



M. Murday & E.R. Gundlach:
Oil spill contingency plan for Mauritius

UNEP Regional Seas Reports and Studies No. 125

Prepared in co-operation with:



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PREFACE

In 1986 the Government of Mauritius approached the United Nations Environment Programme (UNEP) and the International Maritime Organization (IMO) with a request for assistance in the development of a national oil spill contingency plan for Mauritius.

In response to this request, and in close co-operation with the Ministry of Housing, Lands and the Environment of the Government of Mauritius, a mission was organized by IMO in co-operation with UNEP. The terms of reference of the mission were to:

- determine the legal authority requirements for the implementation of an oil spill contingency plan;
- determine the shoreline sensitivities for all geomorphic coastal segments;
- review the known sensitive biological coastal resources;
- review the socio economic coastal resources;
- develop an environmental sensitivity atlas for Mauritius at a scale of 1:25,000, indicating priority areas for spill response and preferred cleanup methods;
- determine the available equipment for oil spill cleanup operations;
- recommend mitigation techniques for the preservation of birds and vegetation;
- recommend methods of the disposal of oily wastes;
- conduct a three day seminar to discuss the implementation of the recommended contingency plan; and
- conduct a spill drill to test the response to a simulated spill.

The mission was undertaken in 1987 in consultation with local officials and national institutions to ensure that proper consideration was given to local and national problems and priorities in drafting the national oil spill contingency plan.

Data and information contained in this document were gathered in part during field work and meetings with the Mauritius government and private organizations.

The "Coastal Sensitivity Atlas of Mauritius for Oil Spill Response", also produced under this project, has been published by the Ministry of Housing, Lands and the Environment, Port Louis, Mauritius.

Special thanks are due to Dr. J. Wonham and Cdr. T. M. Hayes of IMO for information and views contributed during discussions in London, and for reviewing the draft report. Funding for the project was provided by the Government of Mauritius, the International Maritime Organization with support from the Norwegian Agency for Development Cooperation (NORAD) and the Swedish International Development Authority (SIDA), and the United Nations Environment Programme.

1. EMERGENCY ACTIONS

1.1. Form No. 1: Alert and notification

The check list below initiates the alert procedure when an oil spill is reported. It should be at the disposal of personnel at the Emergency Communications Center - Phone 999.

The officer on duty at the Emergency Communications Center will take the following actions when an oil spill is reported:

- (a) Ascertain location and nature of spill (tanker truck/ship/tank farm) from person reporting spill. Ask about injuries, deaths, and fire hazard.
- (b) Notify ambulance/fire station if needed.
- (c) Notify the Director of NOSCP.

Office Phone: _____ Home Phone: _____

- (d) Contact appropriate District Police Station and ask to verify directly or through National Coast Guard Post or Fisheries Post or Fire Station. Ask for return phone call on emergency basis.
- (e) When verification report comes in, immediately communicate it to the Director of NOSCP.
- (f) Fill out Oil Spill Report Form (Form No. 2).
- (g) Stand by to alert key personnel as directed by the Director of NOSCP or the OSC in charge (Form No. 3).

1.2. Form No. 2: Oil spill report

This form must be filled out by the Emergency Communications Center duty officer and submitted to the Director of NOSCP.

Date/Time: _____

(a) Report of oil spill (to be obtained from person reporting spill):

Name/Address/Phone number of person reporting spill

Location of reported spill

Name and type of facility involved (tank truck/ship/tank farm, etc.)

Quantity and type of spilled oil

Fire/injuries/deaths reported

(b) Actions taken by desk officer:

Ambulance or Fire Station alerted/Time

Director of NOSCP alerted/Time

District Police contacted for verification/Time

Verification report from district police/Time

Verification report phoned or given to the Director of NOSCP/Time

Other individuals alerted/Time

1.3 Form 3: Emergency addresses and phone numbers

The following individuals will be contacted by the Emergency Communications Center duty officer after confirmation of an oil spill and as directed by the Director of NOSCP or the OSC.

1. Director of NOSCP

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

2. Commissioner of Police

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

3. Port Master

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

4. OSC LAND

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

5. OSC SEA

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

6. OSC PORT

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

7. Managing Director, CALTEX

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

8. Managing Director, ESSO

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

9. Managing Director, SHELL

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

10. Managing Director, TOTAL

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

11. SUP OIL

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

12. SAC

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

13. Members of SAT

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

14. Members of SOCAT

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

15. Members of SFAT

Name _____

Office address _____

Home address _____

Office phone _____

Home phone _____

2. ABOUT THIS DOCUMENT

2.1. How to use this document

This document describes the national contingency plan for responding to oil spills that may occur in Mauritius and five of the important surrounding islets, not including the island of Rodrigues. It is intended to be used in conjunction with a companion volume titled "Coastal Sensitivity Atlas of Mauritius for Oil Spill Response" (Gundlach and Murday, 1987). The present volume is concerned with the organizational plan, and the legal, mobilization, and operational aspects. The companion volume consists of 1:25,000 scale maps with designations of priority areas for response, and specifications of protection and cleanup strategies at important locations.

Provision should be made for yearly review and updating of the plan. Revised pages should be sent to individuals and organizations indicated on the distribution list provided in the document, with a note dictating that the new pages be inserted at the appropriate places and the older pages discarded. Revisions and distribution are the responsibility of the Director of the National Oil Spill Contingency Plan. A new contingency plan should be prepared at appropriate intervals to reflect changes in the legal and administrative framework, available equipment, response methods, personnel, etc. The new document will replace the present contingency plan.

Certain sections contain remarks under the heading of "Recommended Actions". These are suggestions for upgrading the contingency plan in the near future and during the annual review process. Whenever a "recommended action" is implemented, the corresponding entry should be removed and replaced by text in the appropriate section.

It is intended that this contingency plan be easy to use and not include cumbersome and confusing material. At the same time, it should contain full details concerning certain aspects like the amount, type, and location of equipment. To this end, the document contains appendices to which otherwise important material has been relegated.

2.2. Revisions

This page should be completed and signed by the Director of the National Oil Spill Contingency Plan after each review of the plan has been completed. A copy of it should be mailed to each recipient of the revised pages of the plan (see Distribution List).

[illegible]

2.3. Distribution list

The present document will be distributed to the persons and institutions listed below. All future revisions will also be sent to them.

1. Office of the Prime Minister
Port Louis
Attn: Permanent Secretary
2. Ministry of Housing, Lands and the Environment
Port Louis
Attn: Permanent Secretary
3. Ministry of Housing, Lands and the Environment
Port Louis
Attn: Chief Town and Country Planning Officer
4. Ministry of Housing, Lands and the Environment
Port Louis
Attn: Senior Scientific Officer
5. Ministry of Tourism
Port Louis
Attn: Permanent Secretary
6. Ministry of Trade and Shipping
Port Louis
Attn: Head, Shipping Division
7. Ministry of Economic Planning and Development
Port Louis
Attn: Director
8. Ministry of Agriculture, Fisheries and Natural Resources
Port Louis
Attn: Permanent Secretary
9. Ministry of Agriculture, Fisheries and Natural Resources
Port Louis
Attn: Chief Fisheries Post Officer
10. Ministry of Agriculture, Fisheries and Natural Resources
Port Louis
Attn: Chief, Fisheries Research and Development Services
11. Ministry of Local Government
Port Louis
Attn: Permanent Secretary
12. Ministry of Information
Port Louis
Attn: Information Officer
13. Mauritius Marine Authority
Port Louis
Attn: Port Master

14. Mauritius Marine Authority
Port Louis
Attn: Shipping Controller
15. Mauritius Police Force
Port Louis
Attn: Commissioner of Police
16. Mauritius Police Force
Port Louis
Attn: Chief, Special Mobile Force
17. Mauritius Police Force
Port Louis
Attn: Commander, Mauritius Coast Guard
18. Meteorological Services
Vacoas
Attn: Director
19. Government Fire Services
Port Louis
Attn: Controller
20. Municipal Fire Brigade
Port Louis
Attn: Chief Officer
21. State Trading Corporation
Port Louis
Attn: General Manager
22. State Trading Corporation
Port Louis
Attn: Secretary
23. Mauritius Petroleum Institute Consultative Committee
Port Louis
Attn: Secretary
24. Caltex
Port Louis
Attn: Managing Director
25. Esso Mauritius Limited
Port Louis
Attn: Managing Director
26. Shell Company of the Islands PLC
Port Louis
Attn: Managing Director
27. Total
Port Louis
Attn: Managing Director

28. Mauritius Marine Conservation Society
Port Louis
Attn: Secretary
29. Association of District Councils
Port Louis
Attn: Secretary
30. Association of Urban Authorities
Port Louis
Attn: Secretary
31. Association des Pêcheurs Professionnels de l'Ile Maurice
Port Louis
Attn: Secretary
32. Divers Club
Grand Baie
Attn: Secretary
33. Grand Baie Yacht Club
Grand Baie
Attn: Secretary
34. Mauritius Chamber of Commerce
Port Louis
Attn: Secretary
35. Mauritius Sugar Producers Association
Port Louis
Attn: Secretary
36. University of Mauritius
Réduit
Attn: Vice Chancellor
37. Mauritius Sugar Industry Research Institute
Réduit
Attn: Director
38. Office of the Attorney General
Port Louis
Attn: Attorney General
39. Mauritius Hotels Association
Port Louis
Attn: Secretary
40. Members of Scientific Advisory Team (SAT)
41. Members of Socioeconomic Advisory Team (SOCAT)
42. Members of Strike Force Advisory Team (SFAT)

43. International Maritime Organization
3 Albert Embankment
London, SE1 7SR
England
Attn: Advisor on Marine Pollution
Marine Environment Division
44. United Nations Environment Programme
P.O. Box 30552
Nairobi
Kenya
Attn: Director of OCA/PAC

2.4. Acronyms and definitions

API	American Petroleum Institute
CONCAWE	Oil Companies' European Organization for Environmental Health and Protection
CRISTAL	Contract Regarding an Interim Supplement to Tankers Liability for Oil Pollution
IMO	International Maritime Organization
IOPC	The International Oil Pollution Compensation Fund
ITOPF	International Tanker Owners Pollution Federation
MARPOL	The 1973 International Convention for the Prevention of Pollution from Ships as modified by the Protocol of 1978 and amended in 1984, 1985 and 1987.
MMA	Mauritius Marine Authority
MPICC	Mauritius Petroleum Institute Consultative Committee
MSIRI	Mauritius Sugar Industry Research Institute
MSPA	Mauritius Sugar Planters Association
NOSCP	National Oil Spill Contingency Plan
OILPOL	The 1954 International Convention for the Prevention of Pollution of the Sea by Oil (with 1962, 1969, and 1971 amendments)
OSC	On-Scene Coordinator
OSC LAND	On-Scene Coordinator for National Spills inland
OSC SEA	On-Scene Coordinator for National Spills at sea and on the beaches
OSC PORT	On-Scene Coordinator for Port Spills
SAC	Scientific Advisory Coordinator
SAT	Scientific Advisory Team
SFAT	Strike Force Advisory Team
SOCAT	Socioeconomic Advisory Team
SUP OIL	Field Supervisor for Oil Company Spills
UNEP	United Nations Environment Programme

Oil - Oil of any kind or in any form, including petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

Inland Waters - Internal waters landward of a coastal baseline, normally defined by the low watermark along the coast.

Territorial Sea - Sea water extending from the baseline to a maximum limit of 12 nautical miles.

Exclusive Economic Zone (EEZ) - Sea water beyond and adjacent to the Territorial Sea, extending to a maximum distance of 200 nautical miles from the baseline.

Minor Spill - Any discharge of oil less than 25 barrels in inland waters or less than 250 barrels on land, offshore, or in coastal waters that does not pose a threat to the public health or welfare.

Medium Spill - Any discharge of oil of 25 to 250 barrels in inland waters or 250 to 2,500 barrels on land, offshore, or in coastal waters.

Major Spill - Any discharge of oil over 250 barrels in inland waters or over 2,500 barrels on land, offshore, or in coastal waters.

Note: a spill of lesser volume that poses a threat to the public health or welfare may be classified as a medium or major spill depending on its degree of impact.

National Spills - Spills occurring in areas not covered by Port Spills or Oil Company Spills.

Port Spills - Spills occurring within the boundaries specified by the Ports Act, in and adjacent to Port Louis Harbor.

Oil Company Spills - Spills occurring at any of the operational areas of the oil companies. They are classified as National or Port Spills, depending on their locations.

Public health or welfare - includes considerations of all factors affecting the health and welfare of humans and the natural environment.

3. BACKGROUND

3.1. Introduction

Oil spill contingency plans have been drawn up over the past two decades in oil-producing countries, as well as in others where environmental and economic resources are threatened by oil pollution. Their usefulness has been proven in many instances, and their absence felt in many others. Currently, oil spill contingency plans are mandated by law in several countries. They are established on national and local levels, and for specific facilities such as ports and refineries.

The requirements for an effective oil spill contingency plan have evolved with the experience gained in real situations. It is essential that the plan be supported by appropriate legal authority. The plan itself should set out clearly the responsibilities of the agencies and individuals involved. Appropriate protection, cleanup, and disposal strategies should be identified. An inventory of available equipment and personnel resources for spill response should be made. Ecological and socioeconomic resources should be evaluated and priorities for their protection assigned. Provision should be made for the acquisition of equipment, training of spill response personnel, and periodic review and updating of the plan.

Considerations of increased development activities, sensitive natural resources, and the occurrence of minor oil spills in the recent past have led the Government of Mauritius to commission the present study for the establishment of a National Oil Spill Contingency Plan (NOSCP).

Two documents have been prepared to describe the various elements of NOSCP for Mauritius and five of the important surrounding islets (Coin de Mire, Flat Island, Ilot Gabriel, Round Island, and Serpent Island). The island of Rodrigues is not included. The present document sets out the legal basis and the detailed workings of the plan. It takes into consideration existing capabilities, and contains suggestions for future upgrading. The companion volume is titled "Coastal Sensitivity Atlas of Mauritius for Oil Spill Response" (Gundlach and Murday, 1987). It contains 19 maps at a scale of 1:25,000 covering the coastline of Mauritius and the adjacent islets (Fig. 1), with designations of 10 shoreline types and their relative sensitivities to spilled oil. Summary information on the climate, geology, tides, and currents of Mauritius are also provided. Protection and cleanup methods are suggested for relevant locations.

The present document and the companion atlas are the working documents of the NOSCP.

Recommended action

- The National Oil Spill Contingency Plan should be extended to include considerations for Rodrigues and other islands with sensitive living resources.

3.2. Environmental setting

Mauritius is situated in the belt of the southeast trades and is surrounded by a ring of coral reefs, except for parts of southern and western coasts. The southeast trade winds cause heavy swell to predominate for most of the year around the island. Off the west coast, in the lee of the island, calm seas prevail to about 12 nautical miles offshore. Tropical cyclones are common between November and March, with wind gusts of up to 280 km/hr. With the exception of the calm area close to the west coast, oil spill response operations in the open ocean are expected to be generally difficult, and impossible during stormy conditions.

The south equatorial current system flows offshore in a westerly direction, with variable currents in the quadrants immediately around the island (Dept. of the Navy, 1977). Small-scale description of the current system within and immediately outside the coral reef system is not yet available. The currents within the coral reef are wind-driven. Prediction of oil movement at sea is difficult because of the lack of accurate wind and current data.

Tides are semidiurnal with a mean range of 60 cm at spring tide and 24 cm at neap tide. Beach configurations vary from very gentle slopes to vertical cliffs. Geomorphological shoreline types reflect the volcanic origin of the island and the effects of the coral reef. They have been identified and mapped in the companion atlas. In order of increasing sensitivity to spilled oil (Gundlach and Hayes, 1978), the shoreline types are:

1. Exposed cliffs.
2. Low-lying basalt, beach rock, and seawalls.
3. Exposed boulder/cobble beaches.
4. Sand beaches.
5. Mixed sand and gravel beaches.
6. Exposed sand flats.
7. Sheltered rocky shores.
8. Coral reefs.
9. Sheltered tidal flats.
10. Marshes and mangroves.

Different oil spill response methods are required for each of these shoreline types and are indicated in the companion atlas.

Inland, the terrain rises to a central plateau, and several streams and minor rivers cross a landscape that is dominated by sugar cane fields. Light industries are on the increase and an extensive network of roads supports dense vehicular traffic in populated areas. A booming tourist industry has been accompanied by the development of important hotel complexes fronted by popular beaches. The increase in development activities has resulted in environmental problems on and around the island.

