REGIONAL ENVIRONMENTAL MANAGEMENT IMPROVEMENT PROJECT (REMIP)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

EGYPTIAN ENVIRONMENTAL AFFAIRS AGENCY (EEAA)

STATE OF OIL POLLUTION AND MANAGEMENT IN SUEZ GULF REGION

JULY 2008

REMIP WORKING GROUP 2 (WG2)

(Revised: July 23, 2008)

Note: This book can be distributed to members of external units concerned as well as WG2 and associate members for the purpose of understanding the project background.

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Abbreviations

Abbreviations	Full Names
AASTMT	Arab Academy for Science, Technology and Maritime Transport
AGOSD	Alexandria Organization for Sanitary Drainage
API	America Petroleum Institute
ARE	Arab Republic of Egypt
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
BOP	Blowout Prevention System
CBT	Clean Ballast Tank
CDBA	Central Department of Branch Affairs
CDEP	Central Department for Environment Protection
CEO	Chief Executive Officer
COD	Chemical Oxygen Demand
COR	Central Operation Room
COW	Crude Oil Washing System
CWMP	Coastal Water Monitoring Program
DAF	Dissolved Air Floatation
DMI	Department for Maritime Inspection
DO	Dissolved Oxygen
DOFI	General organization for Industrialization
EEAA	Egyptian Environmental Affairs Agency
EEZ	Exclusive Economic Zone
EGPC	Egyptian General Petroleum Corporation
EIA	Environmental Impact Assessment
EIMP	Environmental Information and Monitoring Program
EMS	Environmental Management Sector
EMU	Environment Management Unit
EPA	Environment Protection Agency in the United States
EPF	Environment Protection Fund
EPRI	Egyptian Petroleum Research Institute
EQS	Environmental Quality Sector
ERC	Emergency Response Committee
FL	Fluorescence Spectrography
FT-IR	Fourier Transform Infrared Spectroscopy
GC-FID	Gaschromatograph (Frame Ionization Detection Method)
GC-MS	Gaschromatograph (Mass Spectrometer)
GDP	Gross Domestic Product
GEAP	Governorate Environmental Action Plan
GIS	Geographic Information System
HPLC	High Performance Liquid Chromatograph

IMO	International Maritime Organization
ISO	International Standards Organization
ISOS	Identification System of Spilled Oil Sources
JCG	Japan Coast Guard
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
L.E.	Egyptian Pound
MALR	Ministry of Agriculture and Land Reclamation
MARPOL	International Convention for the Prevention of Pollution from Ships
MOFA	Ministry of Foreign Affairs
MOH	ministry of Health
MOHP	Ministry of Health and Population
MOHUNC	Ministry of Housing, Utilities and New Urban Communities
MOI	Ministry of Interior
MSEA	Ministry of State for Environmental Affairs
MWRI	Ministry of Water Resources and Irrigation
NCPC	National Contingency Planning Committee
NEAP	National Environmental Action Plan
NGO	Non-Governmental Organization
NIOF	National Institute for Oceanography and Fisheries
NOPWASD	National organization fro Potable Water and Sanitary Drainage
NOSCP	National Oil Spill Contingency Plan
NRC	National Research Center
NWRC	National Water Research Center
OBM	Oil-Based Mud
ORPC	International Convention on Oil Pollution Preparedness, Response and Co-operation 1990
PAHs	Polyaromatic Hydrocarbons
PESCO	Petro Environmental Service Company
RBO	Regional Branch Office
RSPA	Red Sea Port Authority
SBM	Synthetics-Base Mud
SBT	Segregated Ballast Tank
SCA	Suez Canal Authority
SPA	Shore Protection Authority
SS	Suspended Solids
TDS	Total Dissolved Solids
TOC	Total Organic Carbons
TSS	Total Suspended Solids
WBM	Water-Based Mud

CHAPTER 1
INTRODUCTION

1.1 General

This report presents the results of the baseline data & information associated with oil pollution and management in Egypt, especially in Suez Gulf Region.

As already clarified in the Work Plan for Oil Pollution Program, the direct objectives of the Program are expressed as follows:

- To formulate and propose appropriate countermeasures against oil pollution in Gulf Region, and
- To collect related data and information through actual measurement & analysis associated with oil identification including fingerprint analysis, thereby establishing the database for oil identification data. (To realize this, the training for instructing the technology of oil fingerprint analysis is conducted).

The countermeasure to be formulated will contain variety of actions that mainly Suez RBO needs to take so as to manage oil pollution issues as an administrative agency responsible for the environmental management. Strategies necessary for the countermeasure are examined like: how to prevent oil pollution, how to establish oil monitoring and identification system, and how to construct adequate contingency response for oil spill, among others.

As clarified in the Work Plan, such countermeasures are examined and established by analyzing present situations associated with oil pollution in the Step 3. Namely, the work of the Working Group 2 (WG2) proceeds to the problem analysis of oil pollution, based this baseline survey. From this context, the main purpose of this Report is to provide baseline data/information on present situations, which should be commonly shared among all members of WG 2.

The data and information for this report came to the REMIP JICA Team mainly from Department of Environmental Monitoring of EQS, General Directorate of Coastal and Marine Zone Management of EMS, Department of International Relations and Technical Cooperation of EEAA Headquarters, Suez RBO, EMUs of governorates concerned and other related units. Then, the REMIP JICA Team has analyzed and compiled them, collecting supplement data/information from units concerned.

This report has consolidated the fact-finding data/information associated with oil pollution issues, containing:

- Basic information on the Project Area;
- Situation of oil pollution and pollution sources;
- Legal framework and national policy;
- Administrative and institutional setup;
- Current management and practice for oil pollution; and
- Technologies of oil fingerprint analysis.

The initial purpose of this report is to comprehensively contain all necessary data & information on oil pollution issues. It is, however, obvious that some parts of necessary data/information have failed to be included, due to difficulties in accessing proper sources, the limited time allocated and the like. These parts should be supplemented in the course of the program execution.

On the other hand, there is still some data & information collected in this baseline survey which has been not contained in this report. These belong to very general data/information with the character like "common knowledge and prevalent practices" associated with oil pollution. Though these kinds of data & information are considered to be also useful for all working group members, these have been removed from this report in order to avoid redundant description in the rapid understanding of essential contents. Hence, these will be compiled in another volume of the report in the later stage.

1.2 Definitions

The important words used in the Oil Pollution Program are defined as follows:

Asphalt: A brawn to black residue formed from weathered petroleum products, consisting chiefly of a mixture of hydrocarbons in texture from hard and brittle to plastic.

Bio-degradation: The breaking down of substances by microorganism, which use the substances for food and generally release harmless byproducts such as carbon dioxide and water.

Bio-remediation: The process where living organisms (bacteria and fungi) use oil as a food, converting it into a non-hazardous form. Nutrients are often added to speed up the rate of digestion and the rate of reproduction of naturally occurring hydrocarbon-eating microbes. Hydrocarbons-eating organisms' can also be introduced to contaminated sites.

Boom: A temporary floating barrier used to contain an oil spill.

Chemical dispersant: A chemical formulation containing surface active agents (surfactants) that lower the surface tension between oil and water, promoting the formation of oil droplets and reducing the tendency of oil to stick to other droplets or surfaces, thereby enhancing dispersion into water column.

Contingency plan: An action plan prepared in anticipation of an oil spill for a site or region containing guidelines and operating instructions to facilitate efficient and effective clean-up operations, and to protect areas of biological, social and economic importance.

Emulsification: The formation of a water-in-oil mixture. Different oils exhibit different tendencies to emulsify, and emulsification is more likely to occur under high energy conditions (strong winds and waves). An emulsified mixture of water in oil is commonly called "mousse"; its presence indicates a spill that has been on the water for some time.

See also mousse.

Evaporation: The physical change by which any substance is converted from a liquid to a vapor or gas.

Fate: The outcome; the fate of an oil spill is what happens to the oil.

Floating oil: Oil that is floating on the water surface formulating oil layer with a certain thickness.

Hydrocarbons: A large class of organic compounds containing only carbon and hydrogen; common in petroleum products and other oils.

ISOS: "Identification System of Spilled Oil Sources (ISOS)" means the system which identifies polluters of intentional or unintentional oil spill incidents caused from moving or fixed oil sources, by using diverse kinds of data and information on fingerprint of source oil/spilled oil, pollution sources and oil spill incidents.

Kinematic viscosity: A unit of measurement used to define an alternative viscosity measurement, i.e. the fluid dynamic viscosity divided by its density.

Mousse: An emulsified mixture of water in oil. Mousse can range in color from dark brown to nearly red or tan, and typically has a thickened or pudding-like consistency compared with fresh oil. Incorporation of up to 75 percent water into the oil will cause the apparent volume of a given quantity of oil to increase by up to four times. See also emulsification.

National response system: A network of individuals and teams local, state, and federal agencies that combine their expertise and resources to ensure that oil spill control and cleanup activities are timely and efficient and minimize threats to human health and the environment.

Oil: All kinds of oil including mineral oil (crude oil, petroleum, gasoline, etc.), vegetable oil and animal oil.

Oil pollution: The situation of the pollution caused by any kind of oil in the form of floating oil or emulsified oil.

Oil spill (issue or problem): The situation (issue or problem) that oil or oil contained massively in water is intentionally or unintentionally discharged into the environment in the foam of mainly floating oil.

Source Oil: All kind of oils that are stored and used in moving facilities (such as oil tankers, cargo ships, passenger ships, etc.) and fixed facilities (such as oil exploitation sites, oil transfer facilities, bunkering facilities, oil refineries, petro-chemical industries, oil tanks, etc.)

Spilled oil: Oil that is caused by oil spill and in the form of mainly floating oil.

Oily wastewater: Wastewater containing mainly emulsion (or suspended) oil with a certain content.

Fingerprint analysis: Analysis to measure hydrocarbon compositions, physical, chemical and other characteristics (so called fingerprint data, like chromatograms, spectrographs, densities, viscosities, etc.) of oils by means of GC, FT-IR, etc. aiming to identify the sources of oils, and

Oil identification: Activity to find out the sources of oil using fingerprint analysis and other data/information.

Polyaromatic hydrocarbons (PAHs): A family of chemical substances that are found in many types of oil; polyaromatic hydrocarbon vapors can cause harm to humans and animals that inhale them.

Pour point: The temperature below which oil will not flow.

Sheen: A very thin layer of oil (less than 0.003 millimeters in thickness) floating on the water surface. Sheen is the most commonly-observed form of oil during the later stages of a spill. Depending on thickness, sheens range in color from dull brown for the thickest sheens to rainbows, gray, silvers, and near-transparency in the case of the thinnest sheen. Natural sheen can result from biological processes.

Slick: Oil spilled on the water, which absorbs energy and dampens out surface waves, making the oil appear smooth (or slicker) than the surrounding water.

Tar balls: Weathered oil that has formed pliable balls or patches that float on the water. Tar balls can range in diameter from a few millimeters (much less than an inch) to a foot (0.3 meters). Depending on how weathered, or hardened, sheen may not be present the outer layer of the tar.

Tar mats: Non-floating mats of oily debris (usually sediment and/or plant matter found on beaches or just offshore in shallow water.

Viscosity: Having a resistance to flow; substances that are extremely *viscous* do not flow easily.

Volatility: A property of a liquid that has a low boiling point and a high vapor pressure at ordinary pressures and temperatures.

Water column: An imaginary cylinder of water from the surface to the bottom of a water body; water conditions, temperature, and density vary throughout the water column.

Weathering: A combination of physical and environmental processes, such as evaporation, dissolution, dispersion, emulsification, and biodegradation which act on spilled oil to change its physical properties and composition.

CHAPTER 2
PROFILE OF PROJECT AREA

2.1 Project Area

Suez RBO of EEAA manages Gulf Region encompassing five (5) governorates: the Governorate of Suez, the Governorate of Ismailiya, the Governorate of Port Said, the Governorate of North Sinai and the Governorate of South Sinai. In this Project dealing with oil pollution issues, Suez RBO is aiming to take actions particularly in the Gulf of Suez and Suez Canal.

The Gulf of Suez, which is a major water body in the Project Area, is the northwestern arm of the Red Sea between Africa proper (west) and the Sinai Peninsula (east) of Egypt and contacts the Gulf of Aqaba. Also, the Gulf is linked to the Mediterranean Sea by Suez Canal in the north. The part of these water bodies (the Red Sea, the Gulf of Aqaba and the Mediterranean Sea) touching the Gulf of Suez and the Suez Canal are also the object of the survey, since they are deeply related in terms of water pollution.

Accordingly, the project area of this survey is defined to be the geographic area that includes the water bodies of the Gulf of Suez, the Suez Canal and adjacent water bodies, and their peripheral areas, as shown in **Figure 2-1**. The Project Area excludes a part of the Gulf of Suez located along the Governorate of Red Sea, because this area belongs to the administration of Red Sea RBO.

2.2 Geography

The northern end of the Red Sea is bifurcated by the Sinai Peninsula, creating the Gulf of Suez in the west and the Gulf of Aqaba to the east. The Gulf of Suez is a relatively young rift basin, dating back 40 million years. It stretches some 280 km to north, terminating at the City of Suez which is the entrance to the Suez Canal. Along the mid-line of the Gulf lies the border between the continents of Africa and Asia. The entrance of the Gulf of Suez in the south lies atop the mature oil and gas field.

The Suez Canal, extending from Port Said to Port Tawfiq (near Suez) and connecting the Mediterranean Sea with the Gulf of Suez, and thence with the Red Sea. The canal is about 160 km long. The Canal comprises two parts, north and south of the Great Bitter Lake, linking the Mediterranean Sea to the Gulf of Suez on the Red Sea. The Canal allows two-way north to south water transport between Europe and Asia without circumnavigating Africa.

The Red Sea is 1,930 km long and averages 280 km in width, and is shared by Egypt, Sudan, Ethiopia, Republic of Yemen, Saudi Arabia, Jordan and Israel. The Red Sea is a gulf or basin of the Indian Ocean between Africa and Asia. In the north are the Sinai Peninsula, the Gulf of Aqaba and the Gulf of Suez.

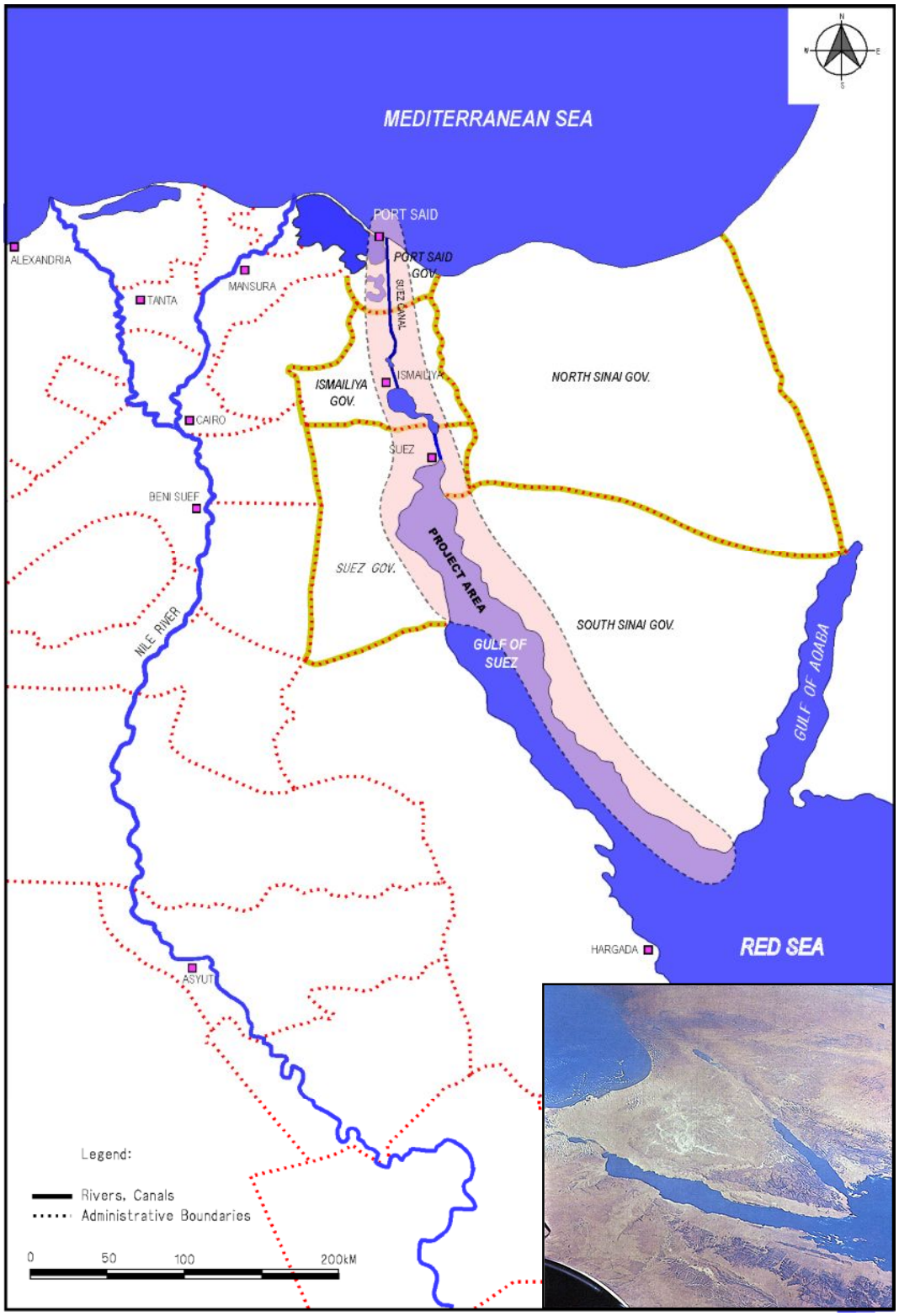


Figure 2-1 Project Area

The Gulf of Aqaba is geologically an integral part of the Great Rift Valley that runs from East Africa through the Red Sea and northwards towards the rift valley containing the Dead Sea. The Gulf of Aqaba is a large gulf of the Red Sea which is located to the east of the Sinai Peninsula and west of the Arabian mainland. Egypt, Israel, Jordan, and Saudi Arabia all have coastlines on the Gulf of Aqaba.

The Gulf of Aqaba, like the coastal waters of the Red Sea, is one of the world's premier sites for snorkeling and Scuba diving. The area is especially rich in coral and other marine biodiversity and contains a number of underwater wrecks, some accidental shipwrecks, others vessels deliberately sunk in an effort to provide a habitat for marine organisms and bolster the local dive tourism industry.

2.3 Socio-Economic Profile[1]

2.3.1 Governorate of Suez

The Governorate of Suez is one of the Canal Region's urban governorates. The Governorate is located in the east Delta, 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 Governorate of Cairo and the Governorate of Giza to the west.

The total area of the Governorate is approximately 9,002 km^2, which is divided into four administrative districts, namely; Suez District, Al-Arbaeen District, Ataka District, and Al-Ganayen District. Ataka District accommodates an industrial zone of the Governorate, while Al-Ganayen District lays mainly agricultural lands. Suez District centralizes most government bureaus and agencies, and encompasses Port Tawfik and the free zones.

The estimated population as of 2004 is 478,500. Al-Arbaeen District has the highest population density, accommodating approximately 47 % of the total population in the Governorate. The annual population growth rate for the Governorate has been stable at an average of some 2 % over the period from 2001 to 2003.

In 2003, the work force in the Governorate represented 30 % of the total population. Out of the 142,000 people in the workforce, almost 85 % are employed. The unemployment rate in the Governorate has been fluctuating from the period from 2001 to 2003, recording 10.2 % in 2001, 8.8 % in 2002, and 15.5% in 2003. The highest unemployment rate is found in Al-Arbaeen District, while the lowest rate is in Al-Ganayen district.

The GDP per capita for the Governorate of Suez recorded LE 9,157 in 2001 to 2002, with enjoying the highest GDP per capita in Suez District, followed by Ataka District, Al-Ganayen District, and finally Al-Arbaeen District. This figure is considerably high as compared to the national average of LE 5,540 in the same year.

There are approximately 20,200 feddans of cultivated agricultural land in the Governorate of Suez, and the main agricultural crops grown are wheat, barely, and sesame. Almost 34 % of the labor force in Al-Ganayen District is engaged in agricultural activities, while this percentage falls to under some 5 % in each of the remaining districts.

[1] : Source: Data were collected from officials of the governorates and extracted from general references.

Industry absorbs almost 40 % of the workforce in Al-Arbaeen and Ataka Districts and falls to 25 % in Suez and Al-Ganayen District. 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 the Governorate. In Suez district almost 72 % of the labor force is engaged in the services sector (mainly in oil-related services as well as marine and cargo services), while this percentage falls to 40 to 50 % in the remaining districts.

Adult literacy rate (over 15 years old) in the Governorate of Suez is recorded to be high with 80 % in 2001, as compared to the national average of 66 %. The highest literacy rate is found in Suez District, followed by Ataka District, Al-Arbaeen District, and finally Al-Ganayen District. There are four (4) university faculties and 2 educational institutions for graduate studies in the Governorate of Suez, in which 14,400 students were enrolled in 2003.

2.3.2 Governorate of Ismailia

The Governorate of Ismailia is located on the two 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, which is divided into 3 administrative districts; 5 Cities, 4 Markaz and city, and 1 Kism.

The estimated population as of 2004 was 844,000. Ismailia City has the highest population density, and hosts almost 36 % of the total population. The annual population growth rate for the Governorate has been stable at an average of 2.0 % over the period from 2001 to 2003.

In 2003, the work force in the Governorate represented 32 % of the total population. Out of the 270,100 in the workforce, almost 79 % are employed. The unemployment rate for the Governorate of Ismailia has almost tripled from around 7 % in 2001 to 2002 to 21 % in 2003. The highest unemployment rate is found in Al-Arab District, while the lowest rate is in Al-Tal Al-Kabeer City.

The GDP per capita for the Governorate of Ismailia recorded LE 5,970 in 2001 to 2002, with the highest in District Three (Ismailia), followed by District One (Ismailia), and Ismailia City.

There are approximately 209,400 feddans of cultivated agricultural land in the Governorate of Ismailia and the main agricultural crops grown are peanuts, wheat, and corn. Almost 46 % of the labor force in Markaz and City of Al-Tal Al-Kabeer and Markaz and City of Al Qantarah are engaged in agricultural activities, while this percentage ranges from 2 to 40 % in the remaining areas.

Industry absorbs almost 30 % of the workforce in District Two (Ismailia), Fayed City, and Ismailia City, and between 10 and 24 % in each of the remaining districts. 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 of the Governorate of Ismailia. More than 70 % of the work force in Al-Qantarah City, District One (Ismailia), Al-Qantarah Sharq City, and District Three (Ismailia) are engaged in services, and between 39 and 69 % of the labor force in the remaining districts.

Adult literacy rate (over 15 years old) in the Governorate of Ismailia recorded 72.8 % in 2001 as compared to the national average of 66 %. The highest literacy rate is found in Third District (Ismailia) at 92.5%. There are 10 university faculties and two (2) educational institutions for graduate studies in the Governorate, in which 18,920 students were enrolled in 2003.

2.3.3 Governorate of Port Said

The Governorate of Port Said is located in the north-east of Egypt, in a unique location along the Suez Canal and Mediterranean Coast. The port in the Governorate receives around 500 ships annually. Together with the free zone areas, it represents the primary source of income to the people and the Governorate.

The total area of the Governorate is approximately 1,340 km^2, which 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 as of 2004 was 529,700. Al-Manakh District has the highest population density, representing approximately 49 % of the total population. The annual population growth rate for the Governorate has been decreasing from 1.7 % in 2001 to 1.5% over the period from 2001 to 2003.

In 2003, the work force in the Governorate represented 33 % of the total population. Out of the 173,100 in the workforce, almost 79 % are employed. The unemployment rate for the Governorate of Port-Said has been fluctuating from the period from 2001 to 2003, recording 8.2 % in 2001, 5.8 % in 2002, and a high of 20.8 % in 2003 (as compared to a national rate of 11 % in 2003). The highest unemployment rate is found in Al-Arab District, while the lowest rate is in Al-Dawahy district.

The GDP per capita for the Governorate of Port Said recorded LE 12,909 in 2001 to 2002, with Port-Fouad District enjoying the highest GDP per capita, followed by East (Port Said) District, Al-Arab District, Al-Manakh District, and finally Al-Dawahy District. The Governorate of Port Said enjoys the highest GDP per capita compared to all other Egyptian Governorates, which is more than double the national average of LE 5,538.

There are approximately 26,700 feddans of cultivated agricultural land in the Governorate of Port Said and the main agricultural crops grown are wheat, rice, and cotton. Almost 36 % of the labor force in Al-Dawahy District is engaged in agricultural activities, while this percentage falls to under 4 % in the remaining districts.

Industry absorbs almost 20 % of the workforce in Al-Manakh District and less than 16 % in each of the remaining districts. The largest industrial activity in the Governorate as of 2003 was food and beverage production, followed by the production of mineral products and machinery/equipment. The service sector is the most important sector to the economy of the Governorate. More than 86 % of the work force in Port Fouad, Al-Arab, Port Said (East), and Al-Manakh Districts are engaged in services, and only 50 % of Al-Dawahy District.

Adult literacy rate (over 15 years old) in the Governorate of Port-Said recorded 83 % in 2001. The highest literacy rate is found in Port-Fouad District, followed by East (Port Said) District, Al-Arab District, Al-Manakh District, and finally Al-Dawahy District. There are 6

university faculties and 6 educational institutions for graduate studies in the Governorate of Port Said, in which 40,760 students were enrolled in 2003.

2.3.4 Governorate of North Sinai

The Governorate of North Sinai is located in the north-east of Egypt and is surrounded to the north by the Mediterranean Sea, to the south by the Governorate of South Sinai, to the west by the Governorate of Ismailia and the Governorate of Port Said, and to the East by the Egyptian border with Israel. The total area of the Governorate is approximately 28,990 km^2, which is divided into three administrative districts; 6 cities, 10 kisms, and one section.

The estimated population as of 2004 was 302,000. Al-Arish City has the highest population density, representing approximately 37 % of the total population. The annual population growth rate for the Governorate has been increase during the period from 2001 to 2003, reaching 8 % in 2003.

In 2003, the work force in the Governorate represented 32 % of the total population. Out of the individuals in the workforce, almost 85 % are employed. The unemployment rate for the Governorate of North Sinai has been stable during 2001 to 2002 at 14 % and increased to 15 % in 2003. The highest unemployment rate is found in Al-Sheikh Zwaied City, while the lowest rate is in Al-Tal Nekhel City.

The GDP per capita for North Sinai Government recorded LE 6,260 in 2001 to 2002, with the highest in Nekhel City, followed by Al-Hasanah City, and First Kism of Al-Arish.

There are approximately 180,200 feddans of cultivated agricultural land in the Governorate of North Sinai and the main agricultural crops grown are olives, almonds, peaches, wheat, and tomatoes. Almost 80 % of the labor force in Kism Al Kosiamah are engaged in agricultural activities, while this percentage ranges from 5 to 75 % in the remaining areas.

Industry absorbs 21 to 24 % of the workforce in Fourth Kism of Al-Arish, Third Kism of Al Arish, and Romanah Section, and between 3 and 19 % of the workforce in each of the remaining districts. The largest industrial activity in the Governorate in 2003 was food and beverages production, followed by the production of mineral goods and equipment and machinery production. Most skilled craftsmen in the Governorate are also involved in the production of mineral-related products and machinery. More than 76 % of the workforce in First Kism and Second Kism of Al Arish are engaged in services, while the services sector absorbs between 17 and 74 % of the labor force in the remaining districts.

Adult literacy rate (over 15 years old) in the Governorate of North Sinai recorded 68 % in 2001, only slightly higher than the national average of 66%. The highest literacy rate is found in Second Kism of Al Arish at 89 %. There are two university faculties and three educational institutions for graduate studies in the Governorate of North Sinai.

2.3.5 Governorate of South Sinai

The Governorate of South Sinai is located on the southern region of the Sinai Peninsula. The total area of the Governorate is approximately 31,270 km^2, which is divided into three administrative districts; 8 cities, and 7 kisms.

The estimated population in as of 2004 was 63,800. Kism and City of Al-Tor have the highest population density, hosting approximately 26 % of the total population. The annual population growth rate for the Governorate has been declined from 2.8 % in 2001 to 1.7 % in 2002 and up again to 2.1 % in 2003.

In 2003, the work force in the Governorate represented 40% of the total population. Out of the 25,500 individuals in the workforce, almost 87% are employed. The unemployment rate for the Governorate of South Sinai has been decreased notably over the period from 2001-2003, from 25 % in 2001, to 20 % in 2002, to 13 % in 2003. The highest unemployment rate is found in Ras Sedr City, while the lowest rate is in Sharm El-Sheikh City.

The Governorate of South Sinai has the second highest GDP rate per capita (LE) in the country, which recorded LE 11,560 in 2001 to 2002, with the highest GDP recorded in Kism and City of Sharm El-Sheikh.

There are approximately 8,100 feddans of cultivated agricultural land in the Governorate of South Sinai and the main agricultural crops grown are wheat, barley, and olives, in addition to palm trees. Approximately 31 % of the labor force in Kism Ras Sedr are engaged in agricultural activities, while this percentage ranges from 0.3-19 % in the remaining areas.

Industry absorbs 61 % of the workforce in Abu Ridis City and 53 % of the workforce in Abu Zenima City, and between 7 and 48 % of the workforce in each of the remaining areas. The largest industrial activity in the Governorate in 2003 was chemical industries, followed by food and beverages production. Almost 47 % of the skilled craftsmen in the Governorate are involved in the production of food & beverages. The service sector is the most important sector to the economy of the Governorate of South Sinai. More than 92 % of the workforce in St. Catherine City are engaged in services, and between 33 and 88 % of the labor force in the remaining districts is working in the service sector.

Adult literacy rate (over 15 years old) in the Governorate of South Sinai recorded 76 % in 2001. The highest literacy rate is found in Dahab City at 98 %. There are currently no university faculties in the Governorate of South Sinai and only one educational institution for graduate studies.

2.4 Natural Conditions[1]

Natural conditions in the Gulf of Suez and areas adjacent to the project area are representatively described below.

2.4.1 Meteorological Conditions

Air Temperature

The climate is arid, with a yearly average net evaporation of 10 mm/day. The monthly variations of air temperatures of Sharm El-Sheikh region, generally varies from 17.8 to

[1] : Source: OECC (Japan), "Study on Status of the Environment and Relevant Policies/Measures in Egypt", 2005 February and other general referential books.

20.3 ℃ in winter, from 24.1 to 31.7 ℃ during spring, from 31.5 ℃to 32.7 ℃ during summer, and from 20.4 to 26.8 ℃ during autumn.

Relative Humidity

The maximum values of humidity vary from 54.6 to 63.5 % in the winter months (November to April), which is a relatively high relative humidity. In the summer months; from May to October; the maximum values of humidity vary from 47.5 to 55.6 %, showing that the summer months are more arid.

Wind

Winds blow mainly from the north-northwest direction throughout the year. Winds also reach the area from other directions but with lower frequency; from April to October, winds are prevailing either from southeast or northeast direction. From November through March, winds swing less frequently from east to west beside the dominant northern winds.

Cloud Cover

The Red Sea is a very unclouded area. The cloudiest months are from December to March when more than one-quarter cover is to be expected for 30 to 40 % of the time. For the rest of the year cloud cover is very small, 10 to 20 % with long cloudless period from June to September.

Rainfall

Rainfall in the region is extremely sparse and localized. The rain is mostly in the form of showers of short duration, often associated with thunderstorms and occasionally with dust storms, resulting in poor visibility. Over the Gulfs of Suez and Aqaba, showers are very infrequent. All of the rainfall in the region occurs within just a few days, mostly in December; during some years none falls. Measured during a 20-year period, the average annual rainfall was about 25 mm for the Gulf of Aqaba. Climatological studies of the area document the large deficit between the amount of precipitation and evaporation. Rainfall at the northern end of the Gulf of Aqaba is normally 22 mm per year. Evaporation is 179 mm, eight times precipitation, leaving a deficit of 157 mm per year. Inflow of waters from the Red Sea balances the deficit.

Groundwater

The groundwater levels are very dependent on the tidal range in the sea level, because the materials underlying the supra tidal zone are very permeable. In summer, evaporation causes the water level to sink a maximum of 10 cm, and more seawater is supplied. In winter, with decreasing evaporation less seawater is supplied even though the winter tides run much higher than the summer tides. It has been observed that the water level rise in winter occurs rather quickly (within a few days). This is due to a sudden rise in tidal levels all along the Red Sea and the Gulf of Aqaba in fall. This phenomenon is not related to the tides themselves, but to the climatic responses (e.g. monsoons) to the movement of the sun around the equinox.

Land and Sea Breezes

As in all coastal areas prone to strong solar heating, the shores of the Red Sea, like in Sharm El Maya and Naama Bay shores, experience diurnal wind changes commonly referred to as land and sea breezes. The sea breeze, a flow of air from the sea towards the land, develops during day light hours, usually reaching maximum strength in early or mid afternoon. The reverse flow, land breeze, occurs at night but most strongly developed around dawn. In the absence of other factors, land and sea breezes tend to flow more or less at right angles to the shoreline.

2.4.2 Oceanographic Conditions

Tide

The physiographic configurations of the Red Sea, and the Gulf are long, narrow and an almost closed embankment, dictate the nature of the tides. Tides are semi-daily and their characteristics differ in the two Gulfs. In the Gulf of Suez, a nodal point occurs near El-Tur about 180 km north of the southernmost limit of the Gulf. The tidal range in the Gulf of Suez, near its northern limit, is about 2 m, decreasing southward to 0 m at El-Tur and increasing again up to about 60 cm near Ras Mohammed. The tidal range in the Gulf of Aqaba is about 70 cm at Taba and 90 cm near Sharm El-Sheikh. No nodal point exists along the Gulf of Aqaba.

Water Movement and Current

The fundamental movements of surface water follow the winds, so that the northerly wind of summer drives surface water south for about four months at a velocity of 12 to 50 cm/sec, while in winter, the flow is reversed, pushing water into the northern Red Sea from the southern part; the net value of the latter movement is greater than the summer current to the north, and the drift continues to the northern end of the Gulf of Suez. The main surface drifts are slow moving and are easily modified and even reversed by local effects and by small tides.

Although south-flowing currents, generated by the prevailing northern winds, exert a major force that affects the sea marginal depositional environments, other northward-moving currents in the southern parts of both gulfs counteract this influence. These northward-flowing currents include currents resulting from salinity differences. A warm less saline surface water current flows into the gulfs from the Red Sea replacing waters lost by evaporation and lost by an out flowing deeper density current of more saline cooler waters. Stormy winds from the south at the tip of the Sinai Peninsula drive currents northward in both gulfs.

The common storms in the Gulf of Aqaba accompanied by winds of up to 45 to 80 knots provide considerable bursts of energy to these currents. Because some of the high winds are southerly, especially in winter, one can expect to find the normal long shore current's flow to be temporarily reversed. Currents in the southern part of the gulf are most affected by strong southerly winds. Oceanic currents in the Indian Ocean change the level of the Red Sea and the gulfs seasonally. The effects in both gulfs are sea levels that are about 30 cm higher in winter than in summer.

Water Temperature

The water temperature is lower in the northern parts than in the southern part of the Red Sea. Sometimes, sudden changes of temperature occur from one area to another, especially in the central part of the area. This change may reflect the natural barriers that prevent free mixing of waters in the area and thus inhabiting regular changes. The Gulf of Suez water affects the northern and western side of the Red Sea down to 200 m in depth. Surface temperature declines slightly towards the entrance of the gulfs, owing to the influx of cooler water from the Gulf of Aqaba, and there is also a gradual decrease of temperature in the northerly direction. The mean annual maximum and minimum water temperatures of the coast of the Gulf of Aqaba are higher than those of the Gulf of Suez.

In Sharm El-Sheikh area the surface water temperature in summer (June 1996) showed a variation from 25.5 to 27.3 ℃, with an average of 26.1℃. In winter (February 1997) the temperatures were lower than that of summer showing less variability at the surface, ranging from 22.6 to 23.2 ℃, with an average of 22.9 ℃.

Salinity

The salinity gradient in the Gulf of Suez is greater than the values recorded for the Red Sea or Gulf of Aqaba. Salinity show limited variation in spite of the presence of desalination plants in Naama and Sharm El-Maya Bays, but it appears to be with negligible effect. In Port Bay, the salinity distribution showed an increase in the North West direction indicating the effect of land drainage resulting from human activities in this area

There is considerable evidence that, in given latitude, salinities are higher on the western side than in the east so that isohalines are aligned generally from north-north east to south-southwest. The difference between the two sides in the same latitude sometimes amounts to as much as 1 %.

The inflow current from the Red Sea at the surface is a less saline, whereas the more saline (denser) waters, resulting from the large evaporation precipitation ratio, sinks and forms a counter flow to the south. A sill at the Strait of Tiran (depth 252 m) separates the Gulf of Aqaba from the Red Sea and restricts deep circulation. The salinity increases from south to north in the Gulf of Aqaba. Low winter and high summer values of salinity are observed.

Dissolved Oxygen

The measured dissolved oxygen concentration in the surface water of the Red Sea is near to saturation values. The saturation values are in the range of 4.8 to 6.5 ml of oxygen per liter depending on temperature and salinity values. The saturated layer in the Red Sea extends to about 100 m depth. Below 100 m in the Red Sea, the dissolved oxygen concentration values drop to only 10 to 25 % of the saturation values. The Gulf of Suez resembles the Gulf of Aden in many others of its characteristics, and has no oxygen minimum, while in the Gulf of Aqaba, there is a gradual decline with depth but never to lower than about 50 % saturation. The dissolved oxygen in the water of Sharm El-Shiekh area showed more or less homogeneous distribution. However, the oxygen content at 100 m layer was significantly lower in spring, yet still indicating a well oxygenated condition (5.3 mg/l).

Horizontal distribution of dissolved oxygen concentrations in summer at the surface of the lagoons in Sharm El-Sheikh showed values ranging from 4.3 to 4.8 mg/l and from 96 % to 108 % saturation. In winter, oxygen distribution showed higher values (5.3 to 5.7 mg/l)

than that of summer, which may be attributed to lower temperatures. Super-saturation of oxygen values is shown in Sharm El-Maya Bay in summer due to photosynthetic activity.

pH Value

The distribution of pH values at the surface water in summer showed values ranging from 8.3 to 8.4 reflecting low variation. In winter, pH values were lower than that recorded in summer with a variation range of 8.0 to 8.2. The observed higher pH values at surface water in summer could be attributed to the photosynthetic activity due to higher temperature and long light span.

Eutrophication

Most of the Red Sea water has been considered oligotrophic with the exception of small areas off the Sinai Peninsula. The upper waters of the Red Sea are nutrient-poor, with nitrate being depleted more than phosphate. High levels of nitrite and ammonia have been recorded in the upper waters, which can be considered as an indicator of high bacterial activity. Seasonal variations occur in dissolved nutrient concentrations near shore and that local eutrophication is resulting from anthropogenic inputs. Water in the Gulf of Aqaba and Gulf of Suez is poor in nutrients compared with the Indian Ocean.

2.5 Environmental Features and Risk

2.5.1 Overview

The Red Sea, the Gulf of Suez and the Gulf of Aqaba constitute a unique and valuable ecosystem. The Red Sea is valuable, not just as a unique environment, but as one of a high diversity, great scientific and ecological sensitivity, and of great beauty and tourist-value. Hence, their natural resources provide a substantial economic support for the region. Furthermore, the regional resources contribute substantially to Egypt's economy, particularly in the areas of oil production, navigation, tourism and fisheries.

2.5.2 General Environment[1]

(1) Gulf of Suez

The Gulf of Suez is relatively shallow, with a maximum depth of about 64 m; outside its mouth the depth drops sharply to about 1,255 m. In contrast, the Gulf of Aqaba attains a depth of about 1,355 m and is separated from the deep waters of the Red Sea by an entrance less then 100 m deep. The Gulf of Suez has a relatively flat bottom with a depth ranging between 55 and 73 m. Hence, the Gulf spreads a shallow basin filled with the surface water of the Red Sea. The Gulf of Suez is the area the most at risk of pollution in the Red Sea, particularly oil pollution.

[1] : OECC (Japan), "Study on Status of the Environment and Relevant Policies/Measures in Egypt", 2005 February and other general referential books.

(2) Red Sea

The sea has a surface area of roughly 450,000 km^2. The sea floor has a maximum depth of 2,500 m in the central median trench and an average depth of 500 m, but it also has extensive shallow shelves, noted for their marine life and corals. The sea is the habitat of over 1,000 invertebrate species and 200 soft and hard corals. The sea occupies a part of the Great Rift Valley. As such, the Red Sea is the world's most northern tropical sea.

It is a semi-enclosed, narrow water body with no river inputs. The surface area of the Red Sea is about 437,970 km^2 and its mean depth is 491 m. In the north, the width is only 175 km but southward it increases to a maximum of 370 km near Jizan, then decreases to 30 to 40 km at Bars El-Mandab.

(3) Gulf of Aqaba

The Gulf of Aqaba in the northern Red Sea is a warm water body, approximately 180 km long and on average 8 km wide, and attains a depth of about 1,355 m. It is a deep basin with narrow shelves, which comprises two isolated depressions separated by a submarine sill. The northern depression is about 1,100 m deep and the southern depression is about 1,420 m deep. The maximum depth within the Gulf of Aqaba is observed near the east coast with a depth of 1,829 m.

The Gulf of Aqaba is a marine environment enclosed by arid lands that experience extremes of temperature and exceedingly low levels of precipitation. These conditions have led to the evolution of unique, and hence internationally important, coral reef and marine ecosystems, which are particularly susceptible to damage from pollution or other forms of environmental impact. The Gulf of Aqaba also represents a natural resource of major economic significance to the four riparian countries (Egypt, Israel, Jordan, and Saudi Arabia) in terms of access to sea transportation and the development of tourism and other industries along its shores.

