The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA)

EGYPT'S NATIONAL PROGRAM OF ACTION FOR THE PROTECTION OF THE RED SEA FROM LAND-BASED ACTIVITIES

Egyptian Environmental Affairs Agency

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PREFACE

The world's oceans play a vital role in the maintenance of the biosphere and life on earth. The oceans are the beginning and the end of the water cycle, nature's solar-driven water pump, wherein the sun evaporates water to form the clouds that provide the rain that nourishes the fields, flows down our rivers and irrigation channels and provides us with life. The oceans act as a giant thermostat regulating our planet's temperature, absorbing vast quantities of the carbon dioxide we pump into the atmosphere, the gas that threatens us with climate change through global warming. The oceans have provided us with a plentiful supply of protein, they are used as a global super highway, and the coastal zone is the most favored place to live and for recreation.

And yet, because they are so vast, and because most water flows back to the oceans, they have become the final repository for much of the waste material that is produced on land. Land-based sources of pollution have become the biggest threats to the health of our coastal and marine ecosystems, to their productivity and biodiversity.

Recognizing this importance, 108 countries and the European Commission expressed their commitment in 1995 through the Global Programme of Action (GPA) to protection of the marine environment from land-based activities. The GPA encourages regional cooperation, which enhances national action, and, as a primary objective, the GPA facilitates action by individual states.

Egypt has borders with two seas, the Mediterranean and the Red Sea, and is signatory to several international conventions for the protection of the marine environment, most notably the Mediterranean Action Plan and the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). Through PERSGA's Regional Programme of Action for the Protection of the Red Sea and Gulf of Aden Environment from Land-Based Activities, Egypt is preparing its National Action Plan to protect the marine and coastal environment of the Red Sea from land-based activities.

This report is an integral step in the development of the necessary action plans that will eventually lead to a reduction in the quantity of pollutants entering the Red Sea and will improve the quality of coastal and marine environments, boosting the economy, safeguarding human health, and ensuring the sustainability of natural resources.

EXECUTIVE SUMMARY

Healthy estuarine, near-shore and oceanic systems provide a variety of economic and life sustaining benefits such as food, building materials, storm protection, tourism opportunities, organisms for biotechnology, and many more. Recognizing the importance of the marine environment, 108 countries and the European Commission have expressed their commitment to pollution prevention through the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA).

The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) took the initiative to commence work on a Regional Programme of Action (RPA) for the protection of the Red Sea and Gulf of Aden from land-based activities. This RPA has been developed in close coordination and with financial support from UNEP/ GPA.

The recommendations of the GPA form a basis for action at national (and local) levels. As threats to the coastal and marine environment vary between regions and countries, each country must prepare its own National Programme of Action based on its own unique circumstances. Development of the Egyptian NPA for the Red Sea coast is one of the national plans proposed in the framework of PERSGA's RPA and has been developed in coordination with the Egyptian Environmental Affairs Agency (EEAA).

The waters of the Egyptian Red Sea include, from north to south, the Suez Canal and its associated lakes, the Gulf of Suez, the Gulf of Aqaba and the northern Red Sea. The Suez Canal is a vital economic resource to the country, providing a link from the Mediterranean to the Indian Ocean. The biodiversity is not high but there are important fisheries, aquaculture and areas for recreation. The Gulf of Aqaba and northern Red Sea are famous for their natural beauty and outstanding biological diversity. The region provides habitats for a significant number of unique species. It is rich in living marine resources and a focal point for tourist activities. Key species groups include corals, mangroves, seagrass beds, a rich fish diversity including many shark species, dugong, nesting turtles and dolphins.

However, anthropogenic activities are threatening the marine and coastal ecosystems of the whole area. Coastal development activities such as urbanization, industry (including power, desalination plants and refineries), recreation and tourism, wastewater treatment facilities, coastal mining and quarrying activities, oil bunkering and habitat modification have imposed enormous stress on the fragile marine environments. These compound the stresses from marine sources of pollution such as transportation (shipping and ferry services), oil exploration and extraction. Sea level rise as a result of climate change is a future concern for low-lying areas.

The relative importance of these threats to the marine environment are not equal across all geographical areas. It is quite clear that the risks and the priorities for action differ between the Suez Canal, the Gulf of Suez, and the Red Sea and Gulf of Aqaba.

The GPA provides a description of the steps to be taken during the preparation of national plans of action. This document is a collation of the key data collected to date and a description of the process taken to identify the key risks to the marine environment in three major water bodies, the Suez Canal, the Gulf of Suez, and the Red Sea and Gulf of Aqaba.

The first step involves an identification and assessment of the problems. Following a description of the local environmental characteristics of the region (meteorological and geographical) the report identifies the main sources of land-based pollution in each of the governorates that border the Suez Canal, the Gulf of Suez, the Gulf of Aqaba and the northern Red Sea. These are the governorates of Port Said, Ismailia, Suez, South Sinai and the Red Sea.

Following a comprehensive review of the key contaminants, the report describes the process of environmental risk analysis undertaken to determine which of the sources of pollution are actually the greatest threat. The highest risks to the environment, and hence the highest priorities for action to reduce deterioration, were established on the basis of a number of variables, economic, social and biological. These included risks to food supplies and public health, the type of contaminant involved, the level of the physical alteration and destruction of habitats, and the nature and extent of the affected area (local, regional, trans-boundary).

A brief description of the current legal and institutional framework for the control of land-based sources of pollution is provided. Expanding from this, a stakeholder analysis was carried out to identify the key players, their interests, importance and influence. The Egyptian Environmental Affairs Agency, Ministry of State for Economic Development, Suez Canal Authority, Coastal Governorates and their Local Parliaments, Holding Company for Water and Waste Water Development, and the Ministry of Agriculture carry the highest influence and wield the necessary power to produce changes to future plans for the control of land-based sources of pollution. They are the important players in controlling pollution and preventing deterioration to environmental resources. Hence these stakeholders need to be involved with the design and implementation of the National Action Plan.

During the preparation of the Action Plan several guiding principles were followed:

- To apply the precautionary principle and the polluter pays principle
- To undertake environmental impact assessment for proposed activities that are likely to cause a significant adverse impact on the marine environment
- To accord priority to integrated pollution control
- To commit to the promotion of integrated management for coastal zones
- To ensure that competent authorities give the public appropriate access to information
- To ensure routine and standardized reporting of toxic emissions to air, water and land by polluting facilities—private, public or owned by the government

On the basis of the issues considered, it is evident that the main land-based sources of pollution originate from continuous coastal development projects, sewage treatment facilities and industrial facilities. Contaminants carried by air were not assessed as no proper surveys were carried out to judge the severity of the problem. However, problems are likely to exist so air pollution was taken into consideration while preparing the Action Plan.

Following the identification stage, the risk analysis, setting of priorities, analysis of the legal framework and stakeholder influence, a strategy was prepared with targets and proposed actions at the national level.

The proposed strategy aims to enhance the quality of the marine environment by improving the shared-management of land-based sources of deterioration. It also aims to facilitate Egypt's implementation of the PERSGA/GPA principles to safeguard the coastal and marine environment of the Red Sea. It is designed to assist Egypt in taking actions within its respective policies, priorities and resources, which will lead to the prevention, reduction, control and/or elimination of the degradation of the marine environment, as well as to its recovery from the impacts of land-based activities.

The following measures may reduce risk to the marine environment from both point and non-point sources:

Strategy 1: Improve legislation, environmental management and institutional arrangements.

Strategy 2: Improve fiscal resource allocation systems and maximize the use of available resources.

Strategy 3: Ensure proper management of waste (including agro-chemicals, pesticides, solid waste and sewage).

Strategy 4: Ensure proper management of industrial waste.

Strategy 5: Build national capacity (through training, awareness, research and monitoring).

Strategy 6: Establish of a central database directory and information system.

Strategy 7: Ensure preparedness to address man-made or natural disasters.

Strategy 8: Stop physical alteration and destruction of habitats.

Actions have been identified and recommended timelines provided. These are presented in tabular form. Implementation of the actions will ensure:

- Improvement to the quality of the marine environment
- Rehabilitation, through natural processes, of impacted ecosystems
- Identification of other mitigation measures needed to protect the marine environment.

1. INTRODUCTION

1.1 SCOPE

Globally, coastal and marine environments, with their natural resources and potential, are particularly important for economic development and poverty reduction. They provide a source of food security, major potential for urban and industrial development, and are crucial for local and international transport and commerce.

Coastal and marine habitats are subject to numerous sources of deterioration due to land- and sea-based activities. Sea-based activities are subject to many international conventions and protocols that ensure a minimal level of protection. On the other hand, land-based activities are often subject only to local legislation which, if not appropriate, may lead to harmful impacts not only locally but also to more distant marine ecosystems both nationally and internationally due to the transboundary movement of pollutants.

In 1995, recognizing that pollution from land-based sources was now the biggest threat to productivity and biodiversity in the marine environment, 108 countries and the European Commission expressed their commitment to reversing the trend by signing the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA). They acknowledged that this demands long-term, cross-sectoral, multi-disciplinary, and participatory responses. The GPA encourages regional cooperation, which enhances national action, and, as a primary objective, the GPA facilitates action by States. It provides recommendations for action at different levels, as well as criteria for their development.

The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) prepared the Preparatory and Fund Raising Phase of the Regional Programme of Action (RPA) for the Protection of the Red Sea and Gulf of Aden Environment from Land Based Activities. It presented two documents: the first described the Road Map (Part I) for the Preparatory and Fund Raising Phase, and the second presented a Portfolio of Project Proposals (Part II). This initiative was carried out in close coordination and with financial support from UNEP/GPA.

The recommendations of the GPA form a basis for action at national (and local) levels. As threats to the coastal and marine environment vary between regions and countries due to a multitude of factors such as their geography, industrial base, and economic development, each country must prepare its own National Programme of Action based on its own unique circumstances. Development of the Egyptian NPA for the Red Sea coast is one of the national plans proposed in the framework of PERSGA's RPA and has been developed in coordination with the Egyptian Environmental Affairs Agency (EEAA).

1.2 NATIONAL PLAN DEVELOPMENT

The waters of the Red Sea are famous for their natural beauty and outstanding biological diversity. The region is rich in marine resources and provides habitats for a significant number of endemic species. Clear waters and coral reefs have been the foundation for a flourishing tourism industry.

However, coastal development activities such as urbanization, industry (including power, desalination plants and refineries), recreation and tourism, wastewater treatment facilities, coastal mining and quarrying activities, oil bunkering and habitat modification have imposed enormous stress on the fragile marine environment. These compound the stresses from marine sources of pollution such as transportation (shipping and ferry services), oil exploration and extraction. Sea level rise as a result of climate change is a future concern for low-lying areas.

1.2.1 METHODOLOGY

While focusing on the key objective, reducing or eliminating land-based sources of pollutants to the marine environment, a key role of the NPA is to mobilize stakeholders and resources, and to ensure that activities fit into existing institutional, policy, societal and budgetary frameworks.

A comprehensive methodology was developed to prepare the National Plan of Action (NPA) within the framework of the Regional (RPA) and Global Programmes of Action (GPA). This methodology consists of six steps (Box 1).

In addition to the six steps in Box 1, the following sustainable development principles are taken into consideration while developing the National Action Plan:

- The economic, environmental, social and cultural values of coastal and marine resources should be identified and the effects of land-based activities on those values determined, as far as possible.

BOX 1

i. **Identification and assessment of problems,** taking into consideration such issues as food security, public and ecosystem health, and economic benefits and uses. A wide range of source categories and areas which may be affected or threatened by environmental degradation are suggested.

ii. The **establishment of priorities** builds upon the previous identification exercise, and outlines considerations that should be taken into account, including relative severity of impacts, ICZM approaches, and linkages to freshwater environments, as well as relevant existing programmes and strategies at the national, regional and global level. The application of the precautionary approach is emphasized.

iii. On the basis of the priorities established, countries **set management objectives for priority problems,** with respect to both source categories and areas affected, that include concrete elements such as specific targets and timetables.

iv. The **identification, evaluation and selection of strategies** to achieve these management objectives should include steps to promote the sustainable use of marine and coastal resources, and to protect or remediate affected areas, and such measures as internalization of environmental costs, technical assistance/co-operation, education and public awareness, identification of data-collection and research needs, identification of institutional arrangements to undertake associated management tasks, and identification of financial sources for carrying out identified strategies and programmes.

v. **Criteria for evaluating the effectiveness of strategies and measures** should include crosscutting elements such as environmental effectiveness, economic costs and benefits, equity, and flexible and effective administrative structures.

vi. **Programme support elements** stress the need to ensure that the necessary administrative and management structures are in place to support the national programme over the long term, including legal and financial mechanisms, contingency plans and public participation measures.

- Assessments of the impact of land-based activities at local, national, regional, and global scales should take into account long-term impacts.
- Cumulative impacts should be taken into account when assessing the impact of land-based activities and determining cooperative action.
- If there is a risk of serious or irreversible damage to coastal or marine environments as a result of land-based activities, those activities should be permitted only if the damage can be adequately mitigated using cost-effective measures, even in the absence of full scientific certainty concerning the possible damage (Precautionary Principle).
- Governments should give due consideration to the positive and negative impacts of domestic legislation and policies, including, amongst others, fiscal measures, such as taxation and subsidies, on land-based activities that contribute to the degradation of coastal and marine environments.
- Effective and high-quality public consultation and participation should be encouraged in both developing and implementing national actions. Indigenous interests in, and knowledge of, the coastal zone should also be recognized and incorporated into management arrangements.
- Local communities should be encouraged to share responsibility for protecting coastal and marine environments from land-based activities.
- The desirability of maintaining natural habitats and sites of ecological, cultural, archaeological, historic and scientific significance should be taken into account.
- Consequences arising from the highly dynamic nature of coastal environments should be recognized. Natural physical and biological processes in the coastal zone should be safeguarded. Developments should be avoided in locations where natural processes may threaten public safety.
- The biological diversity of coastal and marine ecosystems should be maintained for future generations. Where environmental qualities have been degraded, remedial action should be initiated to restore these qualities.

1.2.2 ASSESSMENT OF RISK AND DETERMINATION OF PRIORITIES

Following step 1, the identification of problems and source categories, is an analysis of the risks or threats posed so that priorities can be established within any action plan.

Ecological risk assessment is the process of estimating likelihoods and consequences associated with the effects of human actions or natural events on ecosystems of ecological value (SA/SNZ, 2000)[1], that is, the study of risks to the natural environment (Barnthouse and Suter, 1986)[2]. These risks may be biological (e.g., predation, invasive species), physical (e.g., drought, flood) or chemical (e.g. toxic chemicals). Others may be social, political or economic in origin.

A qualitative approach to risk assessment was used based on the formula of Fournier d'Albe (1979)[3] to identify the level of risk and priorities for action. The formula identifies risk as a function of hazard (probability of an event), vulnerability (communities' ability to prevent or mitigate effects), and preparedness/manageability.

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1 AS/NZS (2000). *Environmental Risk Management: Principles and Practice, Standards Australia & Standards New Zealand, HB203,* Australian Standards International Ltd, Sydney.

2 Barnthouse, L.W. and Suter, G.W. (Eds.) (1986). *User's Manual for Ecological Risk Assessment.* ORNL-6251. Oak Ridge National Laboratory, Oak Ridge, TN.

3 Fournier d'Albe, E.M. (1979). Objectives of volcanic monitoring and prediction. *Journal of the Geological Society of London*, 136, p. 321-6.

Adopting the criteria of 'the higher the risk the higher the priority', risk may be conceptualized as follows:

$$\text{Risk} = \frac{\text{Hazard (H) * Vulnerability (V)}}{\text{Preparedness or Manageability (M)}}$$

Step 1 in the preparation of the National Action Plan involves an identification of the problems and categories of pollutants. In this report, the major sources of land-based pollution are identified geographically by reviewing each of the five governorates with marine borders (Suez Canal, Gulf of Suez, Gulf of Aqaba, Red Sea) from north to south.

Step 2 takes the previous identification exercise into account and, with an understanding of risk and threat, allows for the establishment of priorities.

This is followed by steps 3 and 4, recommended strategies, targets and actions.

1.3 ENVIRONMENTAL CHARACTERISTICS OF THE REGION

An understanding of the climate, the particular oceanographic conditions, the coastal and seabed features, and the biological diversity is important in the assessment of the risk to the marine environment from land-based sources of pollution. This is because factors such as temperature, wind and rainfall patterns can have important consequences with respect to the transport of land-based pollutants to the marine environment, their movement, deposition and eventual degradation. Winds are important as they affect currents that transport pollutants and they can cause rough seas that promote mixing within the water column. Severe rainfall events may cause flash floods that carry debris and pollutants from far inland into the coastal zone and nearshore waters.

Areas rich in biodiversity and with endemic species are potentially more valuable and hence are areas of higher priority when it comes to promoting activities that protect the marine environment from land-based sources of pollution.

The coastal and marine environment of Egypt relevant to the Red Sea coast can be divided into three, more or less, homogeneous water bodies; from north to south:

The Suez Canal and its lakes

The Gulf of Suez; and

The northern Red Sea and Gulf of Aqaba

1.3.1 THE SUEZ CANAL AND ITS LAKES

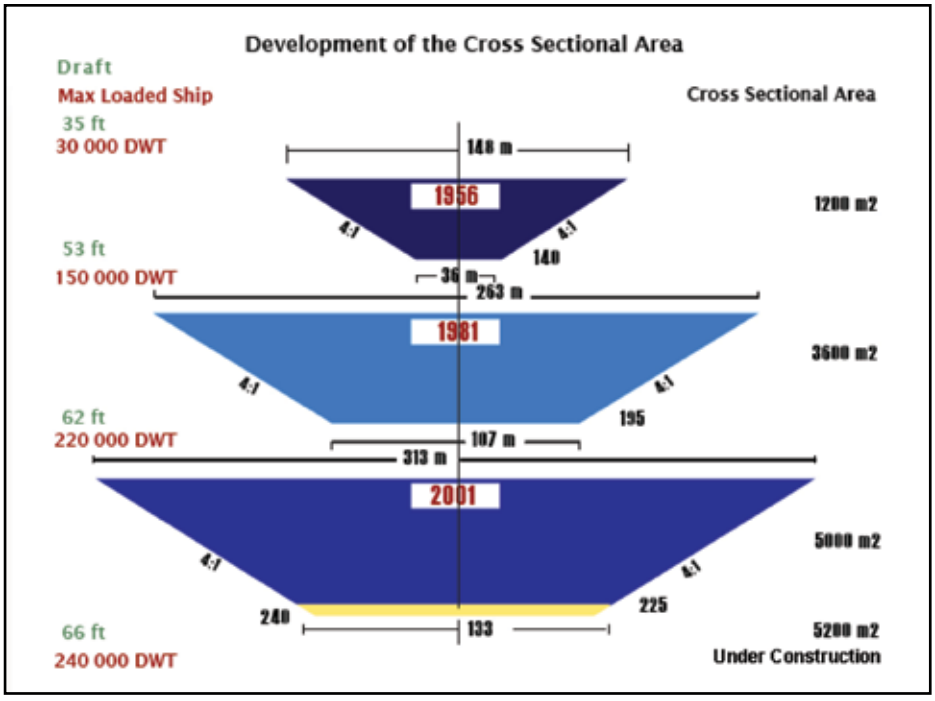
The Suez Canal can be considered as a capillary tube connecting two large basins, the Mediterranean and the Red Sea. It provides the shortest maritime route between Europe and the lands lying around the Indian and western Pacific Ocean. The Canal extends approximately 163 km between Port Said in the north and Suez in the south, with dredged approach channels north of Port Said into the Mediterranean, and south of Suez.

The dry land, which was dug out to form the Canal, comprises approximately 70 km. The rest of the Canal extends through a series of lakes with different ecological conditions, from north to south: Lake Manzala (45 km long), Lake Timsah (4 km long), and the Great and Little Bitter Lakes (37 km long). The net volume of water transported annually to the Mediterranean via the Canal (including any pollutant load it may be carrying) is estimated to be about 4000 x 10^6 m^3 giving an average flow rate of 127 m^3/sec. To the west of the Canal lies the low-lying delta of the Nile; to the east is the Sinai Peninsula.

The Suez Canal, as a vital maritime link connecting the Red Sea and the Mediterranean Sea, is an important economic component to Egypt's GDP.

As an international route, all types of goods and vessels pass through the Suez Canal. Dangerous goods, hazardous and noxious materials are also transported through the Suez Canal, after necessary precautionary actions have been taken.

The Canal depth and width have been enlarged with time (Figure 1). In 1869, the depth of the Canal was 7.8 m and its width was 44–52 m. By the year 1956, it had been artificially widened to 110–160 m and deepened to 12 m. Following its last development in 1985, the Canal now has a width of 250–365 m and 25 m depth. Three parallel shipping lanes of 68 km total length were also added to the Canal at Kabrite, Deversoir and El-Qantara. The Canal continues to be dredged once every three to four years. Currently the Suez Canal has a total length of 190.25 km, its width at 11 m depth is 200–210 m, its water depth is 22.5 m and the maximum draft of ships it can accommodate is 62 feet corresponding to 210 thousand tons dead weight.



Source: Suez Canal Authority official site (http://www.suezcanal.gov.eg/)

Figure 1. Development of cross-sectional area of the Suez Canal.

METEOROLOGICAL AND OCEANOGRAPHIC CONDITIONS

The direction and strength of the wind is a significant factor influencing the current system in the Suez Canal. The winds along the Canal blow almost exclusively from the north-northeast. This contributes to the piling of water in front of Port Said and the creation of southward currents in the Canal. These winds reach their maximum intensity in September. However, in the winter there are some days with southern winds as a result of the distant

influence of the winter monsoon in the Red Sea (Morcos, 1970).

The direction and strength of tides have a further pronounced effect on the currents in the Canal. The southern Canal is characterized by strong tidal currents owing to the high tidal range at Suez (1.5–2.0 m). In contrast, the tidal range at Port Said is relatively small (50 cm); thus the tide plays a smaller role in inducing currents in the northern part of the Canal relative to that in the south (at Suez).

Rainfall in the region is extremely sparse and localized. Heavy showers occur in the Suez Canal region but rarely reach as far south as Suez. Water temperature in the Canal fluctuates seasonally between a maximum of 30 ºC in summer and a minimum of 14 ºC in winter. The Suez Canal is characterized by its exceptionally high salinity and by a large annual salinity range.

The water body of the Suez Canal has been categorized into three regions: the highest salinity region in the Great Bitter Lake where values range from 44 ‰ to 48 ‰, the southern region near Suez Bay with lower salinity between 42 ‰ and 44 ‰, and the northern region, in the vicinity of Port Said, with the lowest salinity of 30-39 ‰ during the late summer and early autumn.

Nutrient salt concentrations show seasonal and regional variations along the Canal. The northern part of the Canal shows the highest concentration of all nutrients for most of the year. Phosphate, ammonia, nitrite and nitrate reach the highest concentrations in spring (i.e., 1.52, 10.2, 0.88 and 3.56 µg/l, respectively), while silicate reaches its highest values during winter (i.e. 10.3 µg/l) particularly in the surface water.

The Suez Canal runs through three governorates, Port Said, Ismailia and Suez.

1.3.2 GULF OF SUEZ

Gulf of Suez is a wide shallow basin with a flat bottom bordered by extensive plains with low relief. It appears to be spreading and exhibits normal faulting. Water depths are mostly less than 50 m, though it reaches 70 m in some places. It has no sill at its connection with the Red Sea.

The coastal zone is characterized by shallow sandy banks and small patch reefs. Soft substrate habitats predominate. Holocene reefs provide most of the foundation for the present reef structures which are of biogenic carbonates. The reefs form barriers to waves and allow for the establishment of soft substrate habitats.

METEOROLOGICAL AND OCEANOGRAPHIC CONDITIONS

In winter, over the Gulf of Suez and the northern part of the Red Sea, the North African anticyclone produces a northerly airflow. As a result the Gulf of Suez experiences predominantly north-west to northerly winds. In summer, the winds over the entire Gulf of Suez come mainly from the north-west and the north. Winds of 4 knots or less occur between

60% and 70% of the time. The mean annual speed in the area is little higher than 10 knots, with September being the windiest month of the year. Occasional gales occur with isolated instances of forces 11-12 recorded.

Rainfall in the Gulf of Suez is about 25 mm/year or less, and is confined to the months between September and April. The rain usually falls as heavy squally showers, sometimes accompanied by thunderstorms, but longer periods of light rain are not uncommon. Across the Sinai Peninsula rainfall generally declines from the north to the south.

The tidal range decreases from the entrance of the Gulf towards El-Tur (>1 m) and then increases again to about 1.5 m in the area of Suez. The time difference between two high waters at the southern and northern ends is about 6 hours. Therefore the tide has the shape of standing wave with high water in the north when it is low water in the south and vice versa. Furthermore, the semidiurnal cycles are not generally identical. Associated with changes in tidal levels there are horizontal movements of water referred to as tidal streams. These do not impose any periodic variation on the layered system of the inflow or outflow currents.

The vertical distribution of temperature in the central section of the Gulf shows distinct differences to other regions. The isotherms in the northern part show a decrease from the surface to the bottom. At the middle part of the Gulf, the isotherms show vertical uniformity from the surface almost to the bottom. Records indicate that isotherms near the southern entrance of the Gulf can change rapidly from high temperatures (around 28 ºC) at the surface to lower values (around 22 ºC) at 500 m depths near the offshore waters of Ras Mohamed.

In the shallow Gulf of Suez, November values for the surface salinity have been shown to vary from a maximum of 42.8 ‰ in Suez Bay in the north, to a minimum of 40.1 ‰ at the southern end of the Gulf. A high rate of evaporation along the western coast, due to local winds, produces a salinity gradient. Salinity decreases from west to east and, in general, from north to south.

The distributions of salinity and temperature along the Gulf of Suez indicate an inflow of low salinity warm surface water from the Red Sea into the Gulf and the outflow of more saline colder bottom water in the opposite direction.

Currents in the Gulf of Suez result from the sum of tidal and non-tidal currents and are directed parallel to the axis of the Gulf. In the upper layer, the non-tidal currents are very sensitive to the effect of local winds and decrease with depth. The tidal current flows northwards while the tide is rising at Suez and southward when it is falling. In the middle, current velocity may vary between 25 cm/sec (i.e. at neap tide) to 75 cm/sec (at spring tide).

In the Gulf of Suez, the oxygen content of water is high throughout the water column and shows only slight variation with depth. Dissolved oxygen content of the Gulf water is generally lower than in the Red Sea where dissolved oxygen concentration in surface waters can reach near saturation values. An oxygen concentration of 4.28 ml/l was recorded at 20 m depth at El-Sokhna\Ras Sudr during the autumn, while a minimum concentration of 2.91 ml/l was recorded at 50 m depth in the same area.