The presence of sensitive or endangered living resources and of valuable industrial or cultural resources dictates priorities for protection from oil spills. The priorities are defined in the companion atlas.

Recommended action

- As more data become available on the oceanographic and meteorological conditions, they should be attached to this document in data summary or cartographic form.

3.3. Sources of oil pollution in Mauritius

Oil-related activities

Major tanker traffic from the Middle East to the West passes through the Mozambique Channel west of Madagascar. The likelihood of oil spills from tanker accidents affecting Mauritius is not expected to be great. There is currently no refinery or oil drilling activity in or near Mauritius which can be expected to result in oil pollution impacting the island.

Previous incidents, however, have taken place in Mauritius. Significant amounts of tar balls were reported by the government in 1978 and were manually removed from the beaches. The source of the tar balls has been suspected to be from tank washing at sea by vessels using improper procedures.

Oil is imported into Mauritius by the State Trading Corporation. It is then sold, upon offloading, to four oil marketing companies (Caltex, Esso, Shell, and Total). The yearly amounts and types of oil imported since 1983 are shown in Appendix 1. Total imports of about 300,000 metric tons arrive in consignments of about 25,000 tons. The oil is discharged through submarine and overland pipelines to tank farms near the harbor.

The most probable sources of oil pollution are related to unloading, offloading, and bunkering in the Port Louis Harbor, to storage, pipeline leak or rupture, overland transportation, and to the indiscriminate disposal of used lubricating oil.

Marine sources

Spills associated with the discharge of oil during operations in Port Louis Harbor and of residues from tank cleaning are likely to be minor spills. Bunkering of large fishing and other vessels takes place in Port Louis Harbor. Improper operational procedures have been observed and result in low-level chronic oil pollution in Port Louis Harbor.

Increasing pleasure boat activity in areas like Grand Baie is likely to contribute to high concentrations of oil in lagoon waters wherever mixing and flushing of these waters are inadequate.

Severe weather conditions during the cyclone season raise the possibility of shipwreck close to the island, with resulting spills in the medium or major category. Pipeline rupture could also result in large spills.

Land sources

Oil is stored at tank farms in Fort Williams and Port Louis, near the harbor. Storage tanks are also located at Plaisance Airport. The number of tanks and their capacities and contents are given in Appendix 2. The tanks and associated pipelines are a potential source of spills. Improper disposal of oily wastes from tank cleaning is also a source of oil pollution at the tank farms. Another tank farm consisting of five storage tanks was constructed in Grand Port around 1944, and is now in disuse. If reactivated, these tanks would become a potential source of spills.

Used lubricating oil is discarded in indiscriminate fashion by filling stations, motor mechanic workshops, and various industrial plants. It can be

expected that significant amounts of waste oil are carried to the rivers and the sea by runoff during heavy rains. Leaching is also likely to be taking place in some areas, posing a threat to groundwater quality.

Petroleum products are transported from Port Louis to all parts of the island by road. Road accidents involving tanker trucks have occurred in the past, with resulting spillage of oil.

4. LEGAL CONSIDERATIONS

4.1. Authority

Protection of the environment is possible only if adequate legal authority and enforcement regulations exist. In Mauritius, as in most other countries, legal authority for some aspects of environmental problems is found in several Acts which were not written with the primary objective of environmental protection. The need to establish oil pollution control legislation has been felt throughout the world since the 1950s. By now, several countries have enacted legislation to control general environmental problems, and oil pollution in particular. International and regional conventions have also been established to deal with the worldwide dimensions of these problems.

International and regional conventions as well as Mauritius legislation related to oil pollution are listed in Appendix 3. Four international conventions, not yet ratified by Mauritius, are of particular interest:

- (a) The 1954 International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), with 1962, 1969, and 1971 Amendments, prohibits oily waste mixtures with more than 100 ppm of crude, fuel, or lubricating oil within 50 miles from the shoreline (extended to 100 miles for certain designated areas, not including Mauritius). Requirements for participating countries include the institution of procedures for the investigation of complaints by other governments, the provision of reception facilities for waste oil and residues, and the keeping of an oil record book by all ships. Operations involving cargo, ballast, and tank cleaning, and quantities of oil recovered and consolidated in slop tanks must be recorded for inspection by port inspectors.
- (b) The 1969 International Convention on Civil Liability for Oil Pollution Damage (Civil Liability Convention) places liability on a tanker's owner when persistent oil escapes from a laden tanker and causes damage to the territory of a state party to the Convention. The limit of liability is set at a maximum of US \$163 per ton of the ship's tonnage, with a maximum of US \$17.1 million (based on exchange rates extant on 30 December 1986).
- (c) The 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (Fund Convention) is supplementary to the Civil Liability Convention and provides for increased compensation. In 1978, the International Oil Pollution Compensation Fund (IOPC Fund) was established. It provides for total compensation of up to US \$73 million, effective as of 1 December 1987 (based on exchange rates extant on 30 December 1986), including the amount of compensation paid by the shipowner or his insurer. The IOPC Fund also indemnifies the owner in most cases for part of his liability under the Civil Liability Convention.
- (d) The 1973 International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), as modified by the Protocol of 1978, provides additional requirements to OILPOL. These include the quantity of oil discharged, an oil discharge monitoring and control system, the addition of petroleum and refined products to the persistent oils specified by OILPOL, the provision of adequate reception facilities, and the use of segregated ballast tanks, dedicated clean ballast tanks, crude oil washing systems, and Inert Gas Systems.

On the regional level, Mauritius is included among the nations designated for the East Africa Regional Seas Programme. The latter promotes cooperation among the East African mainland states and the islands of the southwest Indian Ocean area to control marine and coastal oil pollution. The convention has not been ratified by Mauritius to date.

There is currently no national legislation in Mauritius that deals comprehensively with oil pollution in particular or with environmental pollution in general. Some aspects of oil pollution are covered by three main Acts:

- (a) The Maritime Zones Act 1977 provides for the preservation and protection of the marine environment and the prevention and control of marine pollution (Section 15.2.d) in the territorial waters, the continental shelf, the exclusive economic zone, and the historic waters of Mauritius.
- (b) The Ports Act 1975 empowers the Port Master to control the manner in which cargo and fuel are taken on, discharged, or handled (Section 28.1.c.). He can also cause the removal of any article or thing obstructing navigation or any other business in or over waters which lie within the territorial seas of Mauritius (Section 32).
- (c) The Fisheries Act 1980 provides for penalties against individuals responsible for pollution impacting on fisheries resources from land-based sources.

Recommended actions

- It is essential that legislation be enacted to establish the National Oil Spill Contingency Plan. This action can be taken independently of other environmental considerations, except for hazardous substances which can be included conveniently under the same legislation.
- Given the importance of marine and coastal resources to Mauritius, the multiple problems affecting the island environment, and the administrative requirements for an effective environmental program, it is also appropriate to consider the enactment of comprehensive environmental legislation. An Environmental Protection Act would deal in an integrated fashion with coastal and marine resources management, water and air quality, and oil and hazardous substances pollution.
- Presently, penalties for marine pollution are provided under Section 41 of the Ports Act 1975, which allows for a maximum fine of 10,000 rupees for polluting the environment within the port limits at Port Louis Harbor and Rodrigues Harbor. In order to enable the Government of Mauritius to effectively prosecute offending vessels, it is necessary to draw up clarifying regulations. These could be based on OILPOL and made under Section 15 (2)(d) of the Maritime Zones Act 1977. Maximum penalties could thus be increased to 200,000 rupees or penal servitude not exceeding five years, as provided for under Section 12 of the Act. Jurisdiction would be extended to the Exclusive Economic Zone extending out to 200 nautical miles.
- In order to derive the benefits of regional cooperation in matters such as reliable laboratory fingerprinting of spilled oil, the development and use of a regional trajectory model for forecasting the movement of oil

spilled at sea, personnel training, and equipment support, it would be necessary for Mauritius to ratify the 1985 Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region and its Protocol on emergency co-operation.

- Ratification of MARPOL 73/78 would provide protection for the coastal waters. Its requirement for keeping a record book on board ships to record operations concerning ballasting, de-ballasting, tank cleaning, and discharge of oily mixtures as well as garbage and sewage would reinforce procedures being contemplated by the future Port Louis Harbor Oil Spill Contingency Plan.
- It is important for the Government of Mauritius to consider ratification of the 1969 Civil Liability Convention and the 1971 Fund Convention. With annual contributing oil at about the 150,000 tons minimum level of chargeable oil, an initial contribution of about US \$600 and annual contributions of about US \$300 can be expected. Mauritius would then be entitled to compensation of up to US \$71 million for recovery of cleanup costs for each incident. This action would provide good insurance against major oil spills.

4.2. Enforcement

Oil spill legislation is effective only if it is backed by strong enforcement provisions. To date, enforcement of oil pollution control has been restricted to recovery of cleanup costs for identifiable spills by the Port Master. Several enforcement tools have been found to be of practical value in controlling oil pollution (Murday et al., 1987a). Surveillance of oil pollution can be carried out effectively by existing and planned resources of the National Coast Guard, the Special Mobile Force, and the Mauritius Marine Authority. Competent personnel at the University of Mauritius and other institutions can support a monitoring program for water quality, if provided with some additional equipment. Other appropriate enforcement tools are proposed below.

Recommended actions

An enforcement program should be prepared in conjunction with the legislation necessary for the establishment of the National Oil Spill Contingency Plan (NOSCP) and with the elaboration of the proposed Port Louis Harbor Oil Spill Contingency Plan. The main points to be covered by these regulations are the following:

- The oil marketing companies should be required to obtain an environmental permit which sets out specific requirements for good operational practices. Internationally-recognized standards for this purpose can be obtained from ISGOTT (1984) and the IMO Manual on Oil Pollution (IMO, 1983). The permit would be issued by the Director of NOSCP and would be renewable every five years.
- Violation of a permit condition would constitute an offense for which a fine would be imposed by the Director of NOSCP. In addition, protection and cleanup measures would be the responsibility of the offender.
- Fines should reflect the specific situation. A fine could be applied to each "incident", leaving the discretion with the Director of NOSCP to determine what constitutes an "incident". For example, a permit violation that continues for several days would be counted as one or several incidents, depending on the good faith effort of the offender from the time of notification. Similarly, fines could be reduced according to the amount of oil collected or cleaned up.
- The amount of a fine could be set as a minimum amount per incident, a range from which the Director of NOSCP could select a fine, or an amount per volume of oil spilled.
- The Director of NOSCP would be empowered to carry out protection and cleanup activities in the event that the offender does not take timely or proper action. The costs of such activities would be recovered from the offender.
- A fair appeal process should be established. A stay of execution of a fine should be allowed pending the resolution of the appeal process.
- The oil marketing companies should be required to submit reports of all spills that occur at their facilities.

- The Port Master should commission monthly analysis of water quality parameters for the Port waters.
- The Port Master should commission occasional spot checks by designated inspectors to ensure that correct operational procedures are being followed.

4.3. Jurisdiction and responsibility

In addition to the National Oil Spill Contingency Plan (NOSCP), two categories of oil spill response plans are being formulated in Mauritius: the Port Louis Harbor Oil Spill Contingency Plan (Appendix 4) and contingency plans for the oil companies (the Esso plan is already in existence) - Appendix 5 and Appendix 6. The national plan (NOSCP) takes precedence over all existing and future local oil spill contingency plans. Such plans should be in compliance with the provisions of NOSCP and must be submitted to its Director for approval.

While the Director of NOSCP has final jurisdiction over any oil spill which may occur in Mauritius, the responsibility for containment, cleanup, and disposal will be determined by the geographical location of the spill. For this purpose, three classes of oil spills are recognized:

National Spills

National Spills are defined as oil spills (at sea, on land, in rivers and lakes, and on the beaches) which originate in areas not included in Port Spills and Oil Company Spills. Response to National Spills will be provided by the Director of NOSCP.

Port Spills

Oil spills originating within the boundaries specified by the Ports Act will be the responsibility of the Port Master. The waters within the jurisdiction of Port Louis Harbor, in accordance with the Ports Act 1975, are included by "an imaginary line drawn from Pointe aux Sables to Pointe aux Piments". The Port Master will provide response to Port Spills in accordance with the provisions of the proposed Port Louis Harbor Contingency Plan. He will keep the Director of NOSCP informed about such spills.

Oil Company Spills

Oil spills which originate inland or at sea at any of the operational facilities of the oil marketing companies will be the responsibility of the operator involved. Spill response carried out by oil companies will be overseen by the Port Master or the Director of NOSCP, as dictated by the location of the spill. The operational facilities of the oil company include their boats, tugs, barges, tankers, ships and other vessels at sea, tank farms, pipelines, transportation routes, and all other property where the oil companies carry out oil-related activities.

The NOSCP will be activated in the event that other responsible parties fail to undertake timely or satisfactory response actions. Such intervention will be at the discretion of the Director of NOSCP.

5. ORGANIZATION

5.1. Organizational chart

Contingency plans are already in place to handle emergency situations for cyclones and other natural disasters, fire and other disasters within the port, and search and rescue operations at sea. Lead agencies for these plans are, respectively, the Special Mobile Force (Police Department), the Port Louis Harbor (Mauritius Marine Authority), and the Mauritius Coast Guard (Police Department). The existing capabilities for emergency response are utilized for oil spill response.

The organizational structure for oil spill response provides for the following chain of command:

- (a) The Director of the National Oil Spill Contingency Plan (NOSCP) assumes final authority for all categories of oil spills.
- (b) The Port Master responds to oil spills in the Port and reports to the Director of NOSCP.
- (c) Oil Company managers respond to oil spills in their operational areas. Their response actions are carried out after full consultation with the Port Master for spills in the Port area, or with the Director of NOSCP for all other spills.

Figure 2 shows the organizational response structure of NOSCP. One of three On-Scene Coordinators (OSCs) will carry out response actions, depending on the spill source, on behalf of the Director of NOSCP or the Port Master. In addition, the oil companies will assign Field Supervisors (SUP OIL) to direct field efforts during oil spill response in their areas of operation.

The Director of NOSCP will be represented by an On-Scene Coordinator for inland spills (OSC LAND) and by an OSC for spills offshore, in coastal waters, and on the beaches (OSC SEA). These two OSCs will be in charge of all planning and field operations concerning response to National Spills, each in his own area of operation.

The Port Master will designate an On-Scene Coordinator (OSC PORT) as his representative for response actions to Port Spills.

The Managing Directors of the oil companies will appoint separate Field Supervisors (SUP OIL) or a common SUP OIL to represent their respective or common interests in spill response. The SUP OIL will act as a cleanup contractor and must consult fully with the appropriate OSC - the OSC PORT, the OSC LAND, or the OSC SEA.

Response to spills which originate in one area of jurisdiction and move to another will remain the responsibility of the initial OSC. For example, the OSC LAND will continue to supervise response actions for a spill which originated on land, even after the spill has moved out to sea.

The responding OSC will confer with the other OSCs and the SUP OIL in order to draw upon resources available to them, and for other matters requiring consultation.

Three Advisory Teams (the Scientific Advisory Team - SAT, the Socioeconomic Advisory Team - SOCAT, and the Strike Force Advisory Team - SFAT) will assist the responding OSC. Their activities will be coordinated by a Spill Advisory Coordinator - SAC. Upon request, they will provide the OSC with advice regarding the environmental, socioeconomic, and operational aspects of spill response measures - see section on Advisory Teams.

Through the chain of command, the responding OSC will seek assistance from the Director of NOSCP in order to secure any special support that may be available in Mauritius or abroad.

5.2. Advisory Teams

Three Advisory Teams will stand ready to assist the On-Scene Coordinator (OSC) responding to an oil spill. Their work will be coordinated by a Spill Advisory Coordinator (SAC). The Advisory Teams will meet at the request of the responding OSC, conduct initial assessment of the spill, and provide the OSC with relevant opinions during all phases of spill response. The OSC will formulate his response plan based on their recommendations.

Requests for additional expert assistance, from Mauritius or overseas, will be made by the Advisory Teams to the Director of the National Oil Spill Contingency Plan (NOSCP) through the OSC in charge of a spill. All work to be performed by the Advisory Teams must receive approval by the Director of NOSCP.

Nomination to the Advisory Teams will be made by joint decision of the OSCs (OSC LAND, OSC SEA, OSC PORT), and one designated SUP OIL. The nominations will be reviewed and final appointment made by the Director of NOSCP after consultation with the Port Master and the Managing Directors of the oil companies. All appointments to the Advisory Teams will be reconsidered whenever NOSCP undergoes a review process.