(4) Sinai Peninsula

Sinai Peninsula is a strategic national security zone for Egypt. Sharm El-Sheikh area, located at the southern part of Sinai, was declared as a protected area, because of the diversity of wildlife species and other available natural resources. Sharm El-Sheikh area is characterized by barren terrain with limited vegetation cover, diversity of landscapes, clear skies and clear water with shallow coral reef community. The entire Sinai region is deeply dissected by the river valleys that eroded at earlier geological periods. These river valleys break the surface of the plateau into series of detached massifs with a few oases scattered here and there.

Sinai is a triangular peninsula, the base points to the north and it’s apex to the south. Most lowlands slope gently towards the Gulf of Suez, the lowest forms the El-Qaa coastal plains. In the southern zone, the mountains come close to the sea forming a bold and rocky coastline that runs into the Gulf of Aqaba. The Sinai coastline varies among alternating high mountains, hills and fine-grain yellow sand beaches. The natural wealth of the Sinai region is characterized by internationally recognized coral reefs, clear warm coastal waters, outstanding desert landscapes, sites of cultural and religious importance, and near permanent

sunshine. Those resources, coupled with their proximity to European tourism markets, have stimulated the rapid growth of tourism development that the region is currently experiencing.

2.5.3 Environment-Sensitivities[1]

(1) Overview

The Red sea, the Gulf of Suez and the Gulf of Aqaba, is endowed with high biodiversity. It represents a lot of different environmental ecosystem with more than 10 thousands sea organisms. Among them are fish of over 1,000 species, hard coral of over 250 species, soft coral of 100 species, birds of over 300 species, mammals of about 300 species, algae of over 500 species, sea grasses of 11 species, mangrove of 2 species and sea turtles of 4 species.

In addition, the Red Sea, the fringe areas of the Gulf of Suez and the Gulf of Aqaba and adjacent land territories are a habitat for more than 2,000 kinds of invertebrate animals such as mollusca, crabs echinoderm, worms and hundreds of wild animals, desert plant and salt marsh plants. **Figure 2-2** shows the sensitivities of various environmental parameters in the region.

Specific descriptions on the environment-sensitivities in the Project Area are presented by referring to the NOSCP, as below:

(2) Coral Reefs

Coral reefs are considered as priority areas for protection due to their very high species diversity, their uniqueness and their considerable economic importance for the tourist industry and fisheries.

Extensive coral reefs are found in the Red Sea, the Gulf of Aqaba and a part of the Gulf of Suez. The dominant reef type is the fringing reef extending almost continuously along the coast. Mostly the fringing reefs are narrow extending only a few tens of meters from the shore. In some areas, especially further south, they commonly extend 1 km to seaward.

The coral reefs in the Gulf of Suez are poorly developed. There are little or no corals in the northern half of the Gulf. From Ain Sukhna to the strait of Gubal only patchy fringing reefs are found with a limited coral diversity.

Coral reefs are threatened by small chronic oil spills in particular, but larger acute oil spills may also affect coral reefs. Observed biological impacts of oil spills in reef areas range from mass mortality of fish and invertebrates to apparently no effects.

Generally oil floats over the reef. However oil components may come in contact with corals in a number of ways:

- Some reefs are exposed to the air during low tides. Oil can come in contact with corals and cause severe damage on such reefs;

[1] : Most parts are extracted from “National Oil Spill Contingency Plan”, EEAA.

- Waves breaking on the reefs may create droplets of oil that are distributed into the water-column;
- Weathering processes cause oil to sink;
- Oil components can dissolve in water to some extent which exposes the corals to potentially toxic compounds. However, toxic concentrations are only encountered in the uppermost part of the water-column;
- Sand landing on an oil slick during sand storms can cause the oil to sink; and
- The use of chemical oil dispersants will increase the dispersion of the oil into the water, thus increasing the potential for contact with the corals.

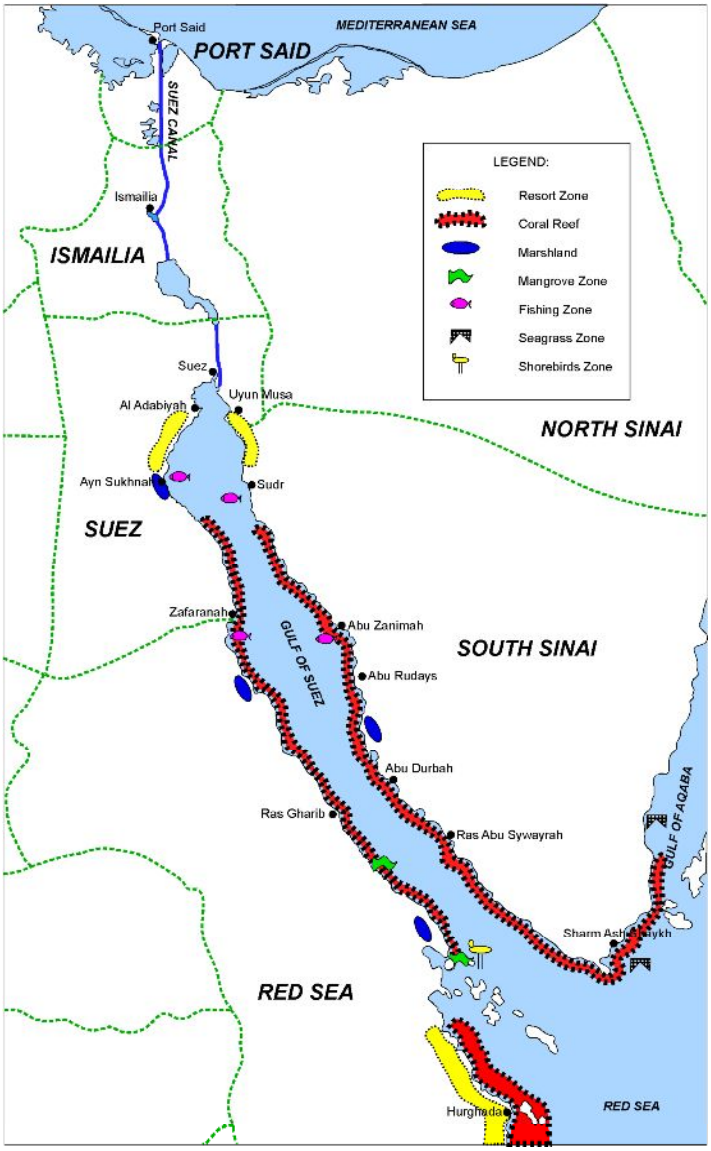


Figure 2-2 Environmental Sensitivities in Gulf Region[1]

[1] : Hazem M. Bashat, "Challenge of Oil Spill Response Capabilities in Egypt".

Based on these considerations coral reefs can be ranked with respect to sensitivity as indicated in **Table 2-1**.

Table 2-1 Sensitivity of Various Types of Coral Reefs.

Degree of vulnerability	Reef Type
Very vulnerable reefs	A. Reefs on very shallow water where the reef edge and reef flats may be exposed to air during low tide. There is a high risk of direct contact between corals and oil and the reef can be severely damaged.
	B. Reefs in sheltered shallow waters where high concentrations of dissolved oil may persist for quite a long time.
	C. Reefs on shallow waters which are already stressed by pollution, sedimentation, tourism etc.
Reefs of medium vulnerability	Reefs on shallow water. High concentrations of dissolved toxic oil components may be encountered in the water around the corals beneath large fresh oil slicks on such reefs.
Reefs of low vulnerability	Reefs on deeper waters. Oil floats over the reef and dilution reduces oil concentrations around the corals to below acute toxic levels.

(3) Mangroves

Mangroves are well known for being particularly sensitive to oil spills and are considered as priority areas for protection. Mangroves are encountered in the Red Sea region, particularly in the southern part. There are only a few isolated mangrove stands in the northern Red Sea. Here the mangroves are at the northern most limits of their range. The dominating mangrove tree in the Red Sea is Avicennia marina.

Mangroves are highly productive ecosystems providing food and shelter for a large number of species. They are important breeding and nursery areas for fish and crustaceans and they are essential habitats for numerous birds.

Mangroves typically grow in more or less anaerobic sediments. They receive oxygen through aerial roots protruding from the sediment surface. There are pores on the aerial roots through which oxygen passes. This root system makes mangroves highly susceptible to oiling. Oil slicks may enter mangroves when the tide is high and are deposited on the aerial roots and sediment surface as the tide recedes. The pores in the aerial roots become clogged by the oil and, if many roots are oiled, the respiratory system collapses and the trees die. Mangroves can also be killed due to toxic effects of oil components, especially low boiling aromatics. The toxicity of oil gradually decreases because the toxic aromatics evaporate. Toxic effects therefore mainly arise from newly spilled oil.

Oil easily gets trapped in the mangroves and usually persists for a very long time. The oil is subject to microbial degradation which may be a rather rapid process in aerobic environments. However, if the oil is buried within the anaerobic sediments, bio-degradation proceeds very slowly.

There is a database attached to each mangrove symbol containing information on; site name, geographical coordinates of the site, national legal status, international status and ecological significance of the site.

It should be noted that there are extensive areas of mangroves along the Red Sea coast between Shalateen and the Sudan border and that the exact locations of these mangroves are not known in detail.

(4) Saltmarshes

Saltmarshes are also sensitive to oil pollution. There are various types of saltmarsh vegetation. Marshes are extremely productive and are valuable habitats for many species. They are essential habitats for numerous birds, both as roosting and breeding sites for resident species and stopover and feeding grounds for migrants. Large reed marshes are found in the coastal lakes along the Mediterranean shore. However, these marsh areas are enclosed within the lakes which are only connected to the sea through narrow gaps.

(5) Bird Sites

Around 70 % of the bird species encountered in Egypt are migratory species which are found only in Egypt on a seasonal basis. The coasts of Egypt are situated along extremely important migration routes for birds and there are very important wintering areas for water birds along the coast.

The migrating birds pass a number of internationally important bottlenecks along the Mediterranean and Red Sea Coast (Zaranik, Ras Mohammed, Suez, Ain Sukhna and Gabel Zeit). Very large concentrations of migrants can be found in the spring and autumn in these areas including a high percentage of the world population of several species.

The lakes along the Mediterranean shores of Egypt and the Bitter Lakes are among the most important areas for migrating and wintering waterbirds in the Black Sea/Eastern Mediterranean region and the entire continent of Africa. Significant concentrations of the world populations of a number of species are found in these wetlands.

The islands in the Red Sea are important breeding grounds for birds, especially gulls and terns, including the globally threatened White-eyed Gull (Larus leucophthalmus). This species only breeds on the Red Sea Islands. In the early 1980s it was estimated that over 30 % of the world population of White-eyed Gull breeds on Egypt's northern Red Sea islands.

The mangroves in the Red Sea are important habitats for birds. Several species of birds are residents of the mangroves, the most prominent being the Spoonbill, Reef Heron, Green Heron and Ospreys. Many migratory and wintering shore birds use the mangroves for food and shelter, which is, otherwise, extremely scarce along the arid Egyptian Red Sea coast.

Waterbirds are perhaps the most prominent victims of oil spills at sea. There are three types of effects:

- Effects caused by the sticky nature of oil. Stains of oil on the plumage may destroy the insulating and water repelling property which may ultimately cause the death of the bird;
- Toxic effects after the ingestion of oil during preening, ingestion of oiled prey, inhalation of oil fumes or absorption of oil through skin or eggs; and

- Indirect effects resulting from destruction of bird habitats or food resources.

The sensitivity to oil for various groups of birds differs considerably. **Table 2-2** gives a ranking of the vulnerability to oil spills of various groups of water birds.

Table 2-2 Relative Vulnerability of Various Groups of Waterbirds

Vulnerability to oil	Group	Remarks
High vulnerability	Diving coastal birds Diving ducks, Grebes, Boobies	These birds stay on the water most of the time. The risk of contact with oil-slicks is high and the birds do not avoid oiled areas. Direct mortality from oil slicks can be very high.
	Waterfowl Dabbling ducks	Dabbling ducks also stay on the water and are therefore highly at risk but they are less vulnerable than diving birds because they prefer shallow habitats with a reduced risk of spill occurrence (Such as the Mediterranean coastal lakes which are only connected to the sea via a few very narrow gaps)
Moderate vulnerability	Diving pelagic seabirds Skuas	These birds do not spend much time on the water surface. Risk of direct mortality due to exposure to oil is therefore smaller. Effects on reproduction from oiling and ingestion of oil have occurred.
	Shorebirds	Shorebirds rarely enter the water. Risk of direct mortality during an oil spill is therefore generally low. Indirect effects from either reduced or contaminated prey are more likely because they feed in intertidal habitats where oil strands
	Wading birds Herons	Do not immerse into the oil. However, wading birds feed in shallow areas which are usually oiled during a spill. Therefore indirect effects can occur from ingestion of oiled prey and from loss of food sources.
	Birds of Prey Eagles, ospreys, falcons	Birds of prey may become oiled via consumption of oiled prey
Low vulnerability	Gulls and terns	Gulls and tern are able to readily avoid oil spills

The risk of oil pollution to bird species not normally associated with water is, of course, much lower than that of waterbirds. However, certain migrating non-water birds, such as birds of prey and storks, can be affected. During migration birds often land to rest along the shoreline or to soak their feet in the tidal zone to cool down.

The risk of oil pollution in Egyptian coastal lakes is much lower than in the marine environment proper; however, the impacts of oil pollution could be potentially more severe as there are much greater numbers of birds utilizing the lakes.

(6) Turtles

Sea turtles are listed as globally threatened species and they are very sensitive to oil pollution. Nesting sites are particularly vulnerable and are therefore considered to be priority areas for protection.

Three species are known to breed in Egypt: the Loggerhead Turtle (Caretta caretta), the Green Turtle (Chelonia mydas) and the Hawksbill Turtle (Eretmochelys imbricata). Leatherback Turtle (Dermochelys coriacea) and Olive (Ridley) Turtle (Lepidochelys olivaccea) are also known from Egyptian waters. The status for these species is indicated in **Table 2-3**.

Table 2-3 Status of Sea Turtles in Egypt

Species	Status in Egypt	Global Status*	National Legal Status	Areas of importance to species
Hawksbill Turtle (*Eretmochelys imbricata*)	Uncommon breeding species in the Red Sea (most common breeding Turtle in Egypt)	Endangered	Protected	Red Sea (Islands)
Green Turtle (*Chelona mydas*)	Scarce breeding species along the Mediterranean and Red Sea Coasts	Endangered	Protected	Mediterranean and the Red Sea Islands
Leatherback Turtle (*Dermochelys coriacea*)	Rare visitor on the Mediterranean coast and uncommon visitor to the Red Sea	Endangered		Mediterranean and Red Sea Islands
Olive (Ridley) Turtle (*Lepidochelys olivaccea*)	Rare visitor to the Red Sea	Endangered		Red Sea
Loggerhead Turtle (*Caretta caretta*)	Scarce breeder on the Mediterranean coast and very rare visitor to the Red Sea	Vulnerable		Mediterranean

* Globally threatened status as specified by the 1990 IUCN Red Data Book (WCMC 1990).:

The Red Sea seems to be more important for nesting sea turtles than the Mediterranean. The Red sea Islands are especially important. However, it should be stressed that sea turtles have not yet been adequately surveyed in Egypt. Surveys for sea turtles are particularly needed along the Delta and North Sinai coasts as well as the Red Sea.

Turtles lay their eggs on sandy beaches during summer. The peak nesting period is June-July. The females bury the eggs in the sand. The nests are normally located above the high tide level and the turtles prefer nesting on isolated beaches.

Turtles are vulnerable to oil, eggs and juveniles being the most sensitive stages. The hatchlings are especially at risk when they dig their way out of the nest and enter the water. If oil is stranded on a nesting beach the juveniles inevitably have to cross an oiled part of the beach and they become smeared in oil. This may cause skin irritation and surface lesions which may weaken them. In severe cases they may die.

During their first period in the sea the young juveniles stay in surface waters and the risk of encounter with oil slicks is therefore high. Young turtles which have been exposed to oil in water may suffer from a wide number of injuries. These injuries may eventually cause the death of the animal.

The eggs are also very vulnerable to oil when buried in the sand. Fresh crude oil on the sand surface significantly affects the hatching success of eggs. If eggs are exposed to a light dosage of oil mixed in sand, the hatchlings become considerably smaller in terms of weight and size than normal. Fortunately, in cases of stranding of oil on the beach, direct oiling of eggs is not likely except during storms because the eggs are usually laid above the high tide mark.

Adults may experience skin irritation or surface lesions if coated with oil. They may also consume tar balls which coat their mouth hampering feeding ability.

(6) Marine Mammals

Data on occurrence of marine mammals in Egyptian waters are scarce. Dolphins and dugong (Dugong dugong) occur in the Red Sea. Dolphins are seldom directly impacted by oil spills. There are no documented accounts of oil spill impacts on dugongs, but as the dugong is a globally threatened species, dugong habitats should be protected from oil spills. The dugong is a rare resident of the Egyptian part of the Red Sea. The main areas for dugongs are large sea-grass beds on which they feed.

(7) Protected Areas

Protected areas and endangered species have a high priority for protection during an oil spill.

The Law concerning Natural Protectorates (the Law No. 102 of 1983) created the framework for the establishment of natural protectorates in Egypt. The National Parks Department of EEAA is responsible for implementation of the Law No. 102 and supervising the national network of parks. To date, 17 Protected Areas have been established in Egypt representing a wide range of critical ecosystems. Two National Parks, five Protected Areas and one Biosphere Reserve are found along Egypt's Mediterranean and Red Sea coasts. These are:

- The Ras Mohammed and the Elba National Parks
- The Ashtun El Gamal, the Zaranik, the El Arash , the Abu Ghalum and the Nabq Protected Areas
- The El Omayad Biosphere Reserve

According to the Law 102/1983, all fauna and flora found in the Protected Areas is strictly protected. The law prohibits "any activity or practice leading to the destruction, degradation and spoiling to the natural ecology or any harm to the terrestrial, aquatic or plant life or causes any damage to the aesthetics of the area."

(9) Sea-Grass Beds

In the Gulf of Suez, Gulf of Aqaba and in the Red Sea sea-grass occurs within the lagoons in the coral fringe. Sea-grass beds are important nursery areas for reef fish and shrimps. They are also feeding grounds for many fish, for Green Turtles and for Dugong.

In most cases oil will flow above the sea-grass without causing damage. However sea-grass beds may be affected if oil is brought in contact with sea-grass. Various types' sea-grass beds can be ranked with respect to sensitivity to oil as indicated in **Table 2-4**.

Table 2-4 Sensitivity of Various Types of Sea-Grass Beds

Degree of vulnerability	Reef Type
Highly vulnerable beds	A. Sea-grass on very shallow water where oil may come in direct contact with the plants during low tide
	B. Sea-grass in sheltered shallow waters where high concentrations of dissolved oil may persist for quite a long time.
Sea-grass beds of medium vulnerability	Sea-grass on shallow water. High concentrations of dissolved toxic oil components may be encountered in the water around the sea-grass beneath large fresh oil slicks on such beds.
Sea-grass beds of low vulnerability	Sea-grass beds on deeper waters. Oil floats over the beds and dilution reduce oil concentrations around the plants to below acute toxic levels.

(10) Fish

Oil components are toxic to fish. However, the toxicity varies a great deal with the life-stage of the fish:

- Larvae are by far the most vulnerable;
- Eggs are less sensitive and
- Adults are the least vulnerable. In addition, adults are able to actively avoid oil slicks.

Generally, toxic concentrations of oil components are confined to the uppermost parts of the water column beneath an oil slick. Larvae, eggs, juveniles and adults at risk are those encountered in the upper water masses. However, in cases where oil is actively dispersed by the application of dispersants, the risk of toxic effects in deeper water increases. In addition the toxicity increases.

In the Red Sea and the Gulf of Aqaba most fish are associated with the coral reefs. There is a vast amount of species. In the Red Sea as a whole 800 different species of fish are encountered. The number of species decreases from the south to the north. In the Gulf of Suez, the abundance of reef fish is small due to the scarcity of coral reefs.

Most of the fish on the reef lay pelagic eggs and the larvae are also planktonic. Eggs and larvae stay on shallow water on the reefs and are therefore highly vulnerable to an oil spill. Generally reef fish are not migrating. Spawning therefore takes place all along the coast of the Red Sea and the Gulf of Aqaba. The abundance of fish on coral reefs is largest on the upper part of the reef front and on the shallow lagoons towards the coast (i.e. generally on waters less than 2 m depth). Adult fish are therefore also at risk in the case of an oil slick entering the reef.

2.6 Pollution of Water Environment[1]

2.6.1 Gulf of Suez

(1) Situation of Water Pollution

The sources and causes of water pollution in Suez Gulf Region can be categorized into: sewage, persistent organic solids, radioactive material, heavy metals, oils (hydrocarbons), nutrients, sediment mobilization, and litter.

Discharge of Domestic and Industrial Wastewater

The marine environment of the bays in the Gulf of Suez is subjected to mixed sources of pollution (industrial, agricultural and domestic sewage) through the direct discharge of El-Kabanon drain, which is considered the main industrial and sanitary drain. Sewage of approximately 120,000 m^3 /day is dumped through El-Kabanon drain into the bay in the Gulf of Suez. The sewage discharged contains 94 ton/year of ammonia, 0.31 ton/year of nitrite, 0.40 ton/year of nitrate, 53 ton/year of inorganic phosphate, 0.41 ton/year of copper, 3.7 ton/year of zinc, and 0.12 ton/year of lead.

In the Gulf of Suez region, the Ras Gharib beach suffers from the highest levels of bacterial pollution. This is primarily due to the discharge of raw sewage from the city of Ras Gharib directly into the Gulf of Suez. Other locations with the Gulf of Suez where high levels of bacterial counts were identified include Kabanon beach (where the source of pollution is the discharge of wastes from the area's meat processing facility), Raks beach (source of pollution is nearby port) and Attaka port (where the primary source of pollution is the ship-building industry). Nutrient levels (ammonia, nitrate, phosphate and chlorophyll) were found to be highest in the area surrounding Suez City due to the discharge of untreated sewage and industrial wastewater as well as the wastes resulting from ships waiting to cross the Suez Canal.

Heavy Metal Concentrations

Research was carried out on heavy metal pollution in the region, where the bay is subjected to industrial run-off from oil refineries, fertilizer plants, and power station in addition to sewage and garbage. The heavy metal concentrations ranged from 7.2 to 148 µg/l for Zn, 10 to 63 µg/l for Cu, 0.7 to 12 µg/l for Pb and 0.01 to 1.3 µg/l for Cd, respectively. Adabiya station showed the highest values, because of the various pollution sources discharged (i.e., harbors, sewage, and industrial drains), while in contrast the station of Ain Sokhna showed the lowest concentrations.

In the Suez area, the investigation on the possibility of using seaweed as an indicator for trace metals pollution was carried out in 2003. The study investigated the trace metals concentration within sediment, water, and seaweed. In water, the annual mean concentrations were 0.27, 0.17 and 0.44 ppb for dissolved, particulate, and total cadmium (Cd), respectively. While in sediment the cadmium concentration was 5.7 ppm. Lead

[1] : OECC (Japan), "Study on Status of the Environment and Relevant Policies/Measures in Egypt", 2005 February and other general referential books.

(Pb) in water showed annual mean concentrations of 1.1, 2.1, and 3.2 ppb for dissolved, particulate, and total lead, respectively; while in sediment lead concentration was 30 ppm.

The annual mean concentration of copper (Cu) in water was 0.97, 0.78 and 1.6 ppb for dissolved, particulate, and total copper, respectively. The total annual mean concentration of copper in sediment was 8.8 ppm with the highest value being 11 ppm and the lowest being 3.5 ppm. Finally the recorded zinc (Zn) annual mean concentrations were 21, 258, and 279 for dissolved, particulate, and total zinc, respectively. The mean zinc concentration in sediment was 23 ppm. The study concluded that sediment is highly polluted by cadmium and in less degree by lead. Also the metal concentrations correlated with industrial activities.

Petroleum Pollution

The Ain Sukhna area in the Gulf of Suez was also found to suffer from extensive chronic petroleum pollution inputs, as it is evident in the vicinity of the SUMED pipeline company terminals, which include both floating and land-based receiving terminals.

Nutrient Concentrations

In the Suez region, a study was carried out in 2003 to measure nutrient salts around the Suez Bay and down to Ain Sukhna area. Nitrate concentration ranged between 0.65 µg-N /l and 26 µg-N /l. The highest value of nitrate recorded was attributed to the fertilizer waste from El-Nasr fertilizer factory and sewage waste disposal from El-Kabanon drain. El-Nasr Factory produces 1,500 ton/day of nitrate salt and discharges 14,000 m^3/ day of low saline wastewater. Nitrite concentration varied between 0.15 to 3.7 µg-N /l. The nitrite concentration recorded was higher than that recorded previously in 1999 (maximum 2.9 µg-N /l). Ammonia concentrations ranged from 0.57 -89 µg-N /l with an annual mean of 9.9 µg-N /l. Also, ammonia concentration recorded in 2003 was higher than the one recorded in 1999, which ranged from 0.14 to 19.4 µg-N /l. Finally, the recorded values of phosphate ranged between 0.22 to 1.6 µg-P /l, while the recorded values in 1999 was lower and ranged between 0.04 -1.21µg-P /l.

(2) Influential activities in Water Environment

Tourism

The negative impacts of coastal tourism are evident in Suez Canal's lakes and Ain Sukhna. These impacts include physical destruction of coastal habitats by construction works, dredging, and pollution from wastewater discharge from coastal resorts. The lack of proper land-use planning, including effective zoning and environmental review procedures in the coastal zone, particularly with regards to urban development and tourism expansion, is a growing problem in many parts of the region. Development often proceeds without the benefit of adequate planning or evaluation of potential environmental impacts.

Ship-Based Activities

One of the main sources of marine pollution in Suez Canal and the Gulf of Suez is from ship-based sources. Transport of oil continues to play a critical role in marine pollution in the northern Gulf of Suez and the Suez Canal. This transport traffic results in chronic marine pollution from discharges of oily ballast water and tank washings by vessels,

operational spills from vessels loading or unloading at port, accidental spills from foundered vessels, and leaks from vessels in transit in the Suez Bay. Other forms of ship-generated waste include oily sludge, bilge water, garbage and marine debris.

The harbors in the region have always been an important Egyptian gate on the Red Sea since historical times. Various activities in harbors have led to an increasing rate of urbanization in the whole region. Taking advantage of the site location, several industries have been established all of them along the western coastal stretch of the Suez Bay down to El-Adabiya in the south.

Domestic Wastewater

The discharge of municipal wastewater at Lake Timsah and Suez Bay continues to present considerable management problems, despite the significant progress made over the last decade through investments to control pollution from this source. In the region, especially on Lake Timsah and south of Suez, the discharge of domestic sewage contributes to the eutrophication of coastal waters in population centers, major ports and tourist facilities.

Industrial Wastewater Management

Suez City has been developed as a center on a mix of labor and capital-intensive industries, using the existing base of petroleum and petrochemical plants. Industries in Suez City include a fiberglass boat building plant, machine shop and assembly plant, merchant steel mill, ship scrapping yard, general engineering foundry, ceramic tiles plant, and denim plant. These industries discharges industrial effluents. Also, wastewater polluted by chemicals and organic matters is discharged from food processing factories. These effluents affect coastal waters in the Gulf of Suez and neighboring water bodies.

The factory of fertilizer and chemicals uses freshwater for cooling and discharges a large volume effluent. This wastewater contains ammonia, phosphate and nitrate in addition to certain metals e.g. copper, zinc and lead which possibly cause water pollution in coastal areas.

Dredging and Filling Operations

Dredging operations of the Suez Canal, and dredging and filling operations associated with urban expansion, industrial and tourism development along the coast of canal lakes and the Gulf of Suez are significant sources of environmental degradation in the region. Sedimentation from these operations suffocates the surrounding benthic communities and has an adverse effect on other ecosystems. These may result in an irreversible loss of the most productive coastal ecosystems, sea grass beds and marine communities.

Offshore and Inshore Oil Production

Extensive oil production operations are taking place in the Gulf of Suez, both inshore and offshore. The spills from oilrigs, ships, seabed pipes and other related facilities have severely affected the inter-tidal zone in the central and southern parts of the Gulf of Suez. It have been found that many rocky shores and beaches are blanketed with tar and oil. There are also environmental concerns about the drilling operations themselves. The discharge of drill mud and rock cuttings during operations results in high turbidity of water probably extending for a few kilometers. It is a possible threat that the sediment generating from drilling operations has killed hermatypic corals.

Power Generation

The thermal power station at Ataqa is one of the largest one in Egypt designed to generate 900 MW/hour of electric power. Cooling water of 200 m^3/h is taken from the Suez Bay via an open canal extending over a half kilometer into the sea. A water temperature rise of about 10 ºC due to the thermal effect of the effluent is recorded in the near shore waters, providing possible influences to the surrounding ecosystem.

Fishing

Improper resource management, in conjunction with a lack of law enforcement, is a hindrance to sustainable development of the marine resources in the Gulf of Suez. Ultimately, this poses a serious threat to its biological diversity and productivity, and puts at risk the livelihood of people engaged in fisheries and aquaculture. The resources status for fisheries is unknown because of a lack of stock assessment and incomplete and unreliable fisheries statistics. The present situation is going to destructive fishing practices with excessive exploitation beyond maximum sustainable yield, the absence of fisheries management plans, and a lack of surveillance and enforcement of existing regulations.

2.6.2 Gulf of Aqaba

The environmental problems in the region of the Gulf of Aqaba are primarily induced by tourism and associated activities as well as maritime traffic. They result in marine, aquifer, soil, and noise pollution, and destruction of coral reef and desert ecosystems. In addition, environmental issues, which are related to the management of wastewater and solid waste, are exacerbated by the increasing resident population of the coastal cities and the numbers of tourists visiting the area.

Human impacts on the environment can be summarized into seven broad categories, as follows: tourism, ship-based activities, wastewater management practices, solid waste management practices, ferry traffic, marine aquaculture, and cruise-boating.

2.6.3 Red Sea

In other areas along the Red Sea coast, the primary source for the higher bacterial counts is the discharge of untreated sewage, whether from human settlements, tourist villages or directly from recreational boats. In general, dissolved oxygen levels were found to be within acceptable levels, with the notable exception of the coastal areas bordering major cities, ports and a number of tourist villages, where discharges of untreated sewage and industrial wastewater result in severe localized deterioration of the water quality.

In these areas, dumping of solid wastes and litter into coastal waters is also a major environmental problem. The results of surveys showed that most of the litter originated from safari and diving boats. The different items collected were shredded car tires used as boat fenders, empty food and beverage cans, gas lighters, glass bottles, oil filters, and empty barrels.

CHAPTER 3
SITUATION OF OIL POLLUTION AND POLLUTION SOURCES

3.1 General

(1) Categories and Properties of Oils

According to the basic definition, oil is an organic compound that is insoluble or not readily soluble in water. It could be a petroleum-based product as well as a non-petroleum product; both categories comprise a number of different kinds of oils. There are a great variety of other naturally occurring types of non-petroleum-based oil; lipids, essential (ethereal) oils, and wood-derived oils.

Any kind of oils is handled in this baseline survey, if it possibly influences to the water environment.

Petroleum-based Oils (Mineral Oils)

The term petroleum is nowadays used as a common denotation for crude oil (mineral oil) and natural gas, i.e., the hydrocarbons from which various oil and gas products are made. Petroleum, then, is a collective term for hydrocarbons, whether solid, liquid or gaseous.

When pumped out of a well on land or in the seabed, crude oil is a complex mixture of thousands of different chemical components, mainly organic compounds (hydrocarbons) which usually make up about 95 % of the crude oil. These hydrocarbons vary in toxicity and degradability, and range from very volatile, light materials like propane and benzene, to heavy compounds such as bitumens, asphaltenes, resins and waxes.

The composition of the crude oil depends on the "raw material" from which the crude was originally formed. Physical properties and chemical composition vary from one reserve to another and even between different depths in the same well. Thus, every crude oil is unique.

Before being used as fuel (for energy generation, machinery and vehicles), or as a raw material in the petrochemical industry, crude oil is refined into different fractions. At the refinery, crude oil is separated into light and heavy fractions, which are then converted into various products, such as petrol, diesel oil, jet fuel, etc.

Non-Petroleum-based Oils (Lipids, Essential Oils, etc)

Lipids, which contain fatty acids, may be of animal origin such as, e.g., whale, seal and fish liver oil, lard and milk fat, or of vegetable original, for example palm oil, rapeseed oil, linseed oil, sunflower oil, olive oil and coconut oil. Essential (ethereal) and wood-derived oils are usually natural including e.g. wood-derivative oils.

Various Oil Products from Crude Oil

The crude mineral oil pumped from wells is a mixture of natural gas, water (formation water or production water) and hydrocarbons. First, the gas is separated from the oil and water and further treated. Water and solid particles are removed from the oil component of the

crude, which is transported to a refinery for distillation and other separation and refinement processes. The resulting products from these processes are a number of fractions with different characteristics and ranges of use, like:

- Natural gas,
- Raw gasoline (benzin and naphtha), the end product of which is petrol (gasoline),
- Intermediate distillates, the end products of which include light gas (fuel) oil, diesel oil, aviation fuels, kerosene, etc.,
- Heavy distillates, giving end products like heavy gas (fuel) oil for cracking processes, as well as lubricants, waxes, etc., and
- Residues, the end products of which are heavy fuel oils, asphalt (bithumen), tar and coke.

Important physical and chemical properties of oils that will affect the behavior and effects of oil in water and aquatic environments are its surface tension, specific gravity, and viscosity. The composition and characteristics of an oil, together with a number of circumstances relating to the time and place of the spill, the amounts of oil, weather conditions etc. will determine how persistent the oil will be, how it will spread, whether it will evaporate or sink, etc.

From an oil spill response point of view, crude oils can be classified on a scale from light, volatile oils, over non-sticky oils to heavy, sticky oils and non-fluid oils. Similarly, refined products can be classified from lightweight gasoline and kerosene over lightweight and medium-weight fuel oils to medium-weight and heavyweight fuel oils/bunker oils.

(2) Production and Transportation of Oil

Oil is transported in the shipping lanes bordering Egypt's coastline in vast quantities. Much of the world's trade in oil is centered on the Middle East, which produces about one quarter of the oil transported globally. Around 117 million tons of crude oil per annum are shipped through the pipeline in the Gulf of Suez, and the vast majority of this cargo is trans-shipped to the ultimate customers in the European countries from the Mediterranean terminal. In addition, about 36 million tons of petroleum products are transported annually through the Suez Canal (of which 26 million tons is northbound).

Furthermore, about 85 % of Egypt's production site of oil and gas are located in coastal waters. The production facilities in the Gulf of Suez produce 36 million tons of oil and gas annually. Offshore production in the Mediterranean is becoming an increasingly important activity, also.

The Gulf Region fatefully faces the threats of oil pollution caused by various sources as mentioned above. Therefore, appropriate measures for limiting the risks of contamination of waters and for conserving marine and coastal biodiversity have to be addressed.

3.2 Sources and Generation of Oil Pollution[1]

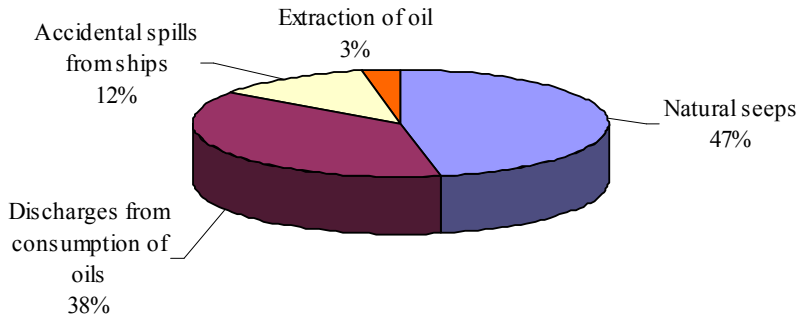
3.2.1 Overview

This section describes the classification of oil pollution sources, the generation modalities of oil pollution caused by respective sources and other related information, which are general fact and present practices common to the worlds.

Accidental, deliberate or operational discharges and spills of oil from ships, especially tankers, offshore platforms and pipelines, are the most obvious and visible cause of oil pollution of the marine environment. The kind of oil spill we usually think about is the accidental or intentional release of petroleum products into the environment as a result of human activity (drilling, manufacturing, storing, transporting, waste management). Examples would be things like well blowouts, pipeline breaks, ship collisions or groundings, overfilling of gas tanks and bilge pumping from ships, leaking underground storage tanks and oil-contaminated water effluent from oil-related industries and streets during rain storms.

However, oils enter the ocean from a variety of sources, and both natural sources (large quantities) and land-based sources account for a large part of the total annual input of oil to the marine environment.

In a report published in 2002 by the U.S. National Academy of Sciences, the average total worldwide annual release of petroleum (oils) from all known sources to the sea has been estimated at 1.3 million tons. According to the report, the main categories of oil pollution sources contribute to the total input as shown in **Figure 3-1**.



Note: Discharge from of oils means operational discharge from ships and discharge from-land-based sources.

Figure 3-1 Contribution Sources of Oil Pollution in World

3.2.2 Classification of Pollution Sources

Sources of oil input to the marine environment are often divided into sea-based and land-based sources, apart from natural causes. In many reports on oil pollution, it is often

[1] : UNEP, the website of "Global Marine Oil Pollution Information Gateway"

seen that three main categories of sources are: discharges during the extraction of oil, discharges during the transportation of oil, and discharges during the consumption of oil (including both sea-based and land-based sources). There are also other ways of placing accidental or operational/deliberate discharges of oils into different main categories.

In the category of sea-based sources and land-based sources, the following venues and activities to cause oil pollution are enumerated:

<Sea-Based Sources>

- Accidental oil spills from tankers, other commercial vessels (cargo ships, passenger ships, leisure boats, etc.), offshore platforms and pipelines, due to unintentional incidents (wrong-operation, breakdown, crash, grounding, fire, explosions, etc.);
- Operational discharges of oil or oily wastewater from tankers and other commercial vessels (cargo ships, passenger ships, leisure boats, etc.), due to intentional or unintentional reasons; and
- Other ship-related activities (dry docking, scrapping).

<Land-Based Sources>

- Discharges of untreated or insufficiently treated waste water from oil-related industries (oil refineries, petrochemical industries, food oil industries, etc.);
- Accidental or operational discharges of oil from oil storage facilities, oil terminals, oil loading/unloading facilities, gas stations, etc.; and
- Discharges of untreated or insufficiently treated municipal sewage and storm water (urban runoff).

3.2.3 Generation of Oil Pollutions

(1) Oil Pollution from Sea-Based Sources

(1-a) Oil Tankers and Other Ships

Accidental Discharge

Accidents involving oil tankers have caused many and sometimes very large oil spills. Such spills are the most obvious, visible and dramatic causes of acute oil pollution of the marine environment. According to estimates made of the contribution of oil to the sea from different sources, approx. 2,000 million tons equivalent to 57 % of the oil consumed in the world was transported by sea in 2001, and accidents involving oil tankers and offshore installations account for some 10 % of the annual total amount of oils entering the marine environment.

Tanker accidents account for most of the world's largest oil spill incidents. However, accidental spills are less frequent than other kinds of oil spills, but typically involve large volumes of spilled oil per an incident, as compared other kinds of oil spills. Leakages from sunken, grounded or abandoned ships are another potential (and often very real) source of oil to the marine environment.

Operational Discharge

Ship-related operational discharges of oil include the discharge of bilge water from machinery spaces, fuel oil sludge, and oily ballast water from fuel tanks. Also other commercial vessels than tankers contribute operational discharges of oil from machinery spaces to the sea. Cargo-related operational discharges from tankers include the discharge of tank-washing residues and oily ballast water.

Before international regulations were introduced to prevent oil pollution from ships, the normal practice for oil tankers was to wash out the cargo tanks with water and then pump the resulting mixture of oil and water into the sea. Also, oil cargo or fuel tanks were used for ballast water and, consequently, oil was discharged into the sea when tankers flushed out the oil-contaminated ballast water to replace it with new oil.

Today, variety kinds of measures for oil pollution are required to be applied to oil tankers under specialized conditions, as follows:

- Crude oil washing systems (COW): Means that the cargo tanks are cleaned by means of high-pressure flushing with crude oil or crude oil plus water. The residues from such tank washing are pumped into slop tanks and left in a reception facility in port.
- Segregated ballast tanks (SBT): Ballast water is taken on board to maintain stability, such as when a vessel is sailing empty to pick up cargo or after having unloaded cargo. Ballast water contained in segregated ballast tanks never come into contact with either cargo oil or fuel oil.
- Clean ballast tanks (CBT): Means that specific cargo tanks are dedicated to carry ballast water only.
- Operational oil separation and filtering equipment with an automatic stopping device: Bilge water is produced when the machinery spaces of a vessel are cleaned. Leaking cooling water often becomes contaminated with fuel oils and lubricant oils. Vessels in operation produce oil-contaminated bilge water to a variable extent. With the right equipment on board, dirty bilge water can be processed in a way that separates most of the oil from the water before it is discharged into the sea. If the oil content exceeds the limit, the discharge is automatically stopped (bilge alarm).

In a sea area with Special Area status under the international MARPOL Convention Annex I (so far, only the Mediterranean Sea area, the Baltic Sea area, the Red Sea area, the Gulf of Aden area, the Antarctic area, and the North West European waters), it is altogether forbidden for oil tankers to discharge oil, oily sludge and oil-contaminated residues from tank washing, or heavily oil-contaminated ballast water. All oily wastes (mixtures) must be kept on board and stored in so-called slop tanks until the vessel reaches a reception facility in port. Furthermore, it is not allowed to discharge bilge water, unless it has been properly cleaned and contains no more than 15 mg/l.

Most sea areas are not Special Areas, but in accordance with international regulations under MARPOL, attempts are nevertheless made to make large oil tankers and product carriers have equipment for crude oil washing and segregated ballast tanks. According to MARPOL Annex I, adopted in 1978, all new crude oil tankers of 20,000 dwt and above, and all new product carriers (30,000 dwt and above), must have SBT. Existing tankers over 40,000 dwt must be fitted either with SBT or with COW systems. For an interim period it was also allowed for some tankers to use CBT.

All oil tankers and other large vessels must be fitted with the equipment described above for bilge water cleaning.