Reactive phosphate concentrations in the Gulf have been shown to vary between a maximum of 3.5 μg/l (recorded in Ras Gharib at 20 m) and a minimum of 'undetectable' in the northern part of the Gulf, throughout the whole water column. The horizontal distribution of phosphate at different depths did not show any particular trend in the Gulf. However, alternate strips of high and low phosphate concentration occur in the northern and central sections of the Gulf, while variation with depth in any particular site within the Gulf was rare.

COASTAL FEATURES AND BIODIVERSITY

Most of the intertidal and shallow coastal waters of the area comprise extensive sand and mud areas. Besides rocky and stony outcrops, shallow coastal lagoons with seagrass beds occur. There are poorly developed fringing reefs and offshore reef patches resting on calcareous sandy substrates, with some more developed reef systems that include coral knolls and seagrass beds. Some sandy bottom shores gradually slope into extensive areas of offshore reefs comprising coral rubble and coral knolls.

There are more extensive reefs in the southern Gulf of Suez, just north of Ras Mohamed, though distribution and development is limited by several factors including temperature, sediment load, salinity and light penetration.

The shallow lagoons are characterized by extensive patches of the seagrasses *Halophila stipulacea*, *H. ovalis* and *Halodule uninervis* with mollusc and polychaete communities. Although the majority of seagrasses occur in depths of less than 10 m, communities in the Suez Gulf are found as deep as 30 m. Also, there are areas covered with algae (e.g., *Padina*, *Caulerpa,* and *Sargassum*) with some scattered coral patches.

Offshore bottom sediments are usually inhabited by a wide variety of organisms such as crustaceans, echinoderms, polychaetes and molluscs.

1.3.3 THE RED SEA AND THE GULF OF AQABA

The land adjacent to the Red Sea is bounded on the western side by a range of coastal mountains. A gently sloping plain of variable width (8 to 35 km) lies between the shoreline and the highlands. A drainage system of shallow wadis meanders over this sand and rock covered plain. The coastal zone is characterized by shallow banks and reefs, but depths of 100 m are reached within a few kilometers offshore, with commonly no effective continental shelf.

The Egyptian coast of the Gulf of Aqaba is the east coast of the Sinai Peninsula. The Gulf of Aqaba is characterized by steep cliffs with narrow fringing reefs. At the entrance to river valleys the fringing reefs may extend outward up to a kilometer from the shore.

METEOROLOGICAL AND OCEANOGRAPHIC CONDITIONS

The Egyptian Red Sea and the Gulf of Aqaba are similar in terms of their oceanographic and climatic characteristics, the types of economic activities practiced in the governorates bordering them, and in their environmental resources.

The local climate is largely controlled by the distribution of winds and changes in atmospheric pressure over a much wider area. During winter, the northern Red Sea is subjected to variability in weather conditions due to the influence of the Mediterranean. Low-pressure troughs moving in from the north accompanied by changes in wind, temperature, humidity and cloud cover, may cause a little rainfall in the southern area.

The region is hot and dry in summer but in winter the weather tends to be warm. The temperature ranges between 23.1 ºC – 37.7 ºC in summer and 6.9 ºC – 29.3 ºC in winter.

The relative humidity is dependent on the wind. In summer the humidity ranges from around 86% down to 13% (average of 54%), and in winter it ranges from 96% down to just below 1% (average of 55%).

The high evaporation rate is the primary factor causing the high salinity level. More water is lost from the Red Sea through evaporation than is gained by precipitation and run off due to its position in an arid zone between two great deserts. Most estimates of the evaporation rate lie between 183 cm/yr and 250 cm/yr.

The predominant wind direction over the Red Sea coast of Egypt is from north-north-west with a speed of 4 knots. Winds from this direction are slightly more frequent in summer than in winter. Southerly winds occasionally blow during winter months at 11 to 12 knots during storm events that do not follow any general trend. However, near the coast, the winds alternate daily between a nocturnal land breeze (offshore) and a daytime sea breeze (onshore). The prevailing wind direction creates a mainly NE-SW oriented wave motion, leading to distinctly higher waves in exposed areas than in protected areas. Dust storms are common events in the Red Sea.

Table 1 presents some water quality indices for the Red Sea. It is apparent that the average surface water temperature lies between 27 °C and 30.3 °C. Surface water salinity is higher in the north than in the south.

Table 1. Some indices of water quality for the Egyptian Red Sea.

Station (North–South)	DO (mg/l)	Sal. ‰	pH	Surface Temp ◦C	TDS (g/l)
El-Hamara	5.35	40.45	8.66	28.30	38.35
El-Ash	5.25	40.06	8.63	29.30	37.78
Wadi-Pali	5.55	40.47	8.61	27.50	38.32
Abu-Shaar	5.31	40.52	8.61	30.30	38.30
Hurghada	5.44	40.30	8.65	27.80	38.10
Safaga	4.30	39.79	8.55	27.00	36.45
El-Quseir (Al Qusayr)	4.40	40.40	8.50	28.30	38.20
Marsa Alam	4.22	39.91	8.71	27.35	37.91

The sea surface temperature range within the Gulf of Aqaba falls between 26.7 ºC (July) and 20.8 ºC (March). During the summer season, an upper, temperature-stratified water mass can be distinguished from a more homogeneous deep water mass. The temperature difference is about 6 °C and the base of the thermocline is at about 200 m. A weak halocline is developed in the northern sector at a depth between 300 and 600 m, with a core of slightly lower salinity being present between 50 and 150 m. The isohalines ascend toward the head of the Gulf and toward the southern sector leading to lateral salinity gradients in the southern sector. High salinity water mass is present at sill depth and can be traced into the Red Sea.

Under the arid and hot climatic conditions of the area, evaporation is extremely high and greatly exceeds precipitation and runoff. The evaporative loss is compensated by inflow of water from the Red Sea through the Straits of Tiran. The main circulation pattern in the Gulf of Aqaba is therefore thermohaline (inverse estuarine), see Figure 2.

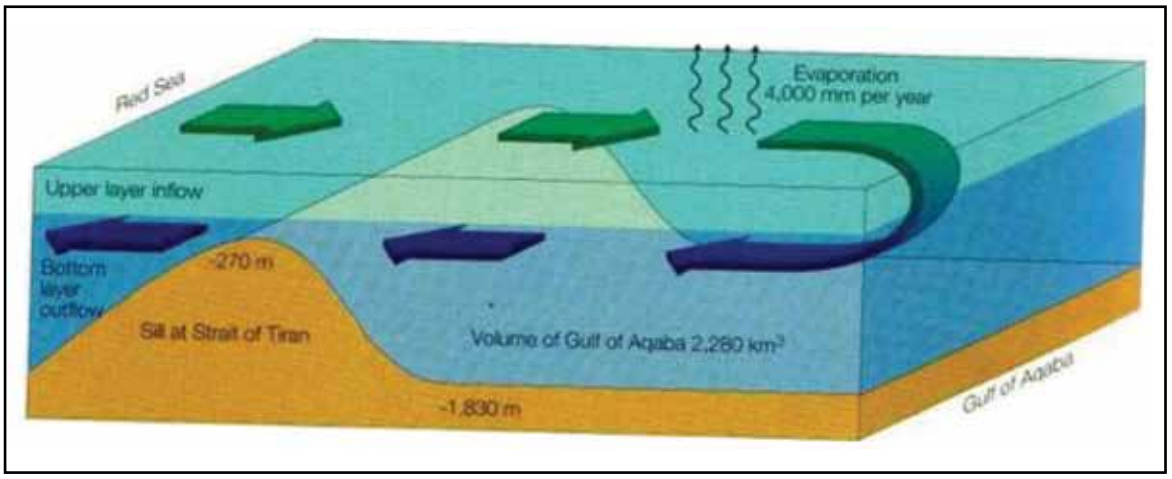


Figure 2. Most probable pattern of circulation in the Gulf of Aqaba.

Tides in the Red Sea overall are essentially oscillatory, of semidiurnal type and the tidal range decreases from north and south ends to the central part of the Red Sea. The spring tide range is about 0.8 m near Hurghada and 0.7 m at Quseir. The velocity of the tidal currents, of the mean lunar semidiurnal wave, is estimated as 2 cm/sec in the northern part of the Red Sea.

The tides in the Gulf of Aqaba are due to those in the Red Sea, the direct effect of moon and sun being relatively small. High water is nearly simultaneous over the whole Gulf, but 1 hour later at the northern end of the Gulf than in the northern Red Sea. Spring tide range increases from 0.5 m at the entrance of the Gulf to a maximum of about 1.5 m at its head. The average tidal range is less than 1 m.

COASTAL FEATURES AND BIODIVERSITY

Coral reefs are among the most beautiful ecosystems on the earth. Reefs are widespread and well developed in the northern Red Sea and Gulf of Aqaba because the surrounding land is arid, contributing little freshwater and sediment input from terrestrial runoff. Further, there is a range of submarine morphology and reef types due to the varied geological history of the area.

Only small areas along the Red Sea coastline are suitable for mangrove development. The raised Quaternary coral reefs are cut by a series of partly sheltered small bays. A supply of fine sand or mud provides these bays and lagoons with habitats favorable for the growth of mangroves. These distinctive habitats are restricted to relatively narrow fringes around the few small protected bays (Sharm El-Bahari and Sharm El-Qibli), barrier islands (Safaga and Abu Minqar Islands), "zero-energy" coastlines (Myos Bay and El-Quaih), and widely scattered lagoons (south of Safaga).

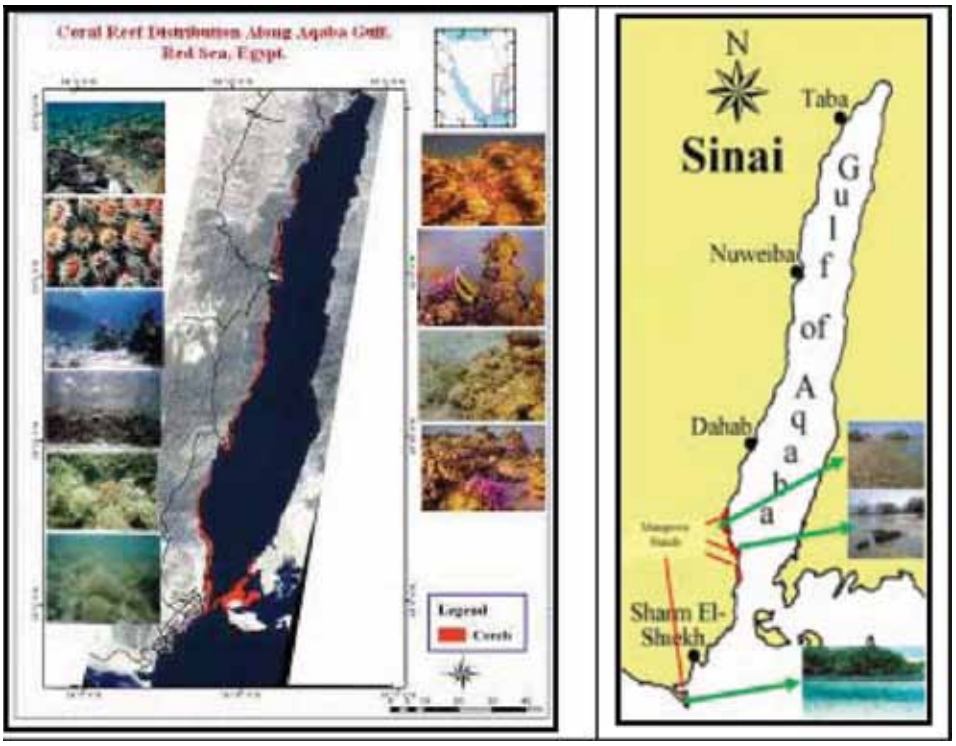
The northern limit to mangrove distribution is determined largely by extremes in air temperatures, the arid nature of the region and the influence of local physical factors such as tidal amplitude, wave exposure, topography (affecting

sediment retention) and sediment supply. Four species of mangrove have been recorded from the Red Sea: *Avicennia marina, Rhizophora mucronata, Bruguiera gymnorhiza,* and *Ceriops tagal*, but only *Avicennia marina*, (and to a lesser extent *Rhizophora mucronata*) grow in this region. The mono-specific stand of *Avicennia marina* at Nabq, Gulf of Aqaba, is the most northern limit for mangroves in the Red Sea. Mangroves provide nurseries for fisheries, erosion control and shoreline stabilization, habitat and food resources for many bird species.

Seagrass communities occur throughout the Red Sea. They are most common in shallow water and soft-bottom habitats on a wide range of substrates, from mud to coarse sand. Seagrass beds occur from the mid-intertidal to a depth of about 50 m. Seagrasses are rooted plants which require soft sediments for colonization. All of the seven Indo-pacific genera occur in the Red Sea from which 11 species have been recognized. There is a wide diversity of species associated with the seagrass beds, though diversity in the intertidal may be limited by physical stress. Dugong (*Dugong dugon*) is known from seagrass areas in both the Gulf of Suez and the Tiran reefs, and there were historical sightings at the Nabq mangroves.

Map 1 shows the distribution of coral and mangrove stands in the Gulf of Aqaba. Within the Egyptian Red Sea, distribution is more extensive as the environmental conditions for coral and mangrove growth are met more frequently towards the south.

The green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles are common in South Sinai. Nesting sites exist at Tiran and Sanafir islands, and Ras Mohamed. These areas are contained within protectorates, and the populations are not thought to be threatened by human activities either by disturbance to nests, collection of eggs, curio collection for their shells or intentional fishing for their meat in the area. The loggerhead turtle has also been observed in the Gulf of Aqaba.



Map 1. Distribution of corals and mangrove stands along the Gulf of Aqaba.

There is a lack of specific data on shark populations in local waters, but fourteen species of shark (grey reef, white tip reef, black tip reef, silver tip, oceanic white tip, oceanic black tip, sandbar, tiger, thresher, scalloped and great hammerheads, leopard, whale, and silky sharks) are known from the Gulf of Aqaba and waters around Ras Mohamed.

The bottlenose dolphin (*Tursiops truncates*) and spinner dolphin (*Stenella longirostris*) are both well known in the Gulf of Aqaba and areas around Ras Mohamed and Sharm el Sheikh. They are occasionally encountered close to shore, with the most common sightings near reefs in the Dahab area. Otherwise, they are found in areas of strong current such as Tiran and the current line between Ras Mohamed and Ras Om el Sid. Population numbers are unknown.

2. LAND-BASED SOURCES OF POLLUTION

The Egyptian Red Sea is bordered by five governorates, namely: Port Said, Ismailia, Suez, South Sinai and the Red Sea Governorate (Map 2). Economic activities take place in each of the five governorates that may cause reduction in the quality of Red Sea waters.

Map 2. Governorates bordering the Egyptian Red Sea.

The Suez Canal runs between Port Said harbour south to the Gulf of Suez, through soils which vary according to the region. The banks of the Canal are protected against the wash and waves generated by the transit of ships by revetments of hard stone and steel piles corresponding to the nature of the soil in each area. The Canal is maintained with constant dredging operations and the Suez Canal Authority (SCA) is forever planning larger channels as ships around the world increase in size.

THE SUEZ CANAL AS A SOURCE OF DEGRADATION OF THE MEDITERRANEAN SEA

In the 19th century, shipping changed. Steel hulled ships replaced wooden hulls and engines replaced sails. One of the biggest and most important changes was the shift from solid ballast to using water. Conditions inside ballast tanks are not ideal for many species but enough are able to survive to cause a problem. Nowadays, samples of ballast water contain an amazing variety of life, from cholera and botulism bacteria to plankton, invertebrates and fish. Ballast water transfer is now considered the primary cause of alien species introductions.

The opening of the Suez Canal in 1869 created the first salt water passage between the Mediterranean and the Red Sea. The water level in the Red Sea is about 1.2 m higher than in the eastern Mediterranean, so the canal serves as a tidal strait that pours Red Sea water into the Mediterranean. The Bitter Lakes, which are hypersaline natural lakes that form part of the canal, effectively blocked the migration of Red Sea species into the Mediterranean for many decades, but as the salinity of the lakes gradually equalized with that of the Red Sea, the barrier to migration was removed, and plants and animals from the Red Sea have begun to colonize the eastern Mediterranean. The ongoing migration of marine species through the Suez Canal, usually from the Red Sea to the Mediterranean Sea, more rarely in the opposite direction, is called the Lessepsian migration.

The Red Sea is generally saltier and more nutrient-poor than the Atlantic, so the Red Sea species have advantages over Atlantic species in the less salty and nutrient-rich eastern Mediterranean. Accordingly, most invasions are of Red Sea species into the Mediterranean, and only few in the opposite direction. Nearly 300 species of Red Sea and Indo Pacific origin have invaded and become established in the Mediterranean and these species have had a large impact on the local marine life.

2.1 THE GOVERNORATE OF PORT SAID

The Governorate of Port Said is located in the north-east of Egypt. The governorate is bordered by Lake Manzala and two marine environments, to the north by the Mediterranean Sea and to the east by the Suez Canal. It is divided into five administrative districts namely: Port Fouad District, East District (of Port Said), Al-Arab District, Al-Manakh District, and Al-Dawahy District.

The estimated population in 2005 was close to 546,000. There are approximately 26,700 feddans (1 feddan is 1.04 acres) of cultivated agricultural land and the main crops grown are wheat, rice and cotton. The largest industrial activity in 2003 was food and beverage production, followed by the production of mineral products and machinery or equipment. Together with the free zone areas, ports represent the primary source of income to the people and the governorate.

2.1.1 LAND-BASED SOURCES OF POLLUTION IN PORT SAID

Direct discharge of liquid effluent, domestic, agricultural or industrial to the Suez Canal is not generally practiced. Only Port Fouad District temporarily discharges partly treated sewage into Canal waters. All other sources discharge to Lake Manzala. However, the Junction Canal that links Lake Manzala with the Suez Canal (Map 3) must be considered as a potential route for a wide variety of pollutants to enter the Suez Canal marine environment. Unfortunately, quantities have not been determined.

DOMESTIC WASTEWATER

The quantity of sewage produced by the Governorate of Port Said is almost 185,250 m^3/day and growing. The majority of the housing complexes within Port Said city are connected via a sewerage system to a secondary biological unit designed to treat 190,000 m^3/day. However, the actual capacity is reported as 120,000 m^3/day; the treated effluent is then discharged to Lake Manzala. Knowing that the total sewage collected by the present city sewerage system is 159,750 m^3/day, this implies that at least 39,750 m^3/day is discharged as raw sewage into the Junction Canal that links Lake Manzala with the Suez Canal through the pumping station known as PS10.

Port Fouad District possesses a sewerage system with holding tanks, but it discharges its effluent, untreated, to the Suez Canal as its sewage treatment plant is not yet operational. Other districts depend on holding tanks from which the effluent is transported via trucks to the main sewage treatment plant at Port Said city (Table 2).

Table 2. Major discharges of contaminated effluents at Port Said.

#	Pump Station	Quantity Discharged m^3/day	Type of Discharge	Compliance Status with Law 48/82
1	Port Said sewage treatment plants (MK)	160,000	Treated sewage	Not compliant
2	Kabouty Junction Pump Station (PS10)	39,500	Mixture, raw domestic and industrial effluent	Not compliant
3	Southern Pump Station	3,500	Mixture, raw domestic and industrial effluent	Not compliant

Source: EEAA

Map 3. Point sources of pollution in Port Said Governorate.

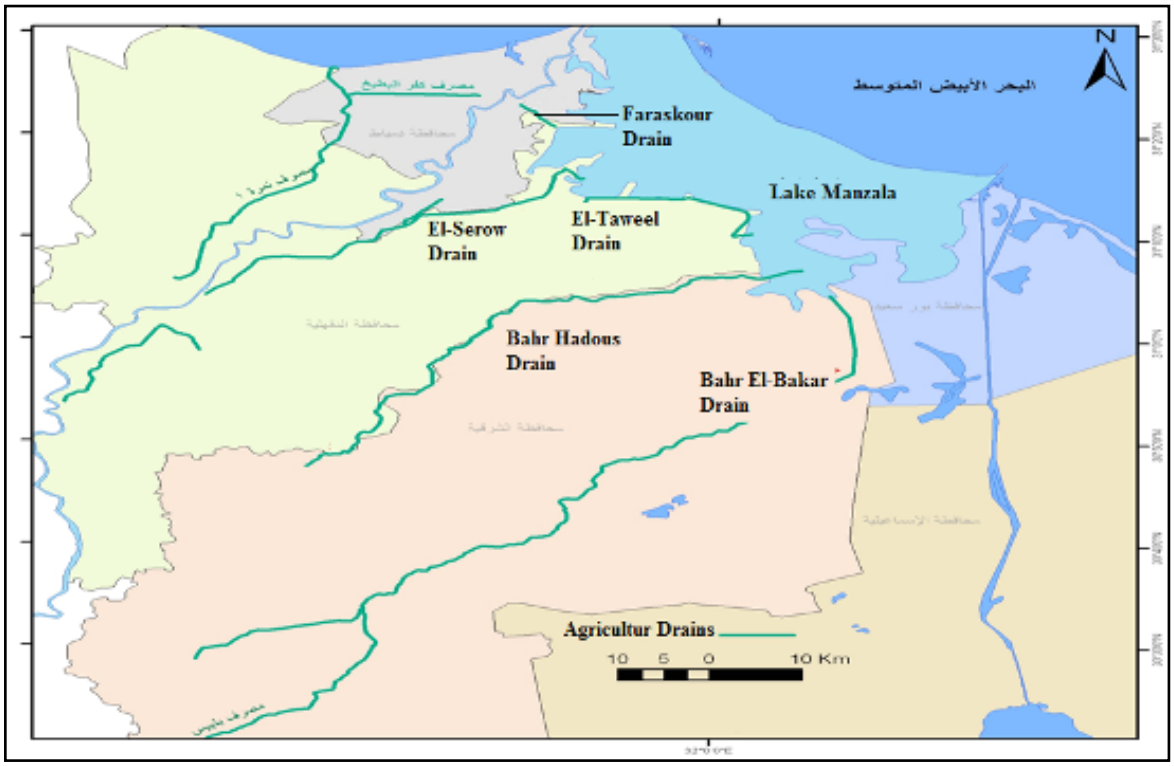
AGRICULTURAL WASTE

Lake Manzala also receives waste from agricultural practices as it is the final discharge point for three major agriculture drains, Bahr El-Bakar, Bahr Hadous and El-Taweel Drains and several minor drains (Map 4). The Bahr El-Bakar drain may be the most contaminated. It runs from outside the Cairo area collecting along its route domestic (treated and untreated), agricultural and industrial liquid wastes. It discharges the mixture near to Port Said (Table 3).

Table 3. Quantity of effluents discharged to Lake Manzala.

Type	Quantity m^3/year	Percentage
Agricultural	6.6×10^9	96.6
Domestic	226×10^6	3.3
Industrial	4.3×10^6	0.1

Aquaculture is also practiced in Port Said Governorate; fish farms are located around Manzala Lake and the stretch bordering the Suez Canal. The majority of these farms take their water from fresh or brackish water sources.



Map 4. Location of major agricultural/industrial drains discharging into Lake Manzala. Source: EEAA

INDUSTRY AND PORTS

The quantity of industrial effluent being produced has not yet been fully assessed. The Investor's area generates 7,110 m^3/day that is then mixed with untreated sewage and discharged through pumping station PS10. A new industrial wastewater treatment plant has been designed to treat the industrial effluent of the industrial zone located south of Port Said. It has a nominal capacity of 4,000 m^3/day and is in the final stages of development. Some power plants also discharge their cooling water into Lake Manzala.

The Governorate of Port Said received more than 6,500 vessels in 2008. Pollution due to accidents within ports is quite rare. A number of oil related activities, which are regarded as potential land-based sources of oil pollution, have been identified by the Environmental Management Unit of the Governorate of Port Said, as shown in Table 4.

Table 4. Oil related facilities in the Governorate of Port Said.

Name of Industries	Activities	Locations
MISR Petroleum	Storage facility for petroleum products for servicing vessels	Customs Area (Suez Canal Port), Port Said (West Bank)
Port Said Company (for container handling)	Loading, unloading and storage of containers	Customs Area (Suez Canal Port), Port Said (West Bank)
Suez Canal Company (for ship building)	Building and maintenance/repair of vessels	Customs Area (Suez Canal Port), Port Said
Suez Canal Repair and Maintenance Workshop	Repair and maintenance for the Suez Canal Authority	Customs Area (Suez Canal Port), Port Fouad
Suez Canal Authority fueling depot	Fueling of Suez Canal Authority machinery and its periodic maintenance	Customs Area (Suez Canal Port), Port Said
Zaki and Ramal for marine works	Building, repair and maintenance of vessels (ships and boats)	Customs Area (Suez Canal Port), Port Fouad
Fueling station for fishing boats	Fueling of fishing boats	Customs Area (Suez Canal Port), Port Said (West Bank)
Port Said Works Company	Ship repair	Customs Area (Suez Canal Port), Port Fouad
Marine Construction Company	Ship repair	Customs Area (Suez Canal Port), Port Fouad (East Bank)
Exxon Mobil for fueling vessels	Fueling vessels	Customs Area (Suez Canal Port), Port Said (West Bank)
Main maintenance and repair	Workshop for maintenance and repair of all Suez Canal Authority machinery	Customs Area (Suez Canal Port), Port Fouad (East Bank)
Suez Canal Authority Power Station	Power generation for the Suez Canal Authority	Customs Area (Suez Canal Port), Port Fouad

Source: Baseline Survey Report On Oil Pollution, Regional Environmental Management Improvement Project, Japan International Cooperation Agency (JICA), March 2006.

Port Said Port Authority controls three ports: Port Said, East Port Said and Arish ports. Egypt is a signatory member state to several International Maritime Organization (IMO) conventions that are applicable to ships and tankers calling at its ports. Port Said Ports Authority abides by these conventions and seeks to enforce the rules and regulations related to marine environmental protection from oil pollution and other incidents, such as:

- International convention for prevention of marine pollution from ships and modifying protocols
- International convention for preparedness, prevention and cooperation to prevent oil pollution
- International convention for prevention of marine pollution from dumping wastes and other substances

The Port Said Port Authority ports are equipped with radioactivity detection devices to inspect containers during trans-shipment of goods. The ports have acceptable procedures pertinent to handling and security of dangerous goods.

The port is equipped with reception facilities and equipment to receive solid waste and used fuel/oil waste from ships. The port has adopted mechanisms to control damage to goods inside the port.

Currently, major works are taking place at the East Port Said port. The construction of another 1,200 m length berth is planned. The overall length of the container terminal will be 2,400 m. This will necessitate, in the near future, completing dredging works and the extension of the inner channel by 5 kilometers south of the current maneuvering circle. Construction in the southern basin may be required for handling different types of goods. A new bunkering terminal will be constructed near to the current container terminal.

DIFFUSE (NON-POINT) SOURCES OF POLLUTION

RUN-OFF

Annual rainfall over Port Said is significant, so urban and agricultural run-off might play an important role in contamination of the Suez Canal. It has not been assessed, but taking into consideration the existing ports, industrial areas and traffic, it is expected that run-off will play an important role in transport of contaminants from land to sea. This also applies to atmospheric deposition which has not yet been assessed.