Scientific Advisory Team (SAT)

A Scientific Advisory Team (SAT) will consist of highly-qualified specialists in the fields of meteorology, environmental chemistry, coastal and marine processes, coastal and marine living resources, health, and waste disposal. These specialists will be drawn from the Meteorological Services, the University of Mauritius, the Mauritius Sugar Industry Research Institute, the Ministry of Housing, Lands and the Environment, the Ministry of Health, the Ministry of Agriculture, Fisheries and Natural Resources (Fisheries Research and Development Services), and any other relevant government or private institution.

The SAT will provide the OSCs with pertinent scientific information and opinions on matters affecting protection and cleanup procedures. These will include initial evaluation of amount and type of spilled oil, prediction of oil movement, degree of probable environmental impact, effects of proposed cleanup and disposal strategies, laboratory analysis, and post-spill studies.

Socioeconomic Advisory Team (SOCAT)

A Socioeconomic Advisory Team (SOCAT) will consist of individuals capable of assessing the social, cultural, and economic impacts of oil spills. They can be drawn from the Ministry of Housing, Lands and the Environment (Town and Country Planning section), the Ministry of Tourism, the Ministry of Agriculture, Fisheries and Natural Resources, the Mauritius Marine Authority, non-governmental organizations, the oil companies, and other relevant government or private institutions.

The SOCAT will advise the OSCs on priority areas in need of protection from oil spills, with due regard to their social, economic, and cultural importance.

Strike Force Advisory Team (SFAT)

A Strike Force Advisory Team (SFAT) will consist of individuals with knowledge of the availability of relevant personnel, equipment, and supplies needed in oil spill response. They will be drawn from the Mauritius Marine Authority, the Public Works Department, the Fire Services, the Special Mobile Force, the oil companies, the Mauritius Sugar Producers Association, and other relevant institutions.

The SFAT will assist the OSCs with the recruitment of spill response crews and the mobilization of equipment and supplies.

Spill Advisory Coordinator (SAC)

In order to avoid confusion in the functioning of the Advisory Teams, a Spill Advisory Coordinator (SAC) will be appointed to coordinate their efforts. The SAC will call separate or joint meetings of the Advisory Teams at the request of the OSC. He will chair their deliberations, facilitate interactions among them, and resolve conflicts in their findings.

Recommended action

- The Ministry of Housing, Lands and the Environment should assume the role of lead agency for the Advisory Teams and designate the Spill Advisory Coordinator (SAC) to coordinate their work.

5.3. Alert procedure

Figure 3 describes the notification and alert procedure to be followed when an oil spill occurs.

Oil spills observed by employees of the oil companies or the Mauritius Marine Authority (in charge of the Port Louis Harbor) can be reported internally, following procedures laid down in their contingency plans. As soon as the spill is confirmed, the Managing Director of the oil company concerned, or the Port Master, will notify the Director of National Oil Spill Contingency Plan (NOSCP).

Oil spills observed by a member of the public will be reported to any Police Station in person or by calling the Emergency Communications Center - phone number 999. The duty officer at the communications desk will immediately notify the Director of NOSCP. The duty officer will then seek confirmation of the spill by calling the relevant District Police Station and, through the latter, a Fisheries Post, Coast Guard Post, or Fire Station close to the reported spill site. Confirmation or negation of the spill will be immediately communicated to the Director of NOSCP. The Director of NOSCP will assign response action to the Port Master or the Managing Director of one of the oil companies if the spill is within his area of responsibility. Otherwise, he will designate the OSC LAND or the OSC SEA as the On-Scene Coordinator.

The responding OSC or SUP OIL will immediately visit the spill site, execute measures to ensure human safety, seal the source of the spill if possible, assess the damage, and file a spill report with the Director of NOSCP. Meanwhile, he would have made arrangements to meet with the other OSCs and to mobilize the advisory teams (SAT, SOCAT, and SFAT) through the Spill Advisory Coordinator (SAC).

Protection and cleanup operations will then take place under the direction of the responding OSC or the SUP OIL.

Recommended actions

- A public education campaign will be necessary to publicize the reporting of oil spills by members of the public. This could be done through mass media announcements promoting citizen reporting of all types of emergencies, and clearly specifying oil pollution reports.
- The Mauritius Marine Authority and the oil companies should inform, and periodically remind their employees of procedures for reporting oil spills. They should post notices regarding these procedures on notice boards in the work areas of their employees.

6. PERSONNEL

6.1. Appointment of key personnel

The National Oil Spill Contingency Plan (NOSCP) provides for the appointment of key personnel from government or the private sector.

Recommended actions

The following appointments are recommended :

- Directors

Director of NOSCP: The Commissioner of Police or the Port Master.
Director of Port Louis Harbor Contingency Plan: The Port Master.
Directors of Oil Company Plans: The Managing Directors of the oil companies.

- On-Scene Coordinators

On-Scene Coordinator of NOSCP for inland spills (OSC LAND): The Chief, Special Mobile Force.
On-Scene Coordinator of NOSCP for spills at sea (OSC SEA): The Commandant of the National Coast Guard.
On-Scene Coordinator of the Port Louis Harbor Contingency Plan (OSC PORT): to be nominated by the Port Master.
Supervisors of the Oil Company Plans (SUP OIL): The Terminal Manager or Operations Manager of each company. The oil companies may elect to nominate a single SUP OIL for their common purpose.

- Spill Advisory Coordinator (SAC)

Senior officer of coordinating Ministry: Senior environmental officer of the Ministry of Housing, Lands and the Environment.

- Advisory Teams

Scientific Advisory Team (SAT): to be appointed.
Socioeconomic Advisory Team (SOCAT): to be appointed.
Strike Force Advisory Team (SFAT): to be appointed.
(see section on "Advisory Teams" for appointment procedure).

6.2. Personnel responsibilities

Plan Director

The Director of the National Oil Spill Contingency Plan (NOSCP) has final authority over all matters concerning any oil spill in Mauritius. Upon notification of the occurrence of a spill, he will decide whether responsibility for action belongs to the Port, an oil company, or NOSCP itself. He will notify the Director of the Port Louis Harbor Contingency Plan or the Oil Company Plan concerned if response is to be provided by one of them. If responsibility belongs to NOSCP, he will appoint the responding OSC for NOSCP (OSC LAND or OSC SEA).

All matters concerning communication with national and international agencies need approval from the Director of NOSCP. He will make necessary arrangements for logistical and other support requested by the responding OSC.

On-Scene Coordinator (OSC)

The On-Scene Coordinator plays a central role in the formulation and implementation of the oil spill response plan. As soon as he is notified of an oil spill, he will take all necessary measures to prevent loss of life and injury, and seek to control the spill. The OSC is in charge of overall planning and makes final operational decisions on behalf of his Plan Director. Communication with the media and the public is handled solely by the OSC. He is responsible for the coordination of the response effort, including technical, legal, and administrative aspects. He establishes response priorities and methods of implementation. The OSC will seek the opinions of the Advisory Teams in order to formulate response strategy. The OSC SEA makes final decisions concerning the use of dispersants, prepares annual updates of NOSCP, and organizes annual training courses for all levels of response personnel.

The OSC will keep a detailed account of the incident and of the countermeasures taken. This will include the maintenance of detailed records and worksheets of all consumable items used, labor employed, vehicles and engineering equipment hired, use of aircraft/helicopter services, vacuum trucks/trailers utilized (with hire costs), costs of temporary storage facilities for recovered oil and oil contaminated material. Similarly, any short-term curtailment of fishing activities and estimated consequent loss of catch should be carefully documented, including damage to the fishing gear, e.g. by oiling. The maintenance of detailed accounts of all expenditures made in connection with the response to an oil spill, and subsequent cleanup operations, is essential in obtaining reimbursement for such costs from the polluter, or the insurer. For this purpose, Appendix 7 provides information for the preparation of claims for compensation, including a daily work report form.

Advisory Teams/SAC

The members of the three Advisory Teams (SAT, SOCAT, and SFAT) provide evaluations of the scientific, socioeconomic, and operational aspects of spill response for the responding OSC. Each Advisory Team will elect a Coordinator to interact with the Spill Advisory Coordinator (SAC) and the OSCs. The teams are expected to hold emergency meetings as requested by the OSC and called by the lead agency's SAC.

Support coordinators

The OSC may appoint support coordinators to perform specific tasks, including the provision of logistical support (meals, clothing, transportation) to field crews, record keeping, and communication.

Response personnel

Personnel to handle spill control, cleanup, and disposal are directed by the OSC or his designated Support Coordinator.

Recommended actions

- Contingency Plans for the Port Louis Harbor and the oil companies should define the responsibilities of the OSC PORT and the SUP OIL, respectively, along the lines of those of the OSCs of NOSCP.
- Arrangements should be made for the release of the Advisory Team members and Support Coordinators from normal work duties at the request of the OSC or the SAC.

7. RESOURCES

7.1 Personnel, equipment and supplies

Personnel capable of handling the various aspects of the National Oil Spill Contingency Plan (NOSCP) have been identified in previous sections. Several of them are involved in existing national emergency plans. Reinforced by cooperation with external organizations specializing in oil spills (see section on Training and Library Material), the level of expertise will be adequate to implement NOSCP.

Personnel for operations at sea should be drawn from the National Coast Guard and the Mauritius Marine Authority (MMA). They can be assisted by additional personnel from the Fisheries Posts and volunteer organizations.

Personnel for operations inland should be drawn from the Special Mobile Force, assisted by the Fire Services and other groups mentioned, including volunteer organizations.

Equipment and supplies suitable for oil spill response are available from several sources. Listings of the material available from the various sources are provided in Appendices 8 to 14. This information will be useful to the members of the Strike Force Advisory Team (SFAT) and to the OSCs when they mobilize equipment and material for oil spill response.

Some material is stocked by the oil marketing companies and the MMA specifically for oil spill use. It must be expected that there can be competing uses for other material not acquired for such purpose. For example, sugar factories may find it difficult to release their trucks and tractors during the sugar cane cutting season. It is essential, therefore, that a reasonable quantity of spill response material be acquired.

It has been found practical to establish, well in advance, the terms of the loan and rental of equipment from potential sources, including private organizations and government. This procedure eliminates confusion and reduces the risk of paying exorbitant rates during an emergency situation.

Locally available material that may be tested for possible use in oil spill cleanup includes the following:

- (a) The by-product bagasse, 10,000 to 15,000 tons of which are in excess every year at the sugar factories.
- (b) Chicken feathers at poultry plants, of which no current use is made.
- (c) Coconut husk, available in abundance.
- (d) Gunny bags, availability of which is reported to be dwindling.
- (e) Cloth remnants, which could be obtained from the textile plants.

Recommended actions

- The following list contains the minimum additional material that should be acquired for effective implementation of oil spill response:

by government:

dispersant spray gear for helicopter use, and arrangements to adapt and utilize a crop-spraying helicopter during oil spills;

one small vessel capable of removing garbage and oil from the sea.

by industry:

dispersant spray gear for boat use;
500 gallons of Corexit 9527 or other acceptable dispersant;
five Manta ray skimmers with pumps and hoses;
large quantity of locally-produced sorbent material;
3,000 feet of oil containment boom;
five portable collapsible tanks.

- Arrangements should be made for the loan and rental of available material by NOSCP. Tractors, front-end loaders, trucks, tanker trucks, graders, as well as hoses, pipes, oil drums, plastic buckets, plastic bags, tool boxes, first aid kits, rubber gloves and rubber boots should be included in the list of needed material. Government departments like the Public Works Department and sources given in Appendices 8-14 should be contacted for that purpose.
- Storage facilities for equipment and supplies should be made available at or near the Port Louis Harbor area.
- A grant should be given to researchers at the University of Mauritius or the Mauritius Sugar Industry Research Institute (MSIRI) to test and manufacture sorbents for spilled oil from material available locally. (A good sorbent material should pick up oil 20 to 60 times its weight). This work should be done in collaboration with the Mauritius Marine Authority or the National Coast Guard to insure that the product is of practical value.
- Laboratory material should be acquired to perform water quality analysis, including the determination of oil and grease concentrations.
- Appendices 8 to 14 should be carefully updated each time the contingency plan is reviewed.

7.2. Environmental and socioeconomic resources

The companion atlas (Gundlach and Murday, 1987) provides 19 annotated maps on a scale of 1:25,000, with symbols showing the locations of sensitive living resources, public beaches utilized by tourists and the local population, and other areas of industrial and cultural importance. Nature and fishing reserves, sensitive species, and relevant industrial plants are listed and mapped. The information is provided in a format convenient for quick reference and interpretation for each of the segments shown in Figure 1. Relevant text describing the environmental and socioeconomic resources in each of the 19 map locations is reproduced in Appendix 15.

The detailed material contained in the companion atlas (Coastal Sensitivity Atlas of Mauritius for Oil Spill Response) should be carefully considered by the members of SAT and SOCAT and by the OSCs in their deliberations regarding strategies and priority areas for protection and cleanup.

Recommended action

- The resources listed in Appendix 15 should be updated each time the contingency plan is reviewed.

8. OIL SPILL RESPONSE STRATEGIES

8.1. Response strategies

Response actions appropriate for different spill scenarios have been perfected over the past several years and are described in many oil spill contingency plans. Useful details can be obtained, for example, from the South Florida Oil Spill Response Handbook (1982), CONCAWE's Field Guide to Inland Oil Spill Clean-up Techniques (1983), API's publication titled Oil Spill Response: Options for Minimizing Adverse Ecological Impacts (1984), Schultze's World Catalog of Oil Spill Response Products (1986), and Environment Canada's Catalogue of Oil Spill Containment Barriers (1986).

Although the conditions prevailing in each case will dictate particular responses, certain general principles do apply. These are discussed below.

If the oil spill is initially observed in offshore waters, it is necessary to monitor its movement. No action should be taken if the oil moves away from land and disperses in the open ocean. If it is judged that landfall is probable, attempts should be made, while the oil is still offshore, to contain and remove it by the use of booms and skimmers. If sea conditions preclude these operations, the use of dispersants should be considered.

Oil on beaches should be removed preferably by the use of rakes, spades, shovels, and sorbent pads. Heavy equipment such as tractors, front-end loaders, graders, and tanker trucks should be used only where the cleanup operations do not cause unnecessary environmental damage. Trampling and use of heavy vehicular equipment in marsh areas, removal of large quantities of sand, and indiscriminate use of dispersants are harmful practices. Oiled vegetation is very difficult to clean. Low-pressure spraying may be attempted. Special precautions should be taken to protect birds from oil spills (see section on Bird Protection).

Spills in rivers can be handled by the use of containment booms and removal by skimmers and sorbent material. Where the oil movement threatens sensitive or economically-important areas, deflection booms can be used to herd the oil to collection points suitable for removal.

Spills on land are handled best by manual methods. Burning in situ can be attempted provided it does not pose an environmental hazard. Danger of contamination to groundwater requires that spills on land be carefully monitored for such impact.

Figures 4, 5, and 6 show the decision-making process in responding to oil spills at sea and in coastal areas. Figure 4 is a decision-tree for the application of chemical dispersants to spills observed offshore. Figure 5 describes the procedures to be followed when it is possible to use booms and skimmers to contain and recover spilled oil at sea. Figure 6 provides suitable response methods for the protection of critical coastal areas.

Attempts have been made to analyze the oil spill response actions suitable for different marine environments including the open ocean, shallow and nearshore waters, enclosed bays, soft-bottom and rocky subtidal areas, coral lagoons, and coral reefs. A useful reference is provided by Janssen and Gundlach (1984).

Several useful illustrations are available, including the report by the Pennsylvania Department of Natural Resources (1986), depicting the field applications of selected response techniques.

8.2. Response techniques for Mauritius

Response in coastal areas

The companion atlas specifies appropriate response methods to be used at various coastal places on 19 section maps of the island. The methods vary according to the shoreline environments exposed to spilled oil, and are reproduced in Appendix 16. They include the following:

- high pressure flushing
- low pressure flushing
- sorbent booms
- deflection booms
- skimmers
- sorbents
- vacuum pumping
- manual cleaning
- trenches lined with plastic sheets
- dispersants in exposed, well-mixed deep waters

It is common experience that unwise cleanup actions can result in more long-term damage than the oil spill itself. Practices to be avoided at important shoreline locations are specified in the companion atlas. They include the following:

- removal of organisms
- trampling and heavy equipment traffic in marsh areas
- removal of substrate
- removal of beach sands
- sand blasting
- dispersants in sheltered areas with inadequate mixing
- dispersants near reef areas
- burning in marsh areas

Response offshore

Spilled oil offshore should be monitored by aerial reconnaissance, using Police or charter aircraft. If its movement does not threaten the island, no response action is necessary. When it is judged that landfall is probable, the responding OSC will decide if the sea state allows the use of booms and skimmers while the oil is still offshore. The region extending to about 12 nautical miles offshore in the lee (west) of the island is often most suited to this action.

