exceptional maritime frontage punctuated by beaches and broken up by deep estuaries.

It is delimited by a narrow continental shelf that is irregular and uneven. This shelf is characterized by steep rocky slopes on the sea bed that are difficult to trawl and it covers almost two thirds of Algeria's sea area.

Between these rocky sections, there are areas where the continental shelf is slightly wider and more favourable for trawling. These account for the remaining one third of the maritime area and are mainly situated in western Algeria (the Gulfs of Ghazaouet and Arzew-Mostaganem), which contain over 60 per cent of Algeria's fishery resources, but they are also found to a lesser extent in eastern Algeria (Skikda and Annaba Bays), as well as in the Bays of Bousmail and Béjaia in central Algeria, which contain sizeable resources of deep sea fish (bluefish) and coral reefs, notably in the furthermost eastern part of the coast (El Kala region), where the largest quantities of red and pink coral are to be found.

These are also extremely important spawning grounds; for example, the western part of the coast between the Moroccan border and Mostaganem is the country's most important breeding area, while there are less important spawning grounds in the central and eastern parts.

The Algerian coast also has exceptional natural and cultural assets that bear witness to the passage of several ancient civilizations.

Some coastal cities not only possess historical remains, but are themselves listed as part of the national cultural heritage; this is the case for the ancient site of Annaba and others which are classified as part of the world heritage such as Tipaza.

The Algerian coast is one of the most densely populated in the Mediterranean. It contains over 20 per cent of Algeria's population in an area that represents less than 0.4 per cent of Algeria's total surface area.

Cities of national importance such as Algiers, Oran, Annaba, Skikda, Béjaia and Mostaganem, whose populations exceed 100,000, account for 12 per cent of Algeria's total population and 62 per cent of the coastal population.

An analysis by commune shows, however, that population density varies greatly from a maximum of 10,170 inh/km^2 in the city of Oran to a minimum of 20 inh/km^2 in the commune of Ain Zouiet in the Province of Skikda.

This clearly underlines the marked imbalance between the high-density urban areas, at the level of communes' administrative centres, and the scattered zones in rural areas whose population density is insignificant in comparison with the total population.

The ongoing decline in these scattered zones is mainly due to the rural exodus, which drains rural communes and increases the population to an excessive extent in urban centres, resulting in problems such as urban pollution, which significantly degrades the environment in the coastal strip and consequently also natural resources.

Although fisheries, tourism, agriculture and industry are the major activities in the coastal strip, industry in particular occupies an important place.

Fishing is mainly concentrated in the eight ports and 10 fishing refuges already existing. It has to be recognized that, even though this sector has been given an additional infrastructure under the plans to build and reorganize ports and fishing refuges, notably certain mixed (trade/fishing) ports, its development is not sufficient because the policy on which it is based essentially focuses on traditional small-scale fishing, which has its limits.

In the area of tourism, the various types of activity carried out along the coast are mainly in seaside resorts, where large luxury complexes have been built near big cities, or in spas. The thermal potential of the Algerian coast is fairly important and it has a role to play at the national level as well as being of top-quality therapeutic value, especially in certain coastal cities of high cultural renown that contain historical sites, for example, Tipaza, which is part of the world heritage.

In addition to its sites, its archaeological remains and its proximity to the capital, Tipaza has almost one half (42 per cent) of total tourist capacity, followed by the two Provinces of Algiers and Oran, which between them have 31 per cent of total capacity.

At the environmental level, it must be stressed that this sector causes problems of domestic origin (liquid and solid wastes), mostly during the summer season when the population may double or even triple. In the majority of cases, the tourism sector is itself the victim of pollution caused by other sectors, in particular industry.

Concerning agriculture, various studies along the coastal strip have shown that its potential as agricultural land corresponds to around 2 per cent of the total area usable for agriculture in the coastal communes.

Provinces in the east, which have the highest forestry potential in the coastal strip, combine agriculture, grazing and forestry. In these regions, there is extensive farming, with the establishment of support structures aimed at the agri-food industry.

In Provinces in the centre, on the other hand, intensive farming is virtually ubiquitous, with the development of cultivation in greenhouses. Intensive farming practices have led to chemical pollution of agricultural origin due to the excessive and irrational use of phytosanitary products.

The majority of industrial activity is also situated on the coast. The four largest port and industrial zones, where there is practically no treatment of industrial waste, are all on the coast. These are, on the one hand, the industrial zones of Skikda and Annaba in the east, Algiers-Oued Smar and Rouiba-Reghaia in the centre, Oran-Arzew in the west, and on the other the industrial complexes of Ghazaouet, Mostaganem, Béjaia and Jijel.

In most instances, these large coastal complexes are sited on land with considerable agricultural potential and close to marine zones that contain the majority of the national fisheries resources.

The vast industrial zones of Arzew (3,500 hectares), Skikda (200 hectares), Annaba (2,000 hectares), Rouiba-Reghaia (1,000 hectares), and the industrial complexes of Ghazaouet and Mostaganem are the most striking examples.

Most of these zones discharge their principal wastes, full of toxic substances, into the sea or nearby wadis, causing heavy pollution along the Algerian coast.

As already emphasized, because of its geographical position, the coastal area is subject to much greater pressure than other areas. This pressure is strongly exacerbated by the

phenomena of urbanization and industrialization experienced in the major cities that are a focus of attraction, for example, Algiers, Oran, Annaba, Skikda, Béjaia and Mostaganem.

The urbanization and industrialization of the principal urban centres means that these cities, which also have a port infrastructure, suffer urban and industrial pollution.

As an example, analyses of samples of seawater and sediment, taken inside and outside the main ports in these cities, show high concentrations of pollutants that in some instances exceed several times the permitted levels in Algeria. This underlines the impact that activities such as maritime transport and industry, and urban waste, have on marine pollution.

These urban and industrial activities generate large amounts of chemical and organic pollutants, which are discharged directly into the marine environment, usually without any treatment.

Like urban and industrial wastewater, solid wastes receive practically no prior treatment and no precautions are taken before they are discharged, as can be seen from the proliferation of illegal dumps that are only too often to be found in or beside wadis, cliffs or other natural depressions. This means twofold pollution of the marine environment by solid wastes: directly, through illegal dumping on cliffs and beaches, and indirectly, through dumping in wadis, where the waste is subsequently carried down to the sea whenever the water level rises.

These major sources of pollution, together with many others, cause extensive damage to marine biological resources and all forms of marine activity. They lead to substantial damage to the marine flora and fauna, thereby destroying many natural breeding areas (spawning grounds of Mostaganem) and natural habitats (zones of Annaba and Ghazaouet), so constituting a major handicap for the fisheries sector.

Other uses of the sea are increasingly being jeopardized by pollution; Algeria's beaches are ceasing to be clean as can be seen from the number where bathing is now prohibited.

Bathing is prohibited at almost one third of the 360 beaches in Algeria because of the danger to bathers' health. The prohibition most affects beaches near large urban, tourist and industrial centres along the coast.

1.2 Conduct of the study

This survey has been carried out by the directorate for the prevention of pollution in the Ministry of State for the Environment, in collaboration with the relevant services of the Ministry of Public Works responsible for water resources (sub-directorate of sanitation), services of the Ministry of Industry, the National Agency for Water Resources (ANRH), the National Land Planning Agency (ANAT), the National Statistical Office (ONS), experts from the National Marine Sciences Institute (ISMAL), and the Maritime Studies Laboratory (LEM).

All the information contained in this report is derived from reports and studies undertaken by the aforementioned services of the various ministerial departments, national agencies and laboratories, as well as from the report containing a METAP study on protecting Algerian ports and coastal areas against pollution, carried out in 1994 by the Danish Water Quality Institute (VKI).

These data reflect the current situation and can be summarized in the following information:

- population and the discharge of wastewaters;

- assessment of industrial pollution based on data from the Ministry of Public Works and some basic theoretical assumptions.

The cost of installing treatment plants for polluting industries cannot be estimated because it would require an in-depth study for each type of industry and a minimum amount of time.

The data on the cost of reorganizing, expanding or installing new treatment plants for the coastal cities are based on the drafts prepared for operations planned by the water resources services of the Ministry of Public Works. Consequently, the estimate of the cost of the investment recommended is only a rough guide and will have to be updated.

2. IDENTIFICATION OF HOT SPOTS - SENSITIVE AREAS

2.1 Methodology

As already mentioned, almost all socio-economic activity is concentrated in the coastal strip where the large urban centres and major industrial hubs are concentrated.

The following were identified as hot spots with a population of 100,000 or over or as major industrial hubs: Algiers, Oran, Annaba, Skikda, Béjaia, Mostaganem, and Ghazaouet (see Table 1).

For sensitive areas, priority was given to zones of the greatest biological, ecological and socio-economic importance on the Algerian coast that faced the potential risk of degradation caused by the discharge of urban domestic and industrial effluents. These are mainly zones situated in the Gulfs of Ghazaouet, Arzew-Mostaganem, the Bay of Algiers, the Gulf of Béjaia, the Bays of Skikda and Annaba (see Table 2).

Table 1

Potential hot spots

Location/city	Population Source: ONS	Main activities
Algiers	1,957,334	Urban, industrial
Annaba	890,000	Urban, industrial
Oran	1,230,000	Urban, industrial
Skikda	747,000	Urban, industrial-port
Béjaia	859,000	Urban, industrial-port
Mostaganem	631,000	Urban, industrial
Ghazaouet	120,000	Urban, industrial

Table 2

Sensitive areas

Location/city	Characteristic(*)	Main activities
Gulf of Ghazaouet	B, S	Urban, industrial
Gulf of Arzew-Mostaganem	B, S	Urban industrial
Bay of Algiers	B, E S	Urban, industrial
Bay of Béjaia	B, S	Urban, industrial
Gulf of Skikda	B, E S	Urban, industrial
Bay of Annaba	B, E, S	Urban, industrial

(*) B: zone of significant biological importance, containing substantial fisheries resources (spawning grounds)

E: zone of ecological importance including national parks and wetlands for waterfowl.

S: zone containing socio-economic infrastructures with high tourism potential.

The major risk for the environment along the Algerian coastline is the discharge of domestic and industrial effluents and the quarrying of sand for building.

3. SOURCES OF POLLUTION

Location	Major sources of pollution	Rate m^3/day(*)	Parameter Tonnes/year(**)	
Algiers	Urban industrial	234,880	BOD_5: 42,865 COD: 71,442 Total N: 10,716 Total P: 4,286	TSS: 64,298
Annaba	Urban industrial	106,800	BOD_5: 19,491 COD: 32,485 Total N: 4,872 Total P: 1,949	TSS: 29,236
Oran	Urban industrial	139,600	BOD_5: 26,937 COD: 44,895 Total N: 6,734 Total P: 2,693	TSS: 40,405
Skikda	Urban industrial	89,640	BOD_5: 16,359 COD: 27,265 Total N: 4,089 Total P: 1,635	TSS: 24,538
Béjaia	Urban industrial-port	103,080	BOD_5: 18,812 COD: 31,353 Total N: 4,703 Total P: 1,881	TSS: 28,218
Mostaganem	Urban industrial	75,720	BOD_5: 13,818 COD: 23,031 Total N: 3,454 Total P: 1,381	TSS: 20,728
Ghazaouet	Urban industrial	64,200	BOD_5: 2,628 COD: 4,380 Total N: 657 Total P: 262	TSS: 3,942

(*) The estimate of the rate of flow of wastewater discharged has been calculated on the basis of 80 per cent of the quantity used daily i.e. 150 l/inh x 80%

(**) The parameters used to quantify pollution have been calculated according to the following formula: BOD_5 : 60g/inh/day, COD: 100 g/inh/day
Total N: 15 g/inh/day, Total P: 6 g/inh/day.

4. INDICATORS OF HOT SPOTS AND SENSITIVE AREAS

The estimate of the eight hot spots and six priority sensitive areas has been determined according to criteria based on the evaluation of potential risks caused by sources of pollution to the quality of drinking water, the effects on public health, aquatic life and the socio-economic conditions, as shown in Table 4.

5. IDENTIFICATION OF PRINCIPAL GAPS AND CONSTRAINTS

The principal gaps are related to:

- the lack of information on the concentration of hydrocarbons, heavy metals and organochlorides in domestic sewage;

- the lack of information on particular industries.

Attention should also be drawn to the major constraint posed by the completion of the questionnaires.

6. PROPOSALS AND RECOMMENDATIONS

The marine environment of Algeria's coastal strip is greatly harmed by the waste from urban and industrial activities, especially along the coast between Oran and Ghazaouet; action should be taken immediately therefore to treat the urban wastewater coming from the major coastal cities by building plants or expanding or reorganizing those already existing.

In addition, the treatment of industrial effluents at sources should be improved before they are discharged into the sanitation network and the municipal treatment plant.

Table 4

Hot spots - Algeria

Country	Name	Type of pollution	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
Algeria	Oran	Urban and industrial	5	1	4	6	5	5	21	100	WWTP : Rehabilitation Expansion PTIW : Implementation	F-B-L-P	35 million ND
	Rouiba-Réghaia	Urban and industrial	5	2	5	5	4	5	21	100	PTIW: Implementation	F-B-L-P-H	2 million
	Ghazaouet	Urban and industrial	5	1	6	5	4	5	20.8	99	WWTP : Construction PTIW : Implementation	F-B-L-P-H	30 million ND
	Algiers	Urban and industrial	5	1	4	6	4	5	20.2	96	WWTP : Construction PTIW : Implementation	F-B-L-P	1.5 million ND
	Mostaganem	Urban and industrial	4	1	6	4	4	5	20	95	WWTP : Construction PTIW : Implementation	F-B-L-P-H	25 million ND
	Béjaia	Urban and industrial	5	1	5	5	4	4	19.4	92	WWTP : Implementation Expansion PTIW : Implementation	F-B-L-P-H	0.9 million ND
	Annaba	Urban and industrial	5	1	4	5	4	4	18.7	89	WWTP : Construction Expansion PTIW : Implementation	F-B-L-P-H	0.6 million ND
	Skikda	Urban and industrial	5	1	5	4	3	4	17.8	84.7	WWTP : Construction PTIW : Implementation	F-B-L-P-H	20 million ND

WWTP : Urban wastewater treatment plant
PTIW : Pretreatment of industrial effluents
ND : Not determined (requires a specific study for each industry)

Table 5

Sensitive areas- Algeria

Country	Name	Type of pollution	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment(*)	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)(**)
Algeria	Gulf of Ghazaouet	Urban and industrial	5	1	5	5	4	5	20.1	100	WWTP : Construction PTIW : Implementation	F-B-L-P	ND
	Gulf of Arzew-Mostaganem	Urban and industrial	5	1	5	5	4	4	10.4	96.5	WWTP : Construction PTIW: Implementation	F-B-L-P-H	ND
	Bay of Algiers	Urban and industrial	5	1	4	5	4	4	18.7	93	WWTP : Reorganization PTIW : Implementation	F-B-L-P-H	ND
	Bay of Annaba	Urban and industrial	5	1	5	4	4	4	18.6	92.5	WWTP : Reorganization Expansion PTIW : Implementation	F-B-L -P	ND
	Gulf of Skikda	Urban and industrial	4	1	5	4	4	4	17.6	87.56	WWTP : Construction PTIW : Implementation	F-B-L-P-H	ND
	Bay of Béjaia	Urban and industrial	4	1	4	4	4	4	16.9	84	WWTP : Construction PTIW : Implementation	F-B-L-P-H	ND

(*) The nature of the investment to protect sensitive areas concerns reorganization of existing treatment plants or the building of new plants to treat urban and industrial wastewater from the majority of population centres and industrial plants situated in the area- including those relevant to the hot spots shown on Table 4.

(**) The financial estimate depends on the nature of the investment to be determined for each specific area (number of population centres and industries)

WWTP : Urban wastewater treatment plant

PTIW : Pretreatment of industrial effluents

ND : Not determined (requires a specific study for each industry)

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

CROATIA

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1. INTRODUCTION

By its geographic situation, Croatia is a Central-European, Mediterranean country. Its population amounts to approximately 4,784,265 million inhabitants and it covers a surface area of 56,538 km^2.

The permanent population of the coastal area amounts to approximately 1 million inhabitants, while in summer months this number increases considerably due to temporary inhabitants and tourists. The largest towns on the coast are Split (207,147 inhabitants), Rijeka (206,229), Zadar (136,572), Pula (85,326), Sibenik (85,002), and Dubrovnik (71,419).

Towards the interior, the coastal strip is bordered by a mountain range which represents the end of the Alps. The coastal strip is fairly narrow, several kilometres on average, while in some places the mountains border directly on the sea (Velebit, Biokovo). In very few areas, this strip is over 10 km wide (Istria peninsula in the north, and Ravni Kotari in the central part of the coast). The mountain range is pierced in several places, either by the flows of carstic rivers (Zrmanja, Krka, Cetina, Neretva), or by mountain passes (Gornje Jelenje, Vratnik, Mali Alan, Klis, Vrulje).

One of the specific features of the Croatian coast is the great number of islands dispersed in one or more rows parallel to the coastline. There are 65 inhabited and 650 uninhabited islands, plus some 460 rocks and reefs. The total length of their coasts amounts to 5,790 km. The insular coast is indented by the index of 1:7.5, while that of the mainland coast is 1:3.4. Such a high index indicates a wealth of geomorphological forms such as bays, capes, channels, isthmuses, straits, and passages, making this coast a unique geomorphological phenomenon. Numerous islands and peninsulas which have created various water units (channels, semi-enclosed bays) have made each island, bay and channel biologically unique. Owing to their great value some areas have been specially protected, for example, the Brijuni archipelago, Velebit, Paklenica, the Talascica Bay, Kornati archipelago, the island of Mljet, and Malostonski Bay.

Generally speaking, the major part of the coastal sea is unpolluted. However, the coastal sea near larger urban agglomerations, and most of the northern Adriatic, are polluted. Economic changes followed upon the socio-political changes in the country and as a result most of the industries that were large polluters were either closed or now work at reduced capacity. The main source of pollution is urban wastewaters that are discharged directly into the sea untreated, mostly through numerous outlets but to a lesser degree through submarine outfalls. Industrial wastewaters, treated either insufficiently or not at all, are discharged into the sea, mostly through surface outfalls. So far, the rivers have not been significant sources of pollution as most of them flow through sparsely inhabited areas. Exceptions are the river Krka and the river Neretva, which mostly flows through the Republic of Bosnia and Herzegovina.

The most serious consequence of sea pollution is accelerated eutrophication followed by changes in the plankton communities, blooming of selected phytoplankton organisms, reduced oxygen content in the bottom layers, and, eventually, mass mortality of marine organisms. Changes also occur in the contents of the benthic communities, so that autochthonous species, sensitive to pollution, such as brown algae, disappear, while less sensitive species, such as nitrophilic sea algae species (green algae) become dominant.

Identification of hot spots and sensitive areas has been made on the basis of analyses of available data, questionnaires, and interviews with representatives of the State Directorate of Water Resources, the Public Water Authority "Croatian Water Resources", the State Directorate of Environment, and the Focal Point for the Strategic Action Programme.

2. PROCEDURE FOLLOWED IN IDENTIFYING HOT SPOTS AND SENSITIVE AREAS

For the selection of hot spots according to the proposed criteria, towns with more than 100,000 inhabitants were taken into consideration, together with those of around 50,000 if they were important tourist centres (Dubrovnik), or if they discharged untreated wastewaters into semi-enclosed bays (Sibenik, Pula) or channels (Zadar), as well as Kaštela Bay in which the excessive pollution has caused considerable changes in living communities.

In the case of industry, attention focused on basic chemical plants located by the sea which discharge insufficiently treated wastewaters directly into the sea, as well as Kaštela Bay in which the excessive pollution has caused considerable changes in living communities.

Among the rivers flowing into the Adriatic Sea, Krka and Neretva were selected due to present and possible future pollution.

Five sites of special biological and environmental importance that already enjoy some degree of protection were selected as sensitive areas.

3. CONTRIBUTIONS OF DIFFERENT SOURCES TO IDENTIFIED HOT SPOTS OR SENSITIVE AREAS

Hot spots	Main sources of pollution	Principal supporting data extracted from the questionnaires
Pula	- Domestic	- BOD 329 t/y - COD 513 t/y - P_{tot} t/y - TSS 259 t/y
Rijeka	- Domestic	- BOD 1,927 t/y - N_{tot} 201 t/y - P_{tot} 33 t/y - TSS 1,728t/y
Zadar	- Domestic - Industrial	- BOD 1,056 t/y - COD 3,940 t/y - N_{tot} 154 t/y - P_{tot} 26 t/y - TSS 1,410 t/y
Sibenik	- Domestic	- BOD 201 t/y - COD 410 t/y - P_{tot} 20 t/y - N_{tot} 89 t/y - TSS 240 t/y
Split	- Domestic - Industrial	- BOD 1,643 t/y - COD 3,286 t/y - N_{tot} 411 t/y - P_{tot} 115 t/y - TSS 1,232 t/y
Kaštela Bay	- Domestic - Industrial	Temporary anoxic condition in a part of the Bay

Hot spots	Main sources of pollution	Principal supporting data extracted from the questionnaires
Dubrovnik	- Domestic	- BOD 160 t/y - COD 310 t/y - N_{tot} 79 t/y - P_{tot} 19t/y - TSS 139 t/y
Oil refinery, Urinj, Rijeka	- Industrial	- BOD 32 t/y - COD 121 t/y - TSS 25 t/y - Oil 8.1 t/y
Accumulation of waste waters, Cokery, Bakar	- Industrial	- Volume 17,000 m^3 - Phenols 100 kg - Cyanides 600 kg
Tannery, Zadar	- Industrial	- Cr_{tot} 3.9 t/y - COD 68.3 t/y
Cannery "Adria", Zadar	- Industrial	- COD 121 t/y - BOD 67 t/y - TSS 18 t/y
Brewery "Kaltenberg", Split	- Industrial	- COD 1287 t/y - TSS 149 t/y
Krka river	- Domestic - Industrial	- COD 232 t/y - Cd 94 kg/y - Cr 73 kg/y
Neretva river	- Industrial - Domestic - Agricultural	- Cd 459 kg/y - COD 1927 t/y - N_{tot} 17 t/y - P_{tot} 4.2 t/y
Sensitive areas	Main sources of pollution	Principal supporting data extracted from the Questionnaires
Malostonski Bay	- Domestic	
Limski kanal	- Industrial	
Kornati islands and Talascica	- Pleasure boats - Tourism	
Mljet	- Pleasure boats - Tourism	
Krka estuary	- Domestic - Industrial	

4. PRIORITY HOT SPOTS AND SENSITIVE AREAS

The priority hot spots and sensitive areas are shown in the table below.

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
HOT SPOTS													
Croatia	Kaštela b.	- Domestic - Industr.	6	1	1	6	4	6	21.7	100	See Split		
Croatia	Split	- Domestic - Industr.	6	1	6	3	3	6	21.1	100	Sewerage + WWTP const.	F, B, L, P, H	66 million
Croatia	Sibenik	- Domestic - Industr.	5	1	3	4	3	6	18.8	98	Sewer exten. + WWTP construction	B, L, P, H	30 million
Croatia	Zadar	- Domestic - Industr.	5	1	4	4	3	6	18.5	97	Sewer+ WWTP construction	F, B, L, P	35 million
Croatia	Pula	- Domestic - Industr.	4	1	4	4	3	6	17.5	94	Sewer + WWTP extension	B, L, P	30 million
Croatia	Oil refin.	- Industr.	2	1	6	4	3	6	16.9	93	Underground sanitation	B, P	8 million
Croatia	Kaltenberg	- Industr.	2	1	6	3	3	3	16.0	91	WWTP construction	B,	2 million
Croatia	Adria	- Industr.	2	1	3	6	5	3	15.9	90	WWTP reconstruction	L	2 million
Croatia	Cokery	- Industr.	6	1	4	5	1	1	15.2	87	Wastewater treatment	B, P	1.5 million
Croatia	Rijeka	- Domestic	4	1	3	4	1	6	15.2	83	WWTP extension	F, B, L, P	25 million
Croatia	Neretva river	- Domestic - Industr.	2	1	2	2	1	3	8.8	70	Management plan	F,B,L,P	700,000

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
Croatia	Dubrovnik	- Domestic	3	1	2	4	1	6	14.5	80	Sewer extension	L, P	6 million
Croatia	Tannery	- Industr.	6	1	2	2	1	2	12.1	75	WWTP reconstruction	B,	1.5 million
Croatia	Krka river	- Domestic - Industr.	2	1	2	4	1	3	10.4	78	See Krka est.	B,L,P	
SENSITIVE AREAS													
Croatia	Malostonski	- Domestic - Industr.	2	1	2	2	2	2	8.9		Management plan and monitoring programme	L,P	1.2 million
Croatia	Limski ch.	- Industr.	2	1	2	2	2	2	8.9		Management plan and monitoring programme	L,P	700,000
Croatia	Kornati	- Pleasure boats - Tourism	1	1	2	2	1	1	6.4		Management plan and monitoring programme	L	900,000
Croatia	Mljet	- Pleasure boats - Domestic	2	1	2	2	1	1	7.4		Management plan and monitoring programme	L	200,000
Croatia	Krka est.	- Domestic - Industr.	4	1	2	2	2	4	12.3		Management plan and monitoring programme	P,L	1.5 million

The town of Pula is situated at the southernmost point of the Istria peninsula, in a small semi-enclosed bay which, at present, receives approximately 40 per cent of urban wastewaters without any treatment through a large number of outlets, together with most of the industrial wastewaters. The most obvious result is the regular yearly occurrence of the "red tide". The remaining part of the wastewaters are discharged, after primary treatment, into the open sea through a submarine outfall.

The town of Rijeka is situated in Rijeka Bay. It is an important harbour and industrial centre. Two-thirds of household wastewaters receive primary treatment and are discharged through a submarine outfall at a depth of 44 m, while the remaining 1/3 is discharged untreated through numerous outlets at the coast itself. Consequently most of the town beaches are not of an adequate sanitary level.

The town of Zadar is located on the central part of the Croatian coast. It has well-developed metal and food-processing industries. Until recently, most of the urban and industrial wastewaters were discharged into the harbour resulting in frequent occurrence of anoxic conditions. Today, most of the wastewaters, without any treatment, are discharged into a 5-6 km wide channel through numerous outlets and an inappropriate submarine outfall. As a result, the sea beside the urban area is of inadequate sanitary quality for bathing.

The town of Sibenik is situated in a channel whose top layers receive the waters of the Krka river, while the bottom layers are sea water. The most important economic activity was the production of aluminum and ferrous alloys, but these activities ceased several years ago. All urban wastewaters are discharged untreated into the channel through numerous outlets. Consequently, there is a high degree of pollution and the sea is not suitable for bathing in certain urban areas.

The town of Split is situated on a peninsula that encloses Kaštela Bay. About 60 per cent of urban wastewaters are discharged untreated into the Brač channel through a submarine outfall at a depth of 35 m and numerous outlets. The result is changes in coastal benthic communities, as well as high faecal pollution in some parts of the coastal part of the channel.

The town of Dubrovnik, an important cultural, historic and tourism site, is located on the very south of the Croatian coast. There are no important industries in the town, even though the wastewaters of the oil factory caused significant pollution of Gruz harbour. Most of the urban wastewaters are pre-treated and discharged into the open sea through a submarine outfall, but a small part is discharged untreated through a number of outlets, causing occasional pollution of the beaches.

Krka is a carstic river whose source is 4 km east of the town of Knin and it flows into the sea in the channel near Sibenik. Over its 63 km length it receives household wastewaters from the nearby settlements amounting to a total population of 80,000. The most significant industrial pollutant of the river is the metal processing industry located in the area of the town of Knin.

The Neretva river rises in the Republic of Bosnia and Herzegovina, and only 28 km of its total length of 215 km are in the Republic of Croatia. Neretva and its tributaries receive untreated urban and industrial wastewaters from the nearby settlements with a total population of about 100,000. The largest industrial polluters are alumina production and the aluminum smelter in the Mostar (Bosnia and Herzegovina) area. At the river delta, intensive agriculture has developed, so the waters are additionally polluted by pesticides and fertilizers.

The oil refinery of Rijeka is the largest in Croatia, with a capacity of 6 million tons of oil derivatives, and is the only one situated on the coast. Although it has appropriate treatment equipment for industrial and rainfall waters, the refinery pollutes the sea and soil with accidental spills of oil and its derivatives. Between 14,000 and 20,000 t of hydrocarbons also containing sulphides and mercaptans, are deposited in the soil. In 1993, soil recovery archives were launched. An additional threat is approximately 8,000 t/y of solid waste remaining in the production and wastewater treatment plants.

For 15 years, a cokery existed in the small semi-enclosed Bakar Bay, but it has now been closed down and is being dismantled. There are 17,000 m^3 of wastewaters rich in phenols and cyanides to be disposed of.

The tannery in Zadar has out-of-date equipment with an inadequate mechanical treatment plant for wastewaters. These are discharged into the urban sewerage system and contain large concentrations of chromium salts, COD and TSS, thus representing an important source of pollution of the coastal sea.

The wastewaters of the cannery "Adria" in Zadar are only subject to mechanical treatment before direct discharge into the sea. They contain large quantities of organic matter and are a large polluter of the coastal sea. In summer months, unpleasant smells spread over a wide surrounding area.

The "Kaltenberg" brewery in Split has no wastewater treatment plant, so its wastewaters contain large quantities of pollutants. Their discharge into the enclosed and shallow part of Kaštela Bay has serious consequences on that part of the Bay.

Kaštela Bay is a semi-enclosed bay covering a surface of 60 km^2 and has a total volume of 1.4 km^3. The exchange rate of water masses with the open sea is comparatively low. For a considerable time, the Bay has been receiving some 40 per cent of completely untreated urban wastewaters from the wider urban area of Split, and all of the industrial wastewaters, only partially treated, from the entire area surrounding the Bay. The consequences can be seen in drastic changes in living communities, yearly occurrence of mass mortality of marine organisms, and unsuitability of the Bay for tourism and recreation.

The Lim channel is situated on the western coast of the Istria peninsula. It is a narrow (600 m) bay cutting deep into the land (11 km). The greatest depth of 33 m is at the entrance to the Bay, while the inner part is considerably shallower. The shallow part is characterized by a great influence of underground fresh waters rich in organic matter. Intensive oyster and mussel farming has therefore developed in this part, while fish farming has developed in the deeper part. Depending on the input of fresh water, the salinity varies between 9 and 38 ppm, while the temperature range is between 9° and 25° C. Because of its high productivity, the Lim channel has been protected as a marine reserve. Several years ago, a threat to the channel arose in the form of wastewaters from a slaughter house. Even though it is situated in the hinterland, the wastewaters reach the Bay through the highly porous carstic terrain.

The Kornati archipelago, situated south of Zadar, has a total surface of some 300 km^2, and is composed of 150 large and small islands and rocks with a total surface of 62 km^2. The Bay of Talascica, 8 km long and between 200 m and 2 km wide, is situated on Long Island, which borders the Kornati archipelago. Owing to their geomorphological and petrographic wealth, as well as their biological wealth and biodiversity, the Kornati archipelago and Talascica Bay have been given the status of national park and nature park respectively. The archipelago is far from any land-based sources of pollution, but is threatened by intensive tourism and nautical activities. The entire area of Kornati and Talascica has not been adequately investigated, so the true effects of tourism are as yet unknown.

The Krka estuary is a deep canyon (some 40 m) 12 km long, whose width ranges from between 200 m to 1.8 km, and it ends in Prokljansko lake. Krka flows into the sea in the Sibenik channel, so its surface layers contain fresh water, while the remaining part is sea water. The Sibenik channel is one of the most productive areas of the eastern Adriatic. It is used for shellfish and acquaculture. Unfortunately, it is heavily polluted, as indicated *inter alia* by high concentrations of some heavy metals in the sediment. The channel is polluted by urban and industrial wastewaters from the town of Sibenik, and metal processing industries located along the Krka river.

Malostonski Bay is 28 km long and has a maximum width of 6.1 km. Both the inner and outer coasts of the Bay are highly indented, so the overall length of the coastline is about 100 km. The greatest part is 29 m, but in more than 80 per cent of the Bay the depth ranges from 20 to 29 m.

The ecological situation of the Bay depends primarily on influences from the land, and only to a lesser degree on those from the open sea. The fresh waters of the Neretva river occasionally affect the outer and central parts of the Bay and the inner part to a lesser extent, especially when there is high water in the river and strong western winds. An important hydrogeological factor affecting the hydro-physical and ecological relations in the Bay is the presence of strong submarine fresh water springs in the inner part of the Bay. According to the concentrations of nutrient salts and quantities of phytoplankton, the Bay can be qualified as a natural, moderately eutrophicated system. The input of organic matter from the land plays an important role in ecological and productive relations. Because of favourable primary production and hydrographic characteristics, shell culture has been developed in the Bay since ancient times. At present, it is the most important shell culture site of Croatia. Owing to the fact that the surrounding areas are sparsely populated, the Bay has never been exposed to anthropogeneous eutrophication of any importance. Because of its high productivity and significance for shell culture, Malostonski Bay has been protected as a marine reserve.

Mljet national park covers the north-western part of the island of Mljet and all the small islands in front of it, including the natural phenomena of the Large and Small Lakes, and the Solinski channel. The total surface of the protected area is 30 km^2, of which the Large Lake accounts for 1.47 km^2 (length of 2.5 km, width up to 1 km, depth up to 31 m), and the Solinski channel for 0.12 km^2 (length 2 km, width 60 m, depth up to 3.7 m). Sanitary wastewaters from the surrounding settlements leak into the lakes.

5. IDENTIFICATION OF MAIN GAPS AND CONSTRAINTS

Due to the experience gained over many years in implementing the national programme for monitoring coastal sea quality, there is a large amount of data on the basis of which it is possible to determine the degree of pollution of most of the coastal sea. There are also numerous data on the quality of wastewaters, both urban and industrial, but, as a rule, data are on wastewater quantities are lacking. Since wastewaters are mostly discharged through numerous outlets which also serve run-off and surface waters, the data on wastewater quality differ considerably from one location to another, and from one town to another. It is therefore impossible to determine precisely the pollution load of urban and industrial wastewaters.

Although there is a great quantity of various data for some areas, no research has been done for other coastal areas so it is impossible to identify sensitive and environmentally important sites.

6. PROPOSED OPTIONS FOR REMEDIAL ACTION

The above mentioned town's problems related to pollution by urban wastewaters can be resolved by the construction of appropriate sewerage systems that would eliminate the numerous outlets through which the wastewaters are now being discharged in the immediate vicinity of the coast. These systems should include treatment plants to purify the wastewaters to the required degree, and submarine outfalls. All industrial plants have to treat their wastewaters at least to the level of urban wastewaters before discharging them into the urban sewerage systems or to the sea. In particular, toxic and persistent matter that could disturb the operation of treatment plants, or is prohibited from being discharged into the sea according to international and/or national regulations must be removed.

For the town of Pula, an additional part of the collection network should be built, and the capacity of the wastewater treatment plant increased. The industrial wastewaters now discharged directly into the sea should be treated to the level of urban wastewaters and discharged into the urban sewerage network.

In the case of Rijeka, part of the present sewerage system should be reconstructed and a new part built so that all the urban wastewaters can be brought to the present treatment plant. The degree of treatment at that plant has to be increased first to the primary level, and later to the secondary level of treatment. The industrial wastewaters now discharged directly into the sea should be treated to the level of urban wastewaters and discharged into the urban sewerage network.

In the town of Zadar, the building and reconstruction of the sewerage network has to be completed so that all the urban and industrial wastewaters can be brought to the locations at which treatment plants should be built. At these plants, the wastewaters should be treated to the secondary level and discharged into the sea of the Zadar channel through two appropriate submarine outfalls to be built.

The urban wastewaters of Sibenik should be collected by the sewerage system and brought to the location at which they should be treated to the primary level, and then discharged into the open sea through a submarine outfall. To achieve that, the existing sewerage system will have to be reconstructed and the necessary collectors, treatment plant and submarine outfall built.

The urban and industrial wastewaters of the wider urban area of Split, which includes the towns of Split, Solin, Kaštela and Trogir, have until now been discharged into the Brač channel and Kaštela Bay without treatment. Appropriate collectors should be built in order to bring these waters to two locations at which treatment plants are planned to be built. After appropriate treatment, the wastewaters should be discharged into the Split and Brač channels through the planned submarine outfalls. The industrial wastewaters must be treated before discharge into the urban sewerage system.

The pollution problems of Kaštela Bay will be resolved by the planned construction of the sewerage system to include the towns of Split, Solin. Kaštela and Trogir, as mentioned above.

The small part of the urban wastewaters of Dubrovnik that are now discharged untreated into the sea should be collected and appropriate collectors should be built for this purpose. They should then be brought to the treatment plant, and, after pre-treatment, discharged through the existing submarine outfall.

The groundwaters polluted by the Rijeka oil refinery should be extracted to the surface and treated in a way that would not threaten the environment.

The wastewaters that remain in the biological treatment plant of the technological wastewaters and the discharge system of the cokery in Bakar should be treated appropriately to avoid spillage into the environment.

Before discharge into the urban sewerage system, the wastewaters of the Zadar tannery should be treated to remove the chromium salts and organic matter and a new treatment plant will have to be built for that purpose. However, before deciding on the construction of a new treatment plant, it would be advisable to consider the possibility of closing the tannery down.

The problem of the wastewaters of the "Adria" cannery in Zadar should be resolved by building an appropriate treatment plant.

An appropriate biological treatment plan should be built to treat the wastewaters of the "Kaltenberg" brewery in Split, before discharge into the urban sewerage system.

Malostonski Bay should be protected by the establishment and implementation of a monitoring programme as part of an appropriate management programme for the entire Bay area. Measures should also be taken to protect the entire watershed so as to prevent pollution of groundwaters that leak into the Bay.

The Lim channel should be protected by preventing the polluted groundwaters from reaching it, which requires the implementation of a comprehensive programme of watershed protection to include *inter alia* treatment and discharge of all household and industrial wastewaters. It is necessary to organize and implement a monitoring programme as part of an appropriate management programme for the entire channel area.

In order to valorize and protect the Kornati archipelago and Talascica Bay further a detailed study of the entire area should be prepared and carried out. It is also necessary to elaborate a programme to monitor the effects of tourism activities on the entire area as a prerequisite for sustainable management of this highly valuable locality.

To protect the national park of Mljet, a programme to monitor the effects of tourism activities on the entire area should be elaborated, and an appropriate regime for the sustainable management of the park established.

The Krka estuary should be protected by the construction of the sewerage system for the town of Sibenik as mentioned above and by implementation of the management plan for the river basin, which should include the construction of a treatment plant for the wastewaters of the industries discharging directly or indirectly into the Krka river, as well as by strict quality control of the waters discharged.