MARINE LITTER

As an international transport route it was expected that marine litter would represent a major problem in the Port Said Governorate. However, because the Suez Canal Authority is managing the water area of the Canal and its banks, and due to the elevated penalties imposed over violators, marine litter does not appear to pose a major problem at this time.

Recreational and tourism activities are well controlled on the Suez Canal. The threats that may arise from these activities are negligible and need no further discussion.

2.1.2 AREAS MOST AFFECTED OR VULNERABLE

The most vulnerable ecosystem that still remains and has not deteriorated as a consequence of economic activities and urban expansion, is the fish production ecosystem with its three major components, spawning areas, nursery and feeding grounds.

2.2 THE GOVERNORATE OF ISMAILIA

The Governorate of Ismailia is located on both banks of the Suez Canal, surrounded to the north by the Governorate of Port Said, and to the south by the Governorate of Suez. The total area of the governorate is approximately 5,070 km^2, divided into five administrative districts.

The estimated population in 2004 was 844,000. There are approximately 209,400 feddans of cultivated agricultural land and the main agricultural crops grown are peanuts, wheat, and corn. The largest industrial activity in the governorate in 2003 was food and beverage production, followed by chemical industries. The service sector is the most important sector to the economy.

Three lakes are connected directly to the Canal and form an integral part of the Suez Canal Marine Environment (Map 5). They are Lake Temsah and the Great Bitter Lakes (Great Bitter Lake and Small Bitter Lake). The lakes act as a transport route for contaminants from land-based activities to the marine environment of the Suez Canal. Both lakes receive a considerable amount of agricultural drainage water, usually mixed with sewage and industrial effluent.

Map 5. Lakes associated with the Suez Canal.

Lake Temsah is a naturally occurring depression that forms a shallow brackish water lake. It has a surface area of 14 km^2 and an average depth of just 10 m, though much is marshy and less than 1 m. It is composed of two parts, Fishermen Pond and Lake Temsah itself (Map 6).

The shores of the Bitter Lakes extend for almost 50 km from Defreswar north of Ismailia to Kabreet in the south. The Bitter Lakes have a surface area of about 250 km^2. The Bitter Lakes and Temsah Lake are considered important locations for tourism development in Ismailia. Fish farming is also considered one of the economic pillars of the area.

Map 6. Drains to Fishermen Pond attached to Lake Temsah.

The sources of contamination of the Suez Canal, Lake Temsah and the Bitter Lakes are numerous. They originate from both point source and non-point source locations in the Governorate of Ismailia. The various types of contaminant include sewage wastewater, agricultural wastewater, waste from industrial zones, floating docks and shipyards, power stations, incinerators, hazardous waste dumps, and development for commerce, industry and tourism (Map 7).

Map 7. Schematic presentation of point sources of discharge to Lake Temsah.

2.2.1 LAND-BASED SOURCES OF POLLUTION IN ISMAILIA

DOMESTIC WASTEWATER

The wastewater treatment for the entire governorate runs at 109,750 m³ per day (Table 5). There are secondary wastewater treatment plants in Ismailia city, Tal El-Kebeer and Qantra West. There is no central wastewater treatment service for the other towns and areas where wastewater is held in tanks and collected by trucks. Treated wastewater is generally disposed of into drains that flow to the lakes.

The raw sewage from Ismailia City is treated at the Serapium treatment plant. The wastewater is passed through mechanical filters to remove sludge, settlement ponds (sand sinks) and then aerated in two sinks with 20 blowers. The final quality of the water is suitable for irrigation of a wood forest run by the Ministry of Agriculture, and to provide water needed for the silk worm project of the Suez Canal Authority. Moreover, some of the treated water is used to clean the plant equipment. Finally however, water is discharged into the Mahsama drain and from there runs to Lake Temsah (Map 6).

Table 5. The quantity of wastewater discharged daily.

Name of Markaz or Town	Volume of daily wastewater	Treatment unit
City and Markaz of Ismailia	90,000 m³ per day	Serapuim plant; Secondary and biological
City and Markaz of Tal Kebeer	9,750 m³ per day	Tal Kebeer plant; Secondary and biological
City and Markaz Kantara West	10,000 m³ per day	Kantara West and Abu Khalifa village; Secondary and biological
City and Markaz Kantara East	No wastewater plant	
City and Markaz Kantara Fayed	No wastewater plant	
Kasasseen Town	No wastewater plant	
Abu Souier Town	No wastewater plant	

AGRICULTURAL WASTE

Lake Temsah receives a large amount of agricultural, industrial and domestic effluent through Mahsama, Abou-Gamous and Bahtimy Drains (Map 6). The three drains discharge their liquid effluent (665.5 million m^3/y) into Fishermen Pond that is directly connected to the Lake.

The flow between the Fishermen Pond and Lake Temsah, and vice versa, depends on the amount of water discharged through the agricultural drains and the tidal cycle within the Suez Canal. Observations, and the spread of water hyacinth, suggest that the predominant flow is from the Fishermen Pond into Lake Temsah.

The quantity of liquid reported discharged to the Bitter Lakes (Table 6) is 175.2 million m^3 and it is composed of agricultural, industrial and domestic wastewater.

Map 8. Point sources of pollution discharging to the Bitter Lakes.

The main point sources of pollution discharging to the Bitter Lakes (Map 8) are:

- **El-Manaif Drain**: This drain runs parallel to El-Mahsama Drain and contains sewage and irrigation effluent from the Ismailia area. It drains into the Great Bitter Lake.
- **Geneifa Drain**: This drain runs parallel to the Great Bitter Lake. It contains sewage and irrigation effluent from the Suez area and drains into the Great Bitter Lake.
- **El-Siel Drain**: This drain also contains sewage and irrigation effluent from the Suez area and drains into the Great Bitter Lake.
- **Shandora Drain**: This drain runs parallel to the Little Bitter Lake. It contains sewage and irrigation effluent from the Suez area and drains into the Little Bitter Lake.
- **Small drains**: There are some other small drains that discharge excess irrigation water directly into the Bitter Lakes.

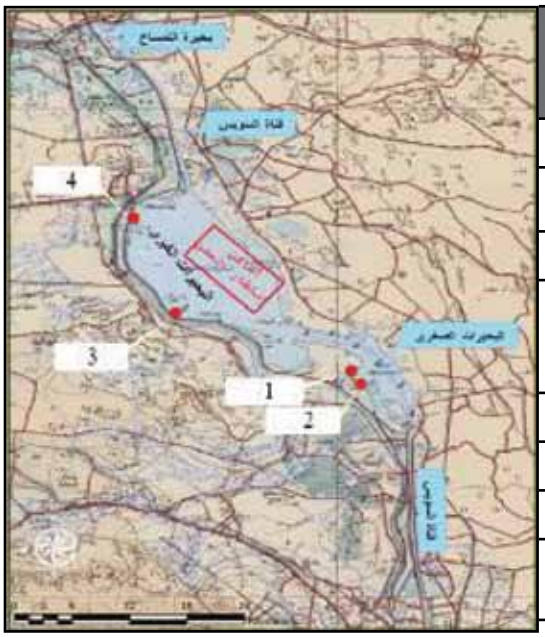
Aquaculture is a widespread activity in the Ismailia Governorate. Official figures list almost 12,000 acres of fish farms, but these do not include the many enclosures in shallow areas. Most farms are fed with brackish or fresh water and discharge their liquid effluent into one of the nearby drains.

Table 6. Liquid waste discharged to the Bitter Lakes.

Source	Great Bitter Lake	Small Bitter Lake	Total	Remarks
	million m^3/y			
Agriculture	81.4	83.3	164.7	Malaria, Kabrit and El-Sail Drains
Domestic	7.5	0.0	7.5	Assumed from collective sources
Industrial	3.0	0.0	3.0	Abou Sultan Power Plant
Total	91.9	83.3	175.2	

A snapshot of the water quality of the Bitter Lakes taken in April 2009 (Table 7) revealed acceptable standards with respect to the items analyzed.

Table 7. Results of water quality analysis in Bitter Lakes, 2009.



Sampling sites

Sample No.	Results			
Items	1	2	3	4
pH	7.90	7.90	8.20	7.80
Water Temp. °C	21.80	21.80	21.20	22.90
Turbidity NTU	12.00	12.00	8.00	11.00
Total Suspended Solids mg/l	25.70	25.70	15.40	35.70
TDS mg/l	40,297	40,297	31,725	43,223
Phenols mg/l	0.08	0.17	0.17	ND
COD mg/l	102.00	29.00	88.00	190.00
Oil and grease mg/l	ND	ND	ND	ND

NTU = nephelometric turbidity units; TDS = total dissolved solids; COD = chemical oxygen demand; ND= not detected;

INDUSTRIAL SOURCES AND POWER

There are a number of industrial areas already established in Ismailia and new industrial areas are planned (Map 9). There is the First Industrial Area (365 acres), the Second Industrial Area (170 acres), the Valley of Technology (16,500 acres), the Free Zone (775 acres), the East (910 acres) and West Kantara (22 acres) industrial areas with the latter currently under construction. Table 8 shows the main industries in the industrial zones of Ismailia Governorate.

Map 9. Location of industrial zones in the Ismailia Governorate.
Source: EEAA, East Delta Regional Branch

The average industrial wastewater flow in the industrial area of Ismailia is 104 m³ per hour. The average industrial wastewater flow in the industrial area in Kantara East is 25 m³ per hour. There is no industrial wastewater plant for the whole of the Industrial Area but there are six industrial wastewater treatment units in some individual factories. These are the industrial wastewater treatment unit of the Arab Albumin Company, the Mohanedes Company, Juton Company for paints, Vertical Jeans, Watany marble and Aman Company for dyeing.

Table 8. Major activities in the industrial zones.

Activity	Number of Factories
Food	38
Garment manufacture	6
Chemical	14
Leather	6
Plastic	14
Electronics	9
Cement and marble	18
Wood and furniture	6
Metal	18

The Abou Sultan electric generating station is located near Abou Sultan village 28 km south of Ismailia city on the shore of the Great Bitter Lake. It produces 600 mega watts (MW) of electricity through four units of 150 MW each and discharges 2.4 million m^3/y of cooling water and 0.65 million m^3/y of industrial liquid waste into the Lake.

DOCKS AND SHIPYARDS

With respect to oil pollution from land-based sources in the Governorate of Ismailia, three important industries located in the vicinity of Temsah Lake and Fishermen Pond are noteworthy.

The floating dock for the repair or building of vessels by the Temsah Shipyard Company is a major source of pollution. When vessels to be repaired are drawn into the floating dock, oil is unloaded and stored in temporary storage tanks. Upon completion of the repair work the oil is reloaded to the vessels. Similar pollution sources are generated by the Arab Contractors Company Shipyard due to activities taking place in the floating dock of their shipyard. These oil transfers are potential sources of spills.

The Hassanein Badran Company is involved with dismantling scrap vessels. In the process of dismantling there is a high probability that the remaining oil in the vessel may be discharged or leak out.

INCINERATORS

The Ismailia Governorate possesses six medical incinerators with capacities ranging between 50 and 100 kg/hour. All of them are in a good working condition and complying with the law. None of them can be considered hazardous waste incinerators. The incinerators are located at the following hospitals: Kantara East, Kantara West, Tal Kebeer, Fevers Ismailai, Suez Canal Authority and Suez Canal University.

DIFFUSE (NON-POINT) SOURCES OF POLLUTION

COASTAL DEVELOPMENT

The Ismailia Governorate provides perfect locations for tourism on both shores of the Suez Canal, on Lake Temsah and the Bitter Lakes. Due to its year round moderate climate, Ismailia is a place for both summer and winter holidays. The governorate has created many gardens and parks, and areas for hobby fishing along the shores of Temsah and Bitter Lakes, the Fayed area, Sarapium, Abou Sultan, the Fanara area and along the Suez Canal.

As a result, Lake Temsah and the Bitter Lakes have suffered from uncontrolled landfill to build tourism development projects and housing complexes. Being so vulnerable to tourism development activities, the coastline has experienced many forms of construction work such as dams, hard shoreline protection structures, seawalls, marinas and urban expansion. Physical alteration, including habitat modification and destructive practices such as dredging, draining of wetlands and the clearing of vegetation have been common practices. Such practices have largely stopped now as environmental impact assessments are required by law.

ATMOSPHERIC DEPOSITION

Atmospheric deposition is the transfer of substances from the air to the surface of the earth or sea either through rain or as gases, aerosols, or particulates. The chief environmental contaminants arise from the combustion of fossil fuels used in transport (cars, trucks, ships, planes) and power generation (especially coal fired plants), and from municipal waste incinerators. The most environmentally damaging compounds (and also the most detrimental to human health) are polyaromatic hydrocarbons (PAHs), oxides of sulphur and nitrogen, and heavy metals such as mercury. The level of atmospheric deposition of pollutants to the marine environment has not yet been established.

OTHER SOURCES OF CONTAMINANTS

LANDFILLS AND HAZARDOUS WASTE SITES

The most important sources of solid waste are domestic waste, street waste, resorts/club waste, commercial, medical and industrial waste, and building waste. It consists of food, paper, plastic bags, other plastics, non–recyclable materials, glass, textiles and other materials.

The quantity of solid waste produced daily in Ismailia Governorate is estimated as 572 tons**.** Local Units (part of the decentralization of administrative services in cities) manage the solid waste by collecting, transporting, sorting and finally by burying it in a public landfill or via composting in two recycling factories (Table 9).

Table 9. Daily volume of solid waste in cities and markazes in Ismailia.

Name of Markaz	Volume of solid waste ton/day
City and markaz of Ismallia	336
City and markaz of Fayed	73
City and markaz of Kantara West	117
City and markaz of Qanatara East	26
City and markaz of Tal Kebeer	13.5
City of Kassassen	2
City of Abu Sweer	4.5
Total	572

The Local Units in the governorate collect the solid waste from small containers in the streets. There are also manual tools and some modern equipment such as tractors and trailers. The solid waste is transferred to larger trucks and taken to the public landfill in the desert near Ismailia city. Some other landfills are used that are more distant to the city (Table 10). Two recycling factories use the waste to produce compost. Both factories have a nominal capacity of 160 ton/10 hour, but they are working at a rate of 50 ton/8 hours shift.

Land transport does not represent a major source of pollution to the Canal at this time. There is insufficient data to assess the risks posed by persistent organic pollutants, heavy metals or radioactive chemicals so a routine assessment of their status, especially in sediments, is important.

Table 10. Details concerning the new public landfill of Ismailia Governorate.

Location	Ismailia –Abu Balah Road
Ownership	Ismailia Governorate
Agency in charge	Ismailia City Council
Date of opening	2000
Total area	400 feddans
Total covered area of solid waste	25 feddans
Total daily solid waste	200 tons
Type of solid waste	Household, industrial and building waste.
Components of waste	From cities: organic waste in limited volume. From First and Second industrial areas in Ismailia: Building waste, chemicals, industrial materials
The depth of solid waste	2.5 m
The final depth of waste	3.5 m
Expected number of operating years for the landfill	50 years
Feed-back system	Manual sorting (plastics- glass- cardboard paper)
Other potentialities	There is no potentiality to dump hazardous waste
Non-recycled waste	60% of the solid waste is disposed in the public land fill
The Landfill	It has no cells. It is not prepared in an environmentally sound manner for the disposal of hazardous waste.

2.2.2 MOST VULNERABLE AREAS

The Suez Canal is a vitally important economic asset and as such is securely protected and the activities allowed on the Canal are restricted to its primary function—marine transport. The land-based sources of pollution that offer the biggest threats to the Canal and its waters take place many kilometers away. The most vulnerable ecosystems are found in and around the Temsah and Bitter Lakes. The shallow marine areas form valuable spawning grounds, fish nursery areas, and feeding grounds for marine biota and the shorelines are under stress from industrial and domestic wastewater discharge and from development activities.

The Suez Canal Authority has taken over responsibility for cleaning the waters of the Canal and associated lakes (Temsah and Bitter Lakes), from hazards related to shipping activities, especially from oil pollution. The Suez Canal Authority also contributes enormously to beautification, landscaping and tree planting in the Canal cities. Moreover, it offers reductions from the normal Suez Canal tolls to environmentally friendly ships.

2.3 THE GOVERNORATE OF SUEZ

The Governorate of Suez is one of the Canal region's urban governorates. It is located northwest of the Gulf of Suez, and is surrounded by the Governorate of Ismailia and the Governorate of North Sinai to the north, the Governorate of Red Sea to the south, the Governorate of South Sinai to the East, and the Governorates of Cairo and Giza to the west.

Suez, the city, is located in the northeast of Egypt at the northern end of the Gulf of Suez and at the southern entrance of the Suez Canal. The city occupies the northern part of Suez Bay which is a shallow extension of the Gulf of Suez. The mean depth of the Bay is 10 m and the surface area is 77 km^2. Suez city, harbor and the major industries occupy the northern part of this bay.

The total area of the Suez Governorate is approximately 9,000 km^2. It is divided into four administrative districts: Suez District, Al-Arbaeen District, Ataka District, and Al-Ganayen District. Ataka District accommodates an industrial zone, while Al-Ganayen District is mainly agricultural land. Suez District holds most of the government bureaus and agencies and encompasses Port Tawfik and the free zones.

The estimated population in 2004 was 478,500. There are approximately 20,200 feddans of cultivated agricultural land, and the main crops grown are wheat, barely, and sesame. The largest industrial activity in the governorate, as of 2003, was food and beverage production, followed by the production of mineral products and machinery. The production of wooden products (including furniture) represents the largest activity for handicraft workers. In Suez District most of the labor force is engaged in the service sector (mainly in oil-related services as well as marine and cargo services).

ENVIRONMENTAL SETTING

Knowledge of the local meteorological and oceanographic conditions operating in the Bay is important to gain an understanding of the complex circulation pattern of pollutants, their residence period in the Bay and their likely final destination. A full description is inappropriate in this report, but the following key points are provided.

Suez Bay has two sources of water, the Suez Canal and the Gulf of Suez. The circulation in the bay is due to those two sources. Water from the Gulf of Suez enters the Bay on the eastern side while it leaves the bay from the western side. High salinity water blown by surface winds from the Suez Canal is generally deflected to the western coast. Therefore, there is a persistent anticlockwise circulation in the bay. However, the current is dominated

by the tidal component due to the high tidal range. The prevailing wind in Suez Bay is north-northwest, however occasional easterly winds during winter confine wastewaters near to the west coast. There is a seasonal variation in water level in Suez Bay, with water level at its lowest value during the summer months (July to September).

2.3.1 LAND-BASED SOURCES OF POLLUTION IN SUEZ

Suez harbor has always been an important gateway on the Red Sea. The growing activity of this harbor has led to an increase in the rate of urbanization in the whole region. Several industries have been established along the western coastal area of Suez Bay down to El-Adabiya in the south. The Bay is subjected to pollution from the usual culprits:

- The discharge of domestic sewage, which contributes through nutrient loading and high biological oxygen demand (BOD) to the eutrophication of coastal waters around population centers, major ports and tourist facilities.
- Agricultural and aquaculture practices that allow excess fertilizer and pesticides from the Suez area to run off into drainage channels that mostly discharge into the Bitter Lakes.
- Direct input from industries close to the coast principally oil related industries, mineral dust from fertilizer and cement factories, chemicals and organic wastes from food processing factories.
- Ports and shipyards where a number of possible sources of oil pollution exist, such as oil loading/unloading facilities, oil pipelines and storage facilities.
- Thermal pollution from power and desalination plants; hypersaline brine from desalination plants.
- Dredging and filling operations associated with urban expansion, industrial development and tourism leading to sedimentation that suffocates the surrounding benthic communities and has adverse effects on more distant ecosystems when currents transport the suspended sediment.
- Impacts from tourism which include physical destruction of coastal habitats by construction works, dredging, and pollution from wastewater discharge from coastal resorts.
- Atmospheric fallout especially toxic gases, petroleum coke, and cement dust.
- Pollution from shipping activities (e.g., dumping of waste from ships and refueling).

The remobilization of heavy metals and toxic chemicals by physical, chemical and biochemical processes from suspended materials and sediments is potentially hazardous for the aquatic ecosystem of the Bay. Unless the uncontrolled disposal of untreated waste ceases, the situation will deteriorate. This is especially pertinent given that urbanization and industrialization on the Suez Gulf is progressively increasing. The wastes have already caused massive fish deaths that have had a significant impact on the local fisheries and tourism economy.

Maps 10 and 11 show the locations of land-based sources of input to the marine environment.

DOMESTIC WASTEWATER

The first elements of a municipal wastewater collection and disposal system for Suez were installed during the mid-1920s. However, until August 1995 the treatment plant was primitive and of limited efficiency. It included primary treatment ponds of 5 acres. The wastewater was then discharged into the bay through El-Kabanon Drain, an open drain, 6 km south of Suez. The sewerage system was constructed to serve 98% of the domestic and commercial wastewater, while 2% was discharged directly to the sea. The discharge amounted to 75,000 m^3 day in winter, increasing to 85,000 m^3 in summer.

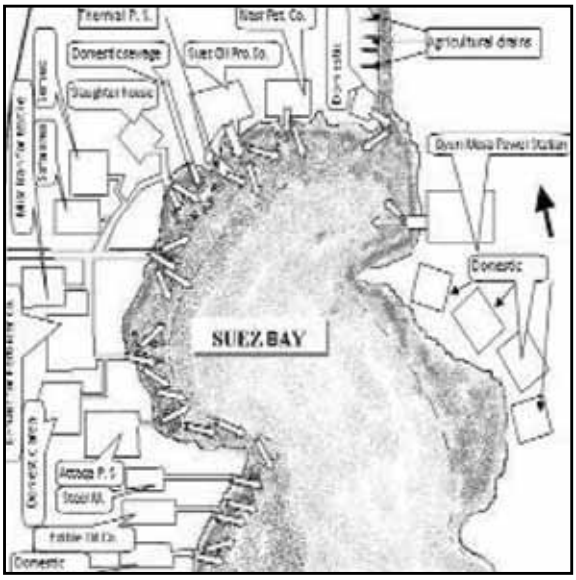
A new wastewater treatment plant has been constructed and is fully operational. It provides treatment capable of meeting the legal effluent standards for BOD (biological oxygen

demand) and TSS (total suspended solids). The system of treatment includes 4 aerated oxidation ponds and 2 basins for mechanical separation of settled solids. The precipitated sludge will be dredged every 6-12 months (depending on the amount of solid material), transported to drying lagoons and then stockpiled for possible use for agricultural purposes. The plant is designed to treat 260,000 m^3/day with the treated water discharged into the Gulf of Suez directly. However, domestic sewage from Hood El-Darrs area is discharged into the Gulf without any treatment.

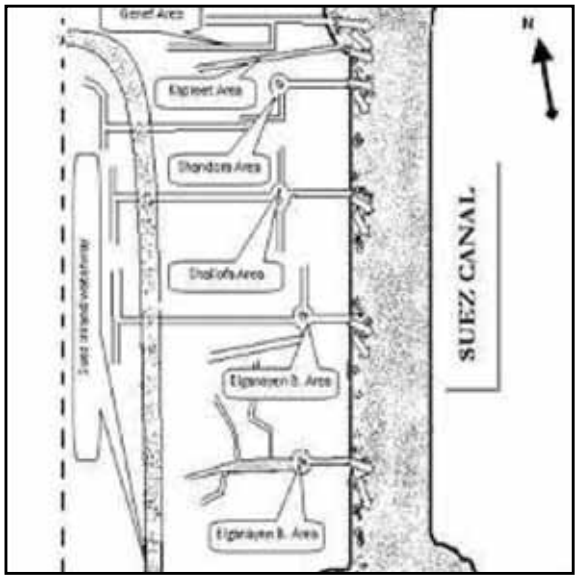
AGRICULTURAL WASTE

At the entrance to the southern end of the Suez Canal, within the borders of the Governorate of Suez, lie some agricultural drains and a fish culture development. They include:

- Geneifa and El-Siel Drains: contain sewage and irrigation effluent from the Suez area and drain into Great Bitter Lake.
- Shandora Drain: contains sewage and irrigation effluent from the Suez area and drains into the Little Bitter Lake.
- El-Shallufa Drain: drains effluent from cattle and chicken farms into the Canal. The agricultural land along the canal banks pollutes the canal with pesticides, herbicides, and excess fertilizer.
- Small drains: there are some other small drains that discharge excess irrigation water directly into the Bitter Lakes.



Map 10. Sites of land-based sources of pollution entering Suez Bay.



Map 11. Agricultural land-based sources.

INDUSTRIAL SOURCES OF POLLUTION

In the Governorate of Suez there are five industrial zones accommodating various categories of industries as shown in Table 11. A total of about 200 industries, not considering very small-scale ones, are operating in these industrial zones. A total of 26 of these industries are oil-related such as oil refineries, petrochemical industries, chemical industries, food oil industries, etc. Many are regarded as potential sources of oil pollution because of their continuous discharge of oily wastewater. Other large scale industries are focused on fertilizers, cement, and textiles. Map 12 shows the locations of some of the major industrial sites.

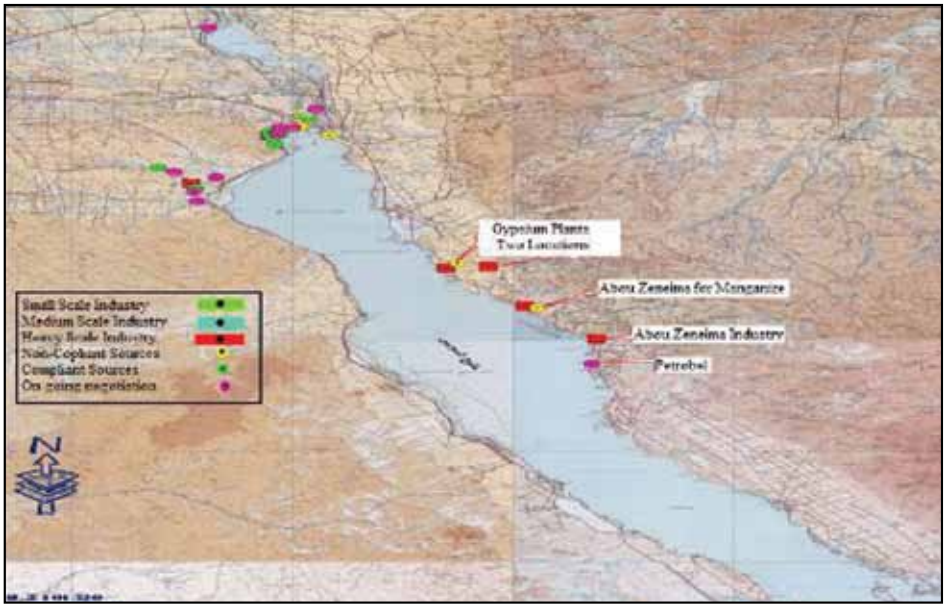
Some of the larger and more important oil related industries include:

(i) El Nasr Petroleum Company. This company refines crude oil to produce petroleum-derivative products such as naphtha, kerosene, gasoline, and asphalt. The company discharges 144,000 m^3 of oily wastewater per day into the Gulf of Suez. El Nasr Petroleum Co. is equipped with an API (oil-water separator) and a dissolved air floatation (DAF) separator. (The name API is derived from American Petroleum Institute.) It has been reported that the water quality of the effluent is 'almost in conformity' with national effluent standard limits; however 2,160 kg of oil and grease is discharged daily into the receiving waters.