When sea conditions do not allow the deployment of booms and skimmers, or when the latter are not adequate, the OSC SEA will decide on the need to use dispersants (see section on Dispersants). Helicopters fitted with spraying apparatus, or workboats equipped with spray booms mounted as far forward as possible, can be utilized to attempt spill control with dispersants.

If the spill is close to the coral reef or within the lagoonal waters, dispersants should not be used. The oil will probably ride over the reef, and containment can be attempted in the calmer waters of the back-reef.

Response inland

Cleanup of inland spills should first be attempted manually with sorbent material and pumps. Dispersants should not be used in fresh water. Where spilled oil is moving downhill due to a topographic gradient, ditches should be dug in its path and lined with plastic material. In all cases, the oily wastes collected should be carefully carried to designated disposal sites.

8.3. Dispersant use

Much research has been conducted on the toxicity of chemical dispersants on marine organisms. Useful references include Environment Canada's Guidelines on the Use and Acceptability of Oil Spill Dispersants (1984), the proceedings of conferences on oil pollution, and other sources listed in the section on Training and Library Material.

Although the practice of using dispersants to control oil spills has been gaining more acceptance in the recent past, its use is normally reserved for special circumstances. The decision to use dispersants is usually based on a judgement as to whether greater harm would ensue with or without its use. In making this choice, the following factors are considered: the fate and movement of the spilled oil, the resources threatened by the oil, and their importance and probable damage (Trudel and Ross, 1987). A detailed knowledge of the local living resources and their behavior to spilled oil is required in order to make a sound judgement.

Figure 4 illustrates the decision-making process for dispersant use on an oil spill which has been observed offshore and is moving towards land. The chart is reproduced from Environment Canada (1984) and is commonly used in oil spill contingency plans.

On behalf of the Director of NOSCP, the On-Scene Coordinator for spills at sea (OSC SEA) will decide on a case-by-case basis whether chemical dispersants should be used. Authority for dispersant use is thus reserved for the National Oil Spill Contingency Plan. Approval of particular dispersant types is also the prerogative of the OSC SEA. The approval process can be based on proof of approval for oil spill use in tropical waters by competent foreign authorities.

Dispersants are effective on freshly-spilled oil, generally not more than 2 to 3 days after the spill. They should be applied in concentrations specified by the manufacturers. Their use is most appropriate in well-mixed deep waters which allow easy dispersion. They are ill-suited to sheltered waters where high concentrations can be harmful to living resources. Dispersants should not be used in the harbor, except when such use is necessary in order to reduce a fire hazard. Dispersants should not be used in fresh water.

Currently, Shell dispersant VDC and Esso dispersants COREXIT 7664, COREXIT 8667, and COREXIT 9527 are available in Mauritius. Another dispersant, the Magnus Maritec "oil spill disperser" is marketed in Mauritius. These products have received approval for use in several countries.

Experience in the use of dispersants on marine oil spills in recent years has indicated that aerial application, e.g. from aircraft equipped for crop spraying, is more cost effective than spraying from a surface vessel, where very poor visibility of the distribution and extent of the oil slick frequently results in ineffective use of dispersant.

Recommended actions

- A list of approved dispersants should be drawn up, and appropriate quantities should be acquired, primarily by the oil companies.

- The use of dispersants in depths of 20 meters or less, or within a mile of such depths, should be prohibited, except in extreme situations when the Director of NOSCP may allow its limited use.
- Research projects should be encouraged to investigate the Mauritius environments where dispersants can be allowed or prohibited.
- Early consideration should be given to the use of aerial spraying of dispersants, with a view to establishing such a capability in one or more of the locally-available crop spraying aircraft.

8.4. Bird protection

Special precautions should be taken to scare shore birds away from the spill area. Birds are usually wary of the presence of objects moving at altitudes higher than theirs. The use of kites and balloons is recommended. Mylar balloons filled with helium, of a diameter of about 50 cm and spaced about 100 m apart, have been found to be effective. Noise-making, firecrackers, and firearms have also been found to be good hazing techniques.

Special bird cleaning stations should be set up to clean captured birds. Bird cleaning techniques have improved through experience. It is important to clean the birds when they are in the best possible physical condition. Rough handling will retard waterproofing. Feathers must be thoroughly cleaned with special cleaning agents (e.g. 9% Karo solution) and rinsed. A gentle water-jet can be applied directly against the skin. The bird is cleaned in several stages, rinsed and dried. Ointment is then applied to its feet and eyes.

A useful handbook for procedures to be employed in the rehabilitation of oiled seabirds is the API publication: Saving Oiled Seabirds (1987).

8.5. Fate and movement of spilled oil

Thickness and coverage

Once a spill has been observed offshore, it is important to estimate its size and forecast its movement. The extent of spilled oil can be estimated by aerial inspection. The thickness of the oil slick is a function of its appearance, as shown in Table 1 below.

TABLE 1

The appearance of oil on water according to film thickness
(adapted from " Manual on Disposal of Refinery Wastes: Vol. I Waste Water Containing Oil", American Petroleum Institute, 1963)

Appearance	Film Thickness		Coverage	
	10 ⁻⁶ in.	nm	gal/mile ²	mg/m ² *
Barely visible under most favorable light conditions	1.5	38	25	38
Visible as silver sheen on surface	3	76	50	76
First trace of color may be observed	6	150	100	150
Bright bands of color are visible	12	310	200	310
Colors begin to turn dull	40	1000	666	1000
Colors are much darker	80	2000	1332	2000

Note: 1 nanometer (nm) = 10⁻⁹ meter

* values assume film specific gravity = 1.0

Movement and trajectories

Oil movement can be estimated by the simple vector calculation:

Oil movement = 3% wind + 100% current.

More sophisticated numerical models exist to forecast landfall of an offshore slick (e.g. Spaulding et al., 1987). Their application to the southwest Indian Ocean is expected to be valuable if applied on a regional scale (Murday, 1987b).

Recommended action

- A predictive model for the movement of spilled oil in the southwest Indian Ocean should be developed. User-friendly computer hardware and software should be located in Mauritius, and nationals trained in its use for regional forecast.

8.6. Collection and storage

Used lubricating oil, oily mixtures from vessels, and spilled oil need to be collected and stored before disposal. Waste oil from regular operations should be stored in permanent centers from which they can be sent periodically for disposal, as described in the next section. In the event of a spill, temporary receiving facilities may also be needed at convenient locations. Pits can be dug and lined with plastic sheets for temporary storage of oil. Plastic bags can also be used to contain waste oil. These should then be carried to approved disposal sites.

In all cases, storage of waste oil should be done in a manner that is safe to public health and welfare, and the environment.

Recommended actions

- Collection centers should be designated by the oil companies for the reception of used lubricating oil from filling stations, motor vehicle workshops, and roadside mechanics. The oil should be stored in an existing tank or one specially constructed for that purpose.
- Tank cleaning residue should be transported by barges belonging to the Mauritius Marine Authority to reception facilities at one of the existing tank farms in Port Louis.

8.7. Disposal

It is very important to choose appropriate disposal methods and disposal sites for the oily products that remain after cleanup and collection. Disposal methods should remedy rather than cause environmental problems. Several methods are in use and are described in publications such as the U.S. Environmental Protection Agency's report on Oil Spill: Decisions for Debris Disposal (1977), the American Society for Testing and Materials manual on Disposal of Oil and Debris Resulting from a Spill Cleanup Operation (1978), Leo's Ölwehrhandbuch (1983), and ITOPF's technical paper on Disposal of Oil and Debris (1984). Disposal methods are discussed briefly below.

Deposition on vacant lots

This method consists of simply dumping the oily debris in vacant lots with little or no soil cover. Environmental effects and aesthetic considerations dictate that this method should be avoided.

Burial

Oily wastes are deposited in pits or trenches and covered by soil. Costs are low, operations are carried quickly, and the land can be returned to its original appearance. However, the oil remains undegraded for a long time, increasing the risk of leaching. Soil contamination also precludes the short-term use of the site for agriculture. This method is not favored for Mauritius.

Encapsulation

Encapsulation of oily waste by treatment with quicklime converts it into an inert material that is suitable for road building. The high cost of equipment and the low amount of regularly-produced waste make the process uneconomical for Mauritius.

Land Farming

Land farming provides a method of utilizing bacteria in the soil to biologically degrade oily material spread over large areas and ploughed into the soil. Arable crops can be grown after a year, although high metal uptake restricts crops to non-consumable products. The high value of land and problems of leaching due to high rainfall do not favor the practice of land farming in Mauritius.

Sanitary Landfilling

Landfilling is the process of disposing oil spill debris with solid waste at sanitary landfills or dumps. Co-disposal of oily and domestic wastes has been used in several places and offers certain advantages (IMO, 1986). Costs are low and equipment needs minimal. Little site preparation is required. However, leaching is possible and monitoring of the site is recommended. It is necessary to leave at least four meters of mature domestic wastes between the base of the landfill and the oily waste. The oil is commonly degraded in three to four years. Quicklime can be mixed with the oily waste to render it inert.

Landfilling is an acceptable disposal method in Mauritius.

Incineration

Incineration is more expensive than landfilling. However, it is possible to consider its utilization for the infrequent treatment of small amounts of oily material expected. Combustion with Bagasse at the sugar factories should be considered. The use of a small incinerator owned by Shell could handle oil from reception facilities.

Burning

Burning oily debris where air quality is not impaired beyond acceptable limits offers the advantage that no aromatics remain after complete combustion. Leaching into groundwater and uptake of harmful organics by plants do not occur.

Burning of oily debris is favored for Mauritius. However, the siting and timing of the operation should be chosen with the full collaboration of the Meteorological Services, so as to avoid air contamination over populated areas.

Recycling

The continual discharge of used lubricating oil into the environment can be controlled through a program for the collection, storage, and recycling of these wastes. Portable units are on the market and are especially suitable for the treatment of the relatively small amounts of waste oil in Mauritius.

Selection of land disposal sites

There are 7 existing and 16 proposed dumping grounds in Mauritius (Appendix 17). Problems of leaching with possible contamination of groundwater render the choice of a site a non-trivial question. It will be necessary to conduct a study into the geological characteristics of the soils in conjunction with the aquifer location around the disposal sites to determine appropriate sites for oily wastes.

Recommended actions

- A study should be commissioned to identify the most appropriate sites for sanitary landfilling.
- The resident oil companies should be required to institute a program, as part of their oil spill contingency plans, to collect, store, and recycle used lubricating oil. Incentives could be provided to filling stations and motor mechanics for the storage and delivery of waste oil to the oil companies.

8.8. International services

Response to major spills will require emergency international assistance. Arrangements can be sought under bilateral and regional treaties, and in the terms of contracts with the oil marketing companies operating in Mauritius. A few of the international services which can provide emergency response or direct Mauritius to appropriate technologies are listed below:

Alba Clean Ltd. - Hareness Road, Unit 4, Altens Industrial Estate, Aberdeen AB1 4LE, United Kingdom (Tél. 224-878188, Telex 26-499).

Byers Spill Control, Inc. - P.O. Box 1578, Harvey, Louisiana 70059, U.S.A. (Tél. 504-367-0993).

Hudson Maritime Services, Ltd. - Hudson Square, 800 Cooper Street, Camden, New Jersey 08102, U.S.A. (Tél. 609-342-7500, FAX 609-342-8722).

International Technology Corp. - 23456 Hawthorne Blvd., Torrance, California 90505, U.S.A. (Tél. 213-378-9933)

Jet-Line Service, Inc. - 441R Canton St., Stoughton, Massachusetts 02072, USA (Tél. 617-843-2829).

LeoConsult, GmbH. - Weserstrasse 84, D-2820 Bremen 70, West Germany (Tél. 0421-66-93-45, Telex 245782 LEO D).

O.H. Materials Company - 16405 Route 224 East, Findlay, Ohio 45840, U.S.A. (Tél. 419-423-3526).

Oilchem Recovery Denmark Pollution Combatting Systems A/S - Wilders Plads, bygning O, DK-1401 Copenhagen K, Denmark (Tél. 45-1-95-70-95, Telex 21188).

Oil Mop, Inc. - P.O. Drawer P., Belle Chasse, Louisiana 70037, U.S.A. (Tél. 504-394-6110, Telex 587-486).

O'Brian Oil Pollution Services, Inc. - 1700 Stumpf Boulevard, Suite 61, Gretna, Louisiana 70056, USA (Tél. 504-394-0893).

OMI Ltd. - Cannon Bridge Works, Cannon Lane, Tonbridge, Kent TN9 1PP, United Kingdom (Tél. 732-352125, Telex 95345 OMIEUR G).

Pollex France, S.A. - 11 Avenue de la République, F-69160 Tassin la Demi-Lune, France (Tél. 078-345095, Telex 330419 Pollex F).

Reidel Environmental Services, Inc. - P.O. Box 5007, Portland, Oregon 97028-5007, U.S.A. (Tél. 503-286-4656 ext 664, Telex 131-572).

World Information Systems - P.O. Box 535, Cambridge, Massachusetts 02238, U.S.A. (Tél. 617-491-5100, FAX 617-492-3312).

9. CONSIDERATIONS FOR THE FUTURE

9.1. Training and library material

It is important that personnel who have been identified for oil spill response should receive training in the various response strategies. The OSC SEA, in collaboration with the other OSCs, will organize yearly training programs for all levels of oil spill response personnel. The training sessions should include the simulated activation of NOSCP so as to test its effectiveness.

Several short courses are held abroad every year on the subject of oil spill response. Arrangements should be made for the OSCs, their assistants, and the members of the Advisory teams to attend such courses, especially those that are held in tropical island environments. Similarly, important conferences such as the Oil Spill Conference (U.S.A.) and the Seminar on the Petroleum Industry and the Nigerian Environment should be attended by these individuals.

Extensive reference material exists on oil pollution, oil spill contingency planning, and response techniques. In particular, the training package of five films on Response to Marine Oil Spills, produced by Videotel Marine International in collaboration with IMO, ITOFF, and the Commission of the European Communities, has been made available to the Ministry of Trade and Shipping by IMO and can be used in training courses. The OSCs should build up a library of reference material which could be stored at the facilities of the Mauritius Marine Authority. The following list gives the sources of relevant material, some of which is available at no charge:

1. American Petroleum Institute
Publications and Distribution Section
1220 L Street, N.W.
Washington, DC 20095
U.S.A
2. Environment Canada
Publications Coordinator
Technology Development and Technical Services Branch
Ottawa, Ontario K1A 0H3
Canada
3. CEDRE
Centre de Documentation de Recherche et d'Expérimentation
sur les Pollutions Accidentelles des Eaux
Boîte Postale 308
29274 BREST CEDEX
France
4. CONCAWE
Babylon-Kantoren A
Koningin Julianaplein 30-9
2595 AA The Haag
The Netherlands

5. International Maritime Organization
Marine Environment Division
3, Albert Embankment
London, SE1 7SR
United Kingdom
6. International Tanker Owners Pollution Federation
Staple House, Stonehouse Court
87-90 Houndsditch
London, EC3A 7AX
United Kingdom
7. United Nations Environment Programme
OCA/PAC
P.O. Box 30552
Nairobi
Kenya
8. United States Coast Guard
Environmental Response Division
Washington, DC 20593
U.S.A.
9. United States Environmental Protection Agency
International Affairs Department
Washington, D.C. 20460
U.S.A.

9.2. Review and update

The On-Scene Coordinator for spills at sea (OSC SEA) will submit to the Director of the National Oil Spill Contingency Plan yearly updates and modifications to the present document. Upon approval, the OSC SEA will send revised material to the individuals and institutions named in the Distribution List.