(1-b) Offshore Exploration and Production

Accidental Discharge

The weight of the drilling fluid/drilling mud acts as the first line of well control by keeping underground pressures in check. If an influx of pressurized oil or gas does occur during drilling, well control is maintained through the rig's blowout prevention system (BOP). This is a set of hydraulically operated valves and other closure devices (rams) which seal off the well, and route the well-bore fluids to specialized pressure controlling equipment. Trained personnel operating this highly reliable equipment minimize the possibility of a blowout or an uncontrolled flow of fluids from a well.

However, it does not always work. The most typical causes of blowouts include equipment failure, personnel mistakes, and extreme natural impacts (seismic activity, ice fields, hurricanes, and so on). Their main hazard is connected with the spills and blowouts of oil, gas, and numerous other chemical substances and compounds. The environmental consequences of accidental episodes are especially severe, sometimes dramatic, when they happen near the shore, in shallow waters, or in areas with slow water circulation. Major oil spill category is drilling accidents which cover catastrophic situations involving intense and prolonged hydrocarbon gushing. These occur when the pressure in the drilling zone is so high that usual technological methods of well muffling do not help. Lean holes have to be drilled to stop the blowout. Drilling accidents are usually associated with unexpected blowouts of liquid and gaseous hydrocarbons from the well as a result of encountering zones with abnormally high pressure. No other situations but tanker oil spills can compete with drilling accidents in frequency and severity.

Operational Discharge

Operational discharges in the offshore exploration for oil and natural gas include operational wastes, such as drilling fluids/drilling muds, produced formation waters and formation cuttings, and machinery space discharges.

During drilling, specially formulated drilling fluids/drilling muds are used to cool and lubricate the drill bit, control pressure and bring the cuttings (rock or sand from a borehole) back to the surface. The mud is pumped down the drill pipe and into the hole at high velocity through nozzles in the drill bit. Drilling muds are usually a mixture of water, clay, a weighting material (usually barite), and various chemicals. Drilling muds are most commonly based on water (WBM), but in some cases mineral oil (OBM) or synthetics (SBM) are believed to be more biodegradable. Although the use of WBM is preferred, sometimes OBM or SBM has to be used when drilling conditions are more difficult.

Inevitably, when drilling with OBM, rock cuttings are contaminated with oil from the muds. In the past when working offshore, these cuttings were often discharged into sea. Where OBM is used offshore, the spent mud and cuttings are now re-injected or transported to shore for treatment and disposal, or recycling. The fluid is recycled through a circulation system where equipment mounted on the drilling rig separates out the drill cuttings and allows the clean fluid to be pumped back down into the hole. The objective of environmental

management of drilling operations is to attempt to minimize the potential environmental impacts.

Where one finds oil, one often also finds water. The water is either naturally present or has been injected into the reservoir to maintain pressure for production. The proportion of water produced increases as the oil field matures. As oil is drawn from a reservoir, it is therefore necessary to separate the water and return it to the ocean. This is what is known as produced formation water (PFW). Great emphasis should be placed on ensuring that the water returned to the ocean is as free as possible from oil and chemicals. The objective of environmental management of produced water is to reduce the quantity and to improve the quality of discharged produced water.

As an oil well is drilled, the drill cuttings, consisted of crushed rock and clay, are brought to the surface by the drilling fluid/drilling mud and discharged overboard. Similar to the bilge water from machinery spaces in ships, oil platform machinery space drainage is an oil-containing mixture. Operational oil separation and filtering equipment is thus needed to clean the drainage before it is discharged into the sea. If such equipment is not installed, the oily drainage should be kept on board until it can be transported to a reception facility.

(1-c) Seabed Pipeline

Whilst there is no certain figure of how long length of offshore pipelines there is in the world today, an estimation says to be about 52,000 km of pipelines. Operational discharges from offshore oil pipelines usually consist of chemical discharges during construction, hydrostatic testing, commissioning, pigging, and maintenance of the pipeline systems. Pipeline discharges usually contain corrosion and scale inhibitors, biocides, oxygen scavengers, and other agents. However, pipelines can also continuously leak oil in small quantities, although the line is intact. When a pipeline breaks, however, the spill will be an acute one, like any other accidental oil spill.

The causes of underwater pipeline damage can differ greatly. They range from material defects and pipe corrosion to ground erosion, tectonic movements on the bottom, and encountering ship anchors and bottom trawls. Depending on the cause and nature of the damage (cracks, ruptures, and others), a pipeline can become either a source of small and long-term leakage or an abrupt (even explosive) blowout of hydrocarbons near the bottom. The dissolution, dilution, and transferring of the liquid and gaseous products in the marine environment can be accompanied in some cases by ice and gas hydrates formation.

It is important to take into consideration that in a number of cases, the accidental oil spills and blowouts on the main pipelines can pose danger to the marine ecosystems. This can also happen when on land pipeline accidents take place near rivers or in locations of their crossing.

Modern technology of pipeline construction and exploitation under different natural conditions, including the extreme ones, achieved indisputable successes. However, pipeline oil and gas transportation does not eliminate the possibility of serious accidents and consequences. Thus, continuously leakage oil for a long time is not avoidable and, when a pipeline ruptures, it causes a large and acute spill.

(2) Oil Pollution from Land-Based Sources

It is a fact that the big oil spills account for a considerably smaller total annual input than the constant, diffuse input from land-based sources, although these daily and never-ending additions to the oil load on oceans and coastal areas is not dramatic.

Oil-related Industries

Most of oil-related industries like oil refineries, petrochemical industries, food oil industries discharge wastewater into rivers, coastal areas and sewerage systems. Because they use and process mineral oils, edible oils or other oils in their production processes, wastewater necessarily contains a certain concentration of oils. Therefore, these industries operationally and continuously discharge oils into the environment, even though wastewaters are treated in compliance with legal effluent standards. In some cases, high strength oil may be accidentally emitted due to wrong operations or troubles of production lines or wastewater treatment facilities.

Oil Loading/Unloading Facilities, Land Pipelines and Storage Facilities

In the region where oil fields or oil-related industries are located, oil loading/unloading, land pipelines (oil pipelines installed on land) and storage facilities are commonly installed in nearby ports. In these port areas, oil spills are frequently happened due to wrong operation and mechanical troubles of related equipment. The amount of spilled oil in these accidents is usually not so large. However, the accidents are ostensible, because they tend to be located adjacent to city areas.

Sewage and Stormwater

Oil discharged with untreated or insufficiently treated municipal sewage and stormwater (urban runoff) comes from cars, machinery, spills at filling stations and garages, flushed-out residues of lubricants, etc. The stormwater contains waterborne and airborne pollutants; everything that is flushed onto or falls down upon the hard surface will become constituents of the contaminated stormwater: car exhausts, particles from worn tires, small spills of oil from engines of different vehicles, small oil spills from garages, workshops, residues of oils and lubricants.

Consequently, a lot of oil goes down the drain from our towns and cities into the sea - either through a municipal sewage treatment plant. When streets, roofs, handling areas in ports, and other hard surfaces are washed by rain and snow, the resulting waste water (stormwater) is flushed into the general sewer system or into storm drains along roadsides. If the sewage treatment is adequate, the stormwater and municipal sewage will both be treated. If no treatment plant exists, or treatment facilities are inadequate, the sewage, including the stormwater, will be discharged into the sea more.

3.3 Pollution Sources in Gulf Region[1]

This section describes the situations of oil pollution sources in five governorates in the Gulf Region, based on the data/information collected as of January 2006. Suez Canal RBO is now carrying out the inventory survey of oil pollution sources as the task of WG2, aiming at the completion in the end of April 2006. Accordingly, this section will be replenished by more comprehensive and precise data/information brought from the inventory survey of oil pollution sources, in the later stage.

3.3.1 Governorate of Suez

The coastline of the Governorate of Suez extends over 135 km along the Gulf of Suez, accommodating numbers of ports, oil transportation bases and industries. Therefore, the Governorate is chronically subjected to oil pollution in the coastal waters and coastal areas. In the Governorate of Suez, main causes for oil pollution may be characterized, as follows:

- Discharge of oil contaminated bilge or ballast water from vessels before entering into the ports of Suez;
- Accidents of vessels;
- Discharge of motor oil of vessels and wastewater used in washing tanks and surfaces of the vessels;
- Leakages during loading/unloading of oil tankers;
- Leakages from petroleum/oil pipelines;
- Industrial wastewater discharge from oil-related industries; and
- Repair and dismantling activities of vessels.

(1) Sea-Based Pollution Sources

According to the data/information from the EMU of Suez Governorate, the total number of vessels passing through Suez Canal amounts to 16,000 vessels annually, with transferring around 125 million tons of oils and oil products annually.

Besides, the total numbers of vessels navigating to the ports located in the Governorate of Suez are estimated at about 3,000 vessels yearly. The numbers of accessing vessels to respective ports are distributed as shown in **Table 3-1**.

The occurrence of oil spills resulting from this heavy oil transport traffic in the Gulf of Suez is the most recognized threat of oil pollution with oil in the Gulf Region (i.e., in not only the Governorate of Suez but also the Governorate of Ismailia and the Governorate of Port Said). These governorates are subjected to frequent oil spills and oil pollution incidents caused by moving pollution sources. The magnitudes of oil spill incidents vary from small to large ones.

[1] : Data & information have been collected mainly from Suez RBO and EMUs of the governorates.

Table 3-1 Vessels Accessing to Ports in Governorate of Suez

Ports	Number of vessels annually
Petroleum Port at Zaityat	120 vessels
Port Tawfik	700 passengers vessels 680 cargo vessels
Adibyah	600 cargo vessels
Sukhna	Not available
Atakah Fishing Port	447 fishing ship 495 fishing boat
Petrochemicals port belonging to Oriental Petrochemicals Company	One vessel with cargo of polypropylene every week

Note: Besides ports listed above, other ports such as port for Suez Oil Company, General Petroleum Company, SUMED, etc. are located in the project area.

Oil spill incidents may be commonly distributed in five categories depending on the quantity and source of oily materials released into the sea, namely:

- Small spills (up to 2 tons), mainly caused by the accidental or intentional release of oil-contaminated bilge or ballast water from freighters;
- Minor spills (up to 20 tons), mainly caused by the release of oily ballast water from an oil tanker or the release of bunker oil during terminal operations;
- Medium spills (up to 100 tons), mainly caused by the release of oil as a result of defective equipment or procedures at an oil terminal or pipeline facility;
- Major spills, mainly caused by the rupture of a bunker oil tank in a bulk/cargo vessel collision (up to 500 tons); and
- Disasters including tanker collision causing the rupture of a single oil tank (up to 7,500 tons) and ship wreckage of a fully loaded oil tanker with release of total oil (up to 100,000 tons).

(2) Land-Based Pollution Sources

Port-related Oil Facilities

The Governorate of Suez accommodates a number of ports for various purposes along the western coast of the Gulf of Suez, as shown in **Figure 3-2**. Therefore, many numbers of possible sources of oil pollution exist, like oil loading/unloading facilities, oil pipelines and storage facilities.

In terms of oil pollution, the situations of respective ports are described below:

- Zatyat Port (Petroleum Port)

Zatyat Port is known as the Petroleum Basin. The harbor consists of five concreted platforms extending for the oil tankers with 18,000 tons capacity. The platforms are equipped with pipe lines to receive and handle all oil product vessels with about 5 m in depth. The total length of platforms is about 510 m. In addition to that a deep platform (about 11 m) is placed outside the harbor to receive oil tankers with 40,000 tons capacity and is managed by Suez Petroleum Manufacturing Co. The maximum length of oil tankers that enter the harbor is 169 m and the maximum depth of oil tankers is 8 m. The port lies to the west from Tawfik Port.

The average number of ships entering the port is 120 annually. The average quantity of petroleum that the port receives annually is approximately 1,000,000 tons.

- Tawfik Port

Tawfik Port lies at the north of Gulf of Suez at the west side entrance of Suez Canal. The land area of the port is around 31 km^2 and contains a commercial basin and another naval basin with a total number of 13 platforms that are 2,100 m long and with a depth between 7 and 8 m.

The average number of passenger ships that visit the port is approximately 700 annually, while the average number of cargo ships is about 680 annually.

- Adabiya Port

The Adaviya Port has the land area of about 85 km^2, lying some 17m to the south of the center of Suez City. It consists of 9 platforms with a total length of 1,840 m and is able to receive ships with depth between 8 and 13 m.

The Port receives an approximate number of 600 cargo ships, annually.

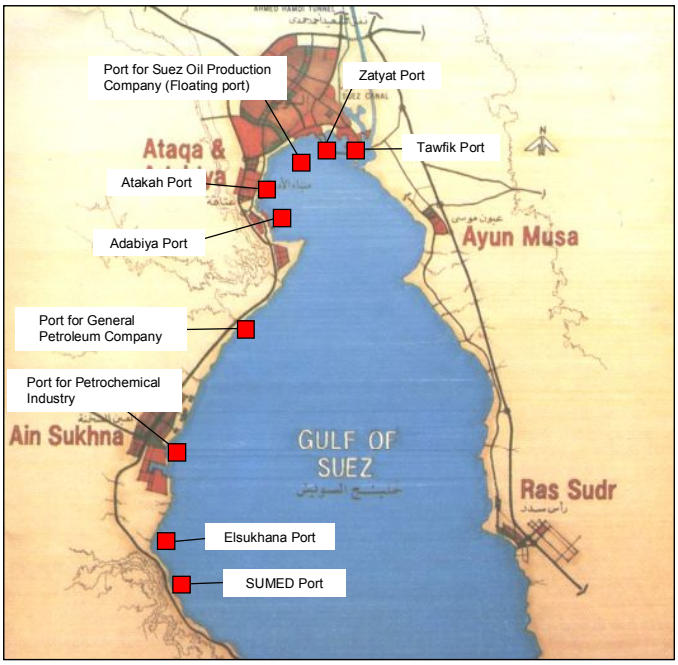


Figure 3-2 Ports in Governorate of Suez

- Elsukhna Port

Elsukhuna Port is located 43 km south of the Suez City with an area of 22.3 km^2. It receives container ships till the depth of 17 m.

- Atakah Port (Fishing Harbor)

Atakah Port (called the fishing harbor) is managed by Public Fish stock Authority in the Ministry of Agriculture. The number of platforms is 2 and the total length of platforms is 456 m to receive the fishing ships and boats. The average number of fishing ships is 447 annually, meanwhile the average number of boats is 495 annually.

- SUMED Port

SUMED Port lies approximately 55 km south of the Suez City and is made of numbers of moorings where oil pipelines can be attached to. The harbor receives oil takers where their loaded oil is pumped through pipelines on land to Sidy-Krair in Alexandria City, and the numbers of oil tankers are approximately 3,000 annually. Some 117 million tons of oil and petroleum products are transported annually.

- Port of General Petroleum Company

Port of General Petroleum Company is made of moorings that receive oil tankers where their oil is pumped through terrestrial pipelines to Cairo City.

Besides these ports mentioned above, the port specializing in loading/unloading for petroleum refinery and petrochemical industry exists in the Gulf of Suez.

Oil-Related Industries

In the Governorate of Suez, there are six industrial zones accommodating various categories of industries as shown in **Table 3-2**. A total of about 200 industries except for very small-scale ones are operating in these industrial zones and, of them, a total of 26 industries are oil-related industries like oil refineries, petrochemical industries, chemical industries, food oil industries, etc. They are regarded as having the possibility in causing oil pollution, especially in continuously discharging oily wastewater, because petroleum or food oils are used in their production lines.

Out of 26 oil-related industries, brief descriptions on oily wastewater discharge for representative five industries are presented below:

- El NASR Petroleum Co.

Refining of oil is the company's main activity to produce petroleum-derivative products like naphtha, kerosene, gasoline, asphalt, etc. The company is one of the companies owned by the Egyptian Public Petroleum Corporation and lies in the most northerly tip of the Gulf of Suez south east of Elzaitiat Harbor. The company discharges oily wastewater of 144,000 m^3/day into the Gulf of Suez.

El Nasr Petroleum Co. is equipped with API separator and the dissolved air floatation (DAF). It is reported that the water quality of the effluent is almost in conformity with the limits of effluent standards in Egypt; however 2,160 kg of oil and greases is discharged daily in the receiving waters.

Table 3-2 Industries in Governorate of Suez

Industrial Areas	Industrial Categories	Numbers of Industries
Nasr Road	Various workshops	Limited numbers
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

- Suez Petroleum Manufacturing Co.

Main activity of Suez Petroleum Manufacturing Co. is the refining of oil to produce petroleum derivative products like naphtha, kerosene, gasoline, asphalt, petroleum coal and sulfur. The company has the production line for producing petroleum coal through coaling towers as well as sulfur. The company is located in the south of El Nasr Petroleum Co. The company discharges oily wastewater into the Gulf of Suez. The discharge rate is 360,000 m^3/day.

Suez Petroleum Manufacturing Co. is equipped with API separator and DAF. It is reported that the water quality of the effluent is almost in conformity with the limits of effluent standards in Egypt; however 6,060 kg of oil and greases is discharged daily in the receiving waters.

- Industries for Storage and Marketing of Petroleum Products

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 wastes and oily wastewater of those companies are transferred to the oil separation basins of Suez Petroleum Manufacturing Co. and El NASR Petroleum Co.

- Suez Gulf Company for Food Oil

Suez Gulf Company has the wastewater treatment facilities consisting of chemical and biological process with the capacity of 300 m^3/day. It is reported that the water quality has been changed considerably since the operation of the treatment facilities in 2004; showing 78 mg/l of COD and 18 mg/l of SS. Its wastewater is discharged into nearby sewerage system.

- SAVOLA for Food Oil Production

SAVOLA is equipped with the wastewater treatment facilities consisting DAF with the capacity of 60 m^3/ day. It is reported that the content of oil and greases 66 mg/l and the rest parameters are within the compliance standards in Egypt. The treated effluent is used for irrigation water in farmland.

3.3.2 Governorate of Ismailia

(1) Sea-Based Pollution Sources

Sea-based pollution sources in the Governorate of Ismailia are the vessels passing through the Suez Canal in both north and south directions. According to the EMU of Ismailia, the numbers of these vessels are around 45 vessels daily (16,000 vessels per year).

(2) Land-Based Pollution Sources

As land-based pollution sources in the Governorate of Ismailia, several industries are working. All three industries are located in Temsah Lake and partly in Sayadeen Lake. They are described as follows:

- Temsah Company (Shipyard for building of ships)

The main source of pollution with the company is the floating dock/basin for repair/building of vessels. When vessels to be repaired are drawn into the floating dock/basin, oil is temporarily unloaded and stored in temporary storage tanks. Upon completion of the repair work the oil/petroleum is again reloaded to the vessels.

- Arab Contractors Company (Shipyard)

The main source of pollution is generated by the activities taking place in the floating dock/basin of the Shipyard.

- Hassanein Badran Company (Dismantling of vessels)

This industry receives scrap vessels for dismantling and re-sale. In the process of dismantling, there is a possibility that the remaining oils in the vessel is discharged or leaked.

3.3.3 Governorate of Port Said

(1) Sea-Based Pollution Sources

As with the case with other Suez Canal governorates, the Governorate of Port Said receives international shipping across Suez Canal. Some 500 vessels annually visit the ports in the Governorate of Port Said.

The offshore of the Governorate lays numbers of sea-based sources of oil pollution relevant with natural gas fields.

(2) Land-Based Pollution Sources

According to the data/information collected from the EMU of the Governorate of Port Said, numbers of industries which are regarded as land-based sources of oil pollution have been identified as shown in **Table 3-3**.

Table 3-3 Industries in Governorate of Port Said

Name of Industries	Activities	Locations
United for Gas Derivatives (UGD)	Extraction, processing and liquefying natural gas	Port Said, Damietta Costal highway (KM I5) on the Mediterranean Coast
Gulf of Suez Petroleum Company (GUPCO)	Extraction, processing and liquefying natural gas	Port Said, Damietta Coastal highway (KM 15) on the Lake Manzalah
Petrobel (Port – Fouad Fields)	Extraction processing and liquefying natural gas	Port Said, Damietta Coastal highway (KM 15) on the Lake Manzalah
MISR Petroleum	Depot (storage facility) for petroleum products for servicing vessels	Customs Area (Suez Canal Port), Port Said (West Bank)
Port Said Company (for Containers 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 (West Bank)
Suez Canal Repair and Maintenance Workshop	Repair and maintenance of the Suez Canal Authority	Customs Area (Suez Canal Port), Port Fouad (East Bank)
Suez Canal Authority Fueling Depot	Fueling of Suez Canal authority machinery and its periodic maintenance	Customs Area (Suez Canal Port), Port Said (West Bank)
Zaki and Ramal for Marine Works	Building, repair and maintenance of vessels (ships and boars)	Customs Area (Suez Canal Port), Port Fouad (East Bank Gates 58 and 62)
Fueling Station for Fishing Boats	Fueling of fishing boars	Customs Area (Suez Canal Port), Port Said (West Bank)
East Port Said Power Station	Power generation	Port Said (El Arish highway on the Mediterranean)

Name of Industries	Activities	Locations
Port Said Works Company	Ship repair	Customs Area (Suez Canal Port), Port Fouad (East Bank)
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 Suez Canal Authority)	Maintenance and repair for all machinery of the SCA	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 (East Bank)

3.3.4 Governorate of North Sinai

In the Governorate of North Sinai, the main sources of oil pollution are related with the activities within and around El Arish Port. The port has received more than 750 vessels in 2007. As with other ports, activities causing oil pollution are:

- Leakages of oil and oily mixtures from fishing boats during periodic maintenance work and cleanliness activities, and
- Discharge of oily mixture from vessels waiting to enter El Arish Port.

In addition, dumping of oil and/or oily mixture from vessels outside the territorial sea is other sources of coastal pollution in the Governorate of North Sinai.

3.3.5 Governorate of South Sinai[1]

The Governorate of South Sinai occupies the southern half of the Sinai Peninsula. Its coast over the Gulf of Suez stretches for around 300 km, while its coast over the Gulf of Aqaba stretches for more than 230 km. Most of the coast on the Gulf of Aqaba is devoted for tourism development and activities and a relatively high percentage of the Gulf of Aqaba coast is also designated as Protected Areas.

The major environmental concerns caused by oil pollution are related with petroleum, mining and industrial activities located along the coast of the Gulf of Suez.

(1) Gulf of Suez

Sea-Based Pollution Sources

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 transmitting crude oil and natural gas is estimated at about 830 km in total.

[1] : The governorate of South Sinai, "South Sinai Environmental Profile"

The main petroleum companies involved in exploration/production in the Gulf of Suez are GUPCO, SUCO and Petrobel. Petroble operates an oil loading port in Feeran, whereas SUCO operates a port in Ras Badran. **Figure 3-3** shows the major oil fields, as well as the major pipelines in the Gulf of Suez.

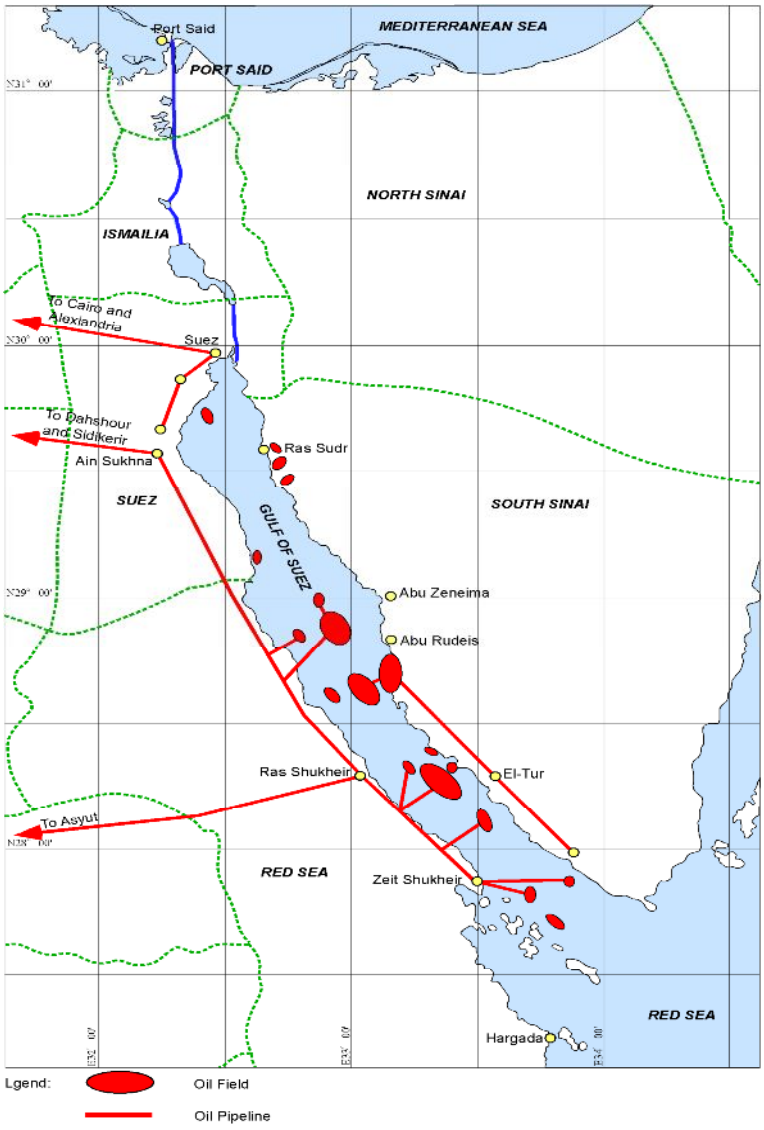


Figure 3-3 Locations of Oil Fields and Pipelines

The activities associated with this extensive petroleum industry like exploration, sea-bed transportation, loading at ports are main possible causes of oil pollution in the region. The typical phenomena of oil pollution in the region may be divided into the following categories:

- Leakages and spills during loading and unloading of crude oil in ports;
- Leakages and spills during fueling of vessels;
- Leakages from offshore platforms and wells;

- Leakages from pipelines, especially old ones with more than 20 years old. Accidents leading to breakages of pipelines can result in significant oil pollution with; and
- Inadequate or absence of reception facilities for oily wastes in ports.

The Gulf of Suez accommodates some 7 % of the annual international shipping. During the period from July 2003 till June 2004, a total of some 16,000 vessels crossed the Gulf of Suez, of which some 2,900 were oil tankers with a total capacity of 125 million tons of oil. In 2005, a total of some 18, 200 vessels crossed the Gulf of Suez, of which some 3,600 were oil tankers with a total capacity of 148 million tons of oil.

Land-Based Pollution Sources

In the Governorate of South Sinai, the industrial zone located 9 km from Abu Zeinima City is planned to accommodate more than 100 industries. Although some 26 plots of land for industrial investments have been allocated, there is only one operational industry and two under construction as of 2004.

There are some seven industries scattered over the Governorate, like construction material industries and metallurgical industry. However, these industries do not necessarily constitute sources of oil pollution.

As the oil pollution source, there is a small refinery with a capacity of 8,500 million barrels/day in Wadi Feeran.

(2) Gulf of Aqaba

Although there is no cargo traffic to the Egyptian coast, the Gulf of Aqaba is a route for international shipping. In 1993, 1,615 vessels passed the Tiran Strait directed to, or originating from Eilat and Aqaba ports in Israel and Jordan respectively. Unloaded cargo averages 6 million tons in Aqaba, mainly comprising crude oil and oil products, and 300,000 tons in Eilat including automobiles, chemicals and limited quantities of crude oil. Cargo loaded on board averages annually 9 million tons in Aqaba and annually 1.2 million ton in Eilat, mainly including bulk phosphate and phosphate derivatives (fertilizer and phosphoric acid).

About 1.25 to 1.5 million passengers per year, mostly expatriate Egyptian workers, use the ferry boat service operating year-round between Nuweiba and Aqaba. In addition, there is small cargo traffics on the same route including loaded trucks and live animals. Such traffic might decrease significantly in the future, if the Taba-Eilat-Aqaba road is constructed as part of the Middle East peace Process.

Sharm El-Sheikh International Port located in Sharm El-Mina is mainly used for international, regional and coastal tourist cruise ships. International cruises have yearly programs, whereas regional (from the Red Sea only) and coastal (from and to Sharm and Hurghada) cruises have variable seasonal and monthly programs. Sharm El-Sheikh Port has a dock of 650 m long, providing a maximum capacity of up to three large cruisers and three yachts per day. The Port also functions as the main naval port for South Sinai and also services the twice-daily ferry services from Hurghada. The major issue associated with

these ports is a lack of services for managing waste. This leads to concerns about discharges at the sea, negatively impacting the environment.

The occurrence of oil spills resulting from sustained oil transport traffic in the Gulf of Aqaba is probably the most recognized potential environmental threat. About 2,500 ships passes the Gulf of Aqaba annually of which 1,600 pass the strait of Tiran.

The risk of oil spill are rated high on about 30 km of the Egyptian coast line from the North of the Strait of Tiran southward, and as medium on the remaining part of the shoreline down to Sharm El Sheikh. They mainly result from the risks of navigation through the straight of Tiran.

From 1961 to 1996, 14 incidents have been recorded between Tiran and Nabq, of which 4 produced an oil spill, most notably, the Lania incident in 1987 which resulted in a bunker oil spill of over 700 tons and the Million Hope incident in 1996 which produced a large spill of an unrecorded volume.

3.4 Oil Spill Incidents

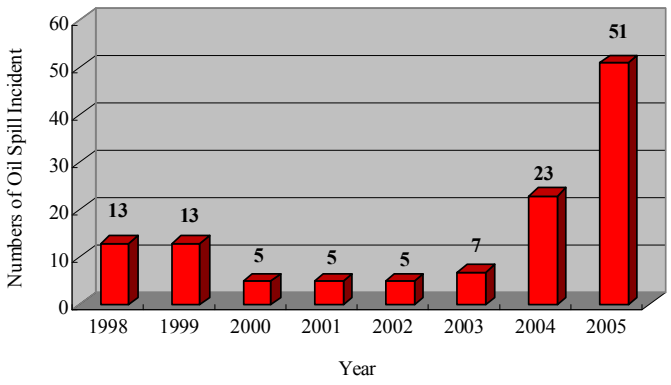
Coastal and Marine Zone Management Division of Environmental Management Sector (EMS) in EEAA has the data/information on oil spill incidents which have happened in the past. Oil spill incidents between 1998 and 2005 are shown in **Annex 1**. This table has been compiled based on the data/information provided by EMS, with some additional data/information replenished by Suez RBO and collected by JICA Expert Team.

Frequency of Oil Spill Incidents

The numbers of oil spill incidents recorded in the Gulf Region is a total of 122 between 1998 and 2005, ranging from a very small spill to a large scale spill. As seen from these records, on average some 15 oil spill incidents are likely to happen annually in the Suez Canal and the Gulf of Suez.

Many numbers of incidents with 51 incidents were recorded in 2005, as seen in **Figure 3-4**. It is not certain whether a sharp increasing tendency is true phenomena, or, whether it is depending on the procedure of data collection of oil spill incidents.

Figure 3-4 Frequency of Oil Spill Incidents in Project Area

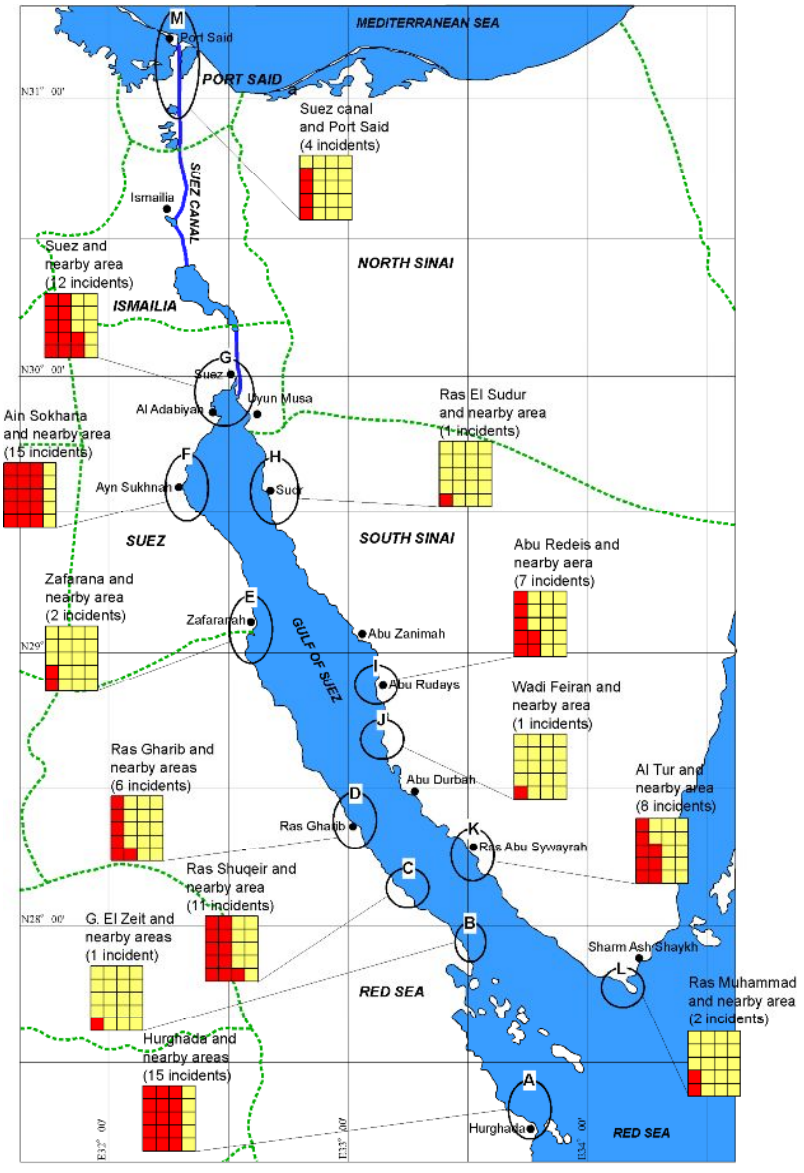


Spots of Frequent Oil Spill Incidents

Of 122 oil spill incidents, the spots of 85 incidents have been identified. **Figure 3-5** shows the zones having suffered from oil spill incidents in the past.

From this figure, it is seen that the Gulf of Suez has possible oil spills on the whole area. However, the following zones have suffered from especially frequent incidents:

- The zone including Abu Rudays of Ras Abu Sywayrah in the Governorate of South Sinai and Ras Gharib and Ras Shuqeir in the Governorate of Red Sea. This zone lays many oil fields and associated pipelines at the seabed and on land, and
- The zone including Suez City and Ayn Sukhnan near the entrance of Suez Canal in the Governorate of Suez. Many ports facilities with oil loading/unloading are located in this zone.



Note: The numbers of oil spill incidents over the past 8 years (1998 to 2005) are shown in the figure.

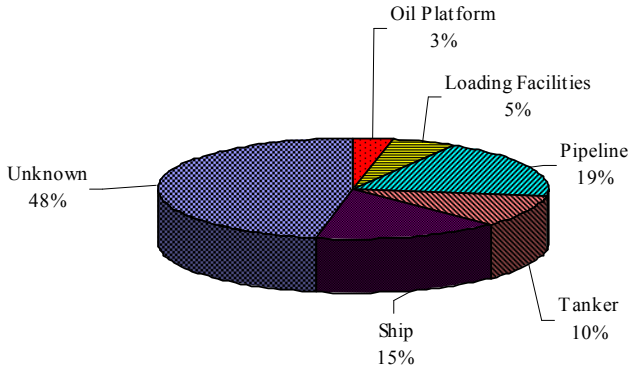
Figure 3-5 Locations of Oil Spill Incidents

Sources of Spilled Oil

Of all the oil spill incidents, incidents in which spilled oil sources were not identified account for 48 %, as shown in **Figure 3-6**. This indicates that finding out the sources of spilled oil is very difficult, resulting into the failure in identifying the sources of nearly half of the oil spill. This clearly implies that secure identification system with analytical technologies for finding out spilled oil sources is strongly needed in the region.

Among the sources of oil spills identified, movable sources like tankers and ships (cargo vessels, passenger ships, fishing ships, etc.) account for 25 %, the largest percentage. Next, oil spills caused by the breakdown or wrong operations in pipelines (especially seabed pipelines), and loading (including unloading) facilities account for large parts with 19 % and 5 %, respectively.

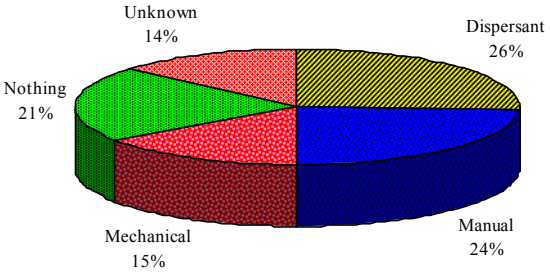
Figure 3-6 Sources of Spilled Oils



Actions Undertaken for Oil Spills

Actions undertaken to contain oil spills are not necessarily recorded for all the incidents. As far as known from the limited records, removals by means of mechanical and manual operation have been the most frequent methods, accounting for some 40 %, as shown in **Figure 3-7**. Despite some recognition of environmental concerns to the marine ecosystem, dispersants have been used often to clean up oil slick, accounting for 26 %.

Figure 3-7 Actions Taken for Oil Spills



Note: This graph presents the results in a total of 66 incidents. The results in remaining incidents have been not recorded.

3.5 Oil Pollution in Coastal Waters

(1) Overview

In general, oil and grease are measured by the analysis method of normal hexane extract substances. It is, however, difficult to quantitatively clarify the situation of oil pollution in the water environment in many cases. This is because:

- Oil and grease do not formulate homogeneous status in the water, since they are not soluble and are light as compared with water,
- In many cases, oil pollution happens accidental and transient oil spills with massive floating oils, and
- Though oil and grease contents are measured in the environmental monitoring by using by the method of normal hexane extract substances, the detectable limitation of this method is limited to 0.5 mg/l, usually.

In Japan, the environmental standard of coastal and marine water for oil and grease is set to be less than 1.0 mg/l and periodical monitoring of oil and greases are carried out in many stations. It is, however, a fact that almost all the measurement results are "not detected" (meaning less than 0.5 mg/l), despite some occurrences of oil spill incidents in nearby waters.

As understood from this, it should be noted that the status of oil pollution caused by oil spills and discharges of oily wastewater may not be exactly evaluated by the measurement of oil and grease contents in most cases.

(2) Interpretation of Monitoring Results of Coastal Water Monitoring

EEAA continuously monitors the water quality along coastal lines like the Mediterranean Sea and the Red Sea in the Coastal Water Monitoring Program (CWMP), one component of the Environmental Information and Monitoring Programme (EIMP), since the second half of 1990s. In CWMP, a total of 16 monitoring stations are located in the Project Area and the water quality measurements have been carried out four times annually, on average.

The CWMP have recorded the situation of oil pollution, observing visually the pollution pattern by tar and oil at respective monitoring points. By employing these results, pollution index of oils have been calculated by means of the methodology shown in **Table 3-4**. In the pollution index of oil, the index "0" means no oil pollution to be observed and the index "15" means the utmost polluted status.

As shown in **Figure 3-8**, Ras Gharib (Su 7 and Su 8) and the coastal stations along the Mediterranean Sea (Me 40, Me 41 and Me 42) indicates the high oil pollution. The locations of these monitoring stations with a higher pollution index are largely consistent with the areas of oil or natural gas field.

The yearly oil pollution indices at the monitoring stations of Ras Gharib (Su 7 and Su 8) are shown in **Figure 3-9**. From this figure, it is understood that the coastal waters at Ras Gharib have chronically suffered from oil pollution.

Table 3-4 Calculation of Oil Pollution Index

In EIMP, observation results of tar and oil have been recorded for the following five items: continuous new tar, continuous old tar, lumps of new tar, lumps of old tar and oil. The magnitudes of the pollution for respective items are assessed by eyes according to: none, light, moderate and heavy, allocating respective scores ranging from "0" to "3" (as shown in the following matrix).

	None	Light	Moderate	Heavy
Continuous new tar	0	1	2	3
Continuous old tar	0	1	2	3
Lumps of new tar	0	1	2	3
Lumps of old tar	0	1	2	3
Oil	0	1	2	3

The total scores of five items stand for the pollution index in a particular monitoring station.

Table 3-5 shows the oil pollution indices of respective years and annual average at the monitoring stations.