(ii) Suez Petroleum Manufacturing Co. The main activity of the Suez Petroleum Manufacturing Co. is refining oil to produce petroleum derivative products like naphtha, kerosene, gasoline, asphalt, petroleum coal and sulfur. The company also has a production line for producing petroleum coal through cooling towers as well as sulfur. The company discharges oily wastewater into the Gulf of Suez at a rate of 360,000 m^3/day. The company is equipped with API and DAF separators. Again it has been reported that the water quality of the effluent is 'almost in conformity' with national effluent standard limits; however 6,060 kg of oil and grease is discharged daily into the receiving waters.

Table 11. Industries in the Governorate of Suez.

Industrial Areas	Industrial Categories	Numbers of Industries
Nasr Road	Various workshops	Limited
Ismailia Road-Suez	Wood and metallurgical	8
	Food	2
	Chemical	2
	Suez City Petroleum	12
	Chemical	8
	Textile	2
	Food	5
	Others	1
Ataka Industrial Area	Food	21
	Chemical	34
	Wood and metallurgical	32
	Textile	4
	Construction material	10
Suez Road-Ain Sokhna	Construction material	11
	Metallurgical	6
	Chemical	7
	Textile	6
	Others	23
Kattamia Road	Construction material	2



Map 12. Major industries around the Gulf of Suez.

These companies—Caltex, Misr Petroleum, Co-operative Petroleum Association, Esso, Mobil—own fuel stations as well as storage facilities. They also have stations for fueling marine vessels. The liquid waste and oily wastewater from these companies is transferred to the oil separation basins of Suez Petroleum Manufacturing Co. and El Nasr Petroleum Co.

FOOD OIL PRODUCTION

(i) Suez Gulf Company. The Suez Gulf Company has wastewater treatment facilities consisting of chemical and biological processes with the capacity of 300 m^3/day. It is reported that the water quality has been improved considerably since the operation of the treatment facilities in 2004, showing 78 mg/l of chemical oxygen demand (COD) and 18 mg/l of suspended solids (SS). The wastewater is discharged into a nearby sewerage system.

(ii) Savola. This company is equipped with a wastewater treatment facility consisting of a DAF separator with a capacity of 60 m^3/day. It is reported that the content of oil and grease (66 mg/l) and the other parameters is within national compliance standards. The treated effluent is used for irrigation water on farmland.

FERTILIZER INDUSTRY

El-Nasr Company–Semadco. The company produces 1000 ton/day ammonium nitrate, 500 ton/day calcium nitrate and 50 ton/day ammonium sulfate, along with aqua-ammonia, sulfuric acid and nitric acid as byproducts. The factory uses freshwater for cooling and the effluent discharge amounts to 60 x 103 m^3/day of low saline water (2.5 ‰). As expected, this water is loaded with ammonia, phosphate and nitrate in addition to certain metals, e.g., copper, zinc and lead (Cu, Zn and Pb).

CEMENT INDUSTRY

Suez Cement Factory lies 40 km south of Suez City. Manufacture of cement is a high temperature process converting more than 30 raw materials to a fine gray cement powder. The process is energy consuming and results in atmospheric discharge of several pollutants. It has been estimated that more than 10 g of lead (Pb) and 600 mg of cadmium (Cd) per ton of cement produced, could be released into the atmosphere. This indicates the huge quantity of trace elements which may be added to the atmosphere and later the terrestrial and marine environments through cement production.

The factory lies on the coastal strip of the Gulf of Suez (5 km inland). Its location and the prevailing NW wind increase the heavy metal and dust load contributed by the factory to the marine ecosystem (no available data). The deleterious effect of the atmospheric fallout represents a threat to coral reefs at Ain El-Sukhna (50 km south of Suez City).

TEXTILE INDUSTRY

The textile industry, represented by Misr-Iran Company and El-Misrya Company, produces cotton fibers (cotton textiles). Sodium hydroxide is used for the mercerization process. The concentrated caustic soda solution increases the softness of the cotton fibers and improves their affinity for dyes and water.

OTHER INDUSTRIES AND INFRASTRUCTURE

The development of Suez is seen as centering on a mix of labor and capital intensive industries, developed on the existing base of petroleum and petro-chemical plants. The NEP report (1978), listed the existing industries in Suez. The study also proposed other new industries for Suez, several that are now in operation such as fiberglass boat building, machine shop and assembly plant, merchant steel mill, ship scrapping yard, general engineering foundry, ceramic tiles plant, and a plant making denim for jeans.

The estimated daily load of contaminants from industrial and agricultural activities discharged into the Gulf of Suez is given in Table 12.

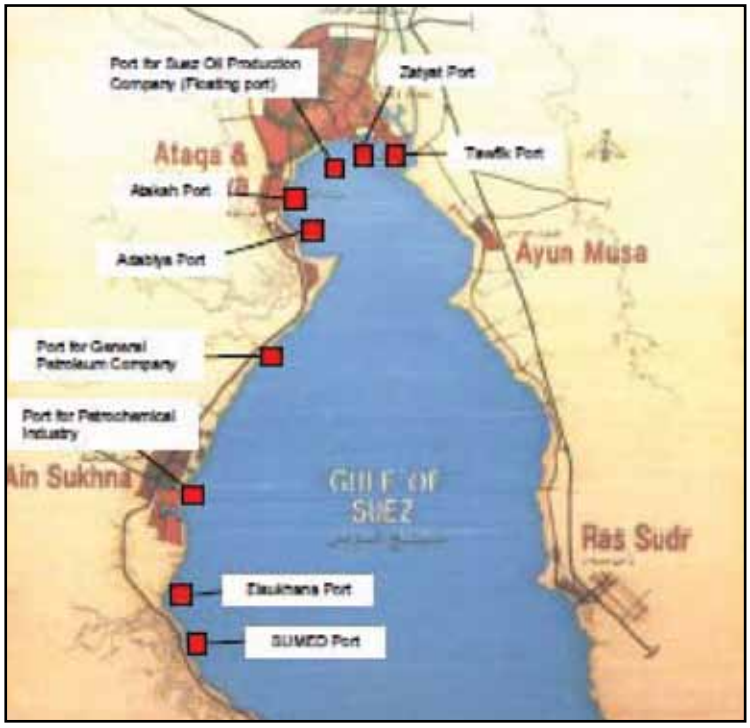
Table 12. Estimated daily load of contaminants from industrial and agricultural activities discharged into the Gulf of Suez.

Contaminants	Load tons/day
BOD	2,924.4
COD	7,146.5
Lead	822.7
Copper	667.7
Zinc	2,009.3
Cadmium	133.2
Chromium	2.5
Iron	80.1
Manganese	3.6
Nickel	0.3
Fluorides	80.1
Bromides	80.1
Oil and Grease	99.5
Ammonia	173.2
Nitrate	2,107.8
Sulphates (SO_4^-)	122.4

Source: Report on Land-Based Activities within the Red Sea Area (North Gulf of Suez and Southern Part of the Suez Canal), Egypt. Faculty of Petroleum and Minerals, 2005.

PORTS

A number of ports cluster along the western coast of the Gulf of Suez, as shown in Map 13 and Table 13. Therefore, a number of possible sources of oil pollution exist, such as from oil loading/unloading operations, oil pipelines and storage facilities. For example Zatyat port receives approximately 1,000,000 tons of petroleum annually and approximately 3,000 oil tankers visit SUMED port per year transporting some 117 million tons of oil and petroleum products.



Map 13. Ports in the Governorate of Suez.

Besides the ports mentioned above, other ports specializing in loading and unloading products from petroleum refineries and the petrochemical industry exist in the Gulf of Suez.

Table 13. Major ports in Suez Bay.

Port	Area ($km^{2)}$	Platforms or berths	Water depth (m)	Vessels per year
Zatyat Port (Petroleum Port)		5 platforms; length 510 m 1 deep water platform	5-8 11	120 oil tankers 18,000–40,000 tons capacity
Port Tawfik	31	Commercial and naval 13 platforms, length 2,100 m	7-8	700 passenger 680 cargo
Adabiya Port	85	9 platforms, length 1840 m	8-13	600 cargo
El Sukhna Port	23		17	Container ships
Atakah Port (Fishing Harbor)		2 platforms; 456 m		447 fishing boats; total 495 boats
SUMED Port		Moorings and attachments for oil pipelines		3000 oil tankers
Port of General Petroleum Co.		Moorings; oil is pumped through pipes to Cairo		Oil tankers

POWER STATIONS

The thermal power station at Ataqa (8 km south of Suez) is one of the largest in Egypt designed to generate 900 MW/h of electrical power. Cooling water (200 m^3/h) is taken from Suez Bay via an open canal extending over a half kilometer into the sea. A water temperature rise of about 10 °C due to the thermal effect of the effluent has been recorded in nearshore waters. Cooling effluent is discharged at a rate of about 200 m^3/h, while sewage discharge is 100 m^3/day.

Two additional power stations exist: Thermal Power Station at Suez City and Oyun Mousa Power Station on the eastern side of the Gulf of Suez.

DREDGING AND INFILLING

In addition to contamination from the aforementioned sources, Suez Bay is suffering from increased sedimentation. This area is subject to a high rate of sediment input, including fine aerosol materials and windblown sands and silts. The repeated dredging of the harbors and the Suez Canal contributes to the high turbidity of the water column. The reduction in light penetration and smothering of organisms has resulted in severe degradation of benthic life. This is shown by the dead coral fringe and dead coral islands in Suez Bay. Even in the intertidal zone the natural biota appears to be in decline.

2.4 THE GOVERNORATE OF SOUTH SINAI

The Governorate of South Sinai is located in the southern region of the Sinai Peninsula (Map 14). It has two coastlines, one bordering the Gulf of Suez and the other bordering the Gulf of Aqaba. The total land area is approximately 31,270 km^2. The governorate is divided into three administrative districts; it has 8 cities, and 7 kisms. The estimated population in 2004 was 63,800. There are approximately 8,100 feddans of cultivated agricultural land and the main crops grown are wheat, barley, olives and palm trees. The leading industrial activity in 2003 was the chemical industry, followed by food and beverage production. The service sector, primarily tourism, is the most important sector to the economy.

Map 14. The Governorate of South Sinai.

The area is characterized by its generally pristine environment with five protected areas that attracted more than 1.7 million international tourists in 2003, the petroleum resources along the Gulf of Suez that account for much of the oil production in Egypt, and the local mineral resources, non-metallic and ornamental stone.

Geographically, South Sinai can be divided into four sub-regions: Gulf of Suez, Gulf of Aqaba, Central Mountain region and Northern Desert region. The latter two, Mountain and Desert are sparsely populated with little agriculture and, from the standpoint of land-based sources of pollution affecting the marine environment, are of little relevance.

1. **Gulf of Suez (the coastal plain from Ras Sudr to Ras Mohamed):** This area contains little in the way of tourism activities but has four significant towns and most of South Sinai's agriculture due to groundwater being in more abundance in this zone than elsewhere. It is also the sub-region where mineral and petroleum exploitation takes place. Its relative proximity to Suez and Cairo gives it a character that is somewhat different from other areas of South Sinai. For example, the tourist establishments that exist are resort villages that mainly cater to Egyptians seeking holiday homes or summer timeshares (the Ras Sudr sector is a two hour drive from Cairo). The towns of Ras Sudr, El Suweira and Abu Zeneima have more small-scale commercial and manufacturing establishments than are normally found in South Sinai.

2. **Gulf of Aqaba (the coastal plain from Ras Mohamed to Taba):** This area is South Sinai's prime tourism location with roughly 90% of all tourist room capacity. It has the towns of Sharm el Sheikh, Nuweiba and Dahab, as well as Taba Centre. This region has fewer groundwater sources than the Gulf of Suez region, and therefore practically no agriculture.

2.4.1 ENVIRONMENT AND BIOLOGICAL DIVERSITY

For a more complete account, refer back to section 2 on the environmental characteristics of the region. A short note is included here to identify some of the key features.

Sinai lies in the arid North African belt characterized by high summer temperatures, mild winters, low humidity, and long rainless periods. However, due to the thin soil and sparse vegetation cover, steep slopes and high relief, heavy winter rainfall can cause major flash floods which carry debris and pollutants to the sea.

The South Sinai waters include three distinct regions: the Gulf of Suez (north of the Straits of Jubal), the Gulf of Aqaba (north of the Straits of Tiran), and the waters of the northern Red Sea (south of the two straits). The marine environment of the northern Red Sea and the Gulf of Aqaba is of particular importance and value on account of its rich biodiversity, particularly coral reefs and seagrass beds. This environment therefore demands a higher priority for control of land-based activities that may cause pollution.

The different oceanographic qualities of the Gulfs of Suez and Aqaba result in clear differences in the structure and ecology of the coral reefs found in each Gulf. Along the western coast of Sinai, the shore is predominantly sandy and muddy. Patch reefs are small and there are poorly developed fringing reefs. However, more extensive reefs occur in the south just north of Ras Mohamed. In the Gulf of Aqaba, there are extensive but narrow fringing reefs along shores with steep cliffs; at the mouths of wadis (river valleys) and across bays, the fringing reefs extend outwards.

Seagrasses are fairly widespread along Sinai's coasts. High concentrations of seagrasses are found at just a few sites in the Gulf of Aqaba but are more plentiful in the Suez Gulf due to the more favorable conditions. Dugong are known from seagrass areas in both the Gulf of Suez and the Tiran reefs.

The green and hawksbill turtles are common in South Sinai. Nesting sites exist at Tiran and Sanafir islands, and Ras Mohamed. Marine resources are plentiful and many shark species are present. The bottlenose dolphin and spinner dolphin are both well known in the Gulf of Aqaba and areas around Ras Mohamed and Sharm el Sheikh.

NATIONAL PROTECTORATES

The importance of the marine and terrestrial ecosystems of the area has been recognized by the establishment of national parks and protectorates. Map 15 shows the location of the five protectorates in South Sinai and Table 14 gives their areas.

Map 15. South Sinai Protectorates.

The five South Sinai Protectorates—Ras Mohamed National Park, Nabq Managed Resource Protected Area, Abu Galum Managed Resource Protected Area, Taba Protectorate and St. Katherine Protectorate cover a total area of 9,836 km^2 (about 35% of the area of the governorate) and include the entire littoral and sublittoral of the Egyptian Gulf of Aqaba.

These areas are obviously of particular concern when addressing the issue of land-based sources of pollution.

Ras Mohamed National Park located at the southern tip of the Sinai Peninsula includes coral reefs, desert ecosystems, mangroves and it is an important spot for migratory birds. Ras Mohamed is renowned globally for the diversity and richness of its coral reefs, rated amongst the world's best, and is a significant draw for tourists in the Sharm el Sheikh area, particularly for scuba divers. The development plan for Ras Mohamed aims to strike a

balance between the protection of natural resources from depletion and destruction, and generating income.

Nabq Managed Resource Protected Area located north of Sharm el Sheikh has a variety of marine and terrestrial ecosystems. The area includes coral reefs, seagrass beds, and the most northerly mangroves in the Red Sea/Indian Ocean complex at the mouth of Wadi Kid.

Abu Galum Managed Resource Protected Area includes unique coastal and mountain ecosystems such as narrow wadis, fresh water springs, coastal sand dunes, gravel alluvial fans, raised fossil coral reefs and saline sabkha. Sandy beaches and rich coral reefs attract tourists.

The Taba and Saint Katherine Protectorates have a rich and varied fauna and flora that attracts many tourists. However, there is no coastal or marine protected area and there is little pollution from these regions into the sea.

Table 14. Protected areas in South Sinai.

Protectorate	Land km^2	Sea km^2	Total km^2	Shore km
Ras Mohamed National Park	133	327	460	56
Tiran-Sanafir	100	271	371	30
Sharm el Sheikh	-	75	75	15
Nabq Managed Resource Protected Area	465	122	577	47
Abu Galum Managed Resource Protected Area	337	121	458	25
Taba Coast	-	735	735	147
Taba Protectorate	2,800	-	2,800	-
Saint Katherine Protectorate	4,350	-	4,350	-
Total	8,185	1,651	9,836	320

2.4.2 LAND BASED SOURCES OF POLLUTION IN SOUTH SINAI

The land-based activities affecting the marine environment are common to the discussions for the previous governorates—domestic and industrial wastewater, effluent from power stations, oil pollution from ports, agricultural and urban run-off, and physical alteration of the coastline for urban, industrial or tourism development. However, due to the nature of the environment and the development that has occurred here, the relative importance of the different activities is different.

COASTAL DEVELOPMENT

With internationally recognized coral reefs, clear warm coastal waters, outstanding desert landscapes, sites of cultural and religious importance and near permanent sunshine, it is clear that the wealth of southern Sinai lies in its natural resources. These resources, coupled with their proximity to European tourist markets, have stimulated the rapid growth of tourism development in the region. This has led to significant changes to the landscape and

beaches during the construction of tourism infrastructure. Since the coastal areas of Sharm el Sheikh have already undergone development, future impacts from sedimentation are of lesser concern. However, construction is currently taking place in South Nabq, Dahab and the area between Nuweiba and Taba, and there is the potential for such impacts in these areas.

Unregulated hotel, resort and other development projects in the area may cause a serious decline in the quality of the coastal environment. Destruction of reefs and vegetation from shoreline 'dredge and fill' operations increase turbidity and sedimentation that can lead to the death of corals. The use of imported fine sand for hotel beaches and eutrophication problems related to nutrient-rich sewage water from hotel gardens, are specific issues that threaten the reefs off Dahab.

Road construction and associated sand and aggregate mining, mineral quarrying, and solid waste dumping are all considered threats to local wildlife and landscapes. Along the Gulf of Aqaba coastal construction has resulted in the loss of large areas of fossilized coral reef terraces.

DOMESTIC WASTEWATER

The control of sewage and wastewater discharges in South Sinai has been very effective, particularly in the Gulf of Aqaba. This is due to the legal requirements and current management practices. There is some concern that the increased area used for agriculture, and greening of urban spaces and tourist resorts, will lead to increased nutrient load in coastal waters. This is a concern that requires careful monitoring. There is also a need to make sure that wastewater treatment systems are upgraded to ensure protection from all forms of pollution, including industrial by-products and waste oils that might be introduced into the wastewater stream.

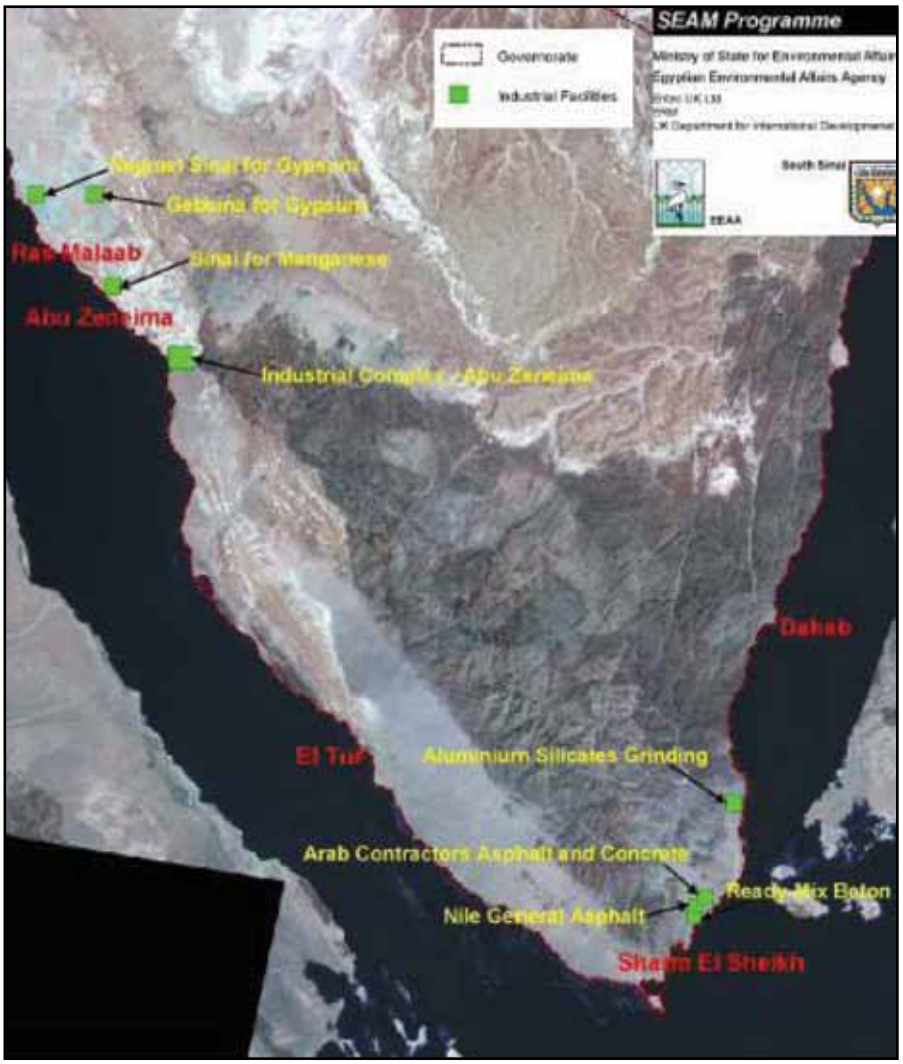
INDUSTRY

Only one industrial zone exists in South Sinai, at Abu Zeneima city. A few industrial facilities are located outside of the industrial zone complex. The major activity focuses on minerals. There are a small number of industrial sites north of Sharm el Sheik. Map 16 and Table 15 show the approximate location of industrial facilities in the governorate.

The Abu Zeneima industrial zone is designed to host approximately 101 facilities. To date, almost half of the land slots have been allocated to investors. A few facilities are currently operating and others are under construction. The major activities planned are those relying on treatment and grinding of minerals such as silicates and calcium sulfate (gypsum), and the manufacture of bricks and tiles. At present, neither a network for the collection of industrial wastewater nor a wastewater treatment facility exists at the industrial complex. Moreover, no area has been allocated for disposal of the solid waste that will be generated by the planned facilities.

Table 15. Industrial facilities located in South Sinai Governorate.

Name	Location	Activity
Ready-Mix Beton	Rowaisat, in Sharm El Sheik	Ready-mix concrete
Nile General for Roads and Bridges Asphalt	5 km north on Sharm el Sheikh–Dahab Highway	Asphalt for road paving
Arab Contractors Asphalt and Concrete Mixing facilities	As above	Asphalt and ready-mix concrete
Aluminium Silicates Grinding Facility	40 kms north on Sharm el Sheikh–Dahab highway	Grinding of aluminum silicates
Sinai for Manganese	In Abu Zeneima city	Produces ferromanganese
Negmet Sinai for Gypsum	In Ras Malaab, 40 km north of Abu Zeneima city	Produces gypsum; approx. 160,000 tons per year
Gebsina for Gypsum	At Gharandal, 30 km from Ras Sudr city	Produces gypsum; approx. 250,000 tons per year



Map 16. Location of industrial facilities in South Sinai.

POWER

At present, power in South Sinai is generated by small thermal power stations located in each of the eight main towns. These were originally diesel driven but, for the most part, have been converted to gas turbines, retaining the diesels for standby. Work is almost finished to connect South Sinai to the national grid. A 400 kVA line from Suez to Taba is complete. It is designed to feed four undersea power lines that transmit power to Aqaba for power sharing with Jordan. A 220 kVA transmission line runs from Aqaba down the Gulf coast to feed Nuweiba, Dahab and Sharm. There are plans to complete a loop running along the Gulf of Suez coast north to Suez. When this is complete, power capacity should be sufficient, at least for the medium term.

PORTS

Nuweiba International Port is managed by the Ministry of Transportation and serves only one company, El Gissr (Egyptian–Jordanian–Iraqi). It has a 366 m long dock with 5 and 8 m water depths. The port serves passenger and cargo vessels operating between Nuweiba and Aqaba. The capacity at any one time is one cargo vessel carrying up to 40 trucks and two ferries carrying up to 1,600 passengers. Between 1.25 and 1.5 million passengers per year use the port facilities. The Ministry has plans to increase the port capacity and to include a special area for tourist yachts.

Sharm el Sheikh International Port located in Sharm el Mina, is used mainly by international, regional and coastal cruise ships. Between July 2003 and March 2004, the port received 202 cruises. Sharm el Sheikh Port has a dock 650 meters long with depths of 5, 8 and 10 m providing a maximum capacity of up to 3 large cruise liners. The port functions as the main naval port for South Sinai, and also services the twice-daily ferry service from Hurghada. It is intended to address overcrowding by upgrading capacity and extending the dock to 710 m.

MARINAS

In 2000, the Sharm el Sheikh Marina was moved to Sharm el Mina, next to the International Port. Managed by Travco, the Sharm el Sheikh Marina currently services approximately 280 recreational boats, most of which service the diving and snorkeling sector. The dock can handle up to 30 boats at a time, depending on their size, and 75 mooring buoys inside the marina provide further berths.

South Sinai hotels and diving clubs operate a secondary jetty for the Sharm el Sheikh area at Naama Bay that services an average of 30 vessels per day. Vessels are required to overnight at the Travco Marina; Naama jetty offers no services other than access to the boat. Limited services for snorkeling and dive boats are also offered in Shark's Bay, Dahab, Taba Heights and the Hilton Hotel in Taba. Facilities are generally limited to a jetty and a marine police station.

FISHING DOCKS

Facilities for fishing vessels exist in El Tur, Dahab, Ghardeheya (also known as Koneissa), Abu Neissa, Abu Desa, and Ras Sudr. El Tur is the most developed of these facilities with a dock capable of servicing up to 15 medium-sized vessels together. El Tur Port provides ice for cold transportation of catches and offers limited facilities for the disposal of waste oil and refuse. The Fisheries Directorate, which manages El Tur Port, would like to develop a small jetty for handling smaller sail-powered vessels, develop a sea wall to protect the south-facing harbor from bad weather, and improve the provision of electricity, water, fuel and waste handling services.

Adjacent to the fishing port are limited facilities for on-shore repair and maintenance of medium sized vessels; these are regularly used by dive boats from Sharm el Sheikh.

BULK CARRIER FACILITIES

The only industrial shipping facility in the South Sinai Governorate is a deepwater terminal inside the Abu Zeneima ferromanganese complex, serving bulk carrier ships. This is operated by the General Company for Ferromanganese and handles about 30,000 tons per year.