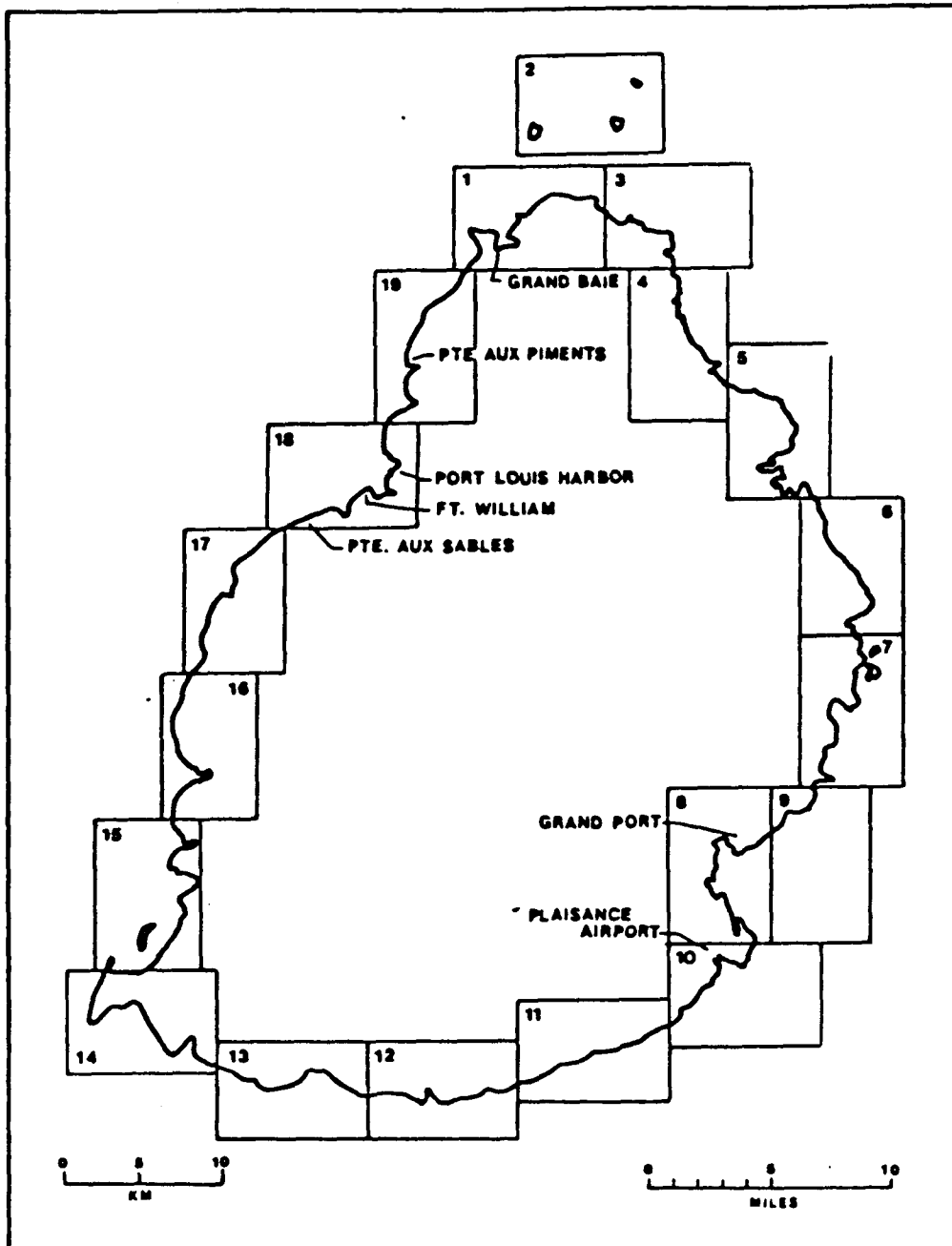


Figure 1: Map of Mauritius showing the 19 segments contained in the "Coastal Sensitivity Atlas of Mauritius for Oil Spill Response".

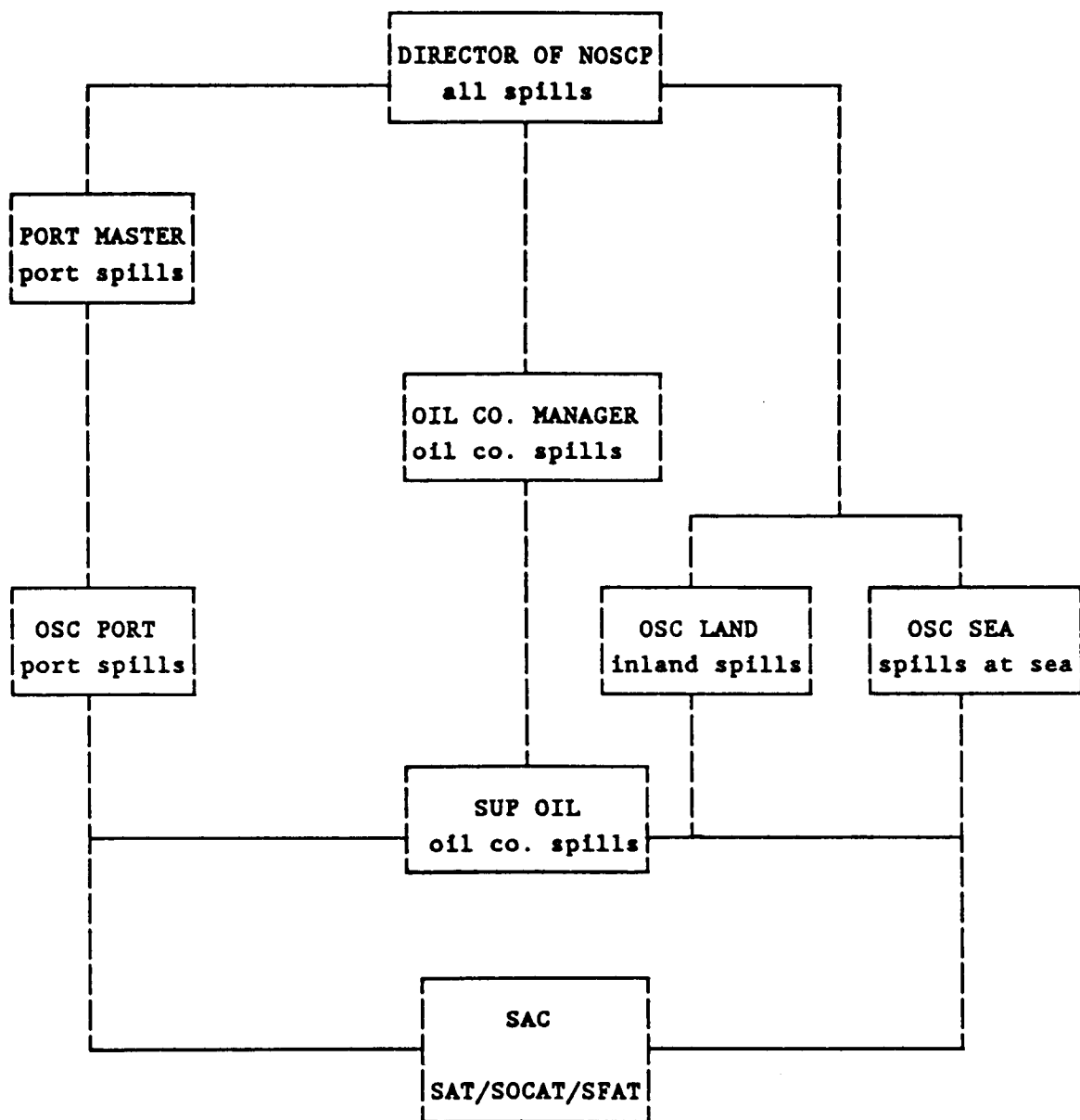


Figure 2: Organizational response chart

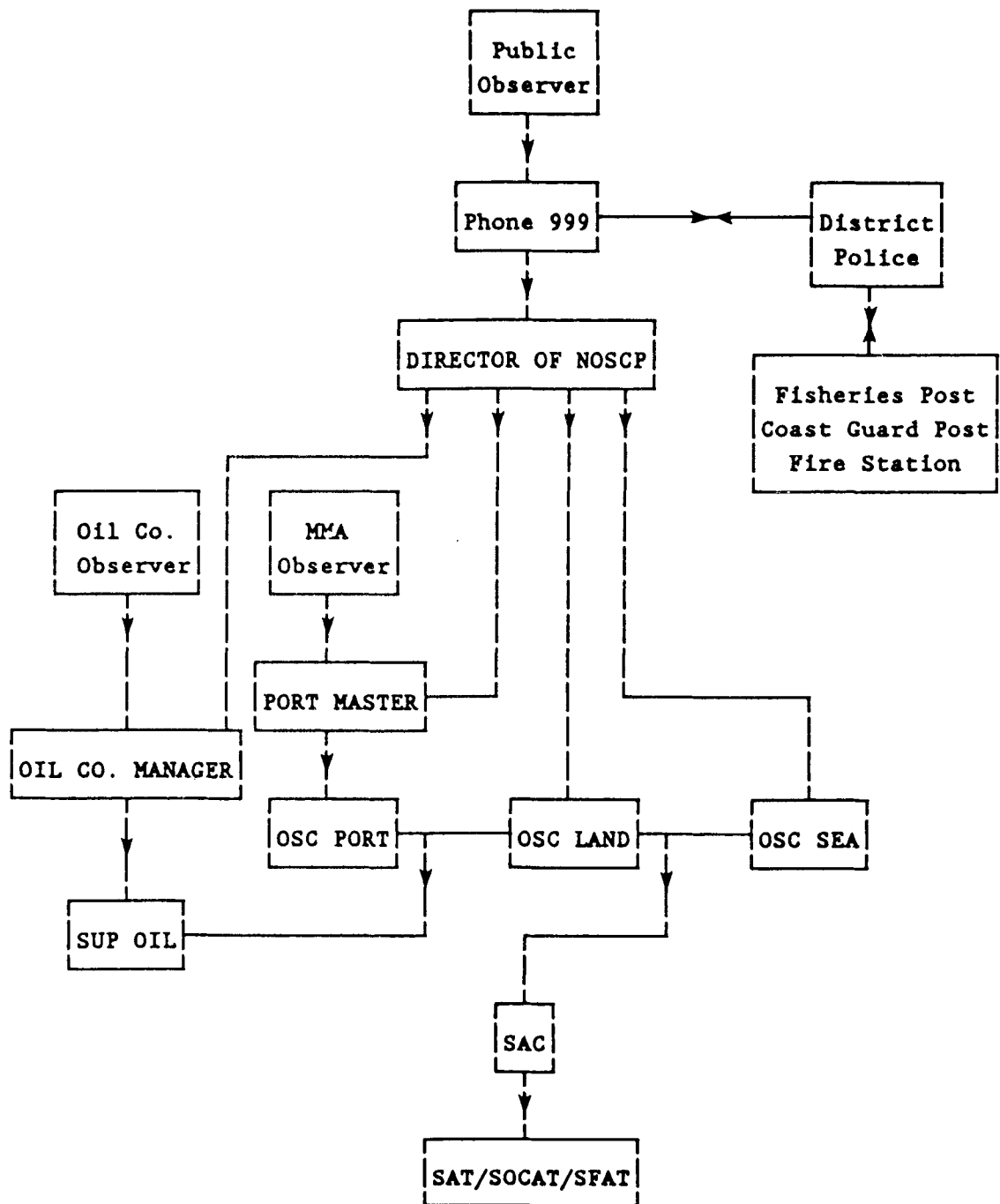


Figure 3: Oil spill alert procedure

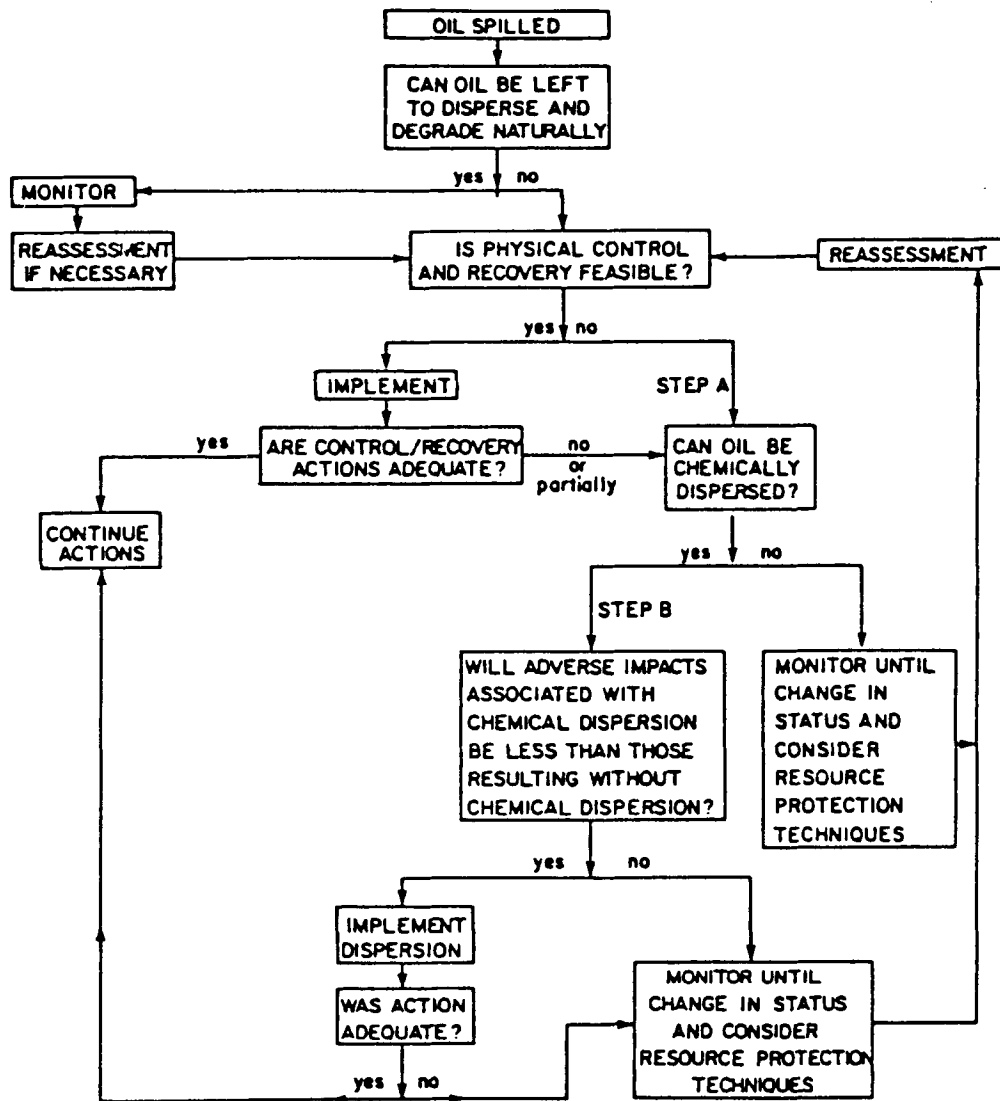


Figure 4: Response guidelines for the use of dispersants at sea (from Environment Canada, 1984).