Some technical assistance (support), not previously quoted, for research, management and monitoring, and public participation mechanisms will be necessary. The amount is estimated at the level of US$ 1,5 million.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

CYPRUS

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1. INTRODUCTION

Cyprus has no heavy industries that produce the more noxious pollutants in their wastes and so there are not many pollution hot spots.

A certain number of industries located in the coastal zone, mainly in the Limassol area, discharge their effluents into the sea untreated. At present, therefore, only a small portion of coastal waters around Cyprus are being polluted by industrial wastes.

Most sewage is either collected in individual cesspit/septic tanks (where the new planned sewerage network has not yet been constructed) or discharged into the sea or stabilization ponds after tertiary treatment.

There are no discharges from rivers or canals.

Proposed remedial measures with their cost estimation are provided for all identified hot spots in Cyprus.

2. APPROACH FOLLOWED

The work was carried out in close cooperation with the National Coordinator (N.C.) for the project, and the following steps were taken to fulfil the assigned task.

(i) Collection of data

- dissemination of relevant questionnaires;
- meetings where appropriate, with the people responsible for filling in the questionnaires for for the prupose of clarifications;
- meetings with the responsible national authorities for a final cross-check of the information provided i.e. the Environment Service (Ministry of Agriculture, Natural Resources and Environment) for liquid discharges, and the Department of Labour (Ministry of Labour and Social Insurance) for air emissions;

(ii) Analysis of data collected;

(iii) Preparation of the list of hot spots and sensitive areas using recommended criteria;

(v) Proposed remedial action with estimated cost.

3. MUNICIPAL DISCHARGES

The three cities for which relevant questionnaires were completed are listed in Table 1.

The pollution loads for Limassol city are shown in Table 2. There are no discharges into the sea from the other two cities.

The city of Limassol has a population of 135,000. A new central sewerage system has been constructed and has been in operation since April 1995. For the time being, only part of the coastal area of Limassol is connected to the system, but is expected that by the year 2010 the whole of the city will be connected.

At present, 6000 m^3/day of tertiary treated effluents are discharged into the sea in the area of Moni through a 200 m outfall. A small amount of the water treated (less than 1000 m^3 per day is used for irrigation).

Pollution loads of the tertiary treated effluents discharged into the sea are shown in Table 4.

The introduction of nutrients (phosphates and nitrates) results from the relative increase in the concentration of phosphates in the sea area adjacent to the outfall discharge point at Moni.

The discharge, at a distance of 200 m, of the tertiary treated effluents, would be better stopped. The Government plan to use the treated water for irrigation is expected, and it is foreseen to be implemented by the year 1998. Even if the treated waters are used for irrigation, and the sea outfall is used only as an emergency outfall in case of the treatment plant's malfunctioning, its length should be extended to the 1 km limit.

4. INDUSTRIAL DISCHARGES

All coastal installations are shown in Table 3. Questionnaires have also been completed for each industry.

Four wine industries and a brewery situated in the same area, between the old and new Limassol harbours, discharge their effluents directly into the sea without any treatment. The "bad housekeeping" and the connection of domestic discharges with the process water result in microbial contamination of the recipient coastal waters. As the F.C. numbers in all stations in the area between the old and new Limassol harbours exceed by far the recommended quality criteria of WHO/UNEP for bathing waters, this area is closed for bathing.

The wastewaters from the refinery are treated and discharged through the main cooling water stream into the sea.

The wastewater (from boilers and heaters) from the two power stations are chemically treated in a common treatment plant at Dhekelia power station. The treated water is used for irrigation.

The pollution loads from all the above industries are shown in Table 2. These are mainly organic matter, solids and nutrients.

There are no liquid discharges from the two cement factories. The pollution loads (NOx, CO, SO_2, and dust) from the two power stations, the two cement factories and the refinery are shown in Table 5.

5. PRIORITY HOT SPOTS AND SENSITIVE AREA

Based on the collected data (3., 4. above) the priority hot spots in Cyprus are described in Table 6.

As can be seen from the table, the five beverage industries in the Limassol area are the main sources of pollution and have major, although local, effects on the biodiversity of the benthic community. This effect extends up to a depth of 30 m in the sea over a radius of about 2km from the source. These hot spots also have a moderate effect on public health, and the area is closed for bathing.

The sea outfall of the Limassol Sewerage Treatment Plant at Moni is another hot spot. Although it has no effect on public health, the effluents are tertiary treated and chlorinated, the introduction of nutrients (10 tons of Total P and 12 tons of Total N) into the extremely oligotrophic waters in the area is a potential danger for the abnormal algal and seaweed growth.

The dust from the Vassilikos cement factory is another major source of pollution of the adjacent sea environment. The emissions of 200mg/NM^3 result in the release of 2,000 tons of dust per year. Depending on the wind regime, a large amount of this dust enters the sea.

The blanketing effect of cement on the sea bottom up to a depth of at least 50m is apparent and has heavy adverse effects on the benthic life of the area. (M. Hadjichristophorou, 1991, Ecological study on marine community and ecosystem in relation to the pollution effect on these from the CCF industries in Vassilikos Area).

The Cyprus Petroleum Refinery faces the problem of proper disposal of its oily sludge. This material consists of kerosene and oil, sand, and other sediments and is disposed of in the area close to the sea off the refinery in specially isolated trenches. This type of disposal poses a potential danger for the adjacent sea and involves a quantity of 100 tons per year.

Vassilikos bay is the only sea area that is at high risk and suffers negative impacts from human activities. In this area, the operation of the Vassilikos cement factory results in the introduction of large amounts of dust, into the sea area in addition to clinker during the loading operations at the small port of Vassilikos. The planned new electric power station of 360 MW capacity will increase the risk of environmental degradation of the area.

6. PROPOSED REMEDIAL MEASURES-COST ESTIMATION

The proposed remedial measures with their estimated costs are described in Table 8.

As can be seen from Table 7, the "hot spots" with the highest total weighted score are the five beverage industries. The following are the proposed remedial measures at source for these industries:

(a) Separation of polluted and clean waters with the construction of a new sewer for the clean water. The estimated cost of this measure is about US$60,000 for each industry.

b) Anaerobic treatment of the polluted waters. The treated water will be connected to the Central Sewage System of Limassol. The total construction cost of the treatment plants for the five industries is estimated to be US$2,5 million. A common treatment plant would perhaps reduce the construction cost by 30 per cent. A common treatment plant is feasible as the five industries are situated in the same area and are close to each other.

Detailed descriptions of the treatment proposed for all the above industries are available. More specifically, information regarding the financial estimation for the proposed remedial measures were obtained from the "control of industrial pollution project" carried out by "Haskoning Consulting Engineers and Architects" within the framework of technical assistance to the Government of the Republic of Cyprus.

The installation of new filters at Vassilikos cement factory could reduce dust emissions by 50 per cent and would cost about US$500,000.

The extension of the 200m outfall is a necessity in order to avoid undesirable situations such as abnormal plant growth as a result of the nutrient input into the Moni area. The estimated cost for the extension of the outfall to 1 km is about US$ 2 million.

Treatment of the oily sludge at the Cyprus petroleum refinery is part of the refinery programme for "better housekeeping". The investment for centrifuge separation of the oils, water, solids and eventual incineration of the contaminated solids is estimated to be of the order of US$1million.

It should be stressed that there is no need for other investment to implement the remedial measures such as capacity building, studies to determine quality standards, etc. as these already exist in Cyprus and are applied by the competent authorities.

Table 1

Coastal installations with liquid discharges and/or air emissions

Name of installation	Main activity	Location/area	Liquid discharges Yes/No	Air emissions Yes\No
ETKO LTD	Wines and spirits	Between old and new Limassol Ports	Yes	No
SODAP LTD	Wines and spirits	>>	Yes	No
LOEL LTD	Wines and spirits	>>	Yes	No
KEO LTD	Wines and spirits	>>	Yes	No
KEO B LTD	Brewery	>>	Yes	No
CYPRUS CEMENT CO.	Cement production	Moni area	No	Yes
MONI POWER STATION	Power plant	Moni area	No	Yes
VASSILIKOS CEMENT FACTORY	Cement production	Vassiliko area	No	Yes
DHEKELIA POWER STATION	Power plant	Larnaca	No	Yes
CYPRUS PETROLEUM REFINERY	Refinery	Larnaca	Yes	Yes

Table 2

Pollution loads from industrial liquid discharges into the sea

Source	Geographical position	BOD_5 t/y	COD t/y	T.S.S t/y	Total N t/y	Total P t/y	Metals t/y				POP's	P.H t/y
ETKO (Winery and distillery)	34° 39 36N 33° 01 20E	88	154	33	5.28	0.55	Negligible				NIL	NIL
SODAP (Winery and distillery)	34° 39 48N 33° 01 30E	315	595	75	5.25	0.6	Negligible				NIL	NIL
LOEL (Winery and distillery)	34° 40 00N 33° 01 54E	130	240	30	4.8	0.5	Negligible				NIL	NIL
KEO (Winery and Distillery)	34° 40 29N 33° 01 57E	228	456	114	11.4	1.4	Negligible				NIL	NIL
KEO B (Brewery)	34° 40 29N 33° 01 57E	400	600	80	0.5	1.6	Negligible				NIL	NIL
CYPRUS PETROLEUM REFINERY	34° 56 37N 33° 38 39E	-	99.				Cu	Pb	Hg	Zn		0.018
							0.9	0.04	0.05	0.7		

Table 3

Coastal cities

CITY	Population	Liquid discharges into the sea	Remarks
LIMASSOL	130,000 (1995)	Yes	Disposal at sea of tertiary treated effluents
LARNACA	55,300 (1990)	NO	Treated effluents in stabilization ponds
PAPHOS	13,124 (1992)	NO	Treated effluents to be used for irrigation

Table 4

Pollution loads from municipal discharges into the sea

CITY	Type of discharge	Geographical position	Volume m^3/day	POLLUTION LOADS				
				BOD_5 t/y	CODt/y	TOTAL-N t/y	TOTAL-P t/y	T.S.S t/y
LIMASSOL	Tertiary treated effluents, 200 meters outfall	34° 41.35N 33° 12.40E	6,000	20	140	12	10	4

Table 5

Pollution loads from air emissions

POLLUTION	Geographical position	NO x t/y	SO2 t/y	CO t/y	Dust t/y
DHEKELIA POWER STATION	34° 59 00 N 33° 44 45 E	6,600	23,000	700	750
MONI POWER STATION	34° 43 00 N 33° 09 00 E	2,200	7,600	230	250
CYPRUS CEMENT CO.	34° 43 00 N 33° 10 00 E				500
VASSILIKOS CEMENT FACTORY	34° 43 30 N 33° 18 28 E				2,000
CYPRUS PETROLEUM REFINERY	34° 56 37 N 33° 38 39 E	137	480		16

Table 6

Priority Pollution Hot spots in Cyprus

Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
ETKO	Winery and distillery	2	1	4	3	3	3	12.6	100	WWT	L	550,000
SODAP	do.	2	1	4	3	3	3	12.6	100	WWT	L	720,000
LOEL	do.	2	1	4	3	3	3	12.6	100	WWT	L	500,000
KEO	do.	2	1	4	3	3	3	12.6	100	WWT	L	745,000
KEO B	Brewery	2	1	4	3	3	3	12.6	100	WWT	L	560,000
Sea outfall of Limassol sewerage treatment plant	Domestic	2	1	2	2	2	2	8.9	71	Extension of sea outfall to be 1 km length	L	2 million
Vassilikos Cement Factory	Dust	2	1	3	4	2	3	11.9	94	Improvement or installation of better filters	B	500,000
Cyprus Petroleum Refinery	Metal and oil Contamination	2	1	2	2	1	2	8.1	64	Separation of contaminated material and incineration		1 million
Dhekelia Desalination Plant	Brine	1	1	3	2	1	1	7.5	50	Better disposal of brine	B	

Table 7

Sensitive area in Cyprus

SENSITIVE AREA	Main sources of pollution	Principal supporting data
VASSILIKOS BAY	- Cement factory - dust. - Vassilikos port: dust (cement) during loading operation. - Operation of C.C.F industries 1987 - 1990. This chemical complex stopped operating in 1990. During its operations, large amounts of metal such as Cu, Zn, Fe, Cd entered the bay. - The construction of a new power station of 360 MW capacity.	The effects of pollution on marine communities were severe up to 50 metres depth. - Ecological study on marine communities and ecosystems in relation to the pollution effect from the CCF industries, by M. Hadjichristophorou, Fisheries Officer, 1991. The sea bottom in the east area of the bay has to a great extent been contaminated with the metals Fe, Cu, Zn as a result of the coastal activities of the CCF industries and the cement factory. - Contamination of Vassilikos bay with metals, S. Varnavas, University of Patras, 2nd Symposium of Environmental Science and Technology - Mytiline Sept. 1991

Table 8

Proposed remedial measures

Source/name	Remedial measures	Estimated Cost US $
ETKO	(a) Separation of clean and polluted waters with the construction of a new sewer for the clean water (b) Anaerobic waste waters treatment (c) Installation of measuring devices for tap water	Construction cost: 65,000 Construction cost: 480,000 Running cost: 100,000 Cost per year: 4,000
SODAP	(a)and (b) as above (c) Replacement of heat exchanger in the cooling system by one suitable for brackish water	Construction cost: 40,000 Construction cost: 60,000 Running cost: 125,000 Cost per year: 80,000
LOEL	(a)] (b)] as for ETKO (c)]	Construction cost: 60,000 Construction cost: 435,000 Running cost: 95,000 Cost per year: 4,000
KEO A	(a) and (b) as for ETKO and (c) as for SODAP	Construction cost: 65,000 Construction cost: 480,000 Running cost: 105,000 Cost per year:: 80,000
KEO B BREWERY	(a) Separation of clean and polluted waters with the construction of a new sewer for clean waters (b) Anaerobic waste waters treatment	Construction cost: 60,000 Construction cost: 500,000 Running cost: 60,000
Limassol sewerage sea outfall at Moni	Extension of existing sea outfall to 1 km	Cost: 2,000,000
CYPRUS PETROLEUM REFINERY	Sludge treatment centrifuge separation - concentration and incineration of contaminated materials	Cost: 1,000,000
VASSILIKOS CEMENT FACTORY	Improvement of existing installation with new dust-filters to reduce dust by 50 per cent	Cost: 500,000

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

E G Y P T

Acknowledgements

The questionnaires used for compiling data for this report (23 in all) and the first drafts of this report were prepared in the Alexandria headquarters of the National Institute of Oceanography and Fisheries (NIOF) of the Academy of Scientific Research and Technology by a team made up of:

- *Dr. Aly Ibrahim Beltagy: Professor of Marine Chemistry, Chairman of the Shore Processing Laboratory, NIOF, and National Coordinator for this activity (team leader)*
- *Dr.(Mrs.) Wafica Mohamed Aboul Naga: Assistant Professor, Marine Chemistry Laboratory, NIOF.*
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About this report

This report sets out to identify the priority hot spots and sensitive areas along the Egyptian Mediterranean coastline, applying a methodology developed by the WHO Coordinating Unit in the UNEP Mediterranean Action Plan (MAP) Secretariat in Athens.

It compiles data on municipal and industrial discharges directly into the sea. The data is used to check and substantiate the original selection of hot spots and sensitive areas and to identify the priority ones.

For each of these, the impacts on six aspects (public health, quality of drinking water, aquatic life (including biodiversity), recreation, other beneficial uses and welfare and economy (including marine resources of economic value) are graded. A multi-criteria weighting scale is used to quantify a relative importance index for each priority hot spot.

For each priority hot spot/sensitive area, attempts are made to obtain from amongst the best available data the most reliable information on the optimum remedial actions and their estimated costs.

1. Introduction

The Egyptian Mediterranean coastline (Figure 1) extends for about one thousand kilometers, from the Gaza Strip in the south-eastern corner of the Mediterranean to the Libyan border at El-Salloum. The coastal zone combines a number of localities of intensive socio-economic activity with long stretches of uninhabited coastline. There are four cities along the Egyptian coastline of more than 100,000 inhabitants (Port Said, Damietta, Rosetta, and Alexandria). Alexandria is the largest coastal city with a population of more than 4 million. The Greater Alexandria area is responsible of about 40% of the total industrial production in the country, while its harbour is the main venue for maritime imports and exports.

The coastline receives most of the pollutants associated with the life and activities of the majority of the country's population. This comes either directly from points of discharge in and around the coastal cities, the two branches of the Nile (Damietta and Rosetta), two irrigation canals (Mahmudiya and Nubariya), or from coastal lagoons (Maryut, Idku, Burullus, Manzala and Bardawil) in which drainage canals discharge agricultural, domestic and industrial effluents, or from two drainage canals that discharge directly into the sea (El-Tabya and El-Umum). Along the length of the river Nile, some 70 drains discharge about 4 billion m^3/yr. of mixed drainage waters. Together, these different sources discharge around 8 billion m^3/yr. into the Mediterranean, carrying heavy loads of pollutants (almost 800 million m^3/yr. of sewage, more than 500 million m^3/yr. of industrial effluents and much larger quantities of agricultural drainage water).

The general pattern of circulation in the offshore area of the south-eastern Mediterranean is from west to east. In the near shore areas, there are some deviations from this general pattern and some gyres and convergence zones exist.

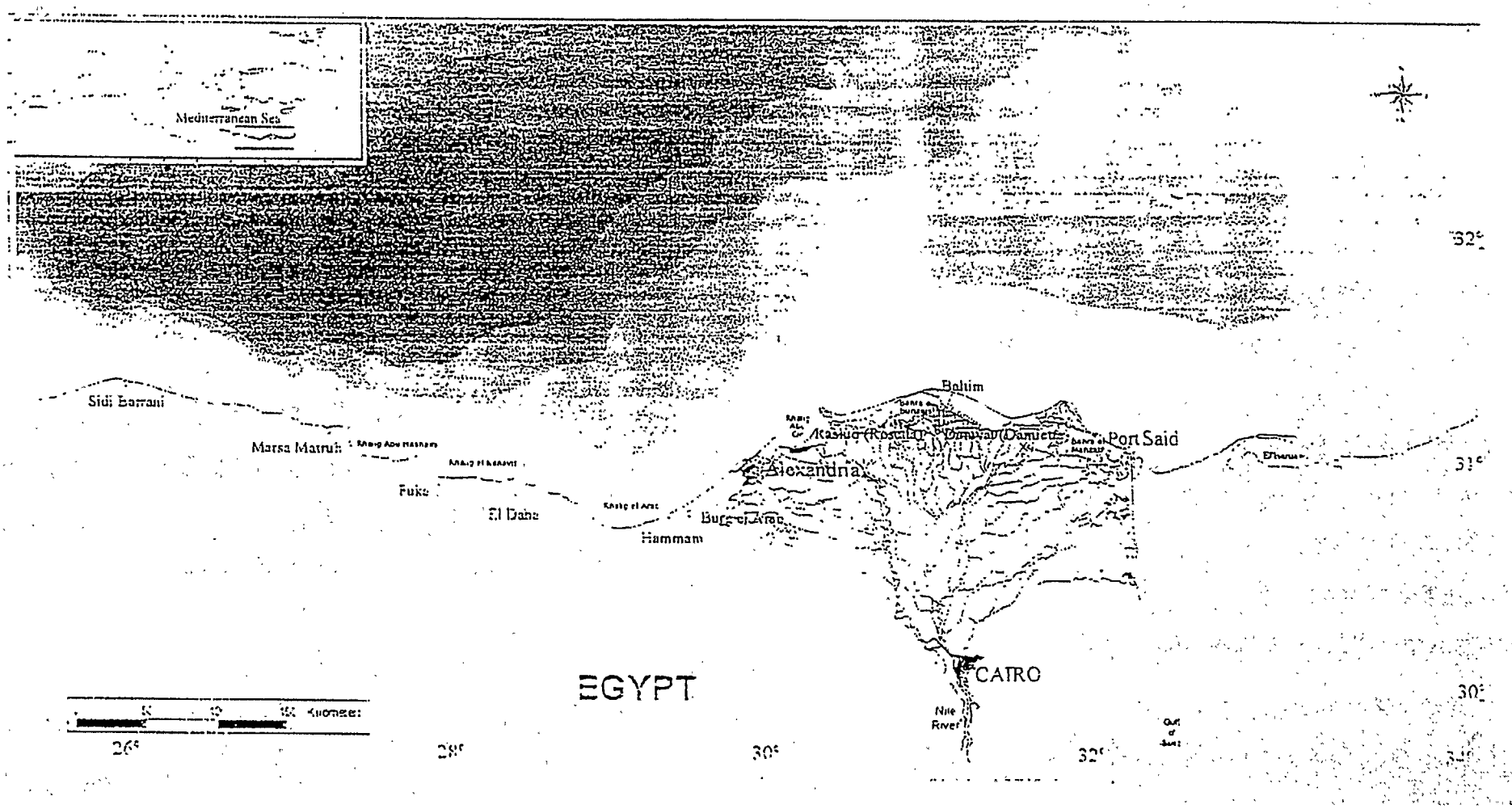

Figure 1. Egyptian coastal water from El-Salloum to El-Arish.

2. Approach adopted in preparing this report:

Work has proceeded in the following sequence of steps:

- Compilation of data on the condition of receiving water along the coastline.
- Preliminary identification of hot spots.
- Compilation of detailed information on hot spots identified, using WHO questionnaires (for municipal, industrial discharges and those of the rivers and other water courses discharging directly into the sea)
- Analysis of results of questionnaires to select priority hot spots
- Ranking of hot spots according to their "weighted total impacts"
- Identifying their transboundary aspects.
- Defining remedial actions and estimating their costs.

3. Data Collection

The data collected falls within two categories. The first is data on the quality of receiving waters. This came mainly from a MEDPOL monitoring programme involving sampling from seven locations (Damietta, Gamasa, Baltim, Rosetta, El-Maadia, El-Mex and Fukah) as well as a compilation of data from various sources on nutrient concentrations along the Mediterranean coast. They covered both nutrients and pollutants. The results are briefly summarised in Section 3.1.

In Section 3.2, the results of data compiled using the questionnaires proposed cover direct discharges into the sea at a number of important locations:-

- Municipal discharges from three cities
- Discharges from the two branches of the Nile (Damietta and Rosetta)
- Two irrigation canals (Mahmuddiya and Nubariya) that end up in the Mediterranean.
- Two drainage canals which carry mixed pollutants originating at some distances upstream of the coastal zone (Al-Tabya and Al-Umum)
- One large lagoon (Lake Manzala) that has several outlets to the Mediterranean
- Industrial discharges at twelve locations (industrial enterprises), mainly in the greater Alexandria area

3.1 State of receiving water

Figure 2 and Table 1 summarise the results of a large scale survey of nutrients carried out in 1994-95 (Beltagy *et al*,1996).

Pollutants monitoring over the period 1992-94, identified five heavy metals in sediments, fish and bivalves samples (copper, lead, zinc, cadmium and mercury). Organo-chlorine pesticides and polychlorinated biphenyls identified included hexachlorobenzene. Lindane, p.p'DDE, p.p'DDD, p.p'DDT, Arachlor and Aldrin. Some apparent trends of decrease in pollutant levels were observed. However, these need to be monitored over longer periods of time to confirm these trends.

3.2 Data on discharges

Data from the 23 discharge points selected is compiled in the questionnaires. Figures 3 and 4 give some indication of the locations of the main discharge points in and around the city of Alexandria and its suburbs.

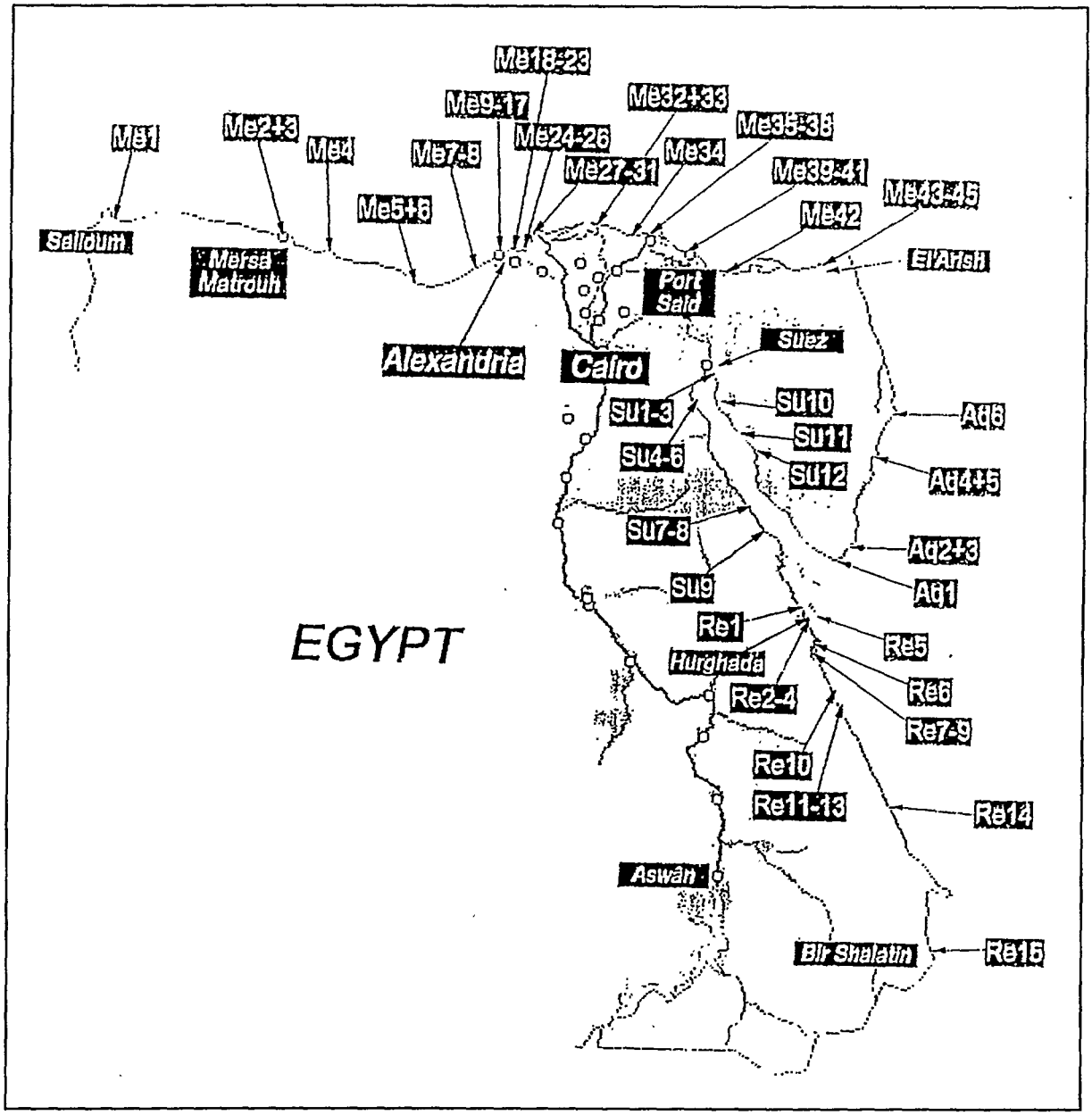

Figure 2. Mediterranean coastal water monitoring (after Jansen and Beltagy, 1997)

Table 1

Nutrient concentrations along the Mediterranean coast of Egypt (See Figure 2)

St. No.	T.P.	Org.P	Nitrate	Nitrite	Ammonia	T.N.	Silicate	Transparency	Chlorophil-a	Reference
Me 1	-	-	-	-	-	-	-	-	-	-
Me 2	2.04	0.04	0.41	0.01	0.96	14.05	1.7	33	0	Fahmy *et al.* (in press)
Me 3	0.75	0.68	0.15	0.01	1.48	3.36	1.01	-	0.04	Fahmy *et al.* (in press)
Me 4	1.82	1.69	0.13	0.08	1.33	42.55	0.09	10.5	0.09	Fahmy *et al.* (in press)
Me 5	1.50	1.29	0.49	0.06	1.59	17.95	1.09	11.5	0	Fahmy *et al.* (in press)
Me 6	0.13	0.13	0.6	0.01	0.97	1.8	1.15	-	-	Fahmy *et al.* (in press)
Me 7	0.92	0.38	0.5	0.55	-	-	18.8	2.5	4.29	Saad & Hemeda 1982
Me 8	1.01	0.44	1.62	0.55	-	-	17.7	1.02	5.67	Mahmoud 1994
Me 9	1.20	1.05	2	0.08	4.25	28.46	-	8.19	2.18	Mahmoud 1985
Me 10	0.19	-	1.8	0.27	0.87		2.45	-	-	Morsy 1994
Me 11	5.64	1.24	18.66		26.82	69.99	-	-	27.66	Mahmoud 1985
Me 11	-	-	-	-	-	-	-	-	2.26	Abu El-Nagah 1979
Me 11	-	-	1.72	0.26	2.28	-	-	-		Mahmoud 1979
Me 11	-	-	8.52	2.57	56.6	-	-	-	0.32	Said *et al.* 1994
Me 11	-	-	5.47	2.73	41.8	-	-	-	1.35	Said *et al.* 1994
Me 11	4.30	1.1	2.5	1.6	3.2	33	8.3	-	-	Fahmy *et al.* 1996
Me 12	-		1.6	1.15	3.77	-	-	-	2.02	Siviadah & Tayel 1992
Me 12	0.92		2	0.56	-	-	17.6	1.92	4.29	Saad & Hemeda 1982
Me 13	10.17	5.94	4.04		49.94	69.33		1.73	4.72	Mahmoud 1985
Me 13	-	-	-	-	-	-	15.2	-	-	Zagloul & Nessim 1990
Me 13	-	-	-	-	-	-	0.03-23	-	-	Zagloul & Nessim 1992
Me 13	-	-	-	-	-	-	2.8 26	-	-	Saad & Hemeda 1992
Me 14	3.35	1.76	1.93	1.69	26.3	-	8.77	5.66	-	El-Nagar 1994
Me 14	-	-	1.32	0.0-1.56	0.0-38.7	-	2	-	1.4	Nessim & Zaghloul 1991
Me 15	-	-	2.07	0.3	2.52	-			-	Mahmoud 1979
Me 15	7.78	3.98	4.07	3.42	28.63	-	4.79	1.69	-	El-Nagar 1994
Me 15	2.81	1.82	4.12	0.56	4.64	9.32	-	1.43	-	Faragallah 1995
Me 15	3.57	2.5	1.09	0.34	3.85	5.99	-	1.45	-	Faragallah 1995
Me 15	-	-	0.36	0.46	1.65	-	9.15	-	-	Mahmoud 1995
Me 15	-	-	1	3.69	6	-	-	-	-	El-Deek & Mahmoud 1988
Me 15	-	-	15	1.59	4	-	-	-	-	El-Deek & Mahmoud 1988
Me 16	3.04	1.4	4.15	0.67	4.48	9.3		1.45	-	Faragallah 1995
Me 17	-	-	0.09	0.34	1.56	-	9.63	-	-	Mahmoud 1995
Me 17	-	-	1.11	0.51	2.76	-	17.43	-	-	Mahmoud 1995
Me 17	-	-	0.04	0.46	1.7	-	4.51	-	-	Mahmoud 1995
Me 17	-	-	0.65	0.41	2.31	-	8.07	-	-	Mahmoud 1995
Me 17	-	-	1.04	0.31	2.16	-	-	-	-	Mahmoud 1979
Me 17	-	-	0.53	0.18	1.6	-	-	-	-	Mahmoud 1979
Me 19	-	-	5.29	0.26	1.65	-	9.58	-	-	Mahmoud 1995
Me 19	-	-	-	-	-	-	-	-	1.13	Abu El-Nagah 1979
Me 20	1.07	0	0.28	0.06	0.01	25.5	0	21	0	Fahmy *et al.* (in press)
Me 21	0.21	0.11	0.28	0	0	0.16	2	5.1	0	Fahmy *et al.* (in press)
Me 21	17	-	-	-	-	75	-	-	-	Mahmoud & Abu El-Hamied 1991
Me 22	20	-	-	-	-	45	-	-	-	Mahmoud & Abu El-Hamied 1991
Me 23	48	-	-	-	-	125	-	-	-	Mahmoud & Abu El-Hamied 1991

St. No.	T.P.	Org.P	Nitrate	Nitrite	Ammonia	T.N.	Silicate	Transparency	Chlorophil-a	Reference
Me 24	2.14	0.32	6.09	1.42	3.62	109.5	8.29	1	1.93	
Me 24	25	-	6.28	0.73	1.88	46	9.51	-	1.24	
Me 25	0.86	0.06	0.59	0	1.25	13.4	0	10	0	
Me 25	30	-	1.96	0.66	1.4	40	5.06	-	1.25	Anon
Me 27	-	-	1.07	0.35	0.94	-	4.5	-	1.08	
Me 27	0.86	0.15	0.42	0	0.41	0.36	2	0.39		
Me 27	0.92	1.56	2.36	1.62	4.49	43.75	33.2	0.163	-	Abu El-Khair 1993
Me 28	4.7	2.27	3.01	2.75	8.53	57.38	54.8	0.135	-	Abu El-Khair 1993
Me 29	4.41	2.31	2.33	2.15	5.58	59.01	61.8	0.125	-	Abu El-Khair 1993
Me 30	3.79	1.8	2.65	2.02	5.58	55.58	25.8	0.143	-	Abu El-Khair 1993
Me 31	3.23	1.68	2.34	2.24	4.51	51.1	34.2	0.155	-	Abu El-Khair 1993
Me 32	-	-	-	-	-	-	--	-	-	
Me 33	0.041	0.038	0.18	0.01	0.29	1.78	1.91	-	-	Ebeid 1993
Me 34	-	-	-	-	-	-	-	-	-	
Me 35	-	-	13.07	2.2	10.52	-	1.32	-	-	El-Deek *et al.* 1994
Me 37	-	-	4.58 18.74	0.2- 2.51	2.31- 11.37	-	0.4 10.13	-	-	El-Deek *et al.* 1994
Me 37	-	-	1.43- 24.78	0.11- 11.30	3.92- 13.73	-	0.35- 10.84	-	-	El-Deek *et al.* 1994
Me 37	-	-	-	-	-	-	-	-	-	
Me 38	-	-	7.69	2.15	5.71	-	7.37	-	-	El-Deek *et al.* 1994
Me 38	8.84	-	57.6	1.71	2.07	-	46.8	1.06	-	Abdel Moali 1981
Me 39	-	-	0.5	0.07	6.33	-	1.8	-	-	Morsy 1994
Me 39	-	-	18.2	7.9	24.43	-	16.76	-	-	Abdel Moali 1981
Me 39	0.15	-	1.84	0.45	0.86	-	4	2.5	-	Morsy 1994
Me 40	-	-	-	-	-	-	-	-	-	
Me 41	-	-	-	-	-	-	-	-	-	
Me 42	-	-	-	-	-	-	-	-	-	
Me 43	-	-	-	-	-	-	-	-	-	
Me 44	0.18	-	1.8	0.17	0.8	-	2.7	-	-	Morsy 1994

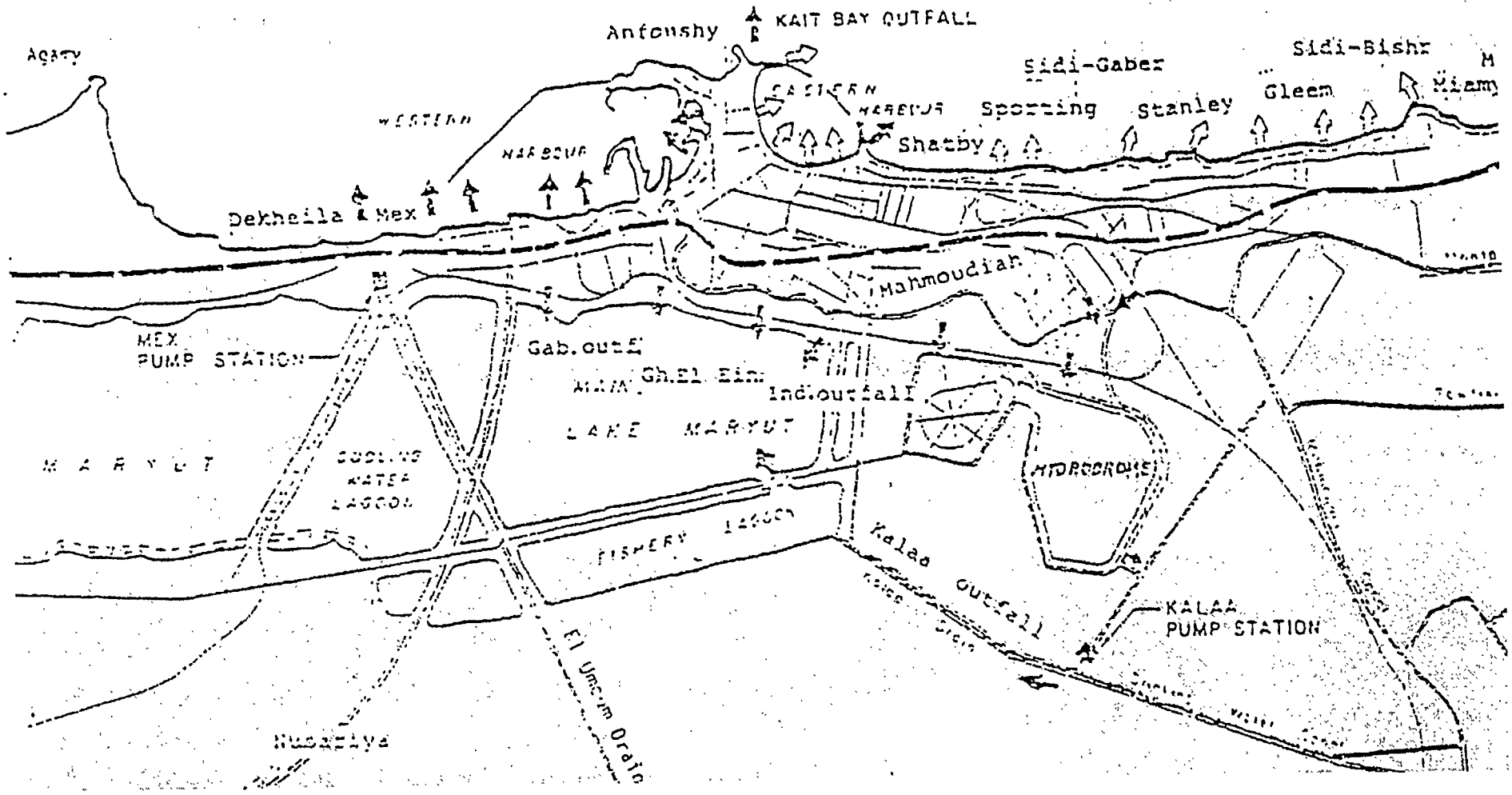

Figure 3. Alexandria coastal water (El-Agamy to Abu-Qir Bay).

