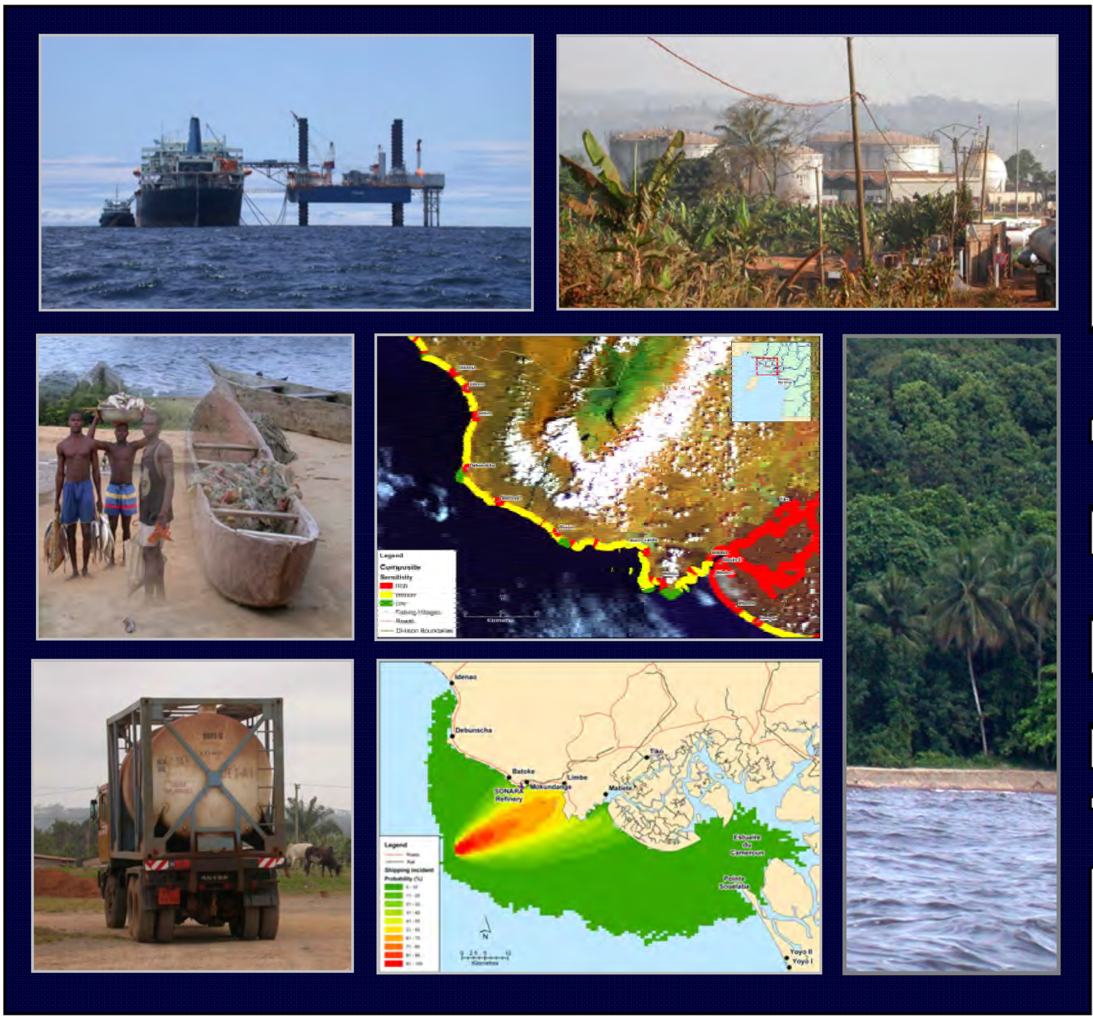
CAMEROON
NATIONAL OIL SPILL CONTINGENCY PLAN



NOSCP

PNLDAH

CSIR ENVIRONMENTEK

September 2004

CAMEROON NATIONAL OIL SPILL CONTINGENCY PLAN

This plan is brought into effect by the powers assigned to me in terms of the Decree of Application promulgated under the Environmental Framework Law (Law No. 96/12 of 5 August 1996)

Signed: .... Date:..

His Excellency: ....

CSIR Report No. ENV-S-C2004-072

PREPARED BY:
CSIR Environmentek
P O Box 320 Stellenbosch
South Africa 7599

CONTACT PERSON:
Mike Burns
Tel: 27 21-888 2404
Fax: 27 21-888 2693
Email: mburns@csir.co.za

PREPARED FOR:
Comité de Pilotage et de Suivi des Pipelines (CPSP)
B.P. 955
Yaoundé
Cameroon

September 2004

FOREWORD

The National Oil Spill Contingency Plan (NOSCP) for Cameroon has been prepared in response to an historic situation that has prevailed within the country, in which a variety of up- and downstream activities associated with the hydrocarbon sector, as well as other activities – for example, shipping - have been conducted in the absence of best-practice strategies and clearly defined roles, responsibilities and communication structures designed to ensure an effective response to oil spills.[1]

The Chad-Cameroon pipeline project is an important catalyst that has triggered the need for the NOSCP. This project, which has been initiated to develop a 1 billion barrel hydrocarbon reserve within Chad, will result in the conveyance by pipeline of some 225 000 barrels per day of heavy crude oil through Cameroonian territory and its discharge at a marine terminal located within Cameroon's coastal waters. Clearly, the issue of risk associated with potential pipeline product spills arises and, therefore, justifies the need for the NOSCP. However, there are other aspects of the hydrocarbon sector within the country that are also important in this regard.

The situation of Cameroon in its central West African regional setting is indicated in the map that follows. In terms of proven reserves of crude oil, the country is currently ranked seventh within the region, with some 0.4 billion barrels. Cameroon is sub-Saharan Africa's fifth largest oil producer, with the year 2000 production levels estimated at 84 800 barrels per day (Energy Information Administration, 2002). Although these statistics reflect a situation of declining production in Cameroon, as the reserves of some of the earliest developed fields are exhausted, there is a national interest in reversing this trend by exploring the potential of new reserves, which may offer development and production possibilities. The results of recent exploration activities, for example, in the Douala Basin, appear to be economically attractive, and it can be anticipated that developments here could proceed to production operations. Similar developments are also anticipated in the Rio del Rey Basin, where exploration activities are underway immediately offshore of the Bakassi Peninsula. It is, therefore, anticipated that there will be an expansion of the current level of upstream activity in the hydrocarbon sector and that this could lead to increased downstream developments as well.

Current activities and anticipated trends in the hydrocarbon sector clearly justify the need for oil spill contingency planning and the development of response capability to be taken up as a national priority. The Comité de Pilotage et de Suivi des Pipelines (CPSP), administered by the Société Nationale des Hydrocarbures (SNH), therefore commissioned the development of this NOSCP - the terms of reference of which are described in the

1 It is important to note that oil spill contingency planning initiatives have previously been conducted in Cameroon (e.g. General Delegation for Scientific and Technical Research, 1983); however, these have not been formally adopted for implementation. It is also important to note that there has been ongoing encouragement by the International Maritime Organization (IMO) for the development of a national oil spill contingency plan, and it is envisaged that the integrity and usefulness of this plan will be strengthened by IMO's continued support for its implementation.

World Bank tender contract No 005/CPSP/02 (Etude d'un Plan National de Lutte contre les Déversements Accidentels d'Hydrocarbures). This report represents the key output of this contract.

Chairman of the Comité de Pilotage et de Suivi des Pipelines

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Energy Information Administration, 2002. Cameroon Country Analysis Brief. Available at website: http://www.eia.doe.gov/emeu/caba/cameroon2.html

General Delegation For Scientific And Technical Research, 1983. Draft contingency plans for accidental marine pollution in Cameroon. Permanent Secretariat, National Committee of Man and Biosphere, Yaounde, Cameroon.

Map of Cameroon set in the context of the Central West Africa region

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15.	Secretary of Defense (SED)	
16.	General Delegation for National Security (DGSN)	
17.	SONARA	
18.	SCDP	
19.	TRADEX	
20.	National Ports Authority	
21.		
22.		
23.		

GLOSSARY: ABBREVIATIONS, ACRONYMS AND TECHNICAL TERMS

API Gravity: An American Petroleum Institute measure of density for petroleum. API gravity = [(141.5 (specific gravity at 16 °C) – 131.5]. Heavy oils are <25 °API; medium oils are 25 to 35 °API; light oils are 35 to 45 °API; condensates are >45 °API.
ASA: Applied Science Associates Inc.
CAMRAIL: Cameroon Railways
CCPP: Chad-Cameroon Pipeline Project
CIME: (Cameroon) Consultants and Intermediaries in Mining, Energy and Environment
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLC '92: International Convention on Civil Liability for Oil Pollution Damage, 1992
COTCO: Cameroon Oil Transportation Company
CPSP: Comite de Pilotage et de Suivi des Pipelines
CSIR: (South African) Council for Scientific and Industrial Research
DGSN: General Delegation for National Security
DIN: Dissolved Inorganic Nitrate
DIP: Dissolved Inorganic Phosphate
EUC: Equatorial Undercurrent
EEZ: Exclusive Economic Zone
FAO: Food and Agricultural Organisation
FUND '92: International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992
GC: Guinea Current
GDP: Gross Domestic Product
GIS: Geographic Information System
GUC: Guinea Undercurrent
HFO: Heavy fuel oil
IPIECA: International Petroleum Industry Environmental Conservation Association
IMO: International Maritime Organization
ITOPF: International Tanker Owners Pollution Federation
IUCN: International Union for the Conservation of Nature or World Conservation Union
MA: Maintenance Area
MINCOM: Ministry of Communication
MINDEF: Ministry of Defense
MINEF: Ministry of Environment and Forestry
MINFIB: Ministry of Finance and Budget
MINJUSTICE: Ministry of Justice
MINMEE: Ministry of Mines, Water Resources and Power
MINEPIA: Ministry of Livestock, Fisheries and Animal Husbandry
MINREST: Ministry of Scientific and Technical Research
MINSANTE: Ministry of Public Health
MINT: Ministry of Transports
MINATD: Ministry of Territorial Administration and Decentralization
NEBA: Net Environmental Benefit Analysis
NECC: North Equatorial Countercurrent
NCC: National Communication Commission

NOSCP:	National Oil Spill Contingency Plan
NOSR-SC:	National Oil Spill Response Standing Committee
NCA:	National Competent Authority
NCOM:	Naval Coastal Ocean Model
NICT:	National Incident Command Team
OPRC '90:	International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990
OSC:	On-Scene Commanders
OSR (000, 001,002):	Oil Spill Report
PAD:	Autonomous Port of Douala
PAH:	Poly Aromatic Hydrocarbons
PNGE:	National Plan for Environmental Management
ROW:	Right of Way
SCDP:	Société Camerounaise des Dépôts Pétrolier
SED:	Secretary of Defence
SONARA:	National Refining Company of Cameroon
SNH:	Société Nationale des Hydrocarbures
Tiers 1, 2, and 3:	Oil Spills (see Section A.5.1 for definitions)
UTO:	Unité Technique Opérationnelle
VOS:	Voluntary Observing Shipping
WWF:	World Wildlife Fund

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RESUME
(FRENCH SUMMARY)

OBJECTIF

L'objectif principal de ce Plan National de Lutte contre les Déversements Accidentels d'Hydrocarbures (PNLDAH) est d'informer le processus de prise de décision et d'assurer un état de préparation, au niveau national, en prévention et en réaction à un déversement d'hydrocarbures qui pourrait se produire sur le territoire camerounais.

Tout en étant complet et extrêmement détaillé, ce plan, fournissant, entre autres, une description détaillée du cadre légal international et national au sein desquels les actions de planification et d'intervention pour les déversements d'hydrocarbures doivent être conduites, ainsi qu'une description détaillée de l'environnement qui pourrait être exposé aux risques associés à de tels déversements, ce plan a été spécialement conçu afin que sa mise en exécution soit *facile*, *pratique* et *immédiate*. L'objectif de ce plan est, par conséquent, d'être à la fois une source d'information générale et un outil puissant afin de promouvoir un état de préparation au niveau national et la coordination et la mise en exécution de mesures d'intervention d'urgence lors d'un déversement accidentel d'hydrocarbures.

STRUCTURE

Le PNLDAH s'applique à la fois au *milieu marin et côtier* et à la partie *terrestre* du pays – une double focalisation reflétée dans la structure même du plan, qui comprend les deux parties principales suivantes:

- ***Plan de lutte contre les déversements accidentels d'hydrocarbures pour le milieu marin et côtier***
- ***Plan de lutte contre les déversements accidentels d'hydrocarbures pour le milieu terrestre.***

Ces deux sections principales du rapport sont elles-mêmes structurées selon les thèmes suivants:

Section A: Stratégie

- **Cadre légal –** comprenant un inventaire des conventions internationales et régionales, les lois et décrets nationaux touchant aux aspects de lutte contre et de planification des déversements accidentels d'hydrocarbures, ainsi que les questions de responsabilités et de compensation.
- **Sources de risques de déversements d'hydrocarbures –** comprenant une description des sites de sources de risques potentielles, des scénarios de déversements et des analyses de l'évolution et de la trajectoire des déversements.

- **Description environnementale *(comprenant l'environnement naturel et socio-économique/culturel),* évaluation des impacts de déversements d'hydrocarbures et analyse de sensibilité environnementale.**
- **Structures organisationnelles, rôles et responsabilités –** comprenant une définition de l'Autorité Compétente Nationale (ACN) du Cameroun.
- **Stratégies de lutte contre les déversements d'hydrocarbures –** comprenant un cadre pour prise de décision concernant le choix de stratégies à mettre en application dans le cas de déversements d'hydrocarbures.
- **Inventaire des ressources et accords de collaboration pour la lutte contre les déversements d'hydrocarbures.**
- **Communications.**
- **Renforcement des capacités et formation.**

Section B: Plan Opérationnel

La lutte opérationnelle contre les déversements accidentels d'hydrocarbures pour le milieu marin et côtier et la partie terrestre du pays est adressée dans le Plan Opérationnel de Lutte contre les Déversements d'Hydrocarbures (Section B*)*, décrit dans le rapport comme les *Pages Bleues* et les *Pages Vertes* respectivement. Ces plans opérationnels fournissent des directives importantes pour la prise d'actions sur le terrain (procédures de notification, stratégies de nettoyage, etc.) dans le cas de déversements d'hydrocarbures constitueront la source primaire de référence pour les utilisateurs du plan dans une telle situation. Ces plans opérationnels diffèrent des autres éléments du PNLDAH, qui créent un contexte général de planification, en ce qu'ils sont conçus pour fournir un support de prise de décision immédiat dans le cas de déversements d'hydrocarbures. Chaque Plan Opérationnel de Lutte contre les Déversements d'Hydrocarbures comprend les éléments suivants:

- ***Procédures d'intervention immédiate et en cours (concentrées, par exemple, sur les procédures de notification et de communication);***
- ***Stratégies de nettoyage;***
- ***Stratégies de gestion des déchets; et***
- ***Directives d'audit et de conservation des rapports.***

Section C: Répertoire de Données

Cette section comporte des listes de coordonnées des acteurs clés, des équipements disponibles à l'utilisation dans le cas de déversements d'hydrocarbures, des cartes, etc.

COMMENT UTILISER LE PNLDAH

Il existe essentiellement deux contextes au sein desquels le PNLDAH peut être utilisé. Le premier concerne le renforcement de capacités et l'accomplissement d'un état de préparation pour sa mise en exécution; le second concerne son utilisation dans le cas de déversements accidentels d'hydrocarbures – c'est-à-dire dans une situation d'urgence.

- ***Comment utiliser le PNLDAH pour le renforcement de capacités et l'accomplissement d'un état de préparation:***

  Au cours de sa phase initiale d'opérationnalisation, le PNLDAH devrait être utiliser pour attribuer rôles et responsabilités aux acteurs principaux décrits dans la structure organisationnelle du plan – c'est-à-dire les parties dont la tâche est la mise en exécution du plan, et celles qui seraient affectées par les directives contenues dans le plan (par exemple, les compagnies de pétrole opérant au Cameroun). Parallèlement à ce processus, et à travers les informations contenues dans le PNLDAH, les lignes de communication cruciales entre toutes les parties concernées devraient être établies et testées. Au cours de sa phase initiale d'opérationnalisation, le PNLDAH devrait également être utilisé pour encrer une compréhension collective des stratégies et des priorités de lutte contre les déversements d'hydrocarbures décrites dans le plan. Les deux sections du plan traitant de *Stratégie* et d'*Opérationnalisation* (Sections A et B) devraient être utilisées pour soutenir le renforcement des capacités de toutes les parties concernées à la mise en exécution du PNLDAH et accomplir un état de préparation à cet égard.

- ***Comment utiliser le PNLDAH dans le cas de déversements accidentels d'hydrocarbures:***

  Dans le cas de déversements accidentels d'hydrocarbures, les utilisateurs de ce plan doivent se référer immédiatement aux Plans Opérationnels contenus dans les Sections B de ce Plan. Dans le cas d'un déversement d'hydrocarbures dans le milieu marin et côtier, les utilisateurs se référeront au Plan Opérationnel (Section B) de la Section Milieu Marin et Côtier – c'est-à-dire les *Pages Bleues*. Dans le cas d'un déversement d'hydrocarbures dans le milieu terrestre, les utilisateurs se référeront au Plan Opérationnel (Section B) de la Section Terrestre – c'est-à-dire les *Pages Vertes*. La partie Introduction de chacun de ces Plans Opérationnels explique comment utiliser ces plans pour une intervention d'urgence de Niveau 1, Niveau 2 et Niveau 3 (incidents à petite et grande échelle).[1]

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1 Le concept d'intervention d'urgence des différents niveaux (1,2, et 3) est expliqué dans les Sections A.5.1 des sections Milieu Marin et Côtier et Milieu Terrestre du plan.

APPROCHE UTILISEE POUR DEVELOPPER LE PNLDAH

L'approche adoptée pour développer le PNLDAH a suivi la série de directives IPIECA concernant les différents aspects de planification et de lutte contre les déversements accidentels d'hydrocarbures; par exemple, *Planification de Mesures d'Intervention d'Urgence*, *Bilan des Avantages Nets pour l'Environnement* (*NEBA*, *Net Environmental Benefit Analysis)*, ainsi que d'autres thèmes liés au sujet. En se basant sur ces fondations - considérées de manière générale comme la norme internationale en matière de planification et d'intervention en cas de déversements accidentels d'hydrocarbures – l'approche adoptée pour développer le PNLDAH se base également sur une compréhension profonde et détaillée des systèmes institutionnels et organisationnels du pays devant être pris en compte dans le plan, ainsi que sur le milieu naturel et socio-économique exposé aux risques de déversements accidentels d'hydrocarbures.

Un processus de consultations avec un large spectre de parties, intéressées et affectées par le PNLDAH, a également considérablement orienté l'approche adoptée pour développer ce plan. A l'issue de ce processus de consultations, l'équipe du projet a pu obtenir une compréhension précise des sources de risques principales de déversements d'hydrocarbures au Cameroun, ce qui a permis la conduite d'une analyse solide se concentrant sur la caractérisation des risques (lieu, nature des produits pouvant être déversés, etc.), des impacts environnementaux et socio-économiques, ou conséquences, de déversements d'hydrocarbures. A cet égard, la réalisation de ce plan de lutte contre les déversements accidentels d'hydrocarbures, a été informée par plusieurs études spécialisées, décrivant, par exemple, les composantes socio-économiques et biophysiques de l'environnement exposé aux risques de déversements. Dans le case du milieu marin et côtier, cette analyse a également été soutenue par une étude de modélisation numérique, à travers laquelle les probabilités d'échouement de pétrole sur la surface de la mer et sur la côte sont quantifiées. Les différentes études spécialisées menées ont permis d'aboutir à une analyse de sensibilité environnementale, décrite dans ce plan, basée sur les attributs physiques, écologiques et socio-économiques de l'environnement, et à partir de laquelle des priorités pour mesures d'intervention en cas de déversements d'hydrocarbures, ont été établies. Le processus de consultations avec les différentes parties clés a également permis la formalisation d'une structure organisationnelle et de communication et, surtout, l'identification d'une Autorité Compétente Nationale (ACN) dont le rôle principal sera la mise en exécution du plan.

Avec une compréhension à la fois des sources de risques principales de déversements d'hydrocarbures et de l'environnement exposé aux impacts de déversements accidentels, et l'existence d'une structure organisationnelle définie pour la mise en exécution du PNLDAH, le dernier aspect du développement de ce plan a consisté en la formulation de stratégies d'intervention, de nettoyage et de gestion des déchets appropriées à mettre en oeuvre au Cameroun.

INTRODUCTION

1. PURPOSE

The primary purpose of this National Oil Spill Contingency Plan (NOSCP) is to inform decision-making and to ensure response preparedness, at the national level, in advance of and during oil spills that could occur within Cameroon.

Whilst the plan is comprehensive, providing considerable detail, for example, of the international and national statutory framework within which oil spill planning and response actions must be located and of the environment that may be exposed to risks associated with oil spills, the plan is specifically designed to be *easily*, *practically* and *immediately implementable*. Its purpose is, therefore, to be broadly informative as well as focussed in order to promote both response preparedness at a national level and co-ordination and implementation of on-the-ground responses that will need to be initiated in the event of oil spills.

Note, that the NOSCP deals only with liquid hydrocarbon product spills (petrol, diesel, crude oil, etc.). It does not deal with spills or emissions of other hazardous substances (e.g. toxic gases).

2. STRUCTURE

The NOSCP applies to both the *marine and coastal environment* and the country's *inland* region – a dual focus that is reflected in the basic structure of the plan, which comprises the following two main sections:

- ***Oil spill contingency plan for the marine and coastal environment***
- ***Oil spill contingency plan for the country's inland region.***

These two main report sections are structured into a number of sub-sections that cover the following aspects:

Section A: Strategy

- **Statutory framework** – including international and regional conventions, national legislation and decrees affecting oil spill planning and response, as well as the issue of liability and compensation.
- **Oil spill risk sources** – including a description of the potential risk source locations, spill scenarios and spill fate analyses.
- **Environmental description** ***(including the natural and socio-economic/cultural environment), oil spill impact assessment and environmental sensitivity analysis.***
- **Organizational structures, roles and responsibilities** – including the definition of the National Competent Authority (NCA) within Cameroon.

- **Oil spill response strategies –** including a framework for decision-making regarding the choice of strategies for implementation in the event of oil spills.
- **Inventory of oil spill response resources and collaboration agreements for combating oil spills.**
- **Communications.**
- **Capacity building and training.**

Section B: Operations

Operational oil spill response within the marine and coastal environment and the country's inland region is covered by the *Operational Oil Spill Response Plan* (Section B*)*, described later in this report as the *blue* and *green pages* respectively. These operational response plans provide important directives for on-the-ground action (reporting structure, clean-up strategies, etc.) in the event of oil spills and will be the primary reference source for users of the plan in such situations. Different to other elements of the NOSCP, which create a broad planning context, the operational oil spill response plans are designed to provide immediate decision-support in the event of oil spill incidents. Each Operational Oil Spill Response Plan incorporates the following:

- ***Immediate and ongoing response procedures (focused, for example, on reporting and communications);***
- ***clean-up strategies;***
- ***waste management strategies; and***
- ***guidelines for auditing and record-keeping.***

Section C: Data Directory

This section contains lists of contact details of key role players, equipment available for use in the event of an oil spill, maps, etc.

3. HOW TO USE THE NOSCP

There are essentially two contexts in which the NOSCP can be used. The first, concerns capacity development and achieving a state of readiness for its implementation; the second, concerns its use in the event of oil spills – i.e. in emergency situations.

- ***How to use the NOSCP for capacity development and achieving a state of readiness:***

  During the initial phase of its operationalization, the NOSCP should be used to assign roles and responsibilities to the main parties described in the plan's organizational structure – i.e. the parties tasked with the plan's implementation, and who are affected by the directives it contains (for example, oil companies operating in Cameroon). In parallel with this process, and through reference to the information contained in the NOSCP, the critical lines of communication between all concerned parties should be established and tested. Also during the initial phase of its operationalization, the NOSCP should be used to entrench a common understanding of the oil spill response strategies and priorities described in the plan. The full text comprising the sections dealing with *strategy* and *operations* (Sections A and B) as previously described, should be used to support the development of capacity to implement the NOSCP and to achieve a state of readiness of all affected parties in this regard.

- ***How to use the NOSCP in the event of oil spill incidents:***

  In the event of oil spill incidents, immediate reference should be made to the Operational Oil Spill Response Plans contained in the operations sections of the plan (Sections B). In the case of incidents located within the marine and coastal environment, reference should be made to the operational plan in Section B of the Marine and Coastal Plan – i.e. the *blue pages*. In the case of incidents located within the country's inland region, reference should be made to the operational plan in Section B of the Inland Plan – i.e. the *green pages*. The introduction to each Operational Oil Spill Response Plan explains how these plans should be used for Tier 1, Tier 2 and Tier 3 (small and large spills) responses.[1]

4. APPROACH USED TO DEVELOP THE NOSCP

The approach used to develop the NOSCP has been informed throughout by the IPIECA guideline series dealing with various aspects of oil spill contingency planning and response; for example, *Contingency Planning*, *Net Environmental Benefit Analysis*, and other related topics (IPIECA, 2000 a,b). Building on this foundation - widely regarded as the international standard for contingency planning for oil spills - the approach used to develop the NOSCP is also based on an in-depth understanding of the local institutional/organizational systems to be accommodated within the plan and the natural and socio-economic environment exposed to the risk of potential oil spills.

Consultation with a range of parties, interested in and affected by the NOSCP, has also directed, to a large extent, the approach adopted in developing the plan. Arising from this consultation process is a clear understanding of the main sources of oil spill risk within Cameroon, which has enabled a broad analysis to be undertaken that focuses on risk characterization (location, nature of potential product spills, etc.), including the socio-economic and environmental impacts, or consequences, of oil spills. In this regard, the development of the plan has been informed by several specialist investigations that describe, for example, the socio-economic and bio-physical components of the environment exposed to the risk of oiling. In the case of the marine and coastal environment this was underpinned by numerical modelling, through which oiling probabilities of the sea surface and coastline are quantified. An end-point of these investigations is the environmental sensitivity analysis that is contained within the plan (based on the physical, ecological and

1 The concept of tiered responses to oil spills is explained in Sections A.5.1 of the Marine and Coastal and Inland Sections of the plan

socio-economic attributes of the environment), from which priorities for oil spill response have been established. The process of consultation with lead parties has also permitted the formalization of an organizational and communication structure and, importantly, the identification of a National Competent Authority (NCA) to operationalize the plan.

With an understanding of both the key sources of oil spill risk and the environment exposed to the impacts of potential oil spills, and with an organizational structure defined for implementing the NOSCP, the final aspect of developing this plan has been the formulation of oil spill response, clean-up and waste management strategies that are appropriate for implementation within Cameroon.

5. TEAM RESPONSIBLE FOR DRAFTING THE NOSCP

A multidisciplinary team was employed to prepare the NOSCP. The following contributions, arranged more or less according to the main spheres of input, are acknowledged.

5.1 Project co-ordination team

Dr Mike Burns
Mr Stuart Heather Clarke
Ms Emma Dunkley

5.2 Technical specialist teams

5.2.1 International and National Statutory Review

Dr Francois Nguene
Mr Anton Moldan

5.2.2 Oil spill contingency planning

Mr Anton Moldan

5.2.3 Marine and coastal environment

5.2.3.1 Physical oceanography and oil spill simulation modelling

Mr Roy Van Ballegooyen
Applied Science Associates Inc.

5.2.3.2 Marine and coastal ecology

Dr David Le Maitre
Mr Iain Bickerton
Mr Simon Hughes

5.2.4 Terrestrial environment

5.2.4.1 Hydrology and geo-hydrology

Dr Pete Ashton
Dr Lisa Cave

5.2.4.2 Terrestrial ecology

Ms Sarah Davies
Mr Pat Morant

5.2.5 Socio-economic environment

Prof Bob NGAMOE
Dr Keye NDOGO
Mr Jean NONO TAGWO
Dr Samuel EKOLLE
Mr Prosper NGOMA

5.2.6 Project facilitation

Mr Honore DAIROU MBOUOMBOUO
Mr Jean Marc BIDJO
Ms Maitre Jeanne EBONGUE
Ms Joan LIMUNGA NJOH

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INLAND

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Strategy

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A.1 STATUTORY AND PLANNING FRAMEWORK

The advent of the Chad-Cameroon Pipeline Project (CCPP) in the early 1990's served as a catalyst for strengthening environmental consciousness and awareness in Cameroon. A situation reinforced by the Rio Earth Summit of June 1992.

The realization of the CCPP called for the participation of the World Bank as a project financing institution for the execution of the project – a role that also extended to one of guaranteeing the environmental performance of the project; i.e. not only were the financial resources of the bank required, but also the institution's approval of the environmental component of the project. The process of approval of the CCPP also heralded the involvement of international environmental organizations. Collectively, this involvement fostered for the first time, in a significant way, an understanding by the citizens of Cameroon of key environmental issues associated with development projects.

The preliminary environmental studies associated with the CCPP were conducted concomitantly with the drafting of the National Environmental Management Plan (PNGE) and the Environmental Framework Law by the Government of Cameroon - both of which were published in 1996. The CCPP thus helped to shape the development of environmental regulations in Cameroon, since from its advent up to the present, numerous laws and regulations have been adopted to either strengthen existing legal instruments or to create new ones to deal with the issues raised by this important development project.

The CCPP also prompted the establishment of environmental institutional structures within the country. To this effect many government departments, for example, the Ministry of Environment and Forests (MINEF, created in 1998), the Ministry of Breeding, Fisheries and Animal Husbandry (MINEPIA, created in 1996), the Ministry of Mines, Water Resources and Power (MINMEE, created in 1996), were re-organized and strengthened in order to enhance their impact in the various sectors in which they have relevance.

A.1.1 International and regional conventions and agreements

The following International and Regional Conventions adhered to by the Republic of Cameroon relate to the protection of the environment, with some of them extended in terms of their application to the country's inland regions:

- The African Convention on Conservation of Nature and Natural resources, Algiers, 15 September 1968;
- The International Convention on Civil Responsibility for Damages Caused by Oil Pollution, London, 27 November 1992;
- The UNESCO convention on the Protection of the World Cultural and Natural Heritage, Paris, 16 November 1972;

- The convention on the International Trade of Fauna and Flora Endangered Species, Washington, 3 March 1973;
- The Ramsar Convention (1971), its 1982 protocol and its 1987 amendment relating to Wetlands of International Importance;
- The International Convention Creating an International Compensation Fund for Damages Caused by Oil Pollution, Brussels, 29 November 1969;
- The Bonn Convention on Conservation of Migrating Wild Species, 23 June 1979;
- The Convention Relating to Cooperation Pertaining to the Protection and Exploitation of the Environment and Coastal Zones of West and Central Africa, Abidjan, 23 March 1981;
- The United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982;
- The Vienna Convention on the Protection of the Ozone Layer, Vienna, 22 Mach 1985;
- The Montreal Protocol on Chlorofluoro-carbon (CFC), Montreal, 16 September 1987
- The Rio Conventions on Climate Change and Biological Diversity, Rio de Janeiro, 14 June 1992

Specifically for the Chad-Cameroon Pipeline Project, the two involved countries maintain a Bilateral Cooperation Agreement, which amongst other aims, calls for sustaining common and joint effort in the protection of the environment (both physical and human environment) affected by the pipeline project.

A.1.2 National legislation and decrees

Flowing from the Rio Earth Summit was the creation in 1992 of a cabinet level department, the Ministry of Environment and Forests (MINEF), through the issuance of Decree n° 92/069 dated 09 April 1992.

MINEF is responsible for the overall formulation and execution of the national environmental policy, the determination of strategies for sustainable management of natural resources and the prevention of pollution. In this regard, a priority for MINEF has been the preparation, and adoption in 1996, of the Cameroon National Plan for Environmental Management (PNGE), which in turn paved the way to the issuance and adoption of the Environmental Framework Law (Law N° 96/12 of 5 August 1996) relating to environmental management.

In 1996, the developing concern for the environment became formally entrenched as a national priority through the emphasis on environmental quality in the preamble of the country's Constitution. This fundamental law prescribes that each person has the right to a clean environment, for which the State is accountable, and that the protection of the environment is the duty of every citizen. During the same year (1996) Law 96/14 dated 5 August 1996 was published, which governs the pipeline transportation of liquid or gaseous hydrocarbons (produced by the other countries) through the territory of the Republic of Cameroon. This law was enacted to enable the realization of the Chad/Cameroon Pipeline Project, a major project with significant potential for environmental impacts. Law 96/14 and its application decree, N° 97/116 issued on 7 July 1997, require from any pipeline operator, adherence to technical norms and best practice regarding the protection of the physical as well as human environment.

In terms of relevance to the NOSCP, the above developments in national environmental legislation are most pertinent. Other developments relating to various laws and decrees concerning oil pollution include:

- Decree n° 77-528 of 23 December 1977 relating to regulation of storage and distribution of petroleum products;
- Law n° 86/016 of 6 December 1986 relating to the general reorganization of Civil Protection;
- Law n° 94/01 of 20 January 1994 relating to Forestry, Wildlife and Fisheries;
- Decree n° 95/135/PM of 3 March 1995 modifying decree 77-528 relating to regulation of storage and distribution of petroleum products;
- Decree n° 96/054 of 12 March 1996 specifying the composition and duties of the National Council for Civil Protection;
- Law n° 96/14 of 5 August 1996 governing the transportation by pipeline through the territory of the Republic of Cameroon of liquid or gaseous hydrocarbons produced by other countries;
- Law n° 96/12 of 5 August 1996 relating to environmental management;
- Decree 97/116 of 7 July 1997, setting conditions and modalities of application of law n° 96/14;
- Ministerial Order n° 01/97/MINMEE of 5 January 1998 relating to modalities for setting up of service stations;
- Decree n° 98/031 of 9 March 1998 relating to the organization of Emergency and Assistance in case of Catastrophes and Major Risks;
- Law n° 98/15 of 14 July 1998 relating to classification of dangerous and unhealthy establishments;
- Law n° 98/20 of 24 December 1998 governing pressure equipment, steam and gases;
- Decree n° 98/345 of 21 December 1998 organizing the Ministry of Environment and Forests;
- Decree n° 99/196 of 10 September 1999 to modify and complete decree n° 98/345;
- Decree n° 99/817/PM dated 9 November 1999 setting the modalities for construction and operation of pressure equipments, steam and gases;

- Decree n° 99/818/PM dated 9 November 1999 setting modalities for setting up and operation of dangerous and unhealthy establishments;
- Decree n° 99/819/PM of 9 November 1999 relating to modalities for selecting inspectors for pressure equipments, steam and gases;
- Decree n° 99/821/PM dated 9 November 1999 setting modalities for selecting inspectors to dangerous and unhealthy establishments;
- Law n° 99/13 of 22 December 1999 setting the Petroleum Code;
- Decree n° 99/899/CAB/PM dated 29 December 1999 related to the National Consultative Commission for Environment;
- Decree 2000/465 dated 30 June 2000 relating to modalities of application of the Petroleum Code;
- Decree n° 2000/305 dated 17 October 2000 awarding an Authorization for Transportation by Pipeline to the Cameroon Oil Transportation Company (COTCO);
- Decree n° 2000/935/PM of 13 November 2000 setting modalities for downstream activities in the petroleum sector;
- Decree n° 2001/024/CAB/PM of 30 January 2001 relating to the Protection Committee for Hydrocarbons Pollution;
- Decree n° 2001/163/PM of 8 May 2001 relating to protection of sources, treatment and reservoirs of drinking water;
- Decree n° 2001/165/PM dated 8 May 2001 relating to protection of surface and subterranean waters;
- Decree n° 2001/718/PM of 3 September 2001 relating to the organization and functioning of the Interministerial Committee for Environment.