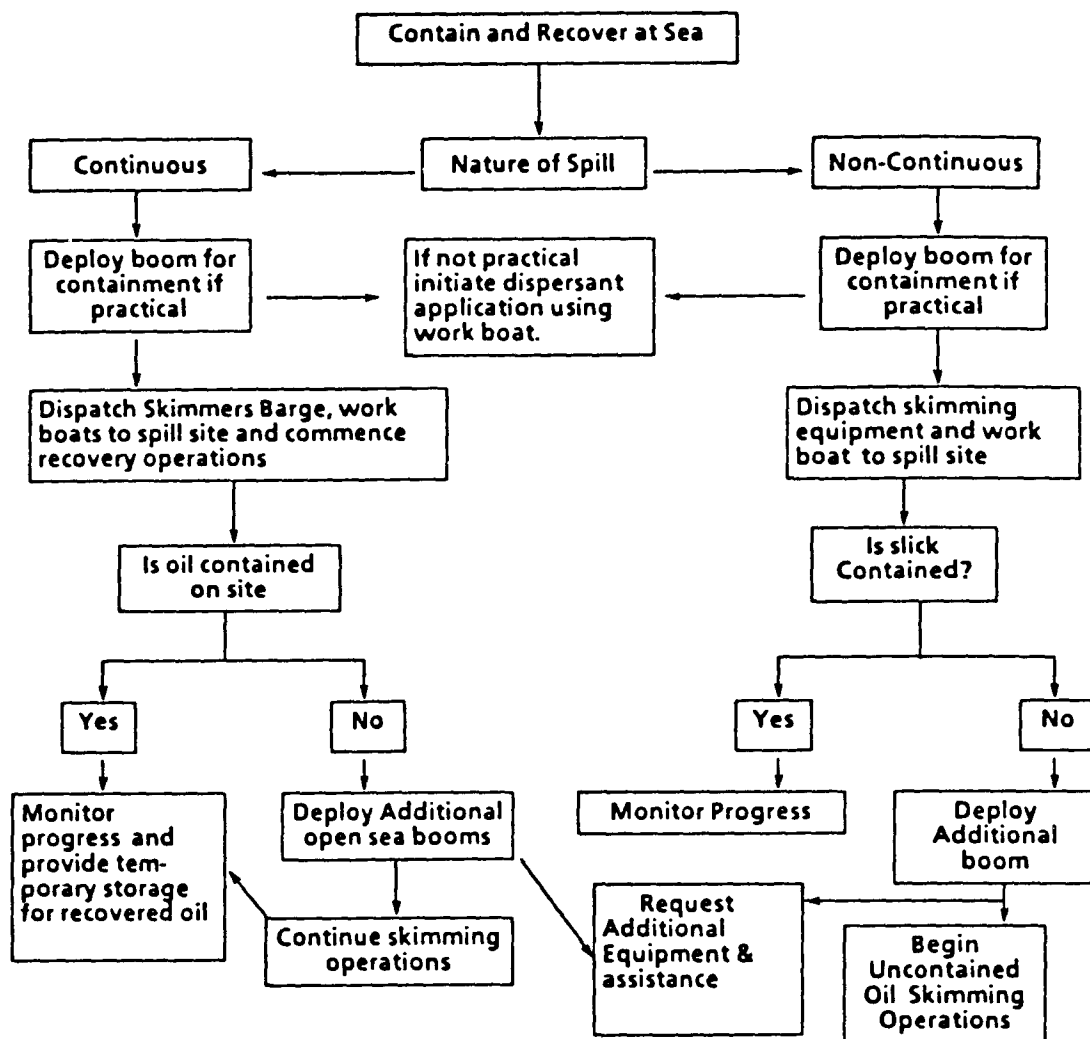


Figure 5: Response guidelines for containment and recovery at sea.

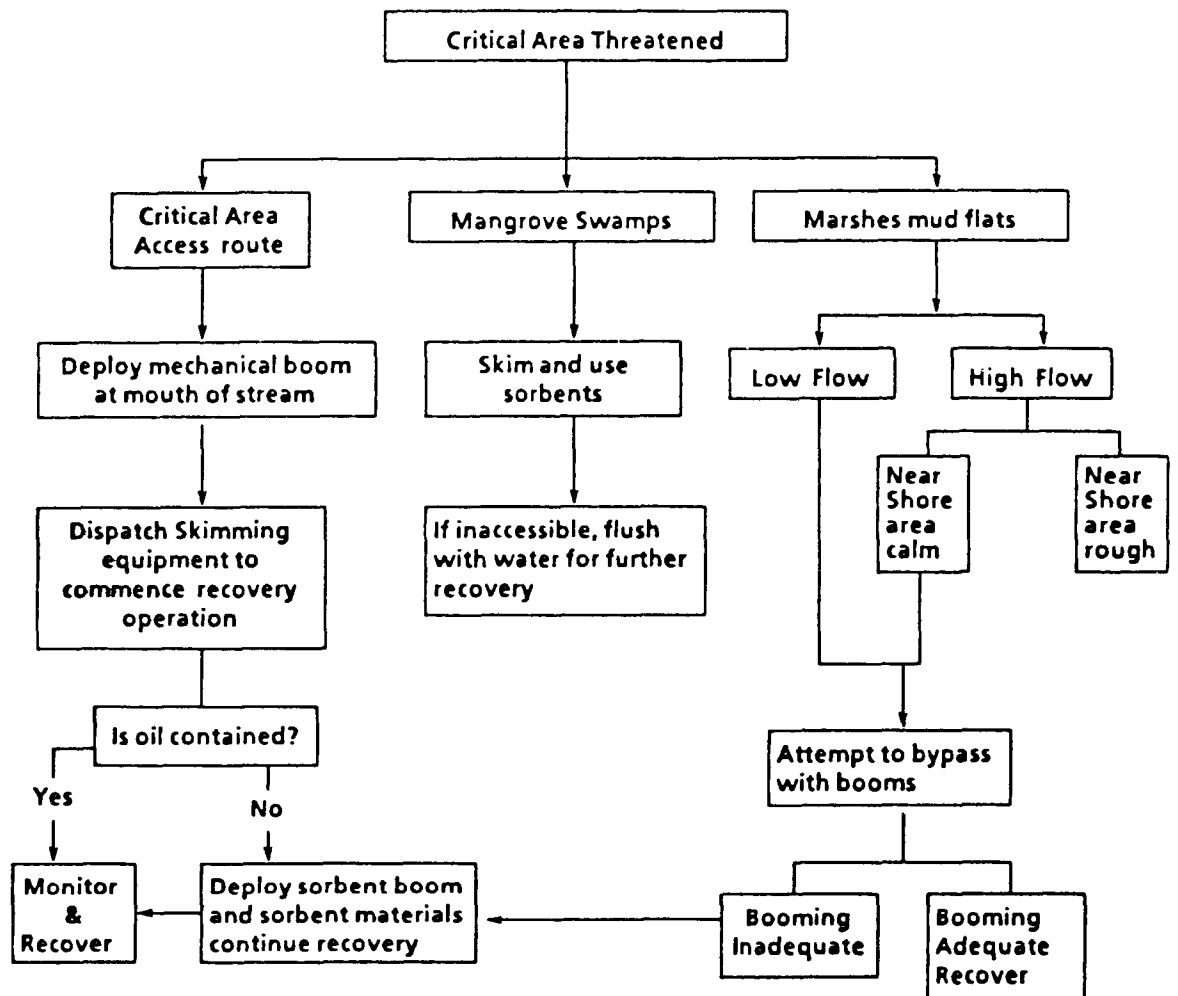


Figure 6: Response guidelines for coastal areas.

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APPENDIX 1
YEARLY IMPORTATION OF PETROLEUM PRODUCTS IN METRIC TONS
(SOURCE: STATE TRADING CORPORATION)

YEAR	MOTOR GASOLINE 95 RON	DUAL PURPOSE KEROSENE	AUTOMOTIVE GAS OIL	BUNKER FUEL OIL	TOTAL
1983	5100	700	9100	12000	26900
1984	12858	4066	31520	42558	91002
1985	26317	52114	69212	55791	203434
1986	40666	87663	131602	73645	333576
1987 (to Sept.)	29459	80604	116637	70643	297343

APPENDIX 2
BULK STORAGE OF PETROLEUM PRODUCTS IN METRIC TONS
(SOURCE: STATE TRADING CORPORATION)

LOCATION	OWNER	TANK NO.	TYPE	CAPACITY
Fort William	joint	1	fuel oil	5,176
Fort William	joint	2	fuel oil	<u>5,163</u>
				<u>10,339</u>
Roche Bois	Shell	1	jet A1	4,933
"	"	2	premium	3,275
"	"	3	gas oil	1,390
"	"	4	kerosene	775
"	"	5	jet A1	1,600
"	"	6	gas oil	3,889
"	"	7	gas oil	1,505
"	"	8	gas oil	2,350
"	"	9	jet A1	2,510
"	"	10	kerosene	<u>715</u>
				<u>22,942</u>
Shell Causeway	Shell	1	fuel oil	7,180
"	"	2	gas oil	3,163
"	"	3	fuel oil	<u>6,062</u>
				<u>16,405</u>
Esso Terminal	Esso	1	ADO	5,500
"	"	2	ill. kerosene	1,000
"	"	3	ill. kerosene	1,000
"	"	4	mogas 95R	2,675
"	"	5	fuel oil	6,350

"	"	6	ADO	4,000
"	"	7	jet A1	3,750
"	"	8	solvent	<u>725</u>
				<u>25,000</u>
Plaisance Airport	Esso	E	jet A1	35
"	"	F	jet A1	35
"	"	G	jet A1	270
"	"	H	jet A1	<u>400</u>
				<u>740</u>
Caltex terminal	Caltex	1	mogas 95R	1,850
"	"	2	jet A1	8,600
"	"	3	ADO	<u>3,100</u>
				<u>13,550</u>

APPENDIX 3
CONVENTIONS AND LEGISLATION RELATED TO OIL POLLUTION

International and regional conventions

The following conventions have been signed by Mauritius:

1. International Convention for the Regulation of Whaling (as amended), Washington, 1946.
2. International Plant Protection Convention, Rome, 1951.
3. Convention on the Continental Shelf, Geneva, 1958.
4. Convention on Fishing and Conservation of the Living Resources of the High Seas, Geneva, 1958.
5. Convention on the High Seas, Geneva, 1958.
6. Treaty banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and under Water, Moscow, 1963.
7. Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-bed and the Ocean Floor and in the Subsoil thereof, London, Moscow, Washington, 1971.
8. Convention on the International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973.
9. United Nations Convention on the Law of the Sea, Montego Bay, 1982.

Pertinent conventions to which Mauritius is not yet a party include:

1. African Convention on the Conservation of Nature and Natural Resources, Algiers, 1968.
2. International Convention for the Prevention of Pollution of the Sea by Oil, London, 1954 (as amended on 11 April 1962 and 21 October 1969).
3. International Convention on Civil Liability for Oil Pollution Damage, Brussels, 1969.
4. International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Brussels, 1971.
5. Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972.
6. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London, Mexico City, Moscow, 1972.
7. International Convention for the Prevention of Pollution from Ships, London, 1973 (as modified in 1978).
- 8a. Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region, Nairobi, 1985.
- 8b. Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region, Nairobi, 1985.
- 8c. Protocol concerning Co-operation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region, Nairobi, 1985.

National legislation

The following laws have possible applications to oil-related pollution and/or resource protection:

1. The Ports Act 1975.
2. The Maritime Zones Act 1977.
3. The Fisheries Act 1980.
4. The Forest and Reserves Act 1983.
5. The Wildlife Act 1983.

APPENDIX 4
THE PORT LOUIS HARBOR OIL SPILL CONTINGENCY PLAN
(SOURCE: MAURITIUS MARINE AUTHORITY)

Recognizing the possibility of an accidental spill in or near the Port Louis Harbor, the Mauritius Marine Authority (MMA) has drawn up the scope of a contingency plan, dated 1985, which is expected to be finalized in the near future.

The document notes that the Port Master is empowered by law (the Ports Act 1975) to take whatever measures are deemed necessary to regulate the movement of vessels in the port, whether under normal circumstances or in the event of a marine accident occurring in the port. The MMA intends to assume responsibility as agency entrusted with the implementation of a contingency plan aimed at protecting the port environment from spills of oil and other noxious substances.

The stated objectives of the plan are reproduced below:

- To develop appropriate systems for the detection and reporting of spillages of oil or other noxious substances or of incidents related to shipping operations which could result in such spillage.
- To ensure that prompt response is made to either prevent pollution or to restrict the spread of contaminants subsequent to an incident.
- To ensure that correct response techniques are used to clean up the pollution.

Three support groups are identified:

- The Police Force.
- The Ministry of Agriculture, Fisheries, and Natural Resources.
- Esso-Shell-Caltex, etc.

The organizational structure gives overall responsibility for spill response to the Port Master. The Fire Superintendent is designated as Pollution Prevention Officer and would be the onsite representative. He would submit situation reports and requests for resources through the Pilots' Office. His main responsibilities would consist of the following:

- Directing the employment of needed resources for prevention of pollution, containment, cleaning up and disposal of any pollutants and restoration of the site.
- Providing a focal point of information for all agencies concerned.
- Preparing cost analysis and a detailed report concerning all aspects of the spill.
- Collecting samples for possible analysis.

Recommended actions

In the light of developments since the formulation of the action plan for Port Louis Harbor, the following measures should be undertaken as soon as possible:

- Draw up an Oil Spill Contingency Plan for Port Louis Harbor with the assistance of international experts, if necessary. In addition to the guidelines already established and reported above, the plan should provide for the sharing of material resources with the National Oil Spill Contingency Plan.
- Clarify the geographic boundaries of the Port Louis Harbor contingency plan.
- Effect periodic cleanup of chronic spills within the harbor. Evolve formulae for the recovery of cleanup and disposal costs from oil operators.
- Continue and formalize procedure for cost recovery of cleanup of identifiable spills. It is probable that this action could be taken on the basis of Sections 41(1)(j) and 42 of the Ports Act.
- Install adequate facilities for the reception of oily bilge water and other oily wastes from tank cleaning operations. This would be in compliance with MARPOL 73/78.

APPENDIX 5
OIL SPILL CONTINGENCY PLANS OF RESIDENT OIL COMPANIES

ESSO MAURITIUS LIMITED.

The Esso oil marketing company has drawn up a current contingency plan for oil spills at Esso Terminal and inland spills resulting from tanker truck accidents. Based on a model from its headquarters, the plan is designed to deal with minor spills. Arrangements are being sought with the Mauritius Marine Authority to acquire dispersant spray booms and to extend the Esso Plan to medium spills. It is reported by the Terminal Manager of Esso that arrangements exist with headquarters to receive external intervention within 48 hours from London.

The main components of the Esso Plan are reproduced in Appendix 6.

SHELL CO. OF THE ISLANDS PLC

No formal contingency plan was made available. Material received concerned the promotion of Shell Dispersant VDC. Through its operations manager, the company is actively involved in keeping abreast of information relevant to spill response.

CALTEX/TOTAL

No contingency plan was made available.

MAURITIUS PETROLEUM INSTITUTE CONSULTATIVE COMMITTEE (MPICC)

This committee is composed of representatives of the four oil companies operating in Mauritius. It meets every fortnight. Plans to form a cooperative for oil spill response have been reported since 1979 (Hayes, 1979), and have yet to be implemented.

Recommended actions

- The oil companies should form a cooperative for oil spill response and formulate a joint Oil Spill Contingency Plan, along the lines of the Esso plan. The MPICC may wish to play a leadership role in such a cooperative. The plan can be easily adapted to the Mauritius situation from existing plans at company headquarters. It should coordinate the international resources which are available from the different companies. It should make specific reference to response to spills that could occur at the tank farms, along the pipelines, during overland transportation, and at sea.
- The foremost task of a cooperative of oil companies should be the acquisition of additional oil spill response equipment and supplies. Minimum needs are recommended in the section "Personnel, Equipment and Supplies". Arrangements should be made for the rental or use of such equipment and supplies by government (NOSCP) at prearranged rates, in the event of spills not involving the operators.

- Another important task is to formalize separately or jointly agreement with external cooperatives for quick response and transfer of equipment and expertise in the event of a major spill.
- As a matter of good operational practice, the oil marketing companies should be encouraged to conduct annual training courses in the handling of oil response equipment. Arrangements should be made for government and other concerned personnel to participate in these courses.
- Authority to require the oil companies or the MPICC to take the above actions could be derived from directives issued by the Ministry of Housing, Lands, and the Environment, or the Prime Minister's Office, or from the terms of the contracts under which the companies operate.
- The oil companies should be required to institute a program for the collection, storage, and disposal of used lubricating oil.

APPENDIX 6
ESSO MAURITIUS LIMITED
OIL SPILL CONTINGENCY PLAN
(SOURCE: ESSO MAURITIUS LIMITED)

Alert procedure

1. Company employee observing a spill notifies the Terminal Manager.
2. Terminal Manager assesses seriousness of spill and need to notify the General Manager.
3. Oil Spill Coordinator alerts Oil Spill Task Force.

External alert procedure

After notifying the General Manager, the Terminal Manager immediately notifies the Port Master, the Department of Fire Services, Esso Europe Africa Services Oil Spill Coordinator in London.

Information transmitted

Information to be gathered and transmitted to Esso headquarters are specified as follows:

1. Time spill occurred or was first observed.
2. Original and present spill location.
3. Type of oil spilled.
4. Estimate of amount spilled or rate of release if continuing.
5. Environmental conditions - winds, waves currents, etc.
6. If from barges or vessels, name of craft, registry, owner or consignee, deadweight tonnage, and draft.
7. Description of area likely to be affected, such as river banks, beaches, properties, wildlife areas, groundwater, etc.
8. Cause of spill, if determined.
9. Action being taken to combat spill.
10. Agencies or persons already notified.

Action procedures

Esso personnel in Mauritius are expected to initiate cleanup procedures. The types of action to be initiated are not specified.

Responsibility

Small spills are the responsibility of the Terminal Manager. Handling of medium and large spills would be supported by other Esso affiliates through arrangements made by the General Manager with the Manager of Europe Africa Services.