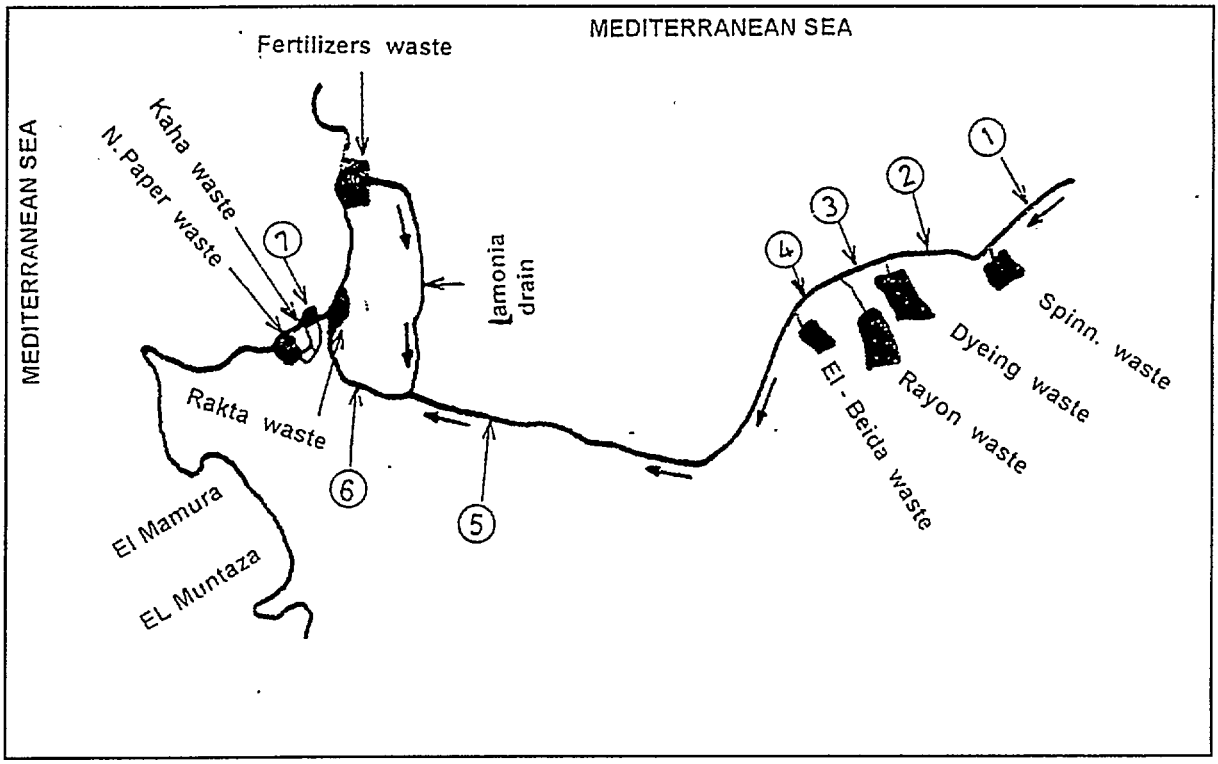

Figure 4. Location of sampling sites along Abu-Qir drain.

(1) Abu-Qir drain before the discharge of spinning waste
(2) Abu-Qir drain after sprinning waste discharge
(3) Abu-Qir drain after dyeing waste discharge
(4) Abu-Qir drain after rayon waste discharge
(5) Abu-Qir drain after Kafr El-Dawaar Industrial Complex
(6) Abu-Qir drain before the discharge of Rakta waste
(7) Tabia pumping station

4. Priority hot spots

On the basis of the data compiled and the methodology proposed in the Guidelines for evaluating their combined impacts, five priority hot spots were identified. These were ranked according to their "weighted total impacts". The results are shown in Table 2. Some figures of pollution loads are summarised in Tables 3 and 4 for the major industrial establishments in the Greater Alexandria area. The pollution loads from rivers and water courses are also given in Table 5.

Fortunately, several environmental audits had already been carried of late for the larger industrial enterprises on the coastline, remedial actions proposed and cost estimates made. The results are given in the list that follows Table 2, and forms part of it. This, however, does not cover all enterprises; but has the advantage of being based on pollution prevention approaches rather than the usual wastewater treatment approach.

5. Priority Sensitive Areas

Unfortunately, many sensitive areas along the Mediterranean coast have already been seriously affected. However, one very valuable area in the Sinai Peninsula (Lake Bardawil) needs to be urgently preserved. The lake has a single outlet to the sea and is rich in valuable fish species. It lies to the north of a national reserve.

However, ongoing and planned development projects (agricultural, municipal, touristic) are potential sources of serious impacts (Beltagi *et al.*, 1996).

6. Identification of main gaps and constraints

The main gaps are the need for more information on:

- concentrations of heavy metals, hydrocarbons and organochlorines.
- the quality of receiving waters, in several places along the Mediterranean, away from the hot spot and about which there are few data at present.

The main constraints:

- have been the short time span for compiling this report, and
- a certain measure of uncertainty and incompleteness about costs of remedial actions. However, the data collected is the most recent and reliable there is.

Table 2

Priority Pollution Hot Spots in the Egyptian Mediterranean Coastline

Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
El-Manzala	Mixed (Wastewater)	6	4	6	5	6	5	26.1	100	WWTP (Rehabilitation)	FHBLP	
Abu-Qir Bay	Mixed	6	1	6	6	6	6	24.9	95	WWTP (Construction)	FHBLP	61.6 million+
El-Mex Bay	Mixed (Wastewater)	6	1	3	5	5	3	19.1	73	WWTP (Construction)	FHBLP	101.2+
Alexandria	Domestic	4	1	4	6	4	3	17.8	68	WWTP (Construction)	FHBLP	In implementation
Damietta	Mixed (River)	6	6	2	2	1	1	16	61		FHBLP	

ESTIMATED INVESTMENTS FOR INDUSTRIAL POLLUTION CONTROL IN ALEXANDRIA

- **ABU QIR INDUSTRIAL AREA**

Establishment	Projects	Investment US$	Source of Inf.
1. RAKTA Paper company	Water Recycling. Waste Minimization. Black Liquor Recovery. WW treatment	60,000,000	UNEP/ Dutch Gov.
2. National Paper company	WW treat. CP	8,000,000	AQ IEMP/STC
3. Abu Qir fertilizers	Urea and AMM. Nitrate recovery. Water Recycling	14,000,000	AQ IEMP/STC
4. ISMADYES	Acids recovery. Process modifications. WW treatment	7,500,000	AQ IEMP/STC
5. Misr Rayon	Chemical recovery. Water Recycling CP, residue processing	5,300,000	AQ IEMP/STC
6. Food (Canning, Milk)	CP, residue processing	5,300,000	AQ IEMP/STC
	Sub-total	101,200,000	

- **MEX INDUSTRIAL AREA**

7. Alex. National Steel	Monitoring Network. Water recycling, acid recovery. WW treatment	8,000,000	EPAP Audit
8. Misr Chemical company	water recycling, chemical recovery	4,500,000	Company estimates
9. El-Nasr tanneries	Chrome recovery. CP WW treatment	8,000,000	EPAP Audit
10.Alexandria Pet. Refinery	Water recycling. DAF, process modifications	12,000,000	Company estimates
11.Amerya Textiles	Color matching. Water recycling, upgrading existing WW Treatment plant	7,600,000	EPAP Audit
12.Egyptian petrochemicals	Chemical recovery process rehabilitation	9,500,000	EPAP Audit
13.Amerya Refinery	water recycling, process modifications	12,000,000	EPAP Audit
	Sub-total	61,600,000	

AQ IEMP/STC is Danish and US technical reports
EPAP Audit is World Bank Project for pollution abatement

Table 3

Industrial pollution loads to Abu-Qir Bay from major industrial company (Tons/year).

Industrial Company	BOD	COD	Total-N	Total-P	TSS	Flow m^3/day
Fertilizer production	362	5140			1770	16,000
Rakta for pulp and paper mill	20624	80470			78050	56,000
National paper	444	2573			377	12,000
Siclam	197	245	1095	913	180	300
Edfina for food preservation	354	347	1132	1971	363	2,800
Kaha company	14.2	48.7	1132	1971	26.3	300
Siouf spinning	622	1866	913	1131	362	5,300
United Arab for textile	2330	3355	913	1131	312.5	2,900
Oriental lines and cotton company	2.3	4.8	913	1131	5.5	2,500

Table 4

Industrial pollution loads to El-Mex Bay from major industrial company (Tons/year).

Industrial Company	BOD	COD	Oil	TSS	Flow m^3/day
Alexandria Petroleum			124-1242		68,360
Misr Chemical			223	189377	35,000
Tanneries and slaughter house	9.9	36.1	75.6	21.5	2,200

Table 5

Rivers and water courses (pollution load Tons/year)

Country	Name	Type	BOD	COD	Total-N	Total-P	TSS	Oil	Flow rate m^3/day
EGYPT	Nile branch at Rosetta	Freshwater	10512	33638	5361	1612	35040	9566	$9.6x10^6$
	Nile branch at Damietta	Freshwater	218124	10906200	219033	23994	7634340	347180	$249x10^6$
	Nubariya Canal	Freshwater	1018	4180	-	-	5815	-	90×10^3
	El-Umum drain	Mixed industrial agricultural wastewater	28470	175200	2081	2628	91433	-	6×10^6
	El-Tabia drain	Industrial wastes	87376	486067	-	-	35746	156971	2.13×10^6

Sensitive area

Country	Name	Justification
EGYPT	BARDAWEEL	This is a lake that has a single outlet to the Mediterranean and is rich in valuable fish species. Extensive development of North Sinai. Channelling Nile water through El-Salam Canal are potential sources of adverse impact on this valuable sensitive area (Beltagy *et al.*, 1996).

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

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Prepared by: Mr Dominique Larré

1. INTRODUCTION

1.1 Method followed towards elaboration of report

According to instructions contact was established with the Ministry of Environment, that provided a list of officers in the Ministry who ought to be consulted as particularly competent regarding various types of pollution, particularly municipal, industrial and nutrient-forming sources. Most were visited, while one sent back written instructions. In turn specialists from the Water Agency for the Rhône Mediterranean-Corsica basin were identified and contacted. Details regarding some individual industrial discharges, as identified through official publications at the national level, were obtained when needed through consulting the relevant Regional administration.

Documentation collected from the Ministry's Water documentation office and Industry and Environment documentation office was also analyzed, as well as from the Rhône-Méditerranée-Corse Water Agency. A list of that documentation appears in the following section.

1.2 Documentation / principal references used

1. Réseau National des Données sur l'Eau : L'assainissement des grandes villes, 1996

2. Réseau National des Données sur l'Eau : Les principaux rejets d'eaux résiduaires industrielles, 1996

3. Réseau National des Données sur l'Eau : Qualité des cours d'eau - Pollution par les nitrates, Edition 1996. Carte.

4. Comité de Bassin Rhône-Méditerranée-Corse, et Préfet coordonnateur de bassin Rhône-Méditerranée-Corse : Schéma Directeur d'Aménagement et de Gestion des Eaux du bassin Rhône-Méditerranée-Corse (SDAGE) -Projet arrêté par le Comité de bassin le 8 septembre 1995 et soumis à la consultation des collectivités territoriales - Volume 1 - Orientations fondamentales, mesures opérationnelles et modalités de mise en oeuvre et Volume 3 - Cartographie des objectifs et des priorités

5. Comité de Bassin Rhône-Méditerranée-Corse, et Préfet coordonnateur de bassin Rhône-Méditerranée-Corse : SDAGE - Atlas du Bassin Rhône-Méditerranée-Corse - Territoire littoral méditerranéen, octobre 1995

6. Comité de Bassin Rhône-Méditerranée-Corse, et Préfet coordonnateur de bassin Rhône-Méditerranée-Corse : SDAGE - Atlas du Bassin Rhône-Méditerranée-Corse - Territoire Petits côtiers Est, octobre 1995

7. Comité de Bassin Rhône-Méditerranée-Corse, et Préfet coordonnateur de bassin Rhône-Méditerranée-Corse : SDAGE - Atlas du Bassin Rhône-Méditerranée-Corse - Territoire corse, octobre 1995

8. Comité de Bassin Rhône-Méditerranée-Corse, et Préfet coordonnateur de bassin Rhône-Méditerranée-Corse : SDAGE - Atlas du Bassin Rhône-Méditerranée-Corse - Territoire Grands côtiers ouest et étangs littoraux, octobre 1995

9. Préfecture des Bouches du Rhône : Arrêté imposant des prescriptions supplémentaires à la Société Aluminium Pechiney à Gardanne, 1er juillet 1996, Article 4

10. Ministère de l'environnement, Carte des zones d'excédent structurel lié aux élevages (découpage cantonal)

11. Ministère des Affaires Sociales, de la Santé et de la Ville, Direction Générale de la Santé, Ministère du travail et des affaires sociales, Ministère de l'environnement : Carte de la qualité des eaux de baignade en mer et en eau douce - Bilan saison estivale 1995

2. Approach followed in identifying hot spots or sensitive areas for the French Mediterranean coast

2.1 Potential municipal hot spots

Urban development of the French Mediterranean coast has led to the growth of a number of new agglomerations, where very dense populations are concentrated in space and also in time, particularly during the summer. These high population densities cause serious sewerage and sewage treatment problems. Existing municipal sewage plants along the coast are not all dimensioned or operated as would be required by the varying population loads and by environmental protection needs. Zones at risk are the largest agglomerations and seaside recreation communities. Urban pressure is compounded by tourism activity, with special reference to the operation of marinas. Bacteriological quality of bathing waters is available in Documentation Reference No 11.

Among major coastal municipal discharges listed in Documentation Ref. No. 1, the main public source of information, specialists from the Ministry of environment identified as potential municipal hot spots four large urban agglomerations for which only primary sewage treatment plants are provided: **Marseille**, **Toulon**, **Cannes** and **Fréjus**. A summary of the data in the relevant questionnaires appear below, chapter 3, as Table 1. Effluents from Montpelier receive secondary treatment and are not discharged directly to the marine environment, thus they were not identified as a potential hot spot according to the criteria posed. However the problems created in the small coastal river Lez itself by the large amounts of treated effluent from **Montpelier** may in the future require the creation of a direct outfall, which in turn might then constitute a hazard for the marine environment. No site for such an outfall seems to have been identified yet.

2.2 Potential industrial hot spots

Industry is broadly sited in specific zones of the French Mediterranean coast. Its development is often linked to port facilities, which permit access and exchange of commercial products.

According to guidance received from the relevant Ministry of environment specialist, to qualify as a hot spot, an industrial site should simultaneously verify two criteria: firstly, it should show significant discharges in relation to all pollution sources; and secondly, it should have a strong potential of reduction because of the absence or insufficiency of past pollution abatement measures. Thus, the yearly national survey regarding the main industrial discharges (Documentation Ref. No 2), a basic public information source, does not by itself permit to identify industrial hot spots. Some form of index of the currently achieved level of pollution prevention and treatment is necessary. This was obtained from the Agence de l'eau Rhône-Méditerranée-Corse.

A sort of iteration process was used. First, an analysis of the pressure along the French Mediterranean coast resulting from industrial activity was achieved using detailed data (available in 1993-1994) shown in Chapter 13 of the Basin-Wide Water Master Plan ("SDAGE") (Documentation Reference No. 5). This identifies fifty homogeneous littoral zones along the

French metropolitan coastline, bordering three regions (Corse, Languedoc-Roussillon, Provence-Alpes-Côte d'Azur). Each zone constitutes a coherent management unit for an integrated approach to best restore and use the littoral fringe (both sea and land). For each zone a detailed map and a one-page, summary identity card provide information regarding four criteria groups: physical, ecological, pressure from human use, environmental quality and pollution loads. From this a summary table, shown below as Table 2, was drawn. That table was discussed with the identified French specialists, who accepted it as useful general background.

2.3 Potentially significant pollution sources from animal husbandry

The development of intensive animal farming in some non-Mediterranean parts of France being recognized as having significant incidence on the coastal and marine environment, was among the questions, i.e. whether any area of the French Mediterranean coast experienced nitrate pollution due to land-spraying practice for the waste from such activity, beyond the natural capacity of sprayed land to accommodate the waste. It was found that no such sites exist in the littoral areas. In the Rhône-Méditerranée-Corse basin, only in the intensive poultry farming zone of the Drôme, many kilometres upstream in the Rhône catchment area, was structural excess (beyond 170 kg nitrogen per hectare) identified. The location of that area, as appearing in Documentation Ref. No 10, is shown as Figure 1 below. Potential residual nitrate pollution of the Mediterranean Sea from the corresponding site, if any, would be included in Rhône river loads.

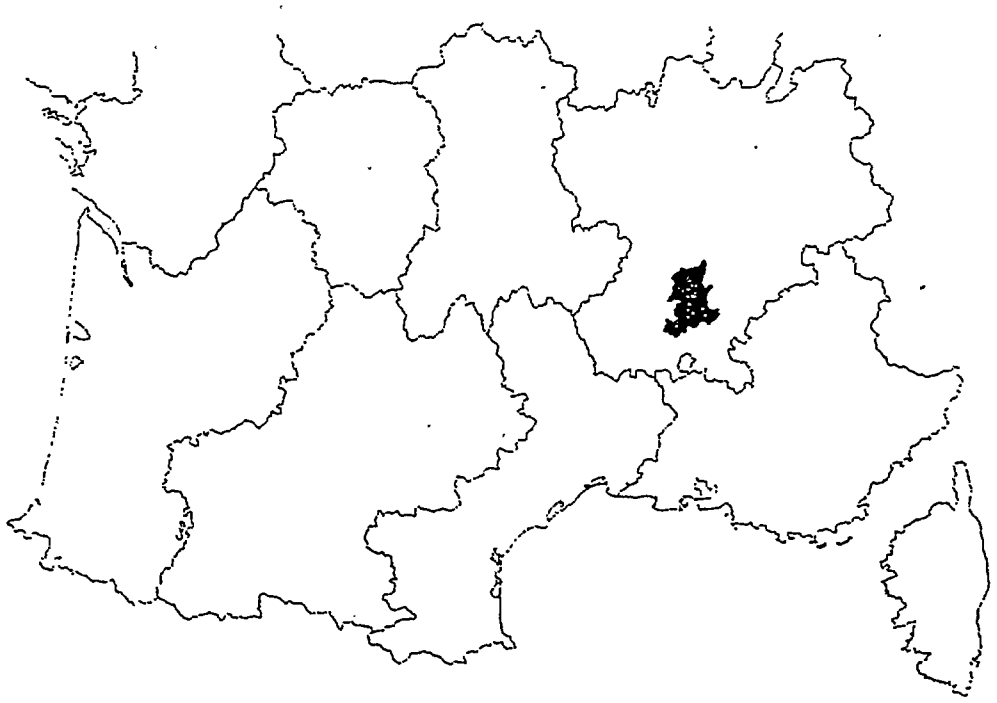

Figure 1.

Animal husbandry sites in Rhône-Méditerranée-Corse basin
characterized by structural excess of nitrogen-rich wastes
(over 170kg N per ha.y)

2.4 Potential sensitive areas

The concept of "sensitive areas" is not to be understood in the specific sense it has in the environmental legislation of the European Union. A sensitive area under the present exercise has been clarified as a coastal zone which does not currently suffer from sufficiently high incidence of pollution to qualify as a pollution hot spot, but which has environmental resources of sufficient value, and/or is at sufficient risk from pollution, that it could possibly become a "hot spot" in the future if conditions were further to deteriorate.

As was explained above (section 2.2), a detailed study of the French Mediterranean coastal zone was implemented on the occasion of the elaboration of the Chapter 13 of the Basin-Wide Water Master Plan ("SDAGE") (Documentation Reference No. 5). This has led to the identification of 50 homogeneous zones, for which detailed information exists on ecological value, human pressure and pollution risks. The seashore area itself has high value on the whole coast. Sensitive zones for the purpose of this exercise were proposed, the zones classified in the SDAGE studies being in the highest risk category.

3. CONTRIBUTION OF POLLUTION SOURCES TO SELECTED HOT SPOT OR SENSITIVE AREAS

3.1 Municipal sources

Table 1

Discharges from main municipal areas of French Mediterranean coast not provided with secondary treatment as of 1997 (Source: Agence de l'eau Rhône-Méditerranée-Corse)

Town	Discharge (equiv. inhabitants)	Treatment level
Marseille	900 000	Primary
Toulon	350 000 (as of June 1997)	Primary
Cannes	180 000	Primary
Fréjus	65 000 + 150 000 seasonal	Primary

3.2 Industrial sources

Table 2

Industrial Pressure in the French Metropolitan Littoral Area
(Source : SDAGE Rhône-Méditerranée-Corse, Chapter 13[1])

Zone Number	Homogeneous Zone concerned	Major type of industrial pressure	Industr. disch. Susp.Sol. T/day (when this appears in the source document)
08	Cap d'Agde-Sète (Est)	Industrial site and harbour zone	
14	Camargue	Industrial discharges into Rhône and Petit Rhône	8
16	Golfe de Fos	Strong industrial and harbour activity (petrochemicals, iron and steel)	1,4
19	Marseille	Industrial stormwater pollution through two small urban rivers, Les Aygalades (Hg) and Huveaune (Cu, Pb...)	
21	Pointe Cassis - Pte de l'Eperon	Industrial outfall (Aluminium Péchiney 7700 meters from shore)	
22	Toulon	Industrial and harbour activities - arsenal, navy base (ships, airplanes)	
26	Saint-Tropez	Navy ship-building	

Table 3

Principal Sources of Isolated Discharges of Industrial Wastewater to the Marine Environment on the French Mediterranean Coast in 1994
Source: Réseau National des Données sur l'Eau (RNDE)

Pollutant type	Estimated discharge loads (tonnes per year)[2]
1) Suspended solids Aluminium Pechiney, Gardanne discharged to: Mediterranean Sea, by outfall	316 000
2) Cyanides SOLLAC, Fos sur Mer discharged to : Mediterranean Sea	1.2

[1] See Document Reference No 4

[2] Annual loads have been roughly estimated by multiplying by 365 the original data, which are expressed in tonnes per day in the information source.

3.2.1 Regarding the "red muds" discharge at sea from the alumina production plant at Gardanne, as condition to recent renewal of the plant's operating permit, there will be an end to the discharge by year 2015, according to the following (ongoing) timetable (see Documentation
Ref. No 9).

Table 3 bis

Aluminium Pechiney, Gardanne
Outfall at Sea (7.7 km from shore)
Timetable for Reduction of Discharge Loads (source: permit)
10^6 tonnes/year Suspended Solids

Year	1986	1990	1995	2000	2005	2010	2015
Load	1.04	0.6	0.33	0.31	0.25	0.18	0

3.2.2 In discussion with regional specialists it was shown that the cyanide-containing effluent from the SOLLAC coking plant:

(1) goes through full biological treatment before discharge, and
(2) is discharged for further dilution into a separate "darse", or large harbour section, not planned for any health-related or ecologically sensitive use,

and thus does not constitute a hazard of hot spot character.

4. RANKING OF HOT SPOTS, SENSITIVE AREAS

4.1 Ranking of hot spots

4.1.1 Criteria towards the ranking of hot spots have been provided and the prioritization of the selected hot spots is to be drawn from an evaluation of the potential risks exerted by the relevant point sources and their effects:

- on public health, interpreted by consultant as risks to human health from direct (normally recreational) contact with seawater and from ingestion of polluted seafood;
- on drinking water quality (apparently not to be considered as all considered discharges are to the sea);
- on recreation (interpreted as non-health hazards of amenity character);
- other beneficial uses;
- aquatic life (interpreted to include risks to natural and aquaculture fish production, as well as to broader ecosystem quality including algal diversity, etc..);
- economy/welfare.

However, the judgement of the relevant national authorities regarding the relative urgency of alternative pollution abatement investments may be in fact based on other criteria, such as compliance with national law and with internationally adopted directives and

implementation timetables, such as those that have been or may be adopted in European Union or Barcelona Convention frameworks. States that are members of the European Union have set themselves the goal of a high level of environmental quality which may lead to investments that go beyond the results of immediate economic cost-benefit analysis.

4.1.2 As explained above, French authorities have conducted detailed analyses towards elaboration of the basin-wide water management masterplan (SDAGE). Table No 5 summarizes the information drawn from Documentation Reference No 4 (SDAGE Chapter 13) regarding the main resources at risk from the selected hot spot zones, as well as a listing of main relevant risks.

In evaluating one potential hot spot area in comparison with another, the following should be kept in mind:

A homogeneous littoral zone classified as " J " in the SDAGE study typology is potentially at risk. It is subject to brutal ecological evolution, should the environment's resilience capacity decrease.

A homogeneous littoral zone classified as " I " in the SDAGE study typology is in the longer run menaced with ecological degradation under the effects of anthropogenic pressure.

Table 4

French Mediterranean Coast - Potential Pollution Hot Spots Hot Spots

Country	Name	Type	PublicHealth	Drinking Water Quality	Aquatic life	Recreation	Other Beneficial Uses	Welfare and Economy[3]	Weighted Total[1]	Relative Importance Index	Nature of Investment	Transboundary Aspects	Preliminary Estimated [4]Financial Requirement (in US$)
FRANCE	Marseille	Municipal	2	1	3	3	3	3	11.9	100	Secondary treatment plant[3]	L, F	110 million
	Toulon	Municipal	2	1	2	3	2	3	10.4	87	Secondary treatment plant[3]	L	40 million
	Cannes	Municipal	2	1	2	3	2	3	10.4	87	Secondary treatment plant[3]	L	32 million
	Fréjus	Municipal	2	1	2	3	2	3	10.4	87	Secondary treatment plant[3]	L	18 million
	Gardanne	Industrial	2	1	3	1	2	5	10.9	92	Implement investments required by new permit[2]	low, B	n.a.

1. Weighting factors are shown between brackets
2. Stepwise reduction of discharge quantities according to permit timetable shown in Table 3 bis.
3. The main framework of investing in higher sewage treatment level is regulatory, in accordance to national legislation translating the relevant European Directive (Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment).
4. Informal communication from Agence de l'eau Rhône-Méditerranée-Corse.

Table 5

Zones of the French Mediterranean Coast Preliminarily Identified as Hot Spots

RESOURCES AT RISK AND MAIN RISKS
Source: SDAGE Chapter 13, Documentation Reference No 4

Zone Number	French Littoral Zone Designation and Class	Main Resources at Risk	Main Risks and Risks Factors
19	Marseille (" J " Zone)	Fisheries spawning and growing areas Fishing resources : diversified but not abundant Natural shellfish sites Posidonia	Stormwater pollution of toxic character through two small coastal rivers (Hg, Cu, Pb), and more generally urban zone stormwater problems Accidental pollution from sea traffic Commercial harbours : dredging waste disposal problems Marinas : 7700 boat spots
22	Toulon (" J "Zone)	Fisheries spawning and growing areas Natural and aquaculture shellfish sites Posidonia Tourism, beaches	Heavy sewage discharges (improvement foreseen June 1997 through new sewage plant providing full primary treatment for the area) Pollution at mouth of Eygoutier river, stormwater pollution Industrial and harbour activities - arsenal, navy base (ships, airplanes) Caulerpa taxifolia site Maritime traffic accidents Marinas and boat repair : 3030 boat spots

(continued ------->)

Table 5 (continued)

Zones of the French Mediterranean Coast Preliminarily Identified as Hot Spots

RESOURCES AT RISK AND MAIN RISKS
Source: SDAGE Chapter 13, Documentation Reference No 4

Zone Number	French Littoral Zone Designation and Class	Main Resources at Risk	Main Risks and Risks Factors
28	Cannes (" I " Zone)	Fisheries spawning and growing areas Diversified fishing resources Natural shellfish sites Posidonia	Some heavy metal (Zn, Pb) and bacteriological pollution Moderate municipal discharges Moderate eutrophication Marinas : 3371 boat sites Receives floatable wastes from the East (current)
27	Fréjus (" I " Zone)	Fisheries spawning and growing areas ; Fishing resources : highly diversified Natural shellfish sites Posidonia	Moderate anthropogenic pressure Marinas : 2949 boat spots
21	Gardanne (" I " class)	Fisheries spawning and growing areas Fishing resources : highly diverse, not abundant Natural shellfish sites Posidonia	Marinas : 4568 boat spots River-carried pollution loads, some mouths right on beaches Municipal wastewater discharges moderate Industrial discharge to the sea (Aluminium Péchiney) 7700 meters from coast

4.2 Sensitive areas

As explained above, it has not been attempted to derive an original ranking of sensitive areas for the present study. Instead, the ranking established at national level, on the basis of extremely detailed and thorough evaluation of available information and data, has been used. Among the " homogeneous littoral zones "classified in the highest risk category (category " J " in Documentation Reference 4), some have been selected as " hot spots ". The sensitive areas presented in this report are " J " zones that are not hot spots.

Table 6, on the next page, provides information on the location of these priority sensitive areas, as derived from Reference 4. For each area, the table provides information on main resources at risk, as well as on main risks faced by these resources.

In the detailed SDAGE studies, no " homogeneous zone " of the Corsican elements of the French metropolitan coast were classified in the highest risk category (category " J "). At the Consultation Meeting of Regional Experts on the report on " Regional Pollution Hot Spots and Sensitive Areas ", Athens, 7-9 April 1997, the expert from Italy listed the Northernmost area of Sardinia, island of Italy, and the Bouches de Bonifacio straits as a sensitive area. A number of experts in the Consultation Meeting and representatives of the MAP Secretariat believed that it would accordingly useful if the report for France could include information on the corresponding French area. This is presented in Table No 7.

Table 6

Sensitive areas, French Mediterranean coast
Resources at Risk and Main Risks
Source: SDAGE Chapter 13, Documentation Ref No 4

French Littoral Zone Numbers	Designation and Class under SDAGE Study Typology	Main Resources at Risk	Main Risks and Risks Factors
2	COLLIOURE - CAP LEUCATE and associated ponds-lagoons	Fisheries spawning and growing areas High fishing resources Natural shellfish sites Posidonia Protected area at the mouth of Tech river	Eutrophication (from small rivers of mediocre quality) Toxic phytoplankton Marinas : 5 775 boat sites
7 to 10	CAP LEUCATE - L'ESPIGUETTE	Fisheries spawning and growing areas High fishing resources Natural and aquaculture shellfish sites, some very large Zostera Tourism, beaches	Accidental pollution, pollution from rivers Some pesticides and tributyltin Contamination from treated urban effluent Envisaged modification (from small river to sea outfall) of discharge point for Montpelier treated sewage
16	RHONE MOUTH - FOS GULF	Fisheries spawning and growing areas, exchange of juveniles with Etang de Berre Posidonia, Zostera RAMSAR zone	Eutrophication Rhône-carried pollution loads Bacterial contamination of shellfish Accidental marine pollution (navigation, harbour activity) Marinas 1550 boat sites

Table 7

Potential Additional Sensitive Site

Source of information: Data from SDAGE Chapter 13, Documentation Ref No 4
(Note: highest priority not suggested for this zone by SDAGE ranking[1].
This site listed for further investigation at the request of experts convened at
Consultation Meeting of Regional experts, Athens, 7-9 April 1997)

French Homogeneous Littoral Zone Number	Designation and Class under SDAGE Study Typology	Main Resources at Risk	Main Risks and Risks Factors
41	Bonifacio (" G " Class)	Diversified and abundant fish resources Natural shellfish Posidonia Classified sites : Natural Marine Reserve (Lavezzi Islands), EU Bird Reserve	Navigation wastes Accidental pollution Maritime traffic in Bouches de Bonifacio

1. In the SDAGE study typology a Class G homogeneous littoral zone is to be considered as a reference zone for the whole Mediterranean shore. It is characterized as showing: high ecological wealth, low to moderate anthropogenic pressure, inputs and environmental quality from good to average.

5. MAIN GAPS AND CONSTRAINTS

Main gaps and constraints regarding the elaboration of this report can be listed as follows:

- Unavailability of economic cost elements for the Aluminium Pechiney discharge at Gardanne.
- Absence of prioritization according to the project methodology among identified sensitive areas. This is because the French Coast has been divided into 50 homogeneous zones and that the few sensitive areas selected among these 50 for the sake of this report have been categorized into the highest risk class.
- Unavailability of economic cost elements concerning identified sensitive areas.

6. PROPOSED OPTIONS FOR REMEDIAL ACTIONS

Proposed actions to remedy the situation are:

- Extension of municipal wastewater systems to reach requirements of relevant European Directive, as transcribed into national law, for Marseille, Toulon, Cannes and Fréjus. An evaluation of corresponding costs appears in Table 4 above. A list of resources concerned, constituting a qualitative list of the main type of benefits to be expected from the implementation of the investments, appears in Table 5. This however does not appreciate the potential value of the potentially increased tourism carrying capacity
- Implementation of the programme of reduction of industrial discharges from the Aluminium Pechiney plant in Gardanne, as given in Table 3. No evaluation of the cost of the required investment was available, but the waste discharge reduction is a condition of the newly revised operating permit.
- Implementation of the Rhône-Méditerranée-Corse Water Management Masterplan (SDAGE), which *inter alia* lists required actions in the Rhône basin and the coastal river catchment areas to conciliate the environmental objectives of the Mediterranean Sea and its French coastal areas with the upstream water use requirements.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

GREECE

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Ms Ziogou	*Sewerage organization of Thessaloniki*
Mr Soupilas	
Mr Vlahonis	*Institute of Marine Biology of Crete*
Mr Varnavas	*University of Patras*

Prepared by: Mr Dimitrios Tsotsos

1. INTRODUCTION

1.1 Current Situation

Greece, as a member of the European Union, is currently undertaking a serious attempt to harmonize its whole legal, administrative and technical framework with the requirements of EU legislation and policy. For wastewater management, two EU Directives provide the guiding principles to be followed in order to deal successfully with the growing problems of effluent discharge into the environment:

- Directive 271/91 (collection, treatment and disposal of municipal discharges);
- Directive 337/85 (environmental impact assessment).

The adoption of these Directives allows the practical application of well-defined effluent quality standards and effective monitoring of the environmental conditions to be met by any enterprise emitting pollution loads into the environment.

The construction and operation of wastewater treatment systems for urban agglomerations and industrial units is subject to the relevant authorization procedures imposed by the state authorities at the regional and central levels. Under these procedures, effluent limit values and the respective treatment/disposal requirements are fixed and monitored according to the prevailing specific conditions, i.e. quality of the receiving environment, industrial production processes etc.

For industries connected with municipal collection/treatment systems, technical prescriptions for the pretreatment of industrial discharges up to the level of raw municipal effluents are set and controlled by the sewerage companies.

Accordingly, a comprehensive and operational regulatory system for municipal and major industrial discharges is applicable throughout the country, and the on-going construction programme will cover the remaining major cities with adequate collection, treatment and disposal systems.

Additionally, the quality of water recipients is continuously studied and controlled by various scientific institutions in the context of the ongoing MEDPOL programme and other research studies.

1.2 Elaboration of the survey

Mr A. Laskaratos, MAP liaison officer (University of Athens), and Ms A. Lazarou, MEDPOL national coordinator (Ministry of Environment, Physical Planning and Public Works), have been appointed as focal points for the collection and evaluation of the data needed for the preparation of this report. This task has been performed in cooperation with the scientific institutions taking part in the MEDPOL programme, as well as with the relevant central and regional authorities in charge of the enforcement of effluent standards.

For the requirements of this report, data were obtained from various central and regional authorities after detailed enquiries. This "scattering" of information, added to the fact that each authority keeping the relevant data has its own specific needs, does not always allow a unified basis for data interpretation. Additionally, the lack of computerized archives at regional level, where the analytical results of effluent concentrations are kept, impeded the rapid retrieval of the data required within the given time limits for this report. These two factors, together with a certain degree of data confidentiality, have affected to some extent the information provided for industrial effluents. More details are given in Chapter 5 (gaps and constraints).

2. IDENTIFICATION OF HOT SPOTS AND SENSITIVE AREAS

2.1 Methodology

For the identification of hot spots and sensitive areas, the following criteria were chosen and they reflect the philosophy and scope of this exercise:

(a) identification of all coastal cities with a population of more than (or approximately) 100,000 inhabitants;

(b) identification of coastal areas with accumulation of urban and industrial activities;

(c) identification of coastal areas where single large industrial units are located;

(d) selection of coastal areas from the list of Greek sensitive areas (according to EU Directive 271/91), which are subject to potential risks due to human activities;

(e) examination of the conditions of the quality of water receiving bodies.

2.2 Pre-selection of hot spots and sensitive areas

Synthesis of the above-mentioned criteria has yielded a list of coastal areas (Table 1), which are classified below (chapter 4) into priority hot spots and sensitive areas on the basis of the data collected and evaluated (Chapter 3).

Table 1

Potential hot spots and sensitive areas

Coastal area	Main city	Population equivalent (p.e.)	Main activities
Inner Saronic gulf	Greater Athens area	3,345,000	Municipal, industrial
Elefsis bay	-	-	Industrial
North-Western Saronic gulf	-	-	Industrial
Thermaikos gulf	Greater Thessaloniki area	1,330,000	Municipal, industrial
Patraikos gulf	Patra	180,000	Municipal, industrial
Gulf of Heraklio	Heraklio	117,000	Municipal, industrial
Pagasitikos gulf	Volos	96,000	Municipal, industrial
Larymna bay (N.Evoikos gulf)	-	-	Industrial
Nea Karvali bay	-	-	Industrial
Amvrakikos bay	Preveza, Arta[1]	47,500	Municipal, agricultural
lagoon of Mesologgi	Mesologgi	18000	Municipal

[1] via river Arahthos

3. POLLUTION SOURCES

In Table 2, the potential hot spots and sensitive areas are presented in correlation with the characteristic values of parameters showing the order of magnitude of the measured/ calculated negative impacts caused in each particular coastal area

Table 2

Assessment of pollution

Coastal area	Main pollution sources	Hydraulic load (m3/day)	Parameter : tn/year
Inner Saronic gulf	Municipal, industrial (connected with municipal sewerage network)	660,000	BOD_5: 59385 COD: 118770 TSS: 42815
Elefsis bay	Industrial	13,200	BOD_5: 61 COD: 446
North-Western Saronic gulf	Industrial	2,950	BOD_5: 21.5 TSS: 5.4
Thermaikos gulf	Municipal, industrial	316,000	BOD_5: 25657
Patraikos gulf	Municipal, industrial	53,200	BOD_5: 6417 COD: 13052
Gulf of Heraklio	Municipal, industrial	21,500	BOD_5: 771 COD: 1422 TSS: 699
Pagasitikos gulf	Municipal, industrial	15,000	BOD_5: 657 COD: 1095
Larymna bay (N.Evoikos gulf)	Industrial	171,600	COD: 7516 TSS: 2505
Nea Karvali bay	Industrial	101,230	BOD_5: 295 COD: 739 Total-N: 625 Total-P: 126 Fe: 3.7 Zn: 2.6
Amvrakikos gulf	Municipal, agricultural	9,340	BOD_5: 351
Lagoon of Mesologgi	Municipal	3,910	BOD_5:28 TSS:28 Total-N:56 Total-P:11

4. RANKING OF HOT SPOTS AND SENSITIVE AREAS

4.1 Introduction

In this chapter, the selected hot spots and sensitive areas have been prioritized by evaluating the potential risks exerted by the relevant point sources and the effects on public health, drinking water quality, recreation, other beneficial uses, aquatic life, and economy / welfare.