The Environmental Framework Law provides for the protection of continental waters and flood plains, soils and the sub-soil as well as human settlements. To this effect, the responsibilities of various Ministries are specified in various laws and regulations, which focus on the specific domains of competence of these Ministeries. Thus, for example, while the overall responsibility for environmental management is vested with the Ministry of Environment and Forests (MINEF), where activities involving hydrocarbons pollution and interactions with classified and dangerous establishments are concerned, the Ministry of Mines, Water Resources and Power (MINMEE) is the competent authority defined in law. When endangered species of fish are of concern, the Ministry in charge of Fisheries (MINEPIA) fulfils the role of competent authority. If an oil spill incident were to be classified as a catastrophe, the Ministry in charge of Territorial Administration (MINATD) would intervene, etc.

To assist the different Ministries, specific Councils and/or Committees have been constituted by either presidential or the Prime Minister's decree. The following bodies are of particular relevance to the NOSCP:

- *The National Council for Civil Protection* created by Presidential decree N° 96/05 on 12 March 1996. The National Council for Civil Protection is in charge of the execution of the general policy on Civil Protection. Among its other duties, the Council is required to evaluate technological risks, risks of serious accidents and calamities and to propose to the President of the Republic appropriate prevention measures.

  The Council, with the approval of the President of the Republic of Cameroon, is responsible for the formulation of a National Plan for Intervention and Organization of Aid or Assistance. The Council is presided over by the Secretary General of the Presidency of the Republic.

  In case of catastrophes or major risks, the presidential order n° 98/031 of 9 March 1998 calls for the implementation of Emergency Plans that specify comprehensive rapid intervention measures in crisis situations. The implementation of the Emergency Plans is the responsibility of:

  - Senior Divisional Officers, at the Division level,
  - Governors at the Provincial level,
  - The Secretary General of the Presidency of the Republic of Cameroon at the National level.

- Supplementing the above initiatives, in the event of catastrophes or major risks, *Crisis Committees* are also constituted at Divisional, Provincial and National levels.

- The *Interministerial Committee for Environment* is a comparatively recently constituted body that assists the Government in its mission of evaluation, coordination, execution and control of national policies for environment and sustainable development. Among others responsibilities, the Committee assists the Government in the prevention and management of emergency or crisis situations, which may constitute serious threats to the environment or which may result in the degradation of the environment. The Committee is presided over by a person appointed by the Minister of Environment.

- The *Protection Committee against Hydrocarbons Pollution*. The committee is a consultative structure, which assists the Government in the application of the legislation and regulations *pertaining* to environmental protection and security regarding petroleum operations.

A.1.3 Claiming procedures

A.1.3.1 Liability

The Environmental Framework Law provides for the assignment of liability and sanctions relating to environmental damage. The terms of this Law, therefore, form the basis of claims for damage and compensation in the event of an oil spill, and the following two articles of the law are relevant in this regard:

ARTICLE 77

1. Without any prejudice to the sanctions applicable within the framework of penal liability, any person transporting or using hydrocarbons or chemical, harmful and dangerous substances, or any operator of a classified establishment who has caused body or material damage directly or indirectly linked to the exercise of the above mentioned activities shall be liable for damages without the need to prove his offence.
2. The reparation of the damage mentioned in (1) of this article shall be jointly borne when the party responsible for the damage proves that such damage is the also fault of the victim. Exoneration applies in the event that a situation has resulted from *force majeur*.

ARTICLE 78

When the constituent elements of an offence originate from an industrial, commercial, cottage industrial, or agricultural establishment, the owner, operator, director or manager (as the case might be) may be liable to fines or legal fees owed by the party responsible for the offence, and for the rehabilitation of the affected site.

A.1.3.2 Claims

All institutions dealing with hydrocarbons and petroleum products are required to maintain effective insurance policies, which include coverage for civil and third parties' liabilities. That is the case, for example, with COTCO's operations, the Petroleum Products Storage Company (SCDP), the National Refinery (SONARA) and the railroad transportation company (CAMRAIL), as well as all fuel distribution companies (Total E and P, Mobil, Texaco, Shell, First Oil) and the many road tanker trucks owners and the private managers of fuel service stations.

A.1.4 Planning Framework

The Republic of Chad, the Central African Republic and the Republic of Cameroon have entered into several international, regional and sub regional conventions and agreements relating to the protection of both the physical and human environments. These conventions and agreements set the rights and obligations of the signatory parties regarding the protection of the environment.

At present the three countries are in various stages of developing their National Oil Spill Contingency Plans. Until these plans are finalized and provide new mechanisms for cooperation, oil spills that have transfrontier implications (e.g. oil spills within river systems that cross international boundaries) will be managed via the existing sub regional agreements – specifically, CEMAC (*Communauté Economique et Monetaire de l'Afrique Centrale*).

With regard to the Chad–Cameroon Pipeline Project, the existing Chad-Cameroon Bilateral Agreement defines the framework for cooperation between the two countries. This includes the protection of the environment affected by the operation of the pipeline.

A.2 ANALYSIS OF INLAND RISK SOURCES

A.2.1 Introduction

This section covers the oil spill risk sources affecting in the country's hinterland; i.e. it excludes the marine and coastal environment risk sources, which are covered in Section A.2 (Marine and Coastal). The discussion of risk sources includes those existing installations present that might affect:

- The terrestrial environment (i.e. all land areas, classified according to the WWF ecoregions of Cameroon);
- The surface water environment (i.e. rivers, streams and freshwater wetlands); or
- The groundwater environment (i.e. upper weathered zone aquifers and lower fractured zone aquifers).

Risk sources were identified by surveying existing information on hydrocarbon production, refining, transport and storage in Cameroon. This preliminary inventory of risk sources was verified through discussions and field investigations undertaken between 1 and 12 December 2002, which covered six of the country's ten provinces (South-West, Littoral, South, West, Centre and East). The principal classes of risk sources that have been identified, and which are included in this plan, are (Figure A.2.1):

- The Chad-Cameroon crude oil pipeline, including the associated Pump Stations 2 (Bélabo) and 3 (Dompla), and Pressure Reduction Station (Kribi) – but excluding the pipeline landfall, subsea pipeline and the offshore floating storage and offloading (FSO) vessel;
- SCDP hydrocarbon storage facilities, including the pipeline from the Port of Douala to the city's main SCDP storage depot;
- Major transport routes for refined hydrocarbon products throughout Cameroon, including both road and rail tanker routes; and
- Other significant users of hydrocarbon fuels, principally power stations burning diesel.

The risk sources associated with the SONARA refinery at Limbe, and its pipeline and marine jetty system are not included in this section, as this infrastructure is situated within the coastal zone and is more closely linked with the coastal and marine environment than with the country's hinterland. Small scale and very numerous risk sources such as filling stations are not included, since these are not considered to be relevant at the national scale of oil spill response and can be addressed more effectively through different planning and control mechanisms.

The following sections describe the inland risk sources in Cameroon, the characteristics and quantities of hydrocarbon fuels present, oil spill scenarios and the likely fate of spilled oil for each risk source or group of risk sources. Potential interactions with terrestrial ecosystems, surface and groundwater resources and road and rail transport routes are described in a subsequent section (Section A.3).

Figure A.2.1: Map showing location of inland risk sources in Cameroon

A.2.2 Chad-Cameroon pipeline section: normal overland routing

A.2.2.1 Description

INFRASTRUCTURE

The Chad-Cameroon crude oil pipeline passes through 1 070 km of Cameroon territory, entering Cameroon from Chad near Mbai Boum, reaching the southern coast of Cameroon near Kribi and ending at the offshore marine terminal in the Atlantic Ocean off Kribi (Figure A.2.1).

The pipeline servitude ('right of way' or 'easement') is approximately 30 m wide, increasing to 50 m at road crossings and 60 m at river crossings. Once construction of the pipeline is complete, a narrower servitude of 15 m width will be maintained; this strip of land has, in some areas, already been released for cultivation of annual crops.

A General and six Area-Specific Oil Spill Response Plans, which set out the response measures to be taken in the event of oil spills, have been prepared for implementation during the operation of the Chad-Cameroon pipeline. Four of the six Area-Specific Oil Spill Response Plans apply within Cameroon territory, three of which concern the inland section and one the offshore facilities. The pipeline has been constructed using a "prevention-based design" approach to reduce the likelihood of pipeline failure and to minimize impacts. The principal oil spill prevention measures employed prior to and during construction were:

- Use of carbon steel pipe with a polyethylene corrosion resistant external coating and cathodic protection; the pipe thickness is increased at river crossings;
- Burying the pipeline approximately 1 m below ground level;
- Block valves ('mainline valves') along the pipeline at approximately 35 km intervals on average; altogether there are 39 block valves along the Cameroon portion of the pipeline route (Maintenance Area (MA) 2 has nine, MA3, fifteen and MA4, fifteen);
- A fibre-optic leak detection and valve control system controlled from the COTCO headquarters at Douala; this system can shut off the flow in the pipeline at certain sections if a leak is detected; other valves are manually controlled; and
- River protection measures such as concrete cladding, a deeper burial level and pairs of block valves, spanning all major river crossings;

In the process of developing the General and Area Specific Oil Spill Response Plans, COTCO conducted a risk analysis for each of the three inland maintenance areas in Cameroon. Six potential spill scenarios associated with the Chad-Cameroon pipeline were identified. These scenarios are presented in Table A.2.1 below.

Table A.2.1: Potential spill scenarios and sources associated with the Chad-Cameroon pipeline (adapted from COTCO, 2002a, 2002b, 2002c).

Potential situation	Potential tier	Potential volumes (m^3)
1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
2. Major pipeline rupture to land	Tier 2	10+ to 2 000
3. Pump station relief tank rupture or pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to10
5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to10+
6. Pressure Reduction Station leak	Tier 1	<1 to 2

RECEIVING ENVIRONMENT

The Chad-Cameroon pipeline passes through four biogeographic zones or ecoregions, as identified and described by Olson *et al.* (2001):

- East Sudanian savanna (WWF Ecoregion AT0705);
- Northern Congolian forest-savanna mosaic (WWF Ecoregion AT0712);
- Northwestern Congolian lowland forests (WWF Ecoregion AT0126); and
- Atlantic Equatorial coastal forests (WWF Ecoregion AT0102).

Since the ecoregions range from semi-arid savanna to humid tropical rainforest, and differ significantly in structure, flora and fauna, the probable fate of oil spills is described separately for each ecoregion.

A.2.2.2 Oil/fuel characteristics

The pipeline will transport heavy crude oil extracted from the major oilfield areas in southern Chad. The characteristics of the crude oil yielded by these fields are shown in Table A.2.2 .

Table A.2.2: Characteristics of crude oil from the four oilfields of southern Chad (after COTCO, 2002a, 2002b, 2002c)

Property	Lower Komé	Upper Komé	Miandoum	Bolobo
°API Gravity	40.6	18-20	24	17-22
Pour Point (°C)	Not available	-9-4	-7	-11-3
Viscosity (cP) (*ca*. 88°C)	0.248	70-296	38	72

The following explanation (Box A.2.1) for the crude oil parameters is adapted from HAZMAT (1995).

Box A.2.1: Description of key crude oil parameters.

The specific gravity of most crude oils lies between 0.78 and 1.00. The American Petroleum Institute's measure of oil density, °API gravity, is inversely proportional to specific gravity and normally falls between 10° and 50° API. The crude oils from the Chad oilfields fall within this range, indicating that they are lighter than water and will thus float on water. Pour point describes the temperature below which the oil cannot be poured, or will not spread. In the case of a spill into water, oil at temperatures below the pour point would congeal into tar-like globules and may sink below the surface. This measure has limited value in Cameroon where the tropical climate would ensure that the crude oil in the pipeline always remains above its pour point. An oil's viscosity is an important variable for environmental response since it determines the product behaviour during a spill, in this case its flow rate over the ground, seepage through soil or its rate of spread over a water surface. High viscosity indicates that oil is 'thick' or 'heavy' and will not spread easily (water has a viscosity cP value of 1 at room temperature, and molasses of 100 000). By this measure the Chad oils are highly variable. Oils from the Lower Komé field being very 'light' and those from the Upper Komé field considerably 'heavier'.

A.2.2.3 Oil Spill scenarios (Tier 1, 2 and 3)

For the portions of the pipeline that are routed overland (i.e. between river crossings and between pump stations), spill scenarios 2, 4 and 5 (◆) are relevant (see Table A.2.3).

Table A.2.3: Potential spill scenarios and sources associated with the Chad-Cameroon pipeline normal overland routing; relevant scenarios are marked with a (◆) (adapted from COTCO, 2002a, 2002b, 2002c)

	Potential Situation	Potential Tier	Potential Volumes (m³)
	1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
◆	2. Major pipeline rupture to land	Tier 2	10+ to 2 000
	3. Pump station relief tank rupture or Pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
◆	4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to 10
◆	5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to 10+
	6. Pump Station or Pressure Reduction Station leak	Tier 1	<1 to 2

A.2.2.4 Probable fate of oil spill

The probable fate of oil spilled into the terrestrial environment under the above scenarios is described according to the major ecoregions through which the pipeline passes.

EAST SUDANIAN SAVANNA

Of the four ecoregions crossed by the pipeline, the savanna areas north of Bélabo face the greatest risk of significant overland flow of oil following a spill. In most of this ecoregion there could be significant overland flow of oil following a spill, particularly downstream of Pump Station 2, where the oil is heated to about 70°C. A spill in this area is of particular concern since it could affect the Mbéré river, an international waterway that flows into Lake Chad. However, the relatively high accessibility of savanna landscapes allows for more effective response and clean-up options than in forest or forest mosaic vegetation types.

Associated with the high likelihood of overland flow is the possibility that spilled oil could flow into streams, and wetlands or seep into groundwater. This risk is particularly serious in the savanna zone because water resources are more scarce here than anywhere else in Cameroon. In addition the soils of the northern parts of Cameroon are, in parts, coarse and sandy, making them relatively permeable to oil. Groundwater is extensively used for household consumption and streams do not have the high flow rates required to dilute oils and remove them from the site of a spill.

NORTHERN CONGOLIAN FOREST-SAVANNA MOSAIC

In Cameroon, the forest savanna transition zone forms a wide band across the middle of the country between the North-western Congolian lowland forests (Olson *et al.,* 2001) in the south and the East Sudanian savanna (Olson *et al.,* 2001) in the north. The forest-savanna transition consists of a mosaic of forest and savanna patches, with each patch of a vegetation type more or less isolated in a matrix of the other. This interface between the ecoregions exhibits a high diversity of plant and animal species, provides important habitat for a diversity of medium-sized and large mammals, allows migration between very different habitats, and in future will provide resilience to climate change.

The fate of oil in such a mosaic environment depends on soil type, vegetation structure and topography. In grassland or lightly wooded savanna on sloping terrain, the likely fate of spilled oil would be to flow downslope to a local low point in the landscape. Refined products would volatilise rapidly, whereas crude oil would persist in the environment for weeks to years (depending on the local climatic conditions). In woodlands and forest patches, spilled oil would not flow readily, but would remain trapped in the dense vegetation. Again, refined products may volatilise before any significant flow occurs, whereas crude oil would remain in place provided that no further spillage occurred; i.e. a small crude oil spill would be localised, whereas a large spill may flow overland. Groundwater is extensively used for household consumption in the forest-savanna mosaic, where shallow wells of 8 to 14 m depth are used to provide water in or close to villages.

NORTHWESTERN CONGOLIAN LOWLAND FORESTS

In primary or secondary forest it is unlikely that even a large spill would progress very far overland. Much of the pipeline route cuts through secondary forest with thick undergrowth and abundant shrubs and climbers. In this situation it is likely that overland flow would be confined to the pipeline servitude. Outside the servitude it is likely that the density of the vegetation and the viscosity of the oil would arrest overland flow, and that the oil would then simply decompose *in situ*. However, due to the relatively high rainfall and the deep weathered zone, penetration of oil into the soil and the resultant potential for contact with either shallow or deep groundwater or with surface water would exist. There are three scenarios for which there could be significant overland flow:

- immediately downstream of Pump Station 3 where the oil is heated to about 70°C;
- in areas where the forest has been cleared for cultivation of annual crops or for settlement; or
- along the cleared pipeline servitude.

ATLANTIC EQUATORIAL COASTAL FORESTS

The Congolian coastal forests of south-western Cameroon are particularly thick and impenetrable and would present a physical barrier to the overland flow of oil. In this situation it is likely that the density of the vegetation and the viscosity of the oil would arrest the flow of oil, and that the product would then simply decompose *in situ*. Overland flow would occur principally:

- in areas where the forest has been cleared for cultivation of annual crops or for settlement;
- along the pipeline servitude; or
- along the sandy beaches at the coast.

It is unlikely that overland flow would occur near the Pressure Reduction Station at Kribi, partly because of the densely forested environment and partly because the oil in the pipeline is not heated at this station.

A.2.3 Chad-Cameroon pipeline section: river crossings

A.2.3.1 Description

The pipeline is buried at least 1 m underground throughout its length. At river crossings, a thicker-walled pipe is used, it is surrounded by a concrete cladding, and the burial depth is increased to 1.5 m. These measures are intended to ensure that the pipeline is beyond the reach of the scouring effects of water, rocks and stones on the river bed and that it is sufficiently weighted to remain seated even if exposed through scouring. Nevertheless, there is still a residual chance that damage to the pipeline will occur through natural means or that some accident or intervention may result in a pipeline rupture or leak at a river crossing. Any leaks that may occur close to river crossings could also result in oil flowing into rivers. Table A.2.4 lists the crossings of major rivers made by the pipeline in Cameroon. There are numerous crossings of smaller rivers and streams and these are treated in a similar way to the larger river crossings.

Table A.2.4: Major river crossings made by the Chad-Cameroon pipeline in Cameroon. Source: Chad Export Project (1999a)

River	Pipeline km
Mbéré	178
Mbéré	324
Mba	432
Pangar	487
Mouyai	529
Lom	539
Sesse	585
Yong	608
Tede	709
Afamba	811
Nyong	907
Lokoundjé	946
Mougue	994
Lokoundjé	1 007
Kienké	1 062

A.2.3.2 Oil spill scenarios (Tier 1, 2 and 3)

For the portions of the pipeline that cross rivers, spill scenario 1 (◆) is relevant (see Table A.2.5).

Table A.2.5: Potential spill scenarios and sources associated with the Chad-Cameroon pipeline river crossings; relevant scenarios are marked with a (◆) (adapted from COTCO, 2002a, 2002b, 2002c)

	Potential Situation	Potential Tier	Potential Volumes (m^3)
◆	1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
	2. Major pipeline rupture to land	Tier 2	10+ to 2 000
	3. Pump station relief tank rupture or Pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
	4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to 10
	5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to 10+
	6. Pump Station or Pressure Reduction Station leak	Tier 1	<1 to 2

A.2.3.3 Probable fate of oil spill

INTERNATIONAL WATERWAYS

The Mbéré river and Lake Chad, which are joined by the Logone Occidental river in Chad, are international waterways. In terms of World Bank Operational Policy 4.1, the partner countries through which these waterways run have been informed of the associated risk of oil spills.

RIVER BASINS

The rivers of Cameroon discharge in one of four ways:

- Rivers of the Atlantic Basin discharge directly into the Atlantic Ocean on the west coast of Cameroon;
- The rivers of the south-east discharge into the Congo river that flows east and south;
- The rivers of the far north and east discharge into Lake Chad; and
- The rivers to the north of the Adamaoua Plateau and the Cameroon highlands join the Niger river in Nigeria.

Oil spills that affect rivers in the Niger or Congo Basins would have international implications similar to those affecting the international waterways mentioned above.

With the exception of the Lake Chad Basin, the rivers of Cameroon have high runoff and fast flow rates due to the abundance of rainfall and general humidity. As a result, oil would be transported rapidly downstream in most rivers. The larger rivers of the Atlantic Basin (Pangar, Mouyai, Lom, Sesse, Yong, Tede, Afamba, Nyong, Lokoundjé, Mougue, Kienké and Lobé) are extensively used by people for potable water, fishing, washing, and subsistence irrigation. Small industries are sometimes established around these rivers, including sand mining, transport of logging products (e.g. Sesse river, Deng Deng area), and would be seriously affected if oil spills occurred. In the event of an oil spill it would be necessary to provide alternative access to the services that rivers provide, especially water and food.

Although the river flow rates would ensure that most spilled oil travelled downstream rather rapidly, riverside vegetation would trap some of the oil and this may persist for a considerable length of time. The fragility and instability of river banks makes the clean-up of spilled oil difficult and environmentally costly. Due to the exchange between groundwater and surface water (groundwater contributes to river base flows, particularly in the dry season), contamination of rivers could result in contamination of groundwater resources, both surface aquifers (more likely) and deeper fractured zone aquifers (less likely). Use of groundwater is widespread on a small scale all over Cameroon, but is particularly important in the drier northern areas. In terms of the pipeline routing, the section of the Lake Chad basin around Mbai Boum where the pipeline enters Cameroon is of relevance.

A.2.4 Chad-Cameroon pipeline: crossings of seasonally inundated grassland

A.2.4.1 Description

Flooded grasslands are associated with some of the larger rivers in central Cameroon, particularly the Mbam-Sanaga and Ndjeke-Sanaga confluences. The pipeline crosses these grasslands between Nanga Eboko and Yaoundé (southern MA3 and northern MA4). In addition, these grasslands may be at risk from a spill upstream in the Sanaga river or one of its tributaries.

A.2.4.2 Oil spill scenarios (Tier 1, 2 and 3)

For those sections of the pipeline which cross seasonally inundated grassland, scenarios 2, 4 and 5 (◆) are relevant (see Table A.2.6).

Table A.2.6: Potential spill scenarios and sources associated with the Chad-Cameroon pipeline crossings of seasonally inundated grassland, relevant scenarios are marked with a (◆) (adapted from COTCO 2002a, 2002b, 2002c)

	Potential Situation	Potential Tier	Potential Volumes (m^3)
	1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
◆	2. Major pipeline rupture to land	Tier 2	10+ to 2 000
	3. Pump station relief tank rupture or Pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
◆	4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to 10
◆	5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to 10+
	6. Pump Station or Pressure Reduction Station leak	Tier 1	<1 to 2

A.2.4.3 Probable fate of oil spill

Inundated grasslands are sensitive to the effects of oil because they are flooded all or part of the time and many have the properties of freshwater aquatic habitats. Hydrocarbons in the water may result in physical smothering and have toxic effects on the stems, leaves and reproductive parts of these plants. Similarly, the fauna associated with the inundated grasslands will be adversely affected by an oil spill. Because they are frequently inaccessible while flooded, the difficulty of removing spilled oil is considerable. Flooded grasslands associated with rivers are also vulnerable to spilled oil that may enter the river system and be swept downstream.

A.2.5 Chad-Cameroon pipeline: crossings of protected areas

A.2.5.1 Description

The Chad-Cameroon pipeline crosses two protected areas of concern; namely the Pangar Djerem Reserve and the Campo-Ma'an Operational Unit, including Campo-Ma'an National Park.

PANGAR DJEREM RESERVE

The Chad-Cameroon pipeline passes through approximately 54 km of the south-eastern portion of the Pangar Djerem Reserve, which lies in the northern Deng Deng region. Pangar Djerem lies in the southern part of the forest–savanna mosaic (Northern Congolian forest-savanna mosaic). This area exhibits high species diversity, provides important ecosystem services such as habitat for a diversity of medium-sized and large mammals, areas for diurnal migration, formation of new species and in future may provide resilience to climate change. The southern and eastern portions of Pangar Djerem are subject to the pressures resulting from the Bélabo-Ngaoundéré railway, which provides access to the reserve, heavy hunting pressure by subsistence and commercial hunters and logging and settlement activities.

Pangar Djerem was proposed for protection in 1969, after which initial surveys were conducted in 1977 and boundaries proposed. However, the boundaries were not completed, the reserve was not gazetted, and it is currently not effectively protected. On finalising the pipeline route, the pipeline consortium proposed a new national park further west in the Deng Deng region (a relatively 'pristine' area), and pledged US$1.5 million (900 million FCFA) for its protection[1]. Despite the ungazetted status of Pangar Djerem, an oil spill in this area would have negative effects on wildlife.

[1] The proposed Mbam-Djerem National Park (3 532 km^2) has been surveyed and has received the endorsement of the Cameroon government; the formal gazettement process has been initiated. The implementing agency is the Wildlife Conservation Society of Cameroon (WCS Cameroon).

CAMPO MA'AN OPERATIONAL UNIT (INCLUDING AREAS OF IUCN CATEGORIES II AND IV)

Campo Ma'an Operational Unit refers to the development and management area to the south and south-east of Kribi, as far as the border with Equatorial Guinea. The Operational Unit consists of a 7 710 km^2 project area under the management of the Conservation and Biodiversity Management Programme[2]. The project aims to conserve biodiversity, utilise resources sustainably and contribute to economic development in the area through a variety of projects. The Unit includes both the Reserve de Faune de Campo and the Campo Ma'an National Park, which have different boundaries. This area is considered to be sensitive as far as oil spills are concerned.

The northern boundary of the Campo-Ma'an Operational Unit lies approximately one kilometre south of the pipeline landfall and could be affected by an oil spill originating from the overland pipeline, the landfall, the subsea pipeline or the Floating Storage and Offloading (FSO) unit at sea. The probability of overland flow of oil from the pipeline reaching the reserve is small, but not absent. Oiling within the Operational Unit could result in degradation of a sensitive coastal area, and of the agricultural land associated with the project. The evergreen Atlantic littoral forest (Letouzey, 1985) is an area of international conservation value, with significant populations of great apes, other primates, large mammals and forest antelope. The consequences of an offshore oil spill affecting the coastline are discussed in Section A.3.3 of the Marine and Coastal section of the NOSCP.

A.2.5.2 Oil spill scenarios (Tier 1, 2 and 3)

Where the pipeline passes through protected areas oil spill scenarios 1, 2, 4 and 5 (◆) are relevant (see Table A.2.7).

Table A.2.7: Potential spill scenarios and sources associated with the Chad-Cameroon pipeline where it passes through protected areas; relevant scenarios are marked with a (◆) (adapted from COTCO 2002a, 2002b, 2002c)

	Potential Situation	Potential Tier	Potential Volumes (m^3)
◆	1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
◆	2. Major pipeline rupture to land	Tier 2	10+ to 2 000
	3. Pump station relief tank rupture or pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
◆	4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to 10
◆	5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to 10+
	6. Pressure Reduction Station leak	Tier 1	<1 to 2

[2] This project is part of the Global Environment Facility-funded Biodiversity Project in Cameroon.

A.2.5.3 Probable fate of oil spill

PANGAR DJEREM RESERVE

The terrain of Pangar Djerem is relatively flat, consisting of a mid-altitude plain at about 800 m with scattered inselbergs. Since it spans the forest–savanna transition, Pangar Djerem is an area of high habitat diversity and complex vegetation structure. In forest areas of the mosaic, and in dense or wide bands of gallery forest in the savanna portions, it is unlikely that oil would flow far overland. In grassland, lightly wooded savanna and areas under annual crops, there could be considerable overland flow, potentially resulting in contamination of land, wetlands and rivers.

CAMPO MA'AN OPERATIONAL UNIT

Although the natural vegetation of this area is dense forest, the area around Kribi is highly transformed, with agricultural lands (annual and tree crops), settlements and secondary and even tertiary forest growth. A spill in this area would result in adverse effects on human and agricultural settlements and therefore on human livelihoods. Overland flow could be significant in cleared, cropped and settled areas. The fact that the Campo Ma'an Operational Unit is a focal area for sustainable development projects indicates that this area should be treated as a special priority with regard to oil spills.

A.2.6 Chad-Cameroon pipeline: pump stations

A.2.6.1 Description

The Cameroon portion of the Chad-Cameroon pipeline includes two pump stations at Dompla (Pump Station 2) and Bélabo (Pump Station 3). Pump Station 2 is scheduled to operate from the time of commissioning, while Pump Station 3 will only operate later on in the project life cycle (close to peak operation when the pipeline will convey up to 225 000 barrels of crude oil per day).

The pump stations are required to provide additional pressure in the pipeline, and are designed to flare off gases and to heat the crude oil to facilitate its passage along the pipeline. The oil is heated to approximately 71°C before leaving the pump station. The first section of the pipeline downstream of the pump stations is buried to a depth of 1.3 m to minimise heat effects on soil fauna. Both pump stations are self sufficient in terms of power supply, water supply, waste disposal, sewage treatment and staff accommodation. The sites are designed to contain stormwater runoff and ensure that any oil is separated before the water is discharged to nearby watercourses. Holding tanks are bunded in concrete lined containment areas of 120% of tank capacity. Spilled or leaked oil can be collected, cleaned and returned to storage without contaminating the areas outside the bunds.

Plate A.2.1: Part of the oil heating apparatus at Pump Station 3 (Bélabo)

A.2.6.2 Oil spill scenarios (Tier 1, 2 and 3)

For the sections of the pipeline in the immediate vicinity of, and including, the pump stations scenarios 3 and 6 (◆) are relevant (see Table A.2.8).

Table A.2.8: Potential spill scenarios and sources associated with pump stations on the Chad-Cameroon pipeline; relevant scenarios are marked with a (◆) (adapted from COTCO 2002a, 2002b, 2002c)

	Potential Situation	Potential Tier	Potential Volumes (m^3)
	1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
	2. Major pipeline rupture to land	Tier 2	10+ to 2 000
◆	3. Pump station relief tank rupture or Pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
	4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to 10
	5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to 10+
◆	6. Pump Station or Pressure Reduction Station leak	Tier 1	<1 to 2

A.2.6.3 Probable fate of oil spill

PUMP STATION 2 - DOMPLA
Pump Station 2 at Dompla lies in the East Sudanian Savanna ecoregion (Olson *et al.,* 2001). The vegetation is wooded savanna, in some areas degraded or fallow fields, sometimes heavily grazed and with a rocky and stony substratum (Letouzey, 1985; Vegetation Types 66, 67 and 68). Drainage or flow of a spill from the pump station site would be in a northerly direction towards the Ligara river, a tributary of the Vina river. The Vina flows into the Logone Occidental, an international waterway and part of the Lake Chad Basin. (The only other international waterway that could be affected by the pipeline is the Mbéré river to the south-west of the pump station site; the Mbéré river also flows into the Logone Occidental, and thereafter, into Lake Chad). Because of the generally flat terrain around the pump station and the open savanna vegetation, overland flow would occur rather slowly, and in a dispersed pattern. In this area spilled oil could enter ecologically and socio-economically important groundwater reserves.
PUMP STATION 3 – BÉLABO
Pump Station 3 near Bélabo is situated on the crest of a hill, in a hilly landscape, not far from the Sanaga river. The vegetation is semi-deciduous forest with varying levels of disturbance as a result of agriculture, settlement and logging (Letouzey, 1985; Vegetation Types 160 and 172). Many small drainage lines and seeps cut through the forest, and in some areas the water table is close to the ground surface. A spill at the pump station could result in oil flowing down the hillslopes and entering rivers or streams. Oil could enter the upper layers of groundwater through seepage. Although the use of the deeper aquifers is uncommon in this part of Cameroon, the upper weathered zone aquifers are frequently tapped by shallow wells for household consumption.

A.2.7 Chad-Cameroon pipeline: Pressure Reduction Station

A.2.7.1 Description

The Pressure Reduction Station at Kribi is the final control point on the pipeline before the last section that links to the offshore facilities. The purpose of the station is to reduce the in-line pressure from 300 psi to 100-150 psi for loading the crude oil onto the Floating Storage and Offloading (FSO) vessel. The station essentially comprises a pair of control valves, a bunded surge tank to manage temporary overloads and a pressure metering skid to detect leaks in the pipeline. There are no gas vents since the gas content of the crude oil is minimal at this point. Oil from the surge tank is fed into the low pressure section of the pipeline between Kribi and the offshore FSO vessel.

A.2.7.2 Oil Spill scenarios (Tier 1, 2 and 3)

Potential spill scenarios 3 and 6 (◆) associated with the Pressure Reduction Station at Kribi are presented in Table A.2.9 below.

Table A.2.9: Potential spill scenarios and sources associated with the Pressure Reduction Station at Kribi (adapted from COTCO, 2002a, 2002b, 2002c).

	Potential Situation	Potential Tier	Potential Volumes (m^3)
	1. Major pipeline rupture with drainage to streams or rivers	Tier 2	10+ to 2 000
	2. Major pipeline rupture to land	Tier 2	10+ to 2 000
◆	3. Pump station relief tank rupture or Pressure Reduction Station storage tank rupture or mechanical failure and flow over secondary containment	Tier 1 or 2	1 to 10+
	4. Pipeline leak due to corrosion or small mechanical or weld defects	Tier 1 or 2	1 to 10
	5. Pipeline damage from 3rd party intervention	Tier 1 or 2	1 to 10+
◆	6. Pump Station or Pressure Reduction Station leak	Tier 1	<1 to 2

A.2.7.3 Probable fate of oil spill

The Pressure Reduction Station at Kribi lies to the south of the Kienké river. The surrounding vegetation is coastal forest heavily impacted by urban expansion and subsistence agriculture. A spill at this site could reach the lowermost reaches of the Kienké river and enter the sea via the Port of Kribi. Such a spill would have an effect on local fishermen and coastwise transport services by denying them the use of the harbour while the spill is cleaned up.