Table 3-5 Oil Pollution Index

Stations		Years						Average
No.	Area	2000	2001	2002	2003	2004	2005	
Me 37	Damietta	-	-	-	-	0.0	-	0.0
Me 40	El-Gamil (E)	-	-	-	-	2.0	1.0	1.5
Me 41	Port Said	-	-	-	-	1.0	2.0	1.5
Me 42	Romana	-	-	-	-	2.0	-	2.0
Su 1	Suez	0.3	0.8	1.0	1.3	0.0	1.0	0.7
Su 2	Suez	0.8	1.0	0.5	0.0	1.3	1.3	0.8
Su 3	Suez	0.3	1.3	0.8	1.0	0.5	0.7	0.7
Su 4	Ain Sukuhna	0.0	0.0	0.0	0.0	0.0	1.0	0.2
Su 5	Ain Sukuhna	0.0	0.0	0.3	0.0	0.3	0.0	0.1
Su 6	Ain Sukuhna	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Su 7	Ras Gharib	1.8	3.0	4.0	2.7	3.0	3.3	3.0
Su 8	Ras Gharib	0.3	2.5	1.3	1.0	0.5	-	1.1
Su 9	Ras Gharib	0.5	0.3	0.5	0.3	0.8	0.7	0.5
Su 10	Abu Zenima	2.5	2.3	0.0	0.0	0.0	-	1.0
Su 11	Abu Zenima	0.0	0.0	0.0	0.0	0.0	-	0.0
Su 12	Ras Budran	0.0	1.0	0.0	0.0	0.3	-	0.3

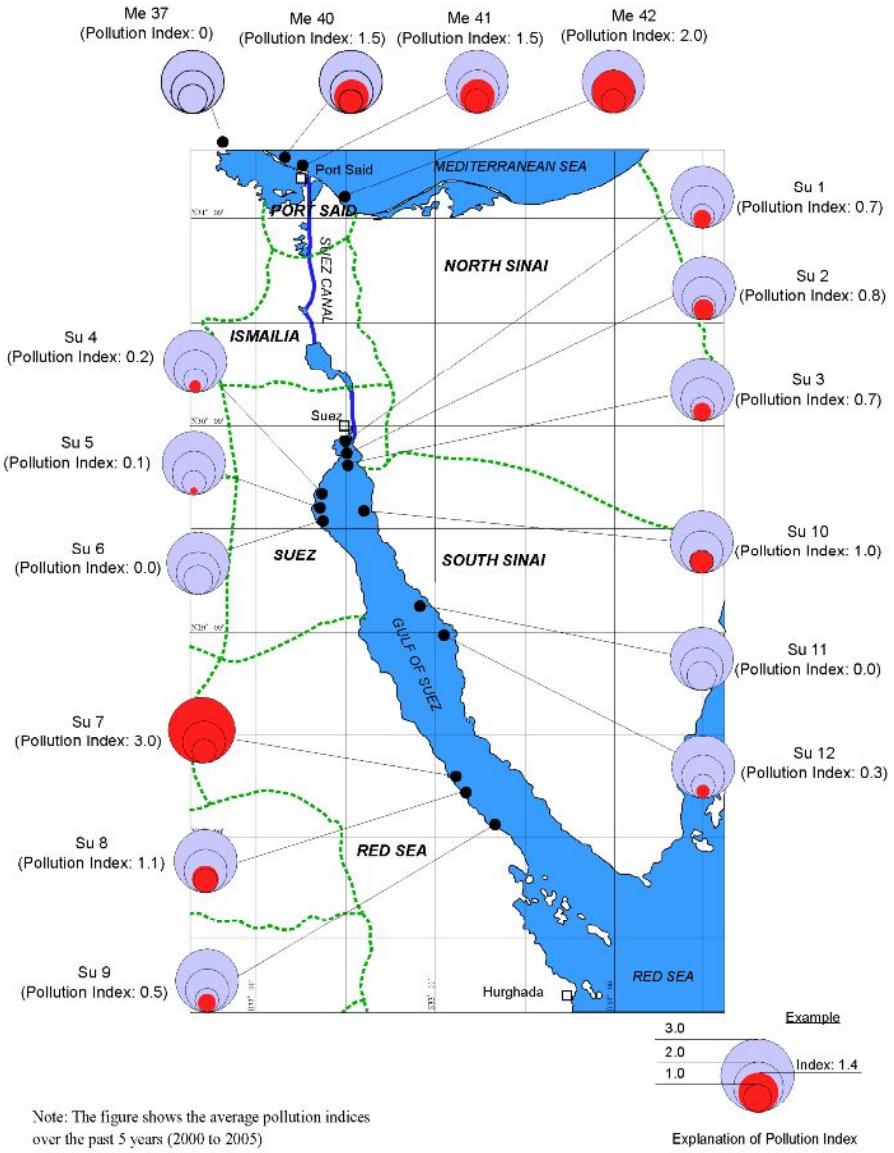


Figure 3-8 Situation of Oil Pollution in Coastal Waters

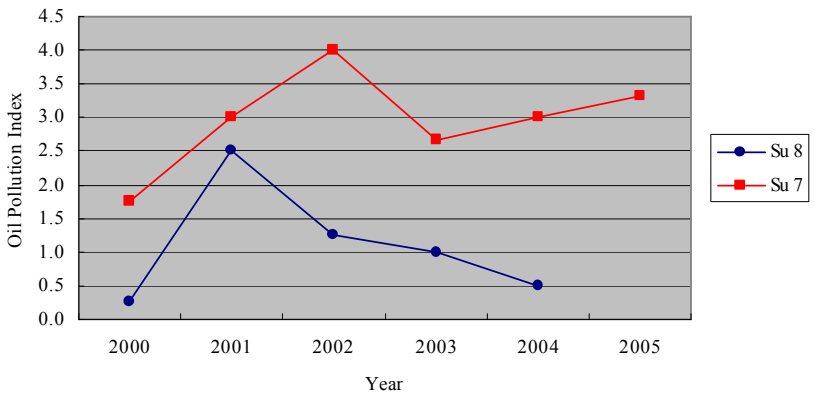


Figure 3-9 Yearly Oil Pollution Index at Ras Gharib

3.6 Oily Wastewater Discharge

Land-based sources like manufacturing industries, sewage treatment plants, etc. are other possible concerns about oil pollution. Unlike transitory oil spills caused, continuous oily wastewater discharge from land-based sources possibly exerts chronic oil pollution, especially in closed-water bodies.

Land-based sources like industries are subjected to the periodical monitoring and the regulation in accordance with the effluent standards of the Law No. 4. **Table 3-6** shows measurement results of water quality monitored bay Suez RBO in 2003 and 2005.

In this table, it is seen that petroleum-related industries very often discharge wastewater with the oil contents by far beyond the effluent standards stipulated in the Law No. 4. This implies that more comprehensive and precise investigation should be undertaken to clarify the situation of oil pollution which may be caused by effluent discharge from industries.

Table 3-6 Measurement Results of Industrial Effluent[1]

Entities	Sampling Time	Measured Oil & Greases Contents (mg/l)
Suez Petroleum Co.	2003, July	213
	2003, September	14
	2004, June	16
	2004, October	34
	2005, March	111
	2005, August	4
Nasr Petroleum Co.	2003, July	112
	2004, June	5.6
	2004, October	8
	2005, March	112
	2005, August	4
Soumed	2005, October	15
Petrol Plaeem – South Sinai	(Unknown)	12
General Petroleum Co. – South Sinai	2005, January	31
Suez for Oil Abu Redais – South Sinai	2004, June	56
Industrial Wastewater Treatment Plant (the combined wastewater treatment plant for five food oil industries)	(Unknown)	31
	2004, June	81
	2004, November	145
	2004, October	181
Effluent Standard (by the Law No. 4/94)		15

[1] : Sourced from Suez RBO

CHAPTER 4
LEGAL FRAMEWORK AND NATIONAL POLICY

4.1 Legal Framework for Environmental Management

4.1.1 Overview

Over the past four decades, Egypt has adopted a number of environment related laws, decrees and regulations addressing various aspects of environmental protection and natural resources management. A total of 26 laws and presidential and ministerial degrees for the legal basis of water resources management are in place in Egypt.

On the ground of various laws and regulations, many authorities are involved in water quality management in Egypt, depending on the water bodies as well as specific actions and roles in the management. **Figure 4-1** delineates the involvement of authorities associated with environmental management. The main and foremost issues regarding water quality and pollution control in Egypt is the absence of an integrated coordinated approach taking into account agreed priority. There is no strong joint strategy or action plan that coordinates the different tasks of the involved ministries and institutions. There appears to be the necessity that the redundancies and split responsibilities between the different ministries, particularly in applying the different laws and in ensuring monitoring and compliance are rectified.

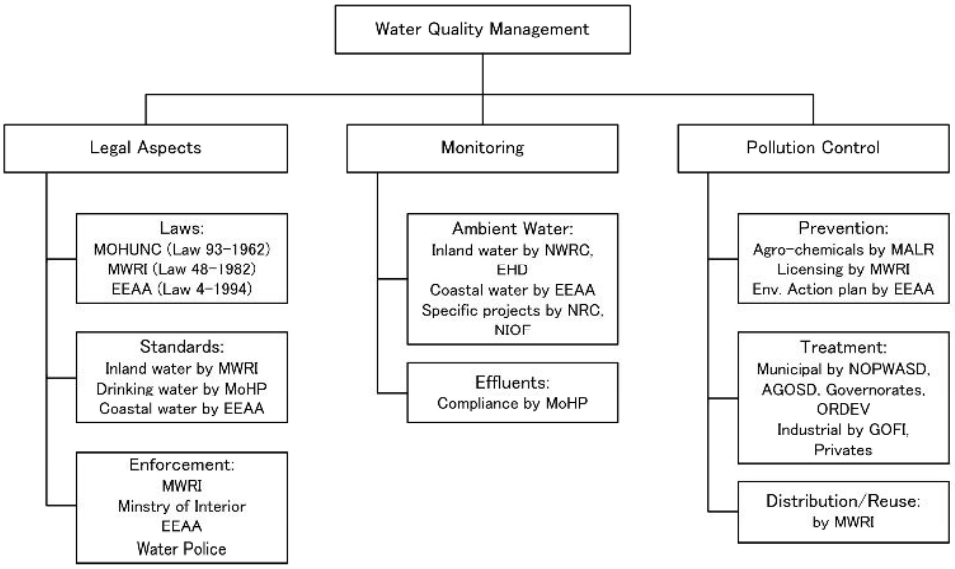


Figure 4-1 Authorities Engaged in Water Quality Issues[1]

Regarding water quality management and regulation, one of important laws are the Law No. 48/1982 which addresses the protection of the Nile River and its related waterways, the Law

[1] : World Bank, "Arab Republic of Egypt Country Environmental Report", 2005

No. 4 (initially promulgated in 1994 and partly altered in 1995) for the protection of the environment and the Law 93/1962 for liquid waste discharge into public sewers. The enactment of the Law No. 4 addressed several significant legislative gaps in the legal framework for environmental protection neglected by the earlier sector laws such as water pollution and waste management laws.

4.1.2 Protection of Nile River and Wastewater Discharge (Law No. 48/1982)

The Law 48/1982 addresses the protection of the Nile River and its related waterways from pollution, with the provision of a series of compliance standards for various discharges. However, discharge into the public sewerage networks is regulated by the Law 93/1962, for which the responsible entity is the Ministry of Housing, Utilities and New Urban Communities (MoHUNC). The standards in this law have been amended by Ministerial Decree No. 44/2000. The standards for both discharge into surface waters and the sewerage network are specified in the Law and the Degree, respectively.

The Ministry of Water Resources and Irrigation (MWRI) is responsible for the protection of the River Nile under Law 48. The MWRI assessed the present laws and recognized that:

- There is a need to integrate the Law No. 4 and the Law No. 48 into 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 the 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 the Law No. 48 is not practically achievable, and therefore, differentiated standards based on "Best Available Technology" should be set,

4.1.3 Environmental Law (Law No. 4/2005)

The Environmental Law (the Law No. 4) was drafted with a view not to replace previous environment-related legislations but to complement these legislations and to address any legal gaps or needs that are not adequately addressed by these previous laws like the Law No. 48. The Law No. 4 and its executive regulations (substituted by Decree No. 1741 in 2005) 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 marine waters.

Though the Law No. 4 gives EEAA diverse legal tools to implement and enforce these provisions, the environmental standards of water quality which are set up to raise the administrative target in many countries are not defined. Meanwhile, the Law No. 4 stipulates specific quality standards for ambient air and noise.

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 of approving them;
- It gives EEAA the power to inspect and enforce the law;
- It establishes an environmental fund and mandated EEAA with the proposal of 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 landfilling; and
- Finally, it increases significantly the fines and penalties for violations.

According to the Law No. 4, EEAA has the responsibility of formulating the general environmental policy as well as the 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.

In specific, the Law No. 4 mandates EEAA with the following:

- Prepare draft laws and decrees related to the fulfillment of its objects and express its opinion on proposed legislation related to the protection of the environment;
- Prepare studies on the state of the environment, formulate the national plan with the projects included for the protection of the environment, prepare the 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;
- 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;
- 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;
- Lay down the principles and procedures for assessing the environmental effects of projects;
- Lay down a plan for environmental training and supervise its implementation;
- Prepare the draft budgets required for the protection and promotion of the environment;
- Propose economic mechanisms to encourage different activities and procedures for the prevention of pollution; and
- Coordinate with the Ministry for International Cooperation to ensure that projects funded by donor organizations and countries are in line with environmental safety considerations.

4.1.4 Natural Protectorates (Law No. 102/1983)

The Nature Protectorates Law (the Law No. 102/1983) addresses the protection of the marine environment including that of the Gulf of Aqaba announced as one of the nature reserves by the Prime Minister decree No. 33/1996, as well as the Red Sea protected islands south of Hurghada. The protectorates encompass the waters with one nautical mile around such islands and mangrove forests.

The provisions of this Law have addressed the protection of the marine environment declared as nature reserves in the Red Sea, Gulf of Aqaba and Red Sea islands. Provisions related with water quality in natural protectorates are in place in the articles of Law No. 102, as follows:

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

4.1.5 Environmental Impact Assessment[1]

The Environmental Impact Assessment (EIA) is a major legal tool which EEAA is given under the Law No. 4 to exercise its law enforcement for comprehensive environmental protection. It is implemented through its Executive Regulations (Prime Ministerial Decree No. 338 of 1995), which came into full implementation in 1998.

EIA is defined as a technical study which clarifies potential environmental impacts resulting from the project and is undertaken by the investor or his representative. Through the study, different impacts of the project are analyzed and measures and alternatives for the different elements of the project are proposed, leading eventually to the elimination or mitigation of these impacts to the lowest extent possible.

This study is taken into consideration by relevant administrative authorities when deciding whether to grant or reject a license to a project. EIA process comprises a number of procedures determined by the Law No. 4 and its Executive Regulation, as well as EIA Principles and Procedures Guideline issued by EEAA, ensuring environmentally sound and sustainable development choices, besides 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.

Specific objectives of each EIA undertaken under the Law No. 4 are described as follows:

[1] : EEAA, "Egypt State of the Environment Report (2004)", 2005

- Providing sound basis for the decision-making process of project component design;
- Ensuring project implementation with full awareness of environmental factors;
- Increasing public awareness of the timing and forms of any potential environmental impacts; and
- Facilitating public participation in the decision-making process.

Facilities subject to EIA conditions are classified according to the following four criteria:

- Type of activity;
- Natural resources used;
- Facility location; and
- Type of energy used.

The general guidelines were issued in 1995 and 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 complete EIA is mandatory due to the magnitude and nature of their potential impacts (Category C).

The guidelines include two screening forms, form A for white list projects and form B for gray list projects. For gray list projects, EEAA may require a scoped EIA, as specified by EEAA on the basis of the information presented by the developer in form B. In 2001, the EIA classification system was updated to include some modifications to the division between the three categories A, B, and C, varying in the severity of possible environmental impacts, as well as the expansion of the lists of facilities in each category to include additional ones, with the purpose of minimizing errors in categorization.

In 2004, the number of EIA forms and studies submitted to EEAA was 15,529 of which 6,979 forms and studies have been received by the Central Department for Environmental Impact Assessment (CDEIA), as shown in **Table 4-1**.

Table 4-1 EIA Processed by EEAA in 2004

Sectors	Numbers of EIA	Ratio (%)
Agriculture Projects	200	3.1
Industrial projects	3,393	62.6
Tourism Projects	107	1.7
Electric Energy Projects	5	0.1
Oil Projects	145	2.3
Service Projects	1,718	26.9
Health Projects	28	0.4

Infrastructure Projects (Roads)	43	0.7
Infrastructure Projects (Water)	98	1.5
Housing Projects	9	0.1
Seaport Projects	1	-
Airport Projects	1	-
Telecommunication Projects	31	0.5
Total	6,079	100

4.1.6 Environmental Protection Fund[1]

One of noteworthy topics in the Law No. 4 is an Environment Protection Fund (EPF) established under the Article 14. The resources of the EPF will be drawn from:

- State budget allocations;
- Grants and donations by national and foreign agencies for protecting and promoting the environment;
- Fines and compensations by court rulings or which are agreed upon for damages affecting the environment; and
- Resources from the Protectorate Fund established by the Law No. 102 of 1983.

The Article 7 of the Executive Regulations of the Law No. 4 also lays down the following sources of income:

- EEAA's share of the 25% dues imposed on travel tickets issued in Egypt in Egyptian currency (according to the Article 1 of the Law No. 5 of 1986 and the Prime Minister's Decree No. 697 of 1986) with a minimum of 12.5 % of the total proceeds;
- The returns from experimental projects undertaken by EEAA; and
- Remuneration for services rendered by EEAA to third parties.

The Fund is allocated in order to achieve its objectives. The Article 8 of the Executive Regulations lists 13 objectives including the following which are relevant for the NOSCP:

- Confronting environmental disasters; and
- Confronting pollution from unknown sources;

EEAA is responsible for administering the national funds for oil spill response which will be available from the Environmental Protection Fund. These funds will be available specifically for providing the financial support for responding to oil spills in which the polluter is unknown.

[1] : JBIC, "Egyptian Pollution Abatement Project II, Needs Assessment Survey", 2005

4.2 Legal Setting Associated with Oil Pollution

4.2.1 Provisions of Law No. 4

In terms of water quality, the Environmental Law (Law No. 4) aims to control the water quality of marine and coastal waters, because the Law No. 48/1982 has already set provisions for other waters like rivers and lakes. Therefore, the Law No. 4 lays numbers of provisions to control water pollutions in coastal and marines, especially oil pollutions to be caused by sea-based and land-based sources. **Annex 2** shows excerpted articles directly related with oil pollution.

Sea-Based Pollution Sources

In the Chapter 1 (pollution from ship) of the Law No. 4, the section 1 (oil pollution) states oil pollution caused by sea-based sources like oil tankers, commercial ship, platforms for oil extraction, etc. From above articles, owners of ships, sea rigs/platforms and companies working in digging, exploitation and exploration for oil at the sea are imposed by the following obligations.

- Not dumping or discharging any oils or oil 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 incidence;
- Preparing marine platforms and facilities working in oil exploitation and exploration by devising appropriate plans and measures required for marine environment 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 breakdowns in a ship or one of its equipment and promptly notifying competent administrative authorities immediately about discharges resulting from such breakdowns in a ship or one of its equipment.

Land-Based Pollution Sources

At the same time, the Chapter 2 of the Law No. 4 (land-based pollution) stipulates regulations about various pollutions including oil pollutions to be generated from land-based sources like industrial and domestic wastewater facilities.

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

According to the Article 1 of the Law, the following establishments are regulated as the 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.

4.2.2 Water Quality Standards for Oil and Greases

Law No. 48/1982 has set up the environment standard in terms of oil pollution. According to the article 40 of the ministerial degree for this law, Nile and canals should maintain less than 0.1 mg/l of oil and greases. Meanwhile, the decree by the Ministry of Health and Population (in 1996) has stipulated less than 0.1 mg/l of oil and greases as the standard quality for swimming purpose.

To mitigate oil pollutions in Egypt, the Law No. 4, the Law No. 48/1982 and others have set numbers of effluent standards including oil and grease. These effluent standards are applied for the wastewater discharged from establishments. There are various standards values existing, depending on the purposes of regulations, as shown in **Table 4-2**.

Table 4-2 Various Effluent Standards of Oil and Greases

Laws and Articles	Applied Values of Oil and Greases
Executive Regulation (1995) of Law No. 4 for land-based sources	Less than 15
Oily mixture discharged from ships specified by the Law No. 4	Less than 15: 1,000,000 (equivalent some 15 mg/l)
Unclean ballast water discharged from oil tankers specified by the Law No. 4	Less than 15: 1,000,000 (equivalent some 15 mg/l)
Law No. 48/1983, Article 60, discharge into fresh water bodies	Less than 0.1 mg/l
Law No. 48/1983, Article 62, discharge into fresh water bodies, special cases in the flow rate of less than 100 m^3/day	Less than 10 mg/l
Law No. 48/1983, Article 61, discharge into fresh water bodies, treated industrial waste discharged into the River Nile and branch canals	Less than 5 mg/l
Law No. 48/1983, Article 66, discharge into brackish or saline water bodies	Less than 10 mg/l
Law No. 93/1962, amended by Ministerial Degree 44/ 2000, discharged into sewerage	Less than 100 mg/l

4.2.3 National Oil Spill Contingency Plan

Through the Article 25, Law No. 4 provides the legal and institutional basis for formulating and updating of Egypt's National Oil Spill Contingency Plan (NOSCP). The Article 25

does not specify any particular type of environmental disaster but it is acknowledged by all concerned that such events include major oil spills. The definition of "environmental disasters" in the Article 1 of the Law reads: "Accidents due to natural or man-made actions that lead to severe damage to the environment and require resources beyond local capabilities to confront.

The NOSCP will, in effect, form a component of the Environmental Disasters Contingency Plan which, under the Article 25, has to be prepared by EEAA. This Plan will have to be approved by the Cabinet of Ministers and Prime Ministerial decree.

The Environmental Disasters Contingency Plan envisaged by Law No. 4 comprises the following elements:

- Determining the different kinds of environmental disasters and the agencies responsible for their occurrence or expected occurrence;
- Establishing a Central Operations Room for receiving the reports about environmental disasters and following up the receipt and dispatch of accurate information with a view to mobilizing the necessary response action,
- Forming a task group to respond to the disaster. The Head of the task group will be delegated power to respond to the disaster, in co-operation and coordination with other concerned agencies.

In relation to oil spills, all these elements will be addressed in the NOSCP.

It should be stressed, however, that the Law No. 4 makes no specific mention of the OPRC Convention to which Egypt is a Party. This is in contrast to the detailed articles of the Law which implement the MARPOL 73/78 Convention.

4.2.4 International Conventions[1]

(1) OPRC Convention

The International Convention on Oil Pollution Preparedness, Response and Co-operation, (OPRC, 1999) provides the international legal framework for establishing national and multinational response systems to oil pollution incidents. The Convention has been ratified by Egypt and it entered into force in 1995. Unlike the MARPOL Convention, specific measures to implement OPRC are not mentioned in the Law No. 4.

The OPRC Convention was the response of the international community to the severity of oil pollution incidents in the 1980s, notably the Exxon Valdez spill. The aim of the Convention is to provide the framework for international co-operation for combating major oil pollution incidents. It recognizes, *inter alia*, the importance of effective preparation for combating oil pollution incidents, including the preparation of oil pollution contingency plans.

The Article 6 of the Convention places a number of specific obligations on Contracting Parties, as: "Each Party shall establish a national system for responding promptly and

[1] : EEAA, "National Oil Spill Contingency Plan.

effectively to oil pollution incidents". Besides, the Article 6 (2) imposes the following additional obligations: "In addition, each Party, within its capability either individually or through bilateral or multi-lateral co-operation and, as appropriate, in co-operation with the oil and shipping industries, port authorities and other relevant entities, shall establish".

There is a requirement that information concerning, *inter alia*, the designation of the competent authorities and contact points, the pollution response equipment and the national contingency plan should be provided to IMO.

In addition to the comprehensive obligations to establish national systems for preparedness and response, the Article 3 identifies a number of potential pollution sources all of which are required to have "local" oil pollution emergency plans which are to be coordinated with the national system.

Furthermore, the Article 4 of the Convention specifies the procedures which shall be established for reporting without delay any event involving a discharge or probable discharge of oil from ships, offshore units, seaports and oil handling facilities to "the competent national authority". These reporting obligations are to be placed on the masters of vessels or those persons in charge of the offshore units, seaports and oil handling facilities regarding discharges or probable discharges from their own activities.

The masters of vessels and persons in charge of offshore units are required to report without delay any observed event at sea involving a discharge of oil or the presence of oil. The Contracting Party's maritime inspection vessels and aircraft, or other appropriate services, are also required to report such incidents and the pilots of civil aircraft should be requested to report any such observed events.

The OPRC Convention recognizes the importance of mutual assistance and international co-operation in responding to oil pollution incidents. Consequently Article 5 stipulates that whenever a Contracting Party receives an oil pollution report, it shall assess the nature, extent and possible consequences of the incident and, without delay, inform all States whose interests are affected or likely to be affected by such an incident.

In conclusion, therefore, the OPRC Convention provides a comprehensive framework to prepare for and respond to an oil pollution incident.

(2) MARPOL Convention

The International Convention for the Prevention of Pollution from Ships (1973), as modified by the Protocol of 1978, is commonly referred to as MARPOL 73/78. In addition to the obligations placed on Contracting Parties in the body of the Convention, there are six Annexes with their associated regulations, two of which are compulsory (Annexes I and II), whereas the others are optional.

- Annex I: Regulations for the Prevention of Pollution by Oil containing Regulations 1-26; and
- Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in bulk, containing 14 Regulations.

As its title implies, the aim of the MARPOL Convention is to prevent pollution from ships. It does not (in general) deal with the preparation for and response to pollution incidents from

ships; these aspects are covered comprehensively by OPRC 1990. Nevertheless, ratification of MARPOL 73/78 is an important prerequisite to oil spill contingency planning in that the overall aims of MARPOL are to achieve the complete elimination of intentional or negligent pollution of the marine environment by oil and other harmful substances and the minimization of the accidental discharge of such substances.

The Article 4 of MARPOL 73/78 requires Contracting Parties to prohibit violations of the Convention and to take procedures against offenders. They are required to:

- Apply these to their own flagships wherever they may be;
- Take proceedings against their own flagships if sufficient information and evidence of a violation is provided by another Party and inform that Party and IMO of the actions taken;
- Take proceedings against other ships which commit a violation within their jurisdiction or inform the flag Administration and provide information and evidence of the violation; and
- Make penalties adequate in severity to discourage violations of the Convention. The penalties shall be equally severe irrespective of where the violations occur (the Article 4 (4)).

In general, the MARPOL 73/78 provisions provide an important legal basis on which to prevent deliberate or negligent discharges of polluting substances from ships.

In contrast to the lack of mention of the OPRC Convention, the Law No. 4 specifically purports to implement the provisions of the MARPOL 73/78 Convention to which Egypt is a Party. In particular, the Law contains the following specific provisions to implement the provisions of MARPOL:

- All ships, regardless of the flag State, are prohibited from discharging oil or oily mixtures in the territorial sea or the EEZ of the Arab Republic of Egypt (Article 49);
- Ships which are registered with the Arab Republic of Egypt are prohibited from discharging oil or oily mixtures anywhere otherwise than in accordance with the provisions of the MARPOL Convention (Article 50);
- Adequate reception facilities for dirty ballast water, tank washings of oil tankers and oily wastes from other ships shall be provided in Egypt's ports (Article 56);
- The Law requires all Egyptian registered vessels, and ships of flag States Party to the MARPOL 73/78 Convention, to maintain a MARPOL Oil Record Book (Article 58); and
- Measures to implement the provisions of MARPOL relating to harmful substances are contained in the Articles 60-65 of the Law and measures relating to ship-generated sewage and garbage are covered by Articles 66-68, which include provisions for ports to provide the necessary reception facilities for sewage and garbage.

4.3 National Policy and Strategy

4.3.1 General Environmental Policy

(1) 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".

(2) 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:

- Strengthening partnership at the national level through full coordination with the national entities that have their environmental projects or their activities have impacts on the environment;
- Supporting bilateral, regional and international agreements in the environmental field;
- Enforcing the Law No. 4 for the protection of environment and the Law No. 102/83 for nature protection;
- Implementing environmental protection projects through national, bilateral, multilateral funds;
- Supporting integrated environmental management systems;
- Supporting the multilateral environmental agreements to which Egypt is a signatory;
- Integrate the use of marked based instrument in the field of protection of environment;
- Transfer and adoption of environmentally friendly technologies;
- Encourage foreign investments in the area of environmental protection through involvement of private sector and
- Support to the policy of the decentralization of environmental management.

(3) Updated National Environmental Action Plan (NEAP) (2002)

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 presents 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. However, in contrast to the NEAP of 1992, this document doesn't provide any cost estimate of the strategic actions proposed, which could make its implementation difficult.

(4) EEAA Five-Year Action Plan

EEAA Five-Year Action Plan is 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 environmental program and develop human resources within the field of environment;
- Environmentally friendly technology transfer and support Egyptian exports program to promote the use of environmentally technology in all economic activities;
- Environmental information and Monitoring system program to enhance the use of information technology specially in the field of environmental management;
- Nature conservation and protecting biodiversity program to conserve national biodiversity;
- Capacity development of EEAA and RBOs program to support the institutional structure of environmental management at the national level;
- Afforestation and Green area expansion program to support governorates and NGOs in establishing nurseries and carrying out greening projects;

- Regional Branches Offices of EEAA Program to support renovation and establishing new RBOs at the governorates level; and
- Environmental Protection Fund Program.

(5) Decentralization Policy of Environmental Management

There is also a strong policy direction away from centralized environmental management activities towards decentralization at 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 26 Governorates. Administratively, EMUs are a part of each governorate's structure, yet, but operationally they follow EEAA. Support has been given to some governorates in the participatory process of preparing the 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 GEAP. 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 protocol of cooperation signed between the MSEA and the Ministry of Local Development.

4.3.2 Policies Associated with Oil Pollution

(1) Overview

Particular documents stating comprehensive descriptions for the management policy specializing in oil pollution are not found in Egypt. The policies for oil pollution issues handled in this Project are contained in various field of the environment, like water quality management, coastal and marine resources management, and disaster prevention management but mainly in coastal water management.

General principles and policies for oil pollution associated with oil pollution are enumerated, below:

(2) General Principles for Protecting Coastal and Marine Environment

The "Egypt State of the Environment Report (2004)" refers to the following principles to be pursued in the seas and coastal zone management in Egypt. For addressing the problems in coastal and marine environment, EEAA states a number of general principles to be monitored:

These principles are:

- Marine pollution threatens all state sectors, and therefore, marine pollution prevention is a collective responsibility, not restricted to one entity;
- Each sector is required to prevent the sources from marine pollution resulting from its activity, in accordance with local laws and according to and in compliance with international and regional conventions;

- Each sector is responsible for protecting its investments from marine pollution hazards and is required to raise its preparedness to address marine pollution to the level corresponding to the hazards such sector causes or is exposed to; and
- Encouraging private sector participation in marine pollution prevention and establishing specialized companies for that purpose.

(3) General Direction for Protecting Coastal Water

The "National Environmental Action Plan 2002" presents the direction and management scheme for protecting coastal waters, as below:

Pollution of coastal areas originates from land-based resources including towns and cities, industries, construction, agriculture and tourism. The contaminants that pose the greatest threat to the marine environment are sewage, chemicals, sediments, litter, plastics, and oil. Some of the materials are toxic and tend to accumulate in living creatures.

Pollution also originates from sea-based activities, like shipping, accidental spills of oil and chemicals and offshore activities. Therefore, the protection of coastal waters should be conducted along the following directions:

- An integrated management scheme to address marine pollution from land-based and sea-based sources are required;
- This scheme should provide a framework within which the role of each stakeholder is identified; and
- In order to assist decision making at all levels, further measures should be considered. These include establishing a database system for coastal water quality and sources of pollution, producing maps for different coastal water and marine environment in Egypt and expanding appropriate monitoring and assessment programs.

(4) Management Scheme of Coastal Water[1]

The MWRI developed a sustainable management scheme for coastal waters in Egypt. An integrated plan for managing and protecting coastal water quality is the output of this program. The expected results of implementing this plan are the improvement of water quality that will have positive economic and financial returns on the cost of the program formulation and implementation. The activities of this scheme include:

- Update and extend existing contingency plans;
- In collaboration with relevant authorities, develop a system to control sources of pollution;
- Set criteria for brine disposal to the marine environment; and
- Support wider ratification and implementation of relevant shipping conventions and protocol.

[1] : EEAA, "The National Environmental Action Plan 2002/17", 2001

4.3.3 National Strategies for Oil Spill Combat

The "National Oil Spill Contingency Plan (NOSCP)" specifically states national combat strategies against oil spill incidents, as below:

Foreign and Egyptian ships are forbidden to discharge oil or oily mixtures into the territorial sea or the exclusive economic zone (EEZ) of the Arab Republic of Egypt (ARE). This is in accordance with the Article 49 of the Law No. 4 in the implementation of the MARPOL 73/78 Convention. Similarly, companies extracting or exploiting offshore oil fields and other natural marine resources, including oil transport facilities, are forbidden to discharge any polluting materials resulting from drilling, exploration, testing of wells, or production activities, into the territorial sea or the EEZ of the ARE (the Article 52 of the Law No. 4).

In accordance with the Article 48 of the Law No. 4, the responsibility for the implementation of these measures rests with MSEA in coordination with the Minister of Maritime Transport and all concerned administrative authorities mentioned in the definition the Article 1 of the Law, each within their field of competence.

According to the NOSCP, the national combat strategy against oil spill incidents will be based on the following principles:

- Terminate or reduce the outflow of oil from the source;
- Monitor the oil slick, where marine or coastal resources are not threatened;
- Attempt control and recovery of the oil at sea by use of mechanical means;
- Apply dispersants only in accordance with the national policy for dispersant use;
- Protect sensitive areas according to the priority ranking of the NOSCP; and
- Shoreline clean-up.

Detail scheme of each principle are described in the section 6.5.

Meanwhile, an oil spill contingency plan against regional-level incidents has not been established in Egypt. In Gulf Region, RSPA, SCA and oil-related entities, RSPA have set individual contingency plans against small-scale incident (defined as Tier I), and have been provided with their own equipment and materials to be used for combating. Regarding oil spill of regional scale (defined as Tier II), Suez RBO has the responsibility for leading the combat. However, such regional regime has not been established as of today, without appropriate regional oil spill contingency plan.

CHAPTER 5
ADMINISTRATIVE AND INSTITUTIONAL SETUP

5.1 Central Government Institutions

5.1.1 Overview

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

- The national environmental organization 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;
- Governmental institutions with specific operational functions on specific environment matters which are performed by their environment units in line ministries;
- Governmental or private units which cooperate with EEAA in terms of the environment control and/or pollution generations, and
- Institutions with supporting activities associated with environment, like universities and research institutes.

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 experiences. However, most of them are relatively newly-established or mandated with environmental concerns, and accordingly they have limited environmental management capacity and experience.

Some ministries, by virtue of their mandate, have a main streamed approach towards environmental issues, such as MOWRI, and MOH. In general, it is reported that the mechanisms for coordination with EEAA and those applied within various ministries are unclear in some areas. **Table 5-1** provides a brief overview on the responsibilities of the different line ministries in the field of the environment, the environmental institutions and/or divisions within these ministries, and their affiliated departments.

5.1.2 Ministry of State for Environmental Affairs (MSEA)

The mandate of MSEA is to achieve a harmonized balance between the needs of developing the State, while protecting her natural resources. MSEA is required to address the cumulative impact of environmental problems that have accumulated over the past 40 years, mobilizing investments and building human capacities.

MSEA has established the National Environmental Action Plan (NEAP). It includes plans to deal with these requirements, which has to be implemented through line ministries in collaboration with major stakeholders, such as NGOs and the private sector.

Table 5-1 Line Ministries and Institutions Associated with Water Issues[1]

Ministries	Affiliated National Institutions or Divisions	Environmental Department or Unit	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 medicine	- Setting environmental health policy and regulation environment-related health problems and diseases through environmental health officers. - Prevention and control of Operating the National Air Pollution and the River Nile Water Quality Networks - Monitoring water quality for drinking and domestic purposes. - Monitoring the 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. - Issue regulations setting water quality standards and discharge limits. - Facility inspection and reporting violations to the police.
	Coastal Protection Authority		Protection of coastal line 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

[1] : World Bank, "Arab Republic of Egypt, Country Environmental Analysis", 2005

Ministries	Affiliated National Institutions or Divisions	Environmental Department or Unit	Responsibility
Ministry of Agriculture & 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

5.1.3 Egyptian Environmental Affairs Agency (EEAA)[1]

(1) General

In Egypt, the environmental policy is set formally by the Ministry of State for Environmental Affairs (MSEA) and Egyptian Environmental Affairs Agency (EEAA) is the executive arm of the MSEA. The Environmental Law (Law No. 4) provides a variety of mandates for EEAA. Given its coordinating and horizontal role among all related ministries, EEAA is put under the responsibility of the Council of Ministers, and the Minister is assigned to oversee the work of the agency and chair EEAA Board of directors.

The Chief Executive Officer (CEO) of EEAA is nominated by the Council of Ministers and has a First Undersecretary rank. The CEO oversees the day-to-day management of the agency and ensures that the policies and guidelines provided by the Board are implemented.

(2) Missions

EEAA, established by virtue of the Law No. 4, replaced the old Agency established by the Presidential Decree No. 631 in 1982. EEAA is the highest authority in Egypt responsible for promoting and protecting the environment, and coordinating adequate responses to these issues.

EEAA covers all fields of the environment including water issues and its missions are to:

- Prepare the National Plans for Environmental Protection;
- Prepare the Emergency Environmental Plan for disasters;
- Prepare the draft laws concerning the Environment;
- Implement the experimental projects;
- Prepare the Environmental Training and Planning Policy;

[1] : EEAA, "Organizational and Functional Structure, Part 1", 1995, with some modifications and supplements by other sources' data/information.

- Draft the necessary norms and standards to ensure that the environment is not polluted;
- Formulate the basis and procedures for the assessment of environmental impacts of projects; and
- Supervise the Environmental Protection and Development Fund.

(3) Organizational Structure and Human Resources

EEAA exercises its responsibilities through a headquarters office in Cairo. Including regional and local staff, it now has a total some 700 permanent staff and a total of some 1,200 contract-base staff.

The organizational structure of the headquarters of EEAA is shown in **Figure 5-1**. In its structure, there are three technical units:

- Environmental Quality Sector (EQS): Responsible for setting policies and plans, monitoring and information, and for developing programs for dissemination of environmental information, the coordination of available data, reports and research studies;
- Environmental Management Sector (EMS): Sets the national program for environmental impact assessment and the implementation of pilot projects. It also supports technology development in the Agency and its directorates for the coastal and marine management, hazardous substances and waste management, and environmental development; and
- Central Department of Nature Protection: Deals with biodiversity and the natural protectorates' management.

Besides the technical units afore-mentioned, numbers of units to support, advise and administrate the headquarters' functions are set up in EEAA. Among them, the ones directly engaged in the environmental management are as follows:

- Central Department for Branches Affairs (CDBA): supervises the EEAA branches and EMUs in the governorates;
- Central Department for Environmental Information and Public Awareness: Concerned with environmental training/dissemination and public awareness; and
- Central Department for Financial and Administrative Affairs: In charge of the financial and administrative supervision.

It should be noted that the reshaping of EEAA's organization is now planned, reviewing principle, supporting and advisory activities of EEAA.

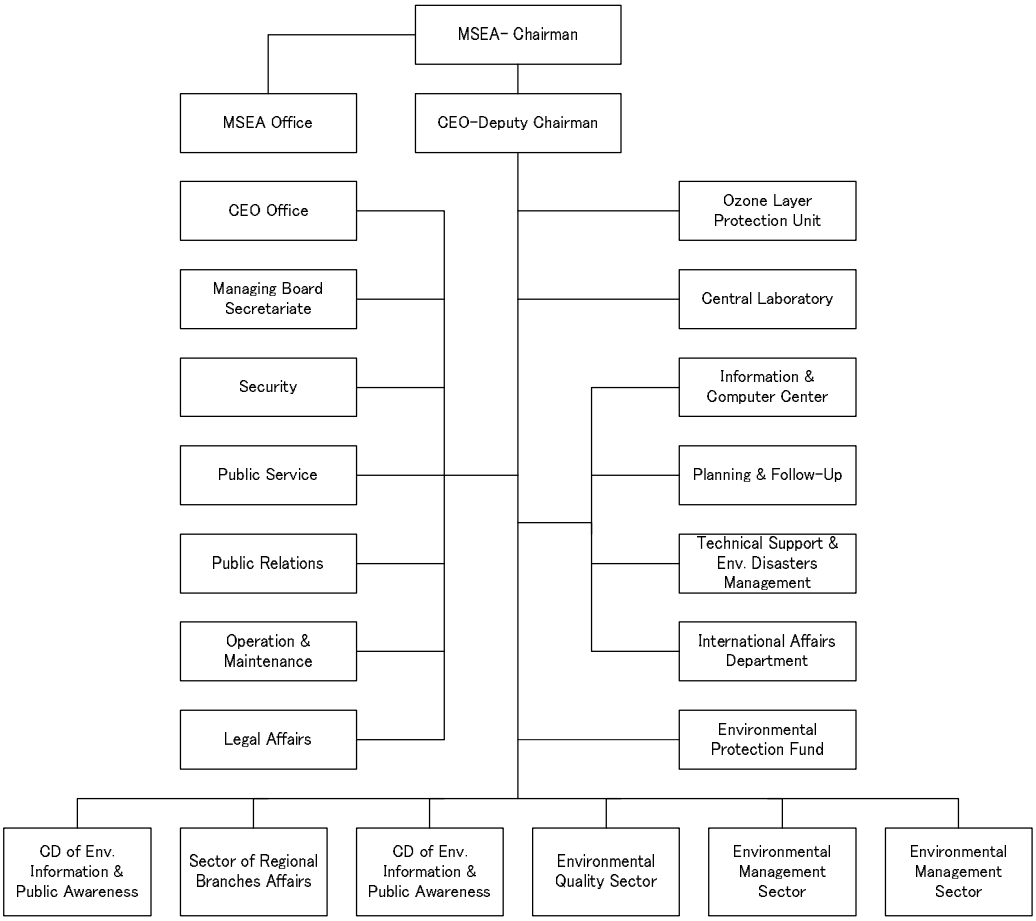


Figure 5-1 Organizational Chart of EEAA

5.1.4 EEAA's Units Associated with Water Issues

This Project deals with oil pollution issues mainly in coastal/marine waters and is lead by Suez RBO. Apart from Suez RBO itself, the following units of the headquarters of EEAA, are directly engaged in this Project in terms of national and technical management or administrative control:

(1) Environmental Quality Sector (EQS)

EQS has the human resources of some 110 staff (including some 80 contracted staff), and its main functions are described as below:

Administrative level:

Sector

Reports to:

CEO

Subordinate Units:

- Air Quality & Noise

- Water Quality
- Land & Soil Quality
- Environment Health
- Environment Monitoring
- Cairo Central Center (Laboratory)

General Functional Role:

Environmental monitoring and research, design and implementation of environmental vulnerability assessments, definition of ambient quality and pollution emission standards, monitoring relevant national and international professional developments, state of environment reports, environmental specific pilot project's on environmental quality.

Specific Functions:

- Setting up policies, plans and executive programs related to environment quality of water, air and land, and means of preservation and protection against pollution.
- Determining of permissible standards of pollution in water, air and land environment, and setting up criteria of their assessment.
- Coordinating researches of the qualities of water, air and land environment, means of controlling environmental pollution, and managing environmental strategy.
- Identification of effects of water, air and land environment quality on public health.
- Setting up, managing and maintaining information systems concerning water, air and land environment quality, availing data, information statistics and different reports necessary to provide information and computer center.
- Supervising and administering international agreements in context of the sector's activities.
- Participating in the preparation of laws and legislations concerning environmental preservation and protection.