Oil Spill Task Force

The composition and contact phone numbers of the task force are given as follows:

	Office	Home
The Oil Spill Coordinator (Mr. G. Merle)	08-4040	86-4815

The Accounting & Finance Manager
(Mr. M. Quevauvilliers)

08-4040

4-2215

Responsibilities of Oil Spill Coordinator

The Oil Spill Coordinator is charged with the following responsibilities:

- Training of personnel in equipment handling.
- Attribution of spill response duties to personnel.
- Maintaining an inventory of spill equipment and personnel.
- Distribution of technical data and training material to personnel.
- Periodic review of company's readiness for response.
- Close liaison with Mauritius Marine Authority with regard to equipment.

Equipment and material

The Esso plan lists the following equipment in stock:

1. One Oil Spill Cleanup Kit consisting of:
 - one SLURP skimmer fitted with FLOAT buoyancy unit;
 - one 3 m length of 1 1/2 inch bore suction/discharge oil hose fitted with 2 female couplings (1 1/2 inch BSP);
 - one EP8CV petrol engine centrifugal self priming pump (complete with control valve and strainer);
 - one HP 1 hand pump kit;
 - one STF (Storage Tank Fittings) kit;
 - two packs of 60 ft length SSM boom;
 - one suction nozzle.
2. Three additional packs (each 60 ft in length) SSM boom.
3. Five barrels COREXIT 7664 dispersant.
4. Five barrels COREXIT 8666 dispersant.

Public relations

Esso instructions regarding contact with the news media call for statements of facts to be issued by a single company official. The duties of the Public Relations Officer are as follows:

- Set up communication facilities for the news media.
- Make arrangements to get local reporters to spillsite or back to communications facilities.
- Provide regular briefings to press and government officials.
- Monitor press and TV coverage.
- Keep corporate headquarters informed.

Press statements

Initial statement

1. Give the name of the installation or vessel(s) involved, the time of the accident, the destination of the vessel(s) and any other facts that are not in dispute (such as the steps the company has taken to contain, control, or handle the spill).
2. State explicitly that it is the company's policy to prevent pollution of the sea, coastline, or inland waters - whatever is appropriate - and to minimize damage to property or the ecology.

Further statements

1. Note that containment and cleanup experts are on (being called to) the scene to supervise the operation.
2. Give the type of product spilled - light or heavy oil? Other?
3. Report whether spill has been controlled.
4. Give the size of the spill - quantity and area affected.
5. Tell how spill is moving, and what factors can affect its movement, such as wind, current, and tides.
6. Describe cleanup measures that have been taken and planned - types and quantities of equipment being used and manpower involved.
7. Describe special efforts taken to protect property and wildlife.

Statements to avoid

The following types of statements are not to be made, unless cleared with corporate headquarters:

1. Speculations concerning liability for the spill or its legal consequences.
2. Speculations regarding the cause of the spill. An extended enquiry may be needed to determine the actual cause, and legal liability could be affected by what is said.
3. Estimates of how long cleanup will take or of cleanup costs.
4. Promises that property, ecology, or anything else will be restored to normal.
5. Opinions concerning the appropriateness of government response to the oil spill.

Reaction to incorrect statements

In the event incorrect statements or unfounded speculations are published, the following steps are suggested:

1. Provide the source with correct information. Arrange for representatives to fly over the spill, or otherwise visit it, to confirm company estimates as to size and damage.
2. Avoid direct rebuttal of erroneous statements; ask for amendments of incorrect details.
3. Do not rebut statements by scientists unless you use a comparable scientific source to back up any statement you make.

APPENDIX 7
PREPARATION OF CLAIMS FOR COMPENSATION
(SOURCES: HAYES, 1987; IMO, 1988)

When a spill occurs, claims for cleanup costs and damage can be brought against the owner of the ship which caused the oil spill and, if the limit of the owner's liability is exceeded, against the IOPC Fund (if the country where the pollution damage is caused is a member of the IOPC Fund) or CRISTAL (if the cargo owner is a CRISTAL member). Normally an Administration will coordinate the submission of the various claims and it is essential that accurate detailed records are kept to support such claims.

Each claim should contain the following particulars:

- the name and address of the claimant or representative;
- the identity of the ship involved in the incident;
- the date, the place, and specific details of the incident, including the type of oil;
- details of the cleanup measures taken, and the kind of pollution damage as well as the places affected;
- the amount of the claim.

Depending on the amount and nature of the claim, it should be broken down into different categories, such as:

- costs of preventive measures and cleanup operations: these should be supported by records such as a summary of events and work carried out, maps and photographs showing contaminated areas, evidence linking the oil pollution with the ship involved, costs of labor, equipment and material, transport, storage, and disposal;
- replacement and repair costs: these can include items such as boats, fishing gear, roads, and clothing;
- economic losses: these include items such as restriction of fishing activity, closure of coastal industrial and processing installations, and loss of income by resort operators.

Form No. 4 is a standard form suitable for use by the OSC in the maintenance of daily work records. Form No. 5 is an example of a claim for reimbursement of cleanup costs.

FORM NO. 4
OIL SPILL RESPONSE
DAILY WORK REPORT

DATE

LOCATION

WEATHER AND SEA STATE

.....

DESCRIPTION OF ACTIVITIES

.....

.....

.....

EQUIPMENT USED INCLUDING OPERATING TIME:

VESSEL/AIRCRAFT/VEHICLE/CONSTRUCTION

BOOMS/SKIMMERS/SPRAY GEARS

.....

CONSUMABLES (DISPERSANTS, SORBENTS, ETC.)

NUMBER OF DISPOSAL LOADS

PERSONNEL AND HOURS WORKED (LIST ALL PERSONNEL):

CASUAL LABOR

.....

EQUIPMENT OPERATORS

.....

CONTRACTORS

.....

SUPERVISOR

FORM NO. 5
EXAMPLE OF CLAIMS DOCUMENT

IOPC Fund
4 Albert Embankment
London SE1

A). Costs of cleanup operations on the
Belle Mare Beach. 4 kms of coastline

Personnel

1-10 April 10 days use of workforce of 25 men		
2000 working hours at \$5 per hour	\$10,000	
overtime 150 hours at \$2.50	<u>375</u>	
		\$10,375

For details of the use of personnel
see enclosed worksheets (enclosures 1-11)

Consumable Material

10 bales of sorbent pads at \$50 per bale	500	
250 gloves at \$1	250	
25 protective overalls, which became too polluted to be cleaned, at \$10	<u>250</u>	
		1,000

see enclosed invoices (enclosures 12-14)

Transport

Use of three lorries with drivers on the beach for the removal of collected oil and debris; the lorries were hired at \$120 per day, for 10 days (enclosure 15)	1,200	
Hire of front end loader and operator at \$200 per day for 10 days (enclosure 16)	2,000	
Transport of personnel to and from the beach by bus every morning and afternoon for 10 days, hire of bus \$50 per day (enclosure 17)	<u>500</u>	
		3,700

Disposal

Costs of handling oily debris at municipal dumpsite, 50 tons at \$20 (enclosure 18)		1,000
----------------------------------------------------------------------------------------	--	-------

Food for personnel

Packed meals brought to the site of the cleanup operation; 250 lunches at \$2.50 (enclosure 19)	<u>625</u>	
		\$16,700

B). Cleanup operations at sea

Helicopter surveillance at sea on 31 March and 2 April, 3 hours per day at \$150 per hour (enclosure 20)	900	
Hire of vessel for 6 hours at \$35 per hour used for spraying dispersants on 1 April (enclosure 21)	\$ 210	
Costs of dispersants, 10-200 litre drums at \$300 per drum (enclosure 22)	3,000	
Hire of vessel laying and recovering booms on 1 and 3 April, 2 days at \$400 (enclosure 23)	800	
Boom rental charges, 3 days, 200 meters at \$6 per meter per day (enclosure 24)	3,600	
Skimmer rental charges, 3 days at \$100 per day (enclosure 25)	300	
Rental of tank truck and driver to remove recovered oil, \$180 per day for 3 days (enclosure 26)	540	
Costs of cleaning booms (enclosure 27)	<u>1,200</u>	<u>\$10,550</u>
TOTAL		<u>\$27,250</u>

APPENDIX 8
AVAILABLE EQUIPMENT AND SUPPLIES
ESSO MAURITIUS LIMITED

The Esso plan lists the following equipment in stock:

1. One Oil Spill Cleanup Kit consisting of:
 - One SLURP skimmer fitted with FLOAT buoyancy unit.
 - One 3 m length of 1 1/2 inch bore suction/discharge oil hose fitted with 2 female couplings (1 1/2 inch BSP).
 - One EP8CV petrol engine centrifugal self priming pump (complete, with control valve and strainer).
 - One HP 1 hand pump kit.
 - One STF (Storage Tank Fittings) kit.
 - Two packs of 60 ft length SSM boom.
 - One suction nozzle.
2. Three additional packs (each 60 ft in length) SSM boom.
3. Five barrels COREXIT 7664 dispersant.
4. Five barrels COREXIT 8666 dispersant.

APPENDIX 9
AVAILABLE EQUIPMENT AND SUPPLIES
NATIONAL COAST GUARD
(SOURCE: NATIONAL COAST GUARD)

- One 37.5-meter patrol boat..
- Two 12.5-meter water-jet propelled fast patrol craft (the Barracuda and the Marlin).
- Seven 15-meter water-jet propelled fast patrol craft.
- Three 7-meter craft with 90 H.P. outboard motor (Rover 1, 2, 3).
- Four 7-meter craft with twin 90 H.P. outboard motor (Rover 4, 5, 6, 7).
- One wooden-hulled craft fitted with outboard motor, suitable for inner lagoon work.
- Several inflatable dinghies suitable for inner lagoon work.

APPENDIX 10
AVAILABLE EQUIPMENT AND SUPPLIES
MAURITIUS MARINE AUTHORITY
(SOURCE: MAURITIUS MARINE AUTHORITY)

The tug Sir Sewoosagur is equipped with limited equipment suitable for oil dispersant use, as follows:

- Two removable spray booms.
- Pumping and detergent pump to spray boom connection.
- Flexible couplings.
- Detergent tank of 11 tonnes capacity.
- Variable nozzles for spraying of detergent.
- Booms fed pump 25-40 cu.m/hr.

APPENDIX 11
AVAILABLE EQUIPMENT AND SUPPLIES
FISHERIES PROTECTION SERVICE
(SOURCE: FISHERIES PROTECTION SERVICE)

Twelve patrol boats are stationed at 10 of the 12 fisheries posts around the island, as listed below. Three of these posts maintain one fast boat fitted with 90 H.P. outboard motors. Discussions are underway to merge these capabilities with those of the Mauritius Coast Guard.

FISHERIES POST	PERSONNEL PER SHIFT	PATROL BOATS	OUTBOARD MOTORS	FAST BOATS (90 HP OBM)
Trou aux Biches	4	1	25 HP	none
Grand Gaube	5	2	25 HP	none
Poudre d'Or	3	none	none	none
Poste Lafayette	2	1	none	none
Trou d'Eau Douce	3	1	15 HP	none
Grand River S.E.	4	1	15/25/35 HP	1
Mahébourg	5	2	three 25 HP	1
Riambel	2	none	none	none
Baie du Cap	2	1	15 HP	none
Case Noyale	2	1	none	none
La Preneuse	5	1	25 HP	1
Pointe aux Sables	3	1	15 HP	none

APPENDIX 12
AVAILABLE EQUIPMENT AND SUPPLIES
FISHERIES RESEARCH AND DEVELOPMENT SERVICES
(SOURCE: FISHERIES RESEARCH AND DEVELOPMENT SERVICES)

Two vessels are stationed in Port Louis with 3 officers and 7 crew. The vessels are equipped with internal radio telephones and Marine VHF channels. They have the following characteristics:

VESSEL	LENGTH	ENGINE	RANGE OFFSHORE	FUEL CAPACITY
Anupama	10 m	one 135 HP	15 n. miles	20 hours
Sphyrna	10 m	two 80 HP	20 n. miles	30 hours

APPENDIX 13
AVAILABLE EQUIPMENT AND SUPPLIES
MAURITIUS POLICE AND AIR MAURITIUS
(SOURCE: MINISTRY OF HOUSING, LANDS AND THE ENVIRONMENT)

Although not primarily meant for oil spill work, fixed wing aircraft and helicopters are available from the Mauritius Police and Air Mauritius. In particular, the Air Mauritius Bell Jet Ranger helicopter is already operational for crop spraying and could be adapted to handle spraying of dispersants.

APPENDIX 14
AVAILABLE EQUIPMENT AND SUPPLIES
FIRE STATIONS
(SOURCE: GOVERNMENT FIRE SERVICES)

Six fire stations are manned round the clock by about 20 firemen and are located at the following places:

- Northern division - Quatre Bornes, Piton, Flacq.
- Southern division - Curepipe, Mahébourg, Rivière des Anguilles.

Available supplies and equipment consist of:

- Eight 1,000-gallon water trucks.
- Several Land Rovers.
- One Metz hydraulic turntable ladder for rescue from very high buildings.
- Four rapid intervention light appliances mounted on Land Rover chassis.
- Two Foam Tenders for fires involving inflammable liquids.
- Three rapid response appliances for fires involving inflammable liquids.
- Portable fire pumps.
- Trailer fire pumps.
- Mobile fire pump appliances.
- Foam-making equipment for inflammable liquid fires.
- Four Turbex High Expansion Foam apparatus for generation of foam in enclosed and underground areas.
- Three close-proximity suits for closer approach to heat and toxic substances.
- Six Automan resuscitation apparatus.
- 590 gallons of protein foam.
- 15,000 feet of hoses.

APPENDIX 15 RESOURCES AT RISK

Natural and socioeconomic resources which would be threatened by the impact of spilled oil are described in the companion atlas (Gundlach and Murday, 1987) for each of the 19 map segments shown in Figure 1. The following account is extracted from the atlas. It should be amended as new information becomes available.

MAP 1

This particular section of shoreline is a primary recreational and tourist area in Mauritius. Public beaches at Mon Choisy, Pereybère, and adjacent to Cap Malheureux, are particularly popular. Club Méditerranée, Royal Palm, Verandah, and Merville are some of the major waterfront hotels present. In addition, several new hotels are planned for Pointe aux Cannoniers and the western shore of the outer portion of Grand Baie. No fishing reserves, nature reserves, or fish ponds are present.

MAP 2

To the north of Mauritius, there are five important islets that are included in this study.

Coin de Mire

This island consists of basaltic cliffs and sloping basalt platforms. The island is a designated nature reserve containing a large population of nesting sea birds (red- and white-tailed tropic birds; paille-en-queue à brins rouges, brins blancs). Coral reef is negligible.

Flat Island and Ilot Gabriel

Flat island is the largest of these offshore islands. Flat Island is connected by a coral reef of the adjacent Ilot Gabriel. Both islands are somewhat different from the others. They are flatter and contain sand around much of the shoreline. The sand appears perched on a rock platform, particularly on Gabriel Island. The southwestern edge of the island does, however, contain steep basalt cliffs. Coral reef extends around much of the islands, but ends in the cliffed areas. Both islands are designated nature reserves, but, unlike the others, do not contain nesting sea bird populations.

Round Island and Serpent Island

Both islands contain, almost solely, steep basaltic cliffs exposed to high-wave energy. Coral reef is nonexistent. Both islands are designated nature reserves, and are known for their endemic terrestrial species and sea bird populations. The blue-faced booby (fou), lesser noddy (marianne), noddy (macoua), and sooty tern (yéyé) nest on Serpent Island. Round island has nesting populations of red- and white-tailed tropic birds (paille-en-queue à brins rouges, brins blancs) and Trinidad petrels (pétrel de la Trinité).

MAP 3

The sheltered area behind Ile d'Ambre is the most prone to long-term oil spill damage. The mangrove habitat is particularly sensitive. Along the

shore, there are several fish ponds (for example behind Butte à l'Herbe, south of Pointe aux Roches, and at Bassins Bernard and Paquet). At Anse la Raie there is a narrow channel opening leading to a small ponded area.

Public beaches are located at Sans Souci, Anse la Raie, and Grand Gaube. The Island View hotel at Grand Gaube is the primary beach hotel in this section, although several others are planned.

MAP 4

The degree of sheltering and extent of mangroves along the shoreline create a highly sensitive area. Large fish ponds are located at Grand Barachois, Bassin Goemons, Bassin Humbert, Haute Rive and Bras de Mer des Frégates. A public park and monument overlooking the water is located at Poudre d'Or. The entire area from Ile d'Ambre south is a designated fishing reserve. The commercial extraction of bottom sand occurs within the lagoon. The dock at Baie la Rivière serves as the site for offloading. No coastal hotels are found in this section.