A.2.8 SCDP fuel storage depots

A.2.8.1 Description

The Société Camerounaise des Dépôts Pétroliers (SCDP) was established on 1 July 1979 to ensure the efficient supply of petroleum products throughout Cameroon. Specifically SCDP is required to:

- Store the necessary range of petroleum products used in Cameroon;
- Maintain a national (state-owned) strategic reserve of petroleum products; and
- Provide national coverage with appropriately located storage depots.

The SCDP is a state-controlled consortium of which the Government of Cameroon holds 51% of the equity. The balance is held by five oil companies: Texaco (11%), Mobil (10%), Total (10%), Shell (10%) and Elf (8%). Technical support is provided by Total Outre Mer.

The total capacity of all the SCDP storage depots is 245 000 m^3 of petroleum products, including petrol (gasoline), diesel (gasoil), kerosene (power paraffin) and aviation fuel (Jet-A1). In addition, storage is provided for a total of 4 500 m^3 of liquid butane.

Storage facilities are maintained in six cities and towns countrywide (Figure A.2.2, Table A.2.10, Plate A.2.3).

Table A.2.10: Location and capacity of SCDP storage facilities

Location	Capacity (m^3)
DOUALA (5 depots):	156 725
Bessengue	75 355
Mboppi	44 420
Bonabéri	3 000
Deido	29 950
Port de Pêche	4 000
YAOUNDE (3 depots):	55 885
Nsam	52 950
Mvolye	1 235
Olezoa	1 700
BELABO	6 080
GAROUA	23 600
NGAOUNDERE	5 540
BAFOUSSAM	18 520

Figure A.2.2: Location of SCDP storage facilities.

The main source of refined products in Cameroon is the SONARA refinery at Limbe, which provides 80% of the country's requirements. The remaining 20% is sourced from refineries in the West African region. Originally SONARA was the sole supplier, but recently this requirement has been relaxed as part of the process of privatising the petroleum storage and distribution operation.

IMPORTATION OF PETROLEUM PRODUCTS

A small, 10 000 m^3 capacity, shuttle tanker, owned by Camship, transports petroleum products from Limbe to the terminal at the Port of Douala. This vessel transports 80% of the petroleum products discharged at the Port of Douala. Charter vessels are used to transport the 20% of petroleum products imported from elsewhere.

THE PORT OF DOUALA

At present a temporary terminal is being used because the original terminal was damaged by a collision with a tanker.

A new petroleum import terminal is to be constructed in the Port of Douala. However, this has been deferred on a number of occasions and no firm date has been set for the commencement of construction.

PIPELINE FROM THE PORT OF DOUALA TO THE BESSENGUE STORAGE FACILITY

The pipeline from the port to the SCDP depot at Bessengue is approximately 3 km long. About 1 km of the pipe is aerial, fenced and patrolled. The remainder of the pipe is buried, mainly in proximity to housing. A new pipeline route is being considered, which will be located away from urban development. The new pipeline route will be provided with a safety corridor and integrated into the urban planning process to prevent a repetition of the urban encroachment that poses a high risk to the present pipeline.

The pipeline is operated passively; i.e. the pumps aboard the tanker(s) transfer the product through the pipeline to the depot at Bessengue. There are three control valves located on the pipeline between the port and the depot. The pipeline is provided with cathodic protection to minimise external corrosion.

THE BESSENGUE STORAGE DEPOT

The Bessengue storage depot is the largest (75 355 m^3) SCDP facility which, with the four other smaller depots in Douala, serves all the regional depots in Cameroon. The depot handles the following volumes of product monthly:

- Diesel fuel — 40 000 m^3
- Jet-A1/kerosene — 25 000 m^3
- Super (petrol/gasoline) — 30 000 m^3

In addition, heavy fuel oil (HFO) is supplied by rail to a cement works in Ngaoundéré.

All the tanks at the installation are bunded, generally to 110% of tank capacity. However, the bunding/spill control at the rail tanker siding is inadequate. Currently there are plans to upgrade the Mboppi siding to act as a temporary facility while the Bessengue siding is rebuilt with an impermeable floor and a sump to gather spillages.

DOUALA/BESSENGUE RISK SOURCES

- **THE PORT OF DOUALA**

The temporary offloading facilities are a cause for concern since by their very nature the minimum will be invested in maintenance. It is critically important that the new terminal is constructed to the highest standards as soon as possible since the volume of petroleum products handled will continue to increase.

Specifications for tankers entering the Port of Douala need to be drawn up – especially for those bringing in the 20% from the open market.

- **OPERATION OF THE PIPELINE BETWEEN THE PORT OF DOUALA AND THE BESSENGUE DEPOT**

Communication between the terminal and the depot

Since the petroleum products are moved using the ship's pumps, co-ordination and communication between the ship's crew and SCDP staff is critical particularly in the case of an emergency. This situation will be exacerbated when the import market is opened up because, besides the Camship tanker, other vessels, unfamiliar with the SCDP procedures for discharging petroleum products, will be involved in transporting the petroleum products.

The pipeline route

Uncontrolled urban development has encroached on the pipeline route. Consequently, the aerial portion of the pipeline has had to be fenced and is guarded continuously. This urban encroachment poses a severe risk in the event of a spillage leading to fire and explosion. Access for fire fighting vehicles is restricted and there is a real danger of such fire spreading into the neighbourhood.

- **BESSENGUE DEPOT**

The Bessengue Depot is equipped to deal with internal spillages (bunded tanks) and fire fighting. The main risk sources are:

- Spillages at the rail tanker loading facility;
- Overflow from the oil/water separator sump; and
- Urban encroachment on the depot site.

It appears that the efficiency of the oil-water separator sump in the stormwater system is less than ideal. It is likely that oily stormwater is discharged from the site during heavy rainfall events. This oily stormwater will eventually reach the Estuaire du Cameroun. Similarly, the management of run-off from the rail tanker loading facility is problematic. There is an urgent need to re-assess the design and operation of the oil/water separator to ensure that the discharged stormwater meets internationally accepted standards.

A.2.8.2 Oil/fuel characteristics – fuel types

A range of refined products is stored at the SCDP depots throughout Cameroon. These products are presently produced at the SONARA refinery at Limbe, and include jet fuel, kerosene (sometimes called 'petrol' in Cameroon), gasoline/petrol and diesel (or 'gazoil' in Cameroon). The properties of these fuels are shown in Table A.2.11 below.

Table A.2.11: Properties of refined fuels. Source: CONCAWE (1992, 1995, 1996, 1998)

Property	Unit	Typical range
Jet fuels A and A-1		
Closed cup flash point	°C	38
Freezing point, max.	°C	-47
Density at 15°C	g/ml	0.775 to 0.840
Straight-run kerosene		
Closed cup flash point	°C	62 (USA samples)
Pour point	°C	-49
Density at 15°C	kg/m^3	0.81
Reid vapour pressure at 37.8°C	hPa	14
Motor gasoline		
Flash point	°C	<-40
Density at 15°C	kg/dm^3	0.72 to 0.79
Vapour pressure at 37.8°C	hPa	350-900
Automotive diesel		
Flash point	°C	>56
Pour point	°C	<30
Density at 15°C	kg/m^3	0.82 to 0.86
Vapour pressure at 40°C	kPa	*ca*. 0.4
Heavy fuel oil		
Flash point	°C	>60
Pour point	°C	<30
Density at 15°C	kg/m^3	950 to 1 010

A.2.8.3 Oil spill scenarios

Two classes of spills, which may occur at the fuel depot, have been identified. These are: normal transfers of fuel between road and rail tankers and the storage tanks (and *vice versa*); and catastrophic spills resulting from the failure of one or more storage tanks.

Operational spills are unlikely to involve more than one road or rail tanker and the volume potentially spilled is unlikely to exceed 66 m^3 (the volume of the largest size of rail tank car). Catastrophic spills could involve the failure of one or more storage tanks. A typical large refined product storage tank has a capacity of 14 300 m^3.

A.2.8.4 Probable fate of oil spill

The bunding of the storage tanks at these facilities should ensure that any spills that occur are kept within the containment areas around the storage tanks. However, attention should be paid to the complete insulation of the bund area from the environment, particularly of the stormwater system. If bund areas are inadequately sealed and lined (e.g. with a drainage pipe to convey routine stormwater out of the bund areas, and having an inadequate oil/water separator system for this purpose), contact could occur with the surrounding environment as a result of slops and spills during oil transfer or from storage tank failure. Contact with groundwater could occur from seepage through the bund floor, or with rivers and streams through the stormwater system.

A.2.9 Road tanker transport routes

A.2.9.1 Description

The potential risks related to a fuel spill are greatest in those regions where traffic densities are highest, particularly where the road traffic includes logging vehicles.

All fuel products, either imported or refined in Cameroon and stored at SCDP facilities, are transported between Douala and a local storage facility and then transported from the storage facility to the point of distribution or sale (e.g. a filling station). While in transit, and while stored in SCDP tanks, the fuel is the property of an oil company, several of which operate as fuel distributors and retailers, and not of SCDP. The oil companies are also responsible for spill response and clean-up, although SCDP would provide technical support in fuel recovery and transfer in the event of an accident. Jet fuel is distributed to the airports and airfields that are located in many of the rural towns as well as the major cities. Kerosene, gasoline/petrol and diesel are distributed to the filling stations in most towns.

Away from the railway lines, fuel is distributed within Cameroon via road tankers. Each fuel tanker is clearly labelled as to the identity of its contents, the maximum capacity of the tanker, and clear warnings as to the “flammability” of the contents. This is in accord with international requirements. However, it is not clear as to the mechanical (and electrical) ‘state’ of the tankers used and their fitness to convey the goods that they carry.

Conventionally, an authorized dealer or agent must regularly service fuel transport tankers, the integrity of the fuel tanks should be certified each time, and notices that declare this state of affairs should be visible on each vehicle.

Given the topography of Cameroon, as well as the high traffic density on many of the secondary roads (logging trucks, sedan cars and motorcycle taxis), combined with the need to have a steep camber and capacious drains on the laterite roads to facilitate rapid drainage of rainwater, there are several points on the road network where accidents seem almost inevitable. If such accidents involve a fuel transport tanker, or are located close to rural or urban communities, the results may be severe.

Despite the above 'adverse' comments, the relative risks posed by road fuel tankers is considered to be moderate, and restricted to specific 'accident black spots' where limited visibility, reduced road widths, poor road surface conditions and, during wet periods, slippery surface conditions, increase the risk of accidents occurring. Regions that receive higher rainfall will have a greater risk potential than drier regions.

Plate A.2.2: Small road tanker carrying jet fuel from the SCDP Bélabo storage depot

As could be expected, roads and railway systems inevitably cross one another at a variety of locations. Appropriate warning signage has been erected at these points, but there are occasions when road vehicles do not have sufficient advance warning that a road-rail crossing is located immediately ahead. Under most circumstances, this would not pose an additional risk to road or rail traffic. However, where these road-rail crossings occur on untarred roads used frequently by heavy vehicles, the dust that such vehicles generate dramatically decreases visibility. In such circumstances, the reduced visibility results in a reduced reaction time available for vehicle drivers to avoid an impact with a train at the crossing point. If either the road vehicle or the train is conveying fuel, there is a risk that an accident could result in a fuel spill.

On surfaced roads, the risk is estimated to be low to medium, provided that the approaches to road-rail crossings are fully visible for a distance of at least 250 m and that warning signage is in place and is clearly visible. On untarred (or gravel-surfaced) roads, visibility is often reduced to less than 30 m due to the dust raised by passing vehicles. In such circumstances, even clearly sign-posted road-rail crossings may not be sufficiently visible to drivers of road fuel tankers. In such circumstances, the risk of an accident occurring is considered to be moderate to high, depending on the specific topographical or terrain characteristics of the site in question. Where a road-rail crossing is located in close proximity to a river or stream, or to a rural community living close to the roadway, the risk potential is considered to be high. Every effort should be made to ensure that no dwellings are allowed within at least 100 m of a road-rail crossing. Similarly, where a potentially 'high risk' road-rail crossing is located near to a sensitive environment such as a swamp forest, careful attention should be directed to ensuring that every attempt is made to reduce potential risks at these points. Clearly, aggravating circumstances caused by dust would be reduced during and after rainfall. However, the laterite road material is prone to be slippery when wet and, despite reduced 'dust' risks, the risk of vehicle accidents remains moderate to high. On those roads that are designated as 'dry season only', the risks become acute during rainy periods.

In relative terms, Cameroon's roads carry a considerable volume of heavy traffic. This is particularly pronounced in the more remote rural areas where forest exploitation activities are occurring, or where logging traffic is normally routed. Where roads are unsurfaced (or have a gravel/laterite surface), the risk is increased; where such roads are used by both logging traffic and fuel transport vehicles, the risks rise even further. Despite the fact that many of Cameroon's roads appear to have originated as access routes for logging activities, logging vehicles do not have preferential access, and these roads now serve as important means of communication and trade between a wide variety of communities.

A.2.9.2 Oil/fuel characteristics – fuel types

A variety of fuel products is produced, distributed and sold in Cameroon, including jet fuel, kerosene, gasoline/petrol, gasoil (diesel) and HFO. The characteristics of these fuels are shown in Table A.2.12 below.

Table A.2.12: Properties of refined fuels. Source: CONCAWE (1992, 1995, 1996, 1998)

Property	Unit	Typical range
Jet fuels A and A-1		
Closed cup flash point	°C	38
Freezing point, max.	°C	-47
Density at 15°C	g/ml	0.775 to 0.840
Straight-run kerosene		
Closed cup flash point	°C	62 (USA samples)
Pour point	°C	-49
Density at 15°C	kg/m^3	0.81
Reid vapour pressure at 37.8°C	hPa	14
Motor gasoline		
Flash point	°C	<-40
Density at 15°C	kg/dm^3	0.72 to 0.79
Vapour pressure at 37.8°C	hPa	350-900
Automotive diesel		
Flash point	°C	>56
Pour point	°C	<30
Density at 15°C	kg/m^3	0.82 to 0.86
Vapour pressure at 40°C	kPa	*ca*. 0.4
Heavy fuel oil		
Flash point	°C	>60
Pour point	°C	<30
Density at 15°C	kg/m^3	950 to 1 010

Plate A.2.3: Loading and offloading gantry at SCDP storage depot in Douala

A.2.9.3 Oil spill scenarios

The most probable spill scenario entails a single road tanker involved in a road accident. In this scenario, the entire contents of the truck could be spilled, resulting in a maximum spill of 10 000 – 40 000 ℓ depending upon the vehicle involved.

A less likely scenario involves an accident between two road tankers. In this case, a maximum of 80 000 ℓ (2 large road tankers) of refined fuel could be spilled.

A.2.9.4 Probable fate of oil spill

The road transport of fuels in Cameroon covers almost every part of the country. As a result, almost every environment is at risk of oiling from accidents and other spills. Oil spills that affect freshwater habitats are of particular concern, since these are vulnerable to both physical and chemical aspects of oiling (Plate A.2.4). The remoteness of many of the smaller towns in Cameroon suggests that spills in these areas would not be readily accessible to response teams particularly during the wet season.

In the case of the 'lighter' refined products (jet fuel, kerosene, gasoline/petrol and diesel), recovery of spilled fuels is very unlikely. The evaporation rate of these fuels is such that after about a maximum of 12 hours very little would remain in the environment. In the case of 'heavier' refined products, such as heavy fuel oil (HFO), the oil may remain *in situ* for a considerable length of time before degrading naturally.

In the northern regions, where soils are sandy and permeable, spilled oil could enter the groundwater. In the wetter parts of the country there is a high likelihood of oil entering rivers or streams, and since the water table is often very high, there is a chance that oil could reach groundwater, probably the shallower aquifers. Although these groundwater resources are relatively small-scale, they are used extensively for household requirements.

Plate A.2.4: Swamp forest of the upper Nyong river, adjacent to the Yaoundé – Bélabo fuel tanker route, showing the presence of both Raphia palms and swamp forest trees

A.2.10 Rail tanker transport routes

A.2.10.1 Description

Cameroon has only one principal rail route, with few spur lines or branches. The railway serves the major towns of Douala, Yaoundé, Ngaoundéré, and a branch from Douala serves Nkongsamba in the Littoral Province.

The rail route used to transport hydrocarbon fuels links Douala, Yaoundé, Bélabo and Ngaoundéré. It is the primary means of providing fuel to the central regions of Cameroon. Where railways do not exist, fuel is trans-shipped from rail to road tanker for distribution. As a result, the largest volumes of fuel are transported by rail and, therefore, theoretically rail transport poses some of the largest sources of potential risk.

Any estimates of potential risk presuppose that there is either an accident involving a railway fuel tanker (or tankers) or that such tankers may have leakages that contribute to a set of unacceptable circumstances (for example, poor housing-keeping at a fuel transfer point causing contamination of a local water source). This aspect is difficult to specify precisely since each fuel transfer point is characterized by the degree of management efficiency and control that is practiced.

In overview, the greatest sources or potential for risk associated with the transport of fuel by rail tankers relates to the potential for an accident to occur. Clearly, the number of fuel tankers that is involved in any such accident would increase the risk proportionately. The greatest impact of any such accident scenario would most likely occur in proximity to an important watercourse (such as the Sanaga river) or to a village or town. Such an accident occurred on 1 February 2003 near Badjob village and the town of Eseka, where there is a rail crossing of the Lebby Stream. This involved the derailment of six Camrail wagons conveying various fuels (diesel, kerosene, etc.) on behalf of SCDP. Spillage of product, of a volume estimated to be around 200 m^3, resulted in a major pollution incident resulting from a direct dishcarge into the Lebby Stream (Plate A.2.6).

Plate A.2.5: Small rail truck (16 500 l) carrying containerised diesel destined for Chad

Plate A.2.6: Derailed Camrail wagons next to the Lebby Stream

A.2.10.2 Oil/fuel characteristics – fuel types

The range of fuels distributed by rail in Cameroon is the same as that distributed by road. The range and characteristics of fuels is shown in Table A.2.13 below.

Table A.2.13: Properties of refined fuels transported by rail.
Source: CONCAWE (1992, 1995, 1996, 1998)

Property	Unit	Typical range
Jet fuels A and A-1		
Closed cup flash point	°C	38
Freezing point, max.	°C	-47
Density at 15°C	g/ml	0.775 to 0.840
Straight-run kerosene		
Closed cup flash point	°C	62 (USA samples)
Pour point	°C	-49
Density at 15°C	kg/m^3	0.81
Reid vapour pressure at 37.8°C	hPa	14
Motor gasoline		
Flash point	°C	<-40
Density at 15°C	kg/dm^3	0.72 to 0.79
Vapour pressure at 37.8°C	hPa	350-900
Automotive diesel		
Flash point	°C	>56

Property	Unit	Typical range
Pour point	°C	<30
Density at 15°C	kg/m^3	0.82 to 0.86
Vapour pressure at 40°C	kPa	*ca*. 0.4
Heavy fuel oil		
Flash point	°C	>60
Pour point	°C	<30
Density at 15°C	kg/m^3	950 to 1 010

A.2.10.3 Oil spill scenarios

Trains transporting refined petroleum products between Douala and the interior comprise between 14 and 19 tank cars ranging in capacity from 45 to 66 m^3. The average volumes transported on different routes are listed below:

Douala – Yaoundé	:	ave. 19 tank cars	:	855 – 1254 m^3
Douala – Bélabo	:	ave. 14 tank cars	:	630 – 924 m^3
Douala – Ngaoundéré	:	ave. 18 tank cars	:	810 – 1188 m^3

The maximum potential spill would be caused by the total loss of a train consisting of 19 x 66 m^3 capacity tank cars with a total volume of 1 254 m^3.

A.2.10.4 Fate of oil spill

The rail tanker route passing through Douala, Yaoundé, Bélabo and Ngaoundéré spans both the moist forested areas of the coastal provinces and the highlands and drier northern areas. All of these areas are potentially sensitive to a larger-scale spill that could result from a train accident or derailment. Communities along the railway line are dependent on groundwater for domestic use and should this become contaminated would require access to alternative sources of water. Spills affecting rivers is a possible scenario and would result in contamination of surface water resources downstream from the spill point.

A.2.11 Electricity power generation facilities

A.2.11.1 Description

Power stations in many parts of Cameroon provide electricity to off-grid applications or to local mini-grids, principally in the smaller towns. For this purpose, diesel is stored at the power station site to supply the needs of the plant. Fuel is supplied at regular intervals by road tanker from regional fuel supply depots. For instance, at the power station on the northern outskirts of Bertoua, on-site storage of fuel consists of four storage tanks of 90 000 ℓ capacity each. The power station uses approximately 18 000 ℓ of diesel per day. It generates 8 000 kVa (or about 8 MW) and supplies Bertoua and three neighbouring towns, Minta, Abong Mbang and Batouri.

At Bertoua the generation and fuel storage facility appears to be well-constructed, and the storage tanks are surrounded by adequate bund (secondary containment) areas estimated to be 1.5 times the total volume of the storage tanks. However, attention should be paid to the sealing of bund areas and the slop recovery and stormwater separation apparatus.

A.2.11.2 Oil/fuel characteristics – fuel types

The fuel used in electrical power generation in Cameroon is automotive diesel (see Table A.2.14).

Table A.2.14: Properties of automotive diesel. Source: CONCAWE (1996)

Property	Unit	Automotive gas oil
Flash point, min.	°C	56
Pour point, max.	°C	-5
Density at 15°C	g/ml	0.82-0.86
Vapour pressure at 40°C	kPa	ca 0.4

A.2.11.3 Oil spill scenarios

The bunding of the storage tanks at these facilities should ensure that any spills that occur are kept within the containment area. However, attention should be paid to the complete insulation of the bund area from the environment, particularly from the stormwater system. If bund areas are inadequately sealed and lined, contact could occur with the stormwater system as a result of slops and spills during oil transfer or from storage tank failure. Contact with groundwater could occur from seepage through the bund floor, or with rivers and streams through the stormwater system.

A.2.11.4 Fate of oil spill

Using the AES SONEL facility at Bertoua as an example, it is possible to generalise on the probable fate of oil spills at power stations. At Bertoua, the storage tanks are adequately bunded and basic spill prevention measures have been taken into account during the construction and operation of the facilities. In the event of a spill, the oil would first accumulate within the bund area. However, there are several possible fates of spilled oil from the bund area, including:

- Contact with groundwater, from seepage through the bund floor;
- Contact with stormwater drainage system, through inadequate separation between the bund and the stormwater system; and
- Contact with land surface through failure or overflow of bund walls.

In general, due to the relatively small amounts of oil involved, oil spills at electrical power generation facilities would be only of local significance (Tier 1).

A.2.12 Discussion of risk sources

The risk sources identified as significant in the inland environment tend to be clustered in the western and central areas of Cameroon, following the footprint of more developed areas.

In summary, the risk sources are distributed across the provinces as follows:

- Chad-Cameroon pipeline: North, Adamoua, East, Centre and South Provinces;
- SCDP fuel storage depots: West, Littoral, Centre, East, Adamoua and North Provinces;
- Road tanker transport routes: traverse all Provinces;
- Rail tanker transport routes: traverse West, Littoral, Centre, East and North Provinces; and
- Electrical power generating stations are scattered throughout Cameroon.

This analysis shows that the Far North Province contains the fewest significant oil spill risk sources.

A.3 ENVIRONMENTAL DESCRIPTION, IMPACT ASSESSMENT AND SENSITIVITY ANALYSIS

A.3.1 Introduction

The following environmental description is intended to provide the background information necessary for the assessment of: (i) the sensitivity of the environment to impacts arising from the oil spill risk sources described above; (ii) the appropriate response mechanisms; and (iii) the prioritisation of spill response actions. In general, only those elements of the receiving environment exposed to at least one risk source are described; however, since the oil spill risk sources are distributed throughout Cameroon, the general environmental description, of necessity, covers the entire country.

The description of the environment is divided into the main physical determinants of the landscape (Section A.3.2), and the biological ecosystems (Section A.3.3). Physical determinants include topography, climate, geology, soils, hydrology and geohydrology. The description of the biological systems is based on the ecoregion components mapped by Olson *et al*. (2001) and described in detail by WWF (2003). These ecoregions represent 'areas of outstanding biodiversity' and comprise distinct assemblages of plants and animal species and communities occurring within boundaries that approximate those associated with the un-transformed, original assemblages.

Key characteristics of the socio-economic and cultural environment are described in Section A.3.4, and an assessment of oil spill impacts affecting both the natural and socio-economic environment is presented in Section A.3.5.

A.3.2 Main physical determinants of the landscape and its constituent ecosystems

A.3.2.1 Topography

The landscape of Cameroon comprises several erosional surfaces that reflect a step-like topography. The western provinces of Cameroon are mountainous, while the southern and northern regions tend to be low-lying (Figure A.3.1).

Coastal plains extend from the Atlantic Ocean 150 km into the interior in an easterly direction and 200 km towards the north. The elevation increases regularly across the coastal plains from sea level to about 300 to 500 m.

A considerable portion of the interior in the South and Central Provinces assumes its character from the South Cameroonian Plateau, which occurs at an altitude between 600 and 800 m above sea level. This region comprises a succession of convex rounded hills interspersed with low-lying flat areas, typically covered by wetlands.

To the north of the South Cameroonian Plateau, the landscape rises to form the higher-lying Adamaoua region. In southern Adamaoua Province, the Meiganga erosional surface, including the Bamoun plateau, is elevated at 800 to 1 100 m. Northern Adamaoua Province is mountainous, particularly in the west, and consists of high plateaux (1 100 to 1 400 m), such as the Bamiléké plateau. Further north, the elevation of the landscape decreases again and the Bénoué Plain, situated mostly in the Northern Province, has an altitude of 300 to 600 m. The landscape then slopes down from this level to return to sea level around Lake Chad in the extreme north.

Several mountain ranges occur along the border with Nigeria, including the Atlantika and Mandara mountains. A mountainous ridge also follows the Cameroon Volcanic Line, extending in an arc from Mount Cameroon on the coast, through the South-West, West and Adamaoua Provinces.

A.3.2.2 Climate

The climatic zones of Cameroon range from *wet equatorial* in the south to *dry tropical*, tending towards *Sahelian,* in the north near Lake Chad (Figure A.3.1). The equatorial region can be divided into three regions: the southern interior and the southern and northern coastal zones. Over most of the southern interior, from Yaoundé, Ebolowa and Ambam in the west, to Yokadouma, Moloundou and Ouesso (Republic of Congo) in the east, four seasons are experienced: two dry seasons, followed by two wet seasons of unequal intensity. This zone is characterised by annual rainfall of 1 500 to 2 000 mm and a mean annual temperature in the order of 25ºC (with an annual variability of about 2ºC). The southern coastal zone has a very similar climate, also with four seasons, but is considerably wetter (average precipitation 2 700 mm at Campo) and more humid. The northern coastal zone extending from Douala to the Nigerian border experiences only two seasons: one wet, and one dry. Rainfall is extremely high and ranges from around 4 200 mm at Douala to 5 000 mm in the Rio del Rey, and to over 10 000 mm per year in the vicinity of Mount Cameroon. The mean annual temperature for the northern coastal areas is 26ºC, with a temperature variability similar to the other equatorial zones.

A transitional zone between equatorial and tropical climate conditions occurs in the region between Yaoundé and the elevated plateaux of the Adamaoua region. A humid tropical climate comprising two seasons is experienced in the Adamaoua Province and the mountains to the west. Annual precipitation varies from 900 to 1 500 mm. The mean annual temperature is slightly higher than in the south at 28ºC, but also has a greater variation of around 6ºC.

Northwards, across the Bénoué Plain, the tropical climate becomes drier and rainfall drops from 1000 mm at Garoua to 800 mm at Maroua, and to 400 mm per annum at Blangoua in the extreme North Province. Here, moving into the Sahel climate region, there is a long dry season lasting seven to nine months. Temperatures average 28ºC, with a variation of up to 8ºC.

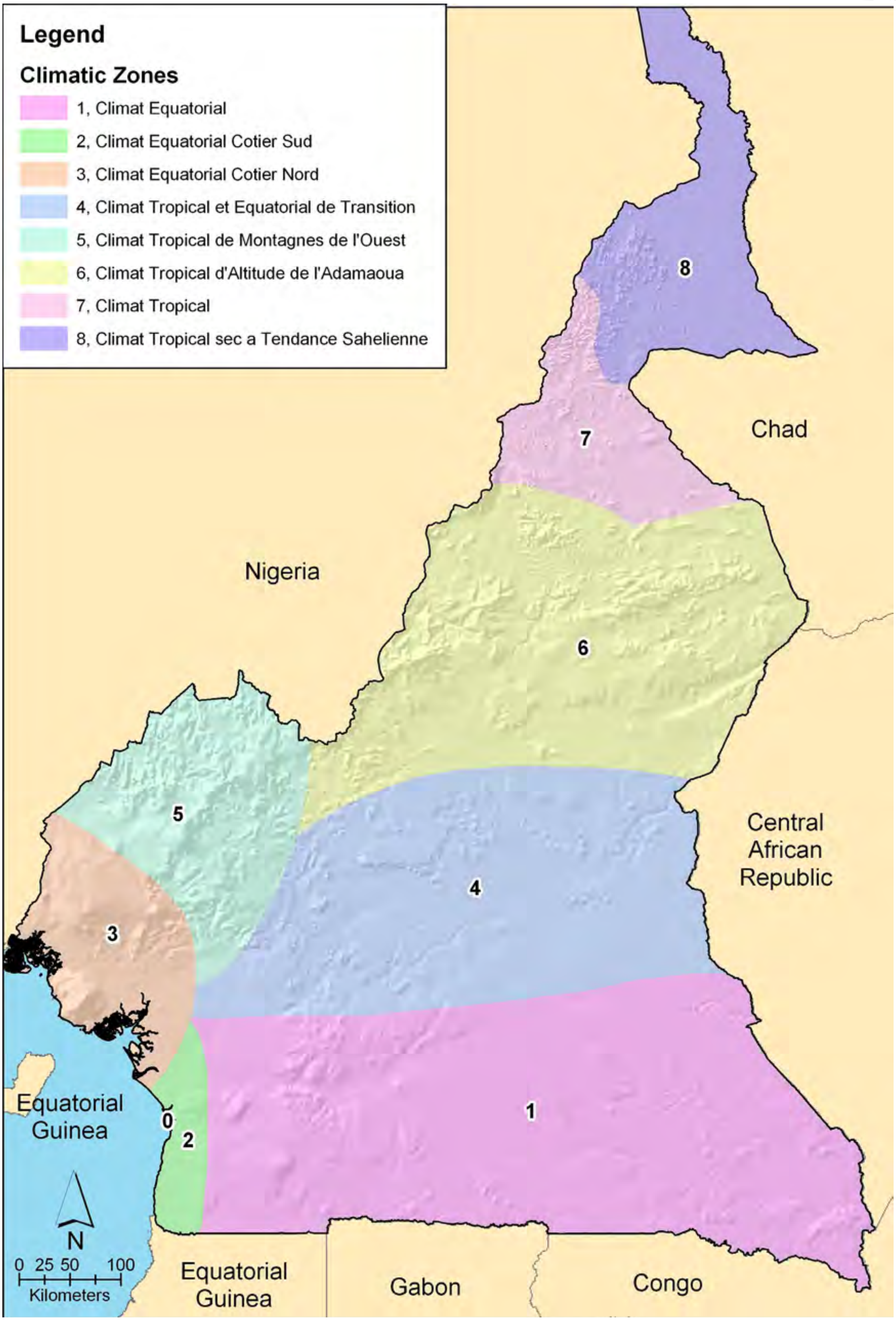


Figure A.3.1: Map showing the climatic zones of Cameroon, superimposed upon topography

A.3.2.3 Geology

The geology of Cameroon is characterised by very old Precambrian metamorphic rocks, overlain in places by Cretaceous and Post-Cretaceous volcanic and sedimentary formations that are intruded by several generations of igneous rocks.

Over eighty percent of the surface of the country, including most of the South, East and Central Provinces, is covered by hard, crystalline rocks of Precambrian age. These comprise mainly schists, micaschists and migmatites, associated with granites. Much of the metamorphism is thought to be associated with the Pan African orogeny, around 600 million years ago. Syntectonic igneous rocks cover a large section of the central and eastern parts of Cameroon and range in composition from granites and syenites to diorites and gabbros.

The Precambrian rocks are typically divided into:

Lower Precambrian basement complex
This comprises the Archean age Ntem complex in the South Province and various micaschists, gneisses, migmatities and granites, forming the bedrock over most of the rest of the country. The Ntem Complex, which forms the north-western margin of the Congo craton, consists of greenstone belts and plutonic igneous rocks of charnockitic to granitic composition (dating 2.9 to 2.6 Ga). The Yaoundé Group gneisses and micaschists were metamorphosed about 620 Ma and thrust over the Ntem Complex.

Plate A.3.1: Outcrop of micaschist in road cutting near Yaoundé

Middle Precambrian formations (Poli, Lom, Ayos and Mbalmayo-Bengbis Series)
These formations consist of metasedimentary rocks, predominantly schists. The Poli Series in the North and Extreme North Provinces includes schists, micaschists and associated

gabbros. The Lom series in the East consists of schists and micaschists. Schists and quartzites of the Mbalmayo-Bengbis and Ayos Series are found in the region east and south of Yaoundé.

Upper Precambrian formations (Lower Dja and Mamgbei Series and Tibati conglomerates)
Metasedimentary formations outcrop in the south-east corner of the country and consist of tillites, quartzities, schists and limestones, with dolerite intrusions. Conglomerates, sandstones and lavas are also found in the Mamgbei Series near Figuil in the north.

There are several sedimentary basins developed in vast synclines in Cameroon. Important basins occur in the south and the north of the country, including:

- Cretaceous sedimentary troughs of the Mbéré Rift Valley and Djerem in the south of Adamaoua Province;
- Cretaceous basin of the Bénoué-Koum area in the North Province;
- Atlantic Basin, situated in the South-West Province. This basin comprises the Campo (50 km^2), Douala (7 000 km^2) and Rio del Rey (85 km^2) sub-basins; and
- Chad-Cameroon basin in the extreme North Province.