The weighted ranking system and relevant explanations (documentation) have been used for this purpose. Relevant factors and multipliers were also extensively used in this analysis. Where there was no information, experience and documentary references were used in order to formulate a fairly reliable picture of the prevailing conditions.

Paragraph 4.3. summarizes the results of applying this system and provides estimated cost figures for remedial action. The main elements and the justification for this action are described in Chapter 6.

4.2 Comments and remarks on criteria/explanations

4.2.1 Public health

Disinfection is always applied before final discharge. In addition swimming is generally prohibited around effluent discharge points, so the probability of direct contact with human beings is extremely unlikely.

Therefore, only the BOD_5-load/heavy metal concentration is taken as a limiting factor.

4.2.2 Aquatic life

The degree of oxygen depletion by municipal/industrial discharges cannot be assessed in the context of this study, especially to the required degree of accuracy (below exact concentration values). Other criteria (heavy metal/oil concentrations), therefore, have to be considered.

Even here, however, the words "any discharge" without assessment of the relevant hydraulic loads, can be misleading. Therefore, ratings were based on the significance of discharge (lower marks for small quantities).

4.2.3 Economy and welfare

The impact of industrial activities on the local economy is usually based on economically crucial figures such as production capacity, number of employees, exporting potential, etc. If these data cannot be assessed, then conclusions are inevitably drawn from the pollution potential caused (hydraulic-pollution loads). In this case, ranking values are given on a comparative basis (number of large industries around a hot spot).

Moreover, the proposed investment figures (US$ 5 - 20 million) mostly apply to very large single industrial units, in the case of industrial agglomerations (industrial zones), or are the total for various interventions for several industries discharging separately at the same hot spot-sensitive area.

Where no industrial effluents are discharged (only municipal effluents), a rating of 2 has been used (slight effects).

4.3 Priority hot spots and sensitive areas

Table 3 summarizes the final results of the weighted ranking analysis and the preliminary cost estimations for remedial actions.

5. IDENTIFICATION OF GAPS AND CONSTRAINTS

5.1 General comments

Data for municipal discharges and for the quality of the water receiving bodies could be relatively easily collected by reviewing past and ongoing MED POL studies and consulting recently installed operational databases at central (ministerial) level.

It should be noted, however, that measurements do not cover the same parameters in all coastal areas, so an integrated and comparative evaluation of the quality of water receiving bodies could not always be made (water, sediments, biota).

Concerning industrial effluents, the organization of data has not progressed so far, so therefore, time consuming contacts with the relevant authorities (Ministry of Industry, Energy and Technology, Industrial Development Bank, regional institutions) and reviews of detailed environmental impact studies of single industrial installations were needed to extract the necessary data for the questionnaires.

For those units connected with municipal sewerage systems, in particular, the lack of computerized data organization did not allow the assessment of relevant pollution loads / population equivalents requested in the questionnaires. A rough estimation could only be made for the grater Athens area.

5.2 Basic assumptions - findings

5.2.1 Municipal discharges

- Wastewater quantity : 125 l/cap.day

5.2.2 Industries connected with the Athens sewerage network

Data : - not recently renewed
- based on water consumption

5.2.3 Industrial areas in Thessaloniki, Patra, Heraklio, Volos (agglomeration of industries served by a central treatment system)

Data : - central treatment plant only
- no information for each connected industry

Result: - calculation of each industrial area as a single source

Table 3

Priority hot spots - sensitive areas

Country	Name	Type HS, SA*	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of Investment	Transboundary aspects	Preliminary estimated financial requirement (in millions of US$)
GREECE	Thermaikos gulf	Municipal, industrial HS	6	1	4	3	4	6	19.5	100	Expansion of plant & industrial feasibility studies	L	- explansion of plant: 40 - feasibility studies (2) : 0.6
	Inner Saronic gulf	Municipal, industrial HS	6	1	4	3	4	6	18.8	96	Secondary treatment	L	130
	Patraikos gulf	Municipal, industrial HS	5	1	4	4	4	4	17.9	92	Treatment plant & outfall	L	15
	Pagasitikos gulf	Municipal, industrial HS	3	1	2	4	3	4	13.7	70	Expansion of plant	L	8
	Gulf of Heraklio	Municipal, industrial HS	3	1	2	3	3	4	12.9	66	-	L	-
	Elefsis bay	Industrial HS	3	1	3	2	1	6	12.6	65	Industrial feasibility studies		0.6
	North-Western Saronic gulf	Industrial HS	3	1	2	2	1	5	11.2	57	Industrial feasibility studies		0.3

* HS = hot spot, SA = sensitive area

Table 3 (Continued...)

Country	Name	Type HS, SA*	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of Investment	Transboundary aspects	Preliminary estimated financial requirement (in millions of US$)
GREECE	Larymna bay	Industrial HS	3	1	3	2	1	4	11.2	57	Industrial feasibility studies		0.3
	Nea Karvali bay	Industrial HS	2	1	2	2	1	4	9.5	49	Industrial feasibility studies		0.3
	Amvrakikos gulf	Municipal, agricultural SA	2	1	2	2	2	2	8.9	46	Treatment plant & outfall	L	11
	Lagoon of Mesologgi	Municipal SA	1	1	2	1	1	2	6.3	32	-		-
											Capacity building/monitoring		

* HS = hot spot, SA = sensitive area

6. REMEDIAL ACTION

6.1 Conclusions

Data review has shown that effluents from the major point sources are adequately treated before final discharge into the marine environment, and plants currently being constructed will soon be operational.

Consequently, suggestions for remedial action focus mainly on capacity-building and industrial pollution prevention, with cost estimations for the necessary feasibility studies. Cost figures for remedial action for municipal discharges refer to the ongoing construction programmes and were provided by the respective authorities.

6.2 Description of remedial actions - cost figures

6.2.1 Municipal discharges

In Table 4, the planned remedial action for major Greek cities is listed according to existing plans.

Table 4

Remedial action for municipal discharges

City	Type of intervention	Budget (mil.$)
Greater Athens area*	Secondary treatment (planned)	130
Greater Thessaloniki area	Expansion of existing plant: additional capacity (+600000 p.e.) & tertiary treatment - submarine outfall (under construction)	40
Patra	Primary - secondary - tertiary treatment & submarine outfall (under construction)	15
Volos	Expansion of existing plant: secondary treatment (planned)	8
Preveza	Primary - secondary - tertiary treatment & submarine outfall (under construction)	11

* Greater Athens area includes the following: Inner Saronic gulf, Elefsis bay, North-Western Saronic gulf.

6.2.2 Industrial discharges

Most of the industries connected with the Athens municipal sewerage network have already applied water-saving measures, in order to face the acute water shortage situation during the period 1992-95.

Any waste minimization techniques (clean technologies) therefore have to focus on savings of raw materials, chemicals and energy.

This is also the case for the large installations directly discharging into the sea, which apply some efficient water recycling methods.

Nevertheless, some improvements can be made (i.e. use of cooling water for some cleaning purposes). End-of-pipe treatment systems are continuously operated by all industrial plants directly discharging their effluents into the sea.

A case-by-case approach for all listed industrial hot spots will certainly reveal technically and economically attractive methods of pollution prevention, water recycling, etc. Relevant concrete projects will emerge after detailed feasibility studies dealing with all necessary aspects for each method have been elaborated: investment / operational costs, environmental impact, modification of production processes, etc.

Estimated cost of each study : approx. US$ 300,000.

6.2.3 Capacity-building / monitoring

Information flow concerning industrial activities at the regional and central levels must be improved (frequent effluent sampling, computerization and updating of archives, reporting). Efficient self-monitoring of industries' environmental performance has to be encouraged and controlled by the state authorities, especially in the case of smaller industries connected with the municipal sewerage system.

A programme for a detailed source inventory of industrial effluents covering the whole country will soon be launched by the Ministry of the Environment. This will be compiled by local authorities and authorized institutions (i.e universities) by using branch-specific questionnaires, rapid assessment methods and targeted sampling-analysis of effluents. It is expected that after this has been done, there will be a computerized system at the central level with all the information needed for effective monitoring of industrial pollution.

Estimated cost : US$ 1 million.

DOCUMENTATION

• World Health Organization: (Regional Office for Europe)	Identification of pollution hot spots and sensitive areas, 1997
• Ministry of Environment, Physical Planning and Public Works:	Evaluation of sensitive and less sensitive areas (by ENVECO S.A.), 1994
• Ministry of Environment, Physical Planning and Public Works:	River water quality, 1994
• National Centre of Marine Research:	Pollution research and monitoring programme in the Saronic gulf, 1996
• University of Athens :	Monitoring programme in the Saronic gulf, 1996
• Institute of Marine Biology of Crete:	MED-POL monitoring programme of pollution sources in Crete, 1996
• Institute of Marine Biology of Crete - University of Crete:	Long-term programme for pollution monitoring and research in the Mediterranean Sea (MEDPOL) - Crete, 1996
• University of Thessaloniki:	Monitoring of Thermaikos - Strymonikos - Kavala gulf (MEDPOL - programme), 1996
• University of Patras:	Long-term programme for pollution monitoring and research in the Mediterranean Sea - Patraikos gulf, 1996

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

ISRAEL

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Prepared by: Mr Louis J. Saliba

1. INTRODUCTION

The survey questionnaires were prepared by the Marine and Coastal Environment Division of the Israeli Ministry of the Environment. Data for completion of the questionnaires were compiled from information already available at the Ministry. Other data, mainly concerning investment costs for remedial action, were obtained from the relevant Authorities.

In general, municipal sewage undergoes treatment and the treated effluent used for irrigation or, in some cases, for recharging aquifers. Under Israeli law, industries are required a permit to discharge their wastes directly into the sea, or into rivers, which eventually carry the wastes out to sea. Conditions for the granting of permits are determined by the Ministry of Environment, which imposes upper limits on pollutant concentrations in such discharges. The Ministry also imposes treatment at source if considered necessary, and also monitors the enforcement of the law. According to permits actual monitoring of pollutant concentrations in effluents is performed by the industries themselves which, however, must have the analyses performed by an approved laboratory, and must submit the original laboratory analysis certificate. Random checks are carried out by the Ministry, which takes samples and has them analysed by a laboratory other than the one performing the original analysis.

The main problems are in the Tel-Aviv region where all municipal waste, along with that from a number of industries, undergoes treatment. The resulting sludge is disposed of at sea through a 5-km long submarine outfall, creating a potential pollution problem. In the other main coastal city, Haifa, the existing wastewater treatment plant has insufficient capacity to cope with current requirements, and treatment is incomplete. There is also a sludge washout from time to time. The excess treated wastewater (i.e. that which cannot be used for agriculture) is disposed of by discharge into the Kishon river which, in turn, discharges into Haifa Bay. There are two small coastal towns (Akko and Nahariya) the municipal waste from which only undergoes primary treatment before discharge into the sea.

Haifa Bay is considered to be the most critical area, not only because of industrial discharges by coastal industries, but mainly because it receives pollutants through the two rivers, the Kishon and the Naaman, of which the former carries the larger pollutant load.

2. APPROACH

It was recognised by the Israeli Ministry of the Environment that the current exercise was one mainly in connection with priority pollution hot spots and sensitive areas, as distinct from a comprehensive survey of all land-based pollution. For this reason, care was taken in pre-selection of localities when completing the questionnaires.

Insofar as municipal hot spots are concerned, the three areas selected were Gush Dan (the Tel-Aviv region), because of the sludge problem, discharged through the Yalmachim outfall between Tel-Aviv and Ashdod in an unpopulated area emanating from a population of 1,100,000, plus industries, and the two coastal cities of Akko and Nahariya, with populations of 46,000 and 37,500 respectively. Regarding industries, Ashdod, where one chemical industry and one refinery discharge their wastes to sea through a common outfall, was selected. Haifa Bay was selected as a hot spot both because it is considered a sensitive area, and because of direct and indirect (river) discharges into it. Two events of algae bloom were observed in the area in the past.

Evaluation of the selected hot spots, including comparative assessment through application of the ranking system, as required by the survey procedure, was carried out in collaboration with the Ministry personnel (Dr Fine and Dr Malester).

The total number of questionnaires completed were three for municipal discharges (Gush Dan, Akko and Nahariya), three for industrial discharges (one into Haifa Bay and two at Ashdod), and two for rivers (Kishon and Naaman).

As the industrial questionnaire dealt only with industries discharging directly into the sea, no questionnaires on industries discharging their wastes into the river Kishon (which opens out into Haifa Bay) was obtained, and this is included in the appropriate questionnaire (i.e. that dealing with the Kishon river).

3. CONTRIBUTION OF DIFFERENT SOURCES TO DEFINED HOT SPOTS AND SENSITIVE AREAS

The five defined hot spots in Israel are listed in Table 1, which also outlines the main pollution sources and the principal supporting data obtained from the questionnaires.

Table 2 lists the hot spots derived from municipal sources, along with the pollution loads for the various parameters. In the case of Gush Dan, no data on BOD and COD loads were available but, taking into account the values for other parameters, it would be expected that the values for both would be correspondingly high. The heavy metal concentrations are due to the industrial component of the sludge. Although the sludge is discharged 5 km out to sea, it could potentially affect coastal areas. In the case of Akko and Nahariya, where the effluent (treated up to the primary stage) is mainly municipal, heavy metal levels were measured, found to be very low, and were considered below recordable limits for the purpose of the present exercise.

Table 3 lists the hot-spots derived from industrial sources discharging directly into the sea, together with, in each case, the name of the Company, the type of industry, and the main pollutant loads. It should be noted that the first industry listed constitutes only a small proportion of the total pollutant load entering Haifa Bay. In the Ashdod area, the other two industries discharge through a common outfall. The main points of concern are Mercury in the case of Haifa Bay, and Phenols, Petroleum Hydrocarbons and Herbicides in the case of Ashdod.

Table 4 lists the two rivers, Kishon and Naaman, along with, in each case, the daily flow and the pollution load with regard to the main parameters recorded in the questionnaires. It should again be noted that both discharge into Haifa Bay.

4. PRIORITY HOT SPOTS AND SENSITIVE AREAS

Table 5 presents the list of priority hot spots in the required format, including the assessment of effects using the ranking system agreed on, the nature of investment required, transboundary aspects, and a preliminary estimated financial requirement in each case.

5. IDENTIFICATION OF MAIN GAPS AND CONSTRAINTS

The main gap, as has been the case with other countries, was the unavailability of information regarding the quality of the receiving marine environment. The main constraint was the time-factor - the time available for completion of the questionnaires was adequate in the case of data already available at the Ministry of Environment, or easily obtainable from other bodies. It was too short, however, in the case of data which consisted of measurements, analyses or long projections. However, the data regarding the quality of the marine environment does exist and can be obtained.

Data for municipalities were 1994 census figures with regard to populations. Other data (pollution loads, etc.) were more recent (1996/1997). In the case of pollution loads, concentrations of the various parameters were measured as mg/L, then converted into pollution loads in tons or kg per year, by correlation with total volumes of wastewater or river flow rates. The data can therefore be considered as valid.

6. PROPOSED OPTIONS FOR REMEDIAL ACTIONS

The options for remedial actions are given in Table 5. With regard to municipal discharges, the proposed option for the two coastal cities of Akko and Nahariya is upgrading of the existing wastewater treatment plants to secondary treatment, estimated at US$ 10,000,000 and US$ 18,000,000 respectively. The case of Gush Dan is different. The immediate requirements are for (a) a comprehensive study on treatment options and possible land disposal of the sludge, and (b) improvements in control of industrial plants in the region, each estimated at US$ 350,000. Further developments will be determined by the results of this initial phase (US$ 90,000).

In the case of the two industries currently discharging at Ashdod, the options are again the upgrading of current treatment facilities. The Refinery will require a pilot plant and biological treatment plant, involving an estimated total cost of US$ 10,000,000. The Agan Plant will require a solvent recovery component and a biological treatment plant, the total cost also estimated at US$ 10,000,000.

Haifa Bay requires a larger investment. Estimates for upgrading the treatment facilities at the Frutarom Company plant are US$ 650,000 for 1997. Further costs for succeeding years will depend on the results of these improvements. Establishment and upgrading of the treatment plants for major industries discharging their wastes into the Kishon river, and for extension of the municipal wastewater treatment plant in Haifa itself are estimated, as a whole, to costs between US$ 50,000,000 and US$ 80,000,000, representing minimum and optimum programmes respectively.

All estimates are preliminary, and should therefore be taken more as indicative of the order of magnitude involved than as final. They are, however, reasonably accurate.

Table 1

Identified hot spots in Israel

Locality	Pollution Sources	Principal supporting data from questionnaires
Haifa Bay	Mixed (industrial discharges) (river discharges	Industries discharging directly into Bay. Mixed discharges (industrial and municipal from rivers)
Gush Dan (Tel-Aviv region) Yalmachim outfall	Activated sludge from sewage treatment plant discharged 5 km out at sea	Heavy pollution load, including a number of heavy metals. Population in region 1,100,000
Akko	Municipal discharge	BOD load of 2,000 tons/year from population of 46,000
Nahariya	Municipal discharge	BOD load of 2,900 tons/year from population of 37,500
Ashdod	Industrial discharge	BOD load of 1,900-2,650 tons/year, 16 tons phenols/year, 140 tons herbicides/year

Table 2

Pollution hot spots from municipal sources in Israel

City	Population	Population served by sewerage	BOD T/yr	COD T/yr	Total N T/yr	Total P T/yr	TSS T/yr	Hg Kg/yr	Cd Kg/yr	Pb Kg/yr	Cr Kg/yr	Cu Kg/yr	Zn Kg/yr	Ni Kg/yr
Gush Dan (Tel Aviv region)	1,100,000	1,100,000	N/A	N/A	2,900	1,200	44,000	60	430	1,670	11,400	19,000	52,000	2,500
Akko	46,000	46,000	2,000	4,400	330	53	2,200	← very low levels →						
Nahariya	37,500	37,500	2,900	6,200	122	86	2,250	← very low levels →						

Table 3

Pollution hot spots due to industrial discharges directly into the sea in Israel

Locality	Company	Type of Industry	Type of Treatment	Pollution Load								
				BOD T/yr	COD T/yr	Total N T/yr	Total P T/yr	TSS T/yr	Phenols K/yr	Herbicides K/yr	Hg K/yr	Oil T/yr
Haifa Bay	Frutarom	Organic and Inorganic chemicals	Hg Precipitation Brine recycling (1)	800	N/A	N/A	N/A	1,400	-	-	7.3	-
Ashdod	Ashdod Refinery	Petroleum Refinery	Oil Separation API	210-880	660-1650	N/A	N/A	33-88	16,000	-	- (2)	11
Ashdod	Agan	Herbicides, Perfumes for detergent industries	Flotation Flocculation Precipitation Filtration PH, Solvent Recovery	1,750	10,500	600	7	150	-	140,000	- (2)	-

Notes: (1) Treatment in process of improvement
(2) Heavy metal content very low

Table 4

Pollution load from main rivers in Israel

River	Locality of discharge	Average daily flow m^3/day	BOD T/yr	COD T/yr	Total N T/yr	Total P T/yr	TSS Kg/yr	Cd Kg/yr	Cu Kg/yr	Zn Kg/yr	Oil T/yr
Kishon	Haifa Bay (South)	173,000	4,500	20,000	11,000	1,250	5,700	2,600 (1)	3,250 (1)	58,500 (1)	425
Naaman	Haifa Bay (North)	30,000	140	770	55	22	1,100	- (2)	- (2)	- (2)	-

Notes:
(1) Data on effluent from fertilizer plant
(2) Very low levels of heavy metals

Table 5

Assessment of Hot Spots in Israel

Country	Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other beneficial use	Welfare and Economy	Weighted Total	Relative Importance Index	Nature of Investment	Transboundary Aspect(s)	Preliminary Estimated Financial Requirement (in US$)
ISRAEL	Haifa Bay	Mixed (River + Industrial)	6	1	6	6	6	6	24.9	100	WWTPs WWTP upgrade	F,B,L,P,H F,B,L,P,H	80,000,000 650,000
	Akko	Domestic	4	1	5	6	6	5	21.4	85.9	WWTP upgrade	F,B,L,P,H	10,000,000
	Nahariya	Domestic	4	1	5	6	6	5	21.4	85.9	WWTP upgrade	F,B,L,P,H	18,000,000
	Gush Dan	Mixed (Sludge)	3	1	6	3	5	6	18.8	75.5	Option trials	F,B,L,P,H	700,000 + 90,000,000
	Ashdod	Industrial	3	1	3	4	3	6	15.8	63.5	WWTP upgrade	F,B,L,P,H	20,000,000

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

I T A L Y

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1. INTRODUCTION

The Italian coast is about 8,000 km long and Italy ranks second after Greece in length of coastline on the Mediterranean Sea. The coast varies in conformation, alternating between rock and sand, straight stretches and rugged areas. It is heavily populated and some parts of it are greatly affected by human and industrial activities. There are important ports such as Genoa, Livorno, Augusta, Venice, Cagliari and Trieste, with heavy traffic resulting from the movement of ships carrying petroleum-derived, petrochemical and chemical products, as shown in Table 1 *(Ministry of the Merchant Marine, 1993)*.

Table 1

Oil and oil compound movement in the main Italian harbours

Port	1985		1995	
Vado Ligure	4.000.000	ton.	6.919.000	ton.
Genova	21.000.000	ton.	23.220.000	ton.
La Spezia	1.000.000	ton.	1.190.000	ton.
Livorno	3.300.000	ton.	7.610.000	ton.
Pontile Solvay (Rosignano)	-		120.000	ton.
Civitavecchia	-		6.450.000	ton.
Fiumicino	3.100.000	ton.	4.000.000	ton.
Gaeta	-		1.200.000	ton.
Napoli	3.300.000	ton.	7.531.000	ton.
Milazzo	1.600.000	ton.	8.000.000	ton.
Augusta	8.000.000	ton.	17.889.000	ton.
Taranto	3.200.000	ton.	5.000.000	ton.
Brindisi	-		2.075.000	ton.
Ancona - Falconara	2.100.000	ton.	3.900.000	ton.
Ravenna	1.600.000	ton.	4.395.000	ton.
Venezia - Porto Marghera	4.500.000	ton.	9.240.000	ton.
Monfalcone	-		150.000	ton.
Trieste	20.800.000	ton.	29.000.000	ton.
Cagliari	10.400.000	ton.	15.000.000	ton.

Source: Ministry of the Merchant Marine, 1993.

In 1991, the Italian coast had a population of around 16,680,885 - that is, about 29.38 per cent of Italy's population. Coast-dwellers were distributed as follows: Tyrrhenian coast, 9,836,266 (17.32 per cent of the overall figure); Mediterranean coast, 1,342,973 (2.37 per cent of the overall figure); Ionian coast, 2,084,434 (3.67 per cent of the overall figure); Adriatic coast, 3,417,212 (6.02 per cent of the overall figure) *(Da Pozzo, 1994)*. In addition to the human population, industry, commercial ports, agriculture, livestock rearing and tourism are also sources of pollutants that have an environmental impact on the Italian coast, although they yield a high turnover. In 1970, tourism employed 5,500,000 people, in 1990 the figure was 9,500,000 accounting for 40.8 per cent of the work force. In 1993, tourism had a turnover of about 100,000 billion lire (8 per cent of GDP), with tourists distributed among 37,000 hotels, 2,200 campsites and 150,000 beds in houses available to tourists *(Da Pozzo, 1994)*. The Italian coast includes large unbroken stretches of built-up areas. This is the case on the coasts near Genoa, Lazio north and south of the mouth of the Tiber, the Gulf of Naples, the Sicilian coast in Messina province, the area between Bari and Barletta, as well as the coast of Romagna (between Cervia and Pesaro) *(Pietrobelli, 1996)*. These stretches of coast often lack any wastewater treatment plants or, if they are available, they are old, too small or not operational.

Around the main ports there are large industrial areas (refineries and petrochemical plants that are among the biggest in Europe), designed in the 1960s or even before to satisfy major requirements such as proximity to water for cooling plants or production purposes and to a port for transporting raw materials and/or finished products, as well as the need to concentrate primary industry and any small-size businesses connected with the industry in the same area. In Italy, this has meant a high concentration of "Companies and warehouses where accidents are likely to happen", thus having a negative impact on both the environment and the coast, including the sea and any trade connected with it.

Table 2

List of "Companies and warehouses where accidents are likely to happen" Source: Italian Ministry of the Environment, 1995.

SARDINIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
CA	CAGLIARI	AGIP COVENGAS	LPG dep.
CA	SARROCH	AGIP COVENGAS	LPG dep.
CA	ASSEMINI	AMBIENTE	plant
SS	PORTO TORRES	BUTANGAS	LPG dep.
CA	CAGLIARI	CEMAT	LPG dep.
SS	SASSARI	CEMAT	LPG dep.
SS	PORTO TORRES	E.V.C.	plant
SS	PORTO TORRES	ENICHEM ELASTOMERI	plant
CA	ASSEMINI	ENICHEM ex ANIC	plant
SS	PORTO TORRES	ENICHEM ex ANIC	plant
CA	SARROCH	ENICHEM ex PRAOIL ex nurac	plant
NU	OTTANA	LANDA ex ENICHEM FIBRE	plant
SS	PORTO TORRES	ENICHEM FIBRE	plant
SS	PORTO TORRES	FIAMMA 2000 ex FIAMMA SARDA	LPG dep.
CA	SERRAMANNA	FIAMMA 2000 ex FIAMMA SARDA	LPG dep.
CA	VILLACIDRO	FIBRE ACRILICHE ex SNIA FIB	plant
SS	PORTO TORRES	LIQUIGAS	LPG dep.
CA	SARROCH	LIQUIGAS ex LIQUIPIBIGAS	LPG dep.
CA	SARROCH	SARAS	plant
NU	CARDEDU	SARDAGAS	LPG dep.
CA	SARROCH	PARAFFINE SARDE	stab
OR	ORISTANO	ULTRAGAS IT.	LPG dep.

CALABRIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
CZ	VIBO VALENTIA	AGIP COVENGAS	LPG dep.
CZ	CROTONE	AGRIMONT	plant
CZ	S.PIETRO LAMETINO	AUTOGAS MERIDIONALE	LPG dep.
CS	MONTALTO UFFUGO	BUTANGAS	LPG dep.
RC	GIOIA TAURO	SOC. PETROLIFERA GIOIA T*	LPG dep.
CS	MONTALTO UFFUGO	ULTRAGAS IT.	LPG dep.
CZ	SELLIA MARINA	ULTRAGAS IT.	LPG dep.

FRIULI - VENEZIA GIULIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
TS	TRIESTE	ALDER	plant
UD	TORVISCOSA	CAFFARO ex CHIMICA DEL FRIULI	plant
UD	UDINE	CEMAT	dep.
UD	CERVIGNANO	ECOGAS*	dep.
UD	BUIA OSOPPO	FANTONI	plant
TS	VILLA OPICINA	FF. SS.	LPG dep.
UD	UDINE	FF. SS.	LPG dep.
UD	PONTEBBA	FF.SS.	LPG dep.
UD	TORVISCOSA	FF.SS.	LPG dep.
UD	CAMPOFORMIDO	FRIULANA GAS	LPG dep.
TS	TRIESTE	SEASTOK	LPG dep.
GO	MONFALCONE	SNAM	LPG dep.
TS	MUGGIA	CONCLUS.LO.NE.ex AQUILA	dep.
TS	S.DORLIGO DELLA VALLE	SIOT	dep.

LIGURIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
SV	CAIRO MONTENOTTE	3M ITALIA	plant
IM	IMPERIA	AGIP ex COVENGAS	LPG dep.
GE	GENOVA CAMPI	COLISA	dep.

PROVINCE	CITY	ENTERPRISE	TYPE
GE	GENOVA S.QURICO	COLISA	dep.
GE	MORIGALLO	COLISA	dep.
GE	S.QUIRICO	COLISA	plant
SV	CAIRO MONTENOTTE	ENICHEM AGR. ex AGRIMONT	plant
SV	VADO LIGURE	EXXON CHEMICAL MED.	plant
GE	GENOVA BOLZANETO	FF.SS.	dep.
GE	BUSALLA	IPLOM	plant
SV	CENGIO	ORGANIC CHEMICALS ACNA CHIMICA ORGANICA	plant
SV	CENGIO	ACNA CHIMICA ORGANICA	plant
GE	GENOVA MULTEDO	PORTO PETROLI GENOVA	dep.
SV	QUILIANO	SARPOM	plant
GE	GENOVA FEGINO	SNAM	dep.
GE	GENOVA PEGLI	SNAM	dep.
SP	PANIGAGLIA	SNAM	plant
GE	GENOVA	SUPERBA	dep.
SV	ALBENGA	ULTRAGAS IT.	LPG dep.

MARCHE REGION

PROVINCE	CITY	ENTERPRISE	TYPE
AN	FABRIANO	AGIP COVENGAS	LPG dep.
AN	FALCONARA	API	plant
AN	FALCONARA MARITTIMA	LIQUIGAS ex LIQUIPIBIGAS	LPG dep.
AN	MARINA DI MONTEMARCIA.	ELF GAS ITALIANA	LPG dep.
AN	SENIGAGLIA	GOLDENGAS	LPG dep.
AN	SENIGALLIA	FF. SS.	dep.
MC	MONTECASSIANO	FIAMMA 2000 ex M-GAS	dep.

ABRUZZO REGION

PROVINCE	CITY	ENTERPRISE	TYPE
CH	FRANCAVILLA	ULTRAGAS IT.	LPG dep.
PE	ALANNO ROSCIANO	ELF GAS ITALIANA ex IPIC	LPG dep.
PE	BUSSI	AUSIMONT	plant

PROVINCE	CITY	ENTERPRISE	TYPE
PE	BUSSI	FF.SS.	dep.
PE	BUSSI	S.I.A.C.	plant
PE	PESCARA	BUTANGAS	LPG dep.
PE	PESCARA	CEMAT	dep.
PE	PESCARA	FF.SS.	dep.

CAMPANIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
CE	CESA	SUD GAS	LPG dep.
CE	MADDALONI MARCIANISE	FF.SS.	dep.
CE	SPARANISE	VERONESE LOGISTICA	dep.
NA	ACERRA	MONTEFIBRE	plant
NA	BOSCOTRECASE	LUMAGAS	LPG dep.
NA	CAIVA	ULTRAGAS IT.	LPG dep.
NA	CASALNUOVO	LIQUIGAS	LPG dep.
NA	CASTELLO DI CISTERNA	SAMAGAS	dep.GPL
NA	MARCIANISE	CEMAT	dep.
NA	MARIGLIA	CANTONE PETROLI*	dep.
NA	NAPOLI	AGIPGAS ed ALTRI	darsena
NA	NAPOLI	AGIP GAS ex COVENGAS	LPG dep.
NA	NAPOLI	CLEAM	LPG dep.
NA	NAPOLI	FAROGAS	LPG dep.
NA	NAPOLI	FF.SS.	dep.
NA	NAPOLI	ITALCOST	LPG dep.
NA	NAPOLI	KUWAIT RAFF. ex MOBIL	plant
NA	NAPOLI	PETROLCHIMICA PARTEPEA	LPG dep.
NA	SAVIA	SO.ME.GAS	LPG dep.
SA	EBOLI	ELLEPIGAS	LPG dep.
SA	PADULA	ULTRAGAS IT.	LPG dep.
SA	PAGANI	DINAGAS	LPG dep.
SA	ROCCADASPIDE	FONTEGAS	dep.GPL
SA	ROCCAPIEMONTE	GAMMA PETROLI	LPG dep.
SA	SCAFATI	FERGAS	LPG dep.
SA	SIA	FA.CO.M*	LPG dep.

EMILIA ROMAGNA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
RA	RAVENNA	ADRIATANK	dep.
RA	RAVENNA	AGIP GAS ex COVENGAS	LPG dep.
RA	RAVENNA	AGIP RAFFINAZIONE	plant
FE	FERRARA	AGRICOLTURAexENICHEM	plant
RA	PORTO CORSINI DI RAVENNA	ALMA PETROLI	plant
RA	RAVENNA	AMBIENTE	plant
RA	RAVENNA	AMBIENTE ex SIRAMBIENTE	plant
FE	FERRARA	ANRIV	dep.
RA	RAVENNA	AZIENDA. MUN.GAS ACQUA	plant
BO	CASTEL MAGGIORE	BAYER ITALIA	dep.
RA	RAVENNA	BORREGAARD	plant
PR	FIDENZA	CARBO CHEMICALS	plant
BO	BOLOGNA	CEMAT	plant
PC	PIACENZA	CEMAT	plant
FE	DOSSO	CHEMIA	plant
BO	PONTECCHIO MARCONI	CIBA-GEIGY	plant
RA	LUGO	CON.A.LUGHESI	dep.
BO	BENTIVOGLIO	COOP. DEP. TRASP. MERCI*	dep.
RA	BAGNACAVALLO	COOP. TERREMERSE*	dep.
RE	CORREGIO	DOW ITALIA	plant
BO	CASTELLO D'ARGILE	DU PONT ITALIANA	dep.
RA	RAVENNA	E.V.C.	plant
RA	RAVENNA	ECOFUEL	plant
FE	FERRARA	ENICHEM	plant
RA	RAVENNA	ENICHEM AG.	plant
RA	RAVENNA	ENICHEM ANIC	plant
RA	RAVENNA	ENICHEM ELASTOMERI	plant
FE	FERRARA	ENICHEM ELASTOMERIex dutral	plant
RA	RAVENNA	ENICHEM SYNTHESIS	plant
BO	BOLOGNA INTERPORTO	FF.SS.	dep.
FE	FERRARA	FF.SS.	dep
FO	S.ARCANGELO DI ROMAGNA	FF.SS.	dep.
PC	FIORENZUOLA	FF.SS.	dep.

PROVINCE	CITY	ENTERPRISE	TYPE
PC	PIACENZA	FF.SS.	dep.
PR	PARMA INTERPORTO	FF.SS.	dep.
RA	RAVENNA	FF.SS.	dep.
RA	RAVENNA	GREAT LAKES	plant
RA	RAVENNA	HYDRO AGRI ITALIA	plant
PR	PARMA	LAMPOGAS EMILIANA	LPG dep.
BO	CRESPELLA	LIQUIGAS ex LIQUIPIBIGAS	LPG dep.
RA	RAVENNA	LONZA ex ALUSUISSE	plant
RA	RUSSI	MOLDUCCI BAYER	dep.
FE	FERRARA	MONTELL ITALIA ex HIMONT	plant
RA	PORTO CORSINI	PETROLIFERA ITALO RUMENA *	dep.
FE	TRAGHETTO	RECHIM	plant
RA	RAVENNA	RIVOIRA	plant
MO	S.MARIA DI MUGNA VACIGLIO	SCAM	plant
BO	S. VINCENZO DI GALLIERA	SIAPA	plant
FO	RICCIONE	SIAPA	dep.
FO	TORRIANA	SOC. IT. GAS LIQUIDI	LPG dep.
RA	RAVENNA	SOLGEA	plant
FE	FERRARA	SOLVAY	plant
FO	FORLI	ULTRAGAS IT.	LPG dep.
FO	VILLA SELVA	ULTRAGAS IT.*	LPG dep.
FE	S.BIAGIO ARGENTA	VEFAGAS	LPG dep.
RA	RAVENNA	VINAVIL	plant
FO	FORLI'	ZANNI CALOR*	dep.

VENETO REGION

PROVINCE	CITY	ENTERPRISE	TYPE
VE	PORTO MARGHERA	ACHETON	plant
VE	CONCORDIA SAGGITARIA	AGIP COVENGAS	LPG dep.
VE	PORTO MARGHERA	AGIP COVENGAS	LPG dep.
VE	VENEZIA	AGIP RAFFINAZIONE	plant
BL	PONTE NELLE ALPI	ALPI GAS	LPG dep.
VE	PORTO MARGHERA	AMBIENTE SPA	dep.
VE	PORTO MARGHERA	API	dep.GPL

PROVINCE	CITY	ENTERPRISE	TYPE
VR	S. AMBROGIO	AREAGAS	LPG dep.
VE	PORTO MARGHERA	AUSIMONT ex MONTEFLOUS	plant
VR	MINERBE	AUTOGAS RD VENETO*	LPG dep.
PD	S.GIUSTINA IN COLLE	AUTOSPED	dep.
VE	BORBIAGO DI MIRA	BRENTAGAS	LPG dep.
VE	PAESE	BUTANGAS	LPG dep.
VE	PORTO MARGHERA	CAMELI PETROLI	dep.
PD	PADOVA FANINI	CEMAT	dep.
PD	PADOVA INTERPORTO	CEMAT	dep.
VR	VERONA Q.E.	CEMAT	dep.
VE	PORTO MARGHERA	CHIMICA PORTO MARGHERA *	plant
VI	MUSSOLENTE	DELTAPUR ex APICHEM	plant
PD	VENTA PADOVANA	D.D.N.	dep.
VE	PORTO MARGHERA	DECAL	dep.
VE	PORTO MARGHERA	E.V.C.	plant
VE	PORTO MARGHERA	ENICHEM AGR. ex AGRIMONT	plant
VE	PORTO MARGHERA	ENICHEM ANIC ex MONTEDIPE	plant
VE	PORTO MARGHERA	ENIRISORSEexNUOVA SAMIN	plant
VE	PRAMAGGIORE	EVER	dep.
VI	MONTECCHIO MAGGIORE	FABB. ITALIANA SINTETICI	plant
VE	MESTRE	FF. SS.	dep.
RO	ARQUA' POLESINE	FF.SS.	dep.
VI	ALTAVILLA	FF.SS.	LPG dep.
VR	DOMEGLIARA	FF.SS.	LPG dep.
VR	VERONA PORTA NUOVA	FF.SS.	LPG dep.
VR	VILLAFRANCA	FF.SS.	LPG dep.
RO	ARQUA' POLESINE	IROP	LPG dep.
VE	SCORZE'	LIGUIGAS ex VOGAS	LPG dep.
PD	CAMPO DARSEGO	MAPLES	plant
VE	PORTO MARGHERA	MARGHERA BUTADIENE	plant
VI	TRISSI	MITENI ex RIMAR	plant
VE	PORTO MARGHERA	MONTEFIBRE	plant
VE	SAN DONA' DI PIAVE	POLETTO ALDO	plant
VR	VILLAFRANCA DI VERONA	PUBLIGAS VERONA	LPG dep.
VI	VICENZA	SATEF HUTTENES ALBERTUS *	plant

PROVINCE	CITY	ENTERPRISE	TYPE
VI	BASSA DEL GRAPPA	SVEG	LPG dep.
VR	MONTE DI ZEVIO	TOLI OSVALDO	plant
VE	MIRA	TRIVENGAS	LPG dep.
VR	SANTA MARIA DI ZEVIO	TURATI OVIDIO	plant
PD	SELVAZZA	ULTRAGAS ITALIANA	LPG dep.
VI	LONIGO	ZAMBON GROUP	plant

TOSCANA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
AR	AREZZO	AGIP GAS ex COVENGAS	LPG dep.
LI	COLLESALVETTI STAGNO	AGIP PETROLI COVENGAS	LPG dep.
LI	COLLESALVETTI STAGNO	AGIP PETROLI ex AGIP PLAS	plant
FI	CAMPI BISENZIO	BEYFIN divisio. ETRURIAGAS	LPG dep.
LU	PORCARI	BUTANGAS	LPG dep.
LI	LIVORNO	CARBOCHIMICA	plant
FI	SESTO FIORENTI	CEMAT	dep.
PI	SALINE DI VOLTERRA	ALTAIR CHIMICA ex BORO L	plant
FI	VINCI	COLOROBBIA ITALIA	plant
LI	LIVORNO	COSTIERO GAS LIVOR ex LIQUIPIBIGAS	LPG dep.
LI	LIVORNO	D.O.C.	dep.
LI	LIVORNO CALAMBRONE	FF.SS.	dep.
LI	ROSIGNANO	FF.SS.	dep.
SI	POGGIBONSI	FF.SS.	dep.
LI	ROSIGNA SOLVAY	INTEROX	plant
GR	SCARLINO	NUOVA SOLMINE	plant
LI	ROSIGNA SOLVAY	SOLVAY	plant
LU	ALTOPASCIO	TOSCOGAS	LPG dep.
FI	FIRENZE	ULTRAGAS ITALIANA	LPG dep.
SI	MONTEPULCIA	VINCENZINI	dep.