2.4.3 MOST VULNERABLE AREAS

The marine and coastal environment adjacent to the marine protectorates of South Sinai is of great economic and biological value. Many observers and tourism industry experts point to deterioration of the environment, and in particular the coral reef systems and marine life, as the single largest threat to the long term growth of tourism in South Sinai. Any deterioration in reef quality may be due to:

- coastal development and construction
- tourist related activities (diving and snorkeling, dive boat anchoring)
- ocean pollution from oil spills, industrial effluent, or raw sewage discharge from boats
- nutrient enrichment from agricultural run-off or over use of treated wastewater

Since tourism is the only engine of growth in South Sinai, it would be prudent to make every effort to mitigate the causes of coral reef and marine life degradation.

2.5 THE RED SEA GOVERNORATE

The Red Sea Governorate is bordered on the north by Suez Governorate, to the east by the Gulf of Suez and the Red Sea, to the south by Sudan and to the west by the mountains facing

Map 17. The Governorate of the Red Sea.

the River Nile valley (Map 17). It has a surface area of almost 120,000 km^2 and a Red Sea shoreline of 1,080 km. The governorate is divided into six districts: Ras Gharib, Hughada, Safaga, Kuseir, Marsa Alam and Shalatein.

The estimated population in 2007 was 288,233. More than 35% of the population has migrated from other governorates. Agricultural practices are oriented toward pastureland, medicinal plants and animal production. There is a shortage of water resources and manpower. Two major economic activities are practiced in the Red Sea Governorate. The first is oil production in the northern part of the governorate and the second is tourism which is spread all along the coast.

2.5.1 ENVIRONMENTAL SETTING

The Egyptian Red Sea coast extends from Suez (latitude 30° N) to Marsa Halaib (latitude 22° N) at the Sudanese–Egyptian border. A relatively narrow coastal plain is bordered to the west by low mountains. The plain is interrupted by shallow drainage patterns.

Coral reefs are widespread and well developed. The diversity of coral genera and species is similar to that found in the Gulf of Aqaba. An almost continuous band of coral reefs lies offshore from Hurghada south to Shalateen making the Egyptian coast of the Red Sea a major tourist attraction. The coral reefs are cut by a series of partly sheltered small bays. These bays and lagoons provide favorable habitats for the growth of mangroves. Important seagrass communities occur along the northern Red Sea coast. Their dependence upon strict environmental conditions limits their distribution.

The area is rich in biodiversity at all levels. Sharks are significant attractions for recreational divers, and are thought to play an important role in the top-down regulation of reef communities. Several endangered species such as the green and hawksbill turtle, and the dugong are found in this region.

NATIONAL PROTECTORATES

With such high biodiversity and concentrated use of the shoreline for tourism development, Egypt has declared four protectorates in the Governorate of the Red Sea, three of them with a Red Sea coastline.

These three protected areas are (i) Red Sea Northern Islands, a protected area that includes all the northern islands with a total area of almost 1,991 km^2 and surrounding waters to a depth of 100 m; (ii) the Wadi el Gemal Protected Area which includes the coastal plain, marine environment and islands; and (iii) the Elba Natural Protected Area located in the southeast of Egypt where the Eastern Desert borders Sudan and the Red Sea (Map 18). The Elba area includes some islands, coastal mangrove woods, coastal sand dunes, sabkha or coastal salt marshes, desert coastal plains and coastal mountains and their surrounding hills with mist oases.

Map 18. Protected Areas in the Red Sea Governorate.

2.5.2 LAND-BASED SOURCES OF MARINE POLLUTION IN THE RED SEA GOVERNORATE

The main issues regarding pollution of the marine environment from land-based sources concern sedimentation from coastal development, discharge of wastewater, oil spills related to support services for the oil extraction or exploration industry, by-products from desalination plants, and point sources such as ports.

SEDIMENTATION

Alterations to the landscape and beaches during coastal development and construction for tourism infrastructure can and has resulted in a number of indirect impacts including increased run-off, sedimentation, and loss of soil into the water from wind erosion, thus impacting coastal areas and reefs.

Until now, few land assignments have been made to the tracts of virgin shoreline found along the shore between Marsa Alam and Shalateen. However outline plans for development have been put forward. Many observers question the feasibility of such plans, noting that there are significant wetlands which need protection.

As in South Sinai, road construction, aggregate mining, and solid waste dumping are all threats to landscapes and nearshore coastal environments. Large areas of fossilized coral reef terraces have also been lost here due to coastal construction activities.

WASTEWATER

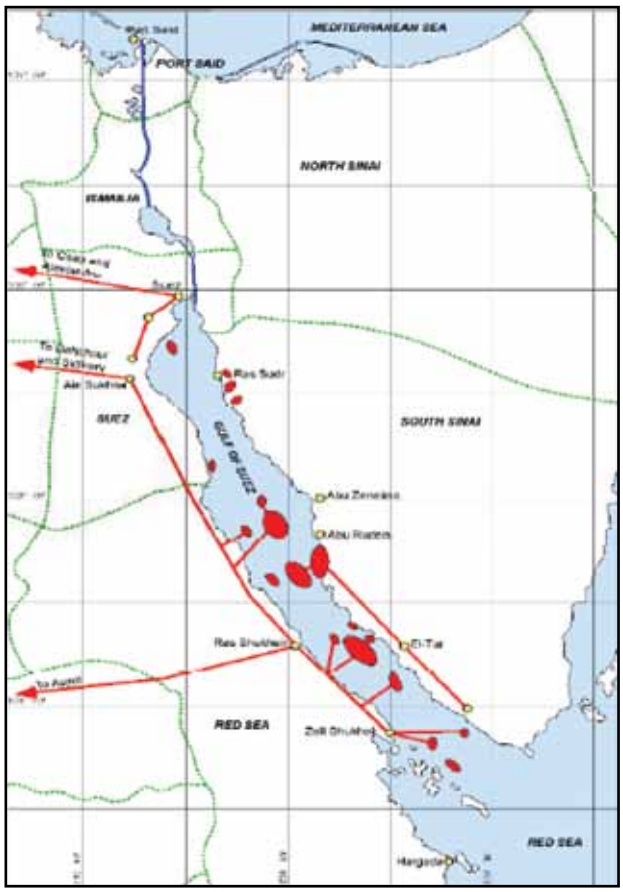
The control of sewage and wastewater discharges in the Red Sea Governorate is very effective. However, discharge of untreated or partly treated domestic waste has been identified as a problem in some coastal and marine locations, for example at Ras Gharib where untreated or partly treated domestic waste from the city is discharged into the coastal area.

In Hurghada, although a zero discharge option has been adopted, nutrients still find their way into the marine environment through non point source or diffuse pollution as all gardens and green areas in tourist resorts are irrigated with treated water from sewage facilities. There is concern that the increased area used for agriculture, and the greening of urban spaces and tourism resorts, will lead to increased nutrient load in coastal waters. This is a concern that requires careful monitoring. There is also a need to ensure that wastewater treatment systems are upgraded to ensure protection from all forms of pollution, including industrial by-products and waste oils that might be introduced into the wastewater stream.

INDUSTRY

Industrial development is not a major issue in the Red Sea Governorate. But, because of oil and mineral resources, exploration, exploitation and production activities represent a major source of potential pollution in specific locations.

Oil as a major economic asset in Egypt, exists in economic quantities in the northern part of the Red Sea Governorate (Map 19), in the Ras Gharib to Gebel El-Zeit area. The Gulf of Suez produces about 36 million tons equivalent to around 60% of the total production of crude oil in Egypt. In the Gulf of Suez there are around 136 petroleum platforms serving some 570 oil wells. The length of the seabed pipelines carrying crude oil and natural gas is estimated at about 830 km. Crude oil, to be exported or used by refineries, needs to pass



Map 19. Oil production facilities in the Gulf of Suez.

through purification steps to remove water, salt and demulsifying agents that were added during pumping. This is done at land-based production plants. Such plants are found at Ras Gharib, Ras Shokeir and Gebel El-Zeit areas.

Oil, heavy metals, and pollutants that raise BOD and COD have the potential to find their way from these plants to the marine environment of the Gulf of Suez and Red Sea.

PORTS

Within the governorate there are several ports. Some are general purpose ports, such as at Hurghada and Safaga, while others are specialized and restricted for particular activities such as the transfer of oil—Ras Gharib, Ras Shukeir, Gabal El-Zeit, and El-Zeit East; mineral ores—Al-Quseir, Abu Tartour Mining Port (Safaga), El Masriyeen Mining Port (Safaga), El Rasif El Bahari (Ras Hagariya); tourism— Gonah, Hurghada, and Port Ghalib; or fishing—Hurghada. Each port is a potential point source of marine pollution. See Table 16 for details.

LITTER

Litter is still a major problem, from monitoring to clean-up. Sources are clearly identified as fishing and diving safaris, beach recreation and most importantly, from the shipping lane. The magnitude of the problem has not yet been fully assessed. A system for managing litter needs to be established as this material considerably lowers the value of an important economic resource—tourism.

Table 16. Ports in the Red Sea Governorate.

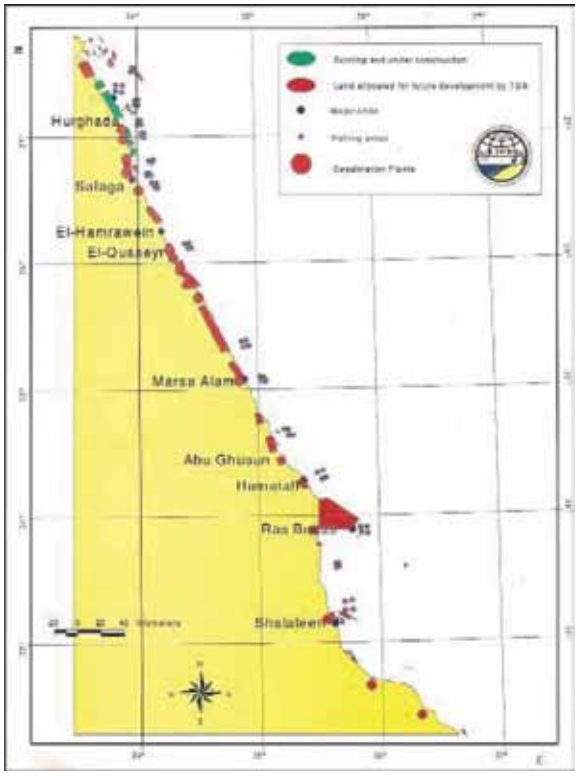
Name	Activity	Size (area)	Berths & Buoys / Capacity	Services and Equipment
Hurghada	Passengers and tourist vessels	Land: 15,690 m^2 Water: 8,344,000 m^2	Navigable waterway length 9,000 m and depth 15 m The annual average number of: tourist vessels: 675 tourist yachts: 210 ordinary passenger vessels: 600 cars accompany passengers: 13,000 tourists: 50,000 ordinary passengers: 500,000 (Hurghada–Dhaba) and (Hurghada–Sharm)	A modern hall of 900 m^2 for passengers equipped with all the necessary services for tourists and inspection systems for baggage.
Safaga	Passengers and tourist vessels		3 berths with a total length of 1,170 m (two at 440 m each with a depth of 10 m and one at 290 m with a depth of 14 m)	
Ras Gharib	Oil shipping and services	Water: 6 km^2	5 tankers/month - 30 barrels/day North Platform: length 52 m minimum depth 4.5 m. A 30 inch diameter petroleum pipeline supplies marine units with fuel. South Platform: small, with water depth of 1.8 m supplies small service yachts with fuel. Anchorage area: 6 buoys for 130,000 tons at 1.5 nautical miles from the shore for the anchorage and reception of petroleum tankers.	Preventive equipment against fire, explosions and pollution. Fresh water, electricity and fuel station. Waste reception and treatment unit.

Ras Shukeir	Petroleum shipping and petroleum marine services	Water: 16 km^2	2-3 vessels/month; vessels with draught of 5 m Two quays: The first is composed of 8 buoys for mooring and reception of tankers with a capacity of 30,000 tons to 250,000 tons and a 22 m draught. The second is composed of 8 buoys for mooring and reception of tankers with a capacity of 30,000 tons to 120,000 tons and a 22 m draught. 3 berths affiliated to GUPCO allocated to service vessels and supply craft. North Berth: 300 m; South Berth: 180 m; West Berth: 245 m	Reception and waste treatment unit. Fresh water, electricity, sewage. Fuel stations and oil spill combating center.
Gabal El-Zeit	Shipping and petroleum services	Water: 4 km^2	4 vessels/month Buoy: SPM (single point mooring) for the reception of tankers with tonnage reaching 130-250 thousand tons and depth 32 m Berths: Two berths for maritime services; length 120 m, water depth 20 m and 5 m	Unit for the reception and treatment of oily wastes.
El-Zeit East	Receiving, shipping and discharging petroleum tankers.	Water: 4,000 m^2	3 carriers/month, capacities up to 100,000 tons and depth 14.5 m Buoys: SPM for the reception of tankers with tonnage reaching 130-250 thousand tons and 32 m depth. Berth: (petroleum marine); service berth with 120 m length and 6 m depth equipped for the reception of tugs, mooring crafts and service craft.	Preventive measures against fire, pollution by hazardous substances. Fresh water, electricity, sewage and fuel. Reception facilities and waste treatment unit for oil service vessels.
Al-Quseir	Shipping of phosphate ore	Water: 27,828 m^2	Shipping of 7,000 tons/day phosphate. Vessels up to 10,000 GRT 2 berths are at the northern port of Gonah. The eastern berth is used for phosphate shipping. The western berth is used for small boats. There are also two anchors fixed on the rocky bed used for mooring purposes.	
Abu Tartour Mining Port (Safaga)	Export of phosphate, packed cement, crude alchortz	Land: 512,450 m^2	Max. capacity: 1.1 million tons phosphate/ year; 0.5 million tons cement/year; shipping rate: 1,500 tons/hr. 1 berth with 280 m length and 14 m depth.	Pure water, electricity, fire combating. Environmental preservation measures, dust suction units and fire combating equipment; handling belts and shipping cranes.
El Masriyeen Mining Port (Safaga)	Shipping of packaged phosphate and unprocessed liquefied cement	Water: 343,018 m^2	1,000 tons/day; the main quay is for the shipment of phosphate and the secondary quays are wooden scaffolds with 150 m length and 10 m width along the main berth. Loading by belts passing from the loading hold to the loading berth and through 2 pipelines connected to a cement silo outside the port.	Fresh water, electricity, sewage and fuel station.

El Rasif El Bahari	Cement and quartz export		Maximum capacity: 16,000 tons One concrete berth 56 m length and 9 m depth, tower, warehouse Transport belts, shipping tower	Water, electricity, sewerage; security, safety and environmental measures; fire fighting facilities.
Gonah	Tourism; El Gonah Resort	3,500,000 m^2	The marina contains 3 docks Berths for 120 yachts with length of 5.6 m up to 50 m 8 berths with length of 700 m and depth from 1.6 m and 3.6 m	Waste collection and treatment station; fire fighting and pollution combating equipment; fresh water, electricity, sewage facilities and fuel.
Hurghada	Tourism Fishing	150,000 m^2 6,000 m^2	Tourism: Max. 220 yachts/month length of 50 m; 130 boats/month. Fishing: Two berths each of 150 m length and 2 m depth	Fresh water; electricity network.
Port Ghalib	Tourist yachts	Water: 125,000 m^2	Port capacity 20 yachts; visits at 2,000 yachts/ year. Berths (first stage): length 3210 m, depth 6.3 m; Pollution control: rubber floating breakwaters, chemical separators and booms for absorbing oils and fuel.	Yacht repair slipway. Facilities for vessel wastes; supply units for pure water, electricity; bunkering services with fuel and oils.

2.5.3 MOST VULNERABLE AREAS

The areas most at threat from land-based sources and therefore with the highest priority for protection from pollution are those most closely associated with the tourism industry (Map 20).



Map 20. Existing and planned tourism locations along the Red Sea Governorate coast.

The challenges facing the Red Sea Governorate with respect to tourism development are identical with those already discussed for South Sinai. Tourism, especially marine tourism, depends on a high quality environment. Although a number of important measures for environmental protection have been taken, consistent enforcement and vigilance is necessary to ensure that potential sources of environmental degradation do not turn into actual sources of degradation.

The key issues will include control of shoreline development and implementation of stringent mitigation measures when necessary to prevent increases in sedimentation and turbidity, assessment and monitoring of diffuse non point sources of pollution especially related to nutrient rich sewage water from hotel gardens, control of desalination effluent, hydrocarbon-based run-off from roads and light industrial areas, and optimal management of recreational activities. The use imported fine sand for hotel beaches should be viewed with caution and prohibited if the sand is found to have a negative effect on local coral reefs.

Again, tourism industry experts note a deterioration in the environment, particularly the coral reef systems, and point to the same stresses and activities leading to this decline in environmental quality:

- coastal development and construction
- tourism related activities (diving, snorkeling, dive boat anchoring, etc.), and
- pollution from oil spills, litter and raw sewage discharge from boats.

To repeat the same message, since tourism is the main engine of growth in the governorate, it would be prudent to make every effort to mitigate any activities that could lead to a decline in the quality of coral reefs and their associated marine life.

3. LEGAL AND INSTITUTIONAL ANALYSIS

Over the past four decades Egypt has adopted a number of laws, decrees and regulations addressing various aspects of environmental protection and natural resources management. More than 26 laws, presidential and ministerial decrees form the legal basis for water resources management in Egypt.

Of those laws and regulations for environmental protection applicable throughout Egypt, a few have particular relevance to land-based activities and the protection of the marine environment from its impacts. These are:

- Law 93/1962 and its amendment No 44/2000 controlling the discharge of liquid effluent into public sewerage networks. The responsibility for implementation lies entirely on the Ministry of Housing, Utilities and New Urban Communities (MoHUNC).
- Law No. 48/1982 which addresses the protection of the Nile River and freshwater waterways. The Ministry of Water Resources and Irrigation (MWRI) is the state authority responsible for its implementation.
- Law 102/1983 or "Law on the Natural Protectorates" and its associated Prime Ministerial decrees regulating activities in protected areas.
- Law 7/1991, and the subsequent Presidential decree no. 274/1991, establishing the Tourism Development Authority (TDA) and regulating management by TDA of state property assigned to the private sector for tourism development; and
- Law 4/1994 and its Executive Regulation as well as their new amendments, or "Law for the Environment", which restructured the Egyptian Environmental Affairs Agency (EEAA) and provided the regulations issued there under.

Through various laws and regulations, many authorities are involved in water quality management in Egypt. Which ones depends on the specific water body in question as well as specific actions and management roles.

3.1 NATIONAL LAWS

3.1.1 PROTECTION OF NILE RIVER AND ITS WATERWAY FROM WASTEWATER DISCHARGE (LAW NO. 48/1982)

The MWRI has assessed the present laws and recognized that:

- There is a need to integrate Law No. 4 and Law No. 48 into an unambiguous environmental law covering the entire environment with enough flexibility and clarity on institutional matters. The use of function-related ambient standards is presently not possible according to Law No. 48;
- Pollution prevention and non-conventional sanitation/treatment should be added to these laws, as it currently considers only conventional treatment; and
- The enforcement of the present effluent standards in Law No. 48 is not practically achievable, and therefore, differentiated standards based on "Best Available Technology" should be set.

3.1.2 ENVIRONMENTAL LAW (4/1994) AND ITS EXECUTIVE REGULATIONS

The Environmental Law (Law No. 4/1994) was drafted to complement existing environment-related legislation rather than replace it, and to address legal gaps or needs that were not adequately addressed by previous laws, such as Law No. 48. Law No. 4 and its executive regulations (1995) define the roles and responsibilities of EEAA, which include regulation of

air pollution, control of hazardous substances, management of hazardous waste and control of discharges to the marine environment.

Law No. 4 gives EEAA diverse legal tools to implement and enforce these provisions. However, environmental standards for water quality are not adequately defined.

The key features of Law No. 4 may be summarized as follows:

- It re-establishes EEAA under the Cabinet of Ministers as the highest national authority in charge of the environment
- It requires all new projects and activities to submit an environmental impact assessment (EIA), and gave EEAA the final responsibility for approving them
- It gives EEAA the power to inspect and enforce the law
- It establishes an environmental fund and mandates EEAA with economic incentives for the protection of the environment
- It addresses gaps in the previous laws (Law No. 48) concerning air pollution, noise, industrial and municipal discharges to the marine environment, hazardous wastes and sanitary land filling; and
- It increases significantly the fines and penalties for violations.

According to Law No. 4, EEAA has the responsibility to formulate general environmental policy as well as plans for environmental protection and to follow up on their implementation in coordination with the competent administrative authorities. In addition, the Agency is responsible for strengthening environmental relations between Egypt and other countries, and regional and international organizations.

Specifically, Law No. 4 mandates EEAA with the following:

- To prepare draft laws and decrees related to the fulfillment of its objectives and express its opinion on proposed legislation related to the protection of the environment;
- To prepare studies on the state of the environment, formulate national plans with projects included for the protection of the environment, prepare estimated budgets for each as well as environmental maps of urban areas and areas to be developed, and lay down the criteria to be observed when planning and developing new areas as well as the criteria targeted for old areas;
- To lay down the criteria and conditions which owners of projects and establishments must observe before the start of construction and during the operation of these projects;
- To conduct field follow-up of compliance with the criteria and conditions that are binding to agencies and establishments and take the procedures prescribed by law against those who violate such criteria and conditions;
- To lay down the principles and procedures for assessing the environmental effects of projects;
- To lay down a plan for environmental training and supervise its implementation;
- To prepare the draft budgets required for the protection and promotion of the environment;
- To propose economic mechanisms to encourage different activities and procedures for the prevention of pollution; and
- To coordinate with the Ministry for International Cooperation to ensure that projects funded by donor organizations and countries are in line with environmental safety considerations.

ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Impact Assessment (EIA) is a major legal tool which EEAA is given under the Law No. 4/1994. It is implemented through its Executive Regulations (Prime Ministerial Decree No. 338 of 1995), which came into full implementation in 1998.

The EIA study is taken into consideration by relevant administrative authorities when deciding whether to grant or reject a license for a project. The EIA consists of a number of procedures determined by Law No. 4 and its Executive Regulation, as well as EIA Principles and Procedures Guidelines issued by EEAA, to ensure environmentally sound and sustainable development choices, and the ability to identify any environmental consequences in the first stages of the planning process.

The Law and Executive Regulation require an EIA for new projects and expansions and renovations of existing ones. Sectoral ministries and governorates are the competent administrative authorities for EIA in Egypt, as they possess the executive powers in relation to development authorization. The Central EIA Department of the EEAA is responsible for supervising the screening process, managing the review of EIA reports, taking decisions on the acceptability of EIA reports and giving an opinion on the development and proposals for mitigation measures.

The specific objectives of each EIA undertaken under Law No. 4 are to:

- Provide a sound basis for the decision-making process in project design;
- Ensure project implementation with full awareness of environmental factors;
- Increase public awareness of the timing and forms of any potential environmental impacts; and
- Facilitate public participation in the decision-making process.

Facilities subject to EIA conditions are classified according to four criteria, (1) Type of activity, (2) Natural resources used, (3) Facility location and (4) Type of energy used. The general guidelines were issued in 1995 and updated in 2003. They describe in detail the screening method which is based on three lists of project types:

- White list projects with minor impacts (Category A);
- Gray list projects which may result in substantial environmental impacts (Category B); and
- Black list projects for which a complete EIA is mandatory due to the magnitude and nature of their potential impacts (Category C).

In terms of water quality, the Environmental Law (Law No. 4/1994) aims to control water quality in marine and coastal waters. Law No. 48/1982 has already set provisions for other waters such as rivers and lakes. Law No. 4 lays down a number of provisions to control coastal and marine water pollution, especially oil pollution likely to be caused by sea-based or land-based sources.

SEA-BASED POLLUTION SOURCES

Law No. 4 Part 3 (Protection of Water Environment from Pollution) Chapter 1 (Pollution from Ships), Section 1 (Oil Pollution) deals with oil pollution caused by sea-based sources such as oil tankers, commercial ships, platforms for oil extraction, etc. The following obligations are imposed on owners of ships, rigs/platforms and companies working in exploration and extraction of oil from the sea through Articles 48-59:

- No dumping or discharge of any oils or oily mixtures into the sea;
- Prompt reporting of spills or leakages resulting from facilities, boats, ships or tankers by the captain or owner of such or by affiliated companies;
- Taking measures and precautions required for preventing the spread of pollution by oil after the occurrence of a pollution incident;
- Preparing the marine platforms and facilities working in oil exploration and extraction through appropriate plans and measures required for marine environmental protection from oil pollution risks;

- Oil tankers shall keep oil registers and make it available for inspection;
- Foreign ships using Egyptian ports or sailing through the special maritime zone shall be equipped with pollution mitigation facilities; and
- Taking all sufficient precautions for the prevention or mitigation of pollution impacts before or after the occurrence of breakdown in a ship or of its equipment and promptly notifying competent administrative authorities immediately about discharges resulting from such breakdowns in a ship or of its equipment.

LAND-BASED POLLUTION SOURCES

At the same time, Part 3, Chapter 2 of Law No. 4 (Pollution from Land-based Sources) defines regulations about various pollutants including oil pollution generated from land-based sources such as industrial and domestic wastewater facilities.

Establishments have to comply with the effluent standards (including oil and greases) for any wastewater discharged. EEAA has the competence to carry out periodical monitoring for compliance checks.

According to Article 1 (clause 34) of the Law, the following establishments are regulated as land-based sources:

- Industrial establishments
- Tourist establishments
- Establishments used for electrical power generation and production
- Mines, quarries and establishments operating in the field of oil exploration, drilling, and transportation
- All infrastructure projects, and
- Any other establishment, activity or project which may have a noticeable impact on the environment

3.1.3 NATURAL PROTECTORATES (LAW NO. 102/1983)

The Nature Protectorates Law (Law No. 102/1983) provides the framework for the protection of terrestrial and marine protected areas. Article (1) states "these areas to be designated and delineated by Decree of the Prime Minister upon the recommendation of the Egyptian Environmental Affairs Agency". The first natural protectorate was Ras Mohamed National Park established in 1983. Elba National Park (Red Sea) was declared in 1986, the Gulf of Aqaba protected by Prime Minister Decree No. 33/1996. The protectorates encompass the waters with one nautical mile around islands and mangrove forests.

Provisions related to water quality in natural protectorates are in place in the articles of Law No. 102, as follows:

- Polluting nature protectorate waters from any source including land or marine sources should be prohibited; and
- The Law mandated EEAA with the protection of the marine environment and processing of violations.

3.2 INTERNATIONAL CONVENTIONS

Egypt has signed or acceded to numerous international conventions (Table 17).

Table 17. International environmental conventions signed/acceded by Egypt.