The Cretaceous sedimentary successions consist mainly of cemented sandstone and limestone deposits. Younger sediments, ranging in age from Tertiary to Quaternary, have been deposited in the coastal basins around Campo, Douala and the Rio del Rey area, as well as over the extreme North Province, where vast intra-continental lacustrine deposits occur around Lake Chad. Clayey and sandy deposits also occur in the Bénoué Basin.

A series of lavas were extruded alongside the sedimentary sequences, forming young volcanic igneous rocks. These are primarily basalts, but also include intermediate and acid lavas, trachytes, phonolytes, rhyolites and ignimbrites. The younger lavas are associated with the Cameroon Line, which is a volcanic zone that extends from the still active Mount Cameroon near Limbe across the Littoral, West and Adamaoua Provinces.

A.3.2.4 Soils

Intensive chemical weathering of the igneous and metamorphic bedrock has produced a thick soil mantle in the wet equatorial and tropical climate zones of southern and central Cameroon. Two thirds of the country is covered by red to yellow coloured ferralitic soils, typically labelled laterites. In some areas of south Cameroon, polycyclic laterite formation has resulted in a soil zone up to 40 m thick on the hilltops. These ferralitic soils are relatively clay-rich. Their mineralogy includes varying amounts of kaolinite and oxidised iron minerals (oxides or hydroxides such as goethite and hematite), with relict primary minerals, such as quartz or micas, from the parent rocks. Manganese oxides may also be present in significant quantities.

Plate A.3.2: Typical red, lateritic soils of Southern and Central Cameroon

Elsewhere in Cameroon, particularly in the drier northern regions, soils are more complex. Coarse, poorly evolved, mineral soils and sands are found in the steep, mountainous regions of northern Adamaoua and fluvial and beach sands near Lake Chad. The plains of the North Province contain dark, clayey vertisols. Localised occurrences of red soils in northern Cameroon include the relatively fertile fersiallitic soils in the Maroua region and the cemented ferruginous horizons around Garoua and the cliffs of northern Adamaoua.

Mull soils are developed on basaltic parent rocks around Mount Cameroon and along the ridges of the Cameroon volcanic line. These yellowish soils are rich in organic matter and plant nutrients and have high moisture content, making them very fertile; however, they are also highly vulnerable to erosion. In contrast, the saline-sodic soils, which have localised development in the East Province and the Mandara Mountains, contain high sodium levels that are toxic to plants.

Hydromorphic gley or pseudogley soils are found in permanently or semi-permanently flooded areas of northern and southern Cameroon. Reducing conditions are generally encountered in such soils, which have a grey or green-grey colour. The hydromorphic soils of Cameroon also include swelling clays in the vicinity of Lake Chad.

A.3.2.5 Hydrology

River systems

Cameroon can be divided into four major catchments or basins: Atlantic, Congo river, Niger and Lake Chad (Neba, 1987, Figure A.3.2). The headwaters of the Niger, Atlantic and Lake Chad basins are situated in the Adamaoua highlands, and those of the Congo basin, in the southern highlands. Some of the rivers are navigable for considerable distances; for example, the Bénoué is accessible from the sea via the Niger river and river boats can reach Garoua (Neba, 1987). The largest river basin is the Atlantic Basin, which has 12 major rivers and numerous smaller ones and extends over an area of about 245 133 km^2 (Table A.3.1). It can be divided into three main sub-basins: the Sanaga river and its tributaries, the 'western' (northern) rivers and the southern rivers (Neba, 1987).

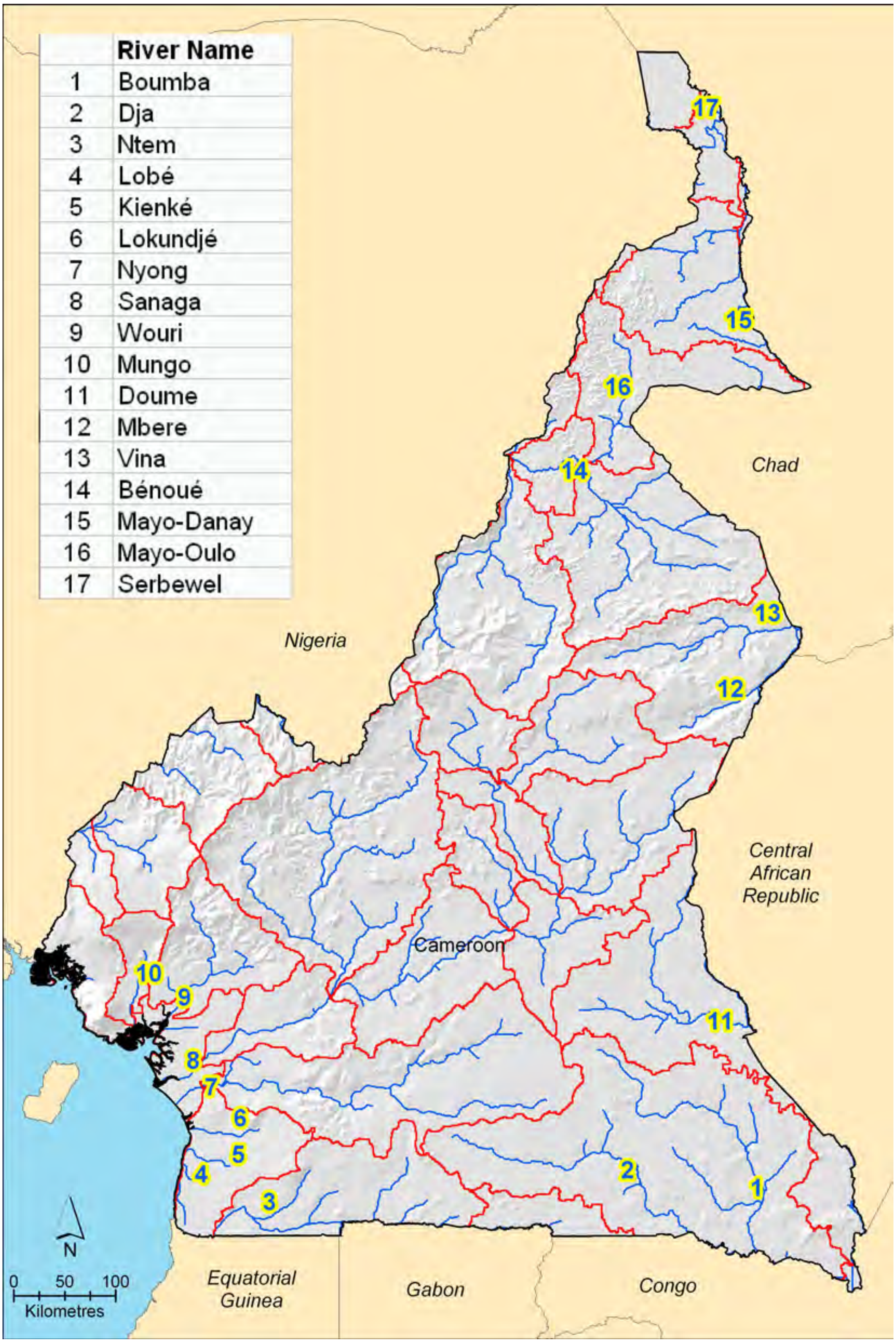


Figure A.3.2: Major river catchments in Cameroon

Table A.3.1: A summary of rainfall and runoff data for the major river basins in Cameroon. Source: AQUASTAT data from FAO (2001).

Major basin	Area of basin (km^2)	Mean precipi-tation (mm/year)	Evapotran-spiration (mm/year)	Runoff and groundwater (mm/yr)	Runoff and groundwater (mm3/yr)	Runoff / precipi-tation ratio(%)
Atlantic Basin	24 5133	2 003	1 333	671	243 710	33.5
Congo river Basin	84 890	1 658	1 186	472	89 300	28.5
Lake Chad Basin	46 377	913	1 012	41	13 316	4.5
Niger Basin	88 765	1 323	965	358	88 706	27.0

The timing of the high and low flows in the country's rivers is determined by the rainfall regime: the bimodal equatorial rainfall results in two periods of high flow, while the tropical Sahelien rainfall results in only one high flow period (Figure A.3.3). Nevertheless, most of the rivers have their period of highest flow during the months of October to January (Rodier, 1983; Dames and Moore, 1997; CEP, 1999). The large river systems, such as the Sanaga, have extended high flow periods because of the time lag associated with river length between their headwaters, the catchment area they drain and the coast. No monthly flow records could be found for rivers in the Atlantic Basin north of the Sanaga river, but the limited available data and seasonality of the rainfall suggests that the peak high flow period would be one to two months earlier than that of the Sanaga river.

Many of the rivers and their tributaries within the hinterland have highly seasonal flows and may be dry for long periods. For example, the Bénoué river at Garoua has a catchment area of about 58 692 km^2 and a total annual runoff of 15 581 million m^3, but has very low mean flows during the dry season of $<10\ m^3$/sec in March and April) (UNH/GRDC, 2002). Minimum recorded flows were $\leq 6.0\ m^3$/sec from December to June with zero flows for the months March, April and May.

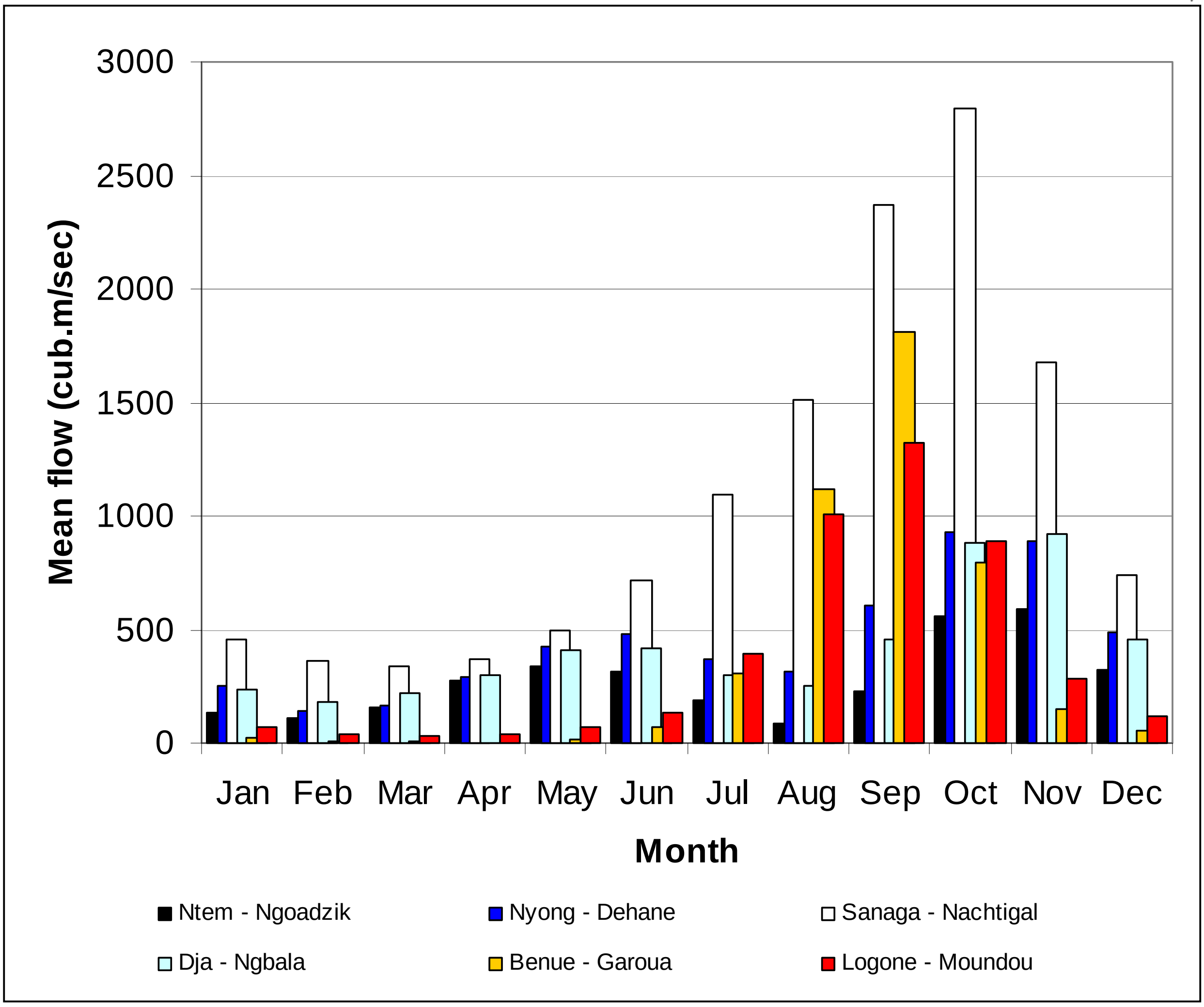


Figure A.3.3: Mean monthly flow in some of the major river systems in Cameroon, based on data from UNH/GRDC (2002). The legend gives the river name followed by the gauging site.

ATLANTIC BASIN

A. Sanaga river sub-basin

The Sanaga river is the largest river in Cameroon with a total catchment area of some 139 000 km^2 and a length of about 920 km. It drains the central and southern Adamaoua plateau via its tributaries, the Djérem, Meng, Vina and Lom rivers. It also drains the northern highlands via the Mbam, Noun and Kim rivers. Despite its size, the Sanaga river is only navigable in sections because of the numerous waterfalls and rapids along its course as far downstream as Edéa, about 80 km from its mouth. It is a very strongly flowing river with a mean flow rate of about 1 985 m^3/sec. The absolute minimum flow recorded at Edéa was 234 m^3/sec and the maximum flood flow was 6 950 m^3/sec (UNH/GRDC, 2002). At Goura on the Mbam river, about 236 km from the mouth, the mean flow has been recorded as 710 m^3/sec and the minimum and maximum as 34 and 2 570 m^3/sec, respectively. At the Nachtigal Falls on the Sanaga main stem (213 km from the mouth) the mean flow rate has been determined as 1 078 m^3/sec, with minimum and maximum flows of 137 m^3/sec and 3 520 m^3/sec respectively (UNH/GRDC, 2002). Dams have been built at Mbakaou on the Djérem river and at Bamendjing on the Noun river to regulate the flow for hydropower generation at Edéa.

B. Western sub-basin
The western sub-basin of the Atlantic Basin includes: (i) the Cross river (the catchment of which is mostly situated in Nigeria); (ii) the Akwayafé, Ndian and Mémé rivers (which drain into the Rio del Rey estuarine complex); (iii) the Wouri, Mungo and Dibamba rivers (which drain into the Estuaire du Cameroun); and (iv) a number of smaller rivers draining the slopes of Mount Cameroon.

C. Southern sub-basin
The southern sub-basin includes: (i) the medium-sized Nyong river, and three smaller rivers, the Lokoundjé, Kienké, and Lobé; and (ii) the Ntem river which forms the part of the country's border with Equatorial Guniea. The main stem of the Ntem is approximately 412 km long and its total catchment area is about 29 600 km^2. Approximately 55% of the catchment is located in Cameroon, with the balance located in Gabon (17%) and Equatorial Guinea (28%). The central portion of the Ntem river is characterised by extensive areas of swamp forest and marsh. There are also marshes in the floodplains of the Nyong river where it crosses the southern plateau. The Nyong river has a mean annual flow at Kaya (233 km from the mouth) of 252 m^3/sec, and the Lokoundjé river has an annual mean flow of 29.8 m^3/sec at Lolodorf (Dames and Moore, 1997).

CONGO RIVER BASIN

The Congo river basin is situated in the south-east corner of Cameroon and has a total area of about 84 890 km^2. It includes the catchments of the Kadéy and Ngoko rivers and their tributaries, comprising the Doumé and the Sangha (in the Central African Republic) and the Dja and Boumba, respectively.

NIGER BASIN

The Niger basin measuring about 88 765 km^2 comprises two parts: (i) the Katsina-ala river, draining the northern part of the western highlands; and (ii) the Bénoué river, draining the north-western Adamaoua plateau and the lowlands around Garoua. The Bénoué river system includes the Lagdo Dam.

LAKE CHAD BASIN

The Lake Chad basin, about 46 377 km^2, also comprises two parts: (i) The Logone river and its tributaries, the Vina and Mbere, which drain the north-eastern part of the Adamaoua plateau. The Logone river is important because, together with the Chari, it is the major water source for Lake Chad and is an International Waterway, providing water to a large number of people in countries other than Cameroon. (ii) The Tsanaga river, which drains the western slopes of the Mandara Mountains and the northern lowlands, and which also flows into Lake Chad.

LAKES

Cameroon also has numerous lakes, created by volcanic activity, particularly in the South-West Province (Neba, 1987). Many of these are found at the tops of hills and are not connected to river systems. They also are often remote and difficult to access and thus are unlikely to be affected by an oil spill. There are also a number of lakes that formed through tectonic activity, including Lake Chad, Lake Ossa (west of Edéa) and Lake Ejagham near Mamfe. These lakes are connected to river systems and are calm, low energy environments where oils spills could have a significant impact. There are also extensive swamps in the interior (e.g. along the Ntem, Nyong, Logone and Bénoué rivers) and swamps and lakes in the coastal lowlands formed by extensive sedimentary deposits of the Douala and Ndian Basin. These environments would also be vulnerable to oil spills.

WATER QUALITY

The *equatorial forest zone* of Cameroon has deeply weathered ferralitic soils, which are relatively poor in nutrients and tend to give rise to acidic waters of pH ≤ 5 (Mink, 1983; Neba, 1987). Decomposition tends to be rapid because of the warmth and abundant precipitation, but may not be complete, resulting in the leaching of humic acid complexes and the formation of nutrient-poor, dark-brown stained water (CEP, 1999). This is particularly evident in the Nyong river below Abong Mbang and in the Lobé and Ntem rivers. The Adamaoua plateau forms part of the ancient African surface, so there has been deep and prolonged weathering resulting in relatively infertile soils which often have hard, iron-rich gravel layers. The water in these areas is of good quality but low in nutrients (see Section A.3.2.6; CEP, 1999). In the lower-lying tropical savanna zone the lower rainfall has limited the rate of weathering and given rise to relatively fertile soils. Leaching is less complete, giving rise to relatively nutrient-rich waters. The alluvial soils of the Bénoué catchment are also relatively fertile and give rise to good quality water with a neutral pH. The northern region in the Chad basin typically has clay-rich soils, which are relatively fertile. The low rainfall results in very limited and highly seasonal runoff in the rivers and limits weathering and decomposition processes.

The volcanic region from Mount Cameroon to the western highlands has soils that are relatively nutrient rich. Decomposition is rapid and there is abundant water to leach the soil, giving rise to crystal clear runoff with a neutral pH. The soils in the Douala sedimentary basin range from coarse sands to fine clays and are relatively infertile, especially in swampy areas. Most of the rivers flowing through these environments carry moderate to fairly high quantities of fine, suspended sediments. The water in the swampy areas is clear, but tends to be stained dark brown and is poor in nutrients and high in iron (Dames and Moore, 1997).

The water quality downstream of the larger towns, such as Douala and Yaoundé, is often poor because of the lack of sewerage and wastewater disposal systems in industrial areas and in both the formal and the informal housing developments (Ibe *et al.*, 1999; Gabche and Smith, 2000). Rivers flowing through these areas are polluted and have relatively high phosphorus and nitrogen levels and high counts of human bacteria and disease-causing organisms (Ibe *et al.*, 1999). Rivers draining extensive areas of cultivated crops and plantations are often polluted because of the excessive use of fertilisers, pesticides and herbicides. The Mungo river system is a good example where these factors, coupled with the natural erodibility of the volcanic soils, result in relatively high sediment and pollution loads. The Mémé and Ndian rivers are likely to be similar judging by the high suspended sediment levels visible in satellite imagery of the waters of the Rio del Rey system.

A.3.2.6 Geohydrology

The main hydrogeological features within Cameroon are indicated in Figure A.3.4.

The country has two distinct hydrogeological settings: the crystalline basement and sedimentary basins.

CRYSTALLINE BASEMENT

The crystalline rocks of Cameroon cover most of the country and include various igneous and metamorphic rock types, which in their unaltered state, are compact and have little or no permeability or porosity. Over the course of geological time, these rocks have been subjected to weathering and multiple tectonic events, resulting in zones of increased schistosity, folding, fracturing or faulting. Several studies in Cameroon have shown that the crystalline basement forms a layered aquifer system of two distinct units - an upper weathered zone aquifer and a lower fractured zone aquifer. The degree of hydraulic connectivity between these two aquifers varies both spatially and seasonally.

The upper aquifer is continuous within the weathered zone and is located in the schistose, granular or, in places, karstic alteration zones of the bedrock. The geometry of the aquifer and the groundwater level depend on the local topography and climatic conditions. Groundwater in this phreatic aquifer is generally intercepted at 8 to 20 m below the surface. Considerable volumes of groundwater may be held in storage in the weathered zone in the high rainfall areas. Because the groundwater is in close proximity to the surface, the upper aquifer is very vulnerable to pollution as a result of land-based human activities (e.g. contamination by sewage, solid waste, stormwater runoff, surface oil spills, etc.).

Water from the upper aquifer supplies the vast majority of community and private wells in the rural and periurban areas. These wells are generally drilled to the contact between the weathered zone and unweathered bedrock. The quantities of groundwater taken from wells are very small, limited by low transmissivities in the clay-rich weathered zone and inefficient methods of abstraction such as buckets and rope or handpumps (Plate A.3.3). Numerous springs are fed by the upper aquifer where the water table intersects with the ground surface. The upper aquifer also provides base flow through lateral drainage into rivers in the dry season.

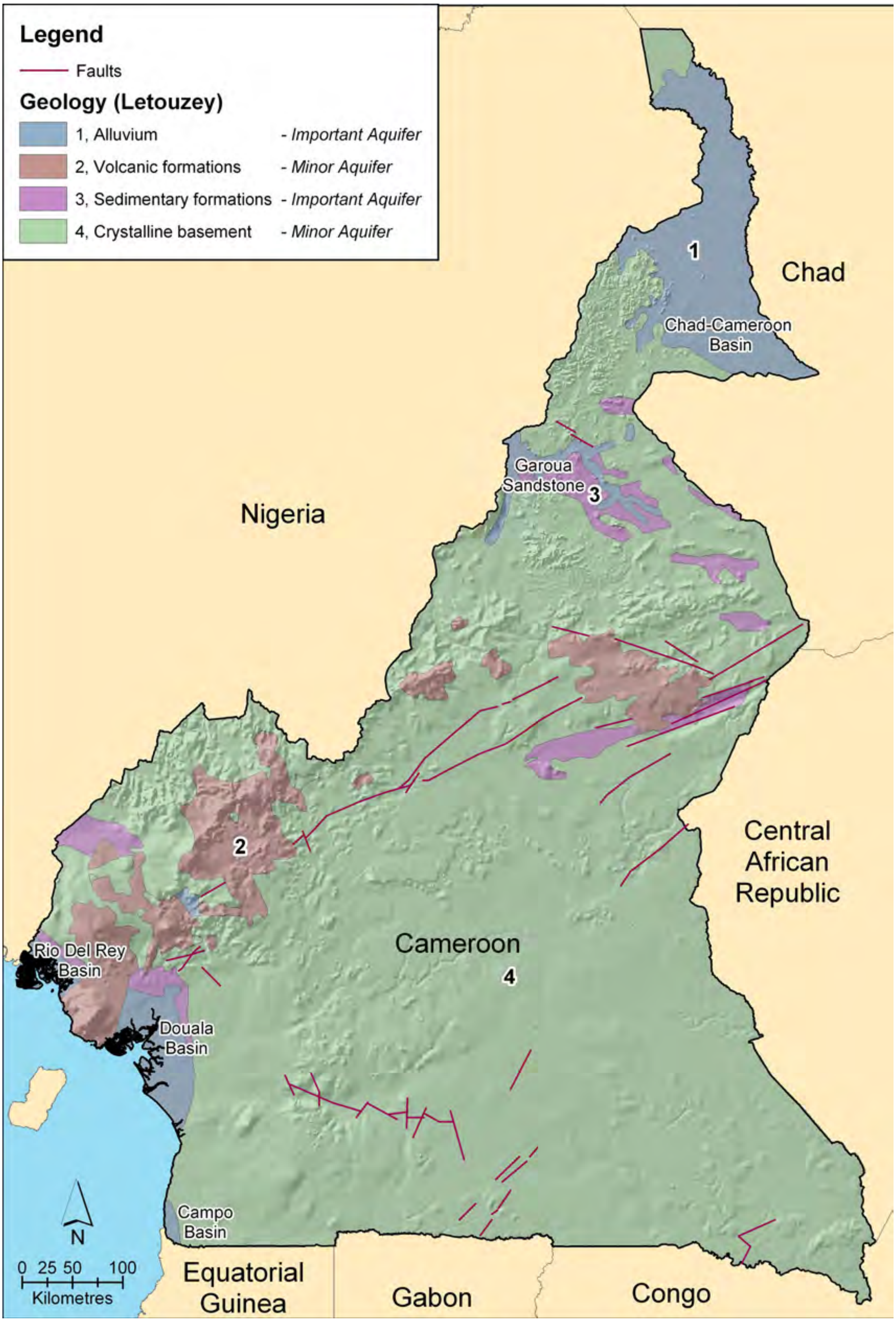


Figure A.3.4: Geohydrology map of Cameroon

Plate A.3.3: Shallow (14 m) borehole with handpump supplying a village in the Lom and Djerem district.

The lower aquifer, unlike the upper aquifer, is discontinuous. This aquifer is generally semi-confined and is located in the unweathered bedrock at depths of over 20 m below surface. Productive areas are associated with major faults and fracture zones, which are the principal drilling targets for groundwater exploration and are sited using aerial or satellite photographs. The deeper bedrock aquifer has variable yields depending on the degree of local fracturing. In poorly fractured areas, the water table may be 60 m or more below surface, in which case it is generally considered futile to drill deeper in search of better yields. In highly deformed zones, changes in structure and texture allow for the passage of water through the rock, which in turn leads to alteration of the primary minerals, creating localised "pockets" of increased porosity.

Recharge to the lower aquifer takes place via two mechanisms: (i) vertical recharge, by inflow of water from the overlying upper aquifer, or directly from precipitation via preferred pathways through the weathered zone; and (ii) lateral recharge, resulting from flow through the banks of surface water courses. During the rainy season, saturation of the weathered zone or flooding of the ground surface over unfractured bedrock, allows for interconnection between pockets of groundwater in the discontinuous lower aquifer. During the dry season, water levels decline and each pocket of groundwater then evolves independently. The structure of the layered aquifer in areas of crystalline basement rocks and the interaction between surface water and groundwater is shown schematically in Figure A.3.5.

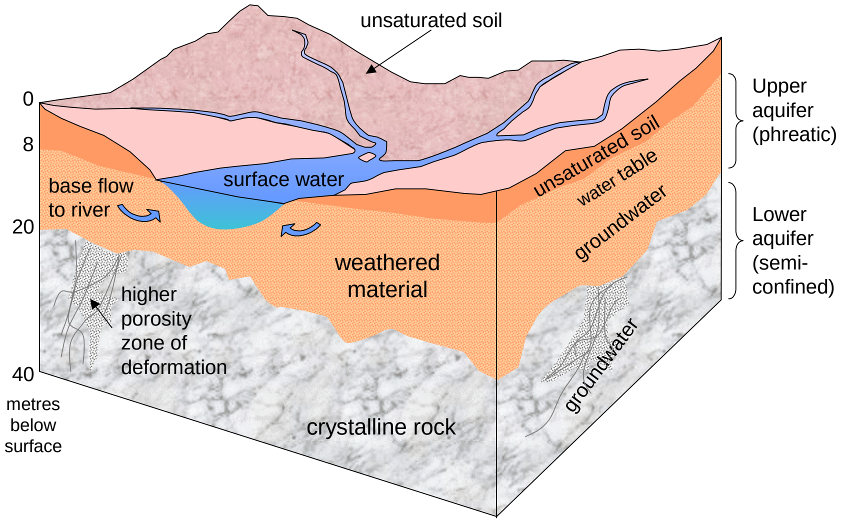


Figure A.3.5: Diagram of layered aquifer in areas of crystalline basement rocks showing base flow to surface water systems

SEDIMENTARY BASINS

The geological formations in the sedimentary basins of Cameroon are stratified and vary in geological composition, degree of cementation, thickness and ages, which range from Cretaceous to Quaternary. In terms of groundwater supply, the three most important sedimentary basins are the Douala Basin, the Bénoué Basin and the Chad-Cameroon Basin. The Chad-Cameroon Basin is of regional significance since its aquifer forms a transboundary water resource shared by Cameroon, Chad, Niger and Nigeria.

The sedimentary aquifers are the only aquifers currently used for bulk water supply in Cameroon. The water supply authority, SNEC, exploits groundwater from the Douala Basin for conjunctive supply with surface water to the city of Douala and abstracts groundwater from the Garoua sandstone aquifer in the Bénoué Basin as a sole source supply for the town of Garoua. Groundwater from the alluvial sediments of the Chad-Cameroon Basin is also used by SNEC as a sole source supply for the towns of Maroua and Kousséri in the Extreme North Province.

For each of these basins the potential yield varies and is controlled by the geological setting. Based on pumping test results, yields were estimated to range from under 4 000 m^3 per day in the Garoua sandstones to over 6 000 m^3 per day in the Chad-Cameroon Basin and the northern (Mbanga) and central (Massoumbou) part of the Douala Basin. The sedimentary basins of Cameroon, therefore, contain considerable groundwater resources.

The town of Garoua is situated on top of an excellent aquifer, which provides large volumes of water of good physico-chemical and bacteriological quality, making treatment before distribution unnecessary. The aquifer is phreatic, but several clay layers impose locally confined conditions. Transmissivity in the upper aquifer varies from 10^{-1} to 10^{-5} m^2/s. Garoua has been linked to a groundwater supply network since 1954, exploiting four boreholes located to the north of the town. The annual volumes of groundwater abstracted are linked to the local population growth and rose from 560 000 m^3 in 1964 to 1 000 000 m^3 in 1970.

In the Douala Basin, important water-bearing strata are found in the sandy formations of both the Palaeocene and Mio-pliocene. The Palaeocene aquifer is situated 15 km east of Douala, has a diameter of about 8 to 10 km and reaches a maximum thickness of 200 m in the Bonabéri depression. This aquifer has a yield of 250 m^3/hour, while the Mio-pliocene aquifer, with a depth of 50 to 60 m, can supply 80 m^3/hour. SNEC constructed their Massoumbou wellfield in the Palaeocene formation, while a number of private enterprises in the city have boreholes that tap the shallower Mio-pliocene layers. Groundwater from the Palaeocene strata requires slightly more financial resources for water abstraction, but can supply greater volumes and is less vulnerable to pollution from the surface.

The sedimentary basins act as porous primary aquifers and are generally recharged by infiltration of local precipitation or by lateral recharge from surface water bodies. For the Atlantic Basin, vast quantities of fresh water are discharged from this aquifer by flow into the marine environment along the coast. Some discharge from the sedimentary aquifers occurs at springs and via baseflow into rivers and lakes. Borehole abstraction probably accounts for a very small proportion of the discharge from Cameroon's sedimentary basin aquifers.

A.3.3 Biological ecosystems

A.3.3.1 Introduction

This environmental description is intended to provide the context for assessing the spill-related impacts in each ecoregion and the interpretation of their relative sensitivity to oiling (Section A.3.5). This information in turn informs the relative priority for oil spill response (Section A.5).

The following description of the biotic environment of Cameroon is based on the known flora, fauna and protection status of the nine most important WWF ecoregions (see Table A.3.2). Although 13 ecoregions were identified for WWF by Olson *et al.* (2001), three ecoregions that cover only a very small portion of Cameroon and which are not exposed to any oil spill risk sources (West Sudanian savanna, Guinean forest-savanna mosaic, and Lake Chad flooded savanna) are considered to be 'marginal' in terms of this study and are not described in detail. These are all situated in the extreme north or north-west of Cameroon. A further ecoregion, the Central African mangroves is restricted to the immediate coastal environment and is covered in the Coastal and Marine section of the

NOSCP (Section A.3.3). The description of the ecoregion deals mainly with each ecoregion as a whole, but wherever possible the characteristics of the ecoregion within Cameroon are also described.

Cameroon is a country extremely rich in all aspects of biodiversity species richness, endemism). For example, Cameroon supports at least 320 species of mammals (Fotso *et al.,* 2001), 27% of the global total. Cameroon forms part of the Guinean Forests of West Africa biodiversity hotspot (Conservation International, 2002; Figure A.3.6). This forest hotspot supports globally significant populations of plants and animals that are found nowhere else on earth, including 48% of the world's mammal species, 22 primate species, 15 even-toed ungulates (antelopes and related groups), and 190 rodent species (see Table A.3.2).

Table A.3.2: Species richness and endemism of vertebrate fauna in the Guinean Forests of West Africa. Source: Species totals from Conservation International (2003); species conservation status from Hilton-Taylor (2000); fish information from WWF (2003).

Taxonomic group	Total no. of species	No. of endemic species	Percentage endemism	No. of Red Data listed species/ subspecies
Plants	9 000	2 250	25	155
Mammals	551	45	8	40
Birds	514	90	18	15
Reptiles	139	46	33	1
Amphibians	116	89	77	1
Fish	354	Unknown; a variety of endemic killifish (*Aphyosemion* spp.), barbs (*Barbus* spp.), and cichlids (Cichlidae) occur	Unknown	27
Invertebrates	Unknown	Unknown	Unknown	1 mollusc species, 3 other invertebrates; total unknown

Apart from the Guinean forest region, which is without doubt the most biodiverse part of Cameroon, 13 ecoregions have been identified within the country (Olson *et al.,* 2001). These are biogeographic zones defined on the basis of both plant and animal communities, and form the basis of the sensitivity analysis and impact assessment presented in this plan (see Table A.3.3 and Section A.3.5).