LAZIO REGION

PROVINCE	CITY	ENTERPRISE	TYPE
RM	SALONE	AGIP GAS ex COVENGAS	LPG dep.
LT	GAETA	AGIP PETROLI	dep.
FR	PATRICA	ALBRIGH &WILSONexMARCH	plant
LT	LATINA	CEMAT	dep
RM	ROMA SMISTAMENTO	CEMAT	dep
FR	PATRICA	CHEMI ITALFARMACO SUD	dep.
FR	FROSINE	COGEGAS	LPG dep.
VT	VITERBO	ELF GAS ex CABO CAMPANELLI	LPG dep.
RM	ROMA	ELFGAS ITALIANA ex MABOGAS	LPG dep.
VT	MONTALTO DI CASTRO	ENEL*	
LT	APRILIA	FF.SS.	dep.
RM	ARDEA	FIAMMA 2000	LPG dep.
FR	SUPI	FIAMMA LAZIALE	LPG dep.
RM	PANTA DI GRA	FINA ITALIANA	dep.
RM	POMEZIA	LIQUIGAS ex LIQUIPIBIGAS	LPG dep.
LT	CISTERNA DI LATINA	NALCO ITALIANA	plant
LT	SERMONETA	PONTINA GAS PETROLI	LPG dep.
RM	PANTA DI GRA	RAFFINERIA DI ROMA	plant
LT	CAMPOVERDE APRILIA	RECORDATI	plant
RM	BAGNI DI TIVOLI	TECLOGISTICA ex ROMADOK	dep.
FR	ANAGNI	ROMANA CHIMICI	dep.
RM	LABARO	S.I.T.I.	dep.
LT	APRILIA	SILIA	plant
RM	CIVITAVECCHIA	SO.DE.CO.	dep.
RM	POMEZIA	SOC.GEST.TERM.FERROVIA. *	dep.
LT	PONTINIA	SUD GAS	LPG dep.
RM	ROMA	SUD GAS	LPG dep.
RM	ROMA	ULTRAGAS	LPG dep.
LT	LATINA SCALO	UNIROYAL CHEMICAL	plant

PUGLIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
BR	BRINDISI	AGIP	stab
FG	FOGGIA	AGIP COVENGAS	LPG dep.
TA	TARANTO	AGIP COVENGAS	LPG dep.
TA	TARANTO	AGIP PETROLI ex AGIP RAFF.	plant
BA	PALO DEL COLLE	AUTOGAS MERIDIONALE	plant
BA	CORATO	BADIGAS	LPG dep.
FG	FOGGIA	BARSANTI TRASPORTI	dep.
BA	BARI	BRAVI SERVIZI LOGISTICI	dep.
BR	BRINDISI	FRENE	plant
BR	BRINDISI	CHEMGAS	plant
BA	SANNICANDRO	BUTANGAS	LPG dep.
BA	MODUG	CARADONNA	dep.
BA	BARI	CEMAT	dep.
BR	BRINDISI	CEMAT	dep.
BR	BRINDISI	E.V.C.	plant
LE	LECCE	EMMEPIGAS	LPG dep.
FG	MANFREDONIA	ENICHEM AGRICOLTURA	plant
BR	BRINDISI	ENICHEMANIC oraENICHEM	plant
BR	BRINDISI	FF.SS.	dep.
TA	TARANTO	INCAGALL SUD	plant
BR	BRINDISI	IPEM	dep.
LE	CAMPI SALENTINA	ITALFIAMMA	LPG dep.
BA	BARI	LIQIGAS ex LIQUIPIBIGAS	LPG dep.
BR	BRINDISI	MONTEDIPE ora ENICHEM	plant
BR	BRINDISI	POLIMERI EUROPA ex BRINDISI ETILENE	plant
BR	S'APOLLINARE	S.I.A.C.	dep.
LE	LECCE	SALENTINA	LPG dep.
BA	BARI	SHELL GAS ex MONTESHELL	LPG dep.
FG	FOGGIA	SIAPA	dep.
BA	BARI	ULTRAGAS ITALIANA	LPG dep.
FG	FOGGIA	ULTRAGAS ITALIANA	LPG dep.
LE	LECCE	ULTRAGAS ITALIANA	LPG dep.

BASILICATA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
MT	PISTICCI SCALO	EPOXITAL	plant
PZ	VESA	INCAGALL SUD	plant

SICILIA REGION

PROVINCE	CITY	ENTERPRISE	TYPE
CL	GELA	AGIP COVENGAS	LPG dep.
CT	BELPASSO	AGIP COVENGAS	LPG dep.
ME	MILAZZO	AGIP PETROLI ex RAFF. MED.	plant
CL	GELA	AGIP PETROLI ex PRAOIL	plant
SR	PRIOLO MELILLI	AGIP PETROLI ex PRAOIL	plant
CL	GELA	AGRICOLTURA ex ENIC. AGR.	plant
SR	PRIOLO GARGALLO	AGRICOLTURA ex ENIC. AGR. ex AGRIMONT	plant
CL	GELA	CEMAT	dep.
CT	CATANIA	CEMAT	dep.
ME	MESSINA	CEMAT	dep.
ME	MILAZZO	CEMAT	dep.
PA	PALERMO	CEMAT	dep.
CT	CATANIA	D.M. SERVIZI	dep.
PA	PARTINICO	DISTILLERIA BERTOLI	plant
CT	BELPASSO	ELF GAS IT. ex AUTOGAS IONICA	LPG dep.
SR	PRIOLO	ENICHEM POLIMERI ora ENI	plant
SR	PRIOLO	ENICHEM ANIC ora ENICHEM	plant
SR	AUGUSTA	CONDEA AUGUSTA ex ENICHEM	plant
CL	GELA	ENICHEM ex ANIC	plant
SR	AUGUSTA	ESSO ITALIANA	plant
CT	BELPASSO	EUROGAS SICULA*	dep.
CL	GELA	FF.SS.	dep.
CT	CATANIA BICOCCA	FF.SS.	dep.
SR	PRIOLO MELILLI	FF.SS.	dep.
CL	GELA	GELAGAS*	LPG dep.
RG	RAGUSA	HYBLEAGAS	LPG dep.
AG	PORTO EMPEDOCLE	ITAL SERVICE*	plant
CT	CATANIA	LIQUGAS ex LIQUIPIBIGAS	LPG dep.

PROVINCE	CITY	ENTERPRISE	TYPE
CT	CATANIA	MISTERGAS SICILIANA	LPG dep.
PA	CARINI	NUOVA TRINACRIA PETROLI	dep.GPL
CT	GELA	POLIMERI EUROPA	plant
SR	PRIOLO	POLIMERI EUROPA	plant
SR	PRIOLO	RAFFINERIA ISAB	plant
CL	CALTANNISETTA	SIAPA	plant dep.
RG	CONTRADA BENEVENTANA	SIAPA	dep.
TP	CAMPOBELLO DI MAZARA	SICILGAS*	LPG dep.
CT	BELPASSO	SICILIAGAS*	LPG dep.
CL	CALTANNISETTA	ULTRAGAS ITALIANA	LPG dep.
CT	CATANIA	ULTRAGAS ITALIANA	LPG dep.
ME	PACE DEL MELA	ULTRAGAS ITALIANA	LPG dep.
TP	MAZZARA DEL VALLO	ULTRAGAS ITALIANA	LPG dep.

Source: **Environmental Ministry of Italy, *1995.***

There are around 7,765,172 houses in coastal cities, representing 32 per cent of the national total and 3,150,000,000 m^3 of cement. There are 158 coastal cities with more than 10,000 houses. Fifty-eight per cent of Italy's coast is completely built-up (civil and industrial buildings), a further 13 per cent is extensively built-up, and 29 per cent has not buildings (Pietrobelli, 1996).

Table 3

Situation of Italian coast

Region	Km of coast	% of coastal areas partly free, with buildings and infrastructure	% of coastal areas partly free with buildings	% of coastal areas partially free, with only infrastructure alone	% of coastal areas completely free	% of coastal areas completely occupied by buildings or industry or infrastructure
FRIULI	116	25.9	5.5	-	25.4	43.3
VENETO	173	15.7	6.9	-	40.2	37.3
EMILIA ROMAGNA	128	8.7	-	-	29.2	62.1
MARCHE	184	25.4	-	8.3	8.3	57.9
ABRUZZO	137	40.1	-	12.3	-	47.6
MOLISE	35	27.1	-	45.7	4.3	22.9
PUGLIA	876	26.6	15.8	6.5	14.0	37.0
SICILIA	1532	11.5	3.4	4.0	17.8	63.2
CALABRIA	723	21.2	6.7	17.3	16.6	38.2
BASILICATA	63	22.1	-	15.9	54.9	7.1
CAMPANIA	498	21.6	8.0	5.7	6.5	58.0
LAZIO	352	11.6	13.5	10.2	17.3	48.0
SARDEGNA	1865	1.8	6.4	0.5	73.6	17.7
TOSCANA	614	7.4	-	9.6	43.3	39.7
LIGURIA	384	18.0	-	10.0	15.0	57.0

Source: Pietrobelli, 1996.

Italy lies entirely within the catchment basin of the Mediterranean Sea and is the scene of human and industrial activities that have led the Ministry of the Environment to declare some areas subject to a negative environmental impact, "Areas where an environmental crisis may occur" *(Ministry of the Environment, 1992).*

Despite these negative factors, many natural and environmental aspects make the Italian coast interesting from an ecological point of view. The vast *Posidonia oceanica* meadows *(Cinelli et al., 1993; Regione Lazio - Università degli Studi di Roma "La Sapienza", 1995; C.N.Bianchi, 1995; Fresi et al., 1996)*, although part of them is in danger, and endemic species of vertebrates, including fish, birds and cetaceans (the last-mentioned species are to be found mainly in the Ligurian Sea), ecologically enhance both the Italian coast and the surrounding seas.

2. MATERIALS AND METHODS

The lack of data on some Italian regions had a significant impact on the collection of data over the short period available for this report; moreover, many of the authorities concerned were unwilling to provide information. In Italy, several of the parameters requested in the questionnaires are not measured systematically, therefore, no detailed database is available. Systemic data on the quality of coastal waters only concerns the parameters for faecal coliforms, total coliforms and streptococci. With the exception of a few regions, no data similar to those requested in the detailed questionnaire are available with regard to the receiving body. Consequently, in addition to collecting data from ISTAT (Central Statistics Institute), the Ministries of Environment, Health, and Civil Defence, a number of unplanned trips had to be made to local authorities to gain access to data that could not otherwise have been obtained. Visits had to be paid to Genoa, Livorno, Ravenna, Forlì, Udine, Trieste and Venice provinces, the Lazio, Sicily, Veneto and Friuli-Venezia Giulia regions, the Centro Ricerche Marine in Cesenatico, the Daphne II oceanographic unit, the ENEA centre in Santa Teresa di La Spezia and Università di Tor Vergata in Rome. Special situations are to be found in the hot spot of Porto Marghera and the sensitive area of Venice. Thirty-two former directors of petrochemical companies that processed vinyl chloride have been committed for trial for manslaughter. The case is being prepared by the Attorney's Office of Venice (Magistrate Casson) following the deaths of several workers in various departments. People were thus very reluctant to supply data (another trial is under way) for the pollution of the lagoon and its waters, instigated by Magistrate Ramacci, and this also underlines the situation of the hot spot of Porto Marghera). Some data on the parameters referred to in the questionnaires may look similar despite different situations, because those who supplied them simply maintained that they were complying with Italian law *(319/76 Merli's Law)* or regional provisions on wastes, although there is evidence to suggest the contrary. The official data were of course processed. For those businesses that did not supply any data about effluents, estimates were made in accordance with the questionnaire, on the basis of the conversion elements available. The data collected were then processed as outlined in the questionnaires. Other relevant information was attached, to allow the degree of degradation of a certain area to be assessed or to support the evaluation of any identified hot spots. Some exhaustive and reliable studies on the quality of the water or sediment of some stretches of sea have been taken into consideration, because they may provide extremely interesting information about areas identified as hot spots or sensitive areas.

Generally speaking, it seemed advisable to use data from comprehensive studies carried out on either the biota or sediments in the context of specifically designed surveys aimed at determining the state of health of part of the coastal ecosystem. Many researchers relied on quality indexes or evidence of harmful effects produced by any source of pollution, as compared to lists of physicochemical parameters relating to water columns or receiving bodies.

The data about companies to be provided in the questionnaire were difficult to find, as explained in the paragraph "Main gaps and constraints". Therefore, indirect data had to be found and estimated. In each hot spot and sensitive area, the businesses considered to be the most polluting were detected. For each of them, pollution was estimated in terms of

equivalent inhabitants, taking into account the number of employees and the relevant conversion ratio (CNR - National Council for Scientific Research -, 1981), as shown in Table 4.

Table 4

Pollution load of industrial category: conversion factor

Type of industry	Conv. fact.
Production of animal and vegetable oil and fat	84
Base-chemical industry	68
Beverages industry	348
Cement, lime and chalk industry	85
Ceramic industry	30
Cheese and milk industry	84
Coke industry	96
Energy production and distribution industry	1.4
Textile fibre finishing industry	18
Production, elaboration and preservation of fish and fish-based products	84
Fishery, pisciculture and services	75
Food industry	84
Production and preservation of fruit and vegetables	84
Fur preparation and dyeing industry	57
Fusion industry	2.3
Gas production and distribution by pipeline	1.4
Glass industry	20
Iron, steel industry	2.3
Production, elaboration and preservation of meat and meat- based products	84
Mechanical industry	2.3
Mineral extraction for chemical and fertilizer industry	30
Oil and natural gas extraction	30
Oil refining industry	65
Other chemical industry	68
Other metallurgy industry	2.3
Other textile industry	18
Paints and mastics industry	68
Pharmaceutical industry	68
Production of articles of plastic material	15
Preparation and spinning of textile fibres industry	18
Press industry	60
Production of paper articles	60
Pulp and paper industry	60
Rubber industry	15
Salt production	30
Seeds and starch production and elaboration	84
Services connected with oil and natural gas extraction	30
Synthetic and artificial fibres industry	40
Soaps and tensioactives industry	68
Tannery industry	57
Tobacco industry	348
Water distribution, sewer and wastewater treatment systems	0.6
Weaving	18

Source: CNR Research Institute on Water, 1981.

3. DEFINITIONS

Hot spots

(a) Point sources on the coast of the Mediterranean Sea which potentially affect human health, ecosystems, biodiversity, sustainability or economy in a significant manner. They are the main points where high levels of pollution loads originating from domestic or industrial sources are being discharged;

(b) Defined coastal areas where the coastal marine environment is subject to pollution from one or more point or diffuse sources on the coast of the Mediterranean which potentially affect human health in a significant manner, ecosystems, biodiversity, sustainability or economy.

Hot Spots indicators (primary)

- BOD_5 , COD
- Nutrients (phosphorus, nitrogen)
- Total suspended solids
- Oil (petroleum hydrocarbons)
- Heavy metals
- Persistent organic pollutants
- Radioactive substances (where applicable)
- Litter
- Microorganisms (faecal coliforms, *E.coli*)

Sensitive areas

Estuaries and coastal waters of natural or socio-economic value are considered sensitive if they are at high risk of suffering a negative impact due to human activities.

Natural characteristics may determine the vulnerability of a coastal system, for example, a bay with a low flushing rate is more sensitive to pollution impact than one that is well flushed. Human activities determine the level of risk, hence planned development may increase the risk of environmental degradation. Both vulnerability and risk contribute to the sensitivity of a particular area or system in the context of this assessment.

4. MAIN SOURCES OF POLLUTION

It should be pointed out that dispersed sources, which do not fall within the scope of this report, are major sources of sea pollution resulting from uncontrolled, undetected accumulation. This is the case, for example, with the "flower riviera", between Imperia and San Remo, in Liguria, where large amounts of pesticides and phytochemicals are released into the sea after being used for growing flowers. As far as agriculture is concerned, the following should be mentioned: Agro Pontino (Latina), Val d'Agri (Metaponto) and the basin of the Po plain - because of its highly-developed pig breeding industry, the number of equivalent inhabitants in the Po basin is around 9 million. Animal excrement, rich in organic matter, zinc and nutrients, is remarkably contaminated by drugs such as sulpha drugs and tetracyclines *(Migliore et al., 1994).* These are released into the sea, thus becoming available to any marine living creatures and improperly entering a trophic network, which may transmit them to humans, with harmful effects.

Table 5

Load of nutrients by Region of Northern Adriatic and main source in per cent

NITROGEN t/y	
Regions	**Load**
Piemonte	42,772
Valle d'Aosta	946
Lombardia	90,774
Trentino Alto Adige	7,699
Veneto	62,353
Friuli Venezia-Giulia	17,288
Liguria	930
Emilia Romagna	48,945
Grand Total	271,707 tons/year

PHOSPHORUS t/y	
Regions	**Load**
Piemonte	3,759
Valle d'Aosta	93
Lombardia	9,175
Trentino Alto Adige	671
Veneto	4,621
Friuli Venezia-Giulia	1,125
Liguria	131
Emilia Romagna	4,406
Grand Total	23,981 tons/year

	PER CENT DISTRIBUTION BY SOURCE	
	P(t)	**N(t)**
Agriculture	29.5	63.8
Humans	33.6	19.3
Husbandry	14.1	5.5
Detergents	12.7	-
Industry	7.4	7.6
Uncultivated soil	2.7	3.8

Source: Marchetti,1987; Emilia-Romagna Region, 1991.

In Italy tourism is one of the main sources of income, therefore, irreversible changes to certain scenery or coastal areas would have a negative impact on both ecosystems and the financial situation. Seasonal increases in the number of tourists affect coastal ecosystems because of higher pollution levels resulting from municipal wastes (as well as production and

unauthorized disposal of urban solid wastes), thus making certain areas (smaller islands, the Amalfi coast, the coast of Lazio, the Ligurian coast, the coast of Romagna, Sardinia and Sicily) vulnerable and endangering them for no less than two months a year.

Emissions into the atmosphere (industrial plants, power stations and motor traffic) fall directly into the sea - because Italy lies entirely within the catchment basin of the Mediterranean Sea - or are released by surface waters, which eventually flow into the sea. Such emissions are hard to evaluate and do not fall within the scope of this report, but they play quite a significant role in sea pollution, at least at a local level.

At the mouth of the Garigliano river, between Campania and Lazio, radioactivity is markedly higher than the standard level because some decades ago a nuclear power station opened in that area, although it is now closed. High radioactivity levels, resulting from an excess of Caesium 175, in concentrations up to 75 per cent higher than natural radioactivity, were also reported in the area of Isolotto di S. Stefano, between the islands of La Maddalena and Caprera off Sardinia, due to maintenance of nuclear-powered submarines at an American military base.

5. PRIORITY HOT SPOTS AND SENSITIVE AREAS OF ITALY AND PROPOSED OPTIONS FOR REMEDIAL ACTION

The following hot spots and sensitive areas were identified, drawing on the analytical data found in the documentation and collected in the questionnaires:

Sensitive areas

Vado Ligure - Savona

Savona province is affected by the release of several pollutants: from the power station in Vado Ligure, and from the heavy sea traffic, due to ships moving to the five piers, in the Savona - Vado Ligure complex, where about 7,000,000 tons of petroleum derived products are transported every year *(Italian Ministry of the Merchant Marine, 1993)*. In addition, the waste water treatment plant in Savona is in a precarious state and has no test certificate. It does not only serve Savona, but also all the towns east of it, from Varazze to Noli. In July and August, due to tourism, the population doubles. Purified water is released through a 1,500 m long pipe. ENEA conducted a thorough, integrated study *(Damiani et al., 1989)*, which showed pollution in sediment caused by heavy metals, PCBs and hydrocarbons. Because of the *Posidonia oceanica* seagrass meadows, near Capo Noli *(Bianchi, 1995)*, their degradation and depletion, the area is considered as sensitive.

Secche della Meloria

Due to the valuable *Posidonia oceanica* seagrass meadows and outstanding biological diversity, the sea area round Torri della Meloria has been included among the areas to be transformed into marine reserves *(Ministry of the Environment, 1982)*. However, no special measures have been taken. As a result, the area - about 3 miles from the entrance to the port of Livorno - is still disturbed by tourism in the summer and pollution coming from the harbour area of Livorno.

Pesaro - Cervia

The coast of Romagna has quite efficient and suitable wastewater treatment plants. However, summer tourism, which causes the population to double, puts wastewater treatment systems to severe test. The area has been degraded by the products brought

down by the Po river for ten years and is eutrophic. A better, mesotrophic state is only experienced in the winter months *(Vollenweider et al., 1996)*. The area is thus sensitive.

Venice and its lagoon

The 3,300,100 m^3/d of water released by the petrochemical complex of Porto Marghera into the Venetian lagoon make the area particularly sensitive. Because of the petrochemical complex and the release of pollutants (TPBs), the lagoon's capacity to change water has been greatly affected and this has resulted in extremely polluted sediment, biota and water. This industrial hot spot and Venice, where sewage is released directly into the lagoon without any wastewater treatment, mean that the whole lagoon is in danger. In addition, some former directors of petrochemical companies have been sent for criminal trial, both for the deaths of workers at CVM and negligent pollution of the waters of the Venetian lagoon *(Ramacci, 1997)*.

Grado and Marano and their lagoon - Torviscosa - Mouth of the Isonzo river - Monfalcone - Trieste

Scientific authorities, universities and local authorities carried out thorough monitoring studies in the Upper Adriatic Sea, mainly in the Friuli region, in the bay of Panzano, near the mouth of the Isonzo river and Trieste. The pollution caused by mercury was monitored and the level of nutrients determined *(Majori et al., 1983)*. The situation of the area, which geopedologic, historical and mercury input from Slovenian mines have made sensitive *(Friuli-Venezia Giulia Region, 1989-1992)*, has been exacerbated, by human and industrial activities. In particular, Industrie Chimiche Caffaro of Torviscosa has a chlorine-soda plant with mercury cells releasing wastes directly into the surface water of the Banduzzi channel, thus resulting in a higher concentration of mercury in sediment in the channel, and this cannot be sustained by the lagoonal ecosystem of Friuli *(Azienda per i Servizi Sanitari n°. 5 Bassa Friulana, 1996)*. The Upper Adriatic Sea is made even more sensitive by nutrients and pollutants coming from Monfalcone and Trieste. Trieste is also the most important oil port in Italy, with a movement of about 29 million tons/year. In addition, the Upper Adriatic Sea has clearly eutrophic features *(Vollenweider et al., 1996)*, particularly on the coast of Friuli - namely in the Trieste, Gorizia (Monfalcone) and Udine (Torviscosa) provinces.

Gulf of Naples - Sarno river

The Gulf of Naples looks - at least within the first bathymetries from land - as though it were dangerously becoming eutrophic, although this has often been averted by frequently surging waves mixing and oxygenating the gulf waters. Industry - which is decaying, although it still plays a significant role - is only partly responsible for making the area sensitive. Nutrients and pollutants coming from under-sized, malfunctioning civil sewers (where these exist) in large amounts lead to a critical situation. In addition, products also come from the Sarno river, which is highly polluted, although not to such a great extent *(Ministry of the Environment, 1992)*.

Hot spots

A number of hot spots listed below were identified and their analytical parameters are fully described in the questionnaires:

CITY	
Genova La Spezia Livorno Rosignano Solvay (Li) Milazzo(Me) Augusta - Priolo - Melilli (SR) Gela (Cl) Crotone	Taranto Brindisi Bari-Barletta Falconara Marittima (An) Ravenna Porto Marghera (VE) Porto Scuso (Ca)

Proposed options for remedial action

Because Italy has developed considerably, priority should be given to some general remedial action involving both industry and civil projects, aimed at adequate management of certain processes and selection of the best wastewater treatment systems available.

Capacity building is an important goal for Italy. Italy has 8,000 Km of coastline but the culture of the health of the sea is not clear and not consolidated. Therefore, each municipality must invest as much as possible in capacity building for marine environment and health.

General suggestions for fund investment

Harbour and industrial sector

- Installation of VTS (Vessel Traffic Service) and HAC (Harbour Approach Control).

  For all Italian harbours - US$ 6 million
  (Source: Ministry of the Merchant Marine)

- Revision of regulatory plans for harbours to separate different types of product (chemical, oil, non-chemical) - US$ 160 million for each big harbour
  (Source: Port Authority and estimation)

- Protected connection system for vessel operation with oil and chemical products instead of the simple socket system
  - US$ 500,000 each socket system

- System of slop collection - US$ 5 million for each harbour
  (Source: Port Authority)

- Change old pipeline - US$ 50 million for each big harbour

- Change the anti-fouling system of coastal plants using seawater for refrigeration to employ a different biocide (not chlorine compound)
  - US$ 100,000 for each plant/y

- Industrial organic landfill, close to coastline, rehabilitation
  - 20,000 m^2 - US$ 16 million

- Treatment plant for emissions from ships (during vessel operation) (e.g. VOC volatile organic compound in Brindisi harbour was about 700 t/y) - airflow NM^3 600 (with 40 per cent hydrocarbon) - US$ 5 million

- Phytopharma study for optimization of use - US$ 320,000 (Source: Puglia region)

- Study on canning industry (food industry) - US$ 500,000 (Source: Puglia and Enea regions)

Civil sector

- Build sewer system for a coastal city (10 Km pipeline) - US$ 7 million
- Build WWTP 50,000 eg./inhabitants - US$ 10 million
- WWT programme for the whole Emilia-Romagnia coastline (from Ferrara to Riccione), including monitoring and control systems - US$ 100 million

Table 6

Ranking system and proposed option for remedial action for hot spots and sensitive areas.

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
HOT SPOTS													
Italy	Genova	Port/mixed	3	1	6	3	5	4	16.7	2	VTS-HAC/deloca-lization/WWTP/ monitoring	F, H, L	d = 10 million i = 80 million
Italy	La Spezia	Port/mixed	3	1	6	3	4	3	16.0	5	VTS-HAC/deloca-lization/WWTP/ energy power stn.	L, H, F	65 million
Italy	Livorno	Port, Industry	3	1	6	2	3	4	15.2	13	VTS-HAC/deloca-lization/WWTP/ monitoring	F, H, L, B	n.a.
Italy	Rosignano Solvay	Cl-NaOH, ethelene	4	1	6	3	3	2	15.6	11	BAT Chlorine/remedial on landfill	P, B, H, L	40 million
Italy	Golfo di Napoli	Port, refinery, domestic	3	1	4	4	3	5	15.9	7	VTS-HAC/WWTP	L, H, P	60 million
Italy	Milazzo	Port, refinery, domestic	3	1	6	3	3	4	16.0	5	VTS-HAC/deloca-lization/WWTP	P, F, H, L	45 million
Italy	Gela	Port, refinery, domestic	4	1	6	4	3	2	16.4	10	VTS-HAC/deloca-lization/WWTP	P, F, H, L	35 million
Italy	Augusta-Melilli	Port, refinery, domestic	5	1	6	3	3	2	16.6	3	VTS-HAC/deloca-lization/BAT chlo-rine/WWTP	P, F, H, L	70 million

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
Italy	Taranto	Port, refinery, domestic	5	1	6	2	3	2	15.8	8	VTS-HAC/WWTP	P, F, H, L	n.a.
Italy	Brindisi	Port, refinery, domestic	5	1	6	2	4	2	16.5	4	VTS-HAC/deloca-lization/WWTP inol/BAT chlorine	P, F, H, L	40 million
Italy	Bari-Berletta	Domestic	6	3	3	2	2	2	15.5	12	WWTP	P, H, B	100 million
Italy	Manfredonia	Port, industry, domestic	4	1	5	2	2	2	13.3	14	VTS-HAC/WWTP	H, B	25 million
Italy	Ancona-Falc.	Port, refinery	3	1	4	4	2	2	13.1	15	Monitoring	L, H	60 million
Italy	Ravenna	Port, refinery	3	1	6	2	4	4	15.9	8	Monitoring/deloca-lization	L, H, F	n.a.
Italy	Porto Marghera (VE)	Port, industry, domestic	6	1	6	4	5	5	21.9	1	VTS-HAC/monitor-ing/BAT CVM/BAT chlorine	P, L, H, F, B	120 million

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
SENSITIVE AREAS													
Italy	Vado Ligure-Savona	Power plant, industry, domestic	2	1	5	4	3	4	15.0	5	WWTP reconstruction/VTS-HAD/monitoring		
Italy	Secche della Meloria	Power plant, industry, domestic	2	1	6	3	2	3	13.6	7	SPA integral conservation		
Italy	Isola d'Elba	Power plant, industry, domestic	2	1	5	6	5	6	19.4	2	Monitoring/WWTP /treatment for emission from steel industry		
Italy	Pesaro-Cervia	Domestic seasonal	4	1	2	5	3	6	16.8	6	WWTP in summer/Po sedi-ment prevention		
Italy	Mouth of the Po	Power plant, industry, domestic	3	1	6	4	3	4	16.8	4	Delocalization pig farming/WWTP upstream/ monitoring		
Italy	Venezia and its lagoon	Power plant, industry, domestic	5	1	6	4	5	4	21.2	1	Delocalization CVM/WWTP		
Italy	Panzano bay	Mercury and Cl-NaOh, oil	4	1	5	3	6	5	19.0	3	BAT for chlorine alkali industry/ WWTP		

6. MAIN GAPS AND CONSTRAINTS

Generally speaking, the systematic data collected on receiving bodies, mainly coastal waters, concern only faecal coliforms, total coliforms and streptococci. Therefore, they are only evaluated from the point of view of human health. Few non-systematic data have been collected about physicochemical parameters and the bottom of the sea, sediment and forms of life on the Italian coast have barely been investigated. The data available concerns only some areas of the Ligurian Sea, the Upper Tyrrhenian Sea and the Upper Adriatic Sea. Funds could therefore be invested in a system to monitor the quality of coastal waters, sediment and biotic parameters using suitable biological indicators.

As far as industry is concerned, the flow of information is inadequate and sometimes no information is available.

Although ISTAT tried in 1991 - through a census of companies - to collect data on wastewater and fumes treatment systems, such data have never been processed, because, according to ISTAT's technicians, those supplied by businesses are considered unreliable.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

LEBANON

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Prepared by: Mr Dimitrios Tsotsos

1. INTRODUCTION

1.1 Current situation

Today, the Lebanese Government finds itself virtually at the point of departure of setting up the entire organizational framework for environmental protection (legislation, institutional arrangements, environmental infrastructure, etc.), needed to cope with the growing population density, mainly on the coast line, and industrial activities that are virtually uncontrolled.

All municipal and industrial effluents are discharged into the sea, directly or via rivers-streams, without any treatment.

The present structure of the recently established Ministry of the Environment is not able to monitor and control effluent quality due to lack of personnel and equipment (instrumentation, laboratories). Relevant effluent and ambient quality standards have been enacted by Ministerial Decision 20/B (1994) which was changed and completed by Ministerial Decision 52/1 (1996), but their benefits in practice largely depend on the authorities' and industry's capacity to measure and control the emissions.

Plans and projects for the repair and expansion of the existing infrastructure are being formulated and prepared.

The Council for Development and Reconstruction (CDR), directly under the authority of the Prime Minister, is mainly responsible for the planning and execution of these major infrastructural projects, including those for liquid-solid waste collection, treatment and disposal. The essential characteristics of this programme in relation to wastewater treatment are mentioned in Chapter 6.

1.2 Elaboration of the survey

This survey has been elaborated on the basis of lengthy discussions with Mr Naji Kodeih, appointed National Coordinator for the Strategic Action Programme, and relevant experts of the Ministry of Environment, as well as on a detailed overview of existing documentation. Major input regarding the plans already existing for remedial action was provided by Mrs Wafa Sharaf el Dine of CDR.

The main report used for this survey is the study Lebanon : assessment of the state of the environment, prepared for the Ministry of the Environment by Environmental Resources Management (ERM) in association with Jouzy and Partners/CEB in the framework of METAP (1995). This study systematically addresses and evaluates all the key issues of environmental concern.

The major problem, which has obviously affected the survey's reliability, is the lack of reliable and systematic data for the past five years : the quantity-quality of municipal and industrial effluents have not yet been measured so no reference could be made to data registers. Consequently, the estimations contained in the METAP report were used when filling in the questionnaires. These estimations of hydraulic and pollution loads for selected major industries are based on a survey of industrial wastes conducted by Bechtel (1991).

2. IDENTIFICATION OF HOT SPOTS - SENSITIVE AREAS

2.1 Methodology

In identifying potential hot spots and sensitive areas on the coast of Lebanon, the following selection criteria were utilized:

1. identification of all cities with more than 100,000 inhabitants;
2. determination of all coastal areas with an agglomeration of potentially hazardous industries (high pollution loads);
3. consideration of major indirect effluent discharges, via streams-rivers, at a short distance from the shoreline;
4. identification of coastal areas of natural and socio-economic value (i.e. potential recreational areas), which are/could be affected by municipal-industrial activities.

2.2 Selection of potential hot spots - sensitive areas

The potential hot spots and sensitive areas selected are listed in Table 1.

Table 1

Potential hot spots - sensitive areas

Location	Main cities	Population equivalents (p.e.)	Main activities
Greater Beirut area	Beirut & suburbs	1,200,000	Municipal, industrial
Tripoli	Tripoli & Tripoli caza	353,000	Municipal
Batroun-Selaata	Batroun	51,000	Municipal, industrial
Jbail (Byblos)	Jbail (Byblos)	66,000	Municipal, industrial
Jounieh	Jounieh	200,000	Municipal, industrial
Saida-Ghaziye	Saida & Saida caza	205,000	Municipal, industrial
Sour	Sour	181,000	Municipal

3. POLLUTION SOURCES

In Table 2, the hydraulic and pollution load figures for each hot spot-sensitive area are shown.

Table 2

Assessment of pollution

Location	Main pollution sources	Total loads	
		Hydraulic (m^3/day)	Parameter: tn/year
Greater Beirut area	Municipal, industrial	192021	BOD_5:29235
Tripoli	Municipal	42360	BOD_5: 7452
Batroun-Selaata	Municipal, industrial	6120	BOD_5: 1077
Jbail (Byblos)	Municipal, industrial	8020	BOD_5: 1397
Jounieh	Municipal, industrial	24940	BOD_5: 4397
Saida - Ghaziye	Municipal, industrial	25050	BOD_5: 5082
Sour	Municipal	21720	BOD_5: 3821

4. RANKING OF HOT SPOTS-SENSITIVE AREAS

4.1 Introduction

In this chapter, the selected hot spots-sensitive areas have been prioritized by evaluating the potential risks exerted by the relevant point sources and the effects on public health, drinking water quality, recreation, other beneficial uses, aquatic life, and economy/welfare.

The weighted ranking system and relevant explanations (documentation) have been used for this purpose. Relevant factors and multipliers were extensively used in this analysis. Where there was no information, experience and documentary references were used in order to formulate a fairly reliable picture of the prevailing conditions.

Paragraph 4.3 summarizes the results of applying this system and provides estimated cost figures for remedial action. The main elements and the justification for this action are described in Chapter 6.

4.2 Comments - remarks on criteria - explanations

4.2.1 Other beneficial uses

On-shore uncontrolled dumping sites of solid wastes are considered as discharges with a high level of solid wastes (i.e. cases of rainstorms, flooding etc.) and odours.

4.2.2 Aquatic life

The degree of oxygen depletion by municipal/industrial discharges cannot be assessed in the context of this study, especially to the required degree of accuracy (below exact concentration values). Other criteria (heavy metal/oil concentrations), therefore, have to be considered.

Even here, however, the words "any discharge" without assessment of the relevant hydraulic loads, can be misleading. Therefore, ratings were based on the significance of discharge (lower marks for small quantities).

4.2.3 Economy and welfare

The impact of industrial activities on the local economy is usually based on economically crucial figures such as production capacity, number of employees, exporting potential etc. If these data cannot be assessed, then conclusions are inevitably drawn from the pollution potential caused (hydraulic-pollution loads).

Moreover, the proposed investment figures (US $ 5 - 20 million) mostly apply to very large single industrial units in the case of industrial agglomerations (industrial zones), or are the total for various interventions for several industries discharging separately at the same hot spot-sensitive area.

Where no industrial effluents are discharged (only municipal effluents), a rating of 2 has been used (slight effects).

4.3 Priority hot spots and sensitive areas

Table 3 summarizes the final results of the weighted ranking analysis and the preliminary cost estimations for remedial action. Areas with specific natural and socio-economic value (Byblos, Sour) and with a moderate risk of permanent damage (lower ranking results) are defined as sensitive.