#	Name of Multilateral Environmental Agreement
1	Convention on Wetlands of International Importance Especially as Water Fowl Habitat (RAMSAR)
2	Convention Relative to the Preservation of Fauna and Flora in their Natural State
3	International Plant Protection Convention
4	African Convention on the Conservation of Nature and Natural Resources
5	Protocol to Amend the Convention on Wetlands of International Importance Especially as Water Fowl Habitat
6	Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)
7	Convention on the Conservation of Migratory Species of Wild Animals (Bonn)
8	Convention on Biological Diversity (CBD)
9	Agreement for the Establishment of the Near East Plant Protection Organization
10	Convention Concerning the Protection of the World Cultural and Natural Heritage
11	United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
12	Agreement for the Establishment of a Commission for Controlling the Desert Locust in the Near East
13	International Tropical Timber Agreement
14	International Tropical Timber Agreement, 1994
15	Protocol Concerning Mediterranean Specially Protected Areas
16	Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean
17	Regional Convention for the Conservation of the Environment of the Red Sea and Gulf of Aden (Jeddah)
18	Agreement for the Establishment of a General Fisheries Council for the Mediterranean
19	United Nations Convention on the Law of the Sea
20	United Nations Convention on Conditions for Registration of Ships
21	International Convention for the Prevention of Pollution of the Sea by Oil
22	International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties
23	Protocol Concerning Cooperation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency
24	Protocol Relating to Intervention on the High Seas in Cases of Pollution by Substances Other than Oil
25	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
26	Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972
27	Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973
28	Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona)
29	Amendment to the Convention for the Protection of the Mediterranean Sea Against Pollution
30	Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft

31	Amendment to the Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft
32	Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources
33	Amendment to the Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources
34	International Convention on Civil Liability for Oil Pollution Damage
35	Protocol of 1992 to Amend the International Convention on Civil Liability for Oil Pollution Damage, 1969
36	Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency
37	International Convention on Oil Pollution Preparedness, Response and Cooperation
38	International Convention on Salvage
39	Convention on Early Notification of a Nuclear Accident
40	Convention Concerning Prevention and Control of Occupational Hazards Caused by Carcinogenic Substances and Agents
41	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal
42	Amendment to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal
43	Bamako Convention on the Ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa
44	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
45	Joint Protocol Relating to the Application of the Vienna Convention (on Civil Liability for Nuclear Damage) and the Paris Convention (on Third Party Liability in the Field of Nuclear Energy)
46	Convention on Nuclear Safety
47	Vienna Convention on Civil Liability for Nuclear Damage
48	Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques
49	Stockholm Convention on Persistent Organic Pollutants (POPs)
50	United Nations Framework Convention on Climate Change
51	Kyoto Protocol
52	Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water
53	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies
54	Vienna Convention for the Protection of the Ozone Layer
55	Montreal Protocol on Substances that Deplete the Ozone Layer
56	(London) Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer
57	(Copenhagen) Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer
58	Convention Concerning the Protection of Workers Against Occupational Hazards in the Working Environment due to Air Pollution, Noise and Vibration
59	Convention Concerning the Protection of Workers Against Ionizing Radiation
60	Treaty Establishing the African Economic Community

Source: EEAA database

3.3 CENTRAL GOVERNMENT INSTITUTIONS

There are a number of environment-related institutions in Egypt which may be classified into the following three categories:

- National environmental organizations represented by the Minister of State for Environmental Affairs (MSEA), the Egyptian Environmental Affairs Agency (EEAA) and its regional branch offices (RBOs) which are charged with overall monitoring and regulatory enforcement and coordination;
- Institutions with specific operational functions on environment which are performed by environment units in line ministries (Table 18), and by environment management units (EMUs) in the governorates; and
- Institutions with environment support roles, such as universities and research institutes.

The Egyptian Environmental Affairs Agency has a central and coordinating role in monitoring, protecting, improving and preventing the deterioration of Egypt's environment.

At the sector level, many line ministries and/or national institutions have a department or unit mandated with environmental management issues. These environmental departments/ units vary in terms of their capacities and experience. However, most of them are relatively newly-established or recently mandated with environmental concerns, and accordingly they have limited environmental management capacity or experience.

Some ministries, by virtue of their mandate, have a mainstream approach towards environmental issues, such as the Ministry of Water Resources and Irrigation (MOWRI), and Ministry of Housing (MOH). In general, it is reported that the mechanisms for coordination with EEAA and those applied within various ministries are unclear in some areas.

3.3.1 NATIONAL POLICY AND STRATEGY

The mandate of the Minister of State for Environmental Affairs (MSEA) is to achieve a harmonized balance between the needs of developing the State, while still protecting her natural resources. The MSEA is required to address the cumulative impact of environmental problems that have built up over the past 40 years, mobilizing investment and building human capacities.

MSEA has prepared the National Environmental Action Plan (NEAP) that includes strategies to deal with these issues and which will have to be implemented through line ministries in collaboration with major stakeholders, such as NGOs and the private sector.

Table 18. Line Ministries with responsibility for environmental protection.

Ministries	Affiliated National Institutions or Divisions	Responsibility
Ministry of Health and Population (MOP)	Central Department for Environmental Affairs General Department for Environmental Health, General Department for Environmental Monitoring General Department for Food Inspection General Department for Occupational and Industrial Health	Setting environmental health policy and regulation of environment related health problems and diseases through environmental health officers. Control and operation of the National Air Pollution and the River Nile Water Quality Networks. Monitoring water quality for drinking and domestic purposes. Monitoring municipal and industrial effluents through sampling.
Ministry of Water Resources and Irrigation (MOWRI)	National Water Research Center Climate Change and Environmental Institute	Protecting all public water resources in Egypt. Regulating and controlling sources of water pollution. Operation of the national surface and groundwater monitoring networks. Issuing regulations setting water quality standards and discharge limits. Facility inspection and reporting violations to the police.
	Shore Protection Authority (SPA)	Protection of coastline against erosion and seawater intrusion.
	Water Quality Management Unit	Policy development, decision support system and monitoring.
Ministry of Housing, Utilities and Urban Communities (MOHUUC)	General Organization for Sanitary Drainage General Department for Control of Industrial Discharge	Provision of water supply, sewage collection and treatment and solid waste management. Planning and construction of new industrial cities. Preparing land use/physical plans.
Ministry of Interior (MOI)	Environment and Surface Water Police	Special police force for enforcement of law 48/82 and law 4/94
Ministry of Agriculture and Land Reclamation (MOALR)	Agriculture Research Center	Management and conservation of agricultural land, wildlife, and biological resources. Preventing soil stripping and protecting land from degradation. Regulating the purchase, importation and handling of pesticides.
Ministry of Foreign Affairs (MOFA)	Department of Environment and Sustainable Development Affairs	Sustainable development

NATIONAL ENVIRONMENTAL ACTION PLAN (1992)

The National Environmental Action Plan (NEAP) of 1992 is the first public document to provide the tools for ensuring that "Egypt's economic growth becomes a sustainable one". It firmly asserts that "Protecting the environment, among other aspects, is one of the key imperatives imbedded in the concept of sustainable development".

POLICY DIRECTIVE OF MSEA (1998)

The policy directives of the Ministry of State for Environmental Affairs (MSEA) were issued in 1998 and updated in 2002 and represent a good start towards establishing an environment management system based on specific programs and outputs that would enable MSEA and EEAA to set specific targets and report on the achievement of those targets. The updated policy directives are as follows:

- Strengthen partnerships at the national level through full coordination with national entities that have environmental projects or activities which will have impacts on the environment
- Support bilateral, regional and international agreements in the environmental field
- Enforce Law No. 4/1994 for the protection of the environment and Law No. 102/83 for nature protection
- Implement environmental protection projects through national, bilateral, multilateral funds
- Support integrated environmental management systems
- Support multilateral environmental agreements to which Egypt is a signatory
- Integrate the use of market-based instruments in the field of environmental protection
- Transfer and adopt environmentally friendly technologies
- Encourage foreign investments in the area of environmental protection through involvement of the private sector, and
- Give support to the policy of decentralization of environmental management

UPDATED NATIONAL ENVIRONMENTAL ACTION PLAN

The updated National Environmental Action Plan (NEAP) of 2002 covers the period from 2002 to 2017. This document is designed to represent Egypt's agenda for environmental actions over the next 15 years. It is also designed to complement and integrate with existing sectoral plans for economic growth and social development. The updating of the NEAP utilized a participatory and consultative approach, whereby several workshops and meetings with stakeholders were conducted to explore their interests, assess assets and resources, and formulate issue-specific working groups to reach a consensus on the issues and priorities as well as directions for future actions.

The NEAP 2002 provides a brief account of the state of the environment by providing information on the following issues:

- Water resources
- Air pollution
- Land issues: Agriculture and human settlements
- Marine environment
- Waste
- Biological diversity
- Bio-safety and biotechnology

The NEAP includes programs and projects that address the aforementioned environmental issues. It also discusses the necessary measures for institutional development. It is viewed as a diagnostic document with qualitative analysis of the environmental issues but with little quantitative analysis for setting priorities, including a plan of strategic actions. In contrast to the NEAP of 1992, this document doesn't provide any cost estimates for the strategic actions proposed, which could make its implementation difficult.

EEAA FIVE-YEAR ACTION PLAN

Based on the NEAP 2002 and the policy directives, EEAA developed its five-year action plan, which includes the following:

- Integrated solid waste management program to achieve sound management of solid waste and healthcare waste in all governorates of Egypt
- Pollution Abatement Program to protect River Nile and water resources and air quality of Greater Cairo
- Environmental education, training and awareness program to increase public awareness of the environmental program and develop human resources within the field of environment
- Environmentally friendly technology transfer and support for Egyptian exports program to promote the use of environmentally friendly technology in all economic activities
- Environmental information and monitoring system program to enhance the use of information technology especially in the field of environmental management
- Nature conservation and biodiversity protection program to conserve national biodiversity
- Capacity development program for EEAA and regional branch offices (RBOs) to support the institutional structure of environmental management at the national level
- Forestation and green area expansion program to support governorates and NGOs in establishing nurseries and carrying out greening projects
- Regional Branch offices of EEAA program to support renovation and establishment of new RBOs at the governorates level, and
- Environmental Protection Fund program

DECENTRALIZATION POLICY OF ENVIRONMENTAL MANAGEMENT

There is a strong policy orientation away from centralized environmental management towards decentralization to the regional and governorate levels. EEAA has set up regional branch offices (RBOs) covering Greater Cairo, West Delta, East Delta, Central Delta, the Suez Canal and Sinai, etc. Several initiatives have taken place to develop the capacities of these RBOs as well as the Environmental Management Units (EMUs) in each of the 29 governorates. Administratively EMUs are a part of each governorate's structure, but operationally they follow EEAA. Support has been given to some governorates in the participatory process of preparing their Governorate Environmental Action Plan (GEAP).

Further support in the future will be needed to ensure sustainability of the progress achieved and to aid in the implementation of the GEAPs. Developments in this area include the creation of a GEAP unit and an EMU unit in EEAA. The EMU unit has been specifically set up to support the cooperation protocol signed between the MSEA and the Ministry of Local Development.

4. STAKEHOLDER ANALYSIS

Stakeholder analysis is a technique that can be used to identify and assess the importance of key people, groups of people, or institutions that may significantly influence the success of an activity or project. Stakeholder analysis is used to:

- Identify people, groups, and institutions that will influence (either positively or negatively) any initiative
- Anticipate the kind of influence, positive or negative, these groups will have on this specific initiative
- Develop strategies to get the most effective support possible for the initiative under consideration and reduce any obstacles to its successful implementation

Knowing that negative or positive impacts will fall upon the environment, local population and national/local economy, major actions are directed to those who control or induce such impacts.

Taking the above into consideration, it was imperative to identify the different stakeholders that have an impact on land-based activities and their affiliations (Table 19) to properly identify the strategies that need to be adopted to promote the National Programme of Action for Protecting the Egyptian Red Sea from Land-Based Activities.

By analyzing the different stakeholders, their interests, importance and influence (Table 20, Figures 3 and 4), it became clear that the Egyptian Environmental Affairs Agency, Ministry of State for Economic Development, Suez Canal Authority, Coastal Governorates and their Local Parliaments, Holding Company for Water and Waste Water Development, and Ministry of Agriculture have the highest influence and potential to promote future plans to control land-based sources of pollution. They are already important players in controlling pollution and preventing deterioration of environmental resources, and they possess the necessary influence and authority to initiate and carry through both policy and procedural changes.

Table 19. List of possible stakeholders controlling land-based activities impacting the Red Sea marine environment.

#	Stakeholder	Affiliation
1	Ministry of Defense and Military Production	Cabinet of Ministers
2	Suez Canal Authority	Prime Minister
3	Coastal governorates	Ministry of State for Local Development
4	Egyptian Mineral Resources Authority (EMRA)	Ministry of Petroleum and Minerals
5	Egyptian General Petroleum Corporation (EGPC)	
6	Egyptian Petrochemicals Holding Company	
7	Governorates local parliaments	Independent
8	Red Sea Ports Authority	Under Secretary for Maritime Transport, Ministry of Transport
9	Port Said Ports Authority	
10	Specialized ports	EGPC/GAFRD/EMRA
11	Egyptian Environmental Affairs Agency (EEAA)	Minister of State for Environmental Affairs
12	General Organization for Physical Planning	Ministry of Housing, Utilities and Urban Development
13	Holding Company for Water and Waste Water Development	
14	Shore Protection Authority	Ministry of water resources and Irrigation
15	Irrigation Research Center	
16	Coastal Research Institute	
17	Fisheries Development Authority	Cabinet of Ministers
18	Ministry of Agriculture and Land Reclamation	
19	Ministry of State for Economic Development	Cabinet of Ministers
20	Tourism Development Authority	Ministry of Tourism
21	National Institute for Oceanography and Fisheries	Ministry of High Education and Scientific Research
22	National Authority for Remote Sensing and Space Sciences	
23	Research institutes and universities	

Table 20. Overview of the different stakeholders, their interests, importance and influence.

#	Stakeholder groups	Interests to the project	Effect of project on interests of the stakeholders [negative (-1), neutral (0), positive (1)]	Importance of stakeholder for success of project [unknown (1), no importance (2), some importance (3), moderate importance (4), very important (5), critical player (6)]	Degree of influence of stakeholder over the project [unknown (1), no influence (2), some influence (3), moderate influence (4), significant influence (5), very influential (6)]
1	Egyptian Environmental Affairs Agency	National/regional management of environmental issues. Prepare draft laws and decrees related to the protection of the environment. Formulate the national strategies/ plans for the protection of the environment. Lay down targets, criteria and conditions that must be observed. Conduct EIA for development projects. Prepare and implement monitoring programmes. Assess the state of environment and propose corrective actions; etc.	1	6	6
2	Ministry of Defense and Military Production	Responsible for national defense and management of military zones	0	4	5
3	Suez Canal Authority	Management of Suez Canal and its banks	1	5	6
4	Coastal Governorates	Local administration, part of the central decision making process. Within their territories, responsible for: development, environment, poverty alleviation, etc.	1	6	4

Table 20. (Continued)

#	Stakeholder groups	Interests to the project	Effect of project on interests of the stakeholders [negative (-1), neutral (0), positive (1)]	Importance of stakeholder for success of project [unknown (1), no importance (2), some importance (3), moderate importance (4), very important (5), critical player (6)]	Degree of influence of stakeholder over the project [unknown (1), no influence (2), some influence (3), moderate influence (4), significant influence (5), very influential (6)]
5	Egyptian Mineral Resources Authority	Management of mineral resources	1	3	3
6	Egyptian General Petroleum Corporation	Control, exploration and exploitation of petroleum resources	1	5	4
7	Egyptian Petrochemicals Holding Company	Development of petrochemical industry	1	5	4
8	Local Parliaments of Governorates	Local administration; part of the constitutional structure of Egypt. Within the governorate borders responsible for: • Monitoring development • Monitoring well-being of the local population • Solving conflict of interests	1	6	5
9	Red Sea Ports Authority	Regional/local management of ports	1	4	4
10	Port Said Ports Authority	Regional/local management of ports	1	4	4

Table 20. (Continued)

#	Stakeholder groups	Interests to the project	Effect of project on interests of the stakeholders [negative (-1), neutral (0), positive (1)]	Importance of stakeholder for success of project [unknown (1), no importance (2), some importance (3), moderate importance (4), very important (5), critical player (6)]	Degree of influence of stakeholder over the project [unknown (1), no influence (2), some influence (3), moderate influence (4), significant influence (5), very influential (6)]
11	Specialized ports	Local/sectoral management of ports	0	4	4
12	General Organization for Physical Planning	National physical planning	0	2	6
13	Holding Company for Water and Waste Water Development	National water supply/management of wastewater	-1	5	5
14	Shore Protection Authority	Coastal defense management	1	4	3
15	Irrigation Research Center	Various mandates toward water management	0	4	4
16	Coastal Research Institute	Research in shoreline protection	1	4	3
17	Fisheries Development Authority	Fisheries and aquaculture development	1	5	2
18	Agriculture Research Center	Various mandates toward aquaculture/ agriculture practices and uses of pesticides	1	6	4
19	Ministry of State for Economic Development	Economic development	0	6	6
20	Tourism Development Authority	Tourism development	1	4	4
21	Research institutes and universities	Variable research	1	4	2

Figure 3. Different stakeholders, their importance and influence.

		Importance					
		Unknown (1)	Little/no (2)	Some (3)	Moderate (4)	High (5)	Critical (6)
Influence	Unknown (1)						
	Little/no (2)				21	17	
	Some (3)			5	14, 16		
	Moderate (4)				9, 10, 11, 15, 20	6, 7	4, 18
	High (5)				2	13	8
	Very influential (6)		12			3	1, 19

Figure 4. Influence and importance of stakeholders in decision making processes.

5. RISK ASSESSMENT

Risk assessments are tools that help systems at risk (organizations, communities, regions, states, and countries) transform their visceral reactions to threats into rational strategies for risk reduction. Type I errors in risk assessment occur when situations are predicted that do not occur (risk is overestimated). Type II errors in risk assessment occur when situations are not predicted that do occur (risk is underestimated). Errors in risk assessment may be reduced through strategies that optimize risk assessment, including the:

a. Adoption of a unified definition of risk and other terms

b. Specification of the system at risk and situations of interest (hazard, event, damage, and health disaster)

c. Adoption of a best practice approach to risk assessment methodology

d. Assembly of the requisite range of expert participants and information

e. Adoption of an evidence-based approach to using information

f. Exclusion of biased, irrelevant, and obsolete information, and

g. Complete characterizations of any underlying fault and event trees

There are basically two types of risk assessment undertaken—qualitative and quantitative. The quantitative approach requires vast amounts of data across different sites and requires significant resources to establish a numerical evaluation of the level of risk. The qualitative approach uses risk in a comparative way to identify if one activity carries higher risk than another. It allows identification of activities which result in higher levels of risk, without the need to determine the absolute value of the risk. This alone dramatically reduces the cost and time of the assessment and can provide the key information needed to establish priority and thus inform the initiation of an adequate management system.

Ecological risk assessment is the process of estimating likelihoods and consequences associated with the effects of human actions or natural events on ecosystems of ecological value (SA/SNZ, 2000[4] and Barnthouse & Suter, 1986[5]). These risks may be biological (e.g., predation, invasive species), physical (e.g., drought, flood) or chemical (e.g. toxic chemicals). Others may be social, political or economic in origin. Therefore, ecological risk assessment is not confined to purely ecological issues but must address a wide range of issues that may be important in influencing ecological outcomes.

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4 AS/NZS (2000). *Environmental Risk Management: Principles and Practice, Standards Australia & Standards New Zealand, HB203,* Australian Standards International Ltd, Sydney.

5 Barnthouse, L.W. and Suter, G.W. (Eds.) (1986). *User's Manual for Ecological Risk Assessment.* ORNL-6251. Oak Ridge National Laboratory, Oak Ridge, TN.

The formula of Fournier d'Albe (1979)[6] was adopted to identify the risks and priorities for action, taking into account the principle of 'the Highest Risk is the Highest Priority'. According to d'Albe, disaster risk is a function of Hazard, Vulnerability and Preparedness. It may be conceptualized as follows:

$$\text{Risk} = \frac{\text{Hazard (H)} * \text{Vulnerability (V)}}{\text{Preparedness or Manageability (M)}}$$

using the following definitions:

Risk	Expected losses (i.e. the probability or likelihood of a specified negative consequence to life, well-being, property, economic activity, environment, and other specified values) due to a particular hazard (or group of hazards) for a given area and time period.
Hazard	The probability or likelihood of a potentially damaging event occurring in a unit of time, often expressed as the probability of occurrence of a given magnitude of event. It is a function of Intensity, Frequency/ Likelihood, Extent and Time Frame.
Vulnerability	A set of prevailing and consequential conditions—physical, social, and attitudinal—which adversely affects a community's ability to prevent, mitigate, prepare and respond to the impact of a hazard event. Vulnerability is about Susceptibility and Resilience under the threat of a hazard event.
Susceptibility	Proximity and exposure to an event. It is the potential to incur harm or avoid loss.
Resilience	Access to resources and capacities which determine the ability to recover from the impacts of a hazard event.
Manageability	The degree to which a community can intervene and manage a hazard in order to reduce its potential impact. This implies that based on people's perception of their disaster risk, they are able to make decisions to adapt to, modify or ignore the risk.
Capacity	Those positive conditions or recourses which increase the ability of a community to deal with hazards. Capacity may have physical, social, organizational, attitudinal, and motivational components.
Preparedness	Denotes the measures taken in anticipation of a disaster to ensure that appropriate and effective actions are taken in the aftermath of a hazard event. Preparedness activities are designed to help save lives and minimize damage by preparing people to respond appropriately.

Nine hazard sources have been identified as the main sources of degradation of the Red Sea coastal and marine environment. They include contaminants from various different sources (sewage, industrial, agricultural, etc.), physical alteration and destruction of habitat, tourism activities and stakeholder conflicts. The hazard components (Table 21) includes the likelihood of an event taking place, its intensity and importance.

[6] Fournier d'Albe, E.M. (1979). Objectives of volcanic monitoring and prediction. *Journal of the Geological Society of London*, 136, p. 321-6.

Table 21. Hazard components.

Hazard	Likelihood	Intensity	Importance
Sewage			
Industrial Effluent			
Oil Pollution			
Agricultural Practices			
Physical Alteration of the Habitat			
Litter			
Tourism Activities			
Filling and Dredging			
Stakeholder Conflict			

High/Will occur = 3 Medium/May occur = 2 Low/Not likely to occur = 1

Seven ecosystem resources were identified as the most vulnerable to the consequences of hazards within the Red Sea. Table 22 presents the vulnerability components.

Table 22. Vulnerability components.

Resources / Hazard	Fisheries & Fish Farming	Water Quality	Public Health	Mangrove	Corals	Tourism & Recreation	Economy
Sewage							
Industrial Effluent							
Oil Pollution							
Agricultural Practices							
Physical Alteration of the Habitat							
Litter							
Tourism Activities							
Filling and Dredging							
Stakeholder Conflict							

Highly Vulnerable = 3 Vulnerable = 2 Low Vulnerability = 1

Manageability is the capability of the system with its vulnerable resources to deal with the hazards imposed from different sources. Table 23 represents the manageability components.

Table 23. Manageability components.

Components / Hazard	Environmental Planning	Monitoring/ Inspection	Public Awareness	Legislation	Enforcement	Early Warning System
Sewage						
Industrial Effluent						
Oil Pollution						
Agricultural Practices						
Physical Alteration of the Habitat						
Litter						
Tourism Activities						
Filling and Dredging						
Stakeholder Conflict						

Good = 3 Modest = 2 Poor = 1

After applying the figures to the equation, it is apparent from Figure 5 that the primary risk is conflict of interest between stakeholders. This is followed by physical alteration and destruction of habitat and then by filling and dredging activities. The lowest risk is from tourism activities.

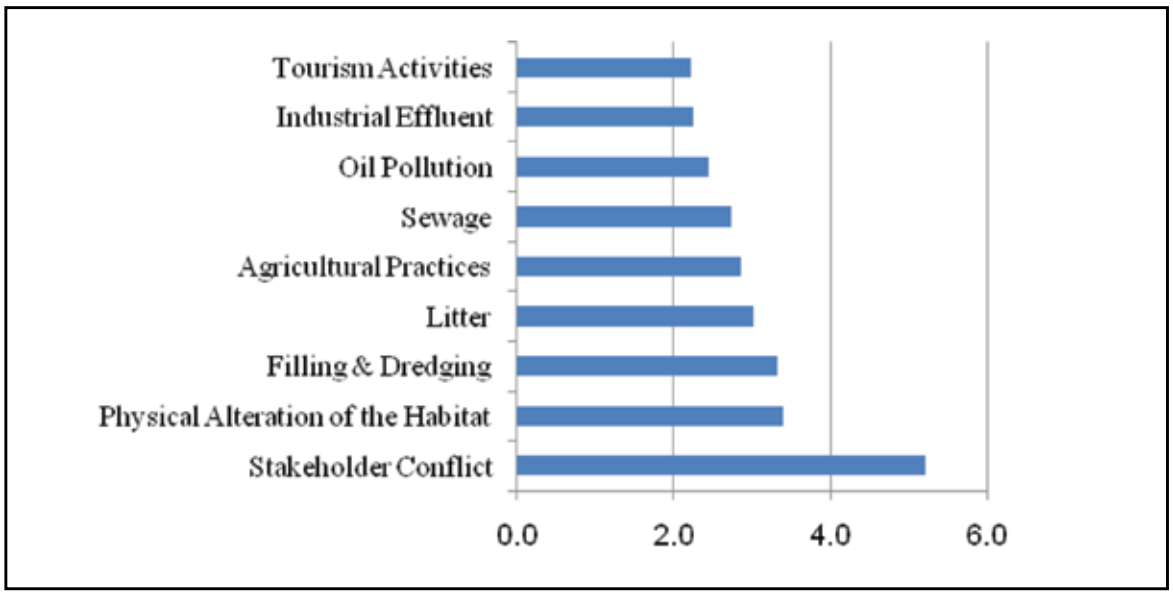

Figure 5. Risks from land-based activities.

It is quite clear from Table 24 that the risks, or the priorities for action, differ between the three water bodies under consideration—Suez Canal, Gulf of Suez and Red Sea and Gulf of Aqaba.

Filling and dredging is the hazard with the highest priority for attention in the Suez Canal, followed in order of priority by stakeholder conflict and the physical alteration and destruction of habitat. Tourism activities cause the lowest risk to the environment.

For the Gulf of Suez, stakeholder conflict is the primary hazard followed by sewage and contaminants (industrial and oil). The hazard with lowest priority is filling and dredging.

The Egyptian Red Sea and the Gulf of Aqaba share with the Gulf of Suez stakeholder conflict as the hazard producing highest risk. However, as tourism is the major economic activity, physical alteration and destruction of habitat appears as the second highest risk or priority for action. Industrial effluent is at the lower end of the risk scale and ranked the lowest priority for action.