(2) Environmental Management Sector (EMS)

EMS has the human resources of some 100 staff (including some 55 contracted staff), and its main functions are described as below:

Administrative level:

Sector

Reports to:

CEO

Subordinate Units:

- Environment Impact Assessment
- Hazardous Substances & Wastes Management

- Disposals Management
- Environment Development
- Coastal & Maritime Zones Management
- Industrial Unit
- Inspection

General Functional Role:

Setting up the environmental impact assessment and auditing system, encouraging the use of recent technology in management of hazardous substances and industrial, hospital and solid waste, setting up standards and planning of environmental development, management of coastal and maritime zones, and supporting of pilot projects in this field.

Specific Functions:

- Setting up of national plan of environmental impact assessment concerning existing and new establishments on different elements, cooperating in preparing drafts of necessary legislations in coordination with responsible authorities.
- Giving necessary approval on environmental impact assessments conducted by authorized organizations coordinating with them in matters related to standards, control factors and bases considered in performing their mission.
- Conducting environmental management of establishments not subject to provisions of environmental impact assessment.
- Hazardous substances and waste management, in coordination with concerned institutions and authorities.
- Supporting pilot projects on hazardous substances and wastes tending to environment preservation and protection against dangers caused by these materials.
- Setting up experimental projects on environment development to raise public awareness level and encourage individual initiatives in this field.
- Updating knowledge about recent international developments in the field of environment management, recommending ways of getting use of these developments applicable in local environment.
- Coordinating and participating with concerned authorities and ministries in the management and control of coastal and maritime zones, so as to conserve and protect them against pollution or damage.
- Supervising and administering International agreements in context of the sector's activities.
- Participating in the preparation of laws and legislations concerning environmental preservation and protection.

(3) Sector of Regional Branches Affairs (SRBA)

SRBA has the human resources of some 25 staff (including some 5 contracted staff), and its main functions are described as below:

Administrative level:

Central Department

Reports to:

CEO

General Functional Roles:

- Acting as Liaison Officer between EEAA and its branches located in different governorates, and
- Coordinating its environmental activities and facilitating their contact with different sectors of EEAA.

Regional Branch Offices:

CDBA has eight regional branch offices (RBOs) in Egypt, with a total of some 400 staff (including 203 temporal), as shown in **Table 5-2**. Besides these eight RBOs, more two RBOs in the north upper Egypt and Sinai have been established in recent.

Table 5-2 Profiles of Regional Branch Offices of EEAA[1]

Name of RBOs	Location of RBOs	Established In:	Governorates Covered	Numbers of Staff
Greater Cairo	Tamouh in Cairo	1996	Cairo, Kalyubia Giza	87 (including 60 temporal)
West Delta and Mattrouh	Alexandria	1999	Alexandria, Bahera, Matrouh	69 (including 30 temporal)
Middle Delta	Tanta	1999	Gharbia, Monifia, Kafr El Sheikh	77 (including 41 temporal)
East Delta	Mansura	1999	Dakahlia, Domyatta, Sharkia	84 (including 37 temporal)
Middle Upper Egypt	Asuit	-	Asuit, Wadi El Gedid, Sohag	24 (including 14 temporal)
South of Upper Egypt	Aswan	-	Qena, Aswan, Luxor, Roshiki	14 (including 2 temporal)
Suez and Sinai	Suez	2000	Suez, Osmailia Port Said, North Sinai, South Sinai	51
Red Sea	Hurghada	-	Red Sea	12 (including 5 temporal)

[1] : EEAA, The data/information on EEAA's RBOs.

- Organizational Structure of RBOs

Though RBOs have a common organizational structure, there are small differences in the organizational structure, depending on RBOs. **Figure 5-2** shows the organizational structure of West Delta and Mattrouh RBO (in Alexandria), as a typical example.

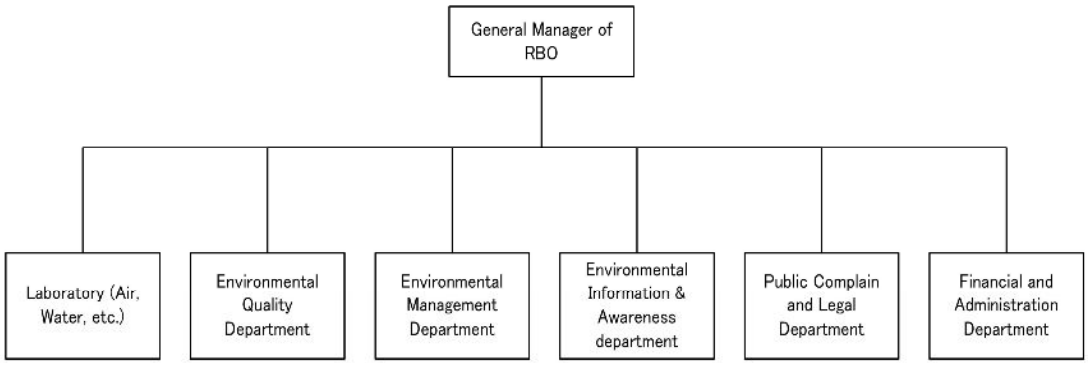


Figure 5-2 Common Organizational Structure of RBOs

5.1.5 Subordinate Units Associated with Oil Pollution

(1) Department of Environment Monitoring

Among the subordinate units of EQS, Department of Environment Monitoring is engaged in the work directly associated with oil pollution issues. In the Coastal Water Monitoring Program, it conducts periodical coastal water quality monitoring in the Gulf of Suez and the Mediterranean Sea.

It has the human resources of 7 staff (including 4 contracted staff). The following is its specific roles/functions:

- General Functional Role:
  - Coordination and following up activities of monitoring networks concerning components and pollutants of environment.
  - Collection of available data.
  - Providing Information & Computer Center of EEAA with necessary information and reports.

- Specific Functions:
  - Determination of institutions concerned with elaboration, management and operating of environmental monitoring networks all over the country, and recommending possible support fulfill their objectives.
  - Coordinating these networks activities so as to ensure monitoring operations for Environment components and pollutants.
  - Following up for available data collection.

- Collecting information and data concerning environment components and pollutants from other departments of EEAA preparing report and data integrating them with those availed from monitoring networks.
- Providing Information and Computer Center of EEAA with necessary information and reports.
- Assuring general coordination of national environment monitoring networks.

(2) General Directorate of Coastal and Marine Zone Management:

Among subordinate units of EMS, General Directorate of Coastal and Marin Zone Management is directly engaged in oil pollution issues. It has human resources of five staff (including two contracted staff).

General Directorate of Coastal and Marin Zone Management is leading the National Oil Spill Contingency Plan and has the following roles/functions:

- General Functional Role:

Planning and management of EEAA tasks concerning development of coastal and marine zones and following up, support of private pilot projects in this field.

- Specific Functions:
  - Coordination and participation with concerned authorities and ministries in preparing integral national plan of administering the coastal and marine zones of the Mediterranean and the Red sea.
  - Control of coastal and marine zones & development in accordance with environment preservation and protection against pollution bases and procedures.
  - Performing the EEAA tasks concerning preserving and protecting environment against pollutants in coastal and marine zones.
  - Supporting pilot projects in the field of coastal and maritime zones development, follow up their activities, and evaluating results of their work, cooperating in publishing studies about their results as a guide for others.
  - Secretariat of the higher steering committee for an integrated coastal management.

- Central Operation Room (COR) for Oil Spill Response

The EEAA has established at EEAA Headquarters at Maadi d and operated the Central Operations Room (COR) for an oil spill response and communications. The EEAA has established the internal response procedures which will be activated in the event of an incident.

5.2 Suez RBO[1, 2]

5.2.1 Overview

Suez RBO covers five (5) governorates: Suez, Ismailia, Port Said, North Sinai and South Sinai. The territory of Suez RBO encompasses the water areas: the Suez Canal, the Gulf of Suez, the Gulf of Aqaba and a part of the Mediterranean Sea and the Red sea which accommodate precious ecological system.

The environmental threats by oil pollution always exist in these waters on the ground that the region lays major oil fields in Egypt and receives very busy traffic of oil tankers and other ships passing through the Suez Canal.

From the reason of such geographical positions, one of important roles of Suez RBO is to properly address such oil pollution issues in the region. That is the reason why Suez RBO is engaged in this Oil Pollution Program as a leading player.

5.2.2 Roles of Suez RBO

Fundamental roles of Suez RBO are to enforce the Law No. 4 and other regulations related with the environmental protection as a front-line player in the region.

Its specific roles are enumerated as below:

- Preparation of reports and studies about the environmental situation and hot spots in the RBO according to the monitoring and environmental measurements.
- Supervision on the fixed environmental air monitoring net to prepare reports on the air quality in the RBO region.
- Executing environmental inspection and taking action against the factories that exceed the limit set in the Law No. 4.
- Following up the implementation of the Law No. 4 through the cooperation with local administrations and the Environmental Management Unit (EMU) in each government.
- Controlling the environmental obligation plan for the institutions and following up the implementation of the Environmental Impact Assessment (EIA) provisions.
- Defining different types of environmental disasters which may occur in each branch region and preparing an emergency plan to face it in case it happens.
- Managing and implementing the empiricism projects that are implemented by EEAA.
- Investigation of the Citizens' environmental complains and taking the appropriate action to eliminate it.
- Studying the EIA for the list (A) which is the lowest pollutant activities.

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[1] : The answers by Suez RBO to the questionnaire.
[2] : EEAA, "Organizational and Functional Structure, Part 1", 1995, with some modifications and supplements by other sources' data/information.

- Implementing training courses about the environmental culture and public awareness for the citizens.

5.2.3 Organizational Structure and Resources

Suez RBO comprises three line departments and other supporting/administrating units with a total of 40 staff (planned to be 66 staff in the future), as shown in **Figure 5-3**.

(1) Technically Core Departments for Environmental Management

Direct activities for the environmental management are implemented through three technical departments: Environment Quality Department, Environment Development Department and Media and Awareness Department.

Environment Quality Department (EQD) with a total of 9 staff is responsible for: i) carrying out environmental monitoring programs with field works and laboratory measurement, ii) reporting measurement results to Inspection Committee, and iii) preparing environmental profile design and environmental map in the region.

Environment Management Department (EMD) with 9 staff is responsible for: i) leading and operating Inspection Committee, ii) examining EIA (Class A), iii) conducting solid and hazardous waste management, and iv) executing coastal zone management.

Public Awareness and Education Department (PAD) with a total of 4 staff is responsible for: i) encouraging public awareness for the environment, ii) carrying out environmental campaign, iii) Communicating with information centers and local press and iv) planning and implementing technical trainings of staffs.

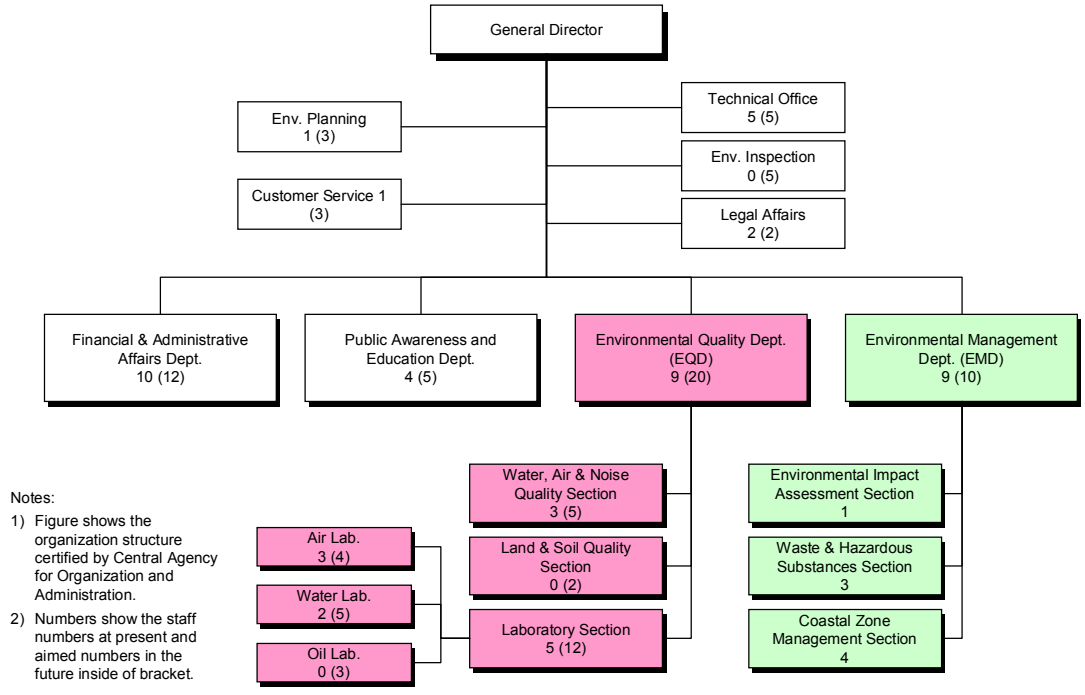

Figure 5-3 Organization and Human Resources of Suez RBO

(2) Information Facilities

Suez RBO owns information facilities: i) computers of 38 sets, ii) printers of 19 sets, and Scanners of 3 sets. It employs them for processing data/information collected and disseminating the environmental information, constructing the database system necessary for operating its activities of the environmental management.

(3) Mobilization Facilities

The mobilizing facilities comprising 4-WD type car (1 set), tractor car (1 set), pickup truck, mini van (2 set) and bus (1 set) are owned by Suez RBO. They are used for transporting equipment and staff for various activities.

(4) Manuals for Environmental Management

Suez RBO has developed and used manuals necessary for various activities like inspections, measurements/analyses, compliance monitoring and other purposes, as detailed below:

- Quality control manuals for ISO 9001 and 17025;
- Inspection manuals of various industrial categories (a total of some 14 manuals);
- Self-monitoring manuals of various industrial categories (a total of some 14 manuals);
- Measurement/analysis standards (EPA, JIS, ASTM, Egyptian method for sampling and analysis); and
- Relevant laws and regulations (Law No. 4, Law No. 48/1982, Law No. 93/1962, Law No. 44/2000, etc.).

(5) Budgetary Situations

The annual expenditures of Suez RBO over the past three years range from some L.E 600,000 to 780,000 (in 2003 - 2005). Of the total of the expenditures, the payroll costs for staff accounts for as high as some 90 %.

5.2.4 Laboratory Facilities and Capacity

Suez RBO owns the laboratory facilities in its office building for measuring and analyzing various parameters of water quality, air quality and others. Its laboratory room has the floor area of a total of 1,700 m^2.

Almost all the laboratory equipment, shown in **Annex 3**, had been provided by Japan in the EMTP Project. Suez RBO is equipped with laboratory equipment necessary for common measurement/analysis for water quality and air quality. Suez RBO has obtained the certification of ISO 17025.

Concerning the field of water quality, the laboratory of Suez RBO is capable of measuring and analyzing the following parameters:

- Field measurement: pH, DO, temperature, salinity, conductivity
- Usually measured parameters: Turbidity, alkalinity, TSS, TDS, BOD_5, COD, oil and grease, nitrite, nitrate, ammonia, total nitrogen, sulfate, total phosphorous, fecal coliform.
- Measured parameters, when necessary: Heavy metals (Cu, Cr, Fe, Pb, Ca, Be, Al, Mg, Ni, etc), mercury, anion ions (SO_4^{-2}, F^-, Cl^-, Br^-, etc.), sulfide, TOC, phytoplankton, chlorophyll-a, total coliform.

Up to now, Suez RBO has little experience in oil fingerprint analysis. Though a set of GC-FID for hydrocarbon analysis is available in its laboratory, the equipment has been not employed for that purpose. In the EMTP-FU of 2004, the introductory training for oil fingerprint analysis was conducted in Suez RBO. Three staff participated in this technical training on the measurement of hydrocarbons by DC-FID. Because this training was not enough for Suez RBO to manage the actual fingerprint analysis of oils, more intensive and practical training are requested.

Other equipment necessary for oil analysis like: FT-IR, fluorescence meter, density meters, refractive meter, etc. are not available in Suez Laboratory, presently. Hence, they will be provided Suez RBO in this Project.

5.2.5 Activities and Programs

(1) Routine Activities

The major routine activities undertaken by Suez RBO are the environmental inspection and the examination of EIA, as described below:

Environmental Inspection

The environmental inspection for establishments located in the region is one of important tasks to be undertaken by Suez RBO. Suez RBO enforces various requirements stipulated in the Law No. 4 and other related laws and regulations, inspecting the compliance status observed by establishments under the cooperation with EMUs and other competent agencies.

In 2005, Suez RBO conducted the environmental inspections for a total of 62 establishments in the region. These establishments contain 48 of industrial facilities, 9 of tourism facilities

and 5 of hospital facilities. The industrial facilities inspected by Suez RBO include different categories like petroleum industries, power generation plant, cement manufacturing, food industries, textile industries, etc. As the result of the environmental inspection, it has been found that about 84 % establishments are not complied with certain standards specified in Law No. 4 and its regulation.

Among the industries inspected, some of them are associated with oil pollution to be possibly caused by land-based pollution sources, discharging oily wastewater. They are petroleum-related industries (9 industries) and food oil manufacturing industries (5 industries).

The environmental inspections for sea-based facilities (oil platforms, seabed pipelines, etc) and port-related facilities (loading/unloading facilities, land pipelines, oil storage tanks) have not been undertaken.

Examination of EIA

Studying the EIA for the list (A) which means the lowest pollutant activities is one of important tasks to be undertaken by Suez RBO in collaboration with EMUs and other competent agencies.

Environmental Impact Assessment (EIA) is defined as a technical study undertaken by the investor or his representative, regarding the project, its location and potential environmental impacts. Through the study, different impacts of the project are analyzed and measures and alternatives for the different elements of the project are proposed. EIA process comprises a number of procedures determined by the Law No. 4 and its Executive Regulation as well as EIA Principles and Procedures Guideline issued by EEAA. Necessary manuals have been distributed to RBOs, EMUs and all stakeholders.

For implementing decentralized environmental management, RBOs have been mandated to review EIA documents on projects classified to the list (A) located in their geographical jurisdiction. Suez RBO has been engaged in these EIA studies for 182 projects in 2004, and 129 projects in 2005 (as of 2005 November) which include different categories shown in **Table 5-3**.

Table 5-3 EIA Processed by Suez RBO in 2005

Categories	Numbers of project
Food Industries	63
Wood Industries	3
Thermal Power Plants	3
Metal manufacturing Industries	16
Handcraft Industries	25
Agricultural Industries	11
Petroleum Industries	1
Power and Infrastructures	1
Mobile Stations	6
Total	129

Public Awareness Raising and Trainings

Suez RBO has carried out massive public campaign for the environmental awareness raising, preparing necessary materials like posters, brochures, booklets, video, magazines and so on. Opportunities of yearly 40 to 60 times have been arranged for awareness raising of school children in 2004 to 2006. Together, many opportunities like workshops, meeting lectures, etc. have been used for general citizens, stakeholders and concerned parties to enhance the environmental awareness and collaborations.

Besides, Suez RBO has undertaken several trainings to educate and strengthen the capacity Suez RBO staffs and EMU staffs.

Laboratory Works (Measurement and Analysis)

The laboratory section of EQD is engaged in measurement and analysis of samples coming from river and coastal water monitorings, environmental inspections, etc. In terms of water quality, the numbers of samples measured annually are largely 100 to 170 of general parameters (like COD, BOD, TSS, etc), 30 to 70 of heavy metals and 26 – 70 fecal coliform, according to activity records of 2004 – 2007. Detail data is shown in **Table 5-4**.

Table 5-4 Numbers of Measured Samples in Suez RBO Laboratory

Parameters	Number of Measured Samples			
	2004	2005	2006	2007
Temperature	166	120	184	101
pH	166	120	184	101
DO	166	120	184	101
BOD_5	166	120	95	80
COD	166	120	184	101
TSS	166	120	184	101
TDS	166	120	184	101
Phenol	10	32	77	39
NH_3	82	71	72	57
$N\text{-}NO_2$	27	18	33	29
$N\text{-}NO_3$	80	68	40	35
T-N	67	55	71	25
SO_4	20	13	79	29
Oil	46	26	86	89
O-Phosphate	62	34	59	16
T-Phosphorous	62	46	68	14
Heavy metal	27	48	33	65
Fecal coliform	70	49	65	26

Source: Annual achievement report of Suez RBO laboratory.

Other Miscellaneous Activities

In addition to works mentioned above, Suez RBO is engaged in many miscellaneous activities which come from other parties concerned with the environmental issues and general citizens. Representative activities are site surveys, rendering of related data & information, dealing with requests and claims and the like which are related with solid waste, hazardous substances, coastal zone management, etc.

(2) Projects and Programs

Apart from routine activities, Suez RBO has initiated and implemented projects/programs specializing in the environmental quality monitoring in the region. They are:

- Ambient water quality monitoring: Suez Canal Water Quality Monitoring Program and Fresh Water Quality Monitoring Program of Ismailia Stream;
- Water pollution sources monitoring at Suez Bay;
- Ambient air quality monitoring: In Suez City and Ismailia City; and
- Stack emission monitoring: Emission from medical incinerators and emission inventory survey (including cement and power plant).

Among projects and programs undertaken by Suez RBO, representative projects associated with water quality are presented hereunder:

Water Pollution Sources Monitoring at Suez Bay (Hotspots Monitoring)

The monitoring for the effluent from pollution sources has been periodically carried out by Suez RBO since the year of 2003. In this program, the wastewaters discharged from large nine (9) industrial establishments located around Suez Bay have been monitored in terms of ammonia, phosphorous, oil, TSS, COD, BOD_5, pH, etc. Several oil-related industries such as Suez Petroleum Co., Nasr Petroleum Co., SUMED Co., General Petroleum Co., etc. are among these monitored establishments.

As the result of this monitoring, it has been found that many establishments frequently discharges oily wastewater with oil concentrations beyond the effluent standard (15 mg/l) specified in Law No. 4.

Fresh Water Quality Monitoring Program of Ismailia Stream

The Program deals with the Suez-Ismailia Stream which is a drinking water source in the region. The objectives of the Program are; i) to provide baseline data on the present situation of Suez-Ismailia Stream water quality, assessing the pollution loadings, ii) to establish linkups with regional authorities and institutions to protect the stream water quality under the Law No. 48/1982, and iii) to establish the database linked with GIS system.

Several-time samplings of waters at a total of five monitoring stations (three stations in Suez City and two stations in Ismailia City) have been conducted four times in 2004 and 2005. The parameters of the measurements are; pH, temperature, DO, COD, BOD, TSS, alkalinity, ortho-phosphorus, ammonium-nitrogen, nitrate-nitrogen and E-coliform.

The outlines of Suez Canal Water Quality Monitoring Program and Water Pollution Sources Monitoring Program at Suez Bay are described in the section 6.1.

5.3 EMUs of Governorates[1]

5.3.1 Tasks of EMUs

The Environmental Management Units (EMUs) is one of functions under the governor of a governorate. Along the decentralization policy in the environmental administration, numbers of roles in the environmental management are going to be transferred into EMUs in Egypt. However, the actual capacity of EMUs is still limited for the time being. Therefore, the intensive capacity building is now under way.

Although the roles to be undertaken by EMUs are commonly expected as described below, many EMUs are on the way to enhance the capacity to carry out them, at present.

Figure 5-4 shows a typical organizational structure of EMUs.

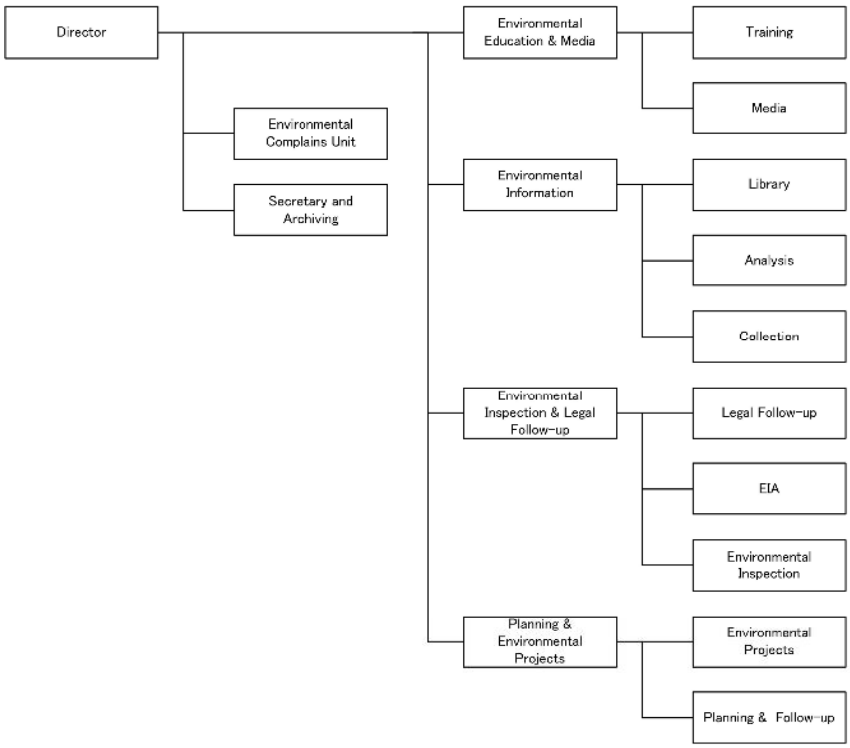

Figure 5-4 Typical Organizational Structure of EMUs

The following are the observation results on the tasks undertaken by the EMU of Greater Cairo[2]:

[1] : The data/information on EEAA's RBOs made by EEAA, with the supplement data/information collected from EMUs.

[2] : JICA, "Recommendation Report of EMTP-FU", 2004.

EIA Section

EMU receives all kinds of the Environmental Impact Statement and transfers them to competent authorities or EEAA Headquarters.

Environmental Compliance Section

EMU assists and reviews subordinate area offices in assessing the permission of the operation or process alteration.

Inspection Section

In response to complaints, EMU conducts the environmental inspection for establishments by itself or under the joint work with RBO concerned (if necessary). EMU has the authorities to cease the operations of entities and to turn in the request of legal treatments against violators.

Public Complain Section

EMU receives complains from public and treats them.

In addition to the aforementioned, EMU conducts public awareness campaign by itself or under the collaboration with RBO concerned.

5.3.2 EMUs in Gulf Region

In the Gulf Region, five EMUs have a total of 84 staff of the human resources, as shown in **Table 5-6**. While EMUs have some equipment for environmental measurements, they are only for the field measurement uses.

Table 5-6 Management Resources of EMUs in Gulf Region

EMUs	Suez	Ismailia	Port Said	North Sinai	South Sinai
Numbers of Staff	14	23	12	20	15
Field Equipment Owned					
Noise Meter	2	1	1	2	1
Water Quality Meter	2	2	1	2	1
Ice Box	2	2	2	3	2
GPS	1	1	1	-	2
SO_x Analyzer	1	1	1	1	2
CO Analyzer	1	1	1	3	2
PM_{10} Analyzer	1	-	1	-	-

5.4 Institutions Associated with Oil Pollution

5.4.1 Ministry of Water Resources and Irrigation (MWRI)

The main task of MWRI in water issues is to enforce the Law No. 48/1982 to protect the fresh water of the Nile River and its related waterways. The organizational structure shown in **Figure 5-5** is set to fulfill that purposes. Meanwhile, MWRI has the limited functions in coastal areas, as described below.

Responsibilities of MWRI for coastal areas are fulfilled through the Shore Protection Authority (SPA). The mandate of the SPA focuses on managing and protecting the coastlines and shorelines from erosion due to natural phenomena or as a result of man made interventions. By virtue of the Law No. 4, the jurisdiction of SPA is extended to cover all the coasts of Egypt.

According to the provisions of the Executive Regulations of the Law No. 4, it is prohibited to construct any establishments on the coastal areas of Egypt within 200 m from the shoreline without the prior approval of SPA and EEAA. Similarly any work or construction that might affect or alter the natural shoreline is prohibited except with a special approval from SPA and EEAA.

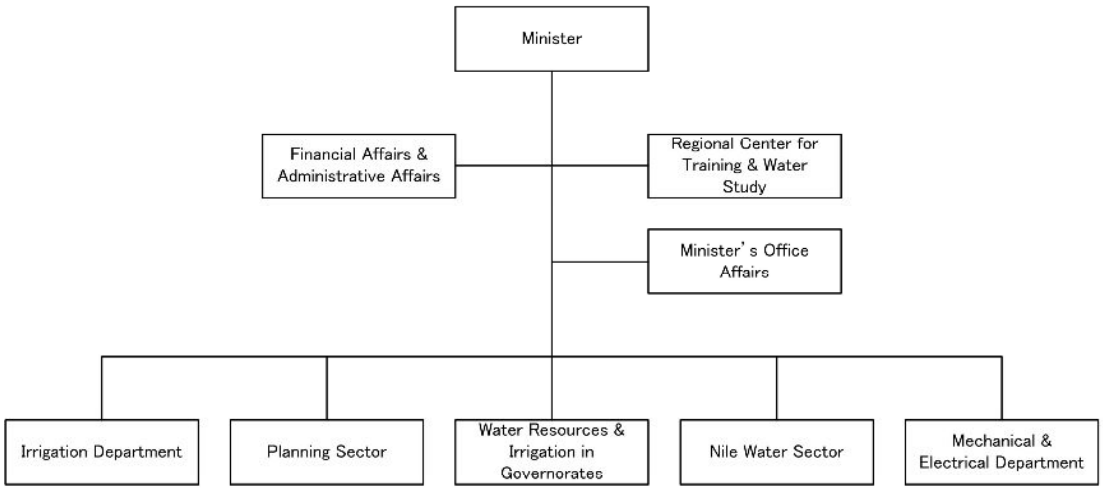

Figure 5-5 Organizational Structure of Ministry of Water Resources and Irrigation

As evident, the SPA of MWRI is mainly concerned with physical impacts on the shoreline from natural and/or man-made origins, and is not concerned with pollution of the coastal waters or the coast with oil or any other pollutants.

MWRI has established the Water Quality Management Department, recently. The mandate of this Department is mainly to address and manage water quality issues in the water bodies under the jurisdiction of the ministry and which include the two lakes located in the Gulf Region.

5.4.2 Maritime Transport Sector[1]

The Maritime Transport Sector in Egypt under the jurisdiction of the Ministry of Transport comprises numbers of authorities over diverse fields associated with coastal and marine transportation. Among them are Alexandria Port General Authority, Port Said Port General Authority, Red Sea Port Authority (RSPA), Damietta Port Authority, Egyptian Authority for Navigation Safety (EANS) and others.

Regarding oil pollution issues, two units both under the jurisdiction of the Maritime Transport Sector in the Ministry of Transport are engaged in mainly tasks associated with oil pollution.

Department for Maritime Inspection (DMI)

Department for Maritime Inspection (DMI) is under the jurisdiction of Egyptian Authority for Navigation Safety (EANS), formerly called the Ports and Lighthouse Authority, that was established in 2004 by the Presidential Degree No. 399/2004. The headquarters of EANS is located in Alexandria and the office for (DMI) is located in each port of Egypt.

Concerning oil pollution, the main role of DMI is to carry out the inspections for vessels to prevent oil pollution, as detailed in the section 6.3. DMI has 65 staff for inspections in the office of Suez Port.

Central Department for Environment Protection (CDEP)

Central Department for Environment Protection (CDEP) is under the jurisdiction of Red Sea Ports Authorities (RSPA). RSPA operates numbers of ports located in the Red sea, the Gulf of Suez and the Gulf of Aqaba, as shown in **Table 5-6**.

Table 5-6 Profiles of Ports Operated by Red Sea Port Authority

Ports	Numbers of Quay	Total Length of Quay (m)	Depth (m)	Capacities (annual)
Taufik	13	2,100	8	1.5 mill passengers 1.5 mill ton
Adabiya	9	1,840	8 to 12	2 mill ton (cargo) 2 mill ton (dry bulk) 2 mill ton (grain) 0.75 mill ton (oil)
Petroleum Basin	5 jetties 1 loading quay	510 120	7 to 11	8 mill ton
Sokhna	6	2,000	17	100,000 containers 1 mill ton (dry bulk) 1 mill ton (cargo)
Safaga	6	1,280	8 to 13	2 mill ton (grain)

[1] : Sourced from related authorities and units by JICA Expert Team.

				2 mill ton (dry bulk) 2.5 mill ton (cargo) 750,000 passengers
Hurghada	1	180	5 to 8	5,000 passengers
Nuweiba	3	355	7 to 10	1 mill passengers 250,000 ton (cargo)
Sharm El Sheikh	1	625	5 to 10	100,000 passengers
El-Tor	1	75	5.5	100,000 ton (cargo)
Special Purpose Ports	-	-	-	At Las Gharib, Ras Shukeir, Wadi Feiren, Ras Sidr and Ras Badran

CDEP was established by the Board's Degree of RSPA in 1999 to deal with the protection of marine environment. The organizational structure of CDEP is shown in **Figure 5-6**.

The main task of CDEP is to prevent oil pollution generated from vessels and port facilities and combating oil spill in the region. It is also involved in the inspection of vessels. Major roles to be undertaken by CDEP are summarized below:

- Undertaking the technical and legal studies relevant to international conferences and treaties on protecting marine environment;
- Implementing the national emergency plan for combating pollution in cooperation with stakeholders;
- Performing scientific studies and research to identify types of pollutants causing sea water pollution within the Authority's geographical scope;
- Preparing scientific studies and research on chemical and mechanic means necessary for combating all types of marine pollution (chemicals, oils, sanitary drainage, etc.);
- Monitoring and controlling marine pollution incidents, estimating necessary damages, and applying, following up and implementing judgments issued thereon;
- Monitoring and following up pollution combating processes in coordination with the General Department for Marine Services;
- Developing and monitoring periodical programs to examine the efficiency of pollution combating equipment;
- Developing a proposal for the plan required for training labor on combating pollution incidents;
- Following up all national and international information on the environmental status and its periodical updates in collaboration with stakeholders;
- Participating in preparing the emergency plan for marine environment and coordination with stakeholders;
- Coordinating the organization and securing of hazardous material handling in ports with stakeholders;

- Developing annual reports on and analyzing incidents and reporting to parties concerned;
- Receiving warning and incident notifications, arranging with stakeholders to overcome oil spots, and participating in implementing the national plan within the limits of the geographical scope; and
- Reviewing means of receiving sanitary drainage materials and ship wastes.

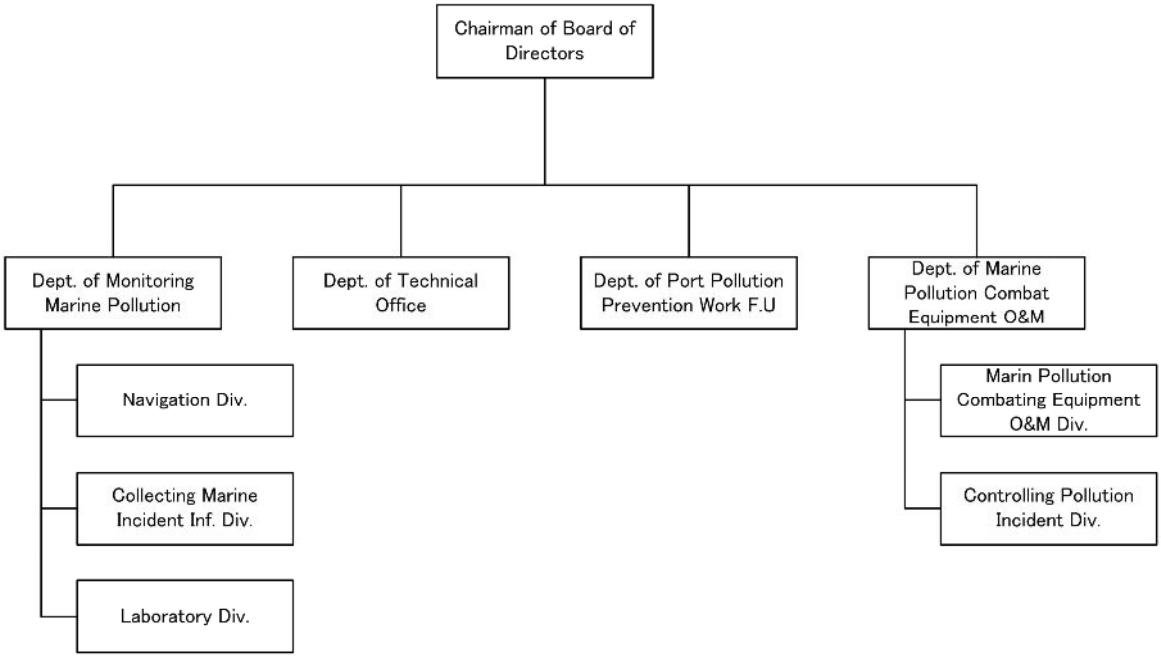

Figure 5-6 Organizational Structure of Central Department of Environment Protection

5.4.3 Suez Canal Authority (SCA)

In cases of the oil spill incidents occurred within the Suez Canal, the major responsibility lies on the Suez Canal Authority (SCA) to contain them. Suez Canal Authority (SCA) has a department specializing in the response of oil spills, hosting 13 well-trained personnel. Most of them are with postgraduate studies in combating oil spills. Besides, 55 captains and 65 technicians work in the department.

The Department owns and operates the following oil spill combating facilities:

- 3000 m of booms;
- 130 oil skimmers;
- 5 halls for oil receiving of 200 tons capacity each;
- 10 arms for the dispersant spraying;
- Different shapes and sizes of anchors for towing;
- 2 load transfer tankers to transfer oil from grounded ship 3,000 ton each; and
- Environmentally accepted dispersants.

5.4.4 Petroleum Sector

(1) Petro Environmental Service Company (PESCO)

The Egyptian General Petroleum Corporation (EGPC) established a consultancy body called Petrosafe which mainly provides consultancy services for the petroleum companies. Then, Petrosafe and Briggs Egypt (a subsidiary of Briggs Environmental Services Limited in UK) have established a Joint Venture Company, Petro Environmental Service Company (PESCO), in order to provide oil spill response services.

PESCO was awarded the management and operation of the four national Oil Spill Response Centers in Egypt owned by EGPC. In May 2003, PESCO was selected by EEAA to manage and operate the fifth Marine Pollution Response Center located in Sham El Sheikh at the entrance of the Gulf of Aqaba.

PESCO is an emergency response company that provides both inland and offshore pollution response. It currently manages the Tier 2 spill response centers and assets on behalf of EGPC and EEAA to provide national support around the Egyptian coastline.

The operation centers of PESCO covering the Gulf Region are located as follow:

Suez Base

- Location: Zaityat Port in Suez City;
- Coverage area: working in the area from the end of Suez Canal in the north to Ras Abu El Darag in the south;
- Personnel of the Suez base: 33 captains, engineers and technicians.

Ras Gharib Base

- Location: El-Sakkala in Ras Gharib City;
- Coverage area: Abu El Darag in the north to Hurghada in the south;
- Personnel: 28 captains, engineers and technicians.

Hurghada Base

- Location: El-Dahhar, opposite to the Red Sea Governorate building;
- Coverage area: responsible for any incidents from Hurghada in the north to Safaga in the south;
- Personnel: 35 captains, engineers and technicians.

Sharm El Sheikh Base

- Location: Sharm El-Sheikh in City Entrance;
- Coverage area: Nabq in the east to Ras Gara in the west;
- Personnel: 35 captains, engineers and technicians.

These centers are responsible for oil spills from 100 to 1,000 ton and, in addition, there are many smaller bases sited along the gulf for the purpose of dealing with smaller spills (less than 100 ton).

PESCO manages the following facilities and equipments that are available in the Suez Center:

- Different types of booms to be used for the containment of the oil spill: Fence booms, light booms, heavy booms, expanded booms used in open sea spills;
- Mechanical: Weir skimmer, transfer pumps, vacuum units, steam jets;
- Physical: Rope skimmer, disc skimmer, belt disc; and
- Chemical: Different types of dispersants.

In addition, the Suez Center has two aluminum boats, one fiber glass boat (land craft) and one floating supplier.

(2) Petroleum Companies

Petroleum companies engaged in oil-related activities like oil exploitation, transportation, refineries, processing and so on are called the oil sector and they forms geographical committees by the regions.

Petroleum companies working in the area have equipment for oil mitigation and control. El Nasr Oil Company has its own equipment, capable of controlling a spill of 500 to 750 ton. The available equipments include the following:

- An oil combat vessel, equipped with holding tank and oil lens on reel of about 200 m in length;
- Oil skimmer for pumping of oil and oil emulsion into holding tank;
- Booms for spread of dispersants; and
- Working boat (200 to 400 HP) .

El Nasr Company has been no longer involved in combating oil spills, because PESCO has been established.

5.4.5 Research and Academic Institutions

(1) Arab Academy for Science, Technology and Maritime Transport (AASTMT)

The Arab Academy for Maritime Transport was established by virtue of the international agreement among Arab countries with headquarters in Alexandria City in 1974. In 1997, the member states signed a new agreement by virtue of which the Academy was amended to the Arab Academy for Science, technology and Maritime Transport (AASTMT). The summarized objectives of the AASTMT are:

- To expand educational and training channels in order to achieve an advanced level of scientific awareness, applicable research for maritime transport; and
- To prepare and qualify maritime cadres, as well as achieve the highest level of maritime safety and environmental preservation.

The Government of Egypt had approved the establishment of an integrated technological complex in the Academy with rendering a key role in implementing the National Oil Spill Contingency Plan (NOSCP). The oil diffusion and drifting simulator in AASTMT is capable of and is used for simulating oil spills. Although there was an attempt to formulate the link-up between AASTMT and Central Operation Room in EEAA in the past, this attempt was not realized successfully.

AASTMT provides the program for technical trainings on oil spill response, employing its professional staffs and computerized education facilities.

(2) National Research Center (NRC)[1]

The National Research Center (NRC) was established under the jurisdiction of the Ministry of State for Scientific Research in 1956. It is the largest multidisciplinary research and development center in Egypt and devoted to basic and applied research within the major fields of interest. The major aim of NRC is to foster basic and applied scientific research, particularly in industry, agriculture, public health and others.