Table 3

Priority hot spots - sensitive areas

Country	Name	Type* HS, SA	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspects	Preliminary estimated financial requirement (in million US$)
LEBANON	Greater Beirut area	Municipal, industrial HS	6	1	4	5	6	3	20.6	100	WWTP-Construction: primary (planned) & secondary (assumed)	L	- Construction Dora plant:47 - Upgrading to sec. treatment: 93
	Jounieh	Municipal, industrial HS	4	1	5	5	5	5	19.9	97	WWTP- construction: primary (planned) & secondary (assumed)	L	- Construction of primary WWTP: 51 - Upgrading to sec. treatment:11.6
	Saida-Ghaziye	Municipal, industrial HS	5	1	5	4	4	5	19.3	94	WWTP: construction: primary (planned) & secondary (assumed)	L	- Construction of primary WWTP: 32 - Upgrading to sec. treatment: 12
	Tripoli	Municipal HS	5	1	4	5	6	2	18.9	92	WWTP- construction: primary (planned) & secondary (assumed)	L - F	- Construction of primary WWTP: 106 - Upgrading to sec. treatment:20.5
	Batroun - Selaata	Municipal, industrial HS	4	1	4	3	4	5	16.8	82	Feasibility study (ongoing) & secondary treatment assumed)	L	- Feasibility study: 0.5 - Sec. treatment:5.4
	Sour	Municipal SA	4	1	3	4	2	2	13.2	64	WWTP- construction: secondary (planned)	L	19

* HS = hot spot, SA = sensitive area

Table 3 (continued)

Country	Name	Type* HS, SA	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspects	Preliminary estimated financial requirement (in million US$)
LEBANON	Jbail (Byblos)	Municipal, industrial SA	2	1	2	4	3	3	12	58	Feasibility study (ongoing) & secondary treatment (assumed)	L	- Feasibility study: 0.5 - Sec. treatment: 7
											Capacity-building & ind. waste masterplan		- Capacity building: 2 - Ind. waste master-plan: 1

* HS = hot spot, SA = sensitive area

5. GAPS AND CONSTRAINTS

5.1 General comments

As mentioned in the introduction, the result of the absence of data registers and of actual measurements of effluents and water quality has been the extensive use of estimations for load calculations.

The relevant figures presented in the METAP report were adopted for municipal and industrial discharges, whereas no data exist for receiving water quality measurements.

The first phase of an industrial waste management plan has recently been completed (1996), and an effort has been made to compile an inventory of industrial pollution sources. Nevertheless, reasonably reliable data on key factors (annual production, water usage, wastewater flow) to be used to estimate wastewater quantities and loads, were difficult to obtain.

Furthermore, past data on population density were used as there has not been any census since 1932. The METAP-report has also been based on these projections.

5.2 Basic assumptions - findings

5.2.1 Municipal discharges

- Wastewater quantity : 120 l/cap.day;
- BOD_5-effluent concentration : 482 mg/l;
- BOD_5-load : 58 g/cap.day;
- Permanent population : to be served by the sewer system;
- Beirut plant (to soon be operational) : present situation.

5.2.2 Industries connected to municipal sewerage networks (Greater Beirut, Jounieh)

- Only the location of the industries is indicated as most of their names are not known.
- Estimated figures from METAP report (hydraulic flow, BOD_5/SS-load) used.
- Per capita loads (120 l/day, 58 g BOD_5/day) as basis for calculation, then highest resulting value adopted.

5.2.3 Industrial discharges directly into the sea

- Only the location and type of industry are indicated as the Ministry of the Environment has no information on their names and capacities.
- Indirect discharges, via small streams rivers at a short distance from the shoreline, have also been taken into account.
- A working period of 250 days/year for industrial production - effluent discharges has been assumed.
- No data available for the fertilizer industry located in Selaata.
- Effluents from tanneries (Bourj Hammoud, Beirut).
- Effluents from detergents (Chouayfat, Beirut).

- Effluents from nutrition industry (Dbayeh, Greater Beirut).
- Effluents from electrochemical, pharmaceutical and nutrition industries (Zouk Mkayel, Jounieh).
- Effluents from fertilizers (phosphogypsum) (Selaata, North Lebanon).
- Effluents from tanneries (Saida-Gazieh, South Lebanon).

6. REMEDIAL ACTION

6.1 Conclusions

This survey's findings have shown clearly the urgent requirements for immediate infrastructural and organizational intervention in order to prevent any further negative impact on coastal waters and to improve the environmental situation gradually.

The Lebanese Government, is fully aware of these requirements and has launched major initiatives to cope with the present situation, namely, the creation of the Ministry of the Environment, the preparation of the most important projects for wastewater collection, treatment and disposal for the main coastal cities (Beirut, Tripoli, Saida, Jounieh and Sour) by CDR, and the preparation of the masterplan for industrial waste management.

The following paragraphs describe the main characteristics of the planned remedial action, as well as the additional action proposed. Cost figures were given by CDR (Programmes Division), and where appropriate cost estimations are based on experience and documentary references. These data are summarized in Chapter 4 (Table 3).

6.2 Description of remedial actions - Cost figures

6.2.1 Municipal discharges

In view of the current situation and the reconstruction priorities fixed, the installation of primary treatment plants (sedimentation), combined with long submarine outfalls, is the option adopted by the Government.

The rehabilitation and expansion of existing sewerage networks is an integral part of each project for the reduction of uncontrolled discharges into the marine environment.

Consequently:

- the el-Ghadir plant, serving almost 50 per cent of the Greater Beirut Area will be operational within the next two to three months, and a feasibility study is currently being prepared on its eventual expansion to a secondary stage (biological);

- studies/tender documents for the Dora plant, which serves the remaining part of the area, will soon be finalized;

- studies/tender documents for each of the plants serving Tripoli, Jounieh, Saida (primary treatment) and Sour (primary/secondary treatment) will be finalized by the end of 1997.

Preliminary (feasibility) studies are being prepared for the areas around the cities of Batroun and Jbail (Byblos).

Cost figures, based on the existing plans-studies (source : CDR), are shown in Table 4.

Table 4

Cost of remedial action (studies-construction) for municipal discharges

City	Type of action	Costs (millions of US dollars)
Beirut (Dora plant)	Main collector, primary treatment, submarine outfall	47
Tripoli	Main collector, primary treatment, submarine outfall	106
Jounieh	Main collector, primary treatment, submarine outfall	51
Saida	Main collector, primary treatment, submarine outfall	32
Sour	Main collector, primary/ secondary treatment, submarine outfall	19

The costs of the feasibility studies for Batroun and Jbail are estimated at US$ 500,000. Cost predictions for secondary treatment can only be based on the figures for Sour and several rough estimates as follows:

- total costs for Sour plant (main collector-primary/secondary treatment) : US$ 15 million (without the outfall);
- cost for secondary stage : US$ 10.5 million (70 per cent of total costs);
- cost/cap in Sour : US $ 58.

The cost of upgrading the planned primary plants to secondary treatment is roughly the following (without considering the size of each city) :

	(millions of US dollars)
Greater Beirut area (el-Ghadir & Dora)	93
Tripoli	20.5
Jounieh	11.6
Saida	12

For Jbail (Byblos) and Batroun the total costs of Sour can be considered (US$ 19 million):

total costs/cap in Sour : US$ 105 so that :

costs for Jbail : US$ 7 million
Batroun : US$ 5.4 million

6.2.2 Industrial discharges

The expansion and completion of the masterplan for industrial waste management must be elaborated, urgently and cover the following aspects:

- pollution source inventory (measurements, data organization - interpretation, archives etc.);
- feasibility studies for pollution prevention/minimization measures;
- design of full-scale treatment plants for each major industry;
- reporting to Governmental authorities;
- financial requirements for investments.

This plan should also contain concrete solutions, applicable to individual branches of industry, and a description of step-by-step implementation of measures with a five-year horizon. The industries defined by this report as hot spots should obviously receive first priority.

It is suggested that this masterplan be completed within the next two years.

Cost figures : The elaboration of the masterplan will cost US$ 1 million (source: Ministry of the Environment).

Its practical implementation will last for five years at least , but the relevant costs cannot be estimated since they greatly depend on the masterplan's findings and proposals.

6.2.3 Capacity-building

In its present condition, the Ministry of the Environment is not in a position to carry out effective monitoring or control compliance by enterprises with set effluent quality standards (lack of personnel and laboratory/analytical equipment). It is therefore urgently necessary to improve its organization and develop it further.

The following main activities should be launched soon:

- establishment of an integrated legal framework for issuing permits (measurable effluent standards, penalties for non-compliance, etc.);
- organization of central-regional laboratories;
- installation of water quality monitoring stations at rivers-coastal waters.

Cost estimations for this immediate plan will greatly depend on the results of a study that has to be carried out first. Nevertheless, costs could not be lower than US$ 2 million.

In addition, this study should also cover, in a separate part, the organization of the institution which will be responsible for operating the municipal wastewater treatment plants.

DOCUMENTATION

World Health Organization :	Assessment of sources of air, water and land pollution. Part I : rapid inventory techniques in environmental pollution (by A.P. Economopoulos) Geneva, 1993
World Health Organization : (Regional Office for Europe)	Identification of pollution hot spots and sensitive areas, 1997
METAP :	Lebanon : assessment of the state of the environment (by ERM-Jouzy and Partners/CEB), 1995
Council for Development - and Reconstruction:	Regional Environmental Assessment, Report on the coastal zone of Lebanon (by ECODIT - IAURIF), 1996

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

LIBYAN ARAB JAMAHIRIYA

Prepared by: Mr A.F. Boargob

1. INTRODUCTION

Libya lies on the African coast of the Mediterranean Sea. It is bordered by Egypt and Sudan in the east, Chad and Niger in the south, Algeria and Tunisia in the west.

The country covers an area of 1.76 million km^2, over 85 per cent of which is barren desert, about 13 per cent is semi-desert and only 2 per cent is suitable for agriculture. According to the 1994 census, Libya's population was 4.6 million. With an annual growth rate of 4.1 per cent, the present population is estimated to be 5 million.

Most of the people reside in urban and semi-urban communities along the 1,900 km of coastline.

About 46 per cent of the population live in the country's two major cities, Tripoli and Benghazi. Tripoli, the largest city, has a population of about 1.2 million and is located on the West Coast. Benghazi, the second largest city, is on the East Coast and has a population of about 880,000.

The Mediterranean region is hot and relatively dry in the summer, and wet in winter. Temperatures ranges from a maximum of around 46 °C to a minimum of 7 °C. Rainfall may be as high as 600 mm annually and as low as 100 mm annually in the coastal regions, and dwindles to zero in the rest of the country.

2. DOMESTIC WATER SUPPLY AND SANITATION

About 95 per cent of the total water supply for domestic use in Libya is obtained from ground water reservoirs. The part refilled by rainfall can be considered as renewable, but the major part is non-renewable.

Many coastal cities are supplied with water for domestic and industrial use by more than 100 desalination units. The overall design capacity of the coastal desalination plants is in excess of 40,000 cm/day. However, the actual volume of desalinated water is significantly less, because of the many operational problems affecting these plants.

According to the Libyan census and statistical department, in 1969, 58 per cent of Tripoli's population and 15 per cent of Benghazi's population were connected to municipal sewers. A further 28 per cent in Tripoli and 81 per cent in Benghazi used cesspools, and the rest had no sewers at all.

At present more than 80 per cent of the inhabitants in Tripoli, Benghazi and all other major towns and cities with moderately large populations and with populations as small as 3,000 inhabitants enjoy the benefits of sewerage and sewage disposal systems.

During the past three decades, attention has been paid to environmental pollution and action has been taken to execute many wastewater treatment plants for both domestic and industrial wastewater.

The most comprehensive environmental legislation, Law no. 7 for the protection of the environment, was issued in 1982. In chapter 3, (*Protection of the seas and marine resources*), section 35 prohibits the discharge of polluted water directly into the sea through pipes leading to or from the coast, or through channels and sewers, including underground or surface drainage systems, before such water has been treated in accordance with the legislation in force and with the regulations promulgated pursuant to this act.

3. CURRENT SITUATION

The total number of wastewater treatment plants in the Libyan Arab Jamahiriya is approximately 56, ranging from 3,000 cm/day to 110,000 cm/day for dry weather flow. Of these, 16 are located on the coastline, eight of which are for domestic wastewater.

In the coastal region there are six major industries, all using well-operated treatment plants with the exception of one plant, which is at present being maintained.

4. INFORMATION OBTAINED

The Technical Centre for Environment Protection distributed a questionnaire on the status of the treatment plants during the past six months. The final result is expected at the end of this year.

The information in this report is based mainly on investigation reports after site visits to the existing treatment plants in the Libyan Arab Jamahiriya, as well as on various studies conducted during the last few years.

The information on new treatment plant projects was obtained from the project department of the Secretariat of Housing and Utilities as well as the cost estimation for the investments.

The information gathered on the treatment plants and their operating lives, as well as the comprehensive analysis (physical, biological, and chemical) may not be as reliable as desired because of the nature of the data available.

The economic situation of the Libyan Arab Jamahiriya allows the country to make investments in the construction or maintenance of treatment plants in the coastal region.

The resource is the swimming areas near the main cities of Tripoli and Benghazi, where the overflow is discharged. It is essential to maintain the treatment plants and bring them up to full capacity. With regard to public health, people avoid such areas. Fishing areas are very far from the coast so there is no problem.

Capacity building is very important to improve the work of existing institutions and the wastewater treatment plants.

5. IDENTIFICATION OF MAJOR GAPS AND CONSTRAINTS

At present, the only obstacle facing the continuous operation of the treatment plants is the lack of skilled labour, (technicians, electromechanical engineers and lab-technicians) so that priority is concentrated on providing assistance for training of Libyan personnel locally and abroad.

Table 1

Contribution of different sources

Locality	Pollution sources	Principal supporting data from questionnaires
Zawia	Domestic	Site investigation and previous studies
Zanzur	Industrial	Site investigation and previous studies
Tripoli	Domestic	Site investigation and previous studies
Benghazi	Domestic	Site investigation and previous studies
Tobruk	Domestic	Site investigation and previous studies

Table 2

Assessment of priority pollution hot spots in Libya

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspects	Preliminary estimated financial requirement (in US$)
LIBYA	Zanzur	Industrial	4	1	4	6	3	3	17	90	Capacity-building (training)		100,000
	Tripoli	Domestic	3	1	4	6	3	2	15,3	96	Extension		12 million
	Benghazi	Domestic	3	1	3	5	3	2	13,8	95	Extension		1 million
	Zawia	Domestic	2	1	3	5	2	2	12	95	Capacity-building (training)		2 million
	Tobruk	Domestic	2	1	3	5	2	2	12	93	Capacity-building (training)		1.5 million

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

M A L T A

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Prepared by: Mr Louis J. Saliba

1. INTRODUCTION

The survey was carried out by the Pollution Control Coordination Unit of the Department of Environmental Protection (Ministry of Foreign Affairs and the Environment). Following consultations during February, the completed questionnaires were reviewed during the week starting 4 March 1997.

The situation in Malta is different from that in other countries, mainly because of the size factor. The total population of the Maltese Islands is approximately 375,000, with 349,000 residing in the main island of Malta, and 26,000 in the Island of Gozo. Building development over the years have turned once distinctly delineated towns and villages into large urban conurbations - this is much more accentuated in Malta than in Gozo.

In both islands, practically the whole population is served by a comprehensive sewerage system. There are a number of relatively isolated farms and residences which are served by individual cesspits. These are regularly emptied, and the waste transported by tanker to the nearest access point of the sewerage system, and discharged into it. All domestic waste is therefore discharged through the sewers.

The major part of the sewerage network serves the whole of the central and southern regions in Malta, and is discharged, mainly untreated, into the sea through a submarine outfall structure (800 m long and 11 m deep) located at Wied Ghammieq, just south of the Grand Harbour (facing north-east). Part of the sewage (currently approximately 10%) is diverted to a Sewage Treatment Plant located at Sant Antnin., in the southern part of Malta. The treated effluent is used for irrigation of agricultural crops.

Another part of the sewerage network serves the northern region of Malta, the effluent, which is untreated, being discharged through an outfall located on the immediate coastline at Ic-Cumnija, near Anchor Bay (facing south-west).

A separate sewerage network exists for Gozo, the effluent being discharged untreated through an outfall located on the immediate coastline at Ras-il-Hobz, in the northern part of the island.

Because of this, towns in Malta and Gozo cannot be treated individually for the scope of this survey, and the Islands have been divided into three regions, with each of the three sites where discharge takes place being considered as hot spots.

A large number of industries exist in both Malta and Gozo. Most of these are very small, and produce electronic components, clothing, shoes, rubber goods, canned foodstuffs, and a variety of other products. No industries exist on the immediate coastline, and all liquid industrial waste is discharged into the municipal sewerage system. There are virtually no industries which produce the more insidious pollutants in their wastes. Regulations have been passed in 1993, whereby all industries are obliged to treat their wastes at source before discharge into the municipal system. This legislation, however, is still not completely enforced.

There are no rivers or canals in Malta or Gozo.

One other factor contributing to the pollution load discharged into the sea is that of agricultural wastes. Wastes from animal farms in all rural areas are collected by tanker and discharged into the municipal sewage system at nearby access points. The total pollution load at the discharge points is therefore much more than what one would expect from human population figures alone.

The existing sewage treatment plant at Sant Antnin is being extended in order to be able to take on a much larger percentage of the sewage from the central and southern regions of Malta. Plans are also in hand for the construction of three new treatment plants at Wied Ghammieq, Ic-Cumnija and Ras il-Hobz. The specifications for these plants have already been completed, and it is estimated that all of them will be operational by the year 2000. This will mean that no untreated liquid waste will be discharged to sea when the necessary works have been completed. It is intended to use as much of the treated effluent as possible for irrigation.

2. APPROACH

Prior to the completion of the questionnaires, a list of potential hot spots was drawn up for consideration. This list included not only the three main discharge points of mixed effluents, but also all sites, such as harbours, yacht marinas, electricity power stations, reverse osmosis desalination plants, and aquaculture areas. Further review of these sites (other than the three main discharge sites) revealed that although varying degrees of pollution of the water did exist, the amounts involved did not in any way justify their inclusion as hot spots.

The final list of hot spots was therefore limited to the three main sewage discharge sites, all containing mixed sewage - domestic, industrial and agricultural at Wied Ghammieq and Ras il-Hobz, and domestic and agricultural at Ic-Cumnija

The only problem encountered was in estimating pollution loads. BOD_5, COD, Total-N, Total-P and TSS were all obtained by direct analysis at the discharge points. The pollution loads were arrived at by using the concentrations obtained as mg per Litre in conjunction with the recorded wastewater flow. No data on the other constituents listed in the questionnaire were available, and analysis could not be done in the short time allocated to the project. Similarly, data on receiving water quality were not available.

The assessment of effects of the three hot spots listed was done not only on the basis of pollution load, but also taking into account the localities of the discharge sites and effected areas in question in relation to sensitive areas such as bathing areas, etc., and the contribution of dispersal in the sea to the final effects.

Estimates of the cost required for construction of the three new sewage treatment plant and for extension of the existing one have been based on projections of the original estimates drawn up when specifications were issued.

3. CONTRIBUTION OF DIFFERENT SOURCES TO THE DEFINED HOT SPOTS

A list of the three identified hot spots, along with the various sources contributing to the discharge, and the principal supporting data expressed as tons of BOD_5 per day, is given in Table 1. A resume of the data contained in the questionnaires, including total loads of BOD_5, COD, Total-N, Total-P and TSS in tons per year, is given in Table 2. Untreated wastewater flow from each site was calculated at 22,000,000 m^3 per year at Wied Ghammieq, 3,100,000 m^3 per year at Ic-Cumnija, and 2,400,000 m^3 per year at Ras il-Hobz.

4. ASSESSMENT OF PRIORITY HOT SPOTS AND SENSITIVE AREAS

The assessment of the three priority hot spots, using the ranking system provided, is given in Table 3.

5. IDENTIFICATION OF MAIN GAPS AND CONSTRAINTS

The main gaps are the lack of information on (a) concentrations of Petroleum hydrocarbons, heavy metals and organochlorines in the effluent, and (b) the quality of receiving waters. This is important, as the effluent is mixed, and analysis of both effluent and receiving waters would help a lot in assessing the efficacy of enforcement of the regulations prohibiting industries from discharging untreated waste into the municipal sewerage system. The information is also important from the point of view of treated sewage re-use.

The main constraint from the point of view of the persons responsible for completion of the questionnaires was the time-factor. This was sufficient, in a small country such as Malta, to collect the information already available. Chemical analysis of the parameters data on which were unavailable could possibly have been done given (a) more time and (b) some degree of assistance.

It is true that the present exercise was limited to hot spots, and was in no way a comprehensive survey of all pollution sources in the Mediterranean. However, it is felt that the time allocated was much too short to enable the work to be done properly.

6. PROPOSED OPTIONS FOR REMEDIAL ACTION

The main option available for remedial action at all three sites is the construction of wastewater treatment plants. These treatment plants would be designed on the orthodox state-of-the-art pattern for dealing with municipal wastes, with the provision that legislation prohibiting the discharge of industrial wastes into the municipal sewerage system will have to be enforced. In actual fact, preliminary estimates of the types and amounts of wastes discharged by industries would have no major impact on the suitability of the effluent for discharge into the after municipal-type treatment, though this has still to be confirmed by analysis. Wastewater designed for use in agriculture and possibly industry (as cooling water) would have to be more comprehensively treated, and this can only be done by the dual system (at source and then before discharge or re-use) envisaged.

It is estimated that the total cost of constructing the three new treatment plants and extending the existing one will be in the region of US$ 48,000,000. As stated earlier in this report, estimates have been based on projections of the original estimates drawn up when specifications were issued. These costs are therefore only approximate, intended to provide an indication of the level of investment involved.

Table 1

Identified hot spots in Malta

Hot Spots	Pollution Sources	Principal Supporting Data
WIED GHAMMIEQ	Mixed	28 Tons BOD/day from 270,085 inhabitants + Industries + Agriculture (Animal farms)
IC-CUMNIJA	Mixed	6,6 Tons BOD/day from 59,224 inhabitants + Agriculture (Animal farms)
RAS IL-HOBZ	Mixed	3,5 Tons BOD/day from 25,957 inhabitants + Industries + Agriculture (Animal farms)

Table 2

Municipal and other discharges from main sewage outfalls in Malta

Outfall	Population	Population served by sewerage	BOD (Tons/year)	COD (Tons/year)	TOTAL N (Tons/year)	TOTAL P (Tons/year)	TSS (Tons/year)
WIED GHAMMIEQ	270,085	270,085	10,250	16,029	135,415	12,447	124,538
IC-CUMNIJA	59,224	59,224	2,412	3,599	1,914	1,495	14,240
RAS IL-HOBZ	25,957	25,957	1,273	3,318	1,777	2,233	28,165

Table 3

Assessment of Hot spots in Malta

Country	Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other Beneficial Uses	Welfare and Economy	Weighted Total	Relative Importance Index	Nature of Investment	Transboundary Aspects	Preliminary Estimated Financial Requirement (in US$)
MALTA	WIED GHAMMIEQ	Mixed	6	1	6	4	4	6	21.9	100.0	WWTP (EXT) WWTP (NEW)	F,H,B,L,P	4,000,000 32,000,000
	CUMNIJA	Mixed	6	1	4	3	3	5	18.1	82.6	WWTP	F,H,B,L,P	8,000,000
	RAS IL-HOBZ	Mixed	5	1	5	3	3	5	17.9	81.7	WWTP	F,H,B,L,P	4,000,000

Priority Sensitive Areas in Malta*

Sensitive Areas	Reason for intervention	Estimated Costs (in US$)
Wied Ghammieq	Construction of a new wastewater treatment plant together with an extension of another wastewater treatment plant (already existing at San Antnin)	Total cost: 36,000,000
Ic-Cumnija	Construction of a new wastewater treatment plant	Total cost: 8,000,000
Ras il-Hobz	Construction of a new wastewater treatment plant	Total cost: 4,000,000

* Because of the size of the country, the priority pollution Hot Spots coincide with the Sensitive Areas.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

MONACO

Information provided by the Monegasque Authorities

CURRENT SITUATION

The Principality of Monaco is equipped with a biological wastewater treatment plant for both domestic and industrial effluents. Treatment is made not only to the effluents from Monaco, but also to those generated by three coastal communities.

There are some industries that do not discharge their wastewater directly into the sea. The coastal zone of Monaco has no canals or rivers.

Therefore, on the basis of the above information, and according to the criteria posed for the definition of pollution hot spots and sensitive areas in the Mediterranean, it is concluded that the coastal zone of the Principality of Monaco cannot be considered either a pollution hot spot or a sensitive area.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

MOROCCO

Prepared by: Mr Mohammed Benyahia

1. INTRODUCTION

Morocco is situated at the intersection of international seaways and so has a privileged geographical position as a coastal State on the Straits of Gibraltar with a dual Atlantic/Mediterranean maritime frontage extending for almost 3,500 km., of which around 500 km are on the Mediterranean.

The importance of such a coastal area, which is as rich as it is large, is not only strategic but also vital from the economic perspective. Thirteen of Morocco's 16 regions have direct access to the sea (three to the Mediterranean coast) and their socio-economic activities thus greatly depend on their coasts.

As far as the Mediterranean coastal zones are concerned, they are subject to several types of depredation and are consequently at risk of degradation and destruction under the combined effect of growing human pressure, accelerated urban growth and both pollution from land-based sources and pelagic pollution.

This report provides a concise summary of the characteristics of the pollution discharged into the Mediterranean by large centres in Morocco.

The data used to draw up this report have mainly been taken from the general liquid sanitation plans and a number of regional reports on the environmental aspect (see the bibliography). These references, however, did not give enough detail concerning all the types of domestic and industrial discharges (concentration of heavy metals, percentage of wastewater directly discharged into the sea, characteristics of the receiving environment, etc.). To remedy this deficiency, a number of national references concerning all Moroccan regions, including the Mediterranean regions, have also been used.

This report is divided into two major sections: the first deals with the environmental problems of the coast in relation to domestic and industrial discharges and the second identifies the hot spots and sensitive areas on Morocco's Mediterranean coast.

2. APPROACH UTILIZED

Analysis of the data collected showed that the Mediterranean coast, which extends from Tangiers to the Algerian border, displays a wide variety of features.

Three zones were therefore defined according to geography, history and the extent of development:

2.1 The western Mediterranean coast

This includes the provinces of Tangiers and Tetouan and is the most urbanized sector where the conflict among tourism, agriculture and industry is at its most acute. The province of Tangiers, for example, which has a population of 526,215, has substantial assets that encourage the installation of industrial production units. Due to its geostrategic position, not far from Europe, and stimulated by economic relations with foreign countries, the city also possesses a basic infrastructure and an important communications network. The province of Tetouan has a population of 367,349 and is an important tourism centre, especially in the summer, but also has a long-standing industrial tradition. Certain production units have been located in the city since long before independence.

2.2 The central Mediterranean coast

This extends for around 150 km; here the conflict is rather among the zone□s different possibilities : tourism (seaside, mountains, winter season), arboriculture, fishing, hunting, livestock farming. The province of Al Hoceima (112,588 inhabitants) is the most economically developed with considerable tourism and industrial potential that will allow future development through the rational exploitation of the local assets and natural resources.

2.3 Eastern Mediterranean coast

This covers the coast of Nador (246,113 inhabitants) up to the Algerian border and includes fairly isolated areas. The agricultural and maritime potential of local resources has promoted the establishment of a number of industrial units in this zone. It also has substantial mining potential (iron, lead, bentonite, kaolin, gypsum, etc.).

The above information shows at the outset that Morocco□s Mediterranean coast has large urban centres whose discharges must be specified in order to assess the level of pollution they cause in the Mediterranean. These are the cities of Tangiers, Tetouan, Nador and Al Hoceima.

3. SOURCES OF POLLUTION

The major sources of pollution of the Mediterranean Sea are :

- domestic wastewater, and
- industrial wastewater.

3.1 Domestic wastewater

The basic data used to typify domestic urban sewage have been taken from the studies for the liquid sanitation plans of Mediterranean cities and the national liquid sanitation plan (SDNAL).

The data required for a complete typification of wastewater in certain centres are not available, but the global pollutant load for all large Mediterranean centres can be found in the SDNAL.

Table 1 below shows the ratio of sewage discharged *per capita*/day and the concentrations of pollution parameters.

Table 1

Typification of domestic sewage

	Total population	Population connected	Percentage connected	Flow l/inh/day	Flow m^3/day	BOD_5 t/day	COD t/day	OM g/inh/day	SM t/day	NTK t/day	Total-P t/day
Tangiers	526,215	373,612	71%	118	44086	29.14	71	--	36.13	3.9	0.63
Tetouan	367,349	282,858	77%	121	34225	22.07	53.6	115	27.65	3.04	0.48
Nador	246,113	159,973	65%	81	12958	4.21	13.53	46	4.9	0.35	0.42
Al Hoceima	112,588	72,056	64%	88.70	6391	1.3	3.41	--	1.65	--	--

Domestic pollution is calculated by multiplying the number of inhabitants by the unit pollution load. It is expressed in terms of biological oxygen demand (BOD_5), chemical oxygen demand (COD), oxydable matter (OM), suspended matter (SM), nitrogen pollution (NTK), and phosphorous pollution (total phosphorous).

The unit flow rate of sewage ranges from 81 l/inh/day in Nador to 121 l/inh/day in Tetouan. This variation is due a number of factors, the main ones being :

- drinking water consumption;
- food and hygiene habits and consequently living standards;
- water supply cuts in centres where there is a shortage;
- type of living accommodation;
- leaks in the water supply;
- the rate of connection to the water supply, whose figures are imprecise;
- the reliability of the results of certain calculations.

The figures for BOD_5 are fairly variable, the low figures mainly being due to the sealing of pipes, which causes large-scale sedimentation, and the dilution due to various factors such as infiltration of the water table into the badly-maintained network.

The high COD and SM figures are for Tetouan and Tangiers. Some high SM figures can be explained by the type of network, usually of a unit type, and also by the state of the roads.

The concentrations of nitrogen and total phosphorous also vary, but in general remain low. These low values are most likely due to factors such as settlement in the network followed by degradation. In some cases, the network acts as a real pre-treatment system.

Microbial pollution in the form of faecal coliforms has been estimated at $24\ 10^8$ col/100 ml.

It should nevertheless be noted that the promotion of tourism as a priority economic sector has led to growing domestic demand at seaside resorts. For example, the population of Martil (the seaside resort at Tetouan) increases at least twofold during the summer season and this is because of the quality of the tourism along the whole Moroccan Mediterranean coast.

In addition, sewage collected from all the population connected is directly discharged into the receiving environment (sea, water system, soil) without prior treatment, except in the city of Nador, which has an activated sludge-type sewage treatment plant, and five small tourism centres at Tetouan for which no data are available.

At the Nador plant, the volume of sewage treated is 8,100m^3/day. The rate of performance at the plant is 95 per cent for BOD_5 and 97 per cent for COD.

3.2 Industrial wastewater

Northern Morocco□s industrial geography is marked by a strong concentration of industrial activity along the western coast of the Mediterranean, principally along the Tangiers-Tetouan axis.

The importance of this concentration is due to the diversity of industries there: agri-food, textiles and leather, mechanical-metallurgical and electrical, chemical- parachemical industries.

In 1990, jobs in industry along the coast as a whole were 32,192, compared with 23,713 in 1982, corresponding to an annual growth rate of 3.9 per cent.

The industrial fabric remains strongly dominated by small-scale and medium enterprises and by the textiles and leather sector, which account for 212 units. Next comes the agri-food sector with 181 units, followed by the chemical-parachemical sector with 174 units, and finally the mechanical-metallurgical and electrical sector with 86 units.

It should first be emphasized that there are no global studies based on a detailed analysis of the pollutant loads generated by the industrial units.

The characteristics of the effluents vary a great deal according to the sectors and types of activity concerned so it was first necessary to identify the polluting industries and then typify their effluents.

A study on the basis of these principles permitted identification of the organic and solid (SM) industrial pollutants discharged into the receiving environment by the four major centres on the Mediterranean coast (Table 2).

Table 2

Flow rate of industrial pollution

City	Industrial unit						Industrial pollution/year			
	AFI	TLI	MMEI	CPI	Total	Rate m3/day	BOD_5	COD	OM	SM
Tangiers	49	188	41	62	340	4406.4	2469	5187	3375	1057
Tetouan	56	21	21	60	158	5702.4	1614	2560	1929	569
Nador	55	3	24	42	124	4000	887	1218	997	268
Al Hoceima	21	0	0	10	31	32.5	210	262	227	60

AFI: Agri-food industry
TLI: Textiles and leather industry
MMEI: Mechanical-metallurgical and electrical industry
CPI: Chemical-parachemical industry

The data contained in Table 2 show that the city of Tangiers has the largest number of industrial units - 340, followed by Tetouan with 158 units, Nador with 124 and Al Hoceima with 31.

The pollution generated by these four cities is of course proportional to the number of industrial units. The cities of Tangiers and Tetouan therefore generate far more than Nador or Al Hoceima.

The wastes contain many pollutants, but only dissolved organic compounds, mainly characterized by the chemical oxygen demand (COD) and the biological oxygen demand (BOD_5), and suspended matter (SM), have been examined.

Regarding heavy metals, the only data available are those concerning industrial wastes from Tetouan. These contain aluminium (1112.21 kg/year), arsenic (62.57 kg/year), cadmium (14.66 kg/year), chrome (75.75 kg/year), copper (572.23 kg/year) cyanure (8.33 kg/year), fluor (12.61 kg/year), mercury (0.38 kg./year), lead (307.59 kg/year), selenium (84.96 kg/year), and zinc (1378.95 kg/year).

3.3 Characteristics of the waters of the major wadis entering the Mediterranean (Oued Martil and Oued Mouloya)

(a) Oued Martil

For the waters of Oued Martil, the parameters are mainly the water temperature, the concentration of dissolved oxygen (DO), the BOD_5, total dry matter (TDM), and the concentration of heavy metals.

The water temperature is relatively stable throughout the wadi, but it varies according to the time of year. On average, it ranges from 13 to 21°C.

Concentrations of dissolved oxygen are very low downstream from Martil, but very high upstream of the wastes from the city of Tetouan. This confirms that the wadi is fairly polluted, even in the wet season, and that this pollution is mainly due to wastewater. Bearing in mind that the minimum DO value should not fall below 4 mg/l in order to maintain fish alive, the figure at plants downstream from the city are below the minimum..

The average concentration of BOD_5 is fairly high downstream from the city and low upstream. The average BOD_5 curve for Oued Martil's waters bolsters the conclusion reached for DO : the water downstream from the city is heavily polluted by urban wastes. In addition, it should be noted that the situation is even more critical in the dry season.

It is obvious that if the wadi was not polluted by waste from Tetouan, the average concentration of BOD_5 would be below 6 mg/l.

A study of TDM shows a decrease in dry matter in the wadi from upstream to downstream. This could be explained by the fact that, on the one hand, the wadi's waters become mixed with those of its tributaries and, on the other, by settlement along Oued Martil.

It should be noted that TDM concentrations are lower downstream than upstream. The biological flora, which should be fairly rich in this section of the wadi, could therefore be effecting some form of treatment.

(b) Oued Moulouya

Physical-chemical and bacteriological levels measured along the length of Oued Moulouya show that the temperatures vary between 10 and 19° C and the pH between 7.4 and 8.

The mineralization of the wadi's waters varies considerably, with a marked increase from upstream to downstream, the conductivity levels rising from 1300 µs/cm upstream to 3500 µs/cm downstream.

Throughout the wadi, the waters are well oxygenated with a decreasing trend from upstream to downstream.

The phosphorous level of the waters of Oued Moulouya is fairly good. Total phosphorous content varied between 0.1 mg/l and 0.2 mg/l, with the exception of the plant situated downstream of the wastes from the town of Missour, where the phosphorous level reached 0.65 mg/l. The nitrogen level was also satisfactory except for downstream of Missour, where it reached 1.4 mg/l.

The organic and bacteriological quality of the waters in the wadi is generally good. The concentrations of BOD_5 and COD recorded were below 5 and 20 mg/l respectively, except for downstream of Missour, where they were 10 and 15 mg/l respectively. Also the nitrate and total coliform levels were 6 mg/l and 1000/100 ml respectively.

3.4 Characteristics of the receiving environment

Studies of the receiving environment (the Mediterranean Sea) are currently being undertaken by the National Environment Laboratory. The only data currently available concern an oceanographic study of the coastal waters of Martil (Tetouan).

Physical-chemical and biological surveys of these waters showed that the average Kjeldahl nitrogen concentration is 0.094 mg/l, with persistent maximum levels close to F□nideq and Martil. The variation in phosphorous levels along the coast follows a similar trend to nitrogen and does not exceed 0.2 mg/l although it is usually over 0.025 mg/l.

The average concentration of SM is 26.26 mg/l, the levels of chrome, cadmium and mercury, when compared with those in the sediment, indicate that they exceed those found naturally in zones not affected by anthropogenic activities.

The results concerning microbiological parameters show that the coastal waters contain an average concentration of faecal coliforms of 131.33 col/100 ml, which is slightly above that of the European Union (100 col/100 ml).

4. Priority zones and sensitive areas

The Mediterranean coast of Morocco extends for around 500 km and plays a leading role in tourism and the economy.

As far as tourism is concerned, it is a favourite spot for many Moroccan and foreign holidaymakers.

At the economic level, almost all Morocco□s fishing is in coastal waters (the Mediterranean and the Atlantic).

This coast, however, suffers different forms of depredation as a result of the various wastes that are discharged without any prior treatment. These disorders alter the balance either temporarily or permanently.

There are three types of disorder:

- Physical-chemical disorders : this category comprises three factors that result in a change in water quality as a result of a modification in the intake of suspended matter, nutrient salts, organic matter or micropollutants (example: the four large Mediterranean centres discharge 16,721 t of suspended matter into the sea each year).

- Biological disorders : these concern pathogenic organisms present in wastewaters, which lead to health disorders.

- Hydrodynamic disorders : these are changes in the hydrodynamic functioning of the coastal area as a result of development along the coast. They affect the sediment or biological balance.

The presence of pathogenic germs in bathing waters leads to skin infections, intestinal upsets, etc.

The presence of high concentrations of heavy metals is the direct cause of toxicity if there is extended or indirect contact through the consumption of contaminated products of the sea.

On the basis of the findings and observations noted above, the conclusions of the sanitation plan, and the indicators fixed for identifying the hot spots on Morocco's Mediterranean coast, namely, the effects on public health, drinking water quality, aquatic life, recreational areas, etc., it can be concluded that :

- The physical-chemical quality of the waters is satisfactory. Nevertheless, certain excesses were recorded at the following sites:

  - beach at Tangiers in the bathing area close to the discharge outlet into the sea;
  - beach at Tangiers a few hundred metres from the port;
  - beach at Al Hoceima near the discharge outlet of Casa Bonita;
  - beach at Al Hoceima in the bathing area near the Quenada hotel;

- The bacteriological quality is good with the exception of the following sites where the quality has deteriorated as a result of the discharge of wastewater without any prior treatment.