Table A.3.3: The 13 ecoregions represented within Cameroon, as identified by WWF (Source: Olson et al.*, 2001)*

Ecoregion	WWF ecoregion ID	Area in Cameroon (km^2)	Notes
Northwestern Congolian lowland forests	AT0126	146 666	Part of Cameroon and Gabon lowlands Endemic Bird Area
Northern Congolian forest-savanna mosaic	AT0712	143 468	
East Sudanian savanna	AT0705	37 731	
Cross-Sanaga-Bioko coastal forests	AT0107	34 050	
Atlantic Equatorial coastal forests	AT0102	33 217	Part of Cameroon and Gabon lowlands Endemic Bird Area
Cameroonian Highlands forests	AT0103	29 011	Part of Cameroon mountains Endemic Bird Area
Sahelian Acacia savanna	AT0713	22 041	
Mount Cameroon and Bioko montane forests	AT0121	1 015	Part of Cameroon mountains Endemic Bird Area
Mandara Plateau mosaic	AT0710	5 872	
Guinean forest-savanna mosaic	AT0707	7 960	No risk sources; very little information available
Central African mangroves	AT1401	2 757	Covered in the Marine and Coastal section (Section A: Strategy)
Lake Chad flooded savanna	AT0904	545	Marginal; no risk sources
West Sudanian savanna	AT0722	9	Marginal; no risk sources

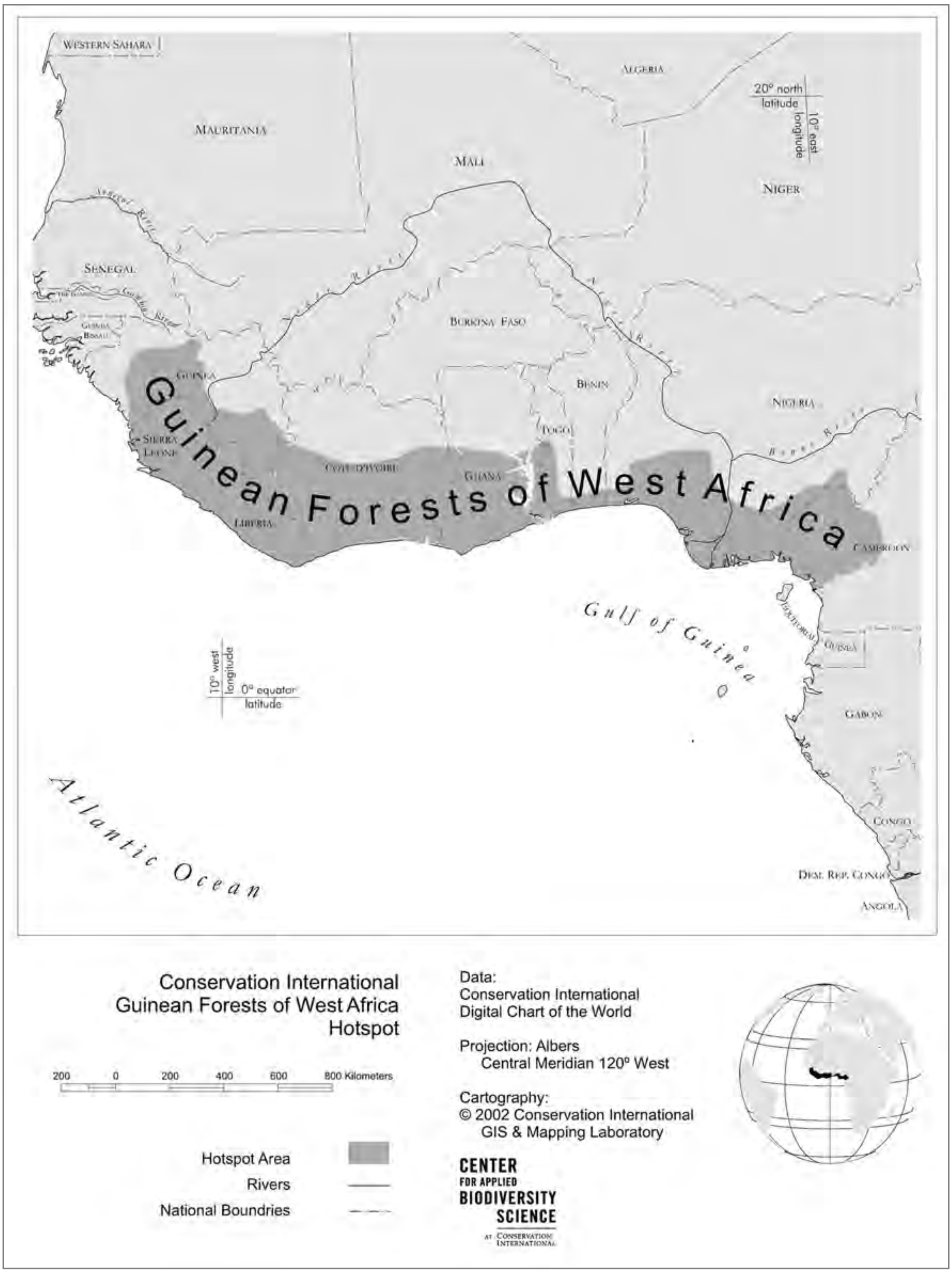


Figure A.3.6: Extent of the Guinean Forests of West Africa biodiversity hotspot in relation to Cameroon (seen in part on extreme right of map). Source: Conservation International website http://www.biodiversityhotspots.org/xp/Hotspots/west_africa/?showpage=Biodiversity#indepth (14 January 2003)

A.3.3.2 Description of ecoregions

SAHELIAN ACACIA SAVANNA (AT0713)

The Sahelian Acacia savanna ecoregion lies between 200 m to 400 m in elevation in far northern Cameroon. The climate is hot and is characterised by highly seasonal rainfall, with a defined six- to eight-month dry season. The rainfall of 600 mm in the south of the ecoregion declines rapidly towards the north to around 200 mm. Human population density is low.

This ecoregion is the transition zone between the wooded savannas of the south and the true Sahara Desert of the north. Species diversity and richness is not particularly high, but there are several endemic species of small arid-adapted rodents - *Gerbillus bottai*, G. *muriculus, G. nancillus* and *G. stigmonyx* - associated with the area of higher land in western Sudan, which forms a small center of endemism for gerbils. Other endemic mammals include one bat species, *Eptesicus floweri*, a zebra mouse species, *Lemniscomys hoogstraali* (DD), and two more gerbils, *T. petteri* and *T. pygargus*. There are two endemic bird species: rusty lark, *Mirafra rufa*, and the sennar penduline tit, *Anthoscopus punctifrons*. The wetlands of the ecoregion are important stop-overs on the Afrotropical-Palaearctic flyway, and for intra-African migrants responding to seasonal weather changes. Among reptiles, ten species are strict endemics.

The ecoregion in Cameroon is protected in the Waza and Kalamaloue National Parks (Figure A.3.7; Table A.3.4). Major threats arise from human activities, including: dry land agriculture, fuel wood collection and uncontrolled burning. In the past, the hunting of large mammals (particularly predators and antelope) decimated the large populations that were present. The scimitar-horned oryx, *Oryx dammah*, is now presumed extinct in the wild, as is the endemic sub-species of the common hartebeest, the bubal hartebeest, *Alcelaphus busephalus buselaphus*. Three gazelle species are Red Data listed: dama gazelle, *Gazella dama* (Endangered), dorcas gazelle, *Gazella dorcas* (Vulnerable), and red-fronted gazelle, *Gazella rufifrons* (Vulnerable). Large predators such as wild dog, *Lycaon pictus*, cheetah, *Acinonyx jubatus*, and lion, *Panthera leo,* have been heavily impacted.

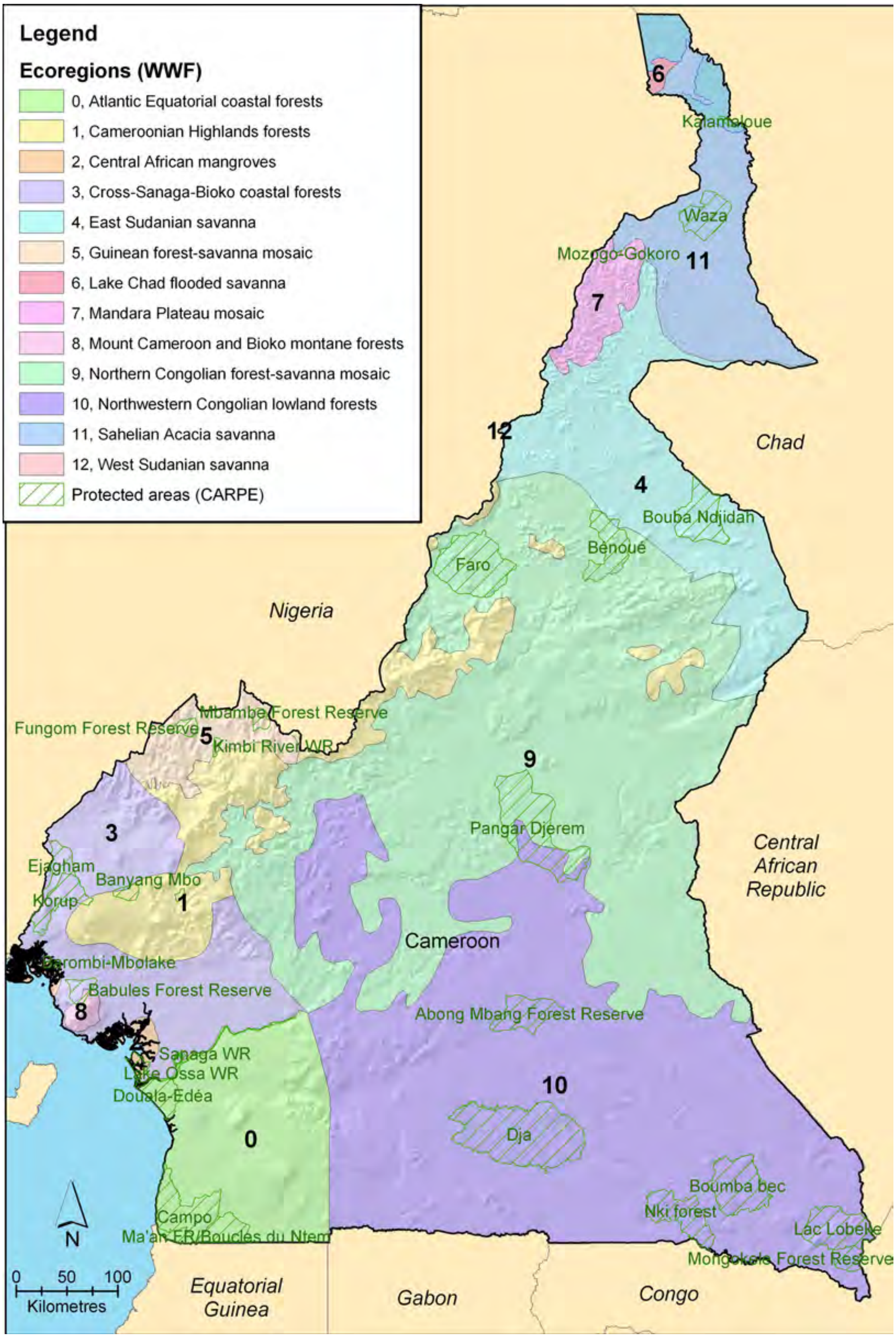


Figure A.3.7: Map showing Cameroon's protected areas in relation to the major ecoregions. Source: WWF (2003).

Table A.3.4: Characteristics and status of the protected areas in Cameroon (II - National Park; protected area for ecosystem protection and recreation; IV - Habitat/Species Management Protected Areas; protected area for conservation through management intervention; FR - Forest Reserve; UA – Unassigned). Source: Central African Regional Programme for the Environment (2002)

Protected area name	Year designated	Size (ha)	Latitude (°N)	Longitude (°E)	IUCN category	Comments
Abong-Mbang Forest Reserve					FR	
Babules Forest Reserve					FR	
Banyang Mbo	1996	38 500	5.45	9.4333	FR	
Barombi-Mbolake Protection Forest		885	4.6667	9.3833	UA	
Bénoué National Park	1968	180 000	8.42	13.8	II	Important Bird Area
Bouba Ndjidah National Park	1968	220 000	8.67	14.66	II	
Boumba bec		0	2.6833	13	FR	Important Bird Area
Campo Faunal Reserve	1932	300000	2.5	10.07	IV	Important Bird Area
Dja Faunal Reserve	1950	526000	3.1	13	IV	Important Bird Area
Douala-Edea Faunal Reserve	1932	160000	3.53	10.2	IV	
Ejagham	1934	74 851			FR	
Faro National Park	1980	330 000	8.17	12.65	II	Important Bird Area
Fungom Forest Reserve					FR	
Kalamaloue National Park	1972	4 500	12.14	14.89	II	Important Bird Area
Kimbi river WR						
Korup National Park	1986	125 900	5.16	9.3	II	Important Bird Area
Lac Lobeke	1974	43000	2.25	15.6667	IV	
Lake Ossa WR						
Ma'an FR/Boucles du Ntem		0	0	0		Important Bird Area
Mbam et Djerem						Important Bird Area
Mbambe Forest Reserve					FR	
Mongokele Forest Reserve		0	0	0	FR	
Mozogo-Gokoro National Park	1968	1 400	10.8833	13.7667	II	
Nki forest		0	0	0		Important Bird Area
Sanaga WR						
Santchou WR						
Waza National Park	1968	170 000	11.25	14.73	II	Important Bird Area

EAST SUDANIAN SAVANNA (AT0705)

The East Sudanian savanna of northern Cameroon is separated from West Sudanian savanna by the Mandara Plateau of north-west Cameroon. The climate of the region is hot and dry (rainfall ranging from 850 to 1 440 mm), with elevation generally below 600 m. The topography is relatively flat, apart from the area bordering the Mandara Plateau and part of the edge of the Adamaoua Plateau in the south.

The East Sudanian savanna in Cameroon is a tall grass savanna, *Pennisetum purpureum, w*ith scattered large *Combretum* and *Terminalia* trees. Although the savanna is very different in appearance from the tropical forests of south and east Cameroon, it also contains valuable forest resources in the form of the gallery forests that fringe the rivers. The Sudanian savanna supports more than 1 000 endemic plant species; however, since the ecoregion is very large, the endemism per unit area is rather low.

Although there are many protected areas within this ecoregion, several of these are poorly enforced and tend to exist on paper only. However, despite this drawback, there are large areas of relatively intact habitat even outside protected areas. In Cameroon, Bouba Ndjidah National Park and a small north-eastern portion of Bénoué National Park lie within the East Sudanian savanna (the remainder of Bénoué National Park lies in the Northern Congolian forest-savanna mosaic ecoregion).

The principal land use pressures are from agricultural and pastoral practices, charcoal production and uncontrolled burning. Although fire plays an important role in maintaining the structure and species composition of the savanna, the frequency, intensity and size of fires are important variables when considering effective management. The ecoregion is generally sparsely populated, but in northern Cameroon, there are high population densities in the areas around Lake Chad.

MANDARA PLATEAU MOSAIC (AT0710)

About four fifths of this ecoregion lies in Cameroon, straddling the north-eastern border and the remainder in Nigeria. The Mandara Plateau consists of a rocky range between about 500 and 1 300 m in elevation, with a defined six-month wet season during which 800 to 1 000 mm of rain falls.

The significant botanical biodiversity is concentrated above 1 200 m in montane communities that have close affinities with the montane communities of East Africa and Ethiopia. They contain a mix of Sudanian and Afromontane species, such as the large succulent *Euphorbia desmondi*, *Olea hochstetteri*, and *Pittosporum viridiflorum*.

Much of the plateau is highly degraded due to agricultural practices, where the population density is high. Bush meat hunting has also severely reduced many of the larger mammal populations. Climate change will have serious consequences on this ecoregion as plants and animals become isolated on rugged hilltops due to increasing heat and dryness at higher elevations. The only protected area within this ecoregion in Cameroon is Mozogo Gokoro National Park.

NORTHERN CONGOLIAN FOREST-SAVANNA MOSAIC (AT0712)

Rainfall in the ecoregion varies from 1 200 to 1 600 mm per year, which is related to latitude as Guineo-Congolian lowland forest grades into Sudanian-Sahelian savanna. The forest-savanna interface is a broad band running in a roughly east-west direction across the middle of Cameroon at lower altitudes (between 500 and 800 m). Within this band, the balance between of forest, woodland and grassland is fluid and changes according to some key variables over both short and long time scales. These key variables include human activities, fire regimes, soil depth and drainage characteristics, and rainfall. Forests tend to be concentrated in the south of the ecoregion, at lower elevations, in valleys and on lower slopes. In the past, the forests would have expanded northwards during wetter periods and savannas southwards during drier periods.

The forest-savanna mosaic contains significant forest resources in the form of gallery and riparian forests. These are forest remnants that extend into the savanna along watercourses, being dependent on the presence of surface water, sufficient rain, available groundwater and protection from fire. Forest species extend into gallery forests in northern savannas, taking advantage of the migration/dispersal corridor provided. The incomplete isolation of gallery and riparian forests in savanna zones, and the ecotonal nature of their environment, has led to high species diversity in these forests and high species turnover between different forest patches. Moreover, the shifting nature of the ecotone as climatic conditions change, and the adaptable nature of many of the species present mean that this forms a buffer against climate change.

Certain species such as the elephant play a role in maintaining the forest-savanna interface, and the loss of these large mammals has resulted in some forest encroachment into grassland areas, with consequent impacts on local agriculture. Land use pressures of significance include: (i) the increasing density of human populations in the ecoregion, resulting in the need for more agricultural land and more intensive use of existing land; and (ii) bush meat hunting and poaching.

Because this region is a centre of diversification and is adaptable to long-term climate change, the appropriate conservation strategy for the ecoregion is broad habitat protection, rather than a focus on individual species conservation. Existing protected areas in the forest-savanna mosaic of Cameroon are Faro National Park, Bénoué National Park and the new Mbam et Djerem National Park, which is still in its establishment phase.

CAMEROONIAN HIGHLANDS FORESTS (AT0103)

This ecoregion is shared by Cameroon and Nigeria, with Cameroon possessing the larger and more pristine portion. The Cameroonian Highlands forests exist in about ten separate patches distributed along the highland border between Cameroon and Nigeria. This ecoregion is naturally patchy, being restricted by altitude (the highland forests occur mainly above 800 to 1 000 m, with their lower boundaries being largely determined by the extent of agriculture and other development in lower lying areas). The highest point within this ecoregion is Mount Oku (3 011 m) in the Bamenda-Banso highlands of Cameroon.

Rainfall ranges between 1 800 and 2 500 mm, declining as one moves inland from the coast.

The highland forests are thought to contain high levels of biodiversity within all plant and animal groups. Although the plant diversity of this ecoregion is not well known, tree species diversity tends to be low, and the diversity of grasses and epiphytes is high. The forest is characterised by species such as *Nuxia congesta*, *Podocarpus latifolius*, *Prunus africanus*, *Rapanea melanophloeos*, and *Syzygium staudtii*.

The ecoregion is known for its exceptional levels of avian endemism, with seven strictly endemic bird species (five are Red Data listed – Hilton-Taylor, 2000) and six near endemics. The ecoregion forms part of the Cameroon Highlands Endemic Bird Area (Stattersfield *et al.,* 1998). There are 11 strictly endemic small mammal species, eight of which are Red Data listed (Hilton-Taylor, 2000). There is also an isolated population of lowland gorilla (the Cross river subspecies, *Gorilla gorilla diehli*), listed as Endangered (Hilton-Taylor, 2000). There are at least nine narrowly endemic species of reptiles (four skinks, three chameleons, a snake and a gecko), and 15 species of endemic amphibians.

Although highland forests are naturally patchy, human-mediated processes are driving the islands of habitat further apart, and contributing to shrinkage of individual patches. For example, the Bamenda-Banso Highlands, which contain the largest intact patch of Cameroonian Highlands Forest, has lost more than 50% of its forests to date.

This ecoregion, together with the Mount Cameroon and Bioko montane forests ecoregion (AT0103 - see below), supports the Cameroon Mountains Endemic Bird Area (Fotso *et al.,* 2001). However, there are no formal conservation areas in the Cameroonian portion of the ecoregion. The principal land use pressures are conversion of land for agriculture, unsustainable levels of timber harvesting and uncontrolled burning. It is one of the most densely populated areas in Cameroon and is an important agricultural area due to the rich, fertile volcanic soils.

MOUNT CAMEROON AND BIOKO MONTANE FORESTS (AT0121)

This ecoregion consists of four mountain peaks on which montane forests occur from elevations of about 500 m (in the case of Mount Cameroon) or 1 500 m (in the case of Bioko Island) to the summits. Some grassland communities occur at high altitudes (above 2 800 m on Mount Cameroon and 2 500 m on Bioko Island). On the mainland and on Bioko Island the ecoregion is completely surrounded by the Cross-Sanaga-Bioko Coastal ecoregion. The ecoregion has some affinities with the Afromontane regions of East Africa, especially in the heathland communities near the summits of the peaks. The south-western sides of both the mountain and the island have a virtually continuous rainy season with precipitation often exceeding 10 000 mm per year, although rain shadows affect north-eastern slopes.

The ecoregion contains exceptional levels of species endemism and richness, in part due to the great altitudinal range and the resulting diversity of habitats. The ecoregion forms part of the Cameroon Highlands Endemic Bird Area (Stattersfield *et al.,* 1998). There is only one protected area in the Cameroon portion of this ecoregion (Babules Forest Reserve), an issue of concern to several non-government organisations operating in the area. There are two protected areas on Bioko Island totalling 840 km^2. Fire and conversion of habitat for agriculture are the major land use pressures on biodiversity.

CROSS-SANAGA-BIOKO COASTAL FORESTS (AT0107)

This ecoregion has well-defined biogeographic limits formed by the Cross river in the north-west and the Sanaga river in the south. These rivers form significant barriers to animal species, and it is on this basis that the ecoregion is separated from those to the north-west and south. It includes the forests up to 800 m elevation on Mount Cameroon and Bioko Island and mangroves, which occur in the north and south of the region at the coast. Rainfall ranges from 2 000 mm in the inland to 3 000 mm at the coast.

Together with the Atlantic Equatorial forest ecoregion to the south, the evergreen forest region supports between 7 000 and 8 000 plant species. The Cross-Sanaga-Bioko coastal forests support representatives of three of tropical Africa's four endemic plant families, about one fifth of the plant genera are endemic, and the ecoregion forms a centre of diversity for the genera *Cola* (Sterculiaceae), *Diospyros* (Ebenaceae), *Dorstenia* (Moraceae), and *Garcinia* (Guttiferae). These high levels of diversity and endemism indicate that this ecoregion is ancient and has experienced a very stable environment during its evolution.

In addition to plants, the ecoregion has extremely high biodiversity among mammals, birds and butterflies. Table A.3.5 lists some of the endemic and conservation-worthy species of the Cross-Sanaga-Bioko coastal forests.

Table A.3.5: Some endemic and conservation-worthy species of the Cross-Sanaga-Bioko coastal forests. EN = Endangered; CR = Critically; VU = Vulnerable. Source: WWF (2003).

English name	Scientific name	Conservation status (Red Data Book)
Drill	*Mandrillus leucophaeus*	EN (distribution bounded in the south by the Sanaga river)
Preuss's red colobus	*Procolobus pennanti preussi*	EN (strictly endemic)
Pennant's red colobus	*Procolobus pennanti pennanti*	EN (near-endemic of Bioko)
Cross river gorilla	*Gorilla gorilla diehli*	CR (strictly endemic sub-species)
Red-eared monkey	*Cercopithecus erythrotis*	VU (near endemic)
Crowned guenon	*Cercopithecus pogonias*	VU (near endemic)
Pallid needle-clawed galago	*Euoticus pallidus pallidus*	EN (endemic of Bioko)
Bibundi bat	*Chalinolobus egeria*	Strictly endemic
Pitch shrew	*Crocidura picea*	CR (strictly endemic)
Long-footed shrew	*Crocidura crenata*	Near-endemic
Eisentraut's mouse shrew	*Myosorex eisentrauti*	EN (near-endemic)
African elephant	*Loxodonta africanus cyclotis*	Endemic sub-species

ATLANTIC EQUATORIAL COASTAL FORESTS (AT0102)

The Sanaga river forms the northern boundary of this ecoregion. The forests extend from the river south through Equatorial Guinea into the coastal and inland areas of Gabon, the Republic of Congo, and the Cabinda Province of Angola, ending in the extreme west of the Democratic Republic of Congo, just north of the mouth of the Congo river. These forests occur in a broad coastal band extending to the eastern escarpment about 500 to 800 m above sea level. In the Cameroon portion of the ecoregion, the climate is hot, with a high relative humidity throughout the year, and rainfall averaging approximately 2 000 mm. The forests of the inland portion have a complex structure, with a canopy of up to 60 m high. Near the coast there are forest-savanna mosaics.

Exceptional species diversity and endemism exists in the Atlantic Equatorial coastal forests. This ecoregion and the adjacent Cross-Sanaga-Bioko coastal forests ecoregion support about half of the 7 000 to 8 000 plants that are endemic to tropical West Africa. Most of these endemics occur in the coastal area of Cameroon. Faunal diversity is also very high. Large mammals include western lowland gorillas, *Gorilla gorilla gorilla*, mandrills, *Mandrillus sphinx*, and sun-tailed monkeys, *Cercopithecus solatus*. The Atlantic Equatorial coastal forests, together with the North-western Congolian lowland forests to the east, comprise part of the Cameroon and Gabon lowlands Endemic Bird Area (Stattersfield *et al.,* 1998). Eight near-endemic and restricted range bird species occur, including: Verreaux's batis, *Batis minima*, black-necked wattle-eye, *Platysteira chalybea*, forest swallow, *Hirundo fulginosa*, Rachel's malimbe, *Malimbus racheliae*, Ursula's sunbird, *Nectarina ursulae*, and the African river-martin, *Psuedochelidon eurystomina*, as well as two globally threatened species, the Endangered Bates' weaver, *Ploceus batesi*, and the Vulnerable Dja river scrub-warbler, *Bradypterus grandis*, (Hilton-Taylor, 2000).

The vast majority of the ecoregion has been logged at least once and sometimes more than twice; i.e. very little undisturbed primary forest remains. Since there are still large blocks of intact (though secondary) forest present in the less densely populated parts of the region, there is good potential for new conservation initiatives. In Cameroon, the National Park within the Campo-Ma'an UTO and Douala-Edéa Wildlife Reserve are protected. The Campo-Ma'an UTO focuses on sustainable agricultural and resource management programmes.

Threats to the ecoregion include forest degradation and elimination when forest access is opened up by logging, which leads to the expansion of agriculture into previously undisturbed areas. Approximately 15% of the ecoregion is formally protected; however, these protected areas do not capture the full spectrum of biodiversity, and more extensive protection initiatives are required.

NORTHWESTERN CONGOLIAN LOWLAND FORESTS (AT0126)

The Northwestern Congolian lowland forests lie, as expected, at low altitudes between 300 and 800 m. Rainfall ranges from 1 400 to 2 000 mm, with most rain falling during two distinct wet seasons. The climate is generally tropical and humidity is high throughout the year.

Biodiversity data for the ecoregion is patchy, with some plant and animal groups having been extensively studied and others not at all. Overall, it is estimated that 8 000 plant species occur in the lowland forests of Cameroon. Large emergent trees such as *Entandrophragma congoense*, *Pentaclethera eetveldeana*, *Pericopsis elata*, *Gilbertiodendron dewevrei*, shrubs, lianas and epiphytes contribute to the complex, multi-layered structure of the forest. Raffia palms are common along the river valleys in the northern portion of the ecoregion.

The area is extremely rich in primates, and supports more great apes than any other area in Africa. The near endemic sun-tailed monkey, *Cercopithecus solatus*, black colobus, *Colobus satanas*, and elegant needle-clawed galago, *Euoticus elegantulus*, occur. Seven species of shrews and one mouse are endemic, as are two species of bat. Among the larger mammals, the forest elephant, *Loxodonta africana cyclotis*, forest buffalo, *Syncerus caffer nanus*, bongo, *Tragelaphus euryceros*, and sitatunga, *Tragelaphus spekei*, are relatively abundant. The ecoregion is very rich in bird species, with one endemic forest robin, *Stiphornis sanghensis*, and four near-endemic species, including: Verreaux's batis, *Batis minima*, Dja river scrub-warbler, *Bradypterus grandis*, forest swallow, *Hirundo fuliginosa*, and Bates's weaver, *Ploceus batesi*. The North-western Congolian lowland forests, together with the neighbouring Atlantic Equatorial coastal forests to the west, comprise part of the Cameroon and Gabon lowlands Endemic Bird Area (Stattersfield *et al.,* 1998). Among the herpetofauna, at least six species of reptiles are endemic and 17 near endemic. At least four frog species are endemic. It is likely that as survey levels improve, more endemic species will be discovered.

Large intact blocks of forest remain relatively undisturbed due to the low human population density in a region not noted for its agricultural potential. In Cameroon, forest disturbance tends to be concentrated along the corridors formed by rivers and roads (in particular, logging tracks). The Dja Faunal Reserve (also a World Heritage Site), Boumba-Bek Forest Reserve, Nki Forest/Faunal Reserve, Lac Lobeke and Abong Mbang Forest Reserve in south and south-east Cameroon are protected. There is a possibility that the Dja Faunal Reserve will be extended to the south in some form.

A.3.3.3 Important bird areas in Cameroon

Thirty-three important bird areas have been identified in Cameroon (Fotso *et al.,* 2001), many of which overlap with protected areas. Of the 908 bird species identified in the country, 38 species are of global concern for conservation. Nine of these species are Palaearctic migrants, illustrating the importance of wetland conservation and Cameroon's accession to the Ramsar Convention. The remaining 29 species are resident in Cameroon, and of these 19 are restricted range species (endemic or near-endemic). Apart from the Important Bird Areas identified by BirdLife International, Endemic Bird Areas have been identified by Stattersfield *et al.* (1998). Two of these fall within Cameroon's borders: the

Cameroon and Gabon lowlands Endemic Bird Area and the Cameroon mountains Endemic Bird Area.

A.3.3.4 Cameroon's international commitments to biodiversity protection

Cameroon is a signatory to five key biodiversity-related conventions:

- Convention on Biodiversity (signed 14/06/1992);
- Convention on International Trade in Endangered Species (CITES - acceded 05/06/1981);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention - entry into force 01/11/1983); and
- United Nations Framework Convention on Climate Change (entry into force 17/01/1995, and the Kyoto Protocol (acceded 28/08/2002).

Cameroon is in the process of acceding to the Convention on Wetlands of International Importance (Ramsar Convention, 1971).

Together, these conventions commit the government of Cameroon to protecting the country's biodiversity and natural environment through legislation and policy, that enforces: (i) sustainable utilisation of biodiversity; (ii) restriction of trade in endangered species; (iii) protection of habitats for migrant species; and (iv) maintenance of forest resources and pollution and waste control to ensure that Cameroon contributes to global efforts to minimise long-term climate change.

A.3.4 Socio-economic and cultural environment

The following section provides a description of communities and aspects of the socio-economic and cultural environment of inland areas in Cameroon in the vicinity of the Chad-Cameroon oil pipeline and other oil spill risk sources.

A.3.4.1 Population demographics and settlement patterns

Although the Chad-Cameroon pipeline passes through many remote and barely accessible areas, towns situated relatively close to the pipeline route include Dompla (close to the border with the Central African Republic), Meiganga, Bélabo, Nanga Eboko, Batchenga, Ngoumou, Lolodorf, Bipindi and Kribi (at the coast). In the vicinity of the pipeline, population settlements and cultivated lands are predominantly distributed along the local road network.

The population density along the pipeline route passing through the Wooded Savanna Zone from the oilfields in Chad to approximately Mararaba in Cameroon is low due to the harsh, dry and desolate conditions of the region. The two main groups living in this zone are permanently resident rural subsistence farmers and nomadic communities who follow the seasonal cattle migration routes seeking fodder and water for their stock.

The Semideciduous Forest Zone between Mararaba and Batchenga is generally rural and sparsely populated, although larger population centres such as Bélabo have developed around the timber concession areas where logging companies are involved in timber exploitation in Deng Deng.

The pipeline's route through the Mixed Forest Zone from Batchenga to Ngoumou, skirts Yaoundé and runs through a heavily populated major commercial centre, which includes industrial-scale palm plantations and cocoa farming alongside traditional forms of subsistence agriculture (COTCO, 2002).

In the Atlantic Littoral Forest Zone between Ngoumou and Kribi it is estimated that approximately 1 000 Bagyeli/Bakola and a further 10 000 Bantu villagers live in the vicinity of the pipeline route.

Oil storage depots are located in major towns including Douala, Garoua, Yaoundé, Ngoundéré, Bélabo and Bafoussam.

A.3.4.2 Cultural characteristics

Rural communities hold great respect for forest and stream dwelling spirits and deities, which are believed to influence the success of fishing and hunting. Desecration of sacred places of the gods is believed to anger these spiritual entities and lead to a scarcity in fish and game. These beliefs are held more strongly by the older generation.

A.3.4.3 Economic livelihoods and activities

AGRICULTURE

A large proportion of the Cameroonian rural population living along the Chad-Cameroon pipeline and along the oil transport corridors (road and rail) is engaged in rainfed subsistence agriculture in savanna and forested areas. Agricultural activities include crop, fruit and vegetable farming as well as stockbreeding. Traditional agriculture takes the form of slash-and-burn agriculture, through which forested areas are burnt and cleared for agricultural land. Shifting cultivation is practiced whereby agricultural land is farmed intensively for a few seasons and then left fallow for short to long periods in order to restore soil fertility. This practice implies that villages sometimes relocate to new farming areas, depending on the availability of land; however, the trend towards permanent cultivation, with shorter fallow periods, is increasing in line with pressures on available farming land due to population growth (Chad Export Project, 1999b. Supporting Documents Vol 5). Subsistence farms rarely exceed 1 ha in size.

Crops cultivated include: cassava, maize, banana, plantain, groundnuts, yam, sweet potatoe and pumpkin. In the drier region of the Wooded Savanna Zone crops such as sorghum, millet and sesame are grown. Tree crops include: mango, pear, guava, kola-nut, lemon, soursop, oil palm, coconuts, avocado and papaya. Small-scale stockbreeding includes goats, sheep, pigs and poultry.

Large plantations of oil palm (*Elaeis guineensis*) and rubber (*Hevea brasiliensis*) are established near Kribi and Yaoundé. Near Mbanjok, on the Sanaga river, there is an extensive sugar cane plantation, and a large tobacco plantation is located to the east of Batchenga (Dames and Moore, 1994). Although coffee used to be the dominant cash crop, its cultivation is currently in decline.