NRC comprises 13 divisions including 95 departments that can be grouped into four main sectors: Industrial sector, agriculture sector, health & environment sector and natural & basic science sector. A total of some 1,600 researchers are working with many other assistant staff.

The Water Pollution Unit headed by Dr. Mohamed Badawy belongs to Environmental Science Division. The Environmental Science Division comprises Air Pollution Unit and Occupation Health & Industrial Medicine Unit in addition to the Water Pollution Unit. The Water Pollution Unit is engaged in not only academic research and development but also consulting services, technical training, etc. as described below:

- Water treatment technology;
- Assessment of water quality and treatment processes for industrial uses;
- Characterization of water resources and their reliability for various uses;
- Characterization and treatment efficiency of wastewater and design of the treatment units;
- Measurement of pesticides, hydrocarbons and toxic chemicals, inorganic pollutants and microbiological quality of drinking water and water resources;
- Assessment of marine pollution with oil and hazardous chemicals;
- Effect of coating materials used for water tanks on water quality;
- Assessment of water quality used for boilers and cooling systems;
- Environmental impact assessment of industrial projects; and
- Sponsoring specialized training programs in the fields of water treatment, pesticides, oil pollution and microbiology.

[1] : NRC, the Brochure of NRC.

In terms of oil analysis, NRC owns and operates laboratory equipment necessary for oil fingerprint analysis like GC-FID and others. Also, it has published large numbers of academic reports on oil pollution issues including associated analytical technologies.

(3) Egyptian Petroleum Research Institute (EPRI)[1]

The Egyptian Petroleum Research Institute (EPRI) established in 1974 is a research and development institute for petroleum under the jurisdiction of the Ministry of State for Scientific Research. It has been engaged in research, development, evaluation, analysis, etc. for petroleum including natural gas. Its human resources are a total of about 1,000 staff (of them, about 400 researchers). It is accommodated in four building and two floors of them are occupied by oil-related analysis laboratory.

EPRI has enough experience and knowledge in research and development activities in the area of oil fingerprint analysis, issuing many technical reports. Especially, Dr. Mohammed Ibrahim Roshdi (Adviser) has been engaged in research and development in the field of oil fingerprint analysis for a long time, presenting many related reports and seminars, internationally.

Almost all the kinds of laboratory equipment necessary for fingerprint analysis (like GC-FID, GC-MS, FT-IR, viscosity, density, pour point, etc.) are available and most of them are actually being used now. While fluorescence spectrography (FL) is not available for an uncertain reason, it has enough experience to use and instruct FL analysis.

Over the years, EPRI has hold many training courses associated with oil-related analysis. EPRI has enough capacity to conduct the technical training for oil finger analysis.

(4) Suez Canal University and National Institute of Oceanography and Fisheries

In the Gulf Region, the Suez Canal University and the National Institute of Oceanography and Fisheries represent the academic institutions capable of identifying and quantifying the magnitude and extent of oil pollution incidents. Both institutes have experience in working in cooperation with the EEAA as external laboratories for oil analyses. The Faculty of Petroleum in Suez Canal University has small scale equipment for control and mitigation of oil spills for the educational purposes.

[1] : Sourced from the website of EPRI.

CHAPTER 6
CURRENT MANAGEMENT AND PRACTICES FOR OIL POLLUTION

6.1 Overview

Oil pollution possibly arises from the sea-based and land-based facilities as the generation sources, and in the way of operational and incidental discharge with unintentional or intentional conducts as the discharge modes. Egypt and the Gulf Region are presently provided with various measures and actions against diverse kinds of oil pollutions, with mobilizing numbers of governmental institutions associated with the environment and the maritime transport and private sectors.

As a whole, it is considered that the present measures and actions are not enough to response the possible oil pollution in the Gulf Region. That is the reason why this Oil Pollution Program is placed as one of important components in the Project. In this chapter, underlying problems in the current practices and system for oil pollution in the region should be profiled.

The problem analysis will be undertaken in the subsequent stage of the Program in order to identify various problems and constrains habiting in the current measures for oil pollution. For that reason, the present measures and actions for oil pollution have to be reviewed and analyzed thoroughly.

To facilitate this problem analysis in the later stage of this Program, current measured and actions for oil pollution are analyzed along the following categorization, as shown in **Figure 6-1**:

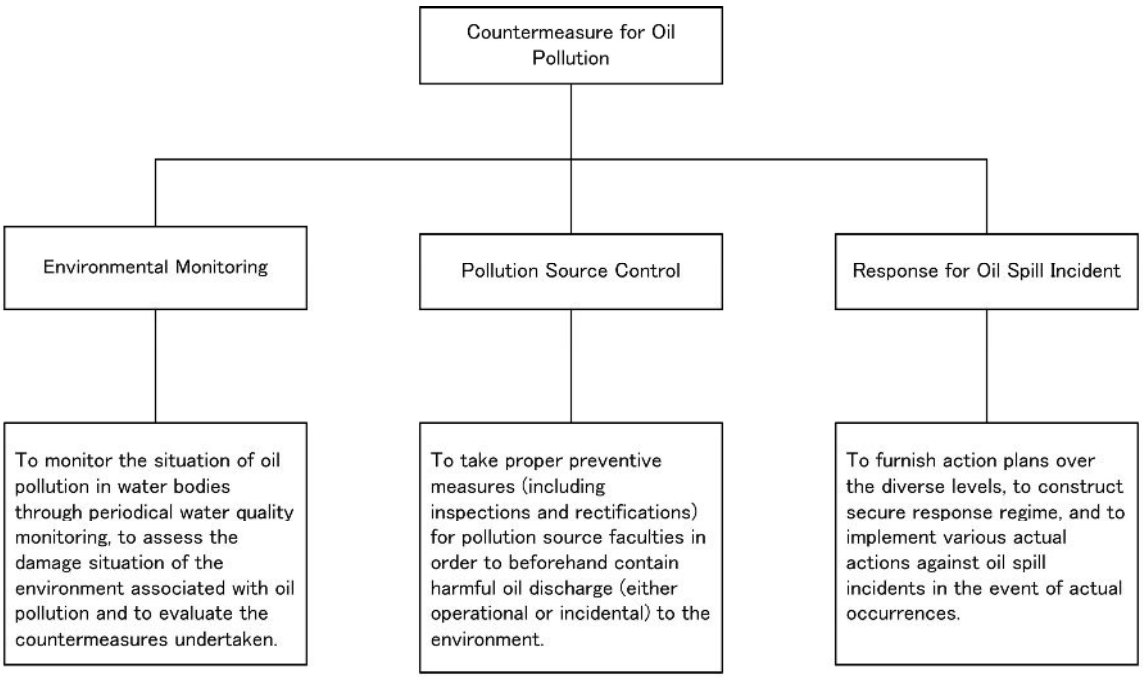

Figure 6-1 Framework of Countermeasures for Oil Pollution

<Environment Monitoring>

The environment monitoring is to monitor the situation of oil pollution in water bodies through periodical water quality monitoring, to assess the damage situation of ecosystem associated with oil pollution and to evaluate the countermeasure undertaken. The mandate associated with the environment monitoring is vested to EEAA mainly by the Article 5 of the Law No. 4. The effectiveness of measures and actions undertaken against oil pollution is evaluated based on the monitoring results.

<Pollution Source Control>

The pollution source control is to take proper preventive measures (including inspections and rectifications) for pollution source facilities in order to beforehand contain harmful oil discharge (either operational or incidental) to the environment. The mandate associated with the pollution source control is vested to EEAA mainly by the Article 5 of the Law No. 4. Specific actions included in the pollution source control are environmental inspections (including effluent monitoring) for land-based facilities (industrial establishments and others) and sea-based facilities (such as oil tankers, commercial vessels, oil platforms, seabed pipelines, loading/unloading facilities, etc.).

<Response for Oil Spill Incidents>

The response for oil spill incidents includes the provision of action plan over diverse levels and the enforcement of various actual actions against oil spill incidents in the event of actual occurrences. The mandate associated with the response for oil spill incidents is vested to EEAA mainly by the Article 5 and the Article 25 of the Law No. 4. Specific actions are the formulation of contingency plans like the National Oil Spill Contingency Plan, the equipage of machines and materials necessary for the oil containment, the actual clean-up work at the site, the identification of spilled oil sources, etc.

Along the categorization mentioned above, the current measures and actions for oil pollution are reviewed as below:

6.2 Water Quality Monitoring[1]

6.2.1 Coastal Water Monitoring Program (CWMP)

The Coastal Water Monitoring Program (CWMP) is a part of the Environmental Information and Monitoring Program (EIMP) which was designed for monitoring the whole Egyptian coast. CWMP and EIMP ware stated by EEAA, supported by Danish International Development Assistance (DANIDA) in 1998 and now they are conducted under the full responsibility of management by EEAA.

The aim of CWMP is to establish a marine monitoring program for the Egyptian Coastal water. CWMP comprises: i) monitoring of water quality parameters on water samples, ii) monitoring of contaminants in sediments, shellfish and coral, and iii) monitoring of benthic infauna and coral reefs.

[1] : Sourced from Suez RBO.

A total of 47 stations are placed along the Egyptian coastline and 39 stations along the coastal areas of the Gulf of Suez, Gulf of Aqaba and the Red Sea proper, as shown in **Figure 6-2**. Among them, a total of 16 stations are located in this Project Area.

Figure 6-2 Monitoring Stations in Coastal Water Monitoring Program

CWMP is designed to cover the different seasons of the year. On each sampling campaign the following parameters are measured: i) hydrographical conditions (water temperature, dissolved oxygen, salinity and pH), ii) bacteriological parameters (total coliform, E coliform and fecal streptococci bacteria), and iii) eutrophication parameters (Chlorophyll-a, total suspended matters, transparency, total nitrogen, nitrite, nitrate, ammonium, total phosphate, etc.). Furthermore, visual observations on weather condition and sewage impacts are made. All measurements are carried out according to related international standards.

Situations of oil pollution in coastal waters are periodically and continuously observed and recorded in CWMP. These observation results are valuable to know the magnitude of oil pollution in a long-term, because no other monitoring is not in place in this regard. The outcomes of CWMP on coastal waters in the Project Area are summarized in the section 3.5.

6.2.2 Regional Program of Water Quality Monitoring

Suez RBO is undertaking regional water quality monitoring programs in the Project Area. The measurements of oil contents are a part of the objectives of these monitoring programs.

(1) Suez Canal Water Quality Monitoring Program

The Program deals with the Suez Canal which is considered to be a semi-closed water area. The objective zone is the canal waters between Suez city at the side of the Gulf of Suez and Port Said at the side of the Mediterranean Sea, encompassing Bitter Lake near Ismailia City, as shown in **Figure 6-3**.

The objectives of the Program are; i) to work out a strategy for dealing with countermeasures against water pollution, ii) to upgrade human capacities of Suez RBO, iii) to establish linkups with regional authorities and institutions, and iv) formulate a plan for the sustainable water quality monitoring of the Suez Canal and Bitter Lake in cooperation with regional institutions.

In the Phase I, seasonal samplings of waters at seven monitoring stations have been conducted four times in 2004 and 2005. The parameters of the measurements are; pH, temperature, turbidity, salinity, DO, chlorophyll a, COD, BOD, TSS, TDS, alkalinity, total-phosphorous, ortho-phosphorus, total-nitrogen, ammonium-nitrogen and nitrate-nitrogen. Furthermore, oil and greases will be added to the parameter to be measured in the Phase II and Phase III.

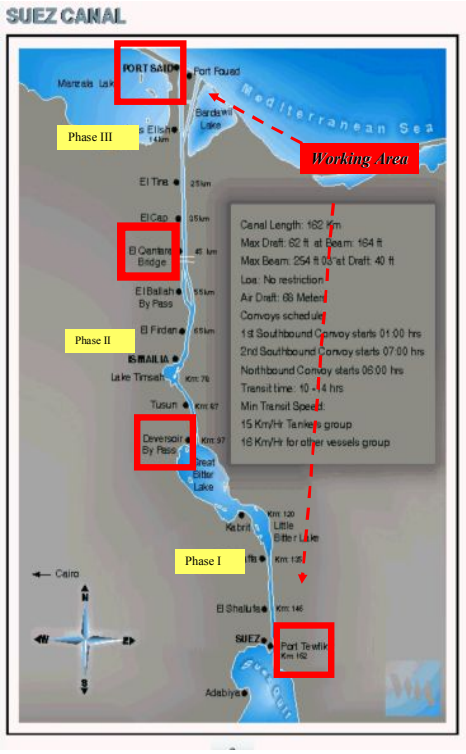

Figure 6-3 Suez Canal Water Quality Monitoring Program

(2) Water Pollution Sources Monitoring Program at Suez Bay

The Program deals with the Bay of Suez which is a hotspot of water pollution in the region, as shown in **Figure 6-4**. The objectives of the Program are; i) to identify the pollution loads discharged from major establishments in the area along the Bay of Suez, and ii) to formulate the plan for reducing the pollution loads.

Two-time samplings of effluent waters at a total of eight establishments have been conducted in 2004 and 2005. The parameters of the measurements are; pH, oil and greases, turbidity, color, temperature, COD, BOD, TSS, TDS, ortho-phosphorus and ammonium-nitrogen.

The results of the water pollution sources monitoring program at Suez Bay are presented in the section 3.6 and the section 6.3.
In this Program, the water quality monitoring of the ambient water quality in the Suez Bay is not conducted.

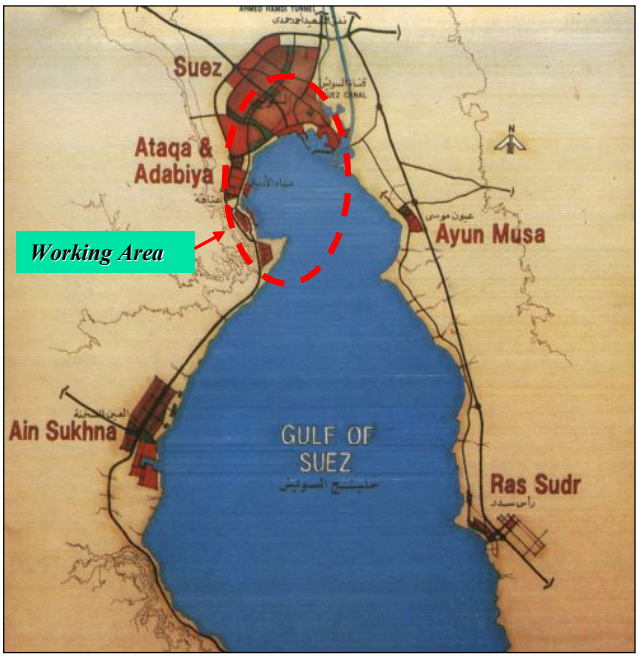

Figure 6-4 Water Pollution Sources Monitoring Program at Suez Bay

6.3 Pollution Source Control

6.3.1 General Situation of Environmental Inspection[1]

The Law No. 4 requires that all land-based establishments which could potentially be a source of pollution keep an Environmental Register. The Environmental Register contains data/information related with the environmental impacts, including; general descriptions of establishment, location, process description, legal requirements, etc.

The Environmental Inspection has taken place since 2004, in order to apply concerned provisions of the Law No. 4 to all types of facilities. EEAA inspectors, in cooperation with related units, are required to inspect the establishments, ensuring that the data/information presented in the Environmental Register conforms to the actual status. EEAA inspectors are also required to take samples and/or conduct tests to assess the status of compliance of the establishment. Thus, the Environmental Inspection is one of important actions to beforehand contain oil discharges from land-based pollution sources.

The land-based sources, such as petroleum facilities and industrial establishments, are inspected for the compliance monitoring by the inspectors of EEAA, RBO and EMUs. In case of non compliance, legal measures are taken against the establishment. According to the record, large numbers of establishments violating were taken to court in the region. In the period from the year 2000 and up to June 2002, the situation of inspections for these 500 establishments in the whole of Egypt are summarized as shown in **Table 6-1**, resulting into the penalties of some 150 cases.

[1] : EEAA, "Egypt State of the Environment Report 2004", 2005.

The results imply that large numbers of violations actually exist in the pollution preventive measures taken in establishments, though the detail information has little been clarified at present.

Table 6-1 Results of Environmental Inspection in Egypt

Processing Situations of Inspection	Number of Establishments
Cancelled due to faulty reporting.	40
Reached reconciliation.	25
Received a verdict less than 1000 L.E.	Some 150
Still being investigated.	150
Proved innocent.	Some 50
Presented the proof that they had removed the violations.	50
The violation was not proven because the source of pollution was closed off at the time of the inspection the premises.	Some 35
Total	500

Environmental inspection is considered to be a crucial procedure to firmly enforce the Law No. 4. It is, however, reported that numbers of impediments to be solved have been identified to properly implement the Environmental Inspection. Among them, major problems are summarized as below:

- Inspection unit in EEAA faces a serious shortage in the number of inspectors who are required to inspect all kinds of establishments indicated in the Law No. 4 at the national level;
- Similarly, Suez RBO has limited in the numbers of personnel with around 24 technical staff. Although the RBO staff are relatively well trained and well equipped, they are required to cover the large area over five governorates and a coastline that stretches over 1,000 km; and
- While each of the five governorates has the EMU at the local level, the organization and operations of EMUs vary depending on the five governorates. Under the existing institutional framework, EMUs represent the primary local authority on the environmental issues and, in many cases, operate as the executing agencies for the EEAA's environmental policies and programs. However, it is the reality that in general, the environmental management at the governorate level is less effective. To be able to perform their functions effectively, all EMUs would need to be reinforced to additional staff, training, office and technical equipment:

Apart from the establishments in land, oil loading/unloading facilities in ports (land-based) and oil platform and seabed pipelines (sea-based) are also pollutions sources on the basis of the definitions in the Law No. 4. It should be noted that, more often than not, EEAA, RBO

and EMU staff faces difficulties in having access to such land-based and sea-based facilities for the inspection, reportedly.

6.3.2 Compliance Monitoring of Effluent[1]

The compliance monitoring of effluent wastewater to be discharged into water courses is a fundamental tool in water quality management. The Law No. 4/94 sets the effluent standard of oil and greases as less than 15 mg/l. In Egypt, the compliance monitoring of industrial effluent is conducted parallel with the environmental inspection afore-mentioned.

Table 3-6 in the section 3.6 shows the measurement results of oil and greases in the effluent of oil-related industries located in the Gulf Region. As understood from these result, the following situations may be observed:

- Large numbers of violations (some 60 % of the total measurement) in the effluent water quality of oil-related industries exist; and
- Some of industry continuously discharges the effluent with the oil contents beyond the standard.

These results imply that Gulf Region needs more stringent regulatory approaches of the industrial effluent to prevent the oil discharge from oil-related industries.

6.4 Inspections of Vessels[2]

Inspections of vessels are undertaken by the Department for Maritime Inspection (DMI) under the jurisdiction of Egyptian Authority for Navigation Safety (formally called Port and Lighthouse Authority) and Central Department for Environment Protection (CDEP), under the jurisdiction of Red Sea Port Authority.

In terms of the inspection for vessels, the tasks of DMI are summarized as below:

- Inspection of pollution prevention equipment;
- Inspection of navigational safety procedures and equipment;
- Technical inspection of national vessels of all kinds;
- Reviewing certificates of foreign vessels;
- Reviewing registers (log books) for oily wastes and solid wastes;
- Reviewing registers concerning vessel crews;
- Collection fees from vessels; and
- Licensing fishing boats (large vessels are licensed from the headquarters of the Authority in Alexandria).

The total numbers of staff of DMI Office in Suez is 65. Daily inspection of vessels is conducted by the team comprising six engineers and 4 technicians. The team makes the

[1] : Sourced from Suez RBO.
[2] : Sourced from Egyptian Authority for Navigation Safety.

inspection for one to three vessels, daily. However, actual results on the vessel inspection by CDEP have little been known at present.

Marine inspection for not only vessels but also stationary facilities like bunkering facilities, loading/unloading facilities is crucial as one of activities to prevent oil pollution. The responsibility for marine inspection belongs to Suez RBO, according to the understanding of Suez RBO. However, the marine inspection for such facilities has not been realized at present.

6.5 Countermeasures for Oil Spill Incident

6.5.1 National Oil Spill Contingency Plan (NOSCP)[1]

(1) Overview

The Law No. 4 places sole responsibility for overseeing all strategic and operational aspects of spill response within the country with EEAA. A National Oil Spill Contingency Plan (NOSCP) was first prepared in 1986 and then was reviewed and updated in 1998 to conform to the requirements of the ORPC. The NOSCP defines procedures for the response to oil spills in a coordinated response by both the public and private sectors.

The NOSCP is a framework for action in the event of an oil pollution incident. It sets out:

- Respective roles and responsibilities of EEAA and all EEAA's partners in the national contingency plan;
- Procedures for notifying EEAA in the event of observing oil pollution or for reporting discharges of oil from ships and offshore platforms;
- Tiered response concept and how this will operate in Egypt including responsibility for taking initial response action to an oil spill;
- Incident command procedures which describe the management responsibilities for the case of Tier One, Tier Two and Tier Three spills; and
- National combat strategy and EEAA's policy on the use of dispersants;

(2) Institutional Arrangements for NOSCP

EEAA is responsible for formulating general policy and preparing the necessary plans for the protection and promotion of the environment under the Law No. 4. It is also required to follow up the implementation of such plan in coordination with the competent administrative authorities. In particular, EEAA is required under the Law to prepare an Environmental Disasters Contingency Plan to be approved by the Cabinet of Ministers. The NOSCP forms a component of the Environmental Disasters Contingency Plan.

EEAA is a leading agency of the NOSCP and responsible for establishing and implementing a national system promptly and effectively to combat oil spill incidents. The National Contingency Planning Committee (NCPC), a permanent Committee, advises and assists

[1] : EEAA, "National Oil Spill Contingency Plan", 2002.

EEAA. In the event of a major oil pollution incident, an Emergency Response Committee (ERC) may be convened to advise and assist EEAA.

EEAA is supported by many governmental and private sectors to combat oil pollution incidents. The following institutions are involved in the NOSCP from the standpoint of respective governing and specializing fields:

- Maritime Transport Sector of Ministry of Transport (Ports and Lighthouse Administration)
- Egyptian General Petroleum Corporation
- Suez Canal Authority
- Ministry of Defence (Navy, Air Force, Search and Rescue, Coast Guard, Army)
- Ministry of Interior (Civil Defence)
- Governorates in the regions
- Arab Academy for Science, Technology and Maritime Transport
- Ministry of Finance (Custom)
- Ministry of Interior (Immigration Authority)
- Academy of Science Research and Technology
- Tourism Development Authority and Ministry of Tourism

(3) Notification and Reporting Procedure

In compliance with the Article 55 of the Law No. 4, EEAA leading the NOSCP must be notified promptly and accurately the occurrence of oil spill incidents. This notification is a legal obligation of companies, captains and owners of land-based and sea-based facilities.

According to the NOSCP, oil spill incidents along with specified information should be reported to EEAA through various routes, depending on the facilities causing the incident, as shown in **Figure 6-5**.

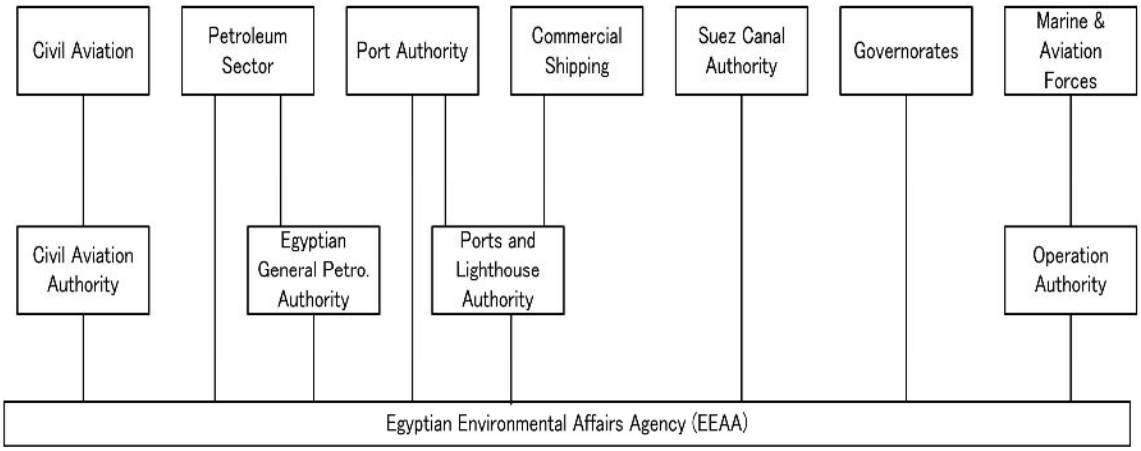

Figure 6-5 Notification Procedure of Oil Spill Incidents

(4) Tiered Response Concept and Initial Response Procedure

A number of factors are taken into account in determining which agency should have responsibility for mounting the initial response action to an oil spill, like:

- The origin (or source) of the spill;
- The geographical location of the spill;
- The size of the spill; and
- The sensitivity of the areas threatened by the spill.

The "Tiered Response" concept is decided, considering these factors and, in particular their relative importance to each other. This is a widely accepted operational concept that provides a convenient categorization of response levels and a practical basis for oil spill contingency planning.

The tiered responses of three categories are set up as follows and shown in **Figure 6-6**.

Tier One

Tier One, a small-scale spill less than roughly 100 m^3, is concerned with preparedness and response to a small spill within the capabilities of an individual facility or port authority. The type of incident typically involved would generally be associated with ship transfer or bunkering operations at a jetty, pier or mooring and around waterside storage tanks. The response will be controlled by the company's or the port's operating procedures in accordance with its own site-specific oil pollution emergency plan. The response will be mounted using company or port authority personnel and company-owned or port-owned (or shared) oil spill combating equipment.

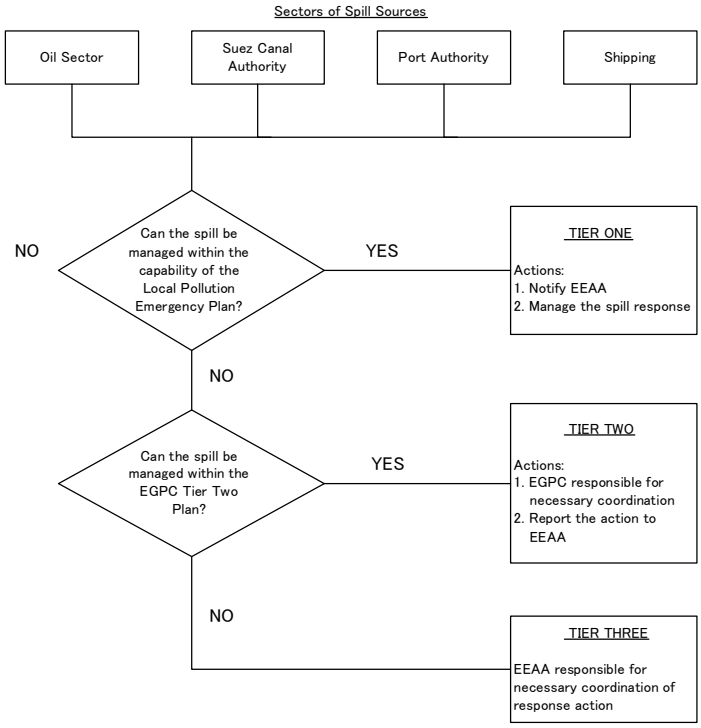

Figure 6-6 Transfer Procedure of Incident Command in Oil Spill Incidents

Tier Two

Tier Two, a medium-scale spill larger than roughly 100 m^3, is concerned with preparedness and response to a spill that requires the coordination of more than one source of combating equipment and personnel (strike teams). Incidents necessitating a Tier Two response would typically be associated with shipping accidents in ports and harbors, or in estuaries or coastal waters, but could also arise from fractured pipelines, tank failures or near shore exploration and production operations.

The concept of Tier Two is that an individual company or port authority has limited control over events (apart from mounting the initial response if the incident occurs within their area of jurisdiction) and the geographical area affected by the spill will necessarily be larger than in a Tier One case. In many cases, public amenities will be threatened.

It is envisaged that two types of contingency plan should be developed to respond to a Tier Two incident:

- Local Contingency Plans describing the detailed planning arrangements needed to respond to an oil spill outside the jurisdiction of a Tier One facility and which could affect a wide geographical area; and
- Sectoral contingency planning arrangements, such as the regional plans for the petroleum sector already developed by the Egyptian General Petroleum Corporation (EGPC).

In principle, EEAA will take responsibility for coordinating the response to a Tier Two incident, although the Agency may delegate its coordinating role to another body. A Tier Two response originating in the petroleum sector will continue to be directed by the EGPC contingency planning arrangements, unless EGPC specifically requests EEAA to act as Incident Commander.

Tier Three

Tier Three is concerned with a major spill in excess of 1,000 m^3, requiring the mobilization of all available national resources and, depending on the circumstances, may involve the mobilization of assistance through sub-regional cooperation agreements with neighboring countries or international assistance from the oil industry's support organization. In most cases the spill of Tier Three will involve a major accident involving a laden oil tanker.

Major oil pollution incidents often become high profile and politically sensitive. EEAA will assume control of any Tier Three incident occurring within Egypt's area of jurisdiction. To assist it in its task, EEAA will convene an Emergency Response Committee to provide relevant assistance and advice.

(6) Operation and Response Centers[1]

Central Operation Room (COR)

The EEAA has established the Central Operations Room (COR) that is manned on a 24-hours basis at EEAA Headquarters in Cairo City. The EEAA has established Internal

[1] : EEAA, "Egypt State of the Environment Report 2004", 2005.

Response Procedures which will be activated in the event of an incident. All reports of oil pollution should be notified to the COR using the standard OILPOL format.

EEAA's functions of overall command in a Tier Two or Tier Three incident will normally be exercised from EEAA's COR. When information is received of a major incident, the COR staff will arrange with the EEAA switchboard for all telephone calls relating to the incident to be transferred to the COR.

Response Centers

Figure 6-7 shows oil response centers in Egypt. The Sharm El Sheikh Center established in 2004 is a regional response center. It is provided with equipment stockpile; oil recovery boat, work boats, barges and other oil removal apparatus.

Egyptian General Petroleum Corporation (EGPC) maintains four centers with stockpile of equipment at Alexandria, Suez, Ras Gharib and Hurghada. Each having boom, skimming equipment, dispersant application units, storage tanks, beach cleaners, landing craft and work boats.

Suez Canal Authority (SCA) also possesses an equipment stockpile, including containment and recovery equipment, dispersants, lightering barges and tugs available for the use outside the Canal.

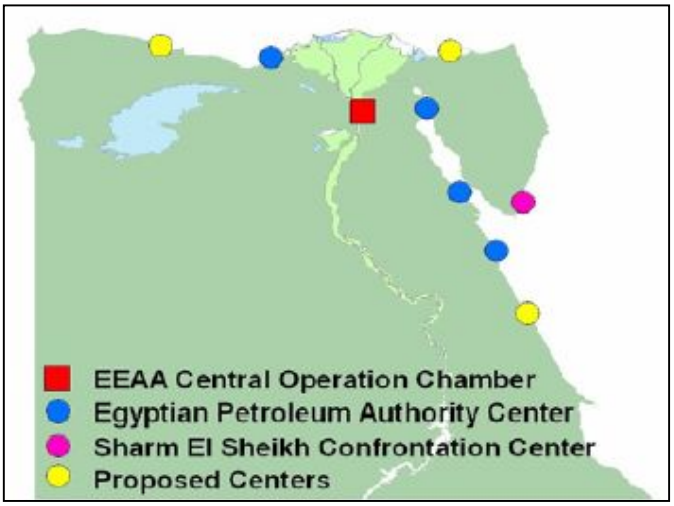

Figure 6-7 Locations of Oil Spill Response Centers

Port Authorities at the four main ports (Damietta, Suez, Port Said and Alexandria) all possesses stocks of specialized equipment in order to provide an immediate response to oil spills from vessels in the harbors.

The role of Suez RBO in responding to oil spills are limited to only site surveys on request from COR of EEAA E/Qs, at present.

(7) Oil Spill Combat Strategy

In the National Oil Spill Contingency Plan (NOSCP), EEAA has established and clarified a series of strategy on how to combat against oil spill and contain it. They are summarized as follows:

Action to terminate or reduce the outflow of oil

The first priority of a ship's captain or the operator of an offshore or onshore oil handling facility must be to terminate the outflow of oil as rapidly as possible. In the case of offshore installations or oil terminals, it is the responsibility of operators:

- To identify the likely sources of oil pollution incidents in their operations and quantify the "most likely" and "worst case" spill scenarios in their Tier One oil pollution emergency plans, and
- To ensure that the most efficient equipment is installed and environmental management systems are in place to minimize the likelihood of incidents occurring and in order to reduce their impact if they do occur.

Monitoring the oil slick where marine or coastal resources are not threatened

If no marine or coastal resources are threatened, the decision may be taken to leave the oil to disperse naturally. This is only an option where vessel-source pollution is involved or an oil slick is observed where the pollution source is unknown. Responsibility for monitoring and coordinating the response to such incidents rests with EEAA.

Mechanical recovery of oil

As a general principle, the mechanical recovery of oil at sea is the most favored response action on the grounds that it causes the least damage to the environment. However, the feasibility of recovering oil by mechanical means will depend on the type and amount of recovery equipment available, weather conditions, the nature of the oil, as well as local conditions.

Application of dispersants

Natural dispersion is a slow process and cannot be relied upon to remove the threat from large oil slicks. The process can, however, be accelerated by the addition of certain chemicals (dispersants) to the oil.

Because dispersing oil plumes are hazardous to marine life, and dispersants can themselves damage marine organisms if not used appropriately, the use of dispersants will be strictly controlled by EEAA under the NOSCP. The approved policy governing the use of dispersants in Egyptian waters is set in the NOSCP and prior approval will have to be obtained from EEAA for their use either as a "standing approval" issued to a port authority or operator or on a case by case basis.

Protection of sensitive areas

The ranking system of ecological sensitivity will be used as the basis for identifying appropriate protection strategies, including the provision of adequate and appropriate equipment and trained personnel.

Shoreline clean-up

The priority of the national combat strategy is to deal with the oil at sea, preferably by mechanical recovery means but, where appropriate, by the use of chemical dispersants. Nevertheless, it is inevitable that in many cases oil spills will reach the shore. In such cases, it is highly desirable to minimize the amount of oil that reaches the shore and to limit the area of coastline affected. The sensitivity mapping survey has also classified the Egyptian coastline according to its beach characteristics and has noted information such as shoreline access points.

Responsibility for dealing with oil pollution when it reaches the shoreline will rest primarily with EEAA, assisted by the coastal governorates. The basis for EEAA's leading role is the Agency's overall responsibility for protection of the environment, its responsibility for and access to the Environmental Protection Fund, and its authority to mobilize the necessary clean-up resources.

6.5.2 Other Contingency Plans for Oil Spill

Complementing the NOSCP, the Oil Spill Contingency of Egyptian Petroleum Industry has been established. This plan provides for a response strategy to oil spills from exploration and production facilities and from transshipment activities at terminals. The responsibility for oil spills from these sources rests with the Ministry of Petroleum that, in practice, delegates this duty to Egyptian General Petroleum Corporation (EGPC).

Suez Canal Authority has drawn up the contingency plan to respond to oil spills within the Canal, also.

Red Sea Port Authority has a contingency plan and has set up a committee for responding to oil spill incidents which possibly happen in the vicinity areas of ports under its jurisdiction. The committee comprises representatives from Red Sea Port Authority, the oil spill combating center, Suez RBO, EMUs of concerned governorates and Port Police. In the event of oil spill incidents, this committee supervises a series of response activities comprising inspection, actual combat at the site, chemical analysis and estimation of the damage.

Regional Oil Spill Contingency Plan (ROSCP) covering Gulf Region has not been developed yet.

6.5.3 Response Experiences for Oil Spill Incidents

The Gulf Region has suffered from numbers of oil spill incidents of various types and scales over the past decades. **Annex 1** outlines the situation of oil spill incidents of a total of 122 which happed in the Gulf Region over the past 8 years.

The following, as typical cases, describes the situations of oil spill incident and measures undertaken by concerned units in the incidents which happened in the region.

The KRITI SEA Incident

In 1996, the KIRITI SEA spilt approximately 50 tons of crude oil after experiencing steering difficulties in the Suez Canal. Although dispersant was applied and containment and

recovery equipment was deployed, the oil entered shores of the Great Bitter Lake. In this cases, manual shoreline clean-up was undertaken.

ALAGAMY Tanker Collision Incident

In 2003, the ALAGAMY Tanker caused the collision with the SALAM No. 3, affiliated with the Suez Canal Authority in the Gulf of Suez about 58 km from Suez City, resulting into the oil spill of 8 to 20 tons to the sea. The remaining loaded oil was transferred to the other tanker. Red Sea Port Authority responded to this incident and dispersants were used for the oil pollution. Many resort areas (Amigo Resort, Palmera Resort, Sand Beach Resort, etc.) and beaches were affected by drifting oil slicks and they were removed mechanically.

The AL SAMIDOON Incident

In 2004, the AL SAMIDOON incident arose from grounding in the central reaches of the Suez Canal. Approximately 9,000 tons of Kuwait Medium Crude was spilled. The response was handled entirely by the Suez Canal Authority, initially by the application of dispersants. As the oil moved to the north along the Canal, the efforts were made to recover oil using booms and skimmers. The slicks migrated to the north where they appeared in the Mediterranean Sea as sheens and tar-balls.

CHAPTER 7
TECHNOLOGIES OF OIL FINGERPRINT ANALYSIS

7.1 General

Fingerprint Analysis is positioned at a central technology in the Identification System of Spilled Oil Sources (ISOS) for identifying the sources of spilled oils. In the measures for oil pollution issues, the significances of fingerprint analysis may be described as below:

- The fingerprint analysis, an analytical tool for identifying a spilled oil source, can provide the scientific evidence in legal cases to identify the polluter responsible for a certain oil spill incident; and
- Reliable identification system of spilled oil sources applying fingerprint analysis raises deterrent effects for the occurrence of oil spill incidents.

Throughout the world, diverse methodologies of fingerprint analysis have been applied, but an internationally unified methodology has been not in place as of today. Respective countries have studied and established their own methodologies appropriate for their purposes and their respective conditions like: circumstances of oil pollutions, required regulatory levels, and their achieved technological standards and the like.

Given diverse methodologies now being used in the world, a certain methodology of fingerprint analysis which meets policy, strategy and technical levels of oil spill prevention in Gulf Region should be concerted in the Program to establish the ISOS for addressing oil pollution in the region.

As such, the objectives of this chapter are:

- To review and extract the differences among the existing technologies of fingerprint analysis in the world; and
- To pick up issues that should be discussed in the Program to establish the methodology of fingerprint analysis appropriate for Gulf Region.

7.2 Basic Method of Fingerprint Analysis

7.2.1 Overview

Oils and oil products are mainly comprised of various hydrocarbons with small part of contents of inorganic constituents. It is widely known that the composition features of oils and oil products are depending on production fields and they have their own specific figures. Based on this fact, the source of certain spilled oil in the incident can be identified by knowing chemical compositions of oils.

In actual oil spill to the environment, some oil components can be changed in the composition rate due to the effect of physical, chemical and biochemical phenomena. This alteration is called weathering. Therefore, actual identification by fingerprint analysis is carried out, taking into account of the alteration likely caused by weathering.

7.2.2 Analytical Parameters and Equipment

Numbers of analytical parameters are measured for identifying oils in the world. Representative analytical parameters and the equipment used for measurement are described hereunder.

Saturated hydrocarbons

Saturated hydrocarbons (mainly occupied by n-alkane hydrocarbons) are measured by gas chromatograph with flame ionization detector (GC/FID). The measurement by GC/FID provides the chromatogram pattern of n-alkanes which are used for judging the similarity between spilled oils and suspected source oils. Selected iroprenoid (pristane and phytane) are also measured by GC/FID. These isoprenoids are hydrocarbons which may be used for the similarity judgment, because these compositions are relatively resistant to weathering.

Polycyclic aromatic hydrocarbons (PAHs)

Generally, polycyclic aromatic hydrocarbons (PAHs) like petroleum specific alkylated homologues of PAHs are resistant to weathering. Therefore, some PAHs are measured by GC/MS or by GC/FID after the fractionation of an oil sample.

Biomarker compounds

Biomarkers compound, including terpanes and steranes are environmentally persistent. Thus, the measurement results of these biomarkers by GC/MS (mass spectrometer) are often used for determining pollution sources.

High-molecular hydrocarbons

Though GC/FID can measure hydrocarbons with wide boiling range, the measurement range is limited to almost less than C_{40} hydrocarbons (or molecular weight 500). Therefore, lubricating oils which contain hydrocarbons more than C_{40} are measured by HPLC (high-performance liquid chromatograph) and the distribution patterns obtained are used for determining pollution sources.

Spectra of infrared ray and fluorescence

Spectra of infrared ray with the range of 4000 to 600 cm^{-1} by means of FTIR (furrier transform infrared spectrometer) are used for determining pollution sources. Also, spectra of fluorescence with range of 280 to 500 nm by means of FL (fluorescence spectrometer) are employed in pollution sources identification.

Sulfur content

The contents of sulfur combined with hydrocarbons are peculiar to oils produced in certain fields and are persistent to weathering in the environment. Thus, the sulfur contents measured by GC/FPD (flame photometric detector) are often used as a one of useful indicators for identifying pollution sources in several countries.

Nickel and Vanadium

The content ratio of nickel (Ni) and vanadium (V) is a useful index tool for pollution source identification. Ni and V are determined by means of AAS (atomic adsorption spectroscopy), after adequate digestion treatment.

Besides the parameters mentioned above, physical properties of oils like kinetic viscosity, refraction index and density are often measured. However, these physical properties are , in many cases, employed mainly for the purpose of clarifying basic characters of oils, rather than determining pollution sources.

As mentioned above, numbers of parameters measured by various analytical equipment are used for pollution source identification in the worlds. **Table 7-1** gathers analytical parameters seen in standards of representative countries and their significances in pollution source identification.