  - beach at Mdiq (Tetouan) near the urban discharge into the sea.

In general, the overall quality of Morocco's Mediterranean waters is good to average, with the exception of the following sites :

- beach at Tangiers near the Tingir camp site;
- beach at F'nideq (Tetouan) near the town's main outlet;
- beach at Mdiq (Tetouan) near the Golden Beach hotel;
- beach at Restinga (Tetouan) near the Club Med.

Although Tangiers and Tetouan are hot spots on Morocco's Mediterranean coast, the city of Al Hoceima has a sensitive area that requires special attention, namely, the National Park of Al Hoceima, which is situated in the limestone range of Bokloya and is the best example of a land-marine park. This coastal park (excluding the surrounding land and sea areas) covers 310 km^2 (285 km^2 in the central land area and 23 km^2 in the central marine area). It contains a number of environments that are of great biological importance.

The city of Nador also has a bay used for fish farming where the rate at which the water is renewed is very low, so all the city's wastewater needs to be treated before being discharged.

5. INFORMATION CONSTRAINTS

The liquid sanitation plans for the four major centres on the Mediterranean coast were implemented at different dates (Nador in 1990, Al Hoceima 1993, Tangiers and Tetouan 1995). This has made it difficult to harmonize the findings : the studies undertaken up to 1994 were based on estimates of the population according to the 1982 census.

It should also be pointed out that, due to the lack of detailed industrial audits and limited cooperation on the part of industrialists, it has been difficult to typify industrial wastes. Consequently, the information obtained corresponds to industrial wastes by centre and not by industrial unit. Moreover, all the parameters for identifying the characteristics of liquid wastes at these units have not been checked, with the exception of Tetouan.

6. POLLUTION REDUCTION MEASURES

The treatment of urban wastewaters is a priority for improvement of the environmental situation of Morocco's Mediterranean coast, but the lack of specific information makes it difficult to estimate the exact cost of treating them, especially industrial wastewaters, which will have to be studied on a case-by-case basis.

According to a study carried out in the context of the national liquid sanitation plan, an estimate of the cost of installing sewage treatment plants could be made on the basis of the number of inhabitants.

For a city with a population exceeding 100,000, the amount required to build a treatment plant is 481 DH/inh (excluding taxes), so the cost of building treatment plants would be US$ 28 million for Tangiers, US$ 19.63 million for Tetouan, and US$ 6.016 million for Al Hoceima.

At Nador, the existing plant should be expanded to cover all the wastewater from the city.

As far as industrial wastes are concerned, pre-treatment in each unit would be necessary before the wastes are finally discharged into the receiving environment.

In order to obtain a picture that is in harmony with other Mediterranean countries, the following conclusions are summarized in Table 3 below:

In conclusion, it can be said that the hot spots on Morocco's Mediterranean coast are the cities of Tangiers and Tetouan. This is because these two cities have large populations (Tangiers : 526,215 and Tetouan : 367,349) and their domestic wastewaters are not treated. In addition, 76 per cent of industrial units on Morocco's Mediterranean coast are in this area (these two cities are only 60 km apart) and industrial wastewaters do not receive any prior treatment either before being discharged into the sea.

As far as the third large city on the coast is concerned, namely Nador, it has a wastewater treatment plant, which considerably reduces the pollutant load discharged into the Mediterranean. It is necessary to expand this plant to cover all Nador's wastewaters.

The city of Al Hoceima has a small population and a limited number of industrial units (31) so at present, in the current situation, it does not represent any great threat to the Mediterranean environment. However, it must not be forgotten that Al Hoceima National Park is fragile and the necessary measures have to be taken to protect it.

Table 3

Highly polluted areas in Morocco

Country	Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other Beneficial Uses	Welfare and Economy	Weighted Total	Relative Importance Index	Nature of Investment	Transboundary Aspects	Preliminary estimated financial requirement (in milions of US$)
Morocco	Tangiers	Domestic and industrial	5	3	3	3	5	6	21	100	WWTP: construction	F,H,B,L,P	28
											PTIW: construction		ND
	Tetouan	Domestic and industrial	5	3	3	3	4	6	19	90,5	WWTP: construction	F,H,B,L,P	19.630
											PTIW: construction		ND
	Nador	Domestic and industrial	3	3	2	3	4	3	15	71,4	WWTP: construction	F,H,B,L,P	ND
											PTIW: construction		ND
	Al Hoceima	Domestic and industrial	3	2	3	2	3	3	13	61,9	WWTP: construction	F,H,B,L,P	6.016
											PTIW: construction		ND

WWTP : Domestic wastewater treatment plant
PTIW: Pretreatment of industrial wastewater
US$1 = DH 9.

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IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

SLOVENIA

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Prepared by: Mr Ante Barić

1. INTRODUCTION

Slovenia is a rather small country, with approximately 2 million inhabitants and covering a surface of 20,251 km². As far as the level of industrial development is concerned, Slovenia is a medium-developed country with mainly small industries and family-run manufacturing. Tourism is very important for its economy: winter tourism inland and summer tourism both inland and in the coastal region.

Slovenia is predominantly a continental state, with most of its territory being part of the eastern Alps (Julian, Karavan, and Karnik Alps), while the coastal strip, facing the Bay of Trieste, is very small. On the coast, Slovenia has borders with Italy in the north and Croatia in the south. The total length of the coastline is 46 km. The permanent population of the coastal region accounts for some 4 per cent of the total population, while the average yearly number of overnight stays is about 1.7 million. The summer tourist season lasts from May to September, peaking in July and August.

In the coastal strip, land use is the subject of intensive competition, especially among housing, tourism, industry and marine activities. Three towns have developed on the coast: Koper, Piran and Izola, and there are a number of smaller settlements and tourist facilities between them, so the entire coast is actually one large urban area. Piran, with the neighbouring Portoroz, is a highly developed tourist centre, Koper is the industrial, business and harbour centre, and Izola is well known for its long tradition in the fishing industry (cannery). Land-use conflicts are most pronounced in Koper, and regard industry, harbour activities and housing. Owing to excellent road and railroad connections inland, the harbour of Koper has become the most important export-import harbour of central Europe, and new activities are constantly being developed in the industrial zone.

The principal sources of pollution of the Slovenian coastal sea are surface flows, numerous urban wastewater outlets and one submarine outfall. The rivers receive untreated urban and industrial wastewaters and thus represent a significant source of pollution by suspended and dissolved matter that affects chemical and biological processes in the coastal sea. The estimated yearly input from land-based sources amounts to 7,002 t of suspended matter, 1,075 t of nitrogen, 134 t of phosphorus, 17 t of lead, 344 t of zinc, 2 t of chromium, and 1.5 t of cadmium. The largest individual polluter of the coastal sea is the river Rizana which is the source of both microbiological pollution and pollution by toxic and persistent organic matter. In summer, high temperatures facilitate decomposition of the organic matter, leading to anoxic conditions and causing mass mortality among marine organisms.

As a result of Slovenia's active participation of Slovenia in the MED POL programme since 1976, data are available on both sea water quality and on the quantities of pollutants discharged into the sea from land-based sources over many years. Hot spots and sensitive areas have been identified on the basis of analyses of available data, questionnaires, and interviews with representatives of the Ministry of the Environment and the SAP Focal Point during a visit to Ljubljana, as well as telephone contacts with the experts of the Marine Biological Station in Piran, which comes under the Institute of Biology of Ljubljana University.

2. PROCEDURE FOLLOWED IN IDENTIFYING HOT SPOTS AND SENSITIVE AREAS

The Bay of Trieste is a comparatively shallow basin with the characteristics defined by its sub-Mediterranean position, fresh water input and large opening to the rest of the northern Adriatic.

The entire area of the Bay of Trieste can be classified as a sensitive area which, for a number of years, has been facing the direct and indirect negative consequences of various human activities. One very serious problem in the bay is the considerable reduction of the oxygen content of the bottom layers of the central part, which occurs almost every year towards the end of summer and beginning of autumn causing mass mortality of marine organisms. The greatest such mass mortality occurred in 1983 when anoxia spread over almost one third of the bay.

The considerable reduction of oxygen concentration and the occurrence of anoxia in the bay are due to the heavy consumption of oxygen during the microbiological decomposition of the organic matter, which cannot be compensated by primary production and aeration. Observations show that the central part of the bay is affected by quantities of organic matter that exceed its assimilative capacity, so that, under certain conditions (stable stratification of the water column with long periods of stable weather without wind, which prevents advection of the bottom layers of water masses), anoxia occurs every year causing mass mortality of marine organisms, to a greater or lesser extent.

The Bay of Trieste also faces local blooming of toxic phytoplankton species, such as *Dinophysis,* which produce DSP toxins. The toxic species have been observed between May and November. The potential toxic species *Alexandrium*, which might produce PSP toxins, have also been recorded.

The suspected cause of the above-mentioned phenomena is the input of nutrient salts and organic matter from the land. It is, however, certain that the contribution of land-based sources situated on the Slovenian coast is much smaller than the overall value for the entire Bay of Trieste. Water input to the entire bay from rivers is estimated at $7{,}300 \times 10^6 m^3$, while on the Slovenia side water input from rivers is estimated at $220 \times 10^6 m^3$, and the total quantity of urban and industrial wastewaters at $600 \times 10^3 m^3$. Data on the reduction of the oxygen content in the bottom layer, which is greater in the central part of the bay than in the coastal waters of Slovenia, as well as the data on the mercury content of the sediment, which decreases from the centre of the bay towards the coastal area, also show that the main source of pollution in the bay are not on the Slovenian side.

With regard to various parameters such as concentrations of dissolved nitrogen and phosphorus, chlorophyll, and degree of oxygen saturation, the coastal sea of Slovenia has been classified as moderately eutrophicated.

Taking into account all the aforementioned factors, the area of the Bay of Trieste, which includes the entire coastal area of Slovenia, can be considered a hot spot. Koper and Piran bays have, however, been selected as sensitive areas, since they can be endangered by the polluted water of the Bay of Trieste and land-based sources of pollution. Outfalls of untreated or partially treated urban and industrial wastewaters, as well as the mouths of rivers into which urban and industrial wastewaters are discharged, under sensitive sea conditions, can be considered hot spots which cause local changes of marine ecosystems.

3. CONTRIBUTION OF DIFFERENT SOURCES TO IDENTIFIED HOT SPOTS OR SENSITIVE AREAS

The seven identified hot spots, as well as two sensitive areas, are listed in the following table. It outlines the main sources of pollution and the principal supporting data obtained from the questionnaires.

Hot spots	Main sources of pollution	Principal supporting data extracted from the questionnaires
Izola domestic wastewater outlets	- Domestic	- BOD 190 t/y - N_{tot} 30.6 t/y - P_{tot} 4.5 t/y - TSS 130 t/y - FC 1.4E+7 col/100 ml
"Delamaris" cannery	- Industrial	- BOD 912 t/y - TSS 584 t/y - N_{tot} 59.5 t/y - P_{tot} 16.8 t/y
Piran submarine outfall	- Domestic	- BOD 125 t/y - COD 290 t/y - FC 9.7E+6 col/100 ml
Rizana river	- Industrial - Domestic	- COD 30,989 t/y - BOD 445 t/y - TSS 987 t/y - Zn 98.8 t/y - FC 1,470 col/100 ml
Badasevica river	- Industrial - Domestic	- COD 4,672 t/y - BOD 74.8 t/y - FC 21,458 col/100 ml
Dragonja river	- Domestic - Agricultural - Leakage from urban solid waste dumping site	- COD 1,590 t/y - BOD 73.7 t/y - Zn 14.4 t/y - FC 250 col/100 ml
Drnica river	- Agricultural - Domestic	- COD 3,419 t/y - KPK 24 t/y - Zn 4.4 t/y - FC 2,100 col/100 ml
Sensitive areas	**Main sources of pollution**	**Principal supporting data extracted from the questionnaires**
Koper bay	- Industrial - Domestic - Harbour - Open sea	- O_2 2.9 ml/l - FC 0-1,000 col/100 ml - N_{tot} 1.54 mg/l - P_{tot} 0.03 mg/l
Piran bay	- Domestic	- O_2 4.0 ml/l - FC 0-100 col/100 ml - N_{tot} 1.83 mg/l - P_{tot} 0.03 mg/l

4. PRIORITY HOT SPOTS AND SENSITIVE AREAS

The priority hot spots and sensitive areas are shown in the table below. The table contains the assessment of effects using the ranking system agreed on, the nature of investment required, transboundary aspects, and a preliminary estimated financial requirement in each case:

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
HOT SPOTS													
Slovenia	Rizana river	Dom.+ ind.	3	1	5	5	4	5	18.2	100	WWTP extension + sewerage systems for Koper City	B, F, L, H	13 million + 3 million
Slovenia	Izola	Dom.+ ind.	3	1	3	5	3	4	15.3	95	WWTP construction + sewerage system reconstruction	B, P, H	10 million + 2 million
Slovenia	Piran submarine outfall	Domestic	2	1	3	4	2	1	10.7	90	WWTP extension + sewerage system reconstruction	B, F, H	6 million + 2.5 million
Slovenia	Delamaris	Industrial	2	1	4	5	3	3	14.2	93	WWTP extension	L, F, H	2.0 million +0.5 million
Slovenia	Badasevica river	Dom. + ind.	2	1	2	3	2	3	10.4	88	See Rizana river	B,L,P	See Rizana river
Slovenia	Dragonja river	Dom. + agricul.	2	1	2	2	2	2	8.9	75	Management plant of the river basin	B,L,P	1.5 million
Slovenia	Drnica river	Dom. + agricul.	2	1	2	2	2	2	8.9	76	- ditto -	B,L,P	1.2 million
SENSITIVE AREAS													
Slovenia	Koper bay	Dom. + ind.	3	1	5	5	4	5	18.2		See Rizana river	P,B,F,L,H	See Rizana river
Slovenia	Piran bay	Domestic	2	1	3	4	2	1	10.7		See Piran	B,F,H	See Piran

- **Consideration of Chapter 4, last column:**

Preliminary estimated Financial Requirements are hardly to be evaluated since physical characteristics of sewage systems to be renewed or constructed need to be defined and a general investment study for integrated water management performed. This should also include catchment level natural resources rehabilitation/restoration programmes and plans for the solution of solid waste deposition problems. The evaluation of composition and quantities of industrial wastewater is also crucial to the planning of rehabilitation programmes, since industrial and traffic activities are rapidly changing. This is particularly true for the Koper municipality (Koper port, chemical industry...). The given numbers in the last column are just preliminary evaluations of the minimal investments to be performed for extension of WWTPs.

5. IDENTIFICATION OF MAIN GAPS AND CONSTRAINTS

There is no doubt that the Rizana river represents the major source of pollution in the Slovenian coastal area. It receives the domestic wastewaters of the town of Koper after primary treatment, as well as untreated wastewaters of most industries located in the urban area of Koper. The quantities and composition of the wastewaters discharged by various industries are unknown, so it is difficult to estimate the funds needed to resolve the problem of industrial wastewaters. The preliminary estimated financial requirement is related only to the solution of domestic wastewater problems (except for Delamaris).

On the basis of the knowledge gained hitherto, it is impossible to assess the true contribution of pollution sources located on the Slovenian coast to the present state of the Bay of Trieste and the coastal sea of Slovenia.

6. PROPOSED OPTIONS FOR REMEDIAL ACTIONS

Construction of a sewerage network to cover larger areas of the towns of Koper, Izola and Piran, with plants for biological treatment of domestic wastewaters together with appropriate submarine outfalls, and treatment of industrial wastewaters to the level of urban wastewaters at origin, removing all toxic and hazardous wastes, would considerably improve the state of the coastal sea of Slovenia, especially with regard to the sanitary quality. However, the entire area would remain under threat due to the input of waste materials from rivers and outfalls on the Italian coast. The proposed financial requirement includes construction costs plus costs of institutional strengthening, management and public participation mechanisms.

In order to resolve the problem of industrial wastewater, an appropriate management plan has to be implemented. The plan can be elaborated in less than one year for a budget of approximately US$ 300,000.

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

SPAIN

Prepared by: Ms Dolores Carrillo Dorado

1. HOT SPOTS

1.1 Barcelona

1.1.1 Metropolitan Organization for Water Services and Waste Treatment

The Metropolitan Organization for Water Services and Waste Treatment, includes 33 municipalities around Barcelona with a total population of 3,037,763 inhabitants and an area of 615 km^2. The major concentration of industrial installations in Spain are placed in that area.

Power plant: Sant Adria; natural gas

Power plant: Besos; fuel oils and natural gas

Incineration plants of Urban Solid Waste:
Sant Adria del Besos;
Moncada y Reixac.

1.1.2 Main industrial sectors

- Manufacture of fabricated metal products;
- Manufacture of machinery and equipment;
- Manufacture of basic industrial chemicals;
- Manufacture of inorganic pigments;
- Manufacture of synthetic resins and textile fibers;
- Manufacture of other chemical products;
- Manufacture of paints, varnishes and lacquers;
- Manufacture of drugs and medicine;
- Manufacture of soaps and detergents;
- Manufacture of rubber products: tire and tube industries;
- Manufacture of paper and paper products;
- printing and publishing and allied industries.

1.2 Tarragona

The industrial and energy sectors in Tarragona have developed around the city and its harbour. The Chemical industry is located in three industrial estates. The North estate with 470 Ha, the South 717 Ha and Flix on the margins of the Ebro river 200 Ha. The energy sector consists of two nuclear power stations (Ascó near the Ebro river and Vandellós on the Mediterranean coast).

- Nuclear power plant: Ascó I + Ascó II; discharging to the Ebro river.
- Nuclear power plant: Vandellós; discharging to the Mediterranean coast.
- Incineration plant of U.S.W.
- Incineration plant of Hazardous Wastes.

1.2.1 Main industrial sectors

- Integrated petroleum refinery;
- Asphaltic plant;
- Chlor/alkali production; membrane cell process; Poligno Sur.
- Chlor/alkali production; mercury process; Flix;

- Manufacture of organochlorine compounds;
- Manufacture of basic industrial chemicals;
- Manufacture of nitrogen, argon and oxygen;
- Manufacture of fertilizers;
- Manufacture of synthetic resins;
- Manufacture of detergents;
- Soya bean milling.

1.3 Valencia

1.3.1 Metropolitan Area of Valencia

The Metropolitan Area of Valencia has an Organization for Water Services and Waste Treatment that includes 54 municipalities around Valencia with a total population of 1,380,000 inhabitants, with treatment plants for 1,032,000 inh. and 400,000 in project.

1.3.2 Main industrial sectors

- Cars manufacture;
- Manufacture of metal products;
- Manufacture of paints, varnishes and lacquers;
- Manufacture of inorganic pigments;
- Manufacture of pesticides;
- Manufacture of soaps and detergents;
- Manufacture of wood & wood products;
- Manufacture of furniture;
- Tanneries and leather finishing;
- Printing and publishing and allied industries;
- Manufacture of ceramic products.

1.4 Cartagena

1.4.1 Main industrial sectors

- Integrated Petroleum Refinery;
- Power plants: Escombreras;
- Primary zinc industrial installation, electrolytic process;
- Manufacture of inorganic fertilizers;
- Manufacture of plastics: polycarbonate;
- Shipyards: shipbuilding and repairing installation.

1.5 Algeciras

- Power plants Los Barrios
- Power plant Algeciras, fuel and natural gas.

1.5.1 Main industrial sectors

- Integrated Petroleum Refinery;
- Manufacture of pulp and paper;
- Manufacture of industrial chemicals.

2. SENSITIVE AREAS

2.1 Aiguammols de l'Alt Emporda; Wetlands of High Emporda

- Protection figure: Parque natural (Natural park) (Law 13-6-85, Cataluña)
- Geographic coordinates: 42° 13' N 3° 05' W.
- Area : 4,824 ha, 850 ha of which are protected.
- RAMSAR
- Length of the coastal line: 3.6 km

Located northwards of the peninsula in the bay of Rosas, this is the second wetland in importance of Catalonia. In this area, different ecological ambiences exist consisting of coastal dunes and reeds that allow the presence of a huge amount of species, plants and animals, specially birds.

Main problems: Pollution arising from the discharges of sewage and agricultural discharges. Tourism development. Building of infrastructures, roads.

2.2 Delta del Llobregat

- Protection figure: Partial Natural Reserve (Law 13-6-85) Catalonia.
- Geographic coordinates: 41° 17' N; 2° 04' W
- Area: 288 ha
- Coastal length 3.00 km.

Located some few kilometers southwards of the city of Barcelona, between the massif of Collserola and Garraf, it consists of a wetland limited at present to the coastal area; it has a great importance for the migrating birds due to its situation between Los Aiguanols del Emporda and the Ebro delta. Even if the extension is scarce, it has a large interest due to its habitat diversity, its interesting populations of invertebrates and as a reference point for migrating birds.

The main problems are: pollution arising from the discharges of urban and industrial waste waters and also from agriculture. Industrial and urban development. Infrastructures (ports, airport, roads, electric power transport).

2.3 Delta del Ebro

- Protection figure: Natural park (Law 13-6-85, Cataluña)
- Geographic coordinates: 40° 41 N; 0° 44' W
- Area : 7,736 ha 2,505 ha of which are protected.
- Length of coastal line : 37 km
- RAMSAR

Located in the mouth of the Ebro river, it is one of the most important wetlands on the West Mediterranean area. The fauna of this delta is particularly rich, as much with regard to invertebrates and vertebrates, being the most outstanding vertebrates birds that find, in this place, an adequate space to be during the whole year.

Main problems: pollution due to the urban and industrial discharges and agricultural diffuse discharges, agricultural land reclamation, tourism development.

2.4 Albufera de Valencia

- Protection figure: Natural Park of Valencia Community
- Situation: 39° 20' N; 0° 20' W
- Area : 21,000 ha
- Length of the coastal line: 28 km.
- RAMSAR

Located Southwards of Valencia city, it has different ecosystems varying from beaches, dunes, a lake and wetlands surrounding the lake.

La albufera de Valencia has an important variety of animal and plant species, outstanding crustaceans, freshwater endemic fish and birds from which the most numerous group is the one consisting of different species of ducks that concentrate every year in 40,000 to 60,000 individuals.

Main problems: pollution due to the urban and industrial waste water discharges, agricultural diffuse pollution, agricultural land reclamation, infrastructures (roads, harbour, electricity transportation).

2.5 Lagunas de la Mata y Torrevieja

- Protection figure: Natural Park of Valencia Community
- Geographic Coordinates of la Mata: 38° 02' N; 0° 41' W
- Area: 900 ha
- Geographic Coordinates of Torrevieja: 38° 00' N; 0° 00' E
- Area: 2,500 ha
- RAMSAR

These two salty lagoons have been used for years for the production of salt. The present production of Torrevieja is about one million tonnes per year. The lagoons traditionally contained seawater, since the seventies they are filled up with salty water proceeding from wells and brought there by pipe along 50 km, the salt concentration of the water is 80 g/l.

Due to its semiarid climate and the content of salt, the vegetation is very exclusive, outstanding different endemic plants, these lagoons are also used by migrating birds.

Main problems: land reclamation, discharges of solid wastes, agricultural discharges.

2.6 Mar Menor

- RAMSAR. (BOE n° 207, 30th April 1982, BOE n° 73 26th March 1993)

Coastal lagoon linked to the sea, with hypersaline water, surrounded by reed beds, salt flats and sand banks, important bird breeding area.

2.7 La Albufera de Alcudia

- Protection figure: Natural area of special interest (Law 1-91-Baleares)
- Geographic coordinates: 39° 47' N; 3° 6' E
- Area: 2,443 ha, 1701 ha of which are protected

- Length of the coastal line: 1.5 km
- RAMSAR

Located in the North of Mallorca island in the bay of Alcudia, it is the most extensive wetland of the Balearic islands, it has a great interest due to its variety of flora and fauna. In the Albudera de Alcudia there are endemic plants very interesting, its bird diversity being very important.

Main problems: Pollution due to urban waste water discharges as well as agriculture diffuse pollution; other problems are: land reclamation for agricultural purposes and tourism.

2.8 Parque natural de Cabo de Gata-Nijar

- Protection figure: Natural park (Law 2-1989, Andalucia)
- Geographic coordinates: 36° 51' N; 2° 6' W
- Area: 26,000 ha
- Length of the coastal line: 64 km
- RAMSAR

This area includes la sierra de Gata that is one of the main volcanic massives in Europe and the coastal strip owing a very important ecological value.

La Sierra de Gata, considering its climatological conditions, is one of the most interesting areas in Spain, due to its flora and its fauna, its maximum height is 491 m and the yearly rainfall is 200 mm, with very acute seasonal variations, the main yearly temperature is 18°C.

Main problems: Land reclamation for agricultural purposes and tourist development.

Table 1

Hot Spots

Area/City	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other Beneficial Uses	Welfare and Economy	Weighted Total
BARCELONA	3	1	6	4	4	3	16.6
TARRAGONA	3	1	4	4	4	3	15.2
VALENCIA	2	1	4	4	4	3	14.2
CARTAGENA	3	1	3	3	3	3	13.6
ALGECIRAS	2	1	4	3	3	3	12.6

Table 2

Sensitive areas (in order of priority)

RANKING OF SENSITIVE AREAS
1. Albufera de Valencia
2. Delta del Llobregat
3. Delta del Ebro
4. Mar Menor
5. Alcudia
6. Cabo de Gata
7. Aigumolls de l□Alt Emporda
8. Lagunas de la Mata y Torrevieja

Table 3

Spanish areas of concern
Coastal cities of more than 100,000 inhabitants and harbours

	Population	WTP	Inhab. Treat.	Equiv. Inhab. Treat.	Port. t/y x 1000	MARPOL
Mataro	134,000	Bio	131,000	451,000		
Barcelona city	1,643,000	Ph/Ch	1,381,000	3,000,000	20,300	YES
Metropolitan Area (project)	3,037,000	Bio	1,193,000	2,247,000		
Taragona	110,000	Bio	61,000	175,000	23,700	YES
Castellon	134,000	Bio		180,000	7,700	YES
Valencia city	753,000	Bio		832,000	13,000	YES
Metropolitan Area	1,390,000	Ph/Ch	1,032,000			
Alicante	265,000	Bio		360,000	2,100	YES
Elche	188,000	Bio		160,000		
Cartagena	168,000	Bio		150,000	8,400	YES
Almeria	141,000	Bio		300,000	7,600	
Malaga	502,000	Bio		100,000	8,900	YES
Algeciras + La Linea	85,000 57,000	Bio		100,000	34,700	YES
Palma de Mallorca	296,000	Bio		500,000	6,000 (todas)	YES

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

SYRIA

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Prepared by: Mr Dimitrios Tsotsos

1. INTRODUCTION

1.1 Current situation

The coastal area of Syria covers approximately 2 per cent of the country's territory and the coast line extends for 210 km. Vital regional resources (water, agricultural land, infrastructure, tourism, industry etc.) are concentrated in this comparatively narrow coastal zone, and the trend towards the concentration of agricultural, industrial and tourism activities is expected to continue in the future.

Several sites of ecological and cultural importance in this coastal region have been identified by previous studies (PAP/CAMP-study : "The Syrian coast" 1992) and need to be effectively protected from environmental degradation.

The Syrian Government, having realized the potential danger caused by uncontrolled emissions for the environment and especially for coastal waters, has formulated a legal and organizational framework, that is of major importance in the authorities' efforts to reduce environmental degradation.

According to Presidential Decree 11 (1991) and the detailed environmental law soon to be ratified by Parliament, all major industrial facilities have to prepare an Environmental Impact Assessment (EIA) study in order to comply with the relevant environmental conditions that must be met in order to obtain an operating licence. Smaller industries have to follow explicit instructions concerning their environmental performance.

In this context, the regional environmental Directorates, as part of the Ministry of the Environment, are responsible for pollution source inventories and for the enforcement of environmental quality standards.

The situation on the coastal area today is characterized by the severe threat to the marine environment caused by uncontrolled discharge and disposal of liquid and solid wastes around the main agglomerations - Lattakia, Jableh, Banias and Tartous. The majority of municipal effluents reach the sea through on-shore outfalls without any prior treatment, although some industries utilize adequate treatment methods. Uncontrolled dumping of solid wastes around the cities is an additional pollution source and cannot be neglected.

This report attempts to evaluate the existing information for the Syrian coast systematically in order to prioritize the areas/sites of major importance for effluent control. The results of this evaluation are summarized in Chapter 4. Suggested remedial action is based on statements by the regional environmental Directorates, the G.C.E.A. and the Directorate of Wastewater and Sewerage (Ministry of Housing).

1.2 Elaboration of the survey

This survey has been elaborated in close cooperation with Mr Yahya Awaidah, Head of the Engineering Group of G.C.E.A. and SAP coordinator, and with Mrs Abir Zeno, environmental engineer and member of the same Group.

The relevant questionnaires were completed by the experts of the local environmental Directorate under Mr Awaidah's coordination. Relevant data reflect the current situation fairly accurately, since they were collected on the spot in February of this year.

Part of the information provided (i.e. some figures concerning population and wastewater flows) appeared to be inaccurate so it was cross-checked with official statistical

sources. In cases of discrepancy, estimated per capita figures based on Syrian conditions were utilized.

Indirect evaluation of industrial pollution has been based on WHO reference guides and on some basic assumptions (Chapter 5).

Input concerning the existing plans for remedial action was provided by Mr Sadek Abou Watfeh, Director of the Directorate of Wastewater and Sewerage (Ministry of Housing).

Since technical/economic information was not provided for industrial installations, cost figures for concrete remedial action could not be estimated without the risk of totally unreliable figures. The detailed characteristics of each particular project will be seen in the suggested industrial management plan (Chapter 6).

2. IDENTIFICATION OF HOT SPOTS - SENSITIVE AREAS

2.1 Methodology

As mentioned in the introduction, major activities are concentrated along the narrow coastal area of Syria, so classifying potential hot spots at this stage could seriously affect the credibility of the survey. All four main cities (Lattakia, Jableh, Banias, Tartous) and the surrounding industrial activities have therefore been examined.

The identification of priority sensitive areas, on the other hand, has given preference to those sites of high natural and socio-economic value, which are subject to higher risks of degradation caused by effluent discharges.

In this context, areas of importance for tourism development and for ecological protection that are vulnerable to uncontrolled activities have been selected.

2.2 Selection of potential hot spots - sensitive areas

The potential hot spots and sensitive areas selected are listed in Tables 1 and 2.

Table 1

Potential hot spots

Location	Main city	Population equivalents (p.e.)	Main activities
Lattakia	Lattakia	746,851	Municipal, industrial
Tartous	Tartous	319,152	Municipal, industrial
Jableh	Jableh	166,779	Municipal, industrial
Banias	Banias	142,564	Municipal, industrial

Table 2

Sensitive areas selected

Location	Characterization	Main activities
Umit Tiur	Beach - cliffs	Tourism - urban development
Wadi Qandeel	Beach - cliffs	Tourism - urban development
Rasl Fassouri	Beach - cliffs	Tourism - urban development
Lattakia beach (southeast)	Beach - sand dunes	Urban development
Arwad	Island	Tourism, fishing

2.3 Risks for sensitive areas

The major environmental risk along the Syrian coast is the uncontrolled development of tourism and the increased occupation of land for urban settlements. More than 20 projects are planned, some of which are to be sited in environmentally valuable areas (Wadi Qandeel, Umit Tiur, Arwad island).

Additional negative effects are caused by intensive urban activities (construction industry) and effluent discharges. These effects occur in the sand-dunes beach south-east of Lattakia, where, *inter alia* there is intensive sand excavation for construction purposes.

Fishing, especially the use of dynamite, can cause devastating effects on the marine environment. This is particularly the case around the small bays of the island of Arwad (0.4 km^2, 4,500 inhabitants).

3. POLLUTION SOURCES

In Table 3, hydraulic and pollution load figures for each hot spot are shown.

Data were not available concerning eventual effluent discharges in sensitive areas.

Table 3

Assessment of pollution

Location	Main pollution sources	Total loads	
		Hydraulic (m^3/day)	Parameter: tn/year
Lattakia	Municipal, industrial	112,813	BOD_5: 16298 Total-N: 150 Total-P: 43 Cd: 0.085 Zn: 7.7
Tartous	Municipal, industrial	47,873	BOD_5: 6756 Total-N: 73.5 Total-P: 34.3 Cd: 0.054 Zn: 5.1
Jableh	Municipal, industrial	26,918	BOD_5: 4063
Banias	Municipal, industrial	30,167	BOD_5: 3173

4. RANKING OF HOT SPOTS - SENSITIVE AREAS

4.1 Introduction

In this Chapter, the selected pollution hot spots - sensitive areas have been prioritized by evaluating the potential risks exerted by the relevant point sources and the effects on public health, drinking water quality, recreation, other beneficial uses, aquatic life, and economy/ welfare.

The weighted ranking system and relevant explanations (documentation) have been used for this purpose. Relevant factors and multipliers were also extensively used in this analysis. Where there was no information, experience and documentary references were used in order to formulate a fairly reliable picture of the prevailing conditions.

Paragraph 4.3. summarizes the results of applying this system and provides estimated cost figures for remedial action. The main elements and the justification for this action are described in Chapter 6.

4.2 Comments - remarks on criteria - explanations

4.2.1 Other beneficial uses

On-shore uncontrolled dumping sites of solid wastes are considered as discharges with a high level of solid wastes (i.e. cases of rain storms, flooding etc.) and odours.

4.2.2 Aquatic life

The degree of oxygen depletion by municipal/industrial discharges cannot be assessed in the context of this study, especially to the required degree of accuracy (below exact concentration values). Other criteria (heavy metal/oil concentrations), therefore, have to be considered.

Even here, however, the words "any discharge" without assessment of the relevant hydraulic loads, can be misleading. Therefore, ratings were based on the significance of discharge (lower marks for small quantities).

4.2.3 Economy and welfare

The impact of industrial activities on the local economy is usually based on economically crucial figures such as production capacity, number of employees, exporting potential, etc. If these data cannot be assessed, then conclusions are inevitably drawn from the pollution potential caused (hydraulic-pollution loads).

Moreover, the proposed investment figures (US $ 5 - 20 million) mostly apply to very large single industrial units, in the case of industrial agglomerations (industrial zones), or are the total for various interventions for several industries discharging separately at the same hot spot-sensitive area.

Where no industrial effluents are discharged (only municipal effluents), a rating of 2 has been used (slight effects).

4.3 Priority hot spots and sensitive areas

Table 4 summarizes the final results of the weighted ranking analysis and the preliminary cost estimations for remedial action.

Ranking of the sensitive areas was based on documented qualitative information (Chapter 2, paragraph 2.3.) and on the priorities of the Syrian environmental authorities (G.C.E.A.). Their classification in order of priority is listed in Table 5.

Table 4

Priority hot spots

Country	Name	Type	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspects	Preliminary estimated financial requirement (in millions of US dollars)
SYRIA	Tartous	Municipal, industrial	5	4	5	5	5	5	23.6	100	WWTP- construction: secondary (planned)	L - F - B	41
	Lattakia	Municipal, industrial	6	4	4	5	5	3	22.5	95	WWTP- construction: secondary (planned)	L	73
	Banias	Municipal, industrial	3	4	4	4	4	6	20	85	WWTP- construction: secondary (suggested)	L	35.6
	Jableh	Municipal, industrial	4	4	3	3	4	5	18.8	80	WWTP- construction: secondary (planned)	L	41.7
											Capacity-building & industrial waste management plan		- Capacity- building: 1 - Industrial waste management plan: 0.5

Table 5

Sensitive areas

Rank	Sensitive area	Protective measures
1	Umit Tiur	Management plan for tourism activities, removal of illegal buildings
2	Arwad island	Rehabilitation plan, prohibition - control of illegal fishing, preservation of submarine life
3	Wadi Qandeel	Characterization as specially protected area, suitable for passive recreation only (bathing, sightseeing boat tours)
4	Lattakia beach (southeast)	Protection from urban development, prohibition of excavation, designation as public beach
5	Rasl Fassouri	Management plan for tourism activities, restoration of surrounding environment

5. GAPS AND CONSTRAINTS

5.1 General comments

As mentioned in the introduction, the information provided by the questionnaires reflects the latest picture of the local conditions and was collected on the spot in February of this year.

Part of this comprehensive set of data had to be checked by considering official statistical sources and the comments of the cooperating Syrian engineers (G.C.E.A.), especially for municipal effluent volumes, which, in some cases, were obviously overestimated by the local experts.

The existing municipal sewerage networks do not cover the increased loads during the tourist season (3-4 months in the summer), because the tourism enterprises, spread along the whole Syrian coast have their own individual systems (package treatment plants/septic tanks).

Concerning industrial discharges, no data were available on effluent concentrations, except for Banias refinery. Load estimations were therefore calculated on the basis of the given figures of annual production and on the rapid assessment methods described in WHO guides.

5.2 Basic assumptions - findings

5.2.1 Municipal discharges

- Wastewater quantity : 150 l/cap.day
- BOD_5 - load : 58 g/cap.day

5.2.2 Industries connected to municipal sewerage networks

Only small units (bakeries, food preparation etc.), which are not mentioned in the questionnaires.

5.2.3 Industrial discharges directly into the sea

- Effluent measurements were generally not available, so pollution loads were estimated by using the WHO guide for rapid assessment (documentation);
- General production figures were available (raw materials and products without specification of unit operations) so typical cases, if mentioned in the WHO guide, or highest pollution load factors were used;
- Working days/year : 250, except refineries, cement factories (365 days) and tomato canning (seasonal operation for 30 days/month);
- Wastewater flows accepted as given in the questionnaires and not calculated (WHO guide) due to the specific local situation (water shortage);
- BOD_5-load for Banias refinery : 50 per cent of the given COD-load;
- Cement factories not classified for liquid waste loads;
- Costs for remedial action were not mentioned and could not even be roughly estimated by the local experts.

6. REMEDIAL ACTION

6.1 Conclusions

The special environmental characteristics of the Syrian coastal area are endangered to a dramatic extent by various municipal and industrial activities, especially along the coast line between Lattakia and Tartous. Immediate action has to be initiated, therefore, in order to reverse the on-going trend towards environmental degradation and to plan carefully the fast-growing tourism development in the area.

In addition to establishing the legal and organizational framework, the Syrian Government has already initiated the preparatory activities (feasibility studies, design/tender documents) for major infrastructural projects to minimize liquid discharges. The treatment plants for Lattakia and Tartous are of major importance, not only because of their direct effect (reduction of municipal effluent discharges), but also as key factors in an integrated waste management plan. The establishment of new administrative structures for their operation/monitoring will thus promote the improved organization of all environmental services and activities such as measurement/registers of effluent concentrations, strengthening of controlling mechanisms, etc. In this context, the expansion and reorganization of the existing local environmental Directorate are essential and should be undertaken soon.