HUNTING

Due to the proximity to forested areas hunting is a popular activity that provides both income, through the sale of bushmeat (medium to large mammals and reptiles), as well as a food source. Attempts at managing the illegal hunting and bushmeat trade are underway, for example, by forbidding bushmeat sellers to travel on Camrail.

FISHING

Fishing is a popular dry season activity practiced largely by children and women in streams and rivers (Chad Export Project, 1999b. Supporting Documents Vol 5). Gillnets, hooks and lines are the most commonly used fishing equipment.

In the Wooded Savanna Zone between Deng Deng and Doba (in Chad) artisanal fishing is practiced at a small-scale along the Mba river in the dry season. Further north, in the Mbéré Rift Valley, fishing is a more important artisanal activity.

The Semi-Deciduous Forest Zone lies in the Sanaga river basin between Batchenga and Deng Deng. In this zone the Lom river supports an important local fishery, which includes both artisanal as well as industrial fisheries. Although fishing is practiced year-round by the local population, during the dry season, locals, as well as people resident further away from the river, establish fishing camps along the Lom river and its many tributaries. Excess fish that is not consumed by the fishermen and the local villagers is sold at markets, such as in Lom Pangar. The Sanaga, Selé, Tedé and Sesse rivers are also popular fishing areas.

In the Atlantic Littoral Forest Zone between Kribi and Ngoumou, a relatively small proportion of the population is involved in fishing activities in the Kienké and Nyong rivers using gillnets, hooks and lines. Fishing is undertaken primarily for domestic consumption, although excess quantities are sold. In the Lokoundjé river fishing is an important dry season economic activity and temporary fishing camps are established along the river in the vicinity of Bipindi.

FOREST EXPLOITATION

Industrial timber exploitation occurs largely between Kribi and Lolodorf, as well as in the vicinity of Bélabo.

Artisanal timber exploitation is undertaken both legally and illegally in forest reserves, with timber being sold in the northern provinces of Cameroon, exported to Chad or used as fuelwood. Forests also provide a source of food, medicinal plants and construction materials as well as serving as the primary hunting ground for bushmeat.

SMALL-SCALE TRADING AND TRANSPORTATION

Small-scale trading is undertaken in most communities, but in particular, is focused around transport infrastructure nodes such as train stations and road toll points. Goods traded include agricultural produce, bushmeat, timber, staple goods and merchandise.

In the Atlantic Littoral Zone where fishing is undertaken along the Lokoundjé river, fish is sold in towns such as Bipindi. Despite being approximately 75 km inland from Kribi and the coast, the majority of fish sold in Bipindi is of marine origin (Chad Export Project, 1999b. Supporting Documents, Vol 5).

The bushmeat trade is predominantly undertaken in the Nanga Eboko, Bertoua, Bélabo and Deng Deng region of the pipeline (Chad Export Project,1999b. Supporting Documents, Vol 5). The trade involves medium- to large-sized mammals and reptile species hunted and killed in the surrounding forest areas despite the legislation that is in place prohibiting such activities. The railway is a primary form of transportation from the source areas to bushmeat buyers in Yaoundé and Douala.

TOURISM AND ECOTOURISM

The pipeline corridor and other main inland sources of oil spill risk are not located in the close proximity of any significant tourism or ecotourism feature within the country's hinterland.

A.3.5 Impact assessment and sensitivity analysis

A.3.5.1 Introduction

In this section the impacts of oil spills are differentiated according to their effect on the country's inland ecosystems and socio-economic environment. Ecosystem impacts reflect the effects of oiling on the various components of the natural environment, while socio-economic impacts reflect the effects of spilled oil on human health, subsistence, economic production systems and livelihoods in general. The assessment conventions that are used to rate the impacts of an oil spill (*intensify*, *temporal scale* and *significance*) are explained in Boxes A.3.1 and A.3.2 for the ecological and socio-economic systems that are appraised.

The spatial scale of an impact can only be assessed for a particular oil spill scenario. In this respect, the environment that will be affected depends mainly on three factors: the location of the oil spill relative to the affected environment and to special features such as inundated grasslands, swamp forests, protected areas, etc. and the amount and type of oil that is spilled. Spatial scale can be divided into the following extreme categories: *localised* –

where a small percentage (<5%) of an ecosystem type is expected to be affected; and *extensive* – a high percentage (>50%) of the ecosystem type is expected to be affected. Between these category extremes, a class of *intermediate* is recognised.

An analysis of the oil spill scenarios suggests that Tier 2, and certainly Tier 3, spills will potentially have spatially *extensive* effects. In contrast, Tier 1 spills will typically have *localised* effects.

Box A.3.1: Rating system for ecological impacts

Intensity: Expected change in ecosystem structure and functioning, where *high* intensity implies a measurable/marked change in ecosystem structure and functioning and *low* represents a barely measurable change. A rating of *intermediate* implies some degree of change that is measurable, but not to the extent that this is marked and permanent. Although spatial scale will affect the intensity of the impact this can only be assessed for a particular spill or spill scenario.

Temporal scale: *Short term*: effects lasting a few days, perhaps as long as two weeks; *Medium term*: effects lasting more than one month, but less than a year; *Long term*: effects lasting more than one year.

Significance: An impact of *high ecological significance* is one that could, for example, result in the extinction of rare/threatened species. It could also be of high intensity, resulting in the permanent deterioration of ecosystem structure and functioning, measurable on an extensive spatial scale and in the long term. The ability of affected ecosystems to revert to their pre-impacted state would be severely compromised. An impact of *low* ecological significance implies that there would be no measurable deterioration in ecosystem structure and functioning beyond, perhaps, some transient (short term) perturbation; i.e. there would be no diminished delivery of important ecosystem services beyond the short term; the significance would also be affected by the spatial scale which will be specific to a particular spill event. An impact of *intermediate* significance would be judged to be intermediate between high and low significance.

A.3.5.2 Ecosystem impacts

The difficulty of assessing the impacts of oil spills on the country's inland environment is attributed to the scarcity of documented accounts of the effects of oil spills on the range of ecosystems encountered in Cameroon. While many studies have reviewed the impacts of, and responses to, marine and coastal oil spills, inland spills have not received the same level of attention. Partly, this is a consequence of the generally smaller scale of such spills. It is also a consequence of the lower profile given to these events, which tend to be superimposed on background environmental perturbations (pollution, massive landscape transformation) that are typically of high intensity. This analysis of potential impacts on land, flora and fauna is, therefore, derived largely from first principles, and is supplemented with adapted information on oil spill impacts pertaining to the marine and coastal environment.

In general, the primary ecological impacts of oil spills can be differentiated according to the receiving environments within which they manifest. These environments include the following:

- the strictly terrestrial or land-based environment;
- the surface water environment, including rivers, streams and other wetlands;
- the groundwater system, including both shallow and deeper fractured zone aquifers; and
- coastal and marine environments.

In each case these primary receiving environments are divided into a number of constituent environment types and the assessment of impacts of oiling deals with each of these.

A.3.5.2.1 Effects of oil on terrestrial ecosystems

In the following discussion, the sensitivity of terrestrial environments to oiling is defined according to: (i) the vulnerability of the habitats to the effects of oil; and (ii) the persistence and severity of the impacts of oiling in these locations. In these respects, the effects of exposure of living organisms and ecosystems to oiling range widely, depending, largely, on the type of oil concerned. For example, refined fuel products (such as kerosene or petrol), which are highly volatile, are relatively toxic but do not persist in the environment, whereas unrefined oils are persistent but less toxic.

The discussion is structured to deal separately with impacts related to the terrestrial or land-based environment, the surface water environment, the groundwater systems and the coastal environment. The discussion is also structured around the sensitive environments identified in terms of the Chad-Cameroon pipeline (Sections A.2.4 and A.2.5), and those identified for the road tanker network (Section A.2.9).

PHYSICO-CHEMICAL EFFECTS OF OILING ON ANIMALS AND PLANTS IN GENERAL

A summary of the main effects of oiling on plants and animals associated with terrestrial environments is presented in Table A.3.6. In the following discussion, differentiation is made between impacts associated with light refined fuel and unrefined product.

Table A.3.6: Effects of oiling on plants and animals in the terrestrial environment

Soil organisms	General	Experimental evidence is scarce, but it is likely that many soil organisms would be negatively affected by oil; however, short life cycles and tropical conditions could lead to fast recovery of the soil fauna through recolonisation. Harmful effects can be transferred to other species through trophic hierarchies, manifesting at higher levels as a result of bioaccumulation.
Terrestrial plants	Herbaceous vegetation and grasses	Vulnerable to toxic effects of oil. Ethylene causes injury to the leaves of sensitive plants including epinasty, chlorosis, curling, leaf abscission and growth retardation. More lasting effects include impairment of reproduction (flowering, seed production and germination). Contact with root systems can cause rapid death of the plant.
	Trees and shrubs	Similar effects to herbaceous vegetation. Species with aerial roots (e.g. in waterlogged areas) are particularly vulnerable to lethal (smothering, toxic) effects on the root system.
Terrestrial invertebrates		Little information is available. Generally speaking, invertebrates are vulnerable to smothering by oil and are sensitive to the toxic effects of ethylene and PAHs.
Terrestrial vertebrates	Amphibians, reptiles	Little information is available on oiling sensitivity. These taxa are reliant on invertebrate prey, which may be in short supply in oiled areas or may be contaminated. Probably vulnerable to both physical oiling and toxic effects of refined products (respiratory effects and skin injuries).
	Small mammals	Little information is available on oiling sensitivity. Reliant on fruits and seeds, which may be in short supply in oiled areas or may be contaminated. Probably vulnerable to both physical oiling and toxic effects of refined products (respiratory effects and skin injuries).
	Birds	Particularly vulnerable. Oiled bird eggs will not hatch. Hatchlings may die from ingesting contaminated food. Oiling of eyes and skin can be severe. In some cases animals will move away from oiled areas.
	Larger mammals	Many larger mammals can move away from oiled areas. However, there is still the risk that they will be oiled. Skin and eyes are sensitive to both crude and refined oils. Species that enter water or riparian areas to feed will be especially at risk. Carnivores and herbivores are at risk from eating contaminated food.

(a) Light refined fuels

The lighter refined fuels covered in this section, include diesel, petroleum, kerosene and jet fuel (or Jet A-1). All of these, apart from the kerosene, which is used for household cooking and heating, are primarily used as transportation fuels.

According to IPIECA (1991)

> *"Experiments on plants and animals have shown that severe toxic effects are associated with compounds with low boiling points, particularly aromatics. The greatest toxic damage has been caused by spills of lighter oil, particularly when confined in a small area."*

The higher fractions of ethylene and polyaromatic hydrocarbons (PAHs) in these fuels are highly toxic to plants and animals. For example, effects on the leaves of sensitive plants include epinasty, chlorosis, curling, leaf abscission and growth retardation. For animals, there are acute toxic effects, including carcinogenic effects, and the causative agents that can accumulate in the upper levels of the food chain and reach toxic levels in some species. The effects of these oils on living organisms are primarily chemical and result in lethal or sub-lethal effects.

(b) Heavy refined fuels and crude oil

The environmental effects of the heavier refined fuel oils (such as HFO or bunker oil) and unrefined crude oil are primarily physical. In relative terms these fuels are less toxic than the lighter products. Particularly in aquatic environments, they tend to smother living organisms rather than cause toxic effects – which diminish over time as the oils degrade through exposure to the elements. Particularly in warm environments, the volatile components evaporate and the harder waxes and tars remain to eventually form insoluble tar or wax balls in water or tarry 'pavements' on land.

Very little HFO is consumed in the country's hinterland. Crude oil will, however, be transported through the Chad-Cameroon pipeline from north-east Cameroon to the country's south coast at Kribi, and it is thus associated with the principal risk source considered in the inland section of the NOSCP.

In assessing the impacts of light and heavy products it is recognised that although the toxicity of light and heavy fuels varies widely, persistence is a key variable that largely balances out the differentiation in resultant environmental effect. Light fuels, although relatively more toxic, evaporate rapidly and do not persist, whereas heavy fuels, although they persist and are difficult to clean up, are less toxic. The environmental impacts associated with both types of product are likely to be of *high intensity* since marked effects will definitely manifest amongst those organisms that come into contact with the oil. The *spatial scale* of the impact, however, is likely to be *localised* and restricted to the area inundated by the spill, while the *temporal scale* over which impacts are likely to result is *medium- to long-term* in the case of both light and heavy fuels. Because of the medium- to long-term temporal scale and high intensity of this potential impact, the *significance* of the impact of oiling is deemed to be *high*.

PHYSICO-CHEMICAL EFFECTS OF OILING ON SENSITIVE TERRESTRIAL ENVIRONMENTS - INUNDATED GRASSLANDS

Three main types of inundated grasslands occur in Cameroon:

- Seasonally inundated grasslands of the Chad Basin (e.g. parts of the East Sudanian savanna ecoregion, AT0705). In these grasslands, drying occurs towards the end of the wet season, when spilled oil may then reach the roots of the plants and cause lethal toxic effects; socially, these areas are important for cropping and livestock grazing in an otherwise semi-arid area;
- Flooded grasslands associated with the upper reaches of larger rivers (e.g. Nyong river (Plate A.3.4) in central Cameroon - Letouzey Vegetation Type 226, and periodically inundated marshy depressions of the Mbam-Sanaga confluence - Letouzey Vegetation Type 152) (Letouzey, 1985); and
- Flooded grasslands of the lower reaches of larger rivers (e.g. *Pennisetum* grasslands along the Mungo river - Letouzey Vegetation Type 244, and Pennisetum and Echinochloa along the Wouri river, Letouzey Vegetation Types 257 and 258 respectively, Letouzey, 1985).

All of these habitats are sensitive to the effects of oil. Because they are flooded all or part of the time, they exhibit many of the properties of freshwater aquatic habitats. The wetland vegetation associated with inundated areas is particularly sensitive to water quality, and hydrocarbons in the water may result in physical smothering and sub-lethal toxic effects on the stems, leaves and reproductive parts of these plants. Because they are frequently inaccessible while flooded, the difficulty of removing spilled oil is considerable. Flooded grasslands associated with rivers have the added sensitivity that spilled oil may enter the river system and be swept downstream.

This impact is considered to be of *high intensity*. The *spatial scale* is expected to be *intermediate to extensive* since some of the flooded grassland systems are very large and contiguous, and the *temporal scale medium-term to long-term*. Overall, the *significance* of the impact of oiling is deemed to be *high*.

Plate A.3.4: Inundated grasslands of the upper Nyong river with swamp forest in the background

PHYSICO-CHEMICAL EFFECTS OF OILING ON SENSITIVE TERRESTRIAL ENVIRONMENTS - SWAMP FORESTS

Inundated forest habitats are scattered across the southern, western and eastern parts of Cameroon, often around the larger rivers, but have not been mapped precisely since they occur patchily. Many swamp forests are associated with rivers, for example, the swamp forests of the upper Nyong river in central Cameroon (near Abong Mbang, Letouzey Vegetation Type 193). These cover large areas alongside the river, and merge into swathes of flooded grassland further downstream. The swamp forests of the Ntem-Ma'an area south-east of Kribi (Letouzey Vegetation Type 242, Letouzey, 1985) occupy broad tracts along the Ntem river with multiple forested islands. Large areas of swamp forest also occur around the Sanaga river near Edéa.

Swamp forests are vulnerable to the introduction of oils because the roots of the plants would be exposed to the soluble portion of refined products, and, during dry periods, to the insoluble (floating) fractions as well. Some of the tree species that occur in these forests have 'mangrove' type aerial roots, or pneumatophores, which are highly sensitive to oiling.

The potential impact of oil from a road, rail or pipeline spill on swamp forest is considered to be of *high intensity*. The *spatial scale* is expected to be *intermediate to extensive* since flooded areas tend to interconnect with river, estuary and wetland systems. The *temporal scale* is expected to be *medium-term to long-term* since there is low velocity flow through these systems. Overall, the *significance* of this impact is deemed to be *high*.

PHYSICO-CHEMICAL EFFECTS OF OILING ON SENSITIVE TERRESTRIAL ENVIRONMENTS - PROTECTED AREAS

Protected areas such as National Parks, Forest Reserves, Faunal Reserves and areas dedicated to sustainable resource utilisation have been accorded their conservation status based on their perceived importance as refugia for local biodiversity or because of their present or future value as resource-rich areas. In addition, many of these areas bring in revenue through tourism and indicate Cameroon's global commitment to biodiversity conservation. Oil spills that affect protected areas should be treated with concern as both the direct impacts of the spill (loss of biodiversity or habitat in the short- or long-term) and the indirect impacts of clean-up (further damage to ecosystems) are costly.

The protected areas most at risk from the Chad-Cameroon pipeline are the Campo-Ma'an UTO (incorporating the recently gazetted Campo-Ma'an National Park) and the Pangar-Djerem Reserve. The proposed Mbam et Djerem National Park would be less at risk since it is not intersected by the pipeline and does not have any major transport corridors running through it. At risk from the transport of fuel by road and rail are the Abong Mbang Forest Reserve and the Douala-Edéa Faunal Reserve, which lies downstream of the fuel transport routes between Douala and Yaoundé.

The impact of oil spills on protected areas is expected to be of *intermediate intensity* over an *intermediate spatial scale*. The *temporal scale*, relating to the persistence of the impact, would be *medium-term*, since oil is likely to persist within the affected environment due to the difficulty of implementing clean-up measures. Overall, the *significance* of this impact would be *intermediate*.

INCREASE IN FREQUENCY AND INTENSITY OF FIRES IN FIRE-SENSITIVE LANDSCAPES

Oil spills have the potential to increase the frequency and intensity of fires, particularly in the case of incidents involving refined fuels, which are highly flammable. The vegetation of the grasslands and woodlands of the forest-savanna mosaic of central Cameroon and the savannas of northern Cameroon are flammable and ignite easily. Although much of Cameroon is a fire-controlled landscape, uncontrolled fires are now a threat to many of its environments. Fires that occur too frequently in savannas and woodlands can result in changes in species composition, for example, with woody plants becoming less dominant and grasses replacing them. Uncontrolled burning of forest edges and gallery forests contributes to the shrinkage of these habitats. In combination with other human impacts such as slash and burn agriculture and shortened fallow periods, fire can have a measurable impact on forest succession.

The following ecoregions are sensitive to increased intensity and frequency of fires:

- Sahelian Acacia savanna;
- East Sudanian savanna;
- Mandara Plateau mosaic;

- Northern Congolian forest-savanna mosaic;
- Cameroonian Highlands forests; and
- Mount Cameroon and Bioko montane forests.

This impact of spill-related fires or increased fire frequency on the above ecoregions is considered to be of *intermediate intensity*. The *spatial scale* would be *intermediate to extensive*, and the *temporal scale* would be *medium-term*. However, repeated spills with accidental or deliberate ignition of the spilled fuel could result in long term or permanent changes in vegetation structure and species composition. In protected areas or wetlands these impacts could be difficult to rehabilitate. In this context, the significance of this impact is deemed to be *intermediate*.

A summary of the assessment of impacts is presented in Table A.3.7, and the conventions used in the impact assessment are explained in Box A.3.1.

Table A.3.7: Summary of potential impacts of oil spills on terrestrial ecosystems

Impact	Intensity	Spatial scale	Temporal scale	Significance
Physico-chemical effects of oiling on animals and plants	High	Localised	Medium- to long-term	High
Physico-chemical effects of oiling on sensitive terrestrial environments - *Inundated grasslands*	High	Intermediate to extensive	Medium- to long-term	High
Physico-chemical effects of oiling on sensitive terrestrial environments - *Swamp forests*	High	Intermediate to extensive	Medium- to long-term	High
Physico-chemical effects of oiling on sensitive terrestrial environments - *Protected areas*	Intermediate	Intermediate	Medium-term	Intermediate
Increase in frequency and intensity of fires in fire-sensitive landscapes	Intermediate	Intermediate to extensive	Medium-term	Intermediate

A.3.5.2.2 Contamination of surface water systems (rivers and wetlands)

A summary of the main effects of oiling on plants and animals, associated with the surface water environment, is presented in Table A.3.8.

Table A.3.8: Effects of oiling on plants and animals associated with surface water environments

Aquatic plants	Floating plants	Can be completely covered by floating oil; photosynthesis and respiration are prevented; sensitive to the toxic effects of lighter oils.
	Rooted plants	Marsh vegetation shows greater sensitivity to fresh light crude or light refined products whilst weathered oils cause relatively little damage. Oiling of the lower portion of plants and their root systems can be lethal.
	Freshwater mangroves	Species with aerial roots (pneumatophores) are extremely susceptible to smothering and product toxicity.
	Riparian vegetation	Oil spilled into rivers will collect along the banks, where the oil clings to plants and grasses. Animals that ingest these contaminated plants may also be affected.
Aquatic invertebrates	Bottom dwellers	Oil in sediments may be very harmful because sediment traps the oil and affects the organisms that live in or feed off the sediments. Indirectly, organisms may be forced from their burrows and shelters; they are then exposed and may be killed or carried downstream by currents.
	Surface dwellers	Very susceptible to physical effects (may be completely covered by floating oil) and toxicity of oil (PAHs).
	In-stream swimmers	The soluble portion of the oil may affect these organisms; if they surface they will be oiled; may at times be exposed to contaminated sediments.
Fish	Adult fish	The soluble portion of oils produces toxic effects on fish, their larvae and eggs; effects on adults include fin erosion, skin sores, liver damage, and inflammation of the olfactory tissue; some effects on reproduction - fewer eggs, and reduced recruitment of adults into the population. Commonly, fish in an exposed area either die quickly or swim away from the area, so it is hard to determine the exact nature of the impact on the total population. Contaminated fish can cause food poisoning in humans when eaten, or tainting may decrease the opportunity to market affected fish.
	Fish larvae	The soluble portion of oils produces toxic effects on fish, larvae and eggs.
	Fish eggs and spawning grounds	The soluble portion of oils produces toxic effects on fish, their larvae and eggs; principal effect on eggs is on egg survival, but young may hatch malformed.
Amphibians	Adults	Frogs may become covered in oil at breeding sites; terrestrial and aquatic species may ingest oil when feeding; susceptible to toxic components of oil (ethylene and PAHs); tadpoles are susceptible to toxic components of oil (ethylene and PAHs); lethal effects.
Birds	Water birds and shore birds	Birds may be coated in oil (affecting thermoregulation, loss of flight or sight), ingest it accidentally or by eating oiled prey, or bring it back to the nest; reproductive effects (reduction in the number of eggs laid, decreased fertility of eggs, decreased shell thickness); nests on margins of streams and wetlands may be oiled; eggs are very susceptible to oiling (do not hatch); toxins may accumulate in these birds.
Mammals	Aquatic and riparian mammals	Oiling of the eyes causes irritation; adhesion of oil to the fur can be followed by skin lesions; lethal and sub-lethal toxic effects through inhalation of lighter fuels; PAHs are carcinogenic to mammals.

EFFECTS OF OIL ON SURFACE WATER SYSTEMS

Freshwater systems are very important to overall ecosystem health and human livelihoods, and are sensitive to oil spills of every type. In Cameroon, rivers and wetlands are used for drinking water and for fishing, and the riparian forests are important hunting areas. Freshwater systems are inhabited by a large diversity of plants, animals, and micro-organisms. These, in association with the physico-chemical environment, produce a complex web of relationships that maintain water quality, sediment structure and fertility and other ecosystem services. The effects of oiling on rivers and wetlands include direct effects on the health of aquatic organisms, the ecological productivity of affected systems and human livelihoods.

Decrease in water quality of wetlands

The effects of oil contamination on standing, or very slow-flowing, water bodies such as marshes and swamps is generally more severe than contamination of swiftly flowing water bodies, since they do not flush easily and do not benefit from the resultant dilution effects. Heavy oils can remain in these areas for long periods unless removed, causing smothering of aquatic plants, invertebrates and vertebrates, and toxic effects that manifest over time. Lighter fuels have rapid toxic effects on aquatic plants and animals, evidenced in developmental and reproductive defects attributable to water quality deterioration.

The impact of a spill affecting wetlands or marshes would be of *intermediate intensity* regardless of product spilled, because of the importance of these resources in terms of both natural and human (fisheries and hunting) value. The impact would be felt over an *intermediate spatial scale* (but would also depend on the size of the wetland affected) and would persist over a *long timescale* because of the difficulties of water quality amelioration through the removal of oil and the persistent effects of toxicity in some organisms. The overall *significance* of this impact is considered to be *high*.

Decrease in water quality of rivers and streams

Flowing water bodies are potentially as sensitive to oil spills as standing water; however, the pollutants tend to be diluted and removed from the initial zone of impact by the river or stream flow. Impacts of oil spills on the riparian zones are potentially more severe than within the river channel itself since pollutants will tend to become distributed along the river banks, fixed to fringing or aquatic vegetation, where they may persist for some time. Animals such as otters and mongooses that feed in water could be affected by oiling of the eyes and adhesion of oil to fur followed by skin lesions. Toxic effects may result from inhalation of volatile compounds and ingestion of the pollutants. Animals that feed on riverside or aquatic vegetation (antelope, particularly the water chevrotain) would be exposed to similar risks. The high flow rates of most of Cameroon's rivers, and thus the ability to transport pollutants rapidly downstream, vastly extends the spatial scale of a river oil spill compared to onland, which widely exposes aquatic species such as Cameroon's endemic fish fauna to the impacts of oiling.

Impacts of oil spills on rivers and streams are expected to be of *intermediate intensity*, extending over an *extensive spatial scale* in the *medium-term*. Overall, the impacts are deemed to be of *high significance*.

Decrease in water quality of rivers and wetlands due to contaminated groundwater base flow
A large oil spill that contaminates groundwater in low lying areas, in particular along the pipeline route, could affect wetland and river ecosystems that are fed by groundwater base flow, particularly in the dry season when hydraulic gradients are more likely to be directed towards surface water systems.

The impact is expected to be of *low intensity* on a *localised spatial scale*, because of the capacity of the soil to attenuate the migration of pollutants associated with oil. Groundwater migration is generally slower than surface water migration, and so the impact will probably be experienced over the *medium- to long-term*. The overall *significance* of the impact on wetland and river ecosystems groundwater contamination along the pipeline route is expected to be *low*.

A summary of potential impacts of oil spills on surface water systems is presented in Table A.3.9.

Table A.3.9: Summary of potential impacts of oil spills on surface water systems

Impact	Intensity	Spatial scale	Temporal scale	Significance
Decrease in water quality of standing water bodies	Intermediate	Intermediate	Long-term	High
Decrease in water quality of flowing water (rivers and streams)	Intermediate	Extensive	Medium-term	High
Decrease in water quality of rivers and wetlands due to contaminated groundwater base flow	Low	Localised	Medium- to long-term	Low

A.3.5.2.3 Contamination of groundwater aquifers

EFFECTS OF OIL ON GROUNDWATER

Groundwater is an important water resource supporting human livelihoods in rural and urban areas of Cameroon. Contamination by an oil spill would impair the quality of the groundwater and could render the water unfit for human or animal consumption, irrigation and domestic (e.g. washing) and industrial use. Potential impacts range from toxic effects on humans and animals that use groundwater for drinking to socio-economic impacts on human livelihoods and loss of revenue for industries and agriculture. Contamination could also affect surface water ecosystems that are fed by groundwater. Toxic and physico-chemical effects of oiling on animals and plants have been described in the previous sections.

The effects of oil spills on groundwater systems are generally less severe than for surface water, because of the attenuation of contaminant migration in the overlying soils and in the aquifer itself. Underground persistent leaks have more serious consequences for groundwater, particularly in the case of small leaks, which may often be undetected.

Crude oil behaviour in the subsurface is complicated by the presence of multiple compounds, each with different properties. The net result is that some hydrocarbon fractions are transported faster than others and a contamination plume of varying intensity may spread over a large area. The heavy compounds in crude oil are often retained in the soil and generally do not migrate very far from the vicinity of the spill, but the lighter, more soluble fraction, including compounds such as benzene, toluene, ethylbenzene and xylene (BTEX), are more mobile. Some of these compounds are hazardous to human health (Table A.3.10).

Table A.3.10: Potential human health impacts of high exposures (by ingestion or inhalation) to chemicals present in crude oil and refined petroleum products. Source: United States Environmental Protection Agency, EPA, and Agency for Toxic Substances and Disease Registry, ATSDR.

Chemical	Health impact	
	Toxic impacts	Carcinogenic impacts
Benzene	Headaches, drowsiness, dizziness, anemia – known to cause harmful effects on the blood.	Known human carcinogen. Causes leukemia.
Ethane	Dizziness, loss of balance and co-ordination, unconsciousness.	No human data. Causes tumours in spleen, pancreas, kidney, abdomen of rats.
Ethylbenzene	Dizziness and throat and eye irritation.	Not classifiable with regard to human carcinogenicity.
Hexane	Neurotoxic effects.	No available data.
Naphthalene	Damage to red blood cells, fatigue, lack of appetite, nausea, vomiting, diarrhoea.	No available data.
Toluene	Affects the brain. Tiredness, confusion, weakness, nausea.	Not carcinogenic.
Xylenes	Affects the brain. High levels can cause headaches, lack of muscle coordination and dizziness.	Not carcinogenic, but evidence is not conclusive.

Many hydrocarbons can be degraded by naturally occurring subsurface bacteria, particularly under aerobic conditions. The process of biodegradation is likely to be favoured by the warm, wet climate in the southern areas of Cameroon. Volatilisation and photodegradation of the lighter compounds in petroleum are, however, not very effective removal mechanisms in the subsurface environment and these contaminants may persist for some time in groundwater.

CONTAMINATION OF GROUNDWATER IN THE GAROUA SANDSTONE AQUIFER

A large spill of refined petroleum products at the Garoua storage depot (the only risk source of potential significance in terms of groundwater contamination) could contaminate the surrounding phreatic sandstone aquifer. This aquifer is an important water resource in the dry Northern Province, supporting a variety of domestic, industrial and agricultural uses. SNEC supplies bulk water to Garoua from a well field to the north of the town, but these boreholes are expected to lie upgradient of the fuel storage depots and should not be affected significantly by an oil spill.

Because of the significant water supply potential of the Garoua sandstone aquifer, the impact resulting from an oil spill are considered to be of *high* enough *intensity* to warrant a full geohydrological investigation should a major spill occur at the fuel storage depot. The *spatial scale* is expected to be *intermediate* and the *temporal scale* of the impact *medium-term* because of the relatively high hydraulic conductivity of the sandstones (10^{-4} to 10^{-5} m/s). The overall *significance* of possible groundwater contamination from a large fuel spill at Garoua is expected to be *high*.

CONTAMINATION OF GROUNDWATER IN THE DOUALA SEDIMENTARY BASIN AQUIFER

A large spill of refined petroleum products at any of the Douala storage depots (again, the only major risk source of potential significance in terms of groundwater contamination) has a high potential to contaminate the surrounding phreatic aquifer, especially since the water table is generally very close to the surface. This aquifer is widely exploited by private individuals and industries in the city, particularly in the peri-urban areas where reticulated water is not always available. The Douala aquifer was used as an important water resource by SNEC to supplement the surface water supply to the city, but the Massoumbou well field, which is located some distance (approximately 15 km) up gradient from the city, is not likely to be affected by a spill at the fuel storage depots. Production from this wellfield has also been significantly scaled down due to borehole failure.

Because of the significant water supply potential of the Douala sedimentary basin, the impact of groundwater contamination is considered to be of *high* enough *intensity* to warrant a full geohydrological investigation should a major spill occur at any of the fuel storage depots. The *spatial scale* is expected to be *intermediate* and the *temporal scale* of the impact *medium-term* because of the relatively high porosity of the coastal sand deposits. The overall *significance* of possible groundwater contamination from a large fuel spill at Douala is expected to be *high*.

CONTAMINATION OF GROUNDWATER IN THE UPPER WEATHERED ZONE

No major aquifers are known to exist in the vicinity of the other SCDP fuel depots in Cameroon and groundwater is not used for bulk supply in towns where these installations are located. Small-scale local users of groundwater may be at risk if a large spill of petroleum products were to occur. This may be of greater economic significance where large industries, such as the breweries in Yaoundé, which make use of groundwater from private boreholes, were affected. Impacts at Ngaoundéré may also be of greater significance, since more people are likely to be reliant on groundwater in the drier part of the country.

Because of the low water supply potential of the local aquifers, the impact is considered to be of *low intensity*. The *spatial scale* is expected to be *localised* and the *temporal scale* of the impact *medium- to long-term*. The overall *significance* of possible groundwater contamination from a large fuel spill at the SCDP storage depots is expected to be *low* at Bafoussam and Bélabo and *intermediate* at Yaoundé and Ngaoundéré.

CONTAMINATION OF GROUNDWATER IN THE COASTAL AQUIFER NEAR KRIBI

A large spill at the Pressure Reduction Station on the Chad-Cameroon pipeline, or along a section of the pipeline near Kribi, could contaminate groundwater contained within the coastal sediments with soluble hydrocarbons.

The impact is considered to be of *intermediate* intensity as the coastal aquifers may have significant water supply potential. The *spatial scale* is expected to be *intermediate* and the *temporal scale* of the impact *medium-term* (groundwater flow and, therefore, dispersion and dilution of contaminants is expected to be faster in the coastal sands than in the clay-rich weathered zone aquifers found inland). The overall *significance* of possible groundwater contamination from a large crude oil spill at the Kribi Pressure Reduction Station is expected to be *intermediate*.

A summary of potential impacts of oil spills on groundwater systems is presented in Table A.3.11.

Table A.3.11: Summary of potential impacts of oil spills on groundwater

Impact	Intensity	Spatial scale	Temporal scale	Significance
Contamination of groundwater in the Garoua sandstone aquifer	High	Intermediate	Medium-term	High
Contamination of groundwater in the Douala sedimentary basin aquifer	High	Intermediate	Medium-term	High
Contamination of groundwater in the upper weathered zone aquifers	Low	Localised	Medium- to long-term	Intermediate
Contamination of groundwater in the coastal aquifer near Kribi	Intermediate	Intermediate	Medium-term	Intermediate

A.3.5.3 Socio-economic impacts

The socio-economic and cultural environment could be affected by impacts resulting from an oil spill originating from one of the oil spill risk sources identified in Section A.2, and could also be exposed to safety risks attributable, for example, to the effects of fire and explosion.