Table 7-1 Analytical Parameters and Their Significances

Items	Methods	Significances	Sources
Hydrocarbons	Gas chromatogram (GC-FID)	• The matching of oil samples is a profiling technique based on the premise that identical oils give identical chromatograms. Normally the matching of a spilled oil to suspect oils can be accomplished by comparison of the chromatograms for each of the oils in an oil spill incident.	From ASTM
		• The GC-FID curve shows a typical separation with features of a homologous series of normal paraffins, the isoprenoid hydrocarbons pristine and phytane, the unresolved envelop and other resolved peaks. All of these features are used to characterize an oil.	From ASTM
		• When an oil is spilled on open water, or a relatively small amount of oil is widely dispersed in an area such as a bilge tank, weathering will progress rapidly. A thin slick on open water may lose significant amounts of its components up to n-C_{15} (271℃ atmospheric boiling point) within 48 hrs of being spilled. It is important to be cognizant of the effects of weathering when analyzing spill samples more than a few hours old. It is advisable to compare only those portions of chromatograms above pentadecane in the boiling point, in order to minimize the difference resulting from changes due to weathering.	From ASTM
		• Light distillate fuels cannot survive heavy weathering and have few hydrocarbons above C_{15}. Comparison of the residues of these oils can only be done qualitatively from about C_8 to C_{15}.	From ASTM
		• Normally a direct comparison of chromatograms, considering the features enumerated above, will suffice for establishing identity or nonidentity	From ASTM

Items	Methods	Significances	Sources
		between samples. The comparison involves a peak-for-peak matching, noting differences or similarities in relative peak size. If the chromatograms are the same on the basis of peak-for-peak matching, there is a high degree of probability that the samples are from the same sources. A mismatch is obtained when the curve are different. The differences may be due to the presence of one or more components in one sample relative to another or consistent differences in relative intensities of peak response, or both. Spill samples may contain components such as bilge cleaning detergents, plastics, paint vehicles, etc. The presence of one or two components in a spill sample, which are absent in a suspect, is not an absolute indication of nonidentity.	
		• In general, n-paraffins with the carbon number of less than 15 disappear after days pass. The rate of disappearing in higher-boiling and higher-viscosity oils is smaller.	From JCG
		• Hydrocarbons with carbon numbers of more than 18 shows no significant change over times in weathering test.	From JCG
		• One of the critical steps in the identification procedure is to decide whether or not a given change is caused by weathering. In this respect, the principles outlined in the following are useful. Oil is often divided into: - Saturated hydrocarbons (straight chains, branched chains, cyclic compounds), - Unsaturated (aromatic) hydrocarbons, and - Asphaltenes. In this method components from all groups, except for the asphaltenes, are used. The groups represent components with different chemical properties, and will be affected by weathering to a varying degree. Weathering can be subdivided into the following main processes:	From NORDTEST

Items	Methods	Significances	Sources
		- Evaporation, - Dissolution, - Biodegradation, - Chemical alteration (e.g. oxidation, photo-oxidation, polymerization), and - Contamination.	
	Gas chromatogram (GC-MS)	• A mass spectrometer (MS) which be used in the same gas chromatographic (GC) separation can analyzes more detail description of the oil, like some specially selected hydrocarbons and hetero compounds.	From NORDTEST
		• GC-MS analysis measures 29 isomer intervals for selected component types. Each of these intervals functions as a "fingerprint" of the sample and, apart from changes due to weathering and analytical inaccuracy, the plots should show exactly the same pattern if the oils are identical.	From NORDTEST
		• Evaluation of the isomer patterns may be performed as a peak-for-peak comparison or using multivariate statistical analysis or similar techniques.	From NORDTEST
Spectra by infrared ray (FTIR)		• In the spectra by IR, oil identification is based on a peak-for-peak comparison of the IR spectra of sample oils. A light-box is convenient for superimposing these spectra. When the results are to be used for forensic purpose, comparisons must be made on spectra obtained by using the same sample preparation, sample cell, and the same instrumental conditions, preferably with the same operator on the same day.	From ASTM
		• Resins separated from oils show almost no change in IR absorption range over time, thereby defining the IR spectra a useful tool for identifying oil.	From JCG
Spectra by fluorescence (FL)		• FL spectra test is useful for rapid identification of waterborne petro oil samples as well as oil samples obtained from fuel or storage tanks, or from sand, vegetation, or other substrates. This test is applicable to weathered and unweathered neat oil samples.	From ASTM
		• The unknown oil is identified through the comparison of the fluorescence spectrum of the oil with the spectra (obtained at	From ASTM

Items	Methods	Significances	Sources
		similar instrumental settings on the same instrument) of possible source samples. A match of the entire spectrum between the unknown and possible source sample indicates a common source.	
		• The FL spectrum will be distorted if an oil sample has been contaminated by an appreciable amount, for example, 1 % of common chemical impurities such as other oils that are fluorescent on excitation at 254 nm.	From ASTM
		• Fluorescent rates at 385 nm / 440 nm and their ratio by the excitation at 340 nm are almost inconsistent with oils.	From JCG
Elements in Oils	Nitrogen (N)	• It has been known that oils, whatever they are crude oils, product oils, have inherent nitrogen contents. In a series of experiments, the nitrogen contents of oils are proved to be little changed over time without receiving weathering effects. Therefore, the nitrogen content of oils may be useful for oil identification.	From JCG
	Sulfur (S)	• It has been known that oils, whatever they are crude oils, product oils, have inherent sulfur contents. In a series of experiments, the sulfur contents of oils are proved to be little changed over time without receiving weathering effects. Therefore, the sulfur content of oils may be useful for oil identification.	From JCG
	Nickel (Ni), Vanadium (V) and Rate (Ni/V)	• It has been known that oils, whatever they are crude oils, product oils, have inherent nickel and vanadium contents. In a series of experiments, the nickel and vanadium contents of oils are proved to be little changed over time without receiving weathering effects. Therefore, the nickel /vanadium contents and rate (Ni/V) of oils may be useful for oil identification.	From JCG
Physical characteristics	Kinetic viscosity	• The values of kinetic viscosity treated by dichloromethane solvent (at 60 ℃) have shown almost constant over time in weathering test. Because oils have inherent values kinetic viscosity, they may be useful for oil identification.	From JCG
	Refraction index	• Refraction rates have tended to increase at a small rate over time in weathering test. If the increases are taken into account, refraction rates may be useful	From JCG

Items	Methods	Significances	Sources
		for oil identification, since oils have inherent refraction rates.	
	Pour point	• Pour points of oils have shown the increase over time in weathering test. This measurement requires a special care for pretreatment. Therefore, pour points may be used only for auxiliary measures in oil identification.	From JCG

7.2.3 Weathering Effects

(1) Overview

One of the critical steps in the identification procedure is to decide whether or not a given change of spilled oils' characters is caused by weathering. Weathering can be subdivided into the following main processes.

- Evaporation
- Dissolution
- Biodegradation
- Chemical alteration (e.g. oxidation, photo-oxidation, polymerization)
- Contamination

(2) Evaporation

Evaporation removes components from the low-boiling range in all groups. This can be seen as a front-end bias in both the GC/FID chromatograms and in some of the GC/MS fragment grams.

Figure 7-1 shows the front-end bias caused by evaporation measured by GC/FID. If a change is caused by evaporation, the following two criteria must be fulfilled:

- The concentration of low-boiling compounds is lower in the spill sample than in the sample taken from a suspected source.
- In the case of compounds with otherwise similar weathering characteristics, the decrease in concentration is always more pronounced in those compounds with lower boiling points.

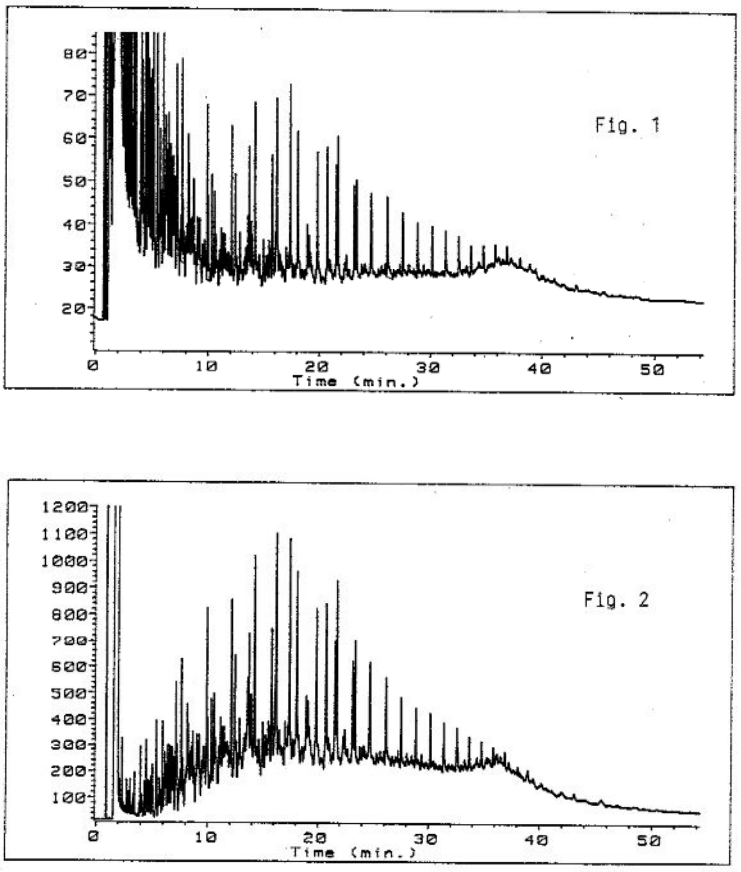

Figure 7-1 Weathering Alteration Caused by Evaporation

(3) Dissolution

Dissolution will remove components according to their solubility in water, as follows:

hetero compounds > aromatic hydrocarbons > saturated hydrocarbons

Within a homologous series, higher substitution will reduce the water solubility, e.g. as follows:

phenanthrene > C1-phenanthrene > C2-phenanthrene > C3-phenanthrene

Dissolution will primarily attack the hetero compounds and the low-substituted aromatics, and only to a very low degree the saturated hydrocarbons. In this method, dissolution should be considered for naphthalenes, phenanthrenes and benzothiophenes, but may be ignored for other compounds. As for evaporation, the possibility of dissolution should be confirmed by a comparison of the change of components within the same homologous series with higher and/or lower water solubility.

The upper figure of **Figure 7-2** shows the original oil, while the lower shows the spill 14 months after the spillage. The relative decrease in concentrations of the low-boiling components is due to the combined effects of evaporation and dissolution.

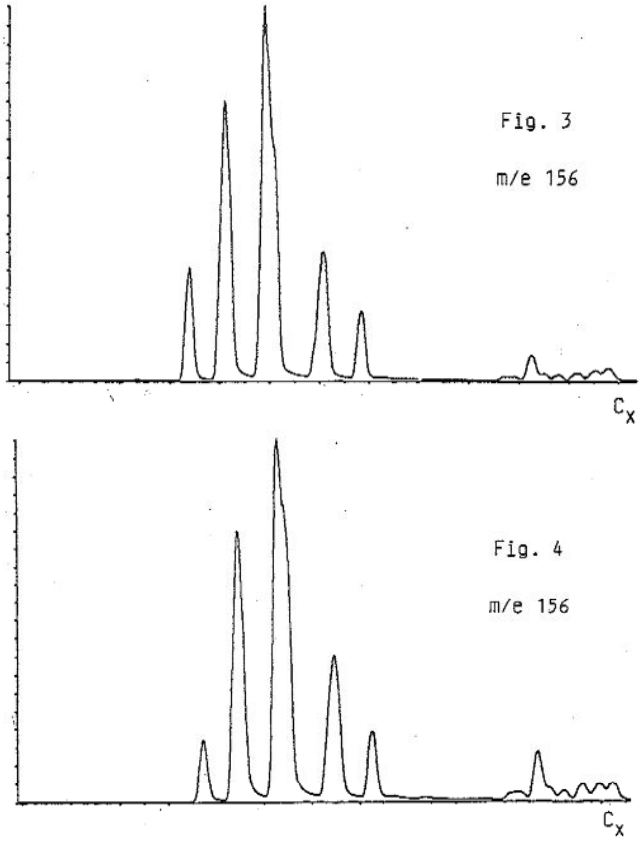

Figure 7-2 Weathering Alteration Caused by Dissolution

(4) Biodegradation

Biodegradation primarily removes the straight-chain hydrocarbons, and in later stages the branched saturated hydrocarbons. Saturated cyclic hydrocarbons are extremely resistant to biodegradation.

Figure 7-3 shows mass 183 of the original oil, while Figure 6 shows the same ion measured on a spill sample taken 14 months after the spillage. Biodegradation has partly removed the n-alkanes and thus caused a relative increase of the branched and cyclic hydrocarbons. Both the unresolved hump and the fine structure between the n-alkanes predominate much more in the spill sample. The 3 predominant components in the light end are norpristane (n-pr), pristane (pr) and phytane (ph). Ion 183 is particularly suitable for examining biodegradation.

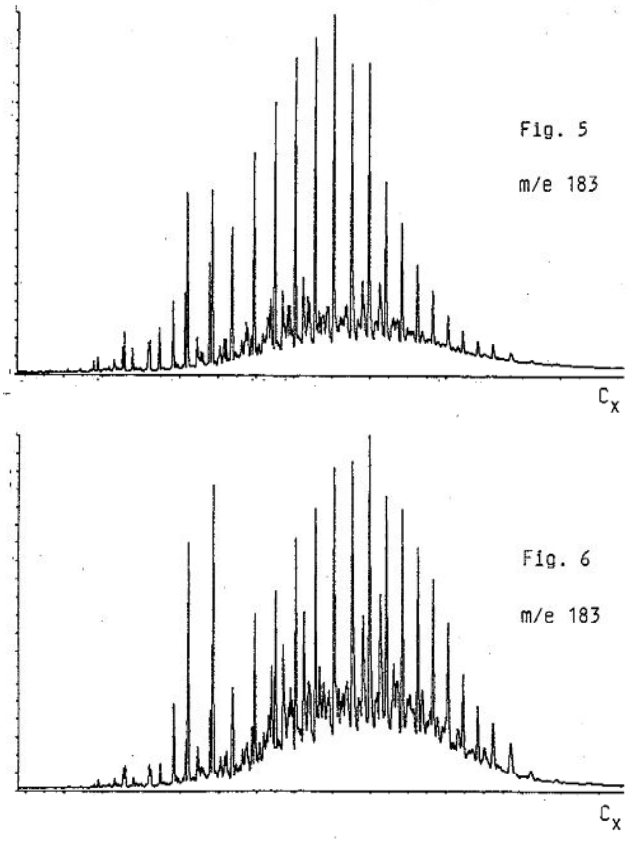

Figure 7-3 Weathering Alteration Caused by Biodegradation

(5) Chemical Alteration

Most of the components used in this method have very limited chemical reactivity. In addition, the GC/MS technique measures oil-specific components, which means that the possible reaction products are very unlikely to interfere. Experiments indicate that chemical alterations are of minor importance in identification by the present method.

(6) Contamination

Contrary to most other weathering processes, contamination adds components to the oil. Most contaminants appear only in the GC screening, and will not interfere with the GC/MS identification. Contaminants and additives used in petroleum products can be distinguished from oil components by their irregular pattern. If an oil component contains one n-alkyl side chain, the oil will always contain similar components with n-1, n-2, etc. side chains, distributed in a regular manner. Such a distribution is not normal in non-petroleum materials. Components with weak bonds are very uncommon in oils, and are normally due to additives or contaminants.

7.3 Protocol of Fingerprint Analysis Applied in the World

7.3.1 Overview

Countries in the world have concerted and applied various methodologies of fingerprint analysis for identifying spilled oil sources. A certain methodology unified internationally has not been in place as of today. It is conceived that this is because causes of oil spills, situation of pollutions sources, legal prescriptions for pollution, etc. are dependent on countries.

In this Study, the following three methodologies being currently used in representative countries are reviewed and discussed, aiming to extract necessary discussion points for the setup of fingerprint methodology appropriate for Gulf Region:

- ASTM (USA, D3415-90)
- Revised NORDTEST (Finland)
- Japan Coast Guard (JCG) Protocol

7.3.2 ASTM

The ASTM D 3415-98 is the latest version for prescribing the standard method for identification of waterborn oils. ASTM prescribes a series of standard methods associated with the analysis for pollution source identification, as follows:

D 3325:	Practice for preservation of waterborn oil samples
D 3326:	Practice for preparation of samples for identification of waterborn oils
D 3328:	Test methods for comparison of waterborn petroleum oils by gas chromatography
D 3414:	Test method for comparison of waterborn petroleum oils by infrared spectroscopy
D3415-98:	Standard practice for identification of waterborn oils
D 3650:	Test method for comparison of waterborn petroleum oils by fluorescence analysis
D 4489:	Practices for sampling of waterborn oils
D 4840:	Guide for sampling chain of custody procedures
D 5037:	Test method for comparison of waterborn petroleum oils by high performance liquid chromatography
D 5739:	Practice for oil spill source identification by gas chromatography and positive ion electron impact low resolution mass spectrometry

The standard practice of ASTM (D 3415-98) describes that the identification should be conducted through preliminary and final analysis. However, unlike the old version (D 3415-90), the ASTM D 3415-98 does not represent an analytical scheme to be applied and evaluation methods of analytical results, specifically.

According to ASTM D 3415-98, preliminary analysis is conducted by means of GC/FID and FPD, FT-IR and FL. This analysis provides the information as to the source of spilled oils, its carbon-number range and resemblance to suspected source oils. If spilled oils are weathered, final analysis should take place by means of GC/MS. In the final analysis, the similarity is determined to check mainly specific biomarkers.

For example, ASTM D 3328-00 represents the following notions regarding the interpretation of analytical results obtained from gas chromatography:

Basis of matching:	The matching of oil samples is essentially a profiling technique based on the premise that identical oils give identical chromatograms. Normally, the matching of a spilled oil to a suspect oil can be accomplished by comparison of the chromatograms for each of the oils in a spill case.
Chromatogram features:	The FID curve shows a typical separation with the features of a homologous series of normal paraffins, the isoprenoid hydrocarbons pristane and phytane, the unresolved envelope and other resolved peaks. All of these features are used to characterize an oil. Meanwhile, the FPD chromatogram has fewer readily ascribed characteristics; it gives the overall sulfur profile generated by the detector. It is useful not only qualitatively, but semi-quantitatively.
Weathering effects:	When an oil is spilled on open water, or a relatively small amount of oil is widely dispersed in an area such as a bilge tank, weathering will progress rapidly. A thin slick on open water may lose significant amounts of its components up to n-C_{15} (271°C atmospheric boiling point) within 48 h of being spilled. It is important to be cognizant of the effects of weathering when analyzing spill samples more than a few hours old. It is advisable to compare only those portions of chromatograms boiling above pentadecane in order to minimize the difference resulting from changes due to weathering. Light distillate fuels cannot survive heavy weathering and have few hydrocarbons above C_{15}. Comparison of the residues of these oils can only be done qualitatively—from about C_8–C_{15}.
Comparison of chromatograms:	Normally a direct comparison of chromatograms, considering the features enumerated above, will suffice for establishing identity or nonidentity between samples. The comparison involves a peak-for-peak matching, noting differences or similarities in relative peak size. If the chromatograms are the same on the basis of peak-for-peak matching, there is a high degree of probability that the samples are from the same source. A mismatch is obtained when the curves are different. The differences may be due to the presence of one or more components in one sample relative to another or consistent differences in relative intensities of peak responses, or both. Spill samples may contain components such as bilge cleaning detergents, plasticizers, paint vehicles, etc. The presence of one or two components in a spill sample, which are absent in a

suspect, is not an absolute indication of nonidentity.

Additional interpretation of capillary chromatographs is based on fine structure, the pattern of many small peaks resolved, or partially resolved, in addition of n-alkanes and isoprenoids. This structure, referred to as "grass," is reproducible and reveals differences among oils that are more resistant to weathering.

Similarity judgment and reporting:

Based upon the visual comparison of chromatograms, the results of the comparison of the spill sample and the sample of unknown origin are reported along with one of the categories below:

Match (M): Like the sample submitted for comparison, that is, the chromatographic patterns are virtual overlays.

Probable Match (PM): The chromatographic pattern is similar to that of the samples submitted for comparison, except: (a) for changes which could be attributed to weathering (specific low molecular weight peak losses), or (b) differences attributable to specific contamination.

Indeterminate (I): The chromatographic pattern is somewhat similar to that of the sample submitted for comparison, except for certain differences in such magnitude that it is impossible to ascertain whether the unknown is the same oil heavily weathered, or a totally different oil.

Non-match (NM): Unlike the samples submitted for comparison.

7.3.3 NORDTEST

The revision of the NORDTEST method has been issued as the result of extensive literature studies and experience among the NORDTEST Project Team. The recommended analytical methodology has been tested and verified in a round robin study, where 12 different laboratories from 10 countries participated. The round robin test demonstrated the potential of this methodology as a strong technically defensible tool in oil spill identification. The protocol recommended includes the following three (3) tiered levels of analysis and data treatment:

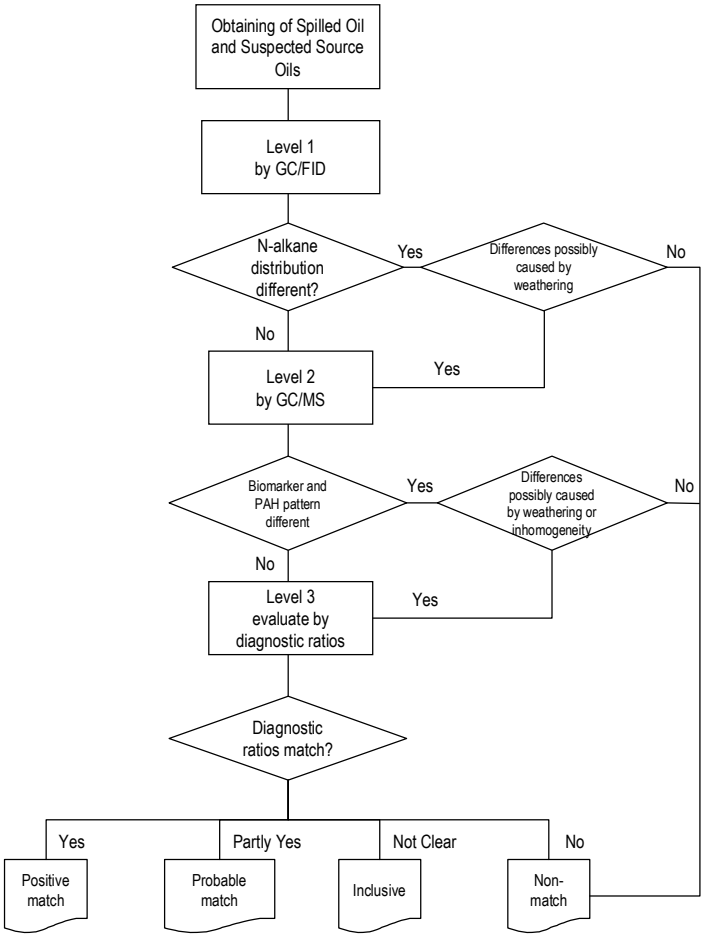

Figure 7-4 Revised Protocol of NORDTEST

Level 1

After sample preparation, the chemical fingerprint analysis in the laboratory starts with gas chromatography (GC/FID) screening on all samples (i.e., both spilled oils and suspected sources). Results of this screening level analysis forms the basis for:

- Characterizing the oil spill sample(s) by obtaining the overall boiling range of the spilled oil (i.e., total distribution of hydrocarbons including n-alkanes $C_{10} - C_{40}$).
- Establishing selected acylic isoprenoid indices readily determined using GC/FID.
- Establishing a "Weathering Check" (self-normalizing to a non-weathered or weathering resistant compound).

At this level of the investigation, the spill samples can be qualitatively and quantitatively compared to the suspected sources, and obviously "non-matched" samples can be ruled out and eliminated from additional levels of analysis.

Level 2

The next analytical level is analysis of spill and candidate source samples using gas chromatography combined with mass spectrometry operated in the selected ion monitoring mode (GC/MS-SIM). This analysis is useful for determining the content and distributions of a suite of petroleum biomarkers and polycyclic aromatic hydrocarbons (PAHs) target analytes. These semi-quantitative data form the basis for:

- Generating a suite of calculated diagnostic rations based on selected PAHs.
- Generating a suite of calculated diagnostic ratios for selected biomarkers (hopanes and other triterpanes, regular steranes and diasteranes and triaromatic steroids).
- Establishing "weathering check" from a suite of selected PAHs groups.

Level 3

At Level 3, more precise assessments with diagnostic ratios take place, as follows:

- Assess the impact of weathering (based on weathering check data of n-alkanes from Level 1 and eventual semi-quantitative distribution of PAHs group from Level 2).
- Evaluate and eliminate those diagnostic rations exhibiting considerable variability due to analytical variance and samples inhomogeneities.
- Correlation studies using results from triplicate analyses used to calculate the analytical relative standard deviation followed by the selection of more robust diagnostic ratios.

The results and the overall conclusions should be reported for the combined results of the test methodology used. For each level, results are specified as "Positive Match", "Probable Match", "Inconclusive" and "Non-Match". These categories represent degrees of differences between the analyses of two oils according to the present criteria, as follows:

Positive Match:	The chromatographic patterns of the spill sample submitted for comparison are virtual identical and the only observed differences between the spill sample and the suspected source are caused by acceptable analytical variance and/or weathering.
Probable Match:	The chromatographic patterns of the spill sample are similar to that of the sample submitted for comparison, except for: i) obvious changes which could be attributed to weathering (e.g. loss of lower-molecular-weight peaks, wax redistribution, etc.), or, ii) differences attributable to specific contamination.
Inconclusive:	The chromatographic patterns of the spill samples are somewhat similar to that of the samples submitted for comparison, except for certain differences of such magnitude that is impossible to ascertain whether the unknown is the same or a totally different oil. These differences may be due to e.g. heterogeneityies of the oil quality either within the spill or within the suspected source (e.g. within the ship tank), that is not reflected in the available samples analyzed.
Non-Match	Unlike the samples submitted for comparison.

In the event of "Non-Match", it is possible to stop the analytical procedures as soon as significant differences (not attributable to weathering) are confirmed. This will save time and resources in cases where the suspected source cannot be responsible for the pollution. Otherwise, the further "Level" in the process will provide more extensive, specific and conclusive documentation.

Final conclusions must be made based on a total evaluation using all available data, including the samples features.

When this identification system is used, all samples requiring comparison should be run on the same instrument, preferably in the same instrumental batch, using the same instrumental parameters, columns and, if possible, batches of solvents or other chemicals. Analysis of reference oil and/or replicate samples may be used to assess analytical variability.

7.3.4 JCG (Japan Coast Guard)

The JCC has not issued a protocol for fingerprint analysis in the form of written documents. However it has established the standard method that is practically employed to identify oil polluters in Japan. The JCG has carried out massive and comprehensive research and development to produce their standard method in 1975 to 1977, and has updated afterward, introducing more advanced analytical measurement, as follows:

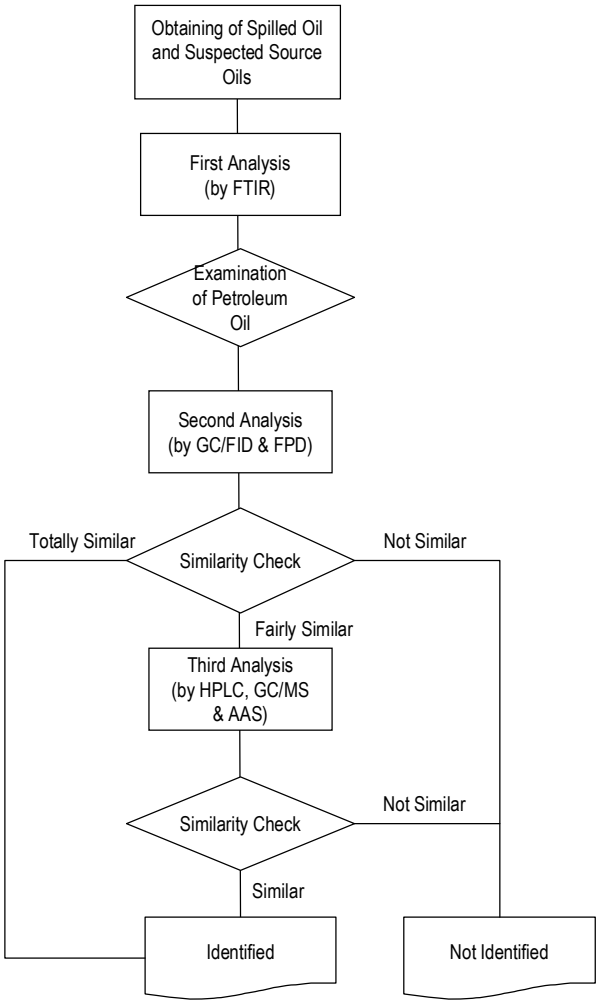

Figure 7-5 Protocol of JCG Fingerprint Analysis

First Analysis

A spilled oil sample is taken from the site of the oil spill incident. Meanwhile, suspected source oil samples are taken from suspected oil sources, which are selected based on circumstance conditions like the location of the incident site and the possible time of

incidents. The first analysis is performed by means of FT-IR, thereby resulting into the decision on whether spilled oils are mineral, vegetable or animal.

As a pretreatment method of oils in JCG analysis, there are basically two ways. One is a method whereby an appropriate solvent (such as n-hexane) is used to extract oil contents, and another a method whereby impurities are removed by centrifugal separation. These methods are selected depending on the conditions of samples and the type of analysis apparatus to be used.

Second Analysis

Following the first analysis, the second analysis takes place by using of GC/FID and FPD. In the measurement by GC/FID, the similarity is checked based the distribution pattern of saturated hydrocarbons (including pristane and phytane concentration, in some cases). This second analysis includes the measurement of sulfur contents by means of GC/FPD, when the chromatogram of saturated hydrocarbons does not present clear pictures for similarity judgment between spilled and suspected source oils.

Third Analysis

When the conclusion is not attained in the second analysis, the third analysis is performed by means of more sophisticated analytical instruments, like GC/MS, HPLC and IPC (Inductively Coupled Plasma Emission Spectroscopy).

GC/MS is employed to measure some biomarkers which can give a clear evidence for identifying pollution sources. HPLC is regarded to be especially a useful tool for the measurement of oils which are predominated by hydrocarbon components with more that C_{40}, like lubricating oils. IPC is used for the measurement of nickel (Ni) and vanadium (V).

7.4 Limitation of Fingerprint Analysis

One of objectives of WG2 is to establish the Identification System of Oil Pollution System (ISOS) suitable for Gulf Region, employing fingerprint analysis technology. To do so, it must be recognized by everybody concerned that we should be well informed with the truth of fingerprint technology and, at the same time, its limitations, as described below:

Complexity of chemical compositions of oils

While oil from one crude oil field is readily distinguish from another, differences in the lot of oils from same crude oil field can often be observed as well. Meanwhile, refined oils are fractions from crude oil stocks, usually derived from distillation processes. Two refined oils of the same type differs each other, because of dissimilarities in the characteristics of their crude oil feed stocks as well as variations in refinery processes and any subsequent contact with other oils mixed in during transfer operations from residues in tanks, ships, etc. Thus all crude oils and product oils, to some extent, have chemical compositions different from each other.

Alteration by weathering and data interpretation

Data interpretation in spilled oil source identification by means of fingerprint analysis is not straight forward. It is fundamentally different from that of quantitative chemical analyses, and, rather, it involves a qualitative comparison of “fingerprints.”

The primary difference arises because of a complication brought about by the chemical alteration of spilled oils. From the moment oil enters the environment, evaporation, dissolution, photo-chemical oxidation, biodegradation and other process begin to alter the oil's characteristics or "fingerprint." The combined effects of these processes are termed weathering, and can significantly complicate data interpretation.

The experienced oil spill analyst is familiar with the complexities of the weathering processes and their impact on the test methods, and is able to distinguish real differences between two oils from those apparent differences resulting from weathering alterations.

Contamination of spilled oils with other oils or chemical substances is another factor which has to be considered carefully. Interference from contaminants can usually be recognized as such and discounted when weighing the test results. However, at times, severe weathering or contamination, or both, can mask most of the inherent similarities between oils. In such cases, comparison of test results may be inconclusive.

Evaluation of similarities

Considering that most suspects of oil polluters tend to try to escape the responsibility, not only one but many similarities (within uncertainties of sample analysis and weathering) will be needed to establish identity beyond a reasonable doubt.

As understood from the above, it should be noted that fingerprint analysis do not satisfy people to try to identify oil polluters, always.

7.5 Data/Information Required for Identifying Pollution Sources

(1) Overview

Based on the review of related references, the Identification System of Spilled Oil Sources (ISOS) is assumed tentatively, as shown in **Figure 7-6**. Data/information necessary for the ISOS are enumerated as below:

(2) Category 1 Data and Information of Pollution Sources

Pollution sources for the data and information belonging to the Category 1 are divided into: moving sources and fixed pollution sources.

Moving Sources

Objectives	Required Data	Method of Data Collection	Data Source (Unit in Charge)
Oil tankers, cargo ships, passenger ships, fishing boats, sport boats, etc.	Name of ships, passing routes, passing dates/times, categories of stored oil, etc.	To refer to the record of passing of ships and vessels	Red Sea Authority and Suez Canal Authority

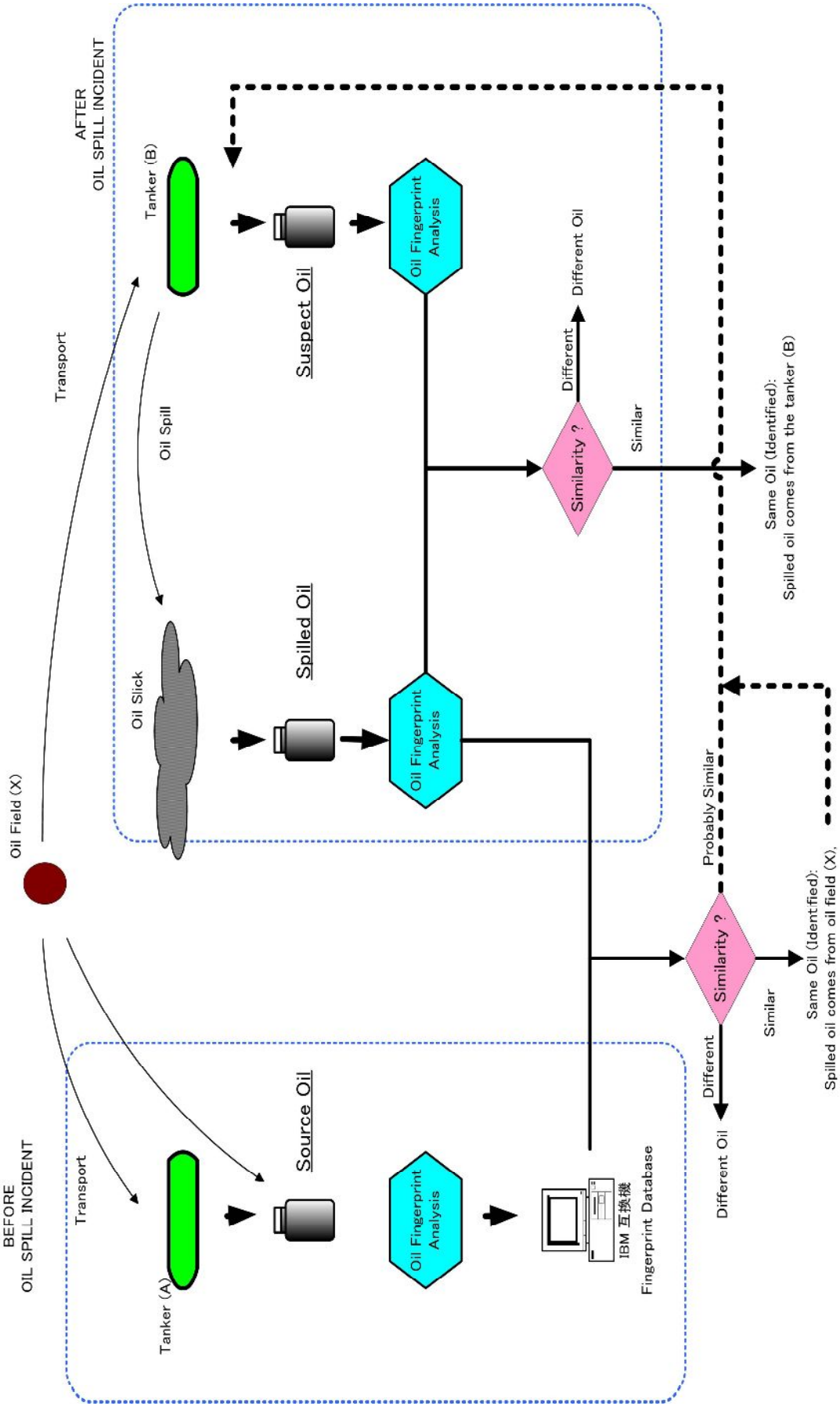

Figure 7-6 Concept of Identification System of Oil

Fixed Pollution Sources

Objectives	Required Data	Method of Data Collection	Data Source (Unit in Charge)
Oil exploitation facilities, oil transport facilities, bunkering facilities, etc.	Categories of oils, locations, oil production rate, oil transfer/handling rate, etc.	To collect existing data through hearing and statistics	Oil Production Sector
Oil refineries and petro-chemical industries, etc.	Categories of oils, locations of industries, locations of effluent outlet, storage volumes, etc.	To collect existing data through hearing, registered record of wastewater discharge, and statistics	EEAA (Suez RBO)

(3) Category 2: Data and Information of Oil Spill Incidents

Objectives	Required Data	Method of Data Collection	Data Source (Unit in Charge)
All oil spill incidents	Locations of incident, Dates/times of incident, scales of oil spill, magnitudes of damage, emergency response taken, etc.	To refer registered record for oil spill incidents.	Red Sea Authority or Suez Canal Authority

(4) Category 3: Fingerprint Data of Source Oils

Objectives	Required Data	Method of Data Collection	Data Source (Unit in Charge)
Fresh oil s of crude oil, heavy oil, light oil, product oils, etc.	GC-chromatogram, IR-spectrogram, refraction rate, density, viscosity, sulfur content, heavy metals, etc.	A series of fingerprint analysis of fresh source oil	EEAA (Suez RBO)
Weathered crude oil, heavy oil, light oil, product oils, etc.	GC-chromatogram, IR-spectrogram, refraction rate, density, viscosity, sulfur content, heavy metals, etc.	A series of fingerprint analysis of weathered source oil with conducting weathering test for 2 to 3 weeks.	EEAA (Suez RBO)

General Directorate of Coastal and Marine Zone Management of EEAA are listed a total of 61 crude oils as source oils. They are produced in Egypt or likely to pass the Egyptian

lands. The database of these crude oils with basic characteristics has been established as shown in **Annex 4**.

(5) Category 4: Fingerprint Data of Spilled Oils

Objectives	Required Data	Method of Data Collection	Data Source (Unit in Charge)
Spilled oil taken at the site of oil spill incidents.	GC-chromatogram, IR-spectrogram, refraction rate, density, viscosity, sulfur content, heavy metals, etc.	A series of fingerprint analysis of spilled oil.	EEAA (Suez RBO)

7.6 Issues to be Discussed

(1) Sample Oils for Analysis

Fingerprint analysis needs two kinds of oils: one is spilled oil sampled at the site of oil spill incident, and the other oils (one sample, at least) are taken from suspected sources (in many cases, several suspected sources are extracted).

As described in the section 7.2, standards/protocol being used in the world requires the following methods concerning the sampling and analysis of suspected source oils:

- Suspected source oils should be sampled from the same lot of the suspected sources as spilled oil (to be thought based on proper circumstantial evidences) after the incident, and
- Suspected source oils should be analyzed in the same analytical works, at the same time when spilled oil is analyzed.

It is, however, suggested by the Egyptian side in the Program that source oils be beforehand collected from possible sources such as tankers, industries, etc., and analyzed beforehand. This idea is based on the assumption that, in case of crude oil, crude oil generated from the same oil field always provides the identical fingerprint data, even though lots of crud oils are not the same. In this procedure, it cannot be denied that the finger prints of both don't match due to the different natures between lots, and contaminations/ alterations during the transportation.

The question is whether different lots of crude oils provide identical fingerprint data, or not. Another question is whether such source oils, which are sampled in the time different from spilled oils provide identical fingerprint data, or not.

This question must be solved to establish adequate ISOS for Suez Region.

(2) Parameters for Measurement

In oil identification, the data indicating the similarity in fingerprint are needed as many as possible in order to prove their same source. However, it must be considered that there is a certain limit in which Suez RBO can manage to conduct analysis, in terms of the provision of analytical equipment and man powers to be mobilized.

The most important in the Program is to create a basic oil identification system in Suez Region, from the standpoint of capacity development, and to continue the expansion of the established system by Suez RBO, itself, in a sustainable way.

From such view, the following parameters for fingerprint analysis are proposed to be dealt as training items in the Program:

- Gas chromatogram (GC/FID)
- Infrared ray (FT-IR) spectra
- Fluorescent (FL) spectra

Besides parameters mentioned above, the measurement of physical properties like density, kinetic viscosity and refractive index are also the subject for technical training. These physical properties are mainly used for referential information for fresh oils.

ANNEX 1

INVENTORY OF OIL SPILL INCIDENTS IN GULF REGION[1]

[1] : The inventory was formed based on the data from General Directorate of Coastal and Marine Zone Management of EEAA, supplemented by other records.