In accordance with this new framework and approach, industries will no longer be able to operate as they do today, where some of them heavily pollute the receiving water and the atmosphere. They will rapidly have to modernize and improve their environmental performance.

An outline of the remedial action already planned and suggested is given in the paragraphs below. The relevant cost figures are summarized in Table 4 (Chapter 4).

6.2 Description of remedial actions - cost figures

6.2.1 Municipal discharges

Secondary treatment plants for Lattakia (500000 p.e.) and Tartous (164000 p.e.) will start to be built by the end of this year with a total budget of US $ 114 million. Fifty per cent of the cost will be met by the European Investment Bank (EIB), and the remainder by the Syrian Government. Design/tender documents are being finalized.

The feasibility study and the tender documents for Jableh will soon be finalized, but there are no concrete financial plans.

The plans-studies for Banias have not yet been prepared.

Estimation of the costs for Jableh and Banias can be based on the relevant figures for Tartous (164,000 p.e., US $ 41 million): cost/cap = US $ 250 so a rough estimate of the costs for Jableh and Banias would be:

Jableh (166,779 p.e.):	US $ 41.7 million
Banias (142,564 p.e.):	US $ 35.64 million

Apparently, the cost figure for Jableh given by the regional environmental Directorate (questionnaires) either referred to the treatment plant alone (without main collector-submarine outfall) or was underestimated.

If the situation is to improve further, the problem of effective management of solid wastes also has to be faced. The installation and operation of controlled landfill sites seem to be the most feasible solution to the current problem.

6.2.2 Industrial discharges

A management plan for industrial wastes has to be implemented, aimed at pollution prevention measures and upgrading the existing end-of-pipe installations.

The plan's main features could be:

- feasibility studies for concrete full-scale solutions for each major industry in the area;
- investment requirements and proposals for funding;
- organization of analytical mechanisms (laboratories, sampling techniques) and self-monitoring;
- reporting to the environmental authorities;
- practical implementation phases.

The plan could be elaborated within two to three years at the initiative of the respective industrial associations or the local authorities with a budget of approximately US $ 500 000. An additional period of four to five years is needed to carry out the action proposed in the plan, but costs depend entirely on the relevant specific projects for each industrial unit.

6.2.3 Capacity-building

The establishment of new agencies for the operation of the plants at Lattakia and Tartous has to be envisaged and their organizational structure designed, even at this early stage, so that they will be fully operational when the plants' construction phase has been completed, hopefully within the next two to three years.

Additionally, the expansion and reorganization of the environmental authorities in the area should be considered so that they can effectively fulfil their monitoring and control responsibilities.

Funds have to be allocated, therefore, for the provision of the necessary sampling and analytical equipment, as well as for the computerization of data sets.

A budget of US $ 1 million appears adequate for purchasing equipment and training personnel for a one-year period.

DOCUMENTATION

MAP/PAP-RAC :	CAMP-Syrian coast, Coastal resources management plan Volume I : Synthesis report Split, February 1992
WHO EURO Project Office : Mediterranean Action Plan	Survey on pollutants from land-based sources in the Mediterranean
World Health Organization :	Assessment of sources of air, water and land pollution. Part I : rapid inventory techniques in environmental pollution (by A.P. Economopoulos) Geneva, 1993
World Health Organization : (Regional Office for Europe)	Identification of pollution hot spots and sensitive areas, 1997

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

TUNISIA

Prepared by: Mr Béchir Benmansour

1. GENERAL BACKGROUND

Tunisia's coast comprises several heterogeneous and unequally developed environments and extends for 1,300 km subdivided into four major zones:

- The north coast, also called the Coral Coast, extends from the Algerian border to Bizerta. It is steep and narrow and opens on to a deep sea. Many coral reefs harbour a wide variety of molluscs and fish. This zone is sparsely inhabited.

- The Gulf of Tunis extends from Bizerta to El Haouaria. It is an important area for fauna. There is intensive pressure from urbanization and tourism development on this part of the coast.

- The Gulf of Hammamet extends from El Haouaria to Chebba.
  The region of Kelibia has a narrow and uneven continental shelf, whereas the region of Sousse-Mahdia has a broad continental shelf.
  Tourism and holiday homes exert strong pressure in some sectors of this coastal zone.

- The Gulf of Gabès extends from Chebba to the Libyan border.
  It has a very wide but shallow continental shelf.
  Posidonia meadows are to be found along the coastline and are a habitat for very varied and rich marine fauna.
  One half of the waterfowl that migrate to the Mediterranean in winter take refuge in the Gulf of Gabès.
  The chemical industry constitutes the major anthropogenic pressure on this part of the coast.

This strategic area comprises :

- 70 per cent of the population, corresponding to around 6,300,000 inhabitants, with marked urban concentrations (2,000 inh/km^2 in Tunis, 1,000 inh/km^2 in Sousse and Sfax, whereas the national average is 57 inh/km^2).

- 73 per cent of the country's housing .

- 93 per cent of tourism units (around 14,000 beds).

- The majority of industrial activities (88 per cent of jobs in the industrial sector) broken down as follows:

  - 95 per cent of the textile industry, in the regions of Sousse and Monastir in the centre, Tunis in the north and Sfax in the south;
  - 70 per cent of the metallurgy industry, in Bizerta and Tunis;
  - 67 per cent of the agri-food industry, in Tunis, Cap-Bon, Sfax and Sousse;
  - 80 per cent of the chemical industry, in Bizerta, Gabès, Sfax and Tunis.

- A large number of ports.

The effect of this concentration of human activity is to contribute towards the degradation of the coastal environment, with the emergence of disturbing factors, despite the 50 treatment plants already existing, of which 30 are on the coast.

Underlining its concern to preserve opportunities for future generations and convinced that economic and social development cannot be viable without taking into account the environment, Tunisia has created:

- the National Sanitation Office in 1974
- the National Environment Protection Agency in 1988
- the Ministry of the Environment and Land Planning in 1991
- the National Commission for Sustainable Development in 1993
- the Coastal Protection and Planning Agency in 1995
- the International Centre for Environmental Technology in 1996
- the Association for the Study and Development of LAC SUD in Tunis
- the Association for the Study and Development of the TAPARURA zone in Sfax in 1995.

and has adopted the following legal texts *inter alia* :

- the land planning and urbanization code in 1994
- a law on the maritime public domain in 1995
- a law on the development and maintenance of industrial zones in 1994.

2. SELECTION OF HOT SPOTS

It has been possible to draw up a list of potential hot spots on the basis of an assessment of pollutants entering the Mediterranean Sea from cities and urban centres along the coast with more than 100,000 inhabitants and/or from large industrial establishments whose wastes are directly discharged into the sea.

The following hot spots that meet the criteria fixed and require urgent action have been identified:

- Gabès
- the lake of Tunis
- the lake of Bizerta
- south Sfax.

2.1 Hot spot no.1 : Gabès

Background data

Situation

The city of Gabès is in south-eastern Tunisia.

Population

The permanent population of Gabés is around 150,000, but it increases by 30 per cent during the summer.

Activities

Four activities are characteristic of this region

(a) Industry

The industrial zone of Gabès covers around 250 hectares and includes *inter alia* a factory manufacturing fertilizer from phosphoric and sulphuric acids, a cement factory, a thermal electric power station, a factory making refined petroleum products, and some mechanical workshops.

(b) Agriculture

Agriculture in the region of Gabès is not related to the sea and mainly consists of market gardens and arboriculture. The Gulf of Gabès is also the most important fishing centre in Tunisia (50 per cent of domestic production, corresponding to 43,000 tonnes a year). This activity is declining significantly, essentially due to the discharge into the sea of phosphogypsum from the fertilizer factory.

(c) Tourism

There are 1,300 hotel beds in Gabès. corresponding to 1 per cent of the total number in Tunisia.

(d) Maritime transport

Gabès is one of Tunisia's six major commercial ports. Each year, 3.2 million tourists pass through the port (20 per cent of the country's total traffic).

Sources of pollution

1. Urban water pollution

Each day, 17,260 m^3 of urban wastewater is generated. Part of this (8,625 m^3) is treated in a two-stage treatment plant (secondary treatment).

Untreated wastewater is discharged directly into the sea. The characteristics of this water are:

- BOD_5 : 715 mg/l
- Total - N : 122 mg/l
- TSS : 605 mg/l
- Some traces of heavy metals as some small industrial units are connected to the urban sanitation network.

Proposal

We propose the expansion of the treatment plant and the establishment of a third treatment stage.

Implementation of this project is estimated at US$ 30,000 and its study is at the detailed preliminary project stage.

2. Industrial pollution

Two types of pollution are characteristic of the industrial zone of Gabés:

- atmospheric pollution
- water pollution

Atmospheric pollution

An atmospheric depollution project is under way and the work is nearly completed; the cost of the project is US$ 40 million.

Water pollution

Industrial wastewaters

Industrial wastewaters from the fertilizer factory are discharged directly into the sea. They essentially contain phosphogypsum (12,000 tonnes discharged each day since the factory started up). Large quantities are deposited on the beach and the remainder flows towards neighbouring regions and may reach the Libyan coast. These phosphogypsum deposits have led to an imbalance in the ecosystem and a marked decline in fisheries resources.

In view of the seriousness and urgency of the situation, the Government has decided to implement a two-phase project:

1 - Cessation of discharge into the sea by building a transfer network and installing a sealed settling tank to prevent contamination of the water table.

2 - Removal of the phosphogypsum deposited on the beach for burial in a special watertight dump.

Preliminary studies for the project (both phases) are under way and will be completed in 1998, implementation is envisaged between 1998 and 2000.

The project's cost is estimated at US$ 120 million broken down as follows:

- Purchase of land: US$ 20 million (land bought)
- Study and implementation of the transfer network: US$ 30 million
- Installation and sealing of the dump and the settlement tank US$ 70 million.

It should be noted that the Tunisian Government has included the financing for part of this project in its five-year development plan.

Cooling waters

Each day 324,000 m^3 of seawater are used for cooling and then discharged into the sea.

Calorific depollution is not deemed to be a priority.

2.2 Hot spot no. 2: lake south of Tunis

Background data

Situation

The lake of Tunis is situated south of the city in the Gulf of Tunis and has a permanent outlet to the sea.

Population

The permanent population of the southern zone of Tunis is 400,000.

Activities

The special feature of this zone is that it is both an industrial and residential area. There are 350 factories in the zone. These are mainly factories manufacturing textiles and foodstuffs, metal processing factories and hydrocarbon storage facilities.

In addition, the third largest commercial port in Tunisia is in the zone (around 4 million tonnes of general cargo).

Sources of pollution

1. Urban water pollution

The urban wastewater generated in the zone south of Tunis amounts to 50,000 m^3 per day, 35,000 m^3 are treated in a two-stage treatment plant and 15,000 m^3 are discharged raw into the lake and then the sea.

In order to prevent the discharge of raw sewage and improve the quality of the water treated, we envisage:

- expansion of the existing plant;
- installing a third treatment stage at the plant.

Studies on the expansion of this project are being completed and the work is estimated at US$ 5 million.

2. Industrial water pollution

Each day 12,000 m^3 of industrial wastewater are discharged into the lake. These contains large quantities of heavy metals (Pb, Cd, Cr).

In order to prevent the discharge of this wastewater without treatment, a treatment plant is planned. The tenders are being scrutinized and the cost is estimated at US$ 10 million.

3. Cumulative pollution in the lake

The lake has been used for discharges of sewage from sanitation networks and is currently highly polluted. In order to reverse this situation, it is proposed to dredge the lake. The studies have been carried out and the cost of this work is estimated at US$ 50 million.

It should be noted that a public company has been set up specially to develop and manage this project.

2.3 Hot spot no. 3 : lake of Bizerta

Background data

Situation

The city of Bizerta is in the north of Tunisia.

Population

The permanent population of Bizerta is around 250,000, but it increases by 50 per cent during the summer.

Activities

Four activities are characteristic of the region of Bizerta:

(a) Industry

There are 200 industrial units in the zone. The majority are small or medium factories, with the exception of two large units, a refinery and a steelworks.

(b) Agriculture

Agriculture not related to the sea

In the region of Bizerta, the most important agricultural sector not related to the sea is market gardening.

Fishing and fish farming

The region is one of Tunisia's important fishing and fish farming areas.

Tourism

Capacity in the region of Bizerta is currently 1,060 hotel beds, but it will reach 4,800 beds by the year 2016.

Maritime transport

The region of Bizerta has the most important port in Tunisia, which handles 4 million tonnes.

The presence of the refinery, the steelworks and the cement factory justify the importance of the port.

It should also be noted that the zone of Bizerta is at the intersection between the western and eastern Mediterranean and is on the main route linking the Suez Canal and the Straits of Gibraltar (150 million tonnes of hydrocarbons and 120 million tonnes of other goods transit through this seaway each day).

Sources of pollution

1. Urban water pollution

Each day 36,000 m^3 of urban wastewater is generated. This is discharged raw into the sea.

A treatment plant with a capacity of 26,600 m^3/day is being built in Bizerta. The cost of this project is estimated at US$ 45 million.

To prevent the discharge of 9,400 m^3/day of untreated wastewater into the sea, it is proposed to extend the sanitation network and to build a new treatment plant in an area that is not covered by the plant currently being built.

The cost of this project is estimated to be US$ 39 million broken down as follows:

- extension of the network : US$ 10 million
- treatment plant : US$ 29 million

2. Industrial water pollution

Around 4,000 m^3/day of industrial wastewater are discharged into the sea. This wastewater mainly comes from the refinery and the steelworks and contains large quantities of heavy metals and hydrocarbons.

In order to reverse this situation, it is proposed to connect these factories to the sanitation network after having installed individual pretreatment plants.

The cost of this project is estimated to be US$ 38 million broken down as follows:

- pretreatment at the refinery:: US$ 10 million
- pretreatment at the steelworks:: US$ 14 million
- pretreatment at the other 198 units : US$ 14 million (an average of D 14 million).

2.4 Hot spot no. 4 : south Sfax

Background data

Situation

The city of Sfax is situated in the south-east of Tunisia, approximately 280 km. from Tunis.

Population

The city has a population of 600,000, of which 395,000 reside in the south Sfax area.

Activities

The area is characterized by a highly developed industrial zone. The most important unit at present is the phosphoric acid and fertilizer factory.

Sources of pollution

1. Urban water pollution

Of the 256,00 m^3 of urban wastewater generated each day, 156,00 m^3 are treated in the existing treatment plant and 10,000 m^3 are discharged raw because the plant is saturated.

In order to remedy the situation, it is proposed to reorganize and expand the existing treatment plant.

The cost of this work is estimated at US$ 30 million

It should be noted that detailed preliminary project studies have been carried out.

2. Atmospheric industrial pollution

Gaseous discharge from the sulphuric acid and fertilizer factory greatly pollutes the region and part of this pollution reaches the sea.

In order to prevent this, it is proposed to install a gas treatment system (electrostatic filters).

HOT SPOTS IN TUNISIA

Country	Name	Type of pollution	Public health	Drinking water quality	Aquatic life	Recreation	Other beneficial uses	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$ million)
Tunisia	Gabès	Municipal Industrial (mainly fertilizer production)	6	2	6	5	3	5	22.2	100	WWTP : expansion Phosphogypsum elimination zone	F,B,H,P,L	30 100
	Lake of Tunis	Municipal Industrial (textiles, metal processing, hydrocarbon storage)	5	2	6	5	3	5	21.2	95	WWTP : expansion + third-stage treatment WWTP - construction Dredging of lake	F,P,H,B	5 10 (financed) 50
	Lake of Bizerta	Municipal Industrial	5	2	5	4	3	5	18.5	84	WWTP : construction WWPTP : construction	F,P,L,B,H	39 38
	South Sfax	Municipal Industrial (mainly phosphated fertilizers, sulphuric and phosphoric acids)	6	1	5	2	3	5	(18.1)	82	WWTP : extension + reorganization -WWPTP : construction -treatment of gases	F,P,B,H	30 Preliminary studies not deemed necessary
	Ghar El Melh	Domestic and industrial	4	1	6	3	4	4	17.7	100	WWTP : construction Recirculation canal: construction	F,B,P,H,L	4

SENSITIVE AREAS IN TUNISIA

Country	Name	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$ million)
Tunisia	Ghar El Melh	Domestic+ Industrial	4	1	6	3	4	4	17.7	100	WWTP (Construction) Recirculation canal : Construction	F,B,P,H,L	4,000,000

IDENTIFICATION OF POLLUTION HOT SPOTS AND SENSITIVE AREAS IN THE MEDITERRANEAN

Country report for

TURKEY

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Prepared by: Mr Louis J. Saliba

1. INTRODUCTION

The survey was coordinated by the Foreign Relations Department of the Ministry of Environment. The relative questionnaires were distributed to the following:

- State Institute of Statistics
- Bank of Provinces
- Technical Institute of Marine Sciences
- Ministry of Tourism
- Provincial Departments of the Ministry of Environment.

During the visit to Turkey from 24 February to 3 March 1997, comprehensive discussions took place with Officials of the Foreign Relations Department of the Ministry of Environment. The completed questionnaires were gone through, and, where necessary, other information was sought and obtained from the sources mentioned above during the period of the visit.

Turkey has a long Mediterranean coastline, on which settlements of different sizes, varying from large cities to small villages, abound. Unlike the situation on the Black Sea coast of Turkey, where populations have remained relatively constant, and also diminished in some cases, the population in Mediterranean coastal settlements is continually on the increase, the figures varying from one locality to another. The last population census was held in 1990, but estimated figures for populations were also available for 1994 and 1995. There was a problem in obtaining further projections, which have to be taken into account when calculating the cost of remedial measures.

Taken generally, a large proportion of municipal waste is discharged into the sea without treatment. Also, in several of the cities and towns, a sewerage network is either absent or incomplete. This situation is being slowly improved, but a lot of work needs to be done.

Turkey is highly industrialized, but a large percentage of industries are located inland. Relatively few industries (as compared to the country total) discharge their wastes directly into the sea. Hot spot areas are coastal cities and towns where the marine environment receives waste from several industries, as opposed to individual industries. The situation regarding treatment of industrial waste is improving at a faster rate than is the case with municipal effluents, and several industries now treat their waste at source, treatment being mainly secondary, but primary in some cases. A number of industries discharge their wastes into rivers, the effluent again varying from untreated to treated up to the secondary stage. Information on individual industries was difficult to obtain, and work had to be done on global figures for the various localities identified as hot spots of industrial pollution.

Six main rivers discharge into the Mediterranean Sea, two of which discharge at two separate points. River pollution is a serious problem in Turkey, and there is a pressing need for a project on river management. It is strongly recommended that ways and means be found by the appropriate International Agency to finance such a project, the first phase of which could be a comprehensive survey of river pollution.

2. APPROACH

A total of forty questionnaires relating to municipal discharges, compiled by the Technical Institute of Marine Sciences, were made available. Many of these were recognized as sources of pollution, and would have normally been included in comprehensive surveys of land-based pollution, but definitely did not rank as priority hot spots. It was therefore decided to draw the line at cities with a permanent population of 100,000 or more inhabitants. Twelve

cities fitted into this category. It was found that the questionnaires were based on population figures drawn from the 1990 census, and did not reflect the present day situation. The questionnaires themselves were therefore discarded and equivalent information reflecting the population situation 1995 obtained from the State Institute of Statistics. This information was made available as an integrated report giving figures for the various sections of the questionnaires, not on the questionnaire forms themselves, but was considered of equal value.

In all the questionnaires, estimations of the loads of the various pollutant parameters were made on the basis of populations, using the following formulae:

BOD_5	60 g / person / day
COD	100 g / person / day
Total N	15 g / person / day
Total P	6 g / person / day
TSS	90 g / person / day

These formulae were applied to the revised population figures made available by the State Institute of Statistics for the calculation of the new pollution loads. These were made on the basis of permanent populations. Figures for summer populations were provided, but were not as reliable as those for permanent populations.

In all cases, pollution data was limited to BOD_5, COD, Total-N, Total-P and TSS. No data regarding the other parameters listed in the questionnaire were available, and analysis could not be done in the short time allocated to the project. Similarly, data on receiving water quality were not available. It was explained that such data would take time to obtain.

In the case of industries discharging directly into the sea, only four completed questionnaires were received, all relating to industries whose effluent was receiving the full range of treatment prior to discharge. These questionnaires could not therefore be utilized, as their discharges were not creating, and did not contribute to, pollution hot spots. During the course of visit, data was received from the State Institute of Statistics. This data was global in nature, the total number of industries discharging their wastes directly into the sea being provided for a number of industrial areas, giving a break-up of the total volume of wastewater discharged as follows:

- Direct industrial discharge without treatment
- Direct industrial discharge with secondary or further treatment
- Direct industrial discharge with primary treatment only
- Direct domestic discharge without treatment
- Direct domestic discharge with treatment

It was not possible to obtain either information on individual industries, or data on pollution loads.

Two industrial hot spots were identified from the list supplied. Adana and Icel were linked to cities, and each hot spot relates to a group of industries. In the case of Adana, where only one industry discharging directly into the sea was listed, the locality was retained as a hot spot on the basis of supplementary information regarding other existing industries, which were not listed.

The assessment of effects of all municipal and industrial hot spots listed was done not only on the basis of pollution load, but also taking into account the localities of the discharge sites and effected areas in question in relation to sensitive areas such as bathing areas, etc., and the contribution of dispersal in the sea to the final effects.

Estimates of the cost required for construction of treatment plants for polluting industries could not be obtained. This would require a comprehensive study of the requirements of each individual industry, and would take considerable time. Costs for the four industrial hot spots, therefore, remain unavailable at the present time, and have been so defined in the assessment table. Costs for new sewage treatment plants for the coastal cities listed, together with costs for construction or extension of sewerage networks, presented a problem. Information was obtained from the Bank of Provinces in Ankara regarding current costs, which are based on populations served, and which were quoted as follows:

- Primary treatment plus Activated sludge: US$ 32 *per capita*
- The above, with extended aeration US$ 42 *per capita*
- Primary treatment plus trickling filter US$ 34 *per capita*
- Primary treatment plus Stabilization Pond US$ 35 *per capita*
- Construction or extension of sewerage network US$ 170 *per capita*

These costs are high as compared with those obtaining for the Black Sea project. These were also made on the basis of population figures, and application of population figures for the towns listed in the Black Sea document to the costs of wastewater treatment plants and sewerage construction and extension gave figures of US$ 18 *per capita* for the former and 23 US$ *per capita* for the latter. It is understood that the Black Sea figures were obtained by taking an average of the costs quoted by national banks and those quoted by the World Bank.

One further problem in arriving at reasonable cost estimates was the fact that the populations of Mediterranean coastal cities and towns in Turkey are continuously increasing. As the increase varies greatly from one locality to another, it is not possible to apply an overall percentage figure. A study of population increases in each locality (a) from 1994 to 1995, and (b) from 1990 to 1995, provided figures which did not correlate in most cases (*i.e.* the 1994-1995 increase and the average annual increase between 1990 and 1995 were very different). Attempts were made to obtain projections for the years 2000 and 2020 from the State Institute of Institute of Statistics, but this was not possible in the time available.

In order to be able to provide a cost estimate, even if only indicative, a compromise was reached by averaging the 1994-1995 increase and the average annual increase between 1990 and 1995. This estimated annual average increase was then applied to the period 1995-2000, (i.e. it was multiplied by 5) based on the 1995 population. The figures were used in conjunction with the third option (Primary treatment plus trickling filter) at US$ 34 *per capita*, to reach an indicative figure.

3. CONTRIBUTION OF DIFFERENT SOURCES TO THE DEFINED HOT SPOTS

A list of the thirteen identified hot spots, along with the various sources contributing to the discharge, and the principal supporting data expressed as tons of BOD_5 per day in the case of municipal sites and wastewater volume in the case of industrial sites, is given in Table 1. A resume of the data contained in the questionnaires on municipal discharges, including total loads of BOD_5, COD, Total-N, Total-P and TSS in tons per year, together with BOD_5 in tons per day, is given in Table 2. The estimated increases in population in the twelve cities identified as hot spots is given in Table 3.

Industrial discharges from the four industrial sites identified, expressed as volumes of treated, partially treated or untreated wastewater flows, are given in Table 4.

The pollution load from the six main Mediterranean rivers at their point of entry into the sea is given in Table 5.

4. ASSESSMENT OF PRIORITY HOT SPOTS AND SENSITIVE AREAS

The assessment of the five priority hot spots, using the ranking system provided, is given in Table 5.

5. IDENTIFICATION OF MAIN GAPS AND CONSTRAINTS

There are a number of gaps. The main ones are the following:

- the lack of information on (a) concentrations of Petroleum hydrocarbons, heavy metals and organochlorines in municipal effluents, (b) the quality of receiving waters;

- the lack of information on individual industries. This has resulted in estimates of the costs involved in remedial action being impossible insofar as this component is concerned.

The main constraint from the point of view of the persons responsible for completion of the questionnaires was the time-factor. This was not sufficient even to collect the information already available as, particularly in the case of industries, the work involved in obtaining the information was, by its very nature, time-consuming. Apart from this, a number of projections, as in the case of population increases, could not be made. During the period of the visit, various items of information were requested, several of which were promptly supplied. Others, however, could not be worked out in the time available.

It is true that the present exercise was limited to hot spots, and was in no way a comprehensive survey of all pollution sources in the Mediterranean. However, it is felt that the time allocated was much too short to enable the work to be done properly.

6. PROPOSED OPTIONS FOR REMEDIAL ACTION

The main option available for remedial action at all sites is the construction of wastewater treatment plants, and in the case of a number of cities, extension of existing sewerage networks or constructions of new ones. In the case of industries, the provision of treatment facilities at source must be accelerated.

The costs involved in the construction of treatment plants and sewerage networks for the cities listed will have to be re-calculated, taking into account not only *per capita* estimates, but also properly designed population projections for each city. In the case of industries, information currently available could not even lead to an indicative estimate, and calculations will have to be worked out for each individual industry. As already stated, one important need is for a project on river management, as a large amount of waste, both industrial and municipal, finds its way into the Mediterranean through rivers.

Table 1

Identified Mediterranean Hot Spots in Turkey

Hot-Spots	Pollution Sources	Principal Supporting Data	
ICEL	Domestic	Untreated sewage from 561,022 Pop.	BOD load: 34 tons per day
Erdemli	Domestic	Untreated sewage from 33,725 Pop.	BOD load: 2 tons per day
Silifke	Domestic	Untreated sewage from 65,821 Pop.	BOD load: 4 tons per day
Tarsus	Domestic	Untreated sewage from 237,245 Pop.	BOD load: 14 tons per day
ANTALYA	Domestic	Untreated sewage from 535,099 Pop.	BOD load: 32 tons per day
Alanya	Domestic	Untreated sewage from 82,102 Pop.	BOD load: 5 tons per day
Side	Domestic	Untreated sewage from 30,087 Pop.	BOD load: 2 tons per day
Manavgat	Domestic	Untreated sewage from 59,921 Pop.	BOD load: 4 tons per day
ADANA	Domestic	Untreated sewage from 1,098,421 Pop.	BOD load: 66 tons per day
	Industrial	Industry discharge 158,400 m^3/year untreated industrial water	
Ceyhan	Domestic	Untreated sewage from 99,864 Pop.	BOD load: 6 tons per day
ANTAKYA	Domestic	Untreated sewage from 141,112 Pop.	BOD load: 9 tons per day
Iskenderun	Domestic	Untreated sewage from 153,649 Pop.	BOD load: 9 tons per day
Dortyol	Domestic	Untreated sewage from 49,390 Pop.	BOD load: 3 tons per day
Kirikhan	Domestic	Untreated sewage from 89,933 Pop.	BOD load: 6 tons per day
BODRUM	Domestic	Untreated sewage from 31,461 Pop.	BOD load: 2 tons per day
Marmaris	Domestic	Untreated sewage from 25,602 Pop.	BOD load: 2 tons per day
Datca	Domestic	Untreated sewage from 7,998 Pop.	BOD load: 0.5 tons per day

Table 2

Municipal discharges from main Mediterranean cities in Turkey

CITY	Population	Population served by Sewerage	BOD (Tons/year)	COD (Tons/year)	TOTAL N (Tons/year)	TOTAL P (Tons/year)	TSS (Tons/year)	BOD (Tons/day)
ICEL	561,022	510,530	12,285	20,477	3,072	1,229	18,429	33.66
ERDEMLI	33,725	--	738	1,230	185	74	1,107	2.02
SILIFKE	65,821	37,517	1,441	2,402	360	144	2,162	3.94
TARSUS	237,245	118,622	5,195	8,659	1,299	520	7,793	14.23
ANTALYA	535,099	--	11,718	19.531	2,930	1,172	17,578	32.10
ALANYA	82,102	50,461	1,798	2,996	449	180	2,697	4.92
SIDE	30,087	30,087	658.9	1098.1	165	66	988.35	1.80
MANAVGAT	59,921	29,960	1,312	2,187	328	131	1,968	3.59
ADANA	1,098,421	878,736	24,055	40,092	6,014	2,405	36,083	65.90
CEYHAN	99,864	89,877	2,187	3,645	547	219	3,280	5.99
ANTAKYA	141,112	134,056	3,090	5,150	773	309	4,635	8.46
ISKENDERUN	153,649	92,189	3,364	5,608	841	336	5,047	9.21
DORTYOL	49,390	--	1,081	1,802	270	108	1,622	2.96
KIRIKHAN	89,933	--	1,969	3,282	492	197	2,954	5.39
BODRUM	31,461	20,449	689	1,148	172	69	1,033	1,88
MARMARIS	25,602	23,041	560	934	140	56	841	1.53
DATCA	7,998	--	175	291	44	17	262	0.47

Table 3

Estimated population increases in main Mediterranean cities in Turkey

CITY	Population 1995	Percent Increase 1994-1995	TOTAL Increase 1990-1995	Average Annual Increase 1990-1995	Estimated Annual Increase 1995-2000	TOTAL Percent Increase 1995-2000
ADANA	1,066,005	3.1%	16.4%	3,28%	3.19%	15.95%
ICEL (City)	694,867	4.9%	64,5%	12.90%	8.90%	44.50%
ANTALYA	505,862	5,96%	33.8%	6.76%	6.36%	31.80%
TARSUS	333,302	2,7%	77.8%	15.56%	9.15%	45.65%
ANTAKYA	317,725	2.24%	156.0%	31.2%	16.72%	83.60%
ISKENDERUN	276,163	1.2%	78.4%	15.68%	8.44%	42.20%
OSMANIYE	139,116	2.6%	13.7%	2.74%	2.67%	13.55%
SILIFKE	128,509	3.6%	174,0%	34.90%	19.20%	96.00%
KIRIKHAN	120,472	3.3%	75.6%	15.12%	9.21%	46.05%
DORTYOL	116,380	0.8%	147%	29.48%	15.14%	75.70%

Table 4

Industrial discharges directly into the sea from main Mediterranean cities in Turkey

City/Province	Number of Industries	Industrial wastewater			Domestic wastewater	
		Untreated m^3/year	Primary treatment m^3/year	Secondary treatment m^3/year	Untreated m^3/year	Treated m^3/year
ADANA	1	---	---	---	---	158,400
ICEL	13	2,164,350	3,150,000	7,093,330	139,732	411,090

Table 5

Pollution load from main Mediterranean rivers in Turkey

River	Number of Measurements	Q Km^3/y	BOD_5 mg/l	COD mg/l	NH3-N mg/l	NO2-N mg/l	NO3-N mg/l	PO4-P mg/l	T.coli No./100 ml	FSTREP. No./100 ml	Cr mg/l	Cn mg/l	Pb mg/l	Zn mg/l	TSS mg/l	Cd mg/l
SEHYAN RIVER KARAYUSUFLU VILLAGE	4	5018	2.4	<20	0.7	0.049	0.43	0.14	NA	NA	NA	NA	NA	NA	113	-
OOKSU RIVER DOWNSTREAM OF SILIFKE	6	2.949	1.1	<20	0.18	0.002	0.59	0.06	NA	NA	NA	NA	NA	NA	159	NA
CEYHAN RIVER BEBELI VILLAGE	4 1	5.931	1.3	<20	0.13	0.009	1.03	0.04	NA	NA	<.005	<.005	0.014	0.111		0.005
MANAVGAT CREEK LAST BRIDGE	4 1	3.806	1.2	NA	0.22	0	0.20	0	70	23	0.005	0.005	0.008	0.005	8	<.005
BUYUK MENDERES SOKE MILAS BRIDGE	3 1	0.777	10.5	37.3	0.33	0.005	0.75	0.07	1500	200	NA	NA	0.015	0.024	46	0.005
GEDIZ RIVER MENEMEN BRIDGE	6 2	0.338	NA	<20	0.005	0.013	1.18	0.14	NA	NA	0.05	0.007	0.019	0.025	26	<.005
MERIC RIVER ENEZII	6 2	2.093	4.8	NA	0.62	0.009	2.3	0.52	0	NA	0	0	NA	NA	-	-

1996 Values of parameters measured.

Table 6

Assessment of Mediterranean priority Hot Spots in Turkey

Name	Main Cities	Type	Public Health	Drinking Water Quality	Aquatic Life	Recreation	Other beneficial use	Welfare and economy	Weighted total	Relative importance index	Nature of investment	Transboundary aspect(s)	Preliminary estimated financial requirement (in US$)
ICEL	Icel	mixed	6	3	6	6	4	5	24.6	100.0	SW	F,B,L,P,H	SW 3.4 million
	Erdemlil	domestic	3	4	4	3	3	4	17.1	69.51	SW+WWTP	F,B,L,P,H	SW 2 million : WWTP 13 million
	Silifke	domestic	3	4	4	3	3	3	16.4	66.66	SW+WWTP	F,B,L,P,H	SW 4 million : WWTP 25 million
	Tarsus	domestic	5	4	5	3	4	5	21.3	86.58	SW	F,B,L,P,H	SW 14 million
ANTALYA	Antalya	domestic	5	5	6	4	3	6	23.8	96.70	--	F,B,L,P,H	* **Financed by World Bank**
	Alanya		3	1	3	6	5	3	16.9	68.69	SW	F,B,L,P,H	SW 5 million
	Side		3	1	3	6	4	2	15.4	62.60	SW+WWTP	F,B,L,P,H	SW 1.8 million : WWTP 13 million
	Manavgat		3	1	3	6	5	3	16.9	68.69	SW	F,B,L,P,H	SW 3.6 million
ADANA	Adana	mixed	5	4	4	5	4	5	22.2	90.24	--	F,B,L,P,H	* **Financed by EIB**
	Ceyhan		3	4	3	2	4	5	17.0	69.10	SW+WWTP	F,B,L,P,H	SW 6 million : WWTP 25 million
ANTAKYA	Antakya	domestic	5	4	5	4	3	4	20.7	84.14	SW	F,B,L,P,H	SW 8.5 million
	Iskenderun	domestic	5	2	5	5	3	4	19.7	80.08	SW	F,B,L,P,H	SW 9.2 million
	Dortyol	domestic	3	4	4	3	3	4	17.1	69.51	SW+WWTP	F,B,L,P,H	SW 3 million : WWTP 13 million
	Kirikhan	domestic	3	5	4	3	2	4	17.3	70.32	SW+wwTP	F,B,L,P,H	SW 5.4 million : WWTP 25 million
BODRUM	Bodrum		3	2	3	6	5	3	17.8	72.35	SW	F,B,L,P,H	SW 1.9 million
	Marmaris		3	2	3	6	5	3	17.8	72.35	SW+WWTP	F,B,L,P,H	SW 1.5 million : WWTP 13 million
	Datca		2	2	3	6	5	2	16.1	65.44	SW+WWTP	F,B,L,P,H	SW 0.5 million : WWTP 13 million

* No estimation was provided
* SW : Solid Wastes

Table 7

Priority Sensitive Areas in Turkey

RANK	NAME	CONSERVATION MEASURES	REMARKS
1	• Adana Seyhan River Mouth Ceyhan River Mouth	Monitoring programme and management plan	Heavy pollution load discharged into the Mediterranean Sea
2	• Izmir Bay Bakirçay River Mouth Gediz River Mouth Küçük Menderes River Mouth	Monitoring programme and management plan	Heavy pollution load discharged into the Aegean Sea
3	• Içel Göksu River Mouth Lamas River Mouth Tarsus River Mouth	Monitoring programme and management plan	Heavy pollution load discharged into the Mediterranean Sea
4	Mersin-Kazanli	Coastal zone management and wastewater Treatment	Marine pollution, coastal erosion and breeding dunes for *Chelonia mydas* and *Caretta caretta*
5	Hatay-Samandag	Monitoring and coastal zone management	Transboundary marine pollution, especially solid waste, endangered species
6	• Aydin Büyük River Mouth • Mugla Dalaman Stream Mouth	Monitoring and pollution prevention and control programme for dumping from ships	Heavy pollution load discharged into the Aegean Sea

Table 8

Preliminary estimated financial requirement

NAME	MAIN CITIES	POPULATION	SOLID WASTE	WASTEWATER *
ICEL	Icel	561,022	3.4 million US$ (JICA is doing feasibility studies)	Feasibility studies are going on within the scope of METAP. For financial support, application has been made to EIB.
	Erdemli	33,725	2 million US$	13 million US$ (feasibility study is completed. There is a necessity for investigation)
	Silifke	65,821	4 million US$	25 million US$ (municipality is searching for foreign finance for the project which has been applied for by Iller Bank)
	Tarsus	237,245	14 million US$ (feasibility study is being prepared. Financing is needed)	Financial support provided by German Government
ANTALYA	Antalya	535,099	Financing by World Bank	Financing by World Bank
	Alanya	82,102	5 million US$	Network and treatment plant are completed in the city centre
	Side	30,087	1.8 million US$	13 million US$ (network and treatment plant are partially completed)
	Manavgat	59,921	3.6 million US$	Treatment system has been completed
ADANA	Adana	1,098,421	The feasibility studies have just been started by JICA	For foreign credit financing is obtained from EIB
	Ceyhan	99,864	6 million US$	25 million US$
ANTAKYA	Antakya	141,112	8.5 million US$	Treatment plants have been completed by Iller Bank
	Iskenderun	153,649	9.2 million US$	Foreign credit has been obtained from a commercial bank
	Dortyol	49,390	3 million US$	13 million US$
	Kirikhan	89,933	5.4 million US$	25 million US$ (It could be taken into the investment programme)
BODRUM	Bodrum	31,461	1.9 million US$	Treatment plant for the city centre has been done by the Ministry of Tourism. There is a sea disposal system and also a land problem for the treatment plant at the west site
	Marmaris	25,602	1.5 million US$	13 million US$ (They are searching for foreign finance
	Datca	7,998	0.5 million US$	13 million US$ (it is in the programme of Iller Bank)