A.3.5.3.1 Sensitivity analysis

The significance of impacts of an inland oil spill or fire will depend on the type of socio-economic environment affected and the scale of the spill. However, there are a number of generic factors that will influence the significance of the impact and the sectors of the community potentially affected most negatively by a spill. These factors are discussed below:

MOBILITY OF THE AFFECTED COMMUNITY

The continuing practice of slash and burn agriculture suggests that, in the event of an oil spill contaminating existing agricultural land, the affected individuals may be forced to abandon the polluted area and continue their agricultural activities elsewhere. This, obviously, is undesireable from a biophysical environmental perspective as it would result in increasing pressure being placed, for example, on natural forests. However, in the case of communities used to this form of shifting agriculture, the impact would be reasonably easy to mitigate (i.e. movement away from polluted areas). Communities with less mobility would be affected to a greater extent, since they could be forced to remain associated with the area affected by the spill. Farmers living in the vicinity of the Chad-Cameroon pipeline between Batchenga and Ngoumou would probably be most sensitive to the impacts associated with an oil spill as population pressure and land scarcity reduces the possibility for affected farmers to shift their cultivation elsewhere.

DEPENDENCE ON NATURAL RESOURCES AS A FORM OF LIVELIHOOD

Communities living along the Chad-Cameroon pipeline route and in the vicinity of other oil spill risk sources whose primary source of income, food and livelihood comes from agricultural and inland fishing activities are expected to be more sensitive to the negative impacts of an oil spill than communities or urban communities whose economic activities are diversified. Outside of the larger towns, most of the communities living in the vicinity of the risk sources are heavily dependent on the natural environment for income and subsistence and are, therefore, sensitive to the impacts associated with a potential oil spill (i.e. contamination of water supplies, agricultural land and fishing areas).

STRUCTURE OF THE ECONOMIC SYSTEM

In what might seem to be a contradiction to the above, individuals who are more entrenched in a monetary exchange system may be more sensitive to the negative impacts of an oil spill than those still reliant on a traditional system of exchange of goods and services. This is argued on the basis that impacts may be more severe if individuals have become dependent on the monetary income provided by the sale of agricultural produce and natural products to purchase basic goods and services and to repay debtors.

PROXIMITY TO THE RISK SOURCE

Communities most sensitive to the risk and impact of an oil spill include those living in the vicinity of the Chad-Cameroon pipeline, the commercial fuel storage installations (in Douala, Yaoundé, Bélabo, Ngaoundéré, Garoua and Bafoussam) and transport corridors for road- and railtankers, who are dependent of the natural environment as a source of livelihood and income (e.g. agriculture and fisheries).

Between approximately Ngoyoum (in the vicinity of Bélabo) and Yaoundé, the Chad-Cameroon pipeline runs in close proximity to the railway line. At times this distance is as close as 250m, with houses and agricultural lands located between the two oil spill risk sources. These locations would, therefore, be at greater risk than most areas due to the possibility of a spill or fire occurring either from the pipeline or from a railtanker. Similarly, communities living near rivers - a key resource for artisanal fishing – who might be located in close proximity to an oil spill risk source are more sensitive to the negative impacts of an oil spill than artisanal fishing communities who live beyond the potential impact zone. For example, the area surrounding Ngoyoum, Ndeng-Ndeng and Bélabo (which is traversed by both the pipeline as well as the railway line used to transport oil) is characterised by a dense network of streams and rivers (including the Sanaga and Lom rivers), which support small-scale fisheries. Similarly between Ngoumou and Kribi, the pipeline crosses the Nyong river, which is also an important river for local fishing activities.

STRUCTURE OF DWELLINGS

The sensitivity of communities to oil spill and fire risks will be influenced by the type of dwelling within which potentially affected individuals live. Houses made from wooden boards and raffia mat roofs will be more seriously damaged by spill-related fires than those made from sun-dried bricks and which have sheet iron roofs.

A.3.5.3.2 Impact assessment

The following section assesses the significance of the impact of a potential oil spill on the activities undertaken by inland communities who may be negatively affected by a spill. The assessment is summarised in Table A.3.12, which refers to the conventions described in Box A.3.2.

In socio-economic terms the spatial scale of an impact would be based on the effect of an oil spill on the local population, tourists, industries, etc. established at, or having a dependency on, the affected environment. A *localised* impact would involve a small proportion of the inhabitants (e.g. a single village) or a small fraction of one or more economic sectors (e.g. artisanal fisheries) and, thus, the general livelihoods of affected communities. An *extensive* impact would involve several villages, or a large town, or a large proportion of one or more economic sectors that sustain the affected communities. An *intermediate* impact would lie between these extremes. An analysis of the oil spill scenarios suggests that Tier 2 and certainly Tier 3 spills will result in an *extensive* socio-economic impact. Tier 1 spills will generally have *localised* effects.

Box A.3.2: Rating system for socio-economic impacts

Intensity: An impact of *high* intensity indicates that the effect of oiling on communities would be measurable, for example, in terms of changed cultural traditions and livelihood strategies (undesirable, unsolicited), and a diminished quality of life in the long term. An impact of *low* intensity would indicate some effect on cultural traditions and livelihoods, more in terms of nuisance effect (transient) than holding serious consequences for communities. A rating of *intermediate* implies that there would be consequences for affected communities that would be measurable somewhere along the continuum between being of nuisance value at the one extreme and being socially severely disruptive at the other. Although intensity will vary with the spatial scale of the impact, the scale cannot be assessed without information on a specific spill or spill scenario (see also Section A.3.1).

Temporal scale: *Short term*: effects lasting a few days, perhaps as long as two weeks; *Medium term*: effects lasting more than one month, but less than a year; *Long term*: effects lasting more than one year.

Significance: An impact of high socio-economic significance would manifest in the form of long term changed (undesirable and unsolicited) cultural traditions and livelihood strategies, probably resulting in the breakdown in established social and economic structures. Quality of life of affected communities would deteriorate in the long term as a result of the permanent diminishment in the delivery of important ecosystem services upon which affected communities are dependent; i.e. the impact would be of high intensity, could be spatially extensive and would persist in the long term. An impact of low socio-economic significance implies that affected communities would experience no measurable change in cultural traditions and established socio-economic structures and patterns following perhaps some minor, transient (short term) perturbation; i.e. in the absence of any serious diminishment in important ecosystem services, socio-economic impacts would be barely measurable. An impact of intermediate significance would be judged to be intermediate between high and low significance.

CONTAMINATION OF AGRICULTURAL LAND

Although the Chad-Cameroon pipeline generally passes through a fairly sparsely populated area (except in the region between Batchenga to Ngoumou), agricultural lands located in close proximity to the pipeline are sensitive to soil contamination in the event of an oil spill. Agriculture is a primary source of both food and income, and the contamination of agricultural land is, therefore, a key concern for affected communities and individuals. However, impacts would be localised as only individuals or communities in the immediate vicinity of the spill would be directly affected. The scale of the spill and the effectiveness of the oil spill response and clean-up operations will ultimately determine the magnitude of the impact. Taking into account the fact that agricultural practice has traditionally been one of shifting cultivation, the impact is assessed to be of *low intensity* as relocating agricultural activities to uncontaminated lands is unlikely to significantly change current livelihood strategies or cultural practices. An oil spill may, however, result in food shortages amongst affected farmers during the period between the spill and the re-establishment of agricultural activities on uncontaminated land.

An indirect impact of agricultural soil contamination is the potential for tensions to arise between affected farmers and neighbouring communities and individuals over competition for land. Taking these factors into account the overall significance of the impact of agricultural land contamination is assessed to be of *intermediate significance*.

DECLINE IN HUNTING

There is a concern amongst communities that the Chad-Cameroon pipeline has delocalised forest spirits. It is believed that this has caused a decline in the amount of animals that are traditionally hunted by the communities.

Hunting is, however, only expected to be negatively effected by an oil spill if the spill results, for example, in a fire that destroys an expansive area of forest or savanna used by surrounding communities as hunting grounds.

The impact of a fire on affected communities is assessed to be of *low intensity* as this is not expected to permanently affect the livelihood and culture of the community. Although a fire may lead to a long-term loss of forest in the area that might be affected by fire following a spill, the *localised* extent of this impact, and the opportunity for communities to hunt in neighbouring forested areas, suggests that the impact of a fire on hunting activities would be of *low significance*.

DEGRADATION OF FISHERIES

Although the Chad-Cameroon pipeline route has been adjusted to reduce the number of rivers and streams that need to be crossed (Chad Export Project, 1999b) it does nevertheless traverse a number of systems that are important for artisanal as well as commercial fishing. These rivers include the Lokoundjé, the Lom, the Sanaga, the Mbéré and their tributaries. Artisanal fisheries in the vicinity of oil spill risk sources may suffer from contamination of streams and rivers in the event of a spill. A spill could negatively affect fishing through immediate fish deaths, long-term decrease in productivity, as well as through damage to fishing equipment from oiling. In general, artisanal fishing remains a predominantly part-time activity undertaken in the dry season and supplements other sources of food and income. Inland communities are, therefore, less dependent on fishing as a source of food and income than coastal communities and will be relatively less sensitive to the impacts associated with an oil spill into a river. However, during the dry season and at times where there is a low yield in agricultural crops, fishing may play a more important role as a source of food and income. Taking these considerations into account the impact on artisanal fisheries is assessed to be of *low intensity* as it will not lead to a change in culture or livelihood of the affected communities. The spatial and temporal scale of the impact depends on the scale of the spill and the effectiveness of the oil spill response. However, the dense network of rivers and tributaries of the Sanaga and Lom rivers allow fishermen to fish in unaffected areas upstream of a spill, which reduces the immediate negative impacts of a spill on fishing activities. Overall, the impact of an oil spill on artisanal fishing is assessed to be of *intermediate significance*.

DECLINE IN SMALL-SCALE TRADING

Although an oil spill may result in a temporary reduction in fish or cultivated products being sold at local markets in the vicinity of an area affected by an oil spill, most fish and produce are for domestic consumption and only a relatively small proportion is sold at markets. This suggests that any negative impact of an oil spill on small scale trading will be of *low* to *negligible significance*.

DAMAGE TO OR DESTRUCTION OF DWELLINGS

In the event of the outbreak of a fire resulting from an oil spill, dwellings and properties of communities situated in close proximity of the incident may be damaged. The impact would be localised and although structural damage may be permanent, it is assessed that with compensation, structures can be replaced with relatively little long-term impact; i.e. following significant short-term disruption, little effect on community livelihoods and culture would persist in the long-term. The impact is, therefore, assessed to be of *low intensity* and *low significance* beyond the *short-term*.

IMPACTS ON HEALTH OF HUMANS AND LIVESTOCK

An oil spill or related fire may negatively affect the health of individuals, communities and livestock through contamination of drinking water and/or soil (where there is a pathway for exposure to such risk). Other health impacts could also result, attributable, for example, to smoke inhalation in the event of fire. Impacts would be *localised* and of *low intensity* as they would not result in a permanent change in cultural traditions and community livelihoods. Health effects may be experienced over the short or long-term depending on the severity of contamination and the period over which contamination persists. The potential for these impacts resulting in the death of individuals provides justification for rating this impact as being of *high significance*.

Table A.3.12: Summary of potential impacts of oil spills on the socio-economic and cultural environment

Impact	Intensity	Spatial scale	Temporal scale	Significance
Contamination of agricultural land	Low	Localised	Short-term	Intermediate
Decline in hunting	Low	Localised	Long-term	Low
Degradation of fisheries	Low	Localised	Medium to long-tern	Intermediate
Decline in small-scale trading	Low	Localised	Short-term	Low
Damage to or destruction of dwellings	Low	Localised	Short-term	Low
Impacts on health of humans and livestock	Low	Localised	Short to long-term	High

A.4 ORGANIZATIONAL STRUCTURES, ROLES AND RESPONSIBILITIES

A.4.1 Introduction

A predetermined organizational structure to respond to oil spill incidents is essential to ensure both a clear understanding of roles and responsibilities related to oil spill incidents and the rapid transition from reactive to proactive management of such incidents. An important element of this organizational structure is the command structure that is activated in the event of an oil spill, and the constitution of this command structure which is determined by the level of the oil spill incident; i.e. Tier 1, 2 or 3.

This section of the NOSCP outlines and illustrates the structure of the national oil spill response organization (applicable to the government, rather than the oil industry operators) for each of the three tiers of oil spill incident; it identifies the key parties constituting the structure; and it describes the roles and responsibilities of these parties.

With this organizational structure in place, and the roles and responsibilities of the governmental parties defined, this allows the oil industry operators to understand where the point-of-contact is located with regards to reporting an oil spill incident and how government coordination of, and contribution to, the response effort will proceed, particularly in the event of Tier 2 and 3 incidents.

Each oil industry operator in Cameroon is responsible for determining their own internal command structure for responding to oil spills. The description provided here indicates the linkage between these separate command structures and the national organizational and command structures.

A.4.2 Command structures

The command structures described below aim to clearly indicate the contributions that will be made by various government institutions (Ministries, the military, etc.) that have a role to play in planning and responding to oil spill incidents. It is noted that there are already certain structures in place to deal with disasters on land which divulge down from MINATD to the Provinces (Governor), the Divisions (Senior Divisional Officers) and finally Sub-Divisions. In this regard, it is recognised that a spill incident on land may first be reported to the local fire brigade or in the absence of a fire brigade and of any administrative authority, the local hierarchy of the National Gendarmerie. In the event of a Tier 1 spill, this is unlikely to present any challenges and it will be important only for the National Competent Authority to record the incident and to inspect the site for possible human health and environmental impacts. However, with regards to Tier 2 and 3 spills the need to involve the National Authorities to assist with coordination of the response to the spill incident is more apparent. In this regard, the organizational structure for Tier 2 and 3 incidents is important as represented in Figure A.4.1.

The main difference in structure applicable, for example, to Tier 2 and 3 incidents, is based on the judgement made by the *National Competent Authority* and the *National Incident Command Team* regarding the need for various authorities and institutions to be informed of an incident and, if so, what contributions are required of them in terms of responding to the incident.

Terrestrial Emergency Response Organization (Tier 1)

A.4.2.1 National Oil Spill Response Standing Committee

As indicated in the organizational diagram that follows (Figure A.4.1), the National Oil Spill Response Standing Committee (NOSR-SC) is the body designated by the Government of Cameroon as having overall responsibility for oil spill planning at the national level, defining the response policies, playing a lead role in certain oil spill response operations, investigating the causes of oil spills and the related environmental and socio-economic impacts and evaluating the effectiveness of oil spill response interventions.

The activities of the NOSR-SC are coordinated by the Ministry of Environment and Forests (MINEF) by virtue of Decree N° 2001/718/PM of 3 September 2001, which assigns to this Ministry a role for the general coordination of environmental matters such as "the prevention and management of environmental emergency situations".

There are no specific restrictions on which parties should be represented on the NOSR-SC; however, it is expected that there will be representation at least by the following parties:

- Ministry of Environment and Forests (MINEF)
- Ministry of Defense (MINDEF): National Navy and National Corps of Fire Fighters
- Ministry of Transports (MINT) - Merchant Navy and the Department of Terrestrial Transportation (Important in terms of contact with IMO)
- Ministry of Mines, Water Resources, and Power (MINMEE)
- Ministry of Territorial Administration and Decentralization (MINATD)
- Ministry of Communication (MINCOM)
- Ministry of Livestock, Fisheries, and Animal Husbandry (MINEPIA)
- Ministry of Scientific and Technical Research (MINREST)
- Ministry of Public Health (MINSANTE)
- Ministry of Justice (MINJUSTICE)
- Ministry of Finance and Budget (MINFIB)
- Secretary of Defense (SED)

- General Delegation for National Security (DGSN)
- National oil industry organizations (SNH, SCDP, and SONARA)
- Oil companies (Total E and P, Pecten, Perenco, COTCO, Phillips and others)
- National Ports Authority, the Autonomous Port of Douala and CAMRAIL
- The office of the Provincial Governors

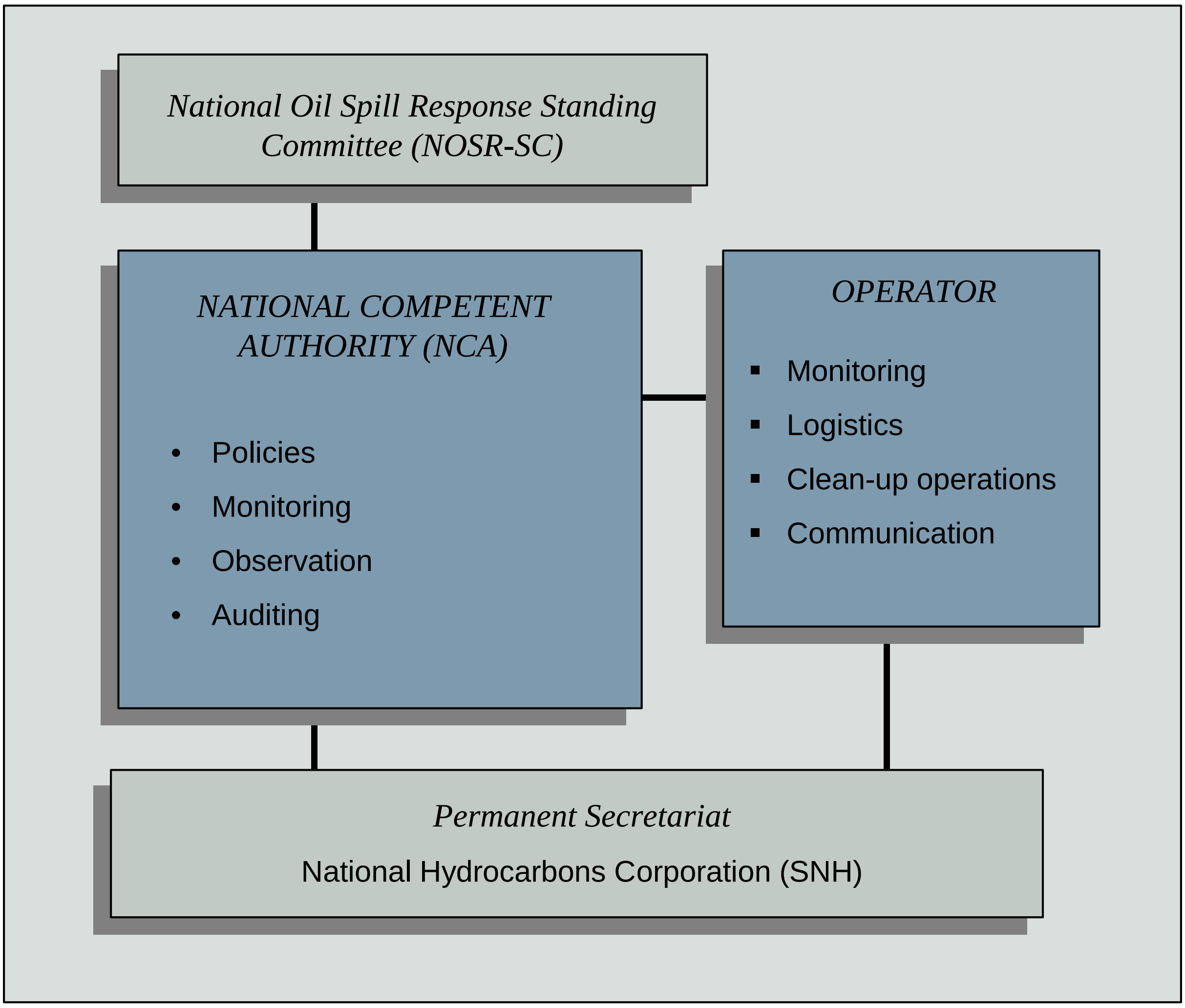


Figure A.4.1: Inland Emergency Response Organization (Tier 1)

In the case of Tier 1 oil spills (see Section A.5.1 for definition) the command structure for response activities is located within the operator's organizational structure. The operator has the responsibility for reporting spills to the National Competent Authority (discussed later in Section B, Operational Plan).

Inland Emergency Response Organization (Tier 2 and 3)

A.4.2.2 The National Crisis Committee

In case of oil spills that present a high risk of catastrophe (Tier 2 and 3 incidents), the terms of Decree N° 98/031 dated 09 March 1998, which relates to emergency planning and aid, will apply. According to this decree it is the responsibility of the competent administrative authority to direct the emergency plan (Figure A.4.2). To this effect, the competent administrative authority will:

- Make the alert
- Immediately engage emergency aid,
- Inform the hierarchy of authorities
- Mobilize the necessary human, equipment and financial resources,
- Immediately notify National Crisis Committee
- Inform the public

A.4.2.3 National Incident Command Team (NICT)

The *National Incident Command Team* (NICT) is a body comprising members drawn from the NOSR-SC, which will be constituted in the event of oil spill incidents (Tier 3, possibly Tier 2 incidents). The team will have expert representation in the field of oil spill response drawn from both the civil and military spheres of authority.

For oil spills in the inland environment, the National Corps of Fire Fighters will lead and coordinate the *National Incident Command Team*.[3] In addition to the National Corps of Fire Fighters the *National Incident Command Team* will include representation by at least the following authorities:

- National Gendarmerie (MINDEF);
- Ministry of Environment and Forests (MINEF);
- SNH (HSE Division);
- Ministry of Transport (MINT);
- Ministry of Territorial Administration and Decentralization (MINATD);
- Ministry of Communications (MINCOM); and
- Ministry of Mines, Water Resources and Power (MINMEE)

[3] Note: For oil spills in the marine environment, the National Navy substitutes the National Corps of Fire Fighters in leading and coordinating the *National Incident Command Team*.

It is the responsibility of the NICT to deploy the resources (equipment, personnel) necessary to fulfill the national mandate with respect to oil spill response, specifically concerning the following:

- Coordination of the national effort in emergency oil spill situations, communication with all affected parties, including the media and counterpart institutional structures in neighboring countries (where this may be required), monitoring of key aspects of oil spill response and clean-up activities, record-keeping (e.g. for the purpose of compensation claims), and reporting progress to the NOSR-SC; and
- Facilitation with the implementation of oil spill response operations conducted by oil industry operators, for example, by arranging immigration and customs clearance for foreign equipment and personnel commissioned to respond to Tier 3 incidents.

The roles and responsibilities of these ministries and other authorities that may be involved in oil spill response at the national level are discussed below.

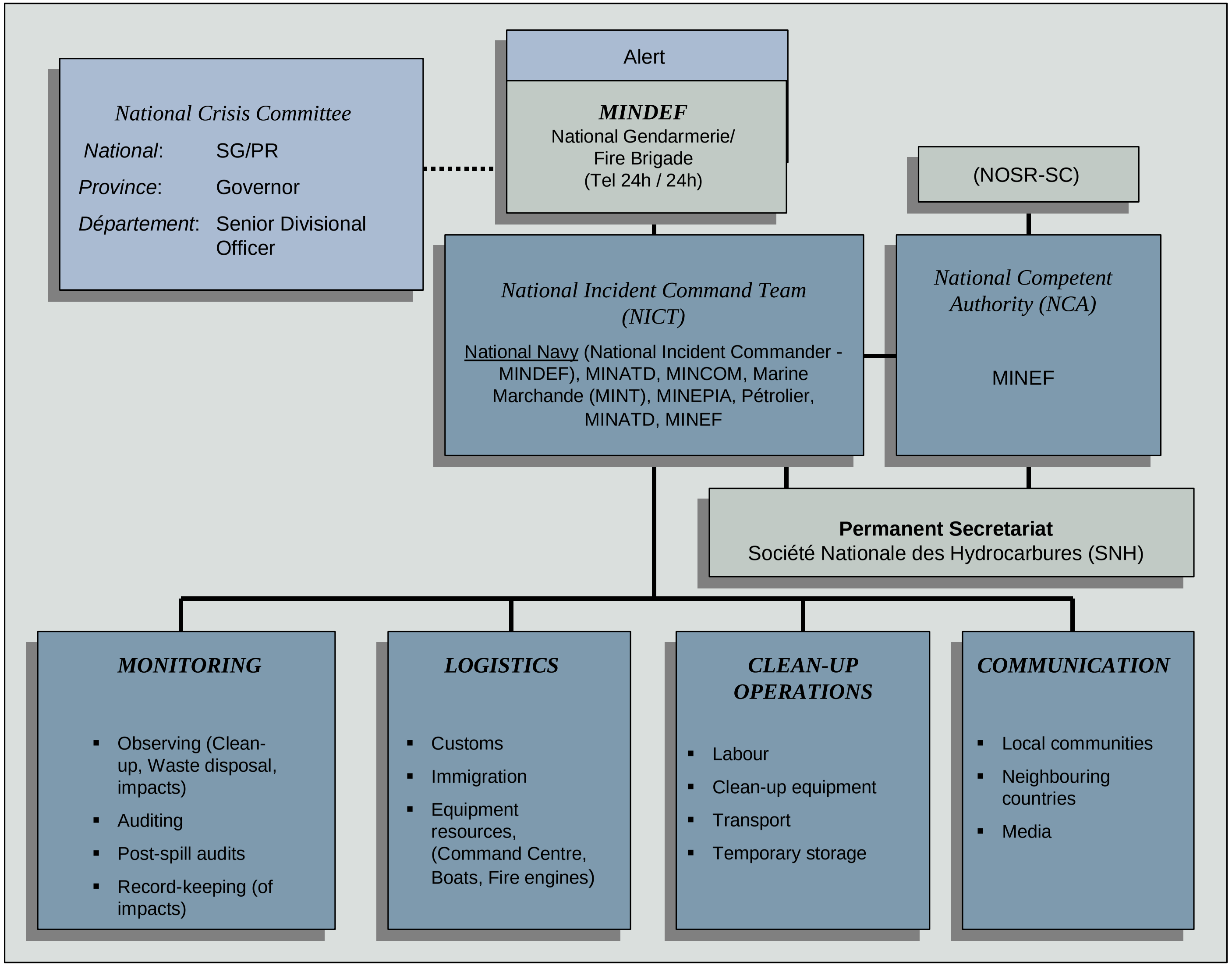


Figure A.4.2: Inland Emergency Response Team Organization (Tier 2 and 3)

A.4.3 Roles and responsibilities

Ministry of Environment and Forests (MINEF): The Ministry of Environment and Forest's main function is to coordinate the activities of the *National Oil Spill Response Standing Committee* (NOSR-SC) and, in fulfilling this function, is recognized as the *National Competent Authority* (NCA). As the NCA, the main functions of MINEF are to convene meetings of the NOSR-SC from time to time, for example to review the National Oil Spill Contingency Plan and the oil spill contingency plans drafted by the various oil industry operators. MINEF will also play a key role as a member of the *National Incident Command Team* (NICT) with the following responsibilities:

- To receive and to respond to notifications of oil spill incidents as these are reported by parties responsible for the incidents [initial Oil Spill Report, Oil Spill Report updates, final Oil Spill Report (Report No. OSR001)].
- To notify and place on the alert (if necessary), the *National Incident Command Team* in the event of receiving notification of a Tier 2 oil spill incident.
- To immediately assemble the *National Incident Command Team* in the event of receiving notification of a Tier 3 oil spill incident – if the local fire brigade or Senior Divisional Officer have not already mitigated this process.
- To coordinate the activities of monitoring certain oil spill incidents, which are undertaken by various government institutions (e.g. MINEPIA and MINREST).
- To receive and review the Oil Spill Incident Review Report (Report No. ORS002) submitted by oil industry operators.
- To approve the terms of reference of post-spill audit reports for Tier 2 and 3 incidents.
- To receive and review post-spill audit reports.
- To coordinate debriefing sessions involving the *National Oil Spill Response Standing Committee* following Tier 2 and 3 incidents.
- To record and file all reports received from operators during an oil spill incident and any other relevant information to be entered into the National Oil Spill Database, which must be established by MINEF.

***National Hydrocarbons Corporation* (SNH)**: The National Hydrocarbons Corporation (Société Nationale des Hydrocarbures, SNH) as the State's secular arm in charge of the management of the State interests in the petroleum sector is ideally placed to make a significant contribution to oil spill preparedness and response at the national level. Important in this regard, are the direct links that SNH has with the activities of essentially all participants in the hydrocarbons sector, typically through partnership and shareholder affiliations. All upstream operators in sector are required to systematically provide up-to-date industry data to SNH, which places the organization in a well-informed position regarding the sector. Thus, SNH will always be one of the first institutions to be alerted, as a matter of course, in the event of oil spills.

Given its well-informed position with regard to the hydrocarbon sector and the resources to which it has access, SNH through its Health, Safety and Environment (HSE) Division will act as the permanent secretariat for the *National Competent Authority* (NCA), the *National Oil Spill Response Standing Committee* (NOSR-SC) and the *National Incident Command Team* (NICT). In this regard, the organization will assume the following responsibilities:

- Assist the NCA in updating of the National Oil Spill Database, making available to the NCA all information it receives regarding oil spills (Database to reside within SNH offices);
- Assist the NCA in assembling the NICT in the event of Tier 3 (possibly some Tier 2) oil spill incidents;
- Assist the NCA to monitor all activities related to oil spills that are undertaken by technical ministries such as MINMEE, MINT, MINEPIA and MINREST;
- Assist the NCA in responding to all notifications of oil spill incidents that are reported to the NCA by the parties responsible for the incidents;
- Assist the NCA with the review of the Oil Spill Reports that are submitted by oil operators – including the review of both the terms of reference for post-spill audits, in the case of Tier 2 and 3 incidents, and the audit reports that are submitted;
- Where required, recommend to the NCA the establishment of appropriate technical sub committees to address issues pertaining to oil spill incidents (monitoring, report reviews, etc.);
- In collaboration with the oil industry operators, prepare the terms of reference for post–spill audits (Tier 2 and 3 incidents);
- Provide communications material to the NCA and NICT required for public debriefing sessions;
- Ensure that the NOSCP strategy is incorporated into the oil spill response plans of oil industry operators (including those of parastatal organizations);
- Ensure that operators have appropriate equipment available and hold sufficient stocks of consumables for responding to oil spills - for which they may be responsible - and to keep all parties (other operators, the NCA) updated with regard to their inventories;
- Foster the establishment of formal agreements between oil operators in Cameroon with regard to collaboration in responding to Tier 2 and 3 incidents;
- Assist the NCA in developing a capacity building plan for all role players involved in the implementation of the NOSCP;
- Organize, under the authority of the NCA, desk-top exercises conducted to evaluate the effectiveness of the NOSCP with regard to communication between, and the response preparedness of, all key role players.

Ministry of Defence (**MINDEF**): The two key administrations within this Ministry include the *National Navy* and the *National Corps of Fire Fighters*. Apart from being members of the *National Oil Spill Response Standing Committee*, these two administrations will play a key lead role as *Incident Commanders* of the *National Incident Command Team* for marine and inland spills respectively. As previously stated, for oil spills in the marine environment, the National Navy will lead and coordinate the *National Incident Command Team* by virtue of Presidential Decree N° 36 of February 4, 2002, which grants the Navy the power to commandeer and mobilize civil and military forces as well as maritime equipment. For oil spills on land, the National Fire Fighting Corps substitutes the National Navy to lead and coordinate the *National Incident Command Team*.

As *Incident Commanders,* the National Navy and the National Corps of Fire Fighters will have the following responsibilities for marine and inland oil spill incidents respectively:

- To coordinate the activities of the *National Incident Command Team*.
- In emergency situations (probably only Tier 3 incidents), to set up a *National Incident Command Centre*, which should be equipped with all of the NOSCP documentation and necessary communications equipment.
- To coordinate customs and immigration clearance for foreign nationals and equipment, imported to assist with the response to Tier 3 incidents, through liaison with the relevant authorities.
- To make available appropriate equipment, such as fire engines and other emergency response equipment and personnel. Where necessary, the oil spill response activities of the National Corps of Fire Fighters will be centred at a fire station located closest to the oil spill incident.
- If required, to participate in the incident debriefing sessions once the emergency response and clean-up actions have been terminated.

Ministry of Territorial Administration and Decentralization (**MINATD**): MINATD is in a position to coordinate clean-up actions through liaison with the offices of the Provincial Governors. By virtue of Law N° 86/016 of 6 December 1986, relating to the organization of civil protection, and Decree N° 98/031 of 9 March 1998, relating to emergency plans for crisis situations, MINATD is best suited to coordinate the logistics and mobilization of resources required for oil spill clean-up, including labour, transport, minor equipment (shovels, buckets, etc.) and temporary waste storage facilities - through the offices of the Provincial Governors and Senior Divisional Officers. Communication with affected communities will be the responsibility of MINATD, also through in liaison with the offices of the Govenors and Senior Divisional Officers.

Ministry of Communication (**MINCOM):** By virtue of the Ministry's statutory mandate, MICOM's main function is to coordinate all Government communication with third parties (excluding local communities) during a spill incident. This will entail communication with the following groups:

- The general public
- Neighboring countries
- The media

Communication initiatives should also involve the National Communication Commission (NCC), which should assist MINATD in disseminating reliable and consistent information. The NCC comprises the Director of Public Communication, the Provincial Delegates for Communication, and the Chiefs of the Communication Units at the ministries represented on *National Oil Spill Response Standing Committee*.

Ministry of Mines, Water Resources, and Power **(MINMEE):** An important function of MINMEE is to ensure that all oil industry operators have in place an Oil Spill Response Plan, which must be submitted for approval by the *National Oil Spill Response Standing Committee* on which MINMEE is represented. MINMEE is also likely to be included in any monitoring activities initiated during and post il spill to observe the response and clean-up actions that are undertaken.

Ministry of Justice **(MINJUSTICE):** The main function of this authority is to assist with the formalization of claims for compensation that may be submitted, for example, in accordance with the provisions of the Civil Liability Convention and the Fund Convention.

Ministry of Finance and Budget **(MINFIB):** The Customs Department, which falls under MINFIB, will play a critical role in the event that oil spill response equipment is commissioned from international sources to respond to a Tier 3 oil spill incident. The Customs authorities will need to assist with prompt temporary importation clearance in this situation. MINFIB will also be responsible for tracking the costs of deploying Government personnel and resources to assist with oil spill response and clean-up actions.

General Delegation for National Security **(DGSN):** Similar to the function of the Customs authorities, the DGSN will be required to process immediate immigration clearances for foreign nationals who are commissioned to assist with Tier 3 incidents. This role is defined as per Decree N° 298/2000 of 12 October 2000, promulgating the law regulating the entry to Cameroon, residence and exit of foreign nationals.

Ministry of Transports **(MINT):** In the event of an inland spill reaching the marine environment, the Merchant Navy may be required to assist the National Navy with the provision of vessels and other equipment required to respond to oil spills. The Department of Terrestrial Transportation may assist MINATD with the logistical aspects of moving clean-up equipment to areas where it is required.