Serial No.	Date of Incidents	Locations of Incidents	Spilled Oil Sources	Reported Spill Sizes	Actions Taken	Legal Procedure
1	1998/1/12	Suez port (Zayteyah Port)	Tanker	3000m x 100m	Dispersant	
2	1998/4/19	28°11'15" N and 33° 26' 45" E	Unknown	500m x 15m	Mechanical	
3	1998/4/19	Island area near Hurghada	Unknown	2 - 3 miles	Nothing	
4	1998/4/25	28° 14.3' N and 33° 49.4 E	Pipeline	3000m x 4000m and 500m x 5m (100 bbl)	Dispersant	
5	1998/5/2	27° 46' 3" N and 33° 39' 05" E	-	No Spill	Nothing	
6	1998/5/18	South of Gubal Island	Unknown	Unknown	-	
7	1998/5/20	Suez Port	-	No Spill	Nothing	
8	1998/5/27	2 miles south of Ras Shuqeir	-	4000m x 20m	-	
9	1998/5/28	Zyteya Port	Unknown	5-6 bbl	-	
10	1998/6/27	Port Tawfik port	-	40m x 3m	Mechanical	
11	1998/9/5	Adabya Port, Suez Port	Ship	4m x 200m	Mechanical	
12	1998/9/10	Wadi Firan - South Sinai	Tanker	70 tons	Dispersant	
13	1998/9/26	Adabeya & Suez Port	Pipeline	Unknown	Nothing	
14	1999/1/3	Lat. 28° 11' 11" N & Long. 33° 28' 55" E	Pipeline	300 bbl	Dispersant	
15	1999/1/5	The area between Gabal Abu Sowair & Hammam Musa	Unknown	Oil Slick hit the beach at the area extend from Gabal Abu Sowair & Hammam Musa	Manual	
16	1999/5/12	Bardawel Lake	Unknown	Unknown	-	
17	1999/5/31	Shuqeir port	Ship	Unknown	Mechanical	
18	1999/7/10	500m from the coast in front of Marsa Alassi, West of Matrouh	-	No oil pollution	-	
19	1999/7/17	SUMED seaport	Ship	Unknown	Mechanical	
20	1999/8/1	Ain Sokhna	Tanker	2,864 bbls	Dispersant	
21	1999/8/9	Platform 14 and 16, Alexandria Seaport	Ship	2m x 100m	Dispersant	
22	1999/8/10	Shamandourat Area, Ain Alsukhna	Unknown	2m x 200m + 2m x 100m	Mechanical	
23	1999/9/12	Safaga	Unknown	Unknown (same size as Salem Express)	Nothing	
24	1999/9/17	Saqalet Al-terazat area	Unknown	0.5m x 20m	Mechanical	
25	1999/9/30	85th Km on the Ain Al-Sukhna road	Pipeline	10m away from road	-	
26	1999/12/1	Ras Shuqeir	Loading facilities	8 bbl	Nothing	
27	2000/2/6	Al Zaafarana, Suez Gulf	Unknown	6miles x 150m	-	
28	2000/9/20	At the end of the wall of Balaim Oil Company, Abu Redees	Unknown	2m3	Mechanical	
29	2000/10/17	Al Adly Camp beach, Abu Redees	Ship	2 bbl	-	
30	2000/11/6	Marsa Feran (harbour) in the Abu Redees Sites	Loading facilities	8-5m2	Dispersant	
31	2000/11/6	Adabeya Seaport	Loading facilities	2m x 200m	-	Yes
32	2001/2/3	Ain Sukhna	Unknown	-	-	
33	2001/2/12	Between Morgan Fields and Golay Fields	Ship	-	-	Yes
34	2001/7/1	Alexandria ports authority	Tanker	2m x 45m	-	Yes

Serial No.	Date of Incidents	Locations of Incidents	Spilled Oil Sources	Reported Spill Sizes	Actions Taken	Legal Procedure
35	2001/7/22	Sadat Beach area, south of Suez city	Pipeline	3000m x 1000m	Mechanical	
36	2001/10/20	Large Gefton Island	Unknown	Oil spots between 30 - 50cm at 5m away from the beach	Manual	
37	2002/3/2	Ras Badran S Sinai	Unknown	35m long oil spot	Manual	
38	2002/4/24	Tor Sinai city, in the area adjacent to Hamam Mousa	Ship	20 - 50cm over the distance of 500m along the beach	Manual	
39	2002/7/17	Ras Ghareb sites	Loading facilities	Separate spots from 2 to 20cm in length and 3500m in length	-	Yes
40	2002/7/22	In front of the Ain Al Sokhna beach	Unknown	Separate spots on the beach of about 0.5m	-	
41	2002/10/8	Dsistinct housing area, south of Safaga	Ship	1000m x 2m perpendicular to the shoreline	-	
42	2003/1/28	Suez Bay in front of SUMED Port	Tanker	About 10m3	-	
43	2003/4/28	Offshore pipeline Shamdoura-4	Pipeline	100 litres crude oil	Dispersant	
44	2003/5/9	From the 22nd to the 85th km (58 km), Suez	Tanker	8 - 20 tons	Dispersant	Yes
45	2003/5/12	Tourist coast of Sokhna Village	Unknown	Unknown	-	
46	2003/5/25	In front of Al Zaafarana site	Unknown	2000m x 300m light diesel oil (oily wastewater from an oil tanker that was being washed)	-	
47	2003/6/9	In front of Ain Al Sokhna hotel	Unknown	2m x 300m	-	
48	2003/7/23	Between the offshore platform 36 and Ras Shuqeir	Pipeline	3/4 miles x 200m	Nothing	
49	2004/1/4	Aldout Reefen area in the Ras Mohamed Protectorate and the Mangrove canal	Unknown	large oil slick and tar balls covering 500 metres	-	
50	2004/1/27	El Gouna, Port Said seaport	Loading facilities	4m x 0.9m	-	Yes
51	2004/2/11	North of Al Tor city, between the old Al Tor seaport and Hamam Mousa	Unknown	100m x 10m	-	
52	2004/2/13	Zayteyat area, Suez	Ship	250m x 7m with a thickness of 5cm	Nothing	
53	2004/3/4	Laguna Area, South Sinai	Unknown	Length 100m x Thickness 1-5cm	Unknown	
54	2004/3/10	North of Balaeim, Abu Redees	Unknown		Unknown	
55	2004/3/23	In front of Tor Sinai airport	Unknown	200m x 1m	-	
56	2004/4/4	Marina beach resort, Doum valley, at the 80th Km mark, Ain Al Sokhna	Unknown	Small oil spots along the beach	-	
57	2004/6/2	Strat of Tiran, South Sinai	Unknown	Length 1mil	Unknown	
58	2004/6/6	Holiday Inn Hotel Beach, Sharm El Sheikh	unknown	Length 20m x Thickness 10cm	Unknown	
59	2004/6/7	Shoab Al Fanadir, Urghada	Unknown	Small oil spots	-	
60	2004/6/8	Palm Beach Hotel, Urghada	Unknown	Smaill oil spots	Manual	
61	2004/6/19	Al Nakheel beach, Ain Al Sokhna	Unknown	1,200m	-	
62	2004/7/12	Elzaeeteat Port	Tanker	Unknown	-	
63	2004/7/15	East of Elareesh Port	Ship	Length 400 m x Thick 15 cm	-	

Serial No.	Date of Incidents	Locations of Incidents	Spilled Oil Sources	Reported Spill Sizes	Actions Taken	Legal Procedure
64	2004/8/6	Adabey seaport	Loading facilities	No oil pollution, but 100 bbl of Butamine dropped on the platform and the seawater	-	
65	2004/9/21	In front of Sun Rise Palacio	Unknown	Sticky oil spots along the beach	Manual	
66	2004/10/4	Ras Shukeir	Pipeline	-	-	
67	2004/10/12	Adjacent to GUPCO field, Gulf of Suez	Oil Platform	Length 2km x Width 5m	-	
68	2004/11/22	SUMED, Ain Al Sokhna	Pipeline	100m x 20m	-	
69	2004/11/27	In the gulf waters, 20m from the beach at Ras Esh area	Pipeline	Slight oil pollution with shiney surface	-	Yes
70	2004/12/14	Navigation route of the Suez Canal ports authority	Tanker	10,000 tons crude oil	-	Yes
71	2004/12/19	Suez seaport	Tanker	100 tons	Dispersant	
72	2005/1/1	July sites, Ras Shuqeir, Red Sea	Unknown	10,000m x 5m	Nothing	
73	2005/1/5	Beach of Samar Palace Hotel, Port Tawfik	Unknown	Along the beach of the hotel	Manual	
74	2005/1/11	Zaiteyat seaport, Red Sea seaports	Unknown	separate areas of 50m, 150m, and 150m in lengths	-	
75	2005/1/23	Ras Sedr area	Unknown	Tar balls spread out over 4000m	Manual	
76	2005/1/27	Ras Gara, Petrobel, S Sinai	Pipeline	Unknown	Mechanical	
77	2005/1/27	GAPCO sites at Ras Shuqeir	Unknown	Unknown	Manual	
78	2005/2/5	North of Damietta, away from the regional waters	Tanker	3m x 500m crude oil	Dispersant	
79	2005/2/13	Infront of Lo'lo'a beach, Ras El Barr	Unknown	2m x 500m	Nothing	
80	2005/2/13	In front of Lawlawh Coast	Unknown	500 m2	Unknown	
81	2005/2/16	Ras Ghareb area	Unknown	500m x 10m	Manual	
82	2005/2/17	Ras Ghareb Area	Unknown	300m x 2m	-	
83	2005/3/21	South West the of the 10th of July platform	Pipeline	19 bbl	Dispersant	
84	2005/3/23	Ras Gara, Abu Redees Barry	Pipeline	200m x 1 - 3m (about 100 bbl crude oil)	-	
85	2005/3/23	Fishery port of Elattaka	Ship		Unknown	
86	2005/3/30	In front El Gouna resort and Palm beach in Urghada	Unknown	Small balls of oil on the beach	Manual	
87	2005/3/31	In front of El Gouna beach	Unknown	Multiple spots along the beach	Manual	
88	2005/4/5	Ras Al Doth, Gulf of Suez	Pipeline	Length 12km	-	
89	2005/4/14	From the Hamam Mousa area (north) to Ras Raya (south), in front of Al Beacon until Al Gebeel resort	Unknown	4000m of many oil spots	Nothing	
90	2005/4/18	Along the length of Mangrof beach in El Gouna resort	Unknown	2000m in length	Manual	
91	2005/4/22	The Sokhna seaport, the eastern platform	Ship	Unknown	-	
92	2005/5/2	From Ras Bekr (north) to Ras El Deb (south)	Unknown	12,000m from the beach	-	
93	2005/5/6	Platform 10 at the Golay site, Ras Shuqeir	Pipeline	7 tons crude oil	-	Yes
94	2005/5/10	Al Sabeel area in S Sinai	Unknown	Multiple oil spots spread over 500m	-	

Serial No.	Date of Incidents	Locations of Incidents	Spilled Oil Sources	Reported Spill Sizes	Actions Taken	Legal Procedure
95	2005/5/23	In front of the Bakr Ras Ghareb station	Unknown	3m x 50m oil slick, and multiple oil spots spread out on the water over 600m	-	
96	2005/6/14	Ras Ghareb area	Unknown	80m x 3m	-	
97	2005/6/21	the 10th of July platform, Suez Gulf	Pipeline	2000m x 150m	Dispersant	
98	2005/7/9	Offshore production platform October Lay, Ras Barr station.	Pipeline	60 bbl	-	
99	2005/7/24	Amigo Resort	Ship	1km2	-	
100	2005/7/27	In front of Fanar Al Sadat	Unknown	1000m x 20m (not confimed)	-	
101	2005/7/29	In front of Portrea resort, Ain El Sokhna	Pipeline	3m x 310m	-	Yes
102	2005/7/30	Touristic harbour, Urghada	Ship	1m x 30m	-	Yes
103	2005/7/30	Western platform of the Ain Al Sokhna seaport	Ship	0.3m x 10m	-	Yes
104	2005/7/31	Moon Beach	Oil Platform	40m x 300m	-	
105	2005/7/31	Beach of Portreah	Pipeline	about 310m	Unknown	
106	2005/8/2	South of Safaga town beach	Unknown	Oil spots spread out over an area of 1m x 300m, brown in colour	Nothing	
107	2005/8/6	Beach of Palmera	Unknown	50m x 300m	Unknown	
108	2005/8/8	Between the Sharqa Tanka production platform and the October platform, Gulf of Suez	Pipeline	5mile x 40m	Dispersant	
109	2005/8/11	South of Eltour City	Oil Platform	-	-	
110	2005/8/15	In front of the Portrea resort, Ain Al sukhna in front of the General Trade and Chemicals Company.	Pipeline	110m	-	
111	2005/8/21	In front of Shedwan reesort, Red sea	Ship	Unknown	Manual	
112	2005/9/18	Near platform 2, Ras Ghareb	Pipeline	7 Bbl	Manual	
113	2005/9/19	In front of Movenpick beach, El Gouna	Tanker	Multiple oil spots along the shoreline with sizes varying between 0.20 - 0.15m	-	
114	2005/10/14	Opposite Dova Hotel, Nuweiba, South Sinai	Ship	Length 500m x Width 70cm	-	
115	2005/11/8	Raas Raya Area, in the direction of the shore	Unknown	2m x 300m	-	
116	2005/11/17	Area B6, at El Ghates, Suez Canal	Unknown	2 - 1m width x 300 - 400m length	Nothing	
117	2005/11/27	Ras Shuqeir (Next to 6th of October power plant)	Unknown	1m x 100m and 2000m x 2000m	Dispersant	
118	2005/11/27	Suez Canal	Ship	2.5 m of oil	Dispersant	
119	2005/12/2	15km away from Abu Redees beach, S Sinai	Oil Platform	100 bbl crude oil	Dispersant	
120	2005/12/4	Fanar Om Elsayyed	Unknown	100m x 100m	Nothing	
121	2005/12/5	Rommana resort and Balouza	Tanker	Damage to an area of 1000 x 5000m	Manual	
122	2005/12/14	Inlet and Outlet of Ettaka Power Station	Unknown	-	Unknown	

Note: Parts by marked by "-" means that no data are available.

ANNEX 2

EXCERPT OF LAW NO. 4/2005

CHAPTER 1 POLLUTION FROM SHIP

Section 1 Oil Pollution

Article 48:

The aim of protecting the water environment from pollution is to achieve the following objectives:

a. To protect the coasts and ports of the Arab Republic of Egypt from the risks of pollution in all its forms and shapes.

b- To protect the environment of the territorial sea and the exclusive economic zone and their living or non-living natural resources by preventing, controlling and reducing pollution from any source.

c- To protect the natural resources in the economic zone and the continental shelf.

d- To compensate any natural or juridical person for any injury they sustain from the pollution of the water environment.

The Minister for Environmental Affairs in conjunction with the Minister of Maritime Transport and the competent administrative authorities referred to in para (38) of article (1) of this Law shall undertake to fulfill the aforesaid objectives, each within their respective fields of competence.

Article 49:

Ships of any nationality are forbidden to discharge oil or oily mixtures in the territorial sea or the exclusive economic zone of the Arab Republic of Egypt.

Military ships or support naval vessels of the Arab Republic of Egypt and other ships owned or operated by the state or by public authorities which are used in non-commercial governmental service and which are not subject to the provisions of the Convention shall take all necessary precautions to prevent pollution of the territorial sea or the exclusive economic zone of the Arab Republic of Egypt.

Article 50:

Ships registered in the Arab Republic of Egypt are forbidden to discharge oily or oil mixtures into the sea, in accordance with the Convention and international agreements to which the Arab Republic of Egypt adheres.

Article 51:

Foreign oil tankers calling at Egyptian ports must comply with all the requirements of Rule 13 of Annex 1 of the Convention as amended.

Oil tankers used in short voyages are exempt from these requirements pursuant to Rule 13c of the Convention as amended, as are oil tankers navigating the Suez Canal which are not obliged to discharge unclean ballast water.

Article 52:

National and foreign companies and organizations licensed to explore, extract or exploit off-shore oil fields and other marine natural resources, including oil transport facilities, are forbidden to discharge any polluting substances resulting from drilling, exploration, testing of wells or production in the territorial sea or the exclusive economic zone of the Arab Republic or Egypt. They are held to use safe measures not liable to harm the water environment and to treat any discharged waste or polluting substance according to the available technical methods and in accordance with the regulations of international conventions.

Article 53:

Without prejudice to the provisions of Law 79 of 1961 concerning marine disasters and shipwrecks, representatives of the competent administrative authority or judicial officers vested with the power to effect seizures shall be entitled to order the captain or the person in charge of the ship to take appropriate protection measures against the effects of pollution in the event of an accident involving a ship carrying an oil cargo which may pollute the territorial sea or the exclusive economic zone of the Arab Republic of Egypt.

Article 54:

The penalties prescribed in this Law shall not apply to cases of pollution resulting from:

a- Securing the safety of a ship or the lives of those on board.

b- Discharge resulting from damage to a ship or its equipment, provided such damage was not caused by the master or the person in charge to disable or destroy the ship or as a result of

negligence. In all cases, the master of the ship or the person in charge thereof must have taken before and after the occurrence of damage all necessary precautions to prevent or reduce the effects of pollution and must have immediately notified the competent administrative authority.

c- A sudden break in the pipeline carrying oil or oily mixtures during the operating, drilling, exploring or testing of oil wells, without any negligence in supervising or maintaining the pipelines, provided sufficient precautions to supervise the operation of the pipeline and immediate measures to control the pollution and its sources have been taken.

This shall be without prejudice to the right of the competent authority to recover the costs of removing the effects of pollution from the party responsible therefore and to claim damages for losses incurred and injuries sustained by reason of such pollution.

Article 55:

The owner of the ship, its master or any person responsible therefore and those responsible for means of oil transport within the port areas or the territorial sea or the exclusive economic zone of the ARE and the companies working in the field of oil extraction are held to notify the competent administrative authorities of any oil spill immediately on its occurrence, with a description of the circumstances of the accident, the type of oil involved and the measures taken to stop or reduce the spill and such other information as determined in the Convention and the executive regulations of this Law.

In all cases, the competent administrative authorities are held to notify the EEAA of all particulars concerning the incident promptly on its occurrence.

Article 56:

All loading ports, ports equipped to receive oil tankers and all dockyards must be fitted out with the necessary equipment to receive unclean ballast water and the bilge wager from cleaning the tanks of oil tankers and other ships.

Ports must be equipped with enough barges and containers to receive the deposits, residues, and waste of oil and oily mixtures from ships docked in port.

No ship or tanker may be licensed to carry out loading and unloading works except after referring to the competent administrative authority which will receive and direct it to the locations for the disposal of waste and unclean ballast water.

Article 57:

he competent minister shall determine the tools and equipment for reducing pollution with which all ships registered in ARE or off-shore platforms installed in the water environment must be fitted out.

Foreign ships calling at Egyptian ports or passing through their littoral zones must be fitted out with pollution reducing equipment in accordance with the provisions of the Convention and its annexes.

Article 58:

Owners or masters of ships registered in the ARE as well as of ships pertaining to the states adhering to the Convention are held to keep a register of the oil on board in which shall be entered all operations relating to oil in the manner determined in the Convention, and in particular the following operations:

a- Loading, delivery or other oil cargo transport operations, while designating the type of oil.

b- Discharge of oil or oily mixture to secure the safety of the ship or its cargo or to save lives, while designating the type of oil.

c- Oil or oily mixture spills as a result of a collision or accident, while indicating the size of the spill.

d- Discharge of unclean ballast water or of bilge water from cleaning the tanks.

e. Disposal of polluting waste.

f. Discharge of machinery space bilges, containing the oil collected within the machinery space, outside the ship while in port.

The executive regulations shall determine the means of recording the processes of discharging oil or oily mixture, in respect of off-shore platforms installed in the water environment.

Article 59:

Without prejudice to the provisions of the International Convention on Civil Liability for Injuries Resulting from Oil Pollution Accidents signed in Brussels in 1969 as amended, all oil tankers whose total tonnage amounts to 2,000 tons or more and which are registered in ARE, and other oil transport equipment whose total tonnage amounts to 150 tons or more operating

in the territorial sea or the exclusive economic zone of ARE, are held to present a financial guarantee certificate in the form of insurance or indemnity bond or any other form of guarantee to the competent administrative authority in accordance with the guidelines laid down in a decree from the Minister of Maritime Transport in agreement with the Minister of Petroleum and the Minister for Environmental Affairs.

The guarantee certificate must be presented when the tanker enters the territorial sea and shall be valid and cover all damages and compensation as assessed by the competent administrative authority.

With regard to ships registered in a country adhering to the International Convention on Civil Liability for Injuries Resulting from Oil Pollution Accidents, such certificate shall be issued from the competent authority in the country where the ship is registered.

CHAPTER 2 POLLUTION FROM LAND-BASED SOURCES

Article 69:

It is prohibited for all establishments, including public places and commercial, industrial, touristic and service establishments, to discharge or throw any untreated substances, wastes or liquids which may cause pollution along the Egyptian sea shores or adjoining waters either directly or indirectly, intentionally or unintentionally. Each day of such prohibited discharge shall be considered as a separate violation.

Article 70:

No building permits shall be granted for establishments or public places on or near the sea shore, which would result in the discharge of polluting substances in violation of the provisions of this Law and the decrees issued in implementation thereof unless the applicant for such permit conducts environmental impact studies and undertakes to provide waste treatment units and to operate them as soon as the establishment commences work.

Article 71:

The executive regulations of this Law shall define the specifications and criteria which must be observed by industrial establishments allowed to discharge degradable polluted substances after they have been treated. The administrative authority, specified in the said executive regulations, shall conduct periodic analysis of samples of the treated liquid waste in its laboratories and notify the competent administrative authorities of the results. In case of violations, the party concerned shall be granted a grace period of one month to treat the waste and render it compatible with the said specifications and standards. If treatment is not completed within the grace period as aforesaid or if the tests carried out during such period prove that continued discharge would result in severe harm to the water environment, discharge shall be halted by administrative means and the establishment license shall be revoked without prejudice to the penalties prescribed in this Law. In addition, the executive regulations shall specify the non-degradable polluting substances which industrial establishments are prohibited from discharging in the water environment.

Article 72:

Without prejudice to the provisions of article 96 of this Law, representatives of the juridical persons or managers of the establishments mentioned in article 69 which discharge in the water environment shall be responsible for any acts carried out by their employees in violation of the provisions of the said article as well as for providing means of treatment in accordance with the criteria and specifications laid down in the executive regulations and shall be liable to the penalties prescribed in Article 87 of this Law.

Article 73:

It is prohibited to construct any establishment within 200 meters of the Egyptian coast lines without the permission of the competent administrative authority in coordination with the EEAA. The executive regulations of this Law shall lay down the procedures and conditions to be followed in this connection.

Article 74:

It is prohibited to take any measures that may affect the natural coast line or alter its configuration either inwards or outwards, without the approval of the competent authority in coordination with EEAA. The executive regulations of this law shall regulate the procedures and conditions to be followed in this connection.

Article 75:

The representatives of the concerned administrative authorities shall be entitled, each within its scope of competence and in coordination with the EEAA, to enter the exclusion zones referred to in articles 73 and 74 of this Law in order to inspect works being carried out therein. If they discover that works contrary to the foregoing provisions are being executed or are intended to be executed, the violator shall be ordered to restore matters to their original state otherwise the works will be halted administratively and matters restored to their original state at the expense of the violator and the beneficiary jointly. Payment shall be collected by means of administrative attachment.

ANNEX 3

LABORATORY EQUIPMENT OF SUEZ RBO[1]

[1] : Sourced from Suez RBO.

Line No.	Code No.	Equipment Name	Manufacturer	Model No.	Origin	Qty	Present Condition
C. Common Analytical Equipment							
1	C-4	A.A.S(Graphite Furnace)w/Auto Sampler	Shimadzu	AA-6800G	Japan	1	A
2	C-5	UV/VIS Spectrophotometer (Single Beam)	Shimadzu	UV-1201	Japan	1	A
7	C-13	Stereoscopic Microscope	Nikon	SMZ-2T-D	Japan	1	A
9	C-15	Handy Type pH Meter	TOA	HM-14P	Japan	1	A
10	C-16	Laboratory pH Meter	TOA	HM-30V	Japan	1	A
11	C-18	Mercury Analyzer	Sugiyamagen	330	Japan	1	A
12	C-19	Glass Wares Set	Shibata		Japan	1	B
13	C-20	Reagents (w/ Standard Samples)	Kanto Chemicals		Japan	1	C
G. General Laboratory Equipment							
1	G-1	Semi-Micro Analysis Balance	Shimadzu	AEL-40SM	Japan	1	A
2	G-2	Macro Analysis Balance	Shimadzu	EB-330S-A	Japan	1	A
3	G-3	High Speed Centrifuge	Shimadzurika	GRX-220	Japan	1	A
4	G-4	Tabletop Type Centrifuge	Shimadzurika	LC-121	Japan	1	A
5	G-6	Muffle Furnace (for Organic)	Isuzu	STR-27K	Japan	1	B
6	G-7	Vacuum Type Constant Temperature Oven	Sibata	VS-300	Japan	1	A
7	G-8	Constant Temperature Oven	Isuzu	SSF-114S	Japan	1	A
9	G-11	Oven for Glass Wares (Dryer)	Advantec	FP-612	Japan	1	A
10	G-12	Autoclave (Vertical Type)	Shimadzurika	MC-30S	Japan	1	A
11	G-13	Incubator	Advantec	CI-610	Japan	1	B
12	G-14	Low Temperature Incubator	Sanyo	MIR-253	Japan	1	A
13	G-15	Rotary Evaporator	Sibata	5021-01	Japan	1	A
14	G-18	Fraction Collector	Shimadzurika	SCF-210	Japan	1	A
15	G-20	Shaker (Middle)	Taitec	SR-2S	Japan	1	A
16	G-21	Shaker (Large)	Taitec	SR-2W	Japan	1	A
17	G-22	Reciprocation Shaker	Takasaki	TA-30S	Japan	1	A
18	G-23	Mixer	Kodaira	KM-201	Japan	2	A

Line No.	Code No.	Equipment Name	Manufacturer	Model No.	Origin	Qty	Present Condition
19	G-24	High Speed homogenizer	Nihonseiki	BM	Japan	1	A
20	G-25	Hot Plate (small)	Advantec	TP-420	Japan	1	A
21	G-26	Magnetic Stirrer (w/Hop Plate)	Shimadzurika	SST-731	Japan	2	A
22	G-27	Multi Magnetic Stirrer	Shimadzurika	SST-66	Japan	2	A
23	G-28	Constant Temperature Water Bath	Advantec	LT-380	Japan	1	A
24	G-29	Rotary Vacuum Pump	Sato Vacuum	DW-60	Japan	1	A
25	G-30	Mini Pump	Sibata	8080-2205	Japan	1	A
26	G-31	Roller Pump	Furue Science	RP-LVS	Japan	1	A
27	G-32	Water Bath	Shimadzurika	GA-12S	Japan	2	A
28	G-33	Cooling Unit	Advantec	LV-200	Japan	1	A
29	G-34	Ultrasonic Cleaner	Sibata	5081-092	Japan	1	A
30	G-37	Ultrasonic Pipette Cleaner	Sibata	5082-100	Japan	1	A
31	G-38	Ion Exchanger	Organo	G-5C/BB-5A	Japan	1	A
32	G-39	Water Distillation Unit	Advantec	GS-990	Japan	1	A
33	G-40	Clean Bench	Shimadzurika	SCB-1000AS	Japan	1	A
34	G-41	Draft Chamber w/Gas Cleaning Device	Shinnihon Kagaku	GEN-120	Japan	1	A
35	G-42	Draft Chamber	Shinnihon Kagaku	SPECIAL	Japan	1	A
36	G-43	AC Stabilizer	Tokyo Rikosha	ASC-20SP	Japan	3	A
37	G-44	Cold Storage Chamber (Pre-fabricated)	Sanyo	SPECIAL	Japan	1	A
38	G-46	Refrigerator	Sanyo	SR-33M	Japan	1	A
39	G-47	Freezer	Sanyo	MDF-235	Japan	1	A
40	G-48	Ice Maker (Cube Ice)	Hoshizaki	IM-100DL-ST2	Japan	1	A
41	G-49	Copy Machine	Selex	GR-2010	Japan	1	C
42	G-50	Monitoring Car	Nissan	FY61NRQ	Japan	1	A
43	G-51	Tool Set	Shinnihon Kagaku	2411 ETC	Japan	1	B
44	G-52	Drafting Set	Uchida	BP-D	Japan	1	A
45	G-53	Locker for Reagents	Shinnihon Kagaku	PRC-120	Japan	1	A
46	G-55	Balance (6 kg)	Shimadzu	EB-6200S-A	Japan	1	A

Line No.	Code No.	Equipment Name	Manufacturer	Model No.	Origin	Qty	Present Condition
47	G-56	Infrared Heater (Lamp)	Sibata	SPECIAL	Japan	1	A
49	G-58	Personal Computer (Arabic/English)	IBM etc	300GL ETC	U.K.	1	B
50	G-59	Video Camera w/ Video monitor Unit	JVC	GR-SZ7000EG	Japan	1	A
51	G-60	Camera	Nikon	F50D	Japan	1	A
52	G-61	Over Head Project (w/Screen)	Elmo	HP-2850P	Japan	1	A
W. Water Quality Monitoring Equipment							
2	W-2	Handy Type D0 Meter	Horiba	OM-14-10	Japan	1	A
3	W-3	Laboratory Type D0 Meter	TOA	DO-25A(Special)	Japan	1	C
5	W-6&7	Tint Meter/Turbidity Meter	Hach	2100AN	USA	1	A
6	W-8	Handy Type Conductivity/Temp. Meter	Horiba	ES-12	Japan	1	A
7	W-9	Conductivity Meter	Horiba	ES-12	Japan	1	A
8	W-10	Salt Meter (Na Ion Meter)	Horiba	C-121	Japan	1	A
9	W-11A	Water Sampler (Hyroht Type)	Sibata	8052-01001	Japan	1	A
10	W-11B	Water Sampler (Pettenkohrfer Type)	Watanabe	KWTW-3103	Japan	1	A
11	W-13	Ekman Barge Grab Sampler	Watanabe	TW-3631A	Japan	1	A
12	W-14	Plankton Net	Watanabe	TW-3851B	Japan	1	A
13	W-15	Distillation Apparatus (for CN,NH4,F)	Sibata	8114-12	Japan	1	A
14	W-16	Oil Content Meter	Horiba	0CMA-310	Japan	1	C
15	W-18	BOD Analyzing Apparatus (Incubator)	Central Kagaku	UD unit	Japan	1	A
16	W-19	COD Analyzing Apparatus (Cr)	Shinnihon Kagaku	Special	Japan	1	C
17	W-22	Waste Water Treatment Equipment	Shimadzurika	DP-50	Japan	1	B
19	W-24	Portable Waste Water Chest (50L)	Shimadzurika	TYPE 50	Japan	1	A
20	W-26	Water Quality Analysis (Temp. pH. Conductivity, Turbidity and DO)	Horiba	U-10	Japan	1	A
21	W-28	Boat for Monitoring (Sea Type)	Yamaha	W-19S	Japan	1	A
22	W-29	Water Proof Camera	Sea&Sea	MMIIEX	Japan	1	A
23	W-30	Automatic Titrator	TOA	AUT-301	Japan	1	A
24	W-31	Ion Analyzer (Electrode Set)	TOA	Special	Japan	1	A
25	W-32	Portable Water Quality Test Kit	Omega	SC-1911	USA	1	A

Line No.	Code No.	Equipment Name	Manufacturer	Model No.	Origin	Qty	Present Condition
26	W-33	Vacuum Filter	Sibata	6170-03	Japan	1	A
A. Air Quality Monitoring Equipment							
1	A-1	Mobile Unit					
2	A-1A	SO_2 Monitor (UV Fluorescence Method)	Environnment SA	AF21M	France	1	A
3	A-1B	NO_x Monitor (Chemiluminescence Method)	Environnment SA	AC31M	France	1	B
4	A-1C	CO Monitor (Non-dispersive IR Method)	Environnment SA	C011M	France	1	A
5	A-1D	Ozone Monitor (UV Absortion Method)	Environnment SA	$0_3$41M	France	1	A
6	A-1E	Hydrocarbon Monitor (FID-GC Method)	Environnment SA	HC51M	France	1	B
7	A-1F	Dust Monitor (Beta-ray Absorption)	Environnment SA	MP101M	France	1	A
8	A-1G/1I	Combined Wind Vane and Anemomeer	Environnment SA	C500	France	1	C
9	A-1H	Thermo-hygrometer	Environnment SA	C502TH	France	1	A
10	A-1J	Solar Radiation Meter	Environnment SA	C511R	France	1	A
11	A-1K	Data Logger	Environnment SA	ENVIDAS/SCANAIR	France	1	A
12	A-1L	Standard Voltage Regulator	Environnment SA	UPS	France	1	A
13	A-1M	Trailer w/Cabin	Environnment SA	TRACTER	France	1	A
14	A-3	Portable Black Fume Monitor	Fujiseiku	FS-102A	Japan	1	A
15	A-4	Orsat Analyzer	Sibata	6072-3	Japan	1	B
16	A-5	Wet Type Gas Collector	Nigorikawa	SPECIAL	Japan	1	A
17	A-6	Gas Sampler (Detector Tube)	Komyo	APS	Japan	1	A
18	A-7	Zero Gas Generator	Environnment SA	ZAG1001	France	1	A
19	A-8	Span Gas Dilutor	Environnment SA	MGC-101	France	1	A
20	A-9	Stack Gas Sampler (for Dust)	Nigorikawa	SPECIAL	Japan	1	B
21	A-10A	Portable Stack Gas Sampler (for Sox)	Nigorikawa	NG-S-A	Japan	1	A
22	A-10B	Portable Stack Gas Sampler (for Nox)	Nigorikawa	NG-N-M-1	Japan	1	A
23	A-11	Gas Meter	Shinagawa	W-N-K1B/-K5B	Japan	1	B
24	A-12	Rotor Meter	Kofloc	RK-1400	Japan	1	A
25	A-13	Mass Flow Meter	Kofloc	3920/PSK-1FCK	Japan	1	A
26	A-15	Auto-Dry Desicator	Sibata	AD-S	Japan	1	A

Line No.	Code No.	Equipment Name	Manufacturer	Model No.	Origin	Qty	Present Condition
27	A-17	Portable HC/CO Analyzer for Stack Gas	Shimadzu	CGT-7000	Japan	1	A
28	A-18	Portable Auto. Sox Analyzer for Stack Gas	Shimadzu	SOA-7000	Japan	1	A
29	A-19	Portable Auto. Nox Analyzer for Stack Gas	Shimadzu	NOA-7000	Japan	1	A
30	A-20	High-Volume Air Sampler	Sibata	8013-01	Japan	1	A
31	A-21	Low-Volume Air Sampler	Sibata	8012-034	Japan	1	A
32	A-22	Deposit Gauge	Sibata	8008-05	Japan	1	A
33	A-23	Andersen Air Sampler	Sibata	8004-01	Japan	1	A
34	A-24	Sulfur Content Analyzer in Fuel Oil	Newley	RX-610SA	Japan	1	C
35	A-25	Standard Gas w/ Cylinder & Regulator	Environnment SA	B30	France	1	A
37	A-27	Tractor for Mobile Unit)	Ford	F-150XLReg.CAB	USA	1	A
C. Common Analytical Equipment: *Equipment Provided in 2002 (Grant Aid)*							
1	C-4A	A.A.S (Flame Attachment Unit)	Shimadzu	ACF-6800	Japan	1	A
2	C-9A	FID Gas Chromatograph	Shimadzu	GC-17A V.3	Japan	1	A
3	C-12	Ion Chromatograph	Shimadzu	HIC-VP Super	Japan	1	A
G. General Laboratory Equipment							
1	G-1B	Analytical Balance	Shimadzu	AW-220	Japan	1	A
W. Water Quality Monitoring Equipment							
1	W-1	Total Organic Carbon Analyzer	Shimadzu	TOC-V CSN	Japan	1	A
A. Air Quality Monitoring Equipment							
1	A-28	Ambient Air Analyzer					
		(VOC/Indoor Ambient Air)	Thermo Electron	Miran 205BXL	USA	1	A
W. Water Quality Monitoring Equipment: *Equipment Provided in 2004 (EMTP-F/U)*							
1		Microscope	Olympus	BX41-32II02	Japan	1	A
2		Digital Camera for Microscope	Olympus	C-5050	Japan	1	A
3		Vandorn Water Sampler	Rigo	5205-B 3L	Japan	1	A
4		International Standard Plankton net		5529-B	Japan	1	A
5		Current Meter	Dentan	CM-1BX	Japan	1	A

Note: In the Column of the present situation, A, B and C stand for “Good Condition”, “in Use” and “Not in Use”, respectively.

ANNEX 4

DATABASE OF CRUDE OILS[1]

[1] : Sourced from the General Directorate of Coastal and Marine Zone Management of EEAA.

Line No.	Name	Country of Origin	Category	Density (kg/l at 15℃)	Pour Point (℃)	Viscosity at (CSt at 20℃)	API Gravity	Tendency to Emulsify
1	Belayim Blend	Egypt	3	0.8920	- 3.0	53.90	27.04	
2	East Zeit	Egypt		0.8920	0.0	6.65	39.08	
3	Geisum	Egypt		0.9425	15.0		18.55	
4	Gulf of Suez Mix	Egypt	3	0.8710	- 6.0		30.86	Strong to Medium
5	Ras Budran	Egypt		0.9075	- 9.0		24.34	
6	Ras Gharib	Egypt		0.9260	6.0		21.20	
7	Western Desert	Egypt		0.9280	42.0		20.90	
8	Zeit Bay	Egypt		0.8540	3.0	13.00	34.09	
9	Abu Al Bu Khoosh	Abu Dhabi		0.8620	- 24.0	11.05	32.60	
10	Arzanah	Abu Dhabi		0.8040	- 9.0	2.49	44.39	
11	Asab	Abu Dhabi		0.8200	- 27.0	4.54	40.96	
12	Bab	Abu Dhabi		0.8145	- 30.0	3.94	42.12	
13	Bu Hasa	Abu Dhabi		0.8285	- 18.0	5.23	39.19	
14	Jarn Yaphour	Abu Dhabi		0.8360	6.0	6.52	37.66	
15	Murban	Abu Dhabi	2	0.8235	- 21.0	8.27	40.22	Medium
16	Sahil	Abu Dhabi		0.8265	- 36.0	6.20	39.60	
17	Shah	Abu Dhabi		0.8740	- 6.0	21.90	30.31	
18	Thammama Con.	Abu Dhabi		0.7720	- 21.0	1.36	51.70	
19	Umm Shaif	Abu Dhabi		0.8355	- 18.0	5.19	37.76	
20	Upper Zakum	Abu Dhabi		0.8535	- 18.0	10.80	34.19	
21	Uweinat Cond.	Abu Dhabi		0.7125	< - 60.0	0.67	66.96	
22	Zakum	Abu Dhabi	2	0.8270	- 18.0	4.84	39.50	Medium
23	Dubai Export	Dubai		0.8660	- 36.0	12.51	31.80	
24	Margham Cond.	Dubai		0.7745	- 15.0	1.29	51.08	
25	Ardeshir	Iran		0.8965	- 30.0	51.00	26.20	
26	Bahrgansar	Iran		0.8950	- 18.0	65.00	26.60	

Line No.	Name	Country of Origin	Category	Density (kg/l at 15℃)	Pour Point (℃)	Viscosity at (CSt at 20℃)	API Gravity	Tendency to Emulsify
27	Darius (Dorood)	Iran		0.8555	- 18.0		33.80	
28	Fereidoon	Iran		0.8720	- 36.0	18.50	30.70	
29	Iranian Heavy	Iran	3	0.8715	- 18.0	16.05	30.77	Very strong
30	Iranian Light	Iran		0.8585	- 30.0	10.40	33.23	Very strong
31	Rostam/Rakhsh.	Iran		0.8475	- 15.0		35.50	
32	Sassan	Iran		0.8575	- 24.0		33.50	
33	Sirri	Iran		0.8710	- 9.0	13.50	30.90	
34	Basra Heavy	Iraq		0.9085	- 30.0	54.40	24.20	Strong
35	Basra Light	Iraq		0.8560	- 27.0	10.44	33.71	Strong
36	Basra Medium	Iraq		0.8760	< - 57.0	22.60	29.90	Strong
37	Kirkuk	Iraq		0.8425	- 39.0	7.16	36.35	Very strong
38	North Rumaila	Iraq		0.8560	< - 57.0		33.70	
39	Kuwait Export	Kuwait	3	0.8720	- 36.0	19.50	30.68	Extremely strong
40	Marib Light	Kuwait		0.8150	- 18.0	3.07	42.01	
41	Khafji			0.8865	- 57.0	40.30	28.03	
42	Mena Saud			0.9530	- 12.0		16.90	
43	Wafra Burgan			0.9150	- 15.0		23.10	
44	Wafra Ratawi			0.9050	- 24.0	6.24	24.80	
45	Oman Export	Oman		0.8480	- 33.0	14.32	35.26	Very strong
46	Qatar Cond.	Qatar		0.7725	- 45.0	1.31	51.55	Relatively weak
47	Qatar Export	Qatar		0.8165	- 36.0	4.01	41.69	Relatively weak
48	Qatar Marine	Qatar		0.8410	- 18.0	6.82	36.65	Relatively weak
49	Arabian Heavy	Saudi Arabia	3	0.8885	- 24.0	40.00	27.67	Very strong
50	Arabian Light	Saudi Arabia	3	0.8570	- 54.0	12.20	33.51	Strong
51	Arabian Medium	Saudi Arabia	3	0.8755	- 48.0		30.03	Very strong
52	Berri	Saudi Arabia		0.8395	- 36.0	7.24	36.95	Relatively weak
53	Mubarek	Sharja		0.7960	- 24.0	1.91	46.15	Relatively weak

Line No.	Name	Country of Origin	Category	Density (kg/l at 15℃)	Pour Point (℃)	Viscosity at (CSt at 20℃)	API Gravity	Tendency to Emulsify
54	Sajaa Cond.	Sharja		0.7800	- 30.0	1.31	49.80	
55	West Ayed	South Yemen		0.8570	3.0	9.60	33.51	
56	Gasolene	Product	1			0.5	> 45	
57	Naptha	Product	1			0.5	> 45	
58	Kerosene	Product	1			2.0	> 45	
59	Gas Oil	Product	2			5.0		
60	Medium Fuel Oil	Product	3			1500 - 3000		
61	Heavy Fuel Oil	Product	4			5,000 - 30,000		

Sources: Oil Spill Service Centre after BP, Sunbury, UK and Exxon through the National Oil Spill Contingency Plan (NOSCP) established by EEAA.