Table 24. Risk/priorities for action for the coastal and marine environment of the Suez Canal, Gulf of Suez, Red Sea and Gulf of Aqaba.

Priorities for Action in the Suez Canal

Source of Hazard	Risk/ Priorities
Filling and Dredging	4.41
Stakeholder Conflict	4.33
Physical Alteration of the Habitat	3.59
Agricultural Practices	3.00
Sewage	2.29
Oil Pollution	1.87
Industrial Effluent	1.86
Litter	1.35
Tourism Activities	0.76

Priorities for Action in the Gulf of Suez

Source of Hazard	Risk/ Priorities
Stakeholder Conflict	5.6
Sewage	4.0
Industrial Effluent	3.5
Oil Pollution	3.3
Litter	3.1
Agricultural Practices	2.9
Tourism Activities	2.6
Physical Alteration of the Habitat	1.7
Filling and Dredging	1.6

Priorities for Action in the Red Sea and Gulf of Aqaba

Source of Hazard	Risk/ Priorities
Stakeholder Conflict	5.71
Physical Alteration of the Habitat	4.83
Litter	4.57
Filling and Dredging	3.92
Tourism Activities	3.33
Agricultural Practices	2.71
Oil Pollution	2.14
Sewage	1.93
Industrial Effluent	1.40

6. PRIORITIES FOR ACTION

Primary risks (the priority issues) likely to cause deterioration to the marine environment of the Egyptian Red Sea were established on the basis of the nature and severity of the problem, the type of contaminants, the physical alteration and destruction to habitats, the sources of degradation, and the nature and extent of the affected area.

The severity of the problem was assessed on the basis of food security, public health, coastal and marine resources, ecosystem health, and economic and social benefits and uses. On the basis of the issues considered in the previous sections, it is evident that the main land-based sources of pollution originate from continuous coastal development projects, sewage treatment facilities, and industrial facilities.

Though stakeholder conflict had a high risk/priority rating for all water bodies, this was mainly due to the spread of issues related to stakeholder conflict all over the region. Applying the Participatory Approach is the only remedy for this issue and will be taken into consideration while preparing the Action Plan.

Leaving aside 'stakeholder conflict', an analysis of the above priority issues filtered on the basis of type of pollutant, severity of impact, area affected and economic considerations, revealed the following:

Filling and dredging in the Suez Canal shows as a high risk factor. However, the Canal is of fundamental importance to the economy of Egypt and cannot exist without continuous dredging of the navigational and approach channels. Hence sewage and industrial effluent take on higher priorities. Handling (collection, treatment and disposal) of domestic and municipal wastes in an environmentally sound manner should be considered one of the country's top priorities, especially around the main cities of Ismailia and Suez.

Although physical alteration and destruction of marine habitats was ranked with a lower priority after assessing the severity of the problem, it is quite apparent that dredging and filling operations have caused considerable damage to marine life and key habitats. The widespread impact of sediments with a high content of organic matter has been observed in Lake Timsah, and on the west coast of Bitter Lakes, where such sediments have formed a thick anoxic veneer of fine sediment on the surface of seagrasses and shallow water communities resulting in their death.

The issue of persistent organic pollutants is of particular importance because of the substantial use of pesticides, insecticides, and herbicides for agricultural purposes. As mentioned before, considerable agricultural activities have been established in the Suez Canal and the Suez Bay area. Fertilizer and pesticide residues are being discharged into them as a result of agricultural run-off. The high nutrient load entering the marine environment can result in significant eutrophication.

Contaminants carried by air were not assessed as no proper surveys have been carried out to judge the severity of the problem. However, logic suggests that problems do exist that may be related to air pollution. For this reason, air pollution was taken into consideration while preparing the Action Plan.

Recommendations for the Action Plan

1. Environmental protection should necessarily be included in all development strategies.

2. Coastal and marine pollution from fertilizer and chemical industries in Suez should be prevented. Industrial discharges, especially from fertilizer and chemical industries, should be monitored on a regular basis to ensure their compliance with local standards and criteria set for effluent discharge into the marine environment.

3. Discharge of untreated or partially treated sewage causing coastal and marine pollution of the Suez Canal lakes and the Suez Canal should be prevented. Urgent steps have to be taken to enforce safe effluent standards, taking into account internationally agreed guidelines. Wastewater treatment and disposal quality criteria should be established and implemented, and an effluent quality-monitoring programme should be implemented, to ensure compliance with the stated discharge criteria and standards. Care should be taken to ensure that the location and design of marine outfall systems to discharge treated effluents into the sea meet the appropriate environmental quality criteria, i.e. avoid the exposure of shell fisheries, water intakes, and bathing areas to pathogens. Also, avoid the exposure of sensitive environments (such as lagoons, bivalve beds, seagrasses, etc.) to excess nutrient loads.

4. The deleterious effects of continued shoreline alteration, dredging and land-filling on the coastal and marine environment should be minimized. Effective controls for the dredging and filling of coastal and marine areas for urban and industrial development, port construction, as well as maintenance and dredging of navigational channels, should be developed and implemented.

5. A comprehensive monitoring and assessment programme should be established to provide baseline information with respect to marine environmental resources and biodiversity. The programme should deal with two major aspects: coastal oceanographic processes and an assessment of the coastal ecosystems in the Suez Canal lakes and Gulf of Suez, their biodiversity and productivity.

6. A water-quality monitoring programme should be established, to assess current marine water quality, and measures established for maintaining and improving water quality. The monitoring programme should include monthly baseline testing at selected locations both along the coast (including bathing areas) and in offshore waters, so as to assess the horizontal and vertical distribution and movement of nutrients, fecal coliforms, algae, dissolved oxygen, salinity, temperature, turbidity, total organic carbon, total solids, etc.

7. Modeling of the assimilation capacity of the Suez Canal's lakes, Suez Bay, and of similar semi-closed water bodies is urgently needed in order to understand the movement, residence and degradation of contaminants. This information is necessary to determine the standards required for controlling the quality and quantity of effluents permitted for discharge into the Bay. Major factors are climatic conditions, the current system, and the residence time of water in the Bay.

8. Daily discharges of freshwater into the Suez Canal lakes and Suez Bay need to be reduced. Diverting freshwater flow for urban development can improve both marine and terrestrial habitats if this water is used to cultivate green streets and green belts around towns and cities.

9. Considerable progress has been made in the region in the collection and treatment of municipal wastewater; however, investments continue to be required for extension of collection networks, expansion and upgrading of treatment facilities, and development of safe wastewater reuse. Serious efforts are also needed to ensure proper operation and maintenance and reliable performance of existing treatment facilities.

7. SETTING STRATEGIES AND TARGETS

The aims of the strategy are to contribute to maintaining and, where appropriate, restoring the productive capacity and biodiversity of the Egyptian Red Sea coastal and marine environment, ensuring the protection of human health, and promoting the conservation and sustainable use of marine living resources.

With the absence of proper baseline studies and an adequate diagnostic study, the proposed priorities for action are based on the Global Programme of Action (GPA), that gives priority to substances that are toxic, persistent and liable to bio-accumulate, in particular persistent organic pollutants (POPs), as well as to wastewater treatment and management. Egypt has adopted the Mediterranean Strategic Action Programme to Address Pollution from Land-Based Activities (MAP Technical Reports Series No. 119, 1998) and the Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden (2005). Both documents were used while setting the general priorities for action for the prevention, reduction and elimination of pollution, also taking into account four pollution-related factors:

- Degradation of the marine environment
- Perturbation of biological diversity
- Land-based origin, and
- Trans-boundary nature (causes or effects)

The following guiding principles were also considered in order to protect the environment and contribute to the sustainable development of Egypt's Red Sea:

- Application of the precautionary principle, by virtue of which where there are threats of serious or irreversible damage, the lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- Application of the polluter pays principle, by virtue of which the costs of pollution prevention, control and reduction measures are to be borne by the polluter, with due regard to the public interest.
- Undertaking environmental impact assessments for proposed activities that are likely to cause a significant adverse impact on the marine environment and are subject to an authorization by competent national authorities.
- According priority to integrated pollution control as an important part of the move towards a more sustainable balance between human activity and socioeconomic development, on the one hand, and the resources and regenerative capacity of nature, on the other.
- Commitment to the promotion of integrated coastal zone management, taking into account the protection of areas of ecological and landscape interest and the rational and sustainable use of natural resources.
- Ensuring that, in compliance with the community right-to-know, the competent authorities shall give to the public appropriate access to information on the state of the environment.
- Ensuring routine and standardized reporting of toxic emissions to air, water and land (including off-site disposal) by polluting facilities—private, public or owned by the government and ensuring active public dissemination by the competent authorities of the data reported, bearing in mind legitimate needs for business confidentiality.

7.1 STRATEGY

The proposed strategy aims to improve the quality of the marine environment by better shared-management of the land-based sources of deterioration. It also aims to facilitate Egypt's implementation of the GPA/PERSGA principles to safeguard the coastal and marine environment of the Red Sea. Therefore, it is designed to assist Egypt in taking actions within

its respective policies, priorities and resources, which will lead to the prevention, reduction, and/or elimination of the sources of degradation to the marine environment, as well as for its recovery from the current impacts of land-based activities.

A number of strategies and measures were identified to address the existing land-based pollution activities. The following measures will reduce risks to the marine environment from both point and non-point sources:

Strategy 1: Improve legislation, environmental management and institutional arrangements

One of the major obstacles facing the protection of the coastal and marine environment from degradation caused by land-based sources is the conflict of responsibilities between different Competent State Authorities, ambiguity of laws and non-adoption of integrated solutions to problems.

To overcome this situation, legislation needs to be improved, simplified and responsibilities better defined. Decentralization, in its proper meaning, and integrated environmental management techniques need to be adopted.

Strategy 2: Improve allocation of fiscal resources and maximize the use of available resources

Perhaps the most important and influential factor for preventing environmental degradation is the availability of sufficient financial resources in due time and the proper use of such resources to solve the root causes of degradation, rather than the application of cosmetic solutions.

This can only be ensured by a proper identification of the problems through a well designed, frequently updated, Diagnostic Analysis Study of the land-based sources of pollution to the coastal and marine environment.

Strategy 3: Proper management of waste (including agrochemicals, pesticides, solid waste and sewage)

In the coastal and marine environment of the Suez Canal and the Gulf of Suez, waste including agrochemicals, pesticides, solid waste and sewage contribute considerably towards polluting the environment. Proper management of waste is needed to minimize and reduce this pollution.

Strategy 4: Proper management of industrial waste

Industrial waste (including from the shipping industry) is a major concern in the coastal and marine environments of the Suez Canal and the Gulf of Suez. Proper management of these industries is needed to reduce pollution from industrial sources.

Strategy 5: Capacity building (training, awareness, research and monitoring)

At the national level, coordinating bodies and research facilities should be strengthened for systematic detection and analysis of marine pollution, for environmental impact assessment and the development of control recommendations. At the local level, government, non governmental organizations and intergovernmental agencies should come forward to

mobilize communities so that they will be more inclined to adopt techniques and activities that are sustainable. Training and awareness programmes aimed at particular focus groups should be promoted.

Strategy 6: Establishment of central database directory and information system

Perhaps the greatest barrier towards the development of coastal-based management projects is the unavailability or inaccessibility of useful data. The extent of environmental damage caused by existing sectors such as ship scrapping and aquaculture should be assessed. A database should be developed for proper management of the resources and to fulfill future demands.

Data and information collected should be stored in a centralized system that enables storage, modification and extraction of information for users. The directory needs to consist of, but not be limited to, the following:

- Land-use zoning maps indicating the types and uses of land in coastal areas with the aim of assisting in the future land use planning process
- A directory of all industries in the coastal zones indicating their location, type, and other parameter sets to assess their impact on coastal ecosystems
- An environmental directory indicating the ecosystem conditions, species abundance, etc., in coastal areas

Strategy 7: Ensure preparedness to address man-made or natural disasters

The occurrence of flood, tidal surges, cyclones, earthquake and more recently tsunamis in coastal areas has increased the need for the development of proper adaptation measures against these natural disasters. Moreover, Egypt's coastal areas are highly vulnerable to the future impacts of climate change which will not only cause an increase in sea level but will also aggravate the frequency and magnitude of natural disasters.

Strategy 8: Stop physical alteration and destruction of habitat

Coastal ecosystems are highly dynamic in nature. To protect the coastal and marine ecosystem and ensure sustainable environment as well as livelihood improvement, large scale rehabilitation of degraded coastal and marine ecosystems is a priority.

7.2 TARGETS AND NATIONAL ACTIONS

In the absence of a proper baseline study of the land-based sources of degradation of the coastal and marine environment of the Egyptian Red Sea, the proposed targets and actions are set for the area in general.

As previously mentioned, the priority actions for the prevention, reduction and elimination of pollution are established taking into account four pollution-related factors, namely: degradation of the marine environment, perturbation of biological diversity, land-based origin, and trans-boundary nature (causes or effects).

Table 25 summaries the major problems and the most probable root causes of coastal and marine degradation due to land-based activities. Table 26 gives the root causes and type of actions that can address them and that can form the basis of the National Action Plan for Egypt.

Table 25. Major problems and their root causes.

Major types of problems	Transboundary elements of major types of problems	Main root causes*	Types of action*
Degradation of coastal and marine ecosystems	• Damage to ecosystems, including loss in productivity, biodiversity and stability • Reduction of regional values • Decreased quality of life • Degradation due to pollution and eutrophication • Region-wide loss of revenue	Management Financial Legal Human Stakeholders	Planning Resources
Unsustainable exploitation of coastal and marine resources	• Impacts on habitats and biodiversity • Impacts of physical changes on coastal and beach dynamics • Loss of existing and potential income from fishing and tourism • Conflicts between user groups	Management Financial Stakeholders Human Legal	Planning Resources
Loss of habitat supporting valuable living resources	• Damage to migratory species and their habitats • Endangered biotic resources • Loss of value for development • Habitat and food web changes	Management Financial Stakeholders Human Legal	Planning Resources
Decline in biodiversity of endangered species and introduction of non-indigenous species	• Loss of regional values • Damage to endangered and endemic species of regional and global significance • Loss of genetic biodiversity	Management Financial Legal Human Stakeholders	Planning Resources
Inadequate protection of coastal and marine environment, increased hazards and risks	• Reduction of regional values • Loss of revenues • High costs of curative interventions • Decreased quality of life	Management Financial Legal Human Stakeholders	Planning Resources
Worsened conditions for human life	• Human health impacts • Costs of dealing with human migration • Reduced human and institutional capacity • Reduction of development potential • Increased poverty with trans-boundary impacts and implications	Management Financial Legal Human Stakeholders	Planning Resources
Inadequate implementation of existing regional and national legislation	• Ineffective protection of the marine and coastal environment • Inadequate monitoring of pollution and consequently inadequate data interpretation for managerial purposes • Poor public education and awareness regarding scientific and economic values and technical options	Legal Management Financial Human Stakeholders	Planning Resources

* Main root causes and types of action are indicated in descending order of significance.

Table 26. Possible root causes and type of actions.

MAIN ROOT CAUSES	
LEGAL Inadequate legal and institutional framework	• Inadequate cooperation at the regional level • Inadequate legislation at the national level relevant to regional problems • Inadequate institutional framework and capacity necessary for the implementation of legislation, ICZM and EIA • Inadequate pollution compliance and trend monitoring • Ineffective coordination between various government sectors and local and national levels
MANAGEMENT Inadequate planning and management at all levels	• Poorly coordinated inter-sectoral planning and management • Lack of integrated watershed/coastal zone management plans • Lack of application of ICZM and its tools • Inappropriate harvesting practices in fisheries • Inadequate pollution control strategies with monitoring
HUMAN Insufficient human and institutional capacity	• Inadequate human and institutional capacity for the implementation of the legislature and ICZM with its tools • Inadequate human and institutional capacity for compliance and trend monitoring of pollution
STAKEHOLDERS Insufficient involvement of stakeholders	• Lack of general environmental awareness • Poor identification of stakeholders • Lack of adequate participation of stakeholders in the planning and management of environmental problems
FINANCIAL Inadequate financial mechanisms and support	• Lack of effective economic instruments • Lack of internalization of environmental costs • Low monetary value assigned to environment within national economic policies
TYPES OF ACTION	
PLANNING Integrated planning and management and reduction of pollution	• Improvement of legal and institutional framework at regional and national level for ICZM and associated tools • Development of integrated management for river basin / coastal areas and for urban agglomerations • Improved involvement of stakeholders in environmental decision making • Identification and elimination of pollution hot-spots • Adequate compliance, trend monitoring and implementation of relevant regional and national legislation
RESOURCES Resources management	• Full implementation of relevant regional and national legislation • Sustainable management of resources • Protection of biodiversity, endangered, endemic and migratory species, habitats and sensitive areas • Development of sustainable fisheries, aquaculture and tourism

7.2.1 MUNICIPAL SEWAGE

Municipal sewage improperly discharged into freshwater and coastal environments may present a variety of hazards. These are associated with:

- pathogens that may result in human health problems through exposure via bathing waters or contaminated shellfish
- suspended solids
- significant nutrient inputs
- plastics and other marine debris
- ecosystem population effects
- heavy metals and other toxic substances, e.g. hydrocarbons, where industrial sources may discharge into municipal collection systems, and
- influx of rainwater containing polluting substances

Environmental effects associated with domestic wastewater discharges are generally local but with trans-boundary implications in certain geographic areas. Domestic wastewater discharges are considered by UNEP as one of the most significant threats to coastal environments worldwide.

Most of the secondary treatment plants are not operated and maintained adequately due to insufficient financial resources and a lack of technical expertise. Many countries are now placing special emphasis on designing wastewater treatment facilities to reuse effluents.

PROPOSED TARGETS

- *To dispose of all municipal wastewater (sewage) in conformity with the provisions of regional protocols and national legislation.*

- *To dispose of sewage from cities and urban centers in conformity with the provisions of regional protocols and national legislation.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Update and adopt, over a period of two years, national regulations concerning sewage discharge into the sea and rivers, which take into account the annexes of regional protocols and national legislation.

- Develop national plans and programmes for the environmentally sound management of sewage:
  - ensure that coastal cities and urban agglomerations are connected to a sewerage system and dispose all wastewater in conformity with a national regulation system;

  - ensure that coastal outfalls are located so as to obtain or maintain agreed environmental quality criteria and to avoid exposing shell fisheries, water intakes, and bathing areas to pathogens and to avoid the exposure of sensitive environments (such as lagoons, seagrass beds, etc.) to excess nutrient or suspended solid loads;

  - promote the primary, secondary and, where appropriate and feasible, tertiary treatment of municipal sewage discharged to rivers and associated canals, estuaries and the sea;

  - promote and control the good operation and proper maintenance of existing facilities;

  - promote the reuse of the treated effluents for the conservation of water resources. To this end, infrastructural measures, treatment at source and the segregation of industrial effluents, shall be encouraged, as well as:

  - the beneficial reuse of sewage effluents and sludge by the appropriate design of treatment plant and processes and controls on the quality of influent wastewaters in accordance with national regulations

  - environmentally sound treatment when domestic and compatible industrial effluents are treated together

- Promote the separate collection of rainwater and municipal wastewater and ensure treatment of rainwater considered particularly polluting.

- Identify the availability and sustainability of productive uses of sewage sludge, such as land-spreading, composting, etc.

- Prohibit the discharge of sludge into water in the Regional Protocol Area.

7.2.2 URBAN SOLID WASTE

Urban solid waste can affect pollution of the sea in a number of ways: through the release of raw waste into the sea, directly or indirectly, especially plastics, and through emissions into the atmosphere of pollutants which may be generated by the combustion of these waste products.

PROPOSED TARGETS

- *To base urban solid waste management on reduction at source, separate collection, recycling, composting and environmentally sound disposal.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Develop national plans and programmes for the reduction at source and environmentally sound management of urban solid waste.

- Establish environmentally suitable and economically feasible systems of collection and disposal of urban solid waste in cities and urban agglomerations.

- Promote the reduction and recycling of urban solid waste.

7.2.3 AIR POLLUTION

Air pollution is an undeclared problem in cities in the region. Concentrations of particulates and lead (Pb) often exceed WHO guidelines by a multiple of two to five in cities near refineries and near fuel-oil fired power plants and industries. Vehicles are a major source of urban air pollution. Air pollution in cities has a substantial impact on human health.

PROPOSED TARGETS

- *The levels of air pollutants in cities shall be in conformity with the provisions of the national legislation and internationally agreed provisions.*

- *The levels of air pollutants in cities exceeding 100,000 inhabitants and in areas of concern shall be in conformity with national legislation and internationally agreed provisions.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL FOR MOBILE SOURCES

- Promote traffic management and give priority to the use of public transport.
- Promote the use of lead-free petrol and low-level aromatic hydrocarbon petrol.
- Improve the inspection and maintenance of vehicles and the renovation of the oldest vehicles (through economic incentives).
- Pursue increased regional and domestic natural gas development in order to substitute high sulphur fuel oil with natural gas and natural gas conversion for urban proximities.
- Promote the introduction of buses using gaseous fuel or other alternative forms of energy instead of diesel oil.
- Support and encourage the participation of the public transport services in the above activities.

7.2.4 INDUSTRIAL DEVELOPMENT

Industrial development in the Red Sea area varies greatly but its capacity to generate pollution and cause damage to the environment is unanimously recognized.

At the international level, priority has been given to pollutants that are toxic[7], persistent and bio-accumulate due to their deleterious effects on human health, biodiversity and ecosystems and their long-term and long-distance effects. A lower priority has been accorded to pollutants that are toxic but non-persistent and do not bio-accumulate such as suspended solids, biodegradable organic matter and nutrients. This is because their effects are much more localized and less persistent.

The governorates bordering the Suez Canal and the Gulf of Suez have an important public and private industrial sector which is composed of large industries. The public industrial sector includes: energy production, oil refineries, petrochemicals, ceramic and tile production, fertilizer production, cement production, and others.

A programme to reduce and to the fullest extent possible eliminate industrial pollution should be applied by all the industrial installations. It could start with public sector enterprises, which would set an example and encourage private companies.

PROPOSED TARGETS

- *Point source discharges and air emissions into the Regional Protocol Area from industrial installations to be in conformity with agreed international and national provisions.*
- *Over a period of 10 years, to reduce by 50% discharges, emissions and losses of substances from industrial installations that are toxic, persistent and liable to bio-accumulate.*
- *Over a period of 10 years, to reduce by 50% discharges, emissions and losses of polluting substances from industrial installations in hot spots and areas of concern.*

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7 Toxicity includes endocrine disrupting effects

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Make or update in as short a period as possible an inventory of point source discharges and emissions of pollutants in hot spots and areas of concern.

- Make or update in as short a period as possible an inventory of point source discharges and emissions of pollutants from the public industrial sector.

- Prepare or update and adopt, as soon as possible, national regulations concerning point source discharges of industrial wastewater into the Regional Protocol Area which take into account the guidelines, common criteria and standards adopted by the Parties.

- Give priority to the environmental problems of small and medium-size companies, favoring the creation of associations in order to minimize waste generation and achieve a joint handling of their wastewater.

- Reduce discharges and emissions of pollutants as much as possible and, in order to do so, promote the implementation of environmental audits and apply Best Environmental Practices (BEP) and, if possible, Best Available Techniques (BAT) in industrial installations that are a source of pollutants.

7.2.5 SUBSTANCES THAT ARE TOXIC, PERSISTENT AND LIABLE TO BIO-ACCUMULATE

Substances that are toxic, persistent and liable to bio-accumulate (TPBs) include organic (e.g. persistent organic pollutants [POPs]), inorganic chemicals such as heavy metals (Hg, Cd and Pb), and some organometallic compounds.

7.2.5A PERSISTENT ORGANIC POLLUTANTS

Persistent organic pollutants (POPs) are a set of organic compounds that: (i) possess toxic characteristics including effects on the function of the endocrine system, (ii) are persistent, (iii) are liable to bio-accumulate, (iv) are prone to long-range transport and deposition, and (v) can result in adverse environmental and human health effects at locations near and far from their source. POPs are typically characterized as having low water solubility and high fat solubility. Once dispersed, clean-up is rarely possible. Because many POPs are relatively volatile, their re-mobilization and long-distance redistribution through atmospheric pathways often complicates the identification of specific sources.

Most POPs are anthropogenic in origin. Anthropogenic emissions, both point and diffuse, are associated with industrial processes, product use and applications, waste disposal, leaks and spills, and combustion of fuels and waste materials.

PROPOSED TARGETS

- *To phase out inputs of the 9 pesticides and PCBs and reduce to the fullest extent possible inputs of unwanted contaminants: hexachlorobenzene (HCB), dioxins and furans.*

- *To reduce by 50% inputs of the 12 priority POPs.*

- *To collect and dispose all PCB waste in a safe and environmentally sound manner.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Make, over a period of two years, an inventory of quantities and uses of the nine pesticides and PCBs, as well as of the industries which manufacture or condition them.

- Phase out the use of the nine pesticides, except those uses which involve the safeguarding of human life when the latter is in danger or when a risk/benefit analysis is very conclusive, according to WHO recommendations.

- Prohibit the manufacture, trade and new uses of PCBs and by the year 2025 all existing uses of PCBs.

- Prepare pilot programmes aimed at the safe disposal of PCBs; these programmes should consider their progressive elimination, including the decontamination of equipment and containers.

- Organize the collection and environmentally sound disposal of the existing quantities of the nine pesticides.

- Reduce the emission of HCB, dioxins and furans as much as possible and, in order to do so, promote the implementation of environmental audits and apply BEP and if possible BAT to the processes which generate these compounds, such as waste-incineration or recovery of metals, mainly copper wire and electric motors.

7.2.5B POLYCYCLIC AROMATIC HYDROCARBONS

The polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals occurring naturally in oil at extremely low concentrations. However, they are also formed from the incomplete combustion of organic matter and this process is the main source of PAHs in air.

PAHs with a molecular weight exceeding 228 are almost completely bound to particles in the air. Also in the aquatic environment PAHs are mainly bound to particles due to their low solubility in water. The most commonly used reference for PAHs is *benzo(a)pyrene*.

The most important sources of PAHs are:

Point sources: primary aluminum industry, power generation, iron and steel industry, ferroalloy industry, shipyards, petroleum refineries, creosote production, asphalt plants and coke ovens, cable burning.

Diffuse sources: road construction, road traffic, use of creosote treated timber, domestic coal and wood combustion.

PROPOSED TARGETS

- *To phase out to the fullest extent possible inputs of PAHs to the environment.*

- *To reduce by 25% inputs of PAHs.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Promote the implementation of environmental audits in industrial installations that are sources of PAHs mentioned in the previous paragraph and located in selected hot spots.

- Reduce the emission of PAHs as much as possible and, in order to do so, to apply BEP and if possible BAT to the processes which generate these compounds.