MAP 5

The highly sheltered environments, particularly those dominated by mangroves, are the most sensitive. Beau Port contains a particularly concentrated area of mangroves. The coastal waters of Bras de Mer Belcourt and Poste de Flacq compose a designated fishing reserve. The La Fayette, Saint-Géran Sun, Sandy Bay, and Maritim Hotel Belle Mare Plage are major coastal resort hotels and others are planned. A sole public beach is located along the sandy shore south of Pointe de Roche Noire.

MAP 6

The sheltered mangroves behind Ilot Mangenie and Ile de l'Est, and within the Barachois Montagu compose the most sensitive environments within this section. The exposed sandy and low-lying basalt are relatively insensitive, although cleanup must be well-supervised. As sheltering increases, as within the Trou d'Eau Douce, sensitivity rises. Fish ponds are located at Bassin Oozeerally, Barachois Montagu, and Beau Rivage. Public beach areas are located along the coastal road adjacent to Pointe des Puits, south of Palmar, at Pointe Quatre Cocos, and at Trou Maho. The waters of Trou d'Eau Douce, connecting to Ilot Mangenie, are part of a designated fishing reserve. The Touessrok Hotel is located on Ilot Lievres, and ten others are planned for the sandy stretch between Pointe Quatre Cocos and Belle Mare.

MAP 7

The mangrove areas behind Ile aux Cerfs and within Anse Bambou are the most sensitive shoreline in this section. For the most part, the shoreline dominated by sand, basalt, and mixed sand and gravel is relatively insensitive. A fishing reserve extends from Ile aux Cerfs to Anse Cunat. Two shrimp species, Penaeus molodon and P. indicus, appear to be concentrated in Anse Cunat south to Anse du Petit Sable. Fish ponds are located at Anse Bambou and on Ile aux Chats. Although no hotels or public beaches are located within this section, Ile aux Cerfs is a popular recreational and tourist area.

MAP 8

Ile Marianne is a designated nature reserve and waters to the interior, adjacent to Mahébourg, are a designated fishing reserve. No public beaches, hotels, or recreational areas are found within this section.

MAP 9

The mangrove environments, particularly those at Anse Cola and behind the causeway, represent the most-sensitive areas within this section. The sheltered tidal flats are next most sensitive. Most of the waters indicated on the map are contained in a designated fishing reserve. The Ile aux Aigrettes is a designated nature reserve. Sand is actively being extracted from the lagoon and being brought to docks at Pointe des Régates and along the causeway in Pointe Jérôme. No hotels or recreational beaches are contained in this area, although the monument at Pointe des Régates provides an overview of the adjacent shoreline.

MAP 10

The most sensitive shorelines are found within Blue Bay and Bras de Mer du Chaland, and even these are of relatively low ranking (primarily sheltered rocks). The only public beach in this section is located at the northern edge of Blue Bay. Blue Bay also contains two coastal hotels, one on each side of Blue Bay. No designated fishing reserves, nature reserves, or fish ponds, are present.

MAP 11

This map section contains the least sensitive coastline in all Mauritius. All beaches are well exposed to very high waves and are, therefore, self-cleaning. Access to the water's edge is extremely difficult and dangerous, and there are no designated reserves, public recreational areas, or coastal hotels.

MAP 12

The single mangrove area is the most sensitive shoreline area within this zone. The rest of the shoreline is relatively insensitive to spilled oil. Gris Gris is a high-energy, sandy public beach. West of Trou d'Esny is another sandy public beach, but more sheltered. A public park area is located at Pointe Lousteau. There are no designated nature or fishing reserves. A coastal hotel is located at Pointe Riambel.

MAP 13

The mangroves at St. Martin represent the only site needing priority protection. The other shoreline types are all of relatively low sensitivity. No nature or fishing reserves are present, nor are hotels and public beaches.

MAP 14

The marsh and mangrove areas represent the most oil-sensitive environments. In the site behind Ilot Fourneau, the marsh area also contains a sheltered tidal flat. A large sheltered flat is also located behind Morne Brabant, and fringing grasses line the upper intertidal on the eastern side of

the flat. Other environments are less sensitive to spilled oil. The Méridien and Brabant Hotels are major resorts in Morne Brabant. There is also a dredged channel for a future marina. A public beach is located at La Prairie. No nature or fishing reserves are present.

MAP 15

The most sensitive areas are the marshes and mangroves. However, most of the marsh areas fringe the upper intertidal zone and are difficult to protect. The upper reaches of Grande Rivière Noire Bay contains the most concentrated set of marsh, mangrove, and tidal flat habitats, and deserves priority protection. The Grande Rivière Noire Bay is also a designated fishing reserve. A coastal hotel is located along the beach in this area. No other hotels are located along the coast, and there are no designated public beaches, nature reserves, or fish ponds. The Grande Rivière Noire Bay is also used as a mooring and docking area for several fishing boats. Salt pans, with sea water connections, are located along several parts of the shoreline.

MAP 16

The most environmentally sensitive area is the marsh/mangrove area at in lower Rivière du Rempart. Four hotels are found along the coast: Villa Caroline, Pearl Beach (Sunset), and La Pirogue in the north, and Tamarin in the south, although the Tamarin Hotel is set across the road from the beach. Public beaches are located at Dileau Bouilli in the north, and at Tamarin in the south. No fishing reserves, nature reserves, or fish ponds are present. Salt production using evaporation pans occurs in Tamarin.

MAP 17

As with the southeastern shore, spilled oil is least damaging and subject to natural dispersion along this type of shoreline. However, the sheltered, interior environment at Albion should be protected. There is also a major fisheries research center at Albion which uses seawater to maintain its tanks. Two hotels are located along the coast overlooking the cliffs. A public beach is located at the sand beach at Albion. There are no fishing reserves, nature reserves, or fish ponds within this map section.

MAP 18

The waters off Port Louis are designated as a fishing reserve. The sole shoreline environment needing protection is the marsh and mangrove area in upper Grande Rivière Bay. A small public beach is present at Mare Samson and there are two coastal hotels in the Pointe aux Sables area. No nature reserves or fish ponds are present. An electricity-generating facility, which uses seawater for cooling, is located at Bain des Dames. A number of small boats are moored in Grande Rivière Bay.

MAP 19

The upper reaches of Tombeau Bay with its marsh area is the most environmentally sensitive area in this section. Fortunately, the marsh is rather small and removed from likely spill impacts. However, other areas of marsh grass fringe the shore and are more exposed to the sea. There are a total of five public beaches and three hotels along this coast, and other hotels are planned. The popular aquarium at Trou aux Biches uses seawater

directly from the ocean. There are no fishing reserves, nature reserves, or fish ponds.

Nature and Fishing Reserves

Ile Cocos - Strict nature reserve
Ilot Sable - Strict nature reserve
Flat Island - Strict nature reserve
Ilot Gabriel - Strict nature reserve
Coin de Mire - Strict nature reserve
Ilot Marianne - Strict nature reserve
Ile aux Aigrettes - Strict nature reserve
Round Island - Managed nature reserve

Rivière du Rempart/Poudre d'Or Fishing Reserve - Multiple use reserve
Flacq Fishing Reserve - Multiple use reserve
Black River Fishing Reserve - Multiple use reserve
Grand Port/Mahébourg Fishing Reserve - Multiple use reserve
Port Louis Fishing Reserve - Multiple use reserve
Trou d'Eau Douce Fishing Reserve - Multiple use reserve

APPENDIX 16 OIL SPILL RESPONSE TECHNIQUES FOR MAURITIUS

Oil spill control and cleanup strategies suitable for different settings are described for areas in each of the 19 maps of the companion atlas (Gundlach and Murday, 1987). The following account is extracted from the atlas. It should be amended as new information becomes available.

MAP 1

Priority should be placed on the offshore dispersal of the oil before it enters the nearshore areas. Once it reaches within the lagoonal system, it should be collected using skimmer boats. Most of the area is open to the sea; hence land-based, deflective booms, except at the entrance to Grand Baie, will not be effective. Onshore, the use of heavy equipment on the sand beaches should be discouraged to avoid excessive removal of sand and the added problem of grinding the oil deeper into the beach. On rocky shores, low-pressure spraying may be effective if the oil is still fresh. As it weathers, high-pressure spraying may become necessary. In all cases, sorbent boom and pads should be used to collect the released oil.

MAP 2

To the north of Mauritius, there are five important islets that are included in this study.

Coin de Mire

Response to an oil spill from the island is extremely difficult since access to the shoreline is impossible in many areas. Fortunately, the sensitivity of the shoreline is very low. The force of wave action is expected to naturally clean the shoreline.

Protection of the island sea birds presents the greatest problem. Loss of, or damage to, the bird colony can result from oiling. Hazing or chasing the birds away from a slick in the water is one possibility. The other is to collect oiled birds for treatment in a cleaning station following internationally accepted practices for bird treatment.

Flat Island and Ilot Gabriel

Response to an oil spill on these two islands would be much easier in that most of the coast is relatively low-lying and accessible. The sand beaches and rocky platforms could be cleaned by manual labor transported from Mauritius. A jetty is located on Flat Island. The exposed cliffs and high-energy platforms would be naturally cleansed by wave activity.

Round Island and Serpent Island

Responding to an oil spill affecting these islands would be extremely difficult. Shoreline access is nearly impossible. Fortunately, the high-energy nature of these shorelines would cause fairly rapid self-cleansing should they become oiled. Treatment of the important, resident bird population is required, through hazing away from oil slicks and an organized bird-cleaning center.

MAP 3

Attempts should be first made to control the spill offshore and then nearshore. If the spill approaches from the north, the use of skimmer boats to protect the area behind Ile D'Ambre should receive priority. Verification of the closing of the fish ponds, and booming of the inlet at Anse la Raie should be completed before landfall occurs. Once onshore, cleanup guidelines should be followed.

MAP 4

The degree of sheltering in the lagoon increases the persistence of spilled oil, but it also aids its collection from the sea surface using skimmers. Onshore all fish ponds should be closed during coastal impacts. As the area is so exposed to incoming oil, shore-placed deflection booms would be ineffective except in providing additional protection to active fish ponds. Once onshore, cleanup guidelines should be followed with areas adjacent to commercial and recreational activities receiving priority.

MAP 5

The calm nature of this environment assists collection at sea using skimmers. Deflection booms should be placed seaward of the mangrove habitats at Bras de Mer Belcourt, and at Pointe de Flacq to assist collection of incoming oil before it further enters Poste de Flacq. The Beau Port tide gates should be closed when oil is present. The excessive removal of sand from recreational and tourist beaches should be avoided.

MAP 6

Within the more sheltered Trou d'Eau Douce and behind Ilot Mangenie/Ile de l'Est mobile skimmers would be able to operate. Protection of the fish ponds and the mangrove areas is the primary protection strategy. Oil can be removed relatively easily from the sand beaches, although excessive sand removal is to be seriously avoided.

MAP 7

The fish ponds should be notified of an approaching spill and verified as to being closed should oil come ashore. Booms may be placed to provide additional protection. Deflection booms should be placed along the pass between Ile aux Lubines and Ile de l'Est to prevent oil from entering the sensitive mangrove area behind Ile aux Cerfs. Otherwise, the response effort should focus on proper shoreline cleanup. It may prove necessary to renourish portions of the narrow beach fronting the coast road should sediment be removed during a cleanup operation.

MAP 8

The reef-edge shoreline of the islets is essentially unprotectable. Fortunately, it contains areas of relatively low sensitivity, particularly the exposed cliffs of the offshore islets. The excessive removal of sediment during cleanup of the mixed sand and gravel beach in front of the coast road should be avoided, and replenishment should be considered to maintain protection of the road.

MAP 9

The large lagoon present adjacent to Mahébourg enables the possible collection of oil before it reaches the shoreline should skimmers be available. Deflection booms should be placed at the entrance to the Anse Colas and along the causeway in Pointe Jérôme to protect the mangrove environments. The presence of jetties around Mahébourg, from which deflection booms can be anchored, should aid the collection of incoming oil.

MAP 10

For the most part, this section of shoreline is notably insensitive to spilled oil. Only the interior of Blue Bay and Bras de Mer du Chaland need protection. In this case, long booms, possibly containing sorbents, could be placed from both the northern and southern edges of the interior of the bay to protect Bras de Mer du Chaland. Sand removal from the recreational areas should be well controlled.

MAP 11

Spilled oil in this zone will do little to no environmental damage and will naturally disperse under continual wave action. Shoreline cleanup is not necessary and response priority should be given to other areas.

MAP 12

The mangroves at Souillac are the only site clearly needing protection. Deflection booms with accompanying skimmers are necessary. Other than this location, cleanup should focus on the recreational areas. Excessive sand removal during cleanup should be avoided. The well exposed areas to the east of Souillac should be left for self-cleansing by wave action.

MAP 13

For this map section, the primary priority for onshore response is the protection of the mangroves at St. Martin using deflection or sorbent booms.

MAP 14

Protection of the upper intertidal grasses in the corner behind Ilot Fourneau, and of the marsh and mangroves in upper Baie du Cap should receive priority. Both can be accomplished using deflection booms and/or sorbent boom. Likewise the dredged channel near the Méridien should be boomed to avoid oiling of the interior cobbles. Shoreline cleanup is the next level of response, with effort concentrating first on public and recreational areas. The excessive removal of sand should be avoided.

MAP 15

The inner marsh/mangrove/tidal flat area of Grande Rivière Noire Bay deserves priority protection. Deflection booms, sorbents, and skimmers are necessary. Operators of the salt pans should be notified to close their intakes. On sand beaches, sand removal during cleanup should be minimized.

MAP 16

The operators of the salt production areas should be notified immediately to close their intake pipes to prevent oiling of the pans. The narrow opening at the mouth of Rivière du Rempart should be boomed with diversionary and sorbent booms to prevent oiling of the interior marsh and mangrove areas. The rest of the shoreline is unable to be protected from the shore. Oil can be collected or chemically dispersed offshore beyond the coral reef. Oil that comes onshore should be removed from the beaches with the least amount of sand or other material. The use of heavy equipment on oiled beaches should be avoided.

MAP 17

The primary strategy is to protect the sheltered environments at Albion using deflection and/or sorbent booms. The research center at Albion should be immediately notified to ensure closure of their seawater intakes. Sand removal during cleanup at Albion should be severely restricted to avoid possible future erosion problems. Access to the high-energy basalt shoreline for cleanup is difficult. Fortunately, most sites will be naturally cleansed in a matter of days.

MAP 18

The port facilities are a possible source of an oil spill. In such an event, the response strategy is to contain the oil within the industrialized port area and not allow it to impact adjacent, more sensitive environments. The calm waters of the port area enable a full response using booms, skimmers, and sorbents, to be undertaken. The electrical station at Bain des Dames must be notified of a spill to determine if intakes should be protected, monitored, or closed. Booms and sorbents should also be used to protect the mangrove and marsh area in Grande Rivière Bay. Oil that impacts adjacent shorelines should be cleaned up with the minimal removal of sand to avoid potential erosion problems.

MAP 19

The aquarium at Trou aux Biches should be notified immediately to close its seawater intakes. Preparations should be made to provide clean seawater from other localities if it appears that the area will be oiled for some time. The relatively narrow channel of the Rivière du Tombeau as it enters Tombeau Bay should be boomed using diversionary and sorbent booms to prevent oil from entering the sheltered, interior environments. The remaining shoreline cannot be protected from the shore. Oil should be collected or dispersed offshore beyond the coral reef. Oil that does reach shore should be removed without the excessive removal of sand. The use of heavy equipment on oiled beaches should be avoided.

APPENDIX 17
DISPOSAL SITES

(SOURCE: MINISTRY OF HOUSING, LANDS AND THE ENVIRONMENT)

There are seven existing dumping grounds for sanitary wastes in Mauritius. Sixteen more have been proposed. They are listed below;

Existing dumping grounds

1. Calebasse
2. Mare aux Songes
3. Petit Bois
4. Poudre d'Or
5. Providence
6. Riche Fond
7. Roche Bois

Proposed dumping grounds

1. Balaclava
2. Belle Mare
3. Camp Diable
4. Cottage
5. Grand Baie
6. Haute Rive
7. Henrietta
8. Long Mountain
9. Mahébourg
10. Montagne Blanche
11. Rivière des Anguilles
12. Rivière des Créoles
13. Rivière Sèche
14. Rose Belle
15. St Pierre
16. Surinam



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