7.2.5C HEAVY METALS (HG, CD, PB)

Mercury, cadmium and lead (Hg, Cd, Pb) reach the environment through liquid discharges and atmospheric emissions. ***Mercury***. The most important industrial sources of mercury are: combustion of coal in power plants; chlor/alkali production; manufacture and disposal of batteries; waste incineration and roasting and smelting in non-ferrous metal smelters. ***Cadmium***. The most important industrial sources of cadmium are: zinc and lead metal processing; electroplating; the production of cadmium compounds; pigment production; the manufacture and disposal of batteries; the production of stabilizers for plastics and phosphate fertilizers. ***Lead***. The most important industrial sources of lead are: lead metallurgy; the manufacture and disposal of batteries; additives for petrol; enamels and ceramic glazes and glass manufacture.

PROPOSED TARGETS

- *To phase out to the fullest extent possible discharges and emissions and losses of heavy metals (mercury, cadmium and lead).*

- *To reduce by 50% discharges, emissions and losses of heavy metals (mercury, cadmium and lead).*

- *To further reduce by 25% discharges, emissions and losses of heavy metals (mercury, cadmium and lead).*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Reduce discharges and emissions of heavy metals as much as possible and, in order to do so, promote the implementation of environmental audits and apply BEP and, if possible, BAT in the industrial installations that are sources of heavy metals, giving priority to installations located in selected hot spots.

- Prepare national programmes on the reduction and control of pollution by heavy metals.

- Adopt at the national level and apply common measures for preventing mercury pollution as adopted by the Parties in 1987 (releases into the sea, maximum concentration 0.05 mg/l).

- Adopt and apply for the industries of the alkaline chloride electrolysis sector, as well as the previous standard, the maximum value of 0.5 g of mercury in the water per tonne of chlorine production capacity installed (brine recirculation), 5 g of mercury in the water per tonne (lost brine technology) and, if possible, 2 g of mercury from total releases into water, air and products.

- Adopt at the national level and apply the anti-pollution common measures for cadmium and cadmium compounds adopted by the Parties in 1989 (releases into the sea, maximum concentration 0.2 mg/l).

- Prepare voluntary environmental agreements to which authorities, producers and users are committed to the basis of a reduction plan.

7.2.5D ORGANOMETALLIC COMPOUNDS

Organometallic compounds are compounds where one metal atom is covalently bound to at least one carbon atom. These types of substances are often used as intermediates in chemical industries. Several organometallic compounds decompose rapidly in water and air and are thus less important as environmental contaminants, However, some organometallic substances are stable and used as pesticides or stabilizers in other chemical products.

Organomercuric compounds: These compounds are used in dyes and as pesticides. The use of these compounds has been drastically reduced in the last 20 years and the input into the environment has therefore decreased.

Organolead compounds: Two compounds, *tetramethyllead* (TML) and *tetraethyllead* (TEL), are of major interest due to the large quantities used as additives to petrol. TML and TEL that evaporate from petrol are stable in air and almost insoluble in water; the degradation product tri-alkyl-lead is soluble in water and toxic.

Organotin compounds: Only the *three-alkyltin* is of commercial importance today. *Trialkyltin* compounds (e.g., *tributyltin oxide, tributyltin fluoride, triphenyltin hydroxide*) are used as anti-fouling agents in paints for boats and wood construction in water due to their biocide properties. They are also used as pesticides in agriculture and as disinfectants in medicine, in cooling systems in industrial installations (power plants, oil refineries) and, due to their physico-chemical properties, as a stabilizing agent for PVC. *Trialkyltin* compounds are lipophilic, very toxic and stable, and their use as antifouling paints and in cooling systems is restricted.

PROPOSED TARGETS

- *To phase out to the fullest extent possible discharges, emissions and losses of organomercuric compounds and reduce to the fullest extent possible those of organolead and organotin compounds.*

- *To reduce by 50% discharges, emissions and losses of organometallic compounds.*

- *To phase out the use of organomercuric compounds.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Reduce discharges and emissions of organometallic compounds as much as possible and, in order to do so, promote the implementation of environmental audits and apply BEP and, if possible, BAT in industrial installations that are sources of organometallic compounds.

- Make an inventory of the uses and quantities of organomercuric compounds used.

- Adopt at the national level and apply the common anti-pollution measures for organotin compounds.

- Phase out the use of organotin compounds as anti-fouling agents in cooling systems.

7.2.6 NUTRIENTS AND SUSPENDED SOLIDS

The effect of enrichment of water by nutrients is enhanced productivity but this can result in eutrophication—excessive algal growth, organic decay of excess plant material, reduction in dissolved oxygen and associated fish death. It is suspected that enrichment also leads to the increased frequency of toxic blooms of algae and other species.

The main anthropogenic sources of nutrients are: a) Municipal sewage; b) Industrial wastewater; c) Agriculture; and d) Atmospheric emissions. The most important industrial sources of these substances are:

- The food and beverage industry: Slaughtering, preparing and preserving meat; manufacture of dairy products; canning and preserving of fruit and vegetables; canning,

preserving and processing of fish, crustaceans and similar foods; manufacture of vegetable oils and fats; sugar factories and refineries

- Manufacture of textiles: Wool processing and cotton processing
- Tanneries and the leather finishing industry
- Paper and paper-pulp industry
- Phosphate fertilizer industry
- Pharmaceutical industry

PROPOSED TARGETS

- *To dispose of all wastewater from industrial installations which are sources of BOD, nutrients and suspended solids, in conformity with national regulations.*
- *To reduce by 50% inputs creating BOD, nutrients and suspended solids from industrial installations.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Reduce discharges of pollutants as much as possible and, in order to do so, promote the implementation of environmental audits and apply BEP and, if possible, BAT in the industrial installations which are sources of BOD, giving priority to installations located in hot spots.
- Develop national programmes for the environmentally sound management of wastewater and solid waste from industrial installations which are sources of BOD, and to this end to ensure:
  - that at least industrial installations which are sources of BOD, nutrients and suspended solids located in areas of concern, dispose of all wastewater in conformity with the national regulatory system.
  - that coastal outfalls are located so as to obtain or maintain agreed environmental quality criteria and avoid the exposure of sensitive environments (such as lagoons, seagrass beds, etc.) to excess nutrients or suspended solid loads.
  - promotion of primary, secondary and, where appropriate and feasible, tertiary treatment of BOD wastewater discharged into fresh-water, estuaries and the sea.
  - promotion of the sound operation and proper maintenance of facilities.
  - the reduction and beneficial use of wastewater or other solutions appropriate to specific sites, such as no-water and low-water solutions.
  - the identification of the availability and sustainability of productive uses of wastewater sludge, and other waste, such as land-spreading, composting, energetic uses, animal feed, etc.
  - the preparation of voluntary environmental agreements to which authorities, producers and users are committed on the basis of a reduction plan.

7.2.7 AGRICULTURE

The nutrient load from agriculture, mainly intensive agriculture, represents a high proportion of the total anthropogenic load of nutrients entering the coastal zone. Intensive agriculture, which encompasses high crop production or high density animal husbandry, can be a major contributor to nutrient loads due either to the use of large quantities of fertilizers, or the production of high amounts of solid and liquid manure by farm animals. Intensive aquaculture can also be a source of nutrients through dispersion of food and excretions from the organisms.

Soil erosion and desertification are also serious problems affecting the region and their contribution to the nutrient budget and sediment load may be important.

PROPOSED TARGET

- *To reduce nutrient inputs, from agriculture and aquaculture practices in areas where these inputs are likely to cause pollution.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Assess the quantities and types of fertilizers used.
- Assess the quantity of solid and liquid manure produced by farm animals.
- Promote the rational use of fertilizers and reduce the losses of nutrients by misuse of inorganic fertilizers and manure.
- Promote ecological agriculture and ecological aquaculture.
- Promote rules of good agricultural practice.
- Participate in the programmes and activities of international organizations, especially FAO, on sustainable agricultural and rural development.
- Promote the implementation of the Convention on Desertification.

7.2.8 PHYSICAL ALTERATION AND DESTRUCTION OF HABITATS

The increase of population and economic activity in coastal areas is leading to an expansion of construction and physical alterations to coastal areas and waters. The building of ports and marinas, dredging operations, sand and aggregate extraction, the building of coastal defenses, the installation of pipelines and coastal outfalls, the restoration of beaches, the erosion caused by inappropriate land use and other activities linked to urban, agricultural and aquaculture expansion, are giving rise to changes in wetlands, shore lands, beachfronts and seafloors. Important habitats are being destroyed.

PROPOSED TARGETS

- *To safeguard ecosystem function, maintain the integrity and biological diversity of species and habitats.*
- *Where practicable, to restore marine and coastal habitats that have been adversely affected by anthropogenic activities.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Support programmes for integrated coastal zone management.

- Undertake studies on the potential effects on the environment or undertake environmental impact assessments according to the importance of the physical alterations and the destruction of habitats related to management projects.

- Establish a system of previous authorization by competent national authorities for works which cause physical alterations to the natural state of the coastline or the destruction of coastal habitats.

7.2.9 MONITORING AND INSPECTION

When management decisions are needed, assessment of pollution-related problems makes it possible to reduce uncertainties and clarify links between inputs, concentrations and the effects of pollutants.

In order to improve the assessment of the inputs of pollutants into the Red Sea and to ensure compliance with the conditions laid down in authorizations and regulations, the authorities responsible should establish systems of monitoring and inspection.

PROPOSED TARGETS

- *Egypt to establish a monitoring programme for inputs of the priority pollutants identified and for the quality of the marine environment.*

- *Egypt to re-orient the existing systems of inspection toward auditing of existing industrial areas to reflect priority pollutants identified.*

- *Egypt to establish a monitoring programme of discharges and emissions of the priority pollutants identified and of the quality of the marine environment.*

PROPOSED ACTIVITIES AT THE NATIONAL LEVEL

- Establish inspection systems to ensure compliance with the conditions laid down in the authorizations and regulations.

- Establish monitoring programmes to evaluate the effectiveness of actions and measures implemented.

- Establish and improve local air pollution monitoring programmes as a priority in cities and urban agglomerations exceeding one million inhabitants.

- Establish and improve local and national monitoring programmes to control and assess effluent discharge and the quality of the marine environment.

- Establish and improve river monitoring programmes.

- Establish permanent registers of river quality and quantity accessible to all Parties on selected rivers.

- Establish a data bank on socio-economic indicators related to sea and river quality and pollutant fluxes associated with a geographic information system (GIS).

- Improve the inventory of major point atmospheric sources following EMEP/CORINAIR guidelines.

7.2.10 CAPACITY BUILDING

The activities proposed aim to improve, *inter alia:* the scientific base, environmental policy formulation, professional human resources, institutional capacity and capability (both public and private), implementation of environmentally sound technologies, implementation of policies for cleaner production and technical cooperation including cooperation in the fields of technology transfer. All these measures come under the heading of capacity-building. As part of the above, the activities will be grouped into two categories that need to be implemented at both national and local level:

- Support, promote and facilitate programmes of assistance in the area of scientific, technical and human resources;

- Support, promote and facilitate, as appropriate, the capacity to apply, develop and manage access to cleaner production technologies as well as the best available techniques (BAT) and the best environmental practice (BEP).

7.2.11 PUBLIC PARTICIPATION

Information and public participation are essential components of a sustainable environmental development policy.

PROPOSED TARGETS

- *To provide to the general public access to the information available on the state of the environment of the Red Sea and its evolution, and the measures taken to improve it.*

- *To enhance the environmental awareness of pollution, and create a common approach to the environmental problems of the Red Sea.*

- *To facilitate public access to activities for the protection and management of the environment and to scientific knowledge.*

- *To mobilize and ensure the participation and involvement of the major actors concerned (local and provincial communities, economic and social groups, consumers, etc.).*

PROPOSED ACTIVITIES AT THE REGIONAL LEVEL

- Identify potential roles for non-governmental organizations in the implementation of the NAP and ensure that all relevant IGOs and NGOs have appropriate access to information concerning the NAP and its application.

- Implement coordinated information campaigns and special activities on environmental protection.

- Continue and expand publication and distribution of brochures, leaflets, posters, reports, newsletters and other information materials, as well as the use of the media in all its forms.

- Enhance and strengthen the exchange of information and experience on the environmental problems of the region, and develop cooperation in this field.

8. PROPOSED PLAN OF ACTION

Fourteen actions were identified as *priority* actions necessary to safeguard the quality of the marine environment of the Egyptian Red Sea. Implementing these actions will ensure:

- Improvements in the quality of the marine environment
- Rehabilitation, through natural processes of impacted ecosystems
- The identification of other mitigation measures needed to protect the marine environment

The Action Plan and time line is presented in Table 27 for all proposed targets. For those actions needed from Egyptian stakeholders, only controlling actions are given a time frame, others are left to the controlling authorities to be timed with the framework of the targeted actions.

Table 27. Targets and proposed actions.

Municipal sewage			Years of the Plan
			10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
Proposed targets		***Dispose all municipal waste water (sewage) in conformity with Regional Protocols & National Legislations.***	
Proposed activities at the National level	**1**	To update and adopt national regulations concerning sewage discharges into the sea and rivers, which take into account the Regional Protocols & National	
	2	To develop National Plans and Programmes for the environmentally sound Management of Sewage that ensure:	
	3	The coastal cities and urban agglomerations are connected to a sewer system and dispose all waste water in conformity with a national regulation system;	
	b	To locate coastal outfalls so as to obtain or maintain agreed environmental quality criteria that avoid exposing fisheries, water intakes, and bathing areas to pathogens and to avoid the exposure of sensitive environments (such as lagoons,	
	c	To promote the primary, secondary and, where appropriate and feasible, tertiary treatment of municipal sewage discharged to rivers and associated canals,	
	d	To promote and control the good operation and proper maintenance of existing	
	e	To promote the reuse of the treated effluents for the conservation of water resources. To this end, infrastructural measures, treatment at source and the segregation of industrial effluents, shall be encouraged, as well as:	
	i	the beneficial reuses of sewage effluents and sludge by the appropriate design of treatment plant and processes and controls of the quality of influent waste waters in accordance with national regulations;	
	ii	the environmentally sound treatment when domestic and compatible industrial effluents are treated together;	
	iii	to promote the separate collection of rain waters and municipal waste waters and ensure treatment of first rain waters considered particularly polluting;	
	iv	to identify the availability and sustainability of productive uses of sewage sludge, such as land-spreading, composting, etc;	
	v	to prohibit the discharge of sludge into water in the Protocol Area.	

Table 27 continued.

Urban Solid Waste			Years of the Plan																										
			10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	***To base urban solid waste management on reduction at source, separate collection, recycling, composting and environmentally sound disposal.***		■	■	■	■	■	■																				
	To base urban solid waste management on reduction at source, separate collection, recycling, composting and environmentally sound disposal in all cities and urban agglomerations.		■	■	■	■	■	■	■	■	■	■	■															
Proposed activities at the National level	**1**	To develop national plans and programmes for the reduction at source and environmentally sound management of urban solid waste.																										
	2	To establish environmentally suitable and economically feasible systems of collection and disposal of urban solid waste in cities and urban agglomerations.																										
	3	To promote the reduction and recycling of urban solid waste.																										

Table 27 continued.

Air Pollution			Years of the Plan																										
			10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*To establish a proper National air monitoring programme for background level of Total Volatile Hydrocarbons, Dioxins and furans in major cities.*		■	■	■																							
	To assess the types and quantities of air contaminants entering to the marine environment through air and water runoff.		■	■	■	■	■	■																				
	The levels of air pollutants in cities exceeding 100.000 inhabitants and in areas of concern shall be in conformity with the National legislations and internationally agreed provisions.		■	■	■	■	■	■	■	■	■	■	■															
	The levels of air pollutants in cities shall be in conformity with the provisions of the National legislations and internationally agreed provisions.		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■										
Proposed activities at the National level	**1**	c management and give priority to the use of public transport.																										
	2	ce of vehicles and the renovation of the oldest vehicles (through economic incentives).																										
	3	nt in order to substitute high sulphur fuel oil with natural gas and natural gas conversion for urban proximities.																										
	4	ses using gaseous fuel or other alternative forms of energy instead of diesel oil.																										
	5	To support and encourage the participation of the public transport services in the above activities.																										

Table 27 continued.

Industrial development			Years of the Plan																									
			10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*Point source discharges and air emissions into the Red Sea area from industrial installations to be in conformity with the provisions of agreed international and national provisions. .*		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	Over a period of 10 years, to reduce by 50 % discharges, emissions and losses of substances that are toxic, persistent and liable to bio-accumulate from industrial installations.		■	■	■	■	■	■	■	■	■	■	■															
	Over a period of 10 years, to reduce by 50% discharges, emissions and losses of polluting substances from industrial installations in hot spots and areas of concern.		■	■	■	■	■	■	■	■	■	■	■															
Proposed activities at the National level	1	To make or update in as short a period as possible an inventory of point source discharges and emissions of pollutants in hot spots and areas of concern.																										
	2	To make or update in as short a period as possible an inventory of point source discharges and emissions of pollutants from the public industrial sector.																										
	3	To prepare or update and adopt, as soon as possible, national regulations concerning point source discharges of industrial waste water into the Protocol Area which takes into account the guidelines, common criteria and standards adopted by the Parties.																										
	4	To give priority to the environmental problems of small and medium-size companies, favouring the creation of associations in order to minimize waste generation and achieve a joint handling of their wastewater.																										
	5	To promote the implementation of environmental audits and apply BEP and, if possible, BAT in industrial installations that are source of pollutants.																										

Table 27 continued.

Substances that are Toxic, Persistent and liable to Bio-accumulate		Years of the Plan																							
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Proposed target	*To phase out inputs of the 9 pesticides and PCBs and reduce to the fullest possible extent inputs of unwanted contaminants such as Hexachlorobenzene, Dioxins and Furans.*	■	■	■	■	■	■																	
	To reduce by 50 % inputs of the priority 12 POPs.	■	■	■	■	■	■	■	■	■	■	■												
	To collect and dispose all PCB waste in a safe and environmentally sound manner.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
Proposed activities at the National level	1 To prepare pilot programmes aimed at the safe disposal of the PCBs; these programmes should consider their progressive elimination, including the decontamination of equipment and																							
	2 To make an inventory of quantities and uses of the nine pesticides and PCBs, as well as of the industries which manufacture or condition them.																							
	3 By the year 2015, to phase out the use of the nine pesticides, except those uses which involve the safeguarding of human life when the latter is in danger or when a risk/benefit analysis is very conclusive, according to WHO recommendations?																							
	4 To prohibit the manufacture, trade and new use of PCBs.																							
	5 To organize the collection and environmentally sound disposal of the existing quantities of the nine pesticides.																							
	6 To reduce the emission of *HCB, dioxins and furans* as much as possible, through, the promotion of the implementation of environmental audits and apply BEP and if possible BAT to the processes which generate these compounds, such as waste-incineration or re																							

Table 27 continued.

Polycyclic Aromatic Hydrocarbons (PAHs)			Years of the Plan																									
			10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*To phase out to the fullest possible extent inputs of PAHs.*		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■										
	To reduce by 25 % inputs of PAHs.		■	■	■	■	■	■																				
Proposed activities at the National level	**1**	To promote the implementation of environmental audits in the industrial installations that are sources of PAHs mentioned in the previous paragraph and located in selected hot spots.																										
	2	To reduce the emission of PAHs as much as possible and, in order to do so, to apply BEP and if possible BAT to the processes which generate these compounds.																										

Table 27 continued.

Heavy metals (Hg, Cd, Pb) and Organometallic compounds		Years of the Plan																										
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*To phase out to the fullest possible extent discharges and emissions and losses of heavy metals (mercury, cadmium and lead).*	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	To reduce by 50 % discharges, emissions and losses of heavy metals (mercury, cadmium and lead).	■	■	■	■	■	■	■	■	■	■	■															
	To further reduce by 25 % discharges, emissions and losses of heavy metals (mercury, cadmium and lead).	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■										
Proposed activities at the National level	To reduce discharges and emissions of heavy metals as much as possible and to promote the implementation of environmental audits and apply BEP and, if possible, BAT in the industrial installations that are sources of heavy metals, giving priority to insta																										
	To prepare National Programmes on the reduction and control of pollution by Heavy Metals.																										
	To adopt at the national level and apply the common measures for preventing mercury pollution (releases into the sea, max. conc. 0.050 mg/l).																										
	To adopt at the national level and apply the anti-pollution common measures for cadmium and cadmium compounds (releases into the sea, max. conc. 0.2 mg/l).																										
	To prepare environmental voluntary agreements to which authorities, producers and users are committed on the basis of a reduction plan.																										

Table 27 continued.

Organo-metallic compounds		Years of the Plan																									
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*To phase out to the fullest possible extent discharges, emissions and losses of organomercuric compounds and reduce to the fullest possible extent those of organolead and organotin compounds.*	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■										
	To reduce by 50 % discharges, emissions and losses of organometallic compounds.	■	■	■	■	■	■	■	■	■	■	■															
	To phase out the use of organomercuric compounds.	■	■	■	■	■	■	■	■	■	■	■															
Proposed activities at the National level	To reduce discharges and emissions of organometallic compounds as much as possible and to promote the implementation of environmental audits and apply BEP and, if possible, BAT in industrial installations that are sources of organometallic compounds.																										
	To make an inventory of the uses and quantities of organomercuric used.																										
	To adopt at the national level and apply the anti-pollution common measures for the organotin compounds.																										
	To phase out the use of organotin compounds as anti-fouling agents in cooling systems.																										

Table 27 continued.

Nutrients and Suspended Solids		Years of the Plan																							
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Proposed targets	*To dispose all waste water from industrial installations which are sources of BOD, nutrients and suspended solids, in conformity with the National Regulations.*	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
	To reduce by 50 % inputs of BOD, nutrients and suspended solids from industrial installations sources of these substances.	■	■	■	■	■	■	■	■	■	■	■													
Proposed activities at the National level	To reduce discharges of pollutants as much as possible and, in order to do so, to promote the implementation of environmental audits and apply BEP and, if possible, BAT in the industrial installations which are sources of BOD, giving priority to installat																								
	To develop National Programmes for the environmentally sound management of waste water and solid waste from industrial installations which are sources of BOD, and to this end to ensure:																								
	To locate coastal outfalls so as to obtain or maintain agreed environmental quality criteria and to avoid the exposure of sensitive environments (such as lagoons, sea grass beds, etc.) to excess nutrient or suspended solid loads;																								
	To promote primary, secondary and, where appropriate and feasible, tertiary treatment of BOD waste water discharged into fresh-water, estuaries and the sea;																								
	To promote sound operation and proper maintenance of facilities.																								

Table 27 continued.

Agriculture		Years of the Plan																								
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*To reduce nutrient inputs, from agriculture and aquaculture practices into areas where these inputs are likely to cause pollution.*																										
Proposed activities at the National level	To assess the quantities and types of fertilizers used.																										
	To assess the quantity of solid and liquid manure produced by farm animals.																										
	To promote the rational use of fertilizers and reduce the losses of nutrients by misuse of inorganic fertilizers and manure.																										
	To promote ecological agriculture and ecological aquaculture.																										
	To promote rules of good agricultural practices.																										
	To participate in the programmes and activities of international organizations, especially FAO, on sustainable agricultural and rural development.																										
	To promote the implementation of the Convention on Desertification.																										

Table 27 continued.

Physical alterations and destruction of habitats		Years of the Plan																										
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*To safeguard the ecosystem function, maintain the integrity and biological diversity of species and habitats.*																										
	Where practicable, to restore marine and coastal habitats that has been adversely affected by anthropogenic activities .																										
Proposed activities at the National level	To support programmes for integrated coastal zone management.																										
	To undertake studies on the potential effects on the environment or Environmental Impact Assessment according to the importance of the physical alterations and the destruction of habitats related to management projects.																										
	To establish a system of previous authorization by competent national authorities for works which cause physical alterations of the natural state of the coastline or the destruction of coastal habitats.																										

Table 27 continued.

Monitoring		Years of the Plan																											
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*By the year 2015, Egypt will establish a monitoring programme of the inputs of the priority pollutants identified in this Programme and of the quality of the marine environment.*	■	■	■	■	■	■																				
	By the year 2013, the Egypt will re-orient the existing systems of inspection toward auditing of existing industrial area to reflect priority pollutiants identified in this Programme.	■	■	■	■																						
	By the year 2015, the Egypt will establish a monitoring programme of discharges and emissions of the priority pollutants identified in this Programme and of the quality of the marine environment.	■	■	■	■	■	■																				
Proposed activities at the National level	The establishment of inspection systems to ensure compliance with the conditions laid down in the authorizations and regulations.																										
	The establishment of monitoring programmes to evaluate the effectiveness of actions and measures implemented under this Programme.																										
	The establishment and improvement of local air pollution monitoring programmes as a priority in cities and urban agglomerations exceeding one million inhabitants.																										
	The establishment and improvement of local and national monitoring programmes to control and assess effluents discharge and the quality of the marine environment.																										
	The establishment and improvement of river monitoring programmes.																										
	The establishment of permanent registers of river quality and quantity accessible to all Parties on selected rivers (about fifty).																										
	The establishment of a data bank on socio-economic indicators related to sea and river quality and pollutants fluxes associated with a Geographic Information System (GIS).																										
	Improve the inventory of major point atmospheric sources following EMEP/CORINAIR guidelines.																										

Table 27 continued.

Public Participation		Years of the Plan																											
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	*to provide to the general public access to the information available on the state of the environment of the Red Sea and its evolution, and the measures taken to improve it;*	■	■	■	■	■	■																				
	to enhance the environmental awareness of pollution, and create a common approach to the environmental problems of the Red Sea;	■	■	■	■	■	■	■	■	■	■	■															
	to facilitate public access to activities for the protection and management of the environment and to scientific knowledge;	■	■	■	■	■	■																				
	to mobilize and ensure the participation and involvement of the major actors concerned (local and provincial communities, economic and social groups, consumers, etc.).	■	■	■	■	■	■	■	■	■	■	■															
Proposed activities at the National level	to identify potential roles for Non-Governmental Organizations in the implementation of the NAP and to ensure that all relevant IGOs and NGOs have appropriate access to information concerning the NAP and its application;																										
	to implement coordinated information campaigns and special activities on environmental protection;																										
	to continue and expand publication and distribution of brochures, leaflets, posters, reports, newsletters and other information materials, as well as the use of the media in all its forms;																										
	to enhance and strengthen the exchange of information and experience on the environmental problems of the region, and to develop cooperation in this field.																										

Table 27 continued.

Capacity Building		Years of the Plan																									
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Proposed targets	To improve the scientific base, environmental policy formulation, professional human resources, institutional capacity and capability, both public and private, implementation of environmentally sound technologies, the implementation of policies for cleaner production and technical cooperation, including cooperation in the fields of technology transfer and know-how process.																										
Proposed activities at the National level	To support, promote and facilitate programmes of assistance in the area of scientific, technical and human resources;																										
	To support, promote and facilitate, as appropriate, the capacity to apply, develop and manage access to cleaner production technologies as well as the best available techniques (BAT) and the best environmental practice (BEP).																										

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