Ministry of Livestock, Fisheries, and Animal Husbandry **(MINEPIA):** MINEPIA's main contribution is to liaise with the industrial and artisanal fishing sectors in the event of oil spills and to monitor and assess the associated impacts. This should be undertaken in collaboration with MINEF and MINREST (see below).

***Ministry of Scientific and Technical Research* (MINREST):** MINREST's main function is to assist MINEF and MINEPIA with the research on marine pollution, and seafood quality.

***Secretary of Defence* (SED):** SED's responsibility is to ensure the readiness of the corps of gendarmes to respond to in-land oil spills in cases where there is no local Fire-Fighting Brigade. Charge shall be taken of the situation until representatives from the National Corps of Fire Fighters are available to take over this function.

***Ministry of Public Health* (MINSANTE):** MINSANTE will help with the identification of health hazards associated with pollution.

***National Oil Industry Organizations* (SNH, SCDP, and SONARA):** The main task of these institutions will be to provide expert input on oil-related issues.

***Oil companies* (Total E and P, Pecten, Perenco, COTCO, Phillips and others):** In terms of their operating licenses, oil companies are required to maintain adequate stocks of equipment and materials and to have in place Oil Spill Response Plans to deal with oil spill incidents arising from their operations. In this regard, they are a key resource for responding to oil spills under a variety of situations and are in the position to provide expert advice and assistance to the Government of Cameroon in the event of incidents where the party responsible for the oil spill does not have the capability to respond (e.g. in the event of a shipping incident).

***Others parties* (e.g. CAMRAIL)**: Institutions that can be called upon to assist in various ways in dealing with oil spill incidents.

A.5 OIL SPILL RESPONSE STRATEGIES

A.5.1 Philosophy and objectives of oil spill response

The prime objective of any oil spill response strategy is to minimise damage to environmental and socio-economic resources in the area of the spill. This is done by selecting the response options that are best suited to the particular set of circumstances prevailing at the time of the spill. The purpose of any oil spill contingency plan is to decide upon as many of the required actions as possible before the time of the spill. This information is then available in advance of an oil spill, which facilitates rapid decision-making when an incident does arise, and avoids delays in response that could lead to increased environmental damage.

The potential or actual intensity and significance of oil spill impacts affecting the natural environment and socio-economic resources exposed to risk is dependent on a variety of factors. These include the volume of oil spilled, the type of product, the sensitivity of the receiving environment in which the impacts of the spill will manifest, the spatial extent of the area contaminated, the weather conditions at the time of the spill, etc. A number of different techniques and methodologies are available to clean up oil that is spilled within Cameroon's hinterland, whether the spill occurs onland or into freshwater bodies (wetlands, rivers). No single technique or methodology is suitable for application under all circumstances and it is, therefore necessary, to consider a number of options, given the availability of equipment and other resources, to cover the circumstances that might prevail. The various techniques and methodologies, as they pertain to the situation in Cameroon, are discussed in detail in Section A.5.2.

A three-tiered oil spill response approach has been developed, which is generally adopted worldwide, in order to structure oil spill response activities relating to a marine oil spill. This permits the response strategy to be escalated as a spill incident may increase in magnitude and/or expose environments to increasing risk. This system is adapted here to address response operations onland and in freshwater environments. The approach allows for easier identification of resources required to address spills of different magnitudes:

- ***Tier 1: Small localised spills***. This covers small spills that are unlikely to have a significant impact on environmental or socio-economic resources and which can be cleaned up with resources and equipment at, or in the vicinity of, the spill site. This type of spill would include, for example, small fuel spills from vehicles, whether on land or in a river, and road or rail fuel tanker accidents resulting in the release of small quantities of fuel.

- ***Tier 2: Medium sized spills with the potential to result in impacts of intermediate (or greater) significance.*** Tier 2 spills usually involve a greater volume of oil than Tier 1 spills and have the potential for giving rise to impacts on the natural and/or socio-economic environment of intermediate to high significance. The clean-up resources and equipment in the vicinity of the spill site are unlikely to be adequate to effectively respond to the spill and would need to be supplemented with materials and equipment sourced from elsewhere. This type of spill would include, for example, a road fuel tanker plunging from a bridge into a river and loosing the majority of its cargo, or a release of oil at a river crossing of the Chad-Cameroon pipeline. A Tier 2 incident, in the context of the examples given here, would not give rise to environmental impacts of catastrophic proportions.

- ***Tier 3: Major spill that exceeds national capacity to respond.*** A Tier 3 incident involves a spill of major proportions, where the oil spill response resources available in the country are inadequate to effectively respond to the situation. This type of spill would be expected to have a significant impact on the environmental and socio-economic resources of Cameroon. Additional resources and equipment would need to be brought into the country from established international oil industry response bases. This type of spill might emanate from a major pipeline rupture resulting in the release of significant quantities of persistent oil into, for example, an important river system.

The general criterion for selecting the most suitable response option under the prevailing circumstances is that the response actions should not be more damaging to the environment or the socio-economic resources than would be the case if the oil was left to natural breakdown. In selecting the most appropriate response option, the option that has the greatest chance of success in removing the oil with the least overall impact on the environment, within reasonable cost restraints, needs to be selected. A "net environmental benefit analysis" (NEBA), as described by IPIECA (2000), needs to be undertaken to identify the most suitable options.

A.5.2 Oil spill response strategies applicable to Cameroon

This section briefly describes the different response options available for responding to oil pollution both on land and in surface water systems, such as rivers. Those options that have an application in Cameroon are described in more detail, and arguments are presented for those options that are not considered to be appropriate.

A.5.2.1 Oil spill response in rivers

The prime goal for the response to oil spills in rivers is to limit the movement of the oil downstream and hence the extent of river impacted by a spill from a particular source; i.e. the aim is to intervene as quickly as possible, thereby preventing the contamination of extensive downstream reaches of the river where the natural environment and local communities would be exposed to the risks of oiling. This is best achieved by attempting to contain and recover the oil as close to the source as possible.

Intervention in the form of containment is more relevant to cases where persistent oil, such as crude oil, is spilled. Lighter oils, such as diesel and petrol, will evaporate and disperse more easily and will not spread for great distances downstream, and such spills do not, therefore, call for the same degree of intervention as for spills of persistent oils.

Many of the rivers in Cameroon are wide and fast flowing. During the rainy seasons, the river flows and water levels are at their highest, making it virtually impossible to contain any oil. However, the water turbulence is typically high in such situations, which enhances the natural dispersion of the oil. The oil is also less likely to stick to the vegetation and accumulate in localised, calm areas under these conditions.

A.5.2.1.1 Surveillance (track and monitor)

Should oil enter a river system, it is essential that its movement, fate and behaviour are closely monitored. This is to ensure that appropriate remedial action is timeously initiated if there is a threat to sensitive resources situated within the path of the oil as it flows downriver. It is particularly important to track the position of the oil to determine its location in relation to communities making use of the river water for domestic purposes, fishing, etc. These communities need to be warned of the approaching oil and must be advised of the risk that it poses to human health and what actions should be taken in terms of impact avoidance.

It is also necessary to undertake environmental monitoring (collection of water samples and monitoring of indicators of water quality) to support any claims for compensation for impacts suffered by the local communities that might be lodged in future.

A.5.2.1.2 Containment

Different types of floating booms can be used in rivers to contain oil and stop it from proceeding downstream, thereby protecting (to the maximum extent possible) sensitive environments. Such booms either concentrate the oil in calm areas, from where it can be removed using skimmers or sorbents, or deflect the product to less sensitive areas from where it can be collected and removed. The conditions for booming in rivers differ markedly from those in the marine environment, in particular with respect to water flow. Certain types of boom have been designed for specific use in rivers to cater for higher current speeds through the addition of tension cabling on the top of the boom, which provides the structure with greater stability in high-flow conditions. This enables the boom to contain oil in current speeds up to three times greater than is possible using booms designed for marine conditions (for marine conditions the incident velocity of the water current perpendicular to the boom should be less than 0.3 m/sec for effective containment of oil). Wherever possible, purpose-built types of booms should be used in river situations.

Specific types of boom are also available to create a seal across the shore and nearshore river bottom when the boom is laid out from a gently sloping riverbank. The top half of the boom is filled with air for buoyancy, whilst a bottom chamber contains water, which creates the seal against the river bottom in shallow water. These types of boom are particularly effective in areas where there is tidal variation in water level.

Where booms are not commercially available, booms constructed from materials of opportunity can be also be used for the same purpose. This can include the use of logs to divert the oil in desired directions – a method that works effectively only under low flow conditions, since the logs have no underwater skirt to improve containment effectiveness. Floating sorbent-type booms can also be constructed from materials such as dry grass or wood chips contained in lengths of rolled wire or nylon mesh.

In narrow, low-flow streams, containment dams or barriers can be constructed using earth or other materials to prevent spilled oil from moving downstream. Here, it is necessary to install siphon or flow pipes at a level below the crest of the dam structure so as not to interrupt water flow and/or to avoid overtopping and spillage of the contained oil.

Effective containment of oil in the majority of rivers in Cameroon can be expected to be difficult due to the size of the rivers and the high flow conditions, particularly during the rainy season. The inaccessibility and presence of dense vegetation along the majority of river banks also makes response actions problematic in Cameroon's riparian environment. It is, therefore, necessary that trained personnel with experience in river booming techniques be used when this response option is considered.

Under high flow conditions, it is not considered feasible to attempt to contain light oils, such as petrol and diesel, as these will evaporate and disperse rapidly. Consideration should only be given to the containment of heavy fuel and crude oils.

A.5.2.1.3 Recovery of oil

Once persistent oil has been contained on the water surface or diverted to a calm water environment it must be collected and removed as soon as possible. A number of techniques are available for this purpose, including:

- Skimming the floating oil off the water surface using various types of skimmers, such as rope mop, weir, disc, barrel or brush skimmers;
- Use of sorbents to absorb the oil when it is present in smaller quantities. These sorbents may be in the form of loose fibres or fibres contained in porous booms or pillows. Re-usable synthetic material, such as expanded polypropylene, sheets or pads may also be used; and
- Various types of pumps, or a vacuum tanker, to remove oil collected against the river banks.

A.5.2.1.4 Temporary storage

Once oil has been collected in the manner described above, it is essential that proper storage methods are used to prevent further contamination of the environment, particularly groundwater resources.

In many cases, it will not be possible for the oil to be removed for final disposal immediately. Here, temporary storage facilities, close to the area of collection, will need to be established. These may take the form of barges or floating storage tanks on the river – although in many cases this will not be feasible due to high flow conditions. Another option is to establish temporary waste storage facilities on land. These can include commercially available frame-based or inflatable portable tanks and bladders, 200 litre drums, tank trucks or excavated areas lined with plastic materials. In all cases, care must be taken to avoid further contamination of the environment during handling and temporary storage of the oil.

A.5.2.1.5 Burning

In certain circumstances *in situ* burning of oil on the water surface of rivers has been recommended. However, in the case of the rivers of Cameroon, this is not considered to be a feasible option for the following reasons:

- Only persistent oils would be considered for burning. The main potential risk of spillage of a persistent oil is the crude oil transported in the COTCO pipeline. This is a heavy oil and is not easy to ignite when spread on a water surface;
- Fire hazard. Many of the river banks are heavily vegetated down to the water's edge or have tree branches overhanging the river. Under the variable flow conditions of the rivers, oil may escape the intended burn site and present a significant hazard downstream;
- As a result of incomplete combustion of crude oils, heavy, tarry residues may be formed, which can sink to the bottom of the river making collection virtually impossible, thereby creating a persistent source of pollution;
- Incomplete combustion of heavy oils also results in large clouds of black carbonaceous smoke, which can contaminate surrounding areas; and
- Fire resistant booms for the containment of burning oil are not available in Cameroon.

The *in situ* burning of persistent oils in river environments in Cameroon should be avoided.

A.5.2.2 Oil spill response onland

Oil spills on land can happen under a variety of circumstances (e.g. large or small spills, spills of various products, etc.) and in different environments (e.g. steeply sloping or flat terrain, porous or impermeable soils, in the proximity of potable groundwater resources that are used by local communities, etc). Response to a spill of light oil resulting from a road tanker accident in an urban situation will differ significantly from a major spill of crude oil from the rupture of the Chad-Cameroon pipeline in a rural terrestrial situation. Due to the high diversity of circumstances and response approaches, not all of these can be covered in detail and only some generic approaches will be addressed to give overall guidance.

A.5.2.2.1 Containment and recovery of free product

The first priority in any spill situation is to stop the source of the leak and to minimise any threat of fire or explosion, ensuring the safety of people in the area. Clearly the advance creation of an awareness of the hazards of oil spills to humans and on-site communication in the event of a spill is important in this regard. It is then necessary to rapidly contain the spilled oil to prevent it spreading and resulting in extensive contamination. Sensitive resources such as ground or surface water, agricultural land and drainage courses need to be identified as soon as possible so that the containment strategy can take their priority protection into account. Once this has been done, any of the following techniques for containing the oil can be employed:

- blocking of drains using plastic bags filled with sand to prevent oil from entering drainage systems;
- construction of barriers using either soil or sand bags within open drains should attempts to prevent the entry of oil into the drains fail;
- construction of an earth barrier around or down-gradient of the spill, either manually or using mechanical equipment;
- creation of diversion channels to areas for easy collection of the spilled oil;
- excavating trenches to stop the flow of the spill and to facilitate easy collection. These should be lined with plastic material where possible; and
- placement of sorbent barriers around small spills.

The above approaches do not require dedicated oil spill response equipment, but the use of materials and equipment that is commonly available on construction sites, maintenance yards, etc. Due to the diversity of possible scenarios, it has to be left to the resourcefulness and ingenuity of the person in charge of the response activities to devise a site-specific method for achieving the above.

Once the spilled oil has been contained, a suitable collection technique must be employed to recover the product for removal to either temporary storage or final disposal. This may include:

- pumping;
- vacuum tanks;
- skimming;
- manual collection; and
- sorbent materials (both commercial products or materials of opportunity, such as dry grass) for small quantities of oil.

A.5.2.2.2 Treatment of contaminated soil

Once spilled free product has been contained and recovered, contaminated soil will usually remain, which could pose a threat to human health, groundwater and other environmental resources. This contaminated material could be physically removed, if in a sensitive area, and dumped at a site where it will either not pose a significant threat to the environment or it can be effectively treated or landfarmed. It is, however, preferable wherever possible, to treat the contaminated soil *in situ* in order to avoid high costs and other problems associated with transporting contaminated soils for treatment offsite.

The approach for stimulating biodegradation of contaminated material, whether *in situ* or off site, is basically the same. Biodegradation involves the breakdown of the oil by either natural or introduced micro-organisms under enhanced conditions. Expert advice should be sought in establishing a landfarm. Certain basic principles do, however, apply:

- Where an offsite location for landfarming is selected, the risk that there could be leaching and contamination of groundwater resources must be avoided. This can be done either by selecting a site where non-porous soils are present or by lining the landfarming area with an impervious material such as an HDPE liner. An open, flat area is required;
- In most cases, unless rapid degradation is required, it is unnecessary to introduce foreign bacterial or fungal strains. If foreign strains are to be introduced, this must be done under expert advice;
- The soil should not be saturated with oil. If it is, fresh soil should be added to reduce the oil to soil ratio. Free oil should not emerge when the contaminated soil is squeezed by hand;
- In its simplest form, landfarming involves the stimulation of naturally-occurring micro-organisms to degrade the oil. To do this, the bacteria require a nutrient to initiate the process. This can take the form of the addition of one handful of mono-ammonium phosphate to one cubic metre of contaminated material. The bacteria require moisture and oxygen to function optimally. It is, therefore, necessary to keep the soil moist, which in most cases, will be achieved naturally through local precipitation and naturally high humidity levels. The contaminated material should be laid out to a thickness of no more than 0.4 m. This allows for it to be rotovated periodically to maintain sufficient oxygen levels. Where the contaminated zone is deeper than this, for example, where the treatment is undertaken *in situ*, slotted pipes may be installed to introduce air into the contaminated soil. The pH of the soil should be maintained between 6.5 and 7.5 and adjusted through the addition of lime, if necessary;
- A more sophisticated approach may be adopted if the rate of biodegradation needs to be optimised;
- Monitoring of the hydrocarbon levels should be conducted to determine when the weathering end-point has been reached.

A.5.2.2.3 Monitoring

In certain cases where oil is spilled on land, it may be preferable that no action, other than monitoring, is undertaken. This is often the case where the contamination poses no threat to human health or sensitive components of the environment; i.e. there are no receptors immediately exposed to risk (humans or sensitive ecosystems) and/or pathways (e.g. groundwater flow) through which such receptors could be exposed to risk. In this situation, where there is no urgency to remove the source of contamination, it may be left to biodegrade or break down through natural processes without any further action, other than monitoring.

A.5.2.2.4 Remediation of contaminated groundwater

As described previously, the vulnerability of the country's ground water resources varies depending upon the aquifer characteristics, but is generally high. However, ecosystems are not necessarily sustained by groundwater and it is not exploited throughout the country as a potable resource (e.g. where there is surface water in abundance). At the time of the spill it is necessary to identify the risks posed to any groundwater resources that may be used for human consumption, agricultural irrigation, etc. If a potential for contamination does exist, expert advice should be sought from a geohydrologist in order to conduct an assessment of the contamination risk and to design a suitable remediation strategy. This is a skilled activity and should only be carried out under expert supervision. Inappropriate actions can lead to an exacerbation of the problem with larger areas and volumes of groundwater ultimately becoming contaminated. Often, natural remediation proceeds within groundwater systems without intervention.

A.5.2.2.5 Waste disposal

A key concern regarding the disposal of oily waste is the potential for human health risks to materialise, for example, through hydrocarbon contamination of ground and surface water resources.

Quantities of oily waste (other than contaminated soil) may be collected during both land-based and river clean-up operations. Such material might include oiled sorbents and oiled vegetation. Dedicated public hazardous waste disposal sites are not available in Cameroon for use in the disposal of large quantities of oily wastes. Decisions regarding the final disposal of oily waste collected as a result of a land-based spill must, therefore, take the prevailing situation into account. Authorities such as MINMEE and MINEF, as well as local authorities, need to be part of this decision-making process. Importantly, expert advice must be sought on a case-by-case basis in order to avoid impacts attributable, for example, to secondary environmental contamination.

It can be expected that smaller quantities of oily waste (other than oil-contaminated soils) will be collected during land-based spill clean-up operations than would be the case in major marine-based oil spill clean-up operations. In this situation, the following disposal methods could be considered:

- Landfarming: Some oiled materials may be added to the contaminated soils that are undergoing bioremediation at sites established for their clean-up;
- Co-disposal with municipal wastes: Large established municipal waste sites are not readily available in Cameroon. However, localised informal sites are used to collect and burn municipal waste. These sites could also be used for dealing with very small quantities of, and unsaturated, oily wastes; and
- Burning: The direct burning of larger quantities of uncontained oily debris is not recommended except in remote areas, since it usually causes atmospheric pollution. However, these problems can be overcome through the use of a suitable incinerator. Portable incinerators, such as rotary kilns and open-hearth types are most suitable. Incineration using this type of equipment, if portable units can be brought to site, is considered to be a feasible disposal option for application in Cameroon.

Three commercial oil treatment facilities are based in Douala, which could be used for treating quantities of contaminated liquid oil.

A.5.3 Framework for decision-making, underpinned by NEBA/RBCA

As with any other emergency plan, an oil spill contingency plan needs to attempt to identify as many appropriate courses of action as possible prior to an incident so as to avoid loss of time involved in decision-making under a crisis situation. However, certain decisions concerning appropriate courses of response action can only be taken once all the prevailing circumstances are taken into account at the time of the incident. These include size and duration of spill, environmental conditions at the time, limitations of response under these conditions, movement of spilled oil, etc. In this decision-making process, the principles of "net environmental benefit analysis" need to be taken into account to ensure that the potential environmental consequences of different actions – including no action - are properly taken into account in the formulation of the decision.

A.5.4 Conclusions and Recommendations

Containing and cleaningup oil spills that might affect Cameroon's hinterland (terrestrial and fluvial environments) is not a process that is established to the same extent as response operations within the marine and coastal environment. In particular, the process is complicated by the diversity of site-specific environmental conditions in which spills might occur (certainly more diverse than marine environmental conditions), which are attributable to the following:

- Diverse topography, geology and soils, climate and ecosystems;
- High overall precipitation, with run-off typically directed into large, fast-flowing river systems and aquifers; i.e. a complex and dynamic component of the receiving environment;
- Remoteness and inaccessibility of large portions of the country, leading to difficulties in responding to spills that move into these areas through river flow;
- Lack of formal disposal facilities; and
- Lack of resources in many areas.

It will, therefore, be necessary to largely improvise response strategies according to the specific circumstances surrounding the incident at the time, based on the principles pertaining to response strategies described above. Expert advice should be sought when technically complex oil spill response interventions are required, such as landfarming and groundwater remediation operations. At all times it is necessary to employ the "net environmental benefit analysis" philosophy to ensure that greater harm is not caused by inappropriate actions that may have a more detrimental effect than would be the case if no action were taken.

A.6 OIL SPILL RESPONSE RESOURCE INVENTORY AND COLLABORATION AGREEMENTS

The offshore oil production and refinery industry in Cameroon owns a certain amount of dedicated oil spill response equipment for combating oil spills at sea (see Section A.6 of the Marine and Coastal section of this report). A certain amount of this equipment is also suitable for use in rivers and is listed in Section C.2 of the Data Directory. The largest body of dedicated oil spill response equipment suitable for use in the country's hinterland, is owned and operated by COTCO for the purpose of responding to oil spills emanating as a result of a failure of the Chad-Cameroon crude oil pipeline. At present, no formal agreements or arrangements have been established for the use of this equipment by parties other than COTCO.

In the majority of oil spill incidents, non-dedicated equipment can be used for oil spill clean–up, such as shovels and spades, and mechanical earth-moving equipment, which is held, for example, by civil contractors and local authorities and can be accessed by arrangement with local Senior Divisional Officers in the various provinces. Of importance in this regard will be the effectiveness of the organizational structure and understanding of the roles and responsibilities of different parties, as described in Section A.4.

A.6.1 Existing equipment

A list of existing equipment known to be currently located in Cameroon is contained in Section C.2 of the Data Directory. In the course of revision of the NOSCP, this list must be updated on the basis of information supplied by the various operators.

A.7 COMMUNICATIONS AND LOGISTICS

A.7.1 Framework for communication

Effective and efficient communication is central to a rapid response to oil spill emergencies and the minimisation of damage to the natural and social environment. Two main forms of communication need to be employed at the time of a spill. Firstly, communication procedures must be initiated by the operator (or party responsible for the oil spill) in order to initiate immediate and ongoing emergency response operations; secondly, communication must be initiated with the National Competent Authority to other parties, who may need to become involved with (or who may be affected by) a spill following the initial emergency response being implemented.

The National Competent Authority is responsible for co-ordinating communication via The National Incident Command Team with all involved Government authorities, organizations, affected local communities and, potentially, the neighbouring countries in the event of a spill being reported. The level of communication will vary according to the type and scale of the incident. The framework within which communication is conducted is illustrated in Figure A.7.1.

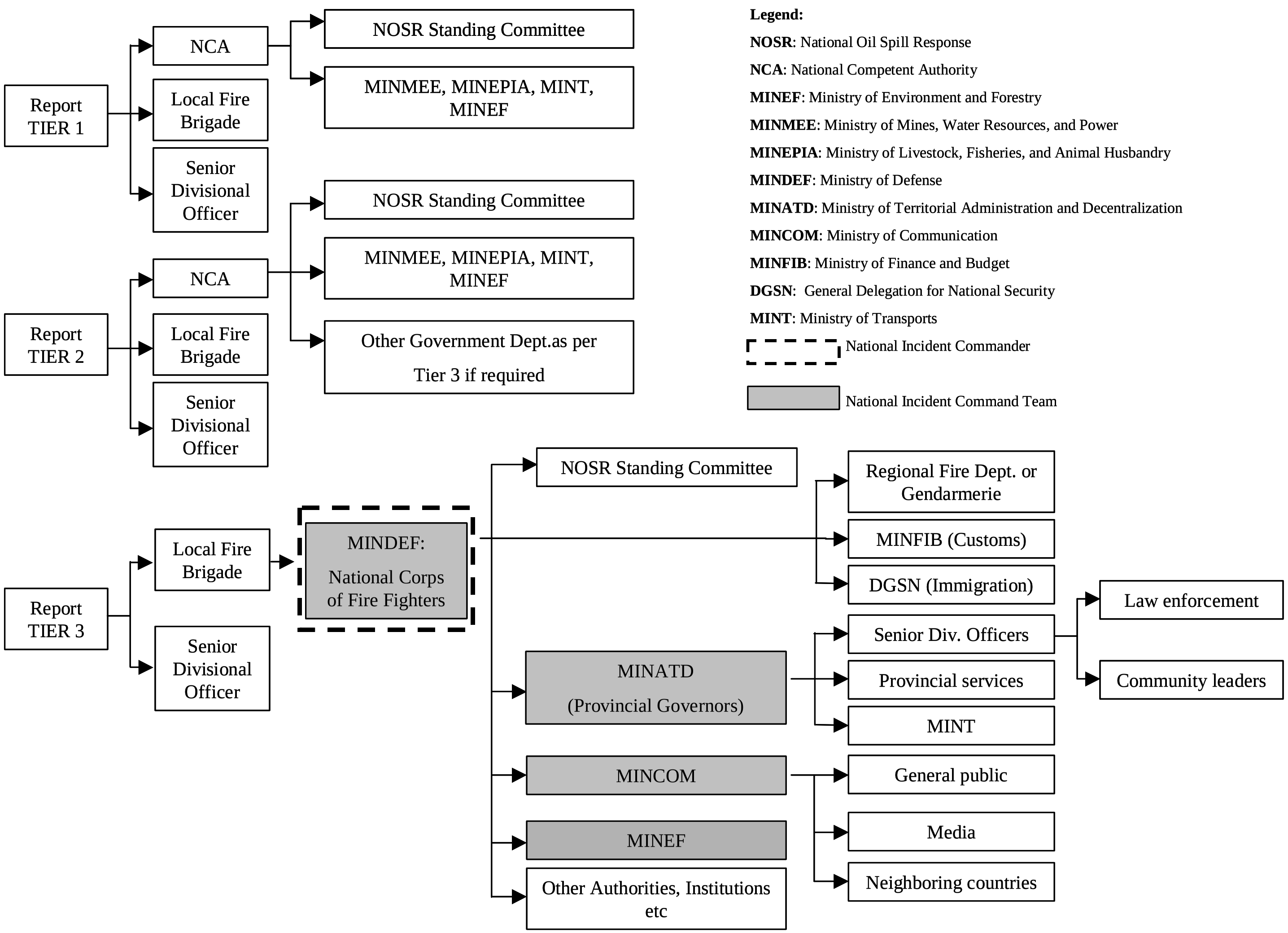
In the event of a Tier 1 or 2 oil spill incident, an operator is responsible for internal communications for the purpose of implementing the organization's oil spill response plan, which includes communication with the National Competent Authority. Such communication will be co-ordinated from the Operator's *Command Centre* and will include communication with the offices of the National Competent Authority.

In the event of a Tier 3 oil spill incident, an operator will immediately communicate with the offices of the National Competent Authority. Thereafter, further communication will be undertaken with the identified *National Incident Commander* who will put into operation the *National Command Centre* within the National Corps of Fire Fighters (Yaoundé).

A.7.2 National command and control

Command and control centres function as communications hubs through, and around, which information flows and technical and logistical support can be co-ordinated. The National Corps of Fire Fighters in Yaoundé will be used as a 24-hour facility for co-ordinating the response activities surrounding a Tier 3 oil spill incident, if the need arises. Communications with the operator (or party responsible for the oil spill) will take place through the operator's *Command Centre.* Communication with provincial and local authorities (who may be affected by and become involved in coordinating coastal clean-up operations) and with public bodies, such as the police and gendarmeric will be conducted from the *National Command Centre*.

NOSCP Cameroon: Communication Network for Inland Oil Spills Response



Legend:

NOSR: National Oil Spill Response
NCA: National Competent Authority
MINEF: Ministry of Environment and Forestry
MINMEE: Ministry of Mines, Water Resources, and Power
MINEPIA: Ministry of Livestock, Fisheries, and Animal Husbandry
MINDEF: Ministry of Defense
MINATD: Ministry of Territorial Administration and Decentralization
MINCOM: Ministry of Communication
MINFIB: Ministry of Finance and Budget
DGSN: General Delegation for National Security
MINT: Ministry of Transports
(dashed box) National Incident Commander
(grey box) National Incident Command Team

PNLDAH

Figure A.7.1: Framework for communication between the National Competent Authority and other involved or affected parties

A.7.3 Communications involving local communities

As described in the section dealing with communication around oil spills affecting the marine and coastal environment, the importance of developing an effective strategy for communicating with local communities is illustrated by a recent disaster involving a road tanker accident in Cameroon. This incident resulted in the loss of human life and damage to property, which was avoidable. Two factors explain why this tragedy occurred, and highlight what needs to be done in the way of developing a communication strategy in order to prevent such incidents in future. Firstly, villagers are not sensitized to the health and safety risks posed by oil spills and cannot immediately anticipate what action should be taken in the event of emergency situations. Secondly, the choice of *language* in which communication is conducted in advance, and at the time, of an incident limits the extent to which hazardous situations are understood by local communities.

In the case of an inland oil spill, particularly a spill into a river, it is vital that communities that might be affected by the spill (i.e. communities living downstream of the spill site) should be informed of the health and safety implications of the spill so that impact avoidance measures can be instituted. Many communities live in remote regions of the country where communications can be difficult, and the role of the local authority in facilitating such communication, specifically the office of the Senior Divisional Officer in whose area of jurisdiction the communities are resident, is very important.

Clearly, the issues of advanced community awareness and preparedness regarding oil spill risk is a priority to be addressed in the implementation phase of the NOSCP, in particular with respect to immediate measures to be taken prior to expert intervention in an emergency situation. These issues have also emerged in the form of public opinion regarding the Chad-Cameroon pipeline project, which emphasizes the need for creating a general awareness amongst local communities regarding oil spill risks and, more specifically, the need for communication strategies to be implemented to empower local communities to protect themselves from such risks.

A.7.4 Communications equipment

As a minimum, the *National Command Centre* should be equipped with the communications equipment identified in Table A.7.1 to ensure that communications can be maintained with the command centres of the operators, the provincial and local authorities and public bodies, such as the police and the gendarmeric. The communications network must be adequate for geographical coverage of the country's inland environment within which oil spills could occur.

Table A.7.1: Communications equipment identified for the National Command Centre.

Type	Use	Range
VHF-AM Aircraft	Ground-to-air communication	Line of sight
UHF-Oil Spill	Oil company frequencies for communication with individual oil companies	Line of sight
High Frequency Radio	Single side band for distances over 30 miles offshore	30 to 50 miles
Cellular Phones	Mobile communication where network is available	Within network area
Satellite Telephones	Voice, data and facsimile offshore or remote locations where approved	Worldwide
Telephone and Facsimile equipment	Transmission system to cover the geographical are of the spill	Not mobile

A detailed list of equipment, radio frequencies, telephone, facsimile numbers and email addresses of all parties likely to be involved in oil spill incidents is contained in the Data Directory (Section C) of the Inland Section (*green pages*).

A.7.5 Logistical support

Each operator will be responsible for the logistical arrangements for mobilising equipment, company personnel and international assistance that may be involved in oil spill response and clean-up following an incident. In the event of a Tier 3 incident the *National Incident Commander* (National Corps of Fire Fighters), as part of the National Incident Command Team will be responsible for facilitating some of the logistical arrangements that may be required by an operator, for example, involving Customs and Immigration, for rapid customs clearance of oil spill response equipment that might be imported and immigration clearance of foreign nationals who may be commissioned to assist with an oil spill response.

The National Incident Command Team will also be responsible for co-ordinating logistical arrangements involving other authorities in the event of an oil spill. In this respect, examples of the response and logistical support that may be required from the authorities are listed in Table A.7.2 below:

Table A.7.2: Examples of the response and logistical support required from the authorities.

Level of oil spill	Response by the authorities	Logistical support required
Tier 1	Audit team may be required to visit the site on one occasion	Transport (vehicle) Accommodation Equipment required for environmental data collection and analysis
Tier 2	Audit team may be required to visit the site on more than one occasion	Transport (vehicle) Accommodation Equipment required for environmental data collection and analysis
Tier 3	An observer will be required to monitor response and clean-up actions during and after the spill	Transport (vehicle) Accommodation Equipment required for environmental data collection and analysis
	An audit team will be required to visit the affected environments on more than one occasion	Transport (vehicle) Accommodation Equipment required for environmental data collection and analysis
	The import of foreign personnel and equipment will need to be facilitated to ensure rapid customs clearance	Custom clearance certificates Immigration clearance
	Contracting of local labour to assist with oil spill clean-up	Procurement/contracting Transport (vehicle) Accommodation Clean-up equipment Temporary waste storage sites Waste disposal

It should be noted that in the event of an oil spill where the authorities are required to mobilise resources as indicated above, detailed records of the equipment used, vehicle, accommodation expenses, etc. should be maintained for possible claims at a later stage. Detailed records of the impact of the oil spill (i.e. audit results) must also be maintained in order to facilitate later compensation claims that may be processed (see Section B.7).

A.8 TRAINING AND EXERCISES

A.8.1 Training

Any oil spill contingency plan has little value if the identified role players do not have the capacity or adequate training to properly activate and implement the actions identified in the plan. It is therefore essential that all role players, including Fire Chiefs and the Provincial Delegates of the relevant government ministries, receive proper training in oil spill response activities. Section A.8 of the Marine and Coastal section of this report contains recommendations for a program of training for private and public sector personnel in various aspects of oil spill response, modelled according to the International Maritime Organisation training courses. In addition to these courses, various organisations administer training courses on inland oil spill response; e.g. the services provided by Oil Spill Response Ltd in Southampton, who present both marine and inland courses, which could be presented in Cameroon as a single training package.

A.8.2 Exercises

Once the key oil spill response role players have been trained in the application of the NOSCP, or industry-specific oil spill response plans, it is important that exercises are undertaken that test the effectiveness of the plans with regard to communications, understanding of roles and responsibilities and the implementation of oil spill response strategies. These can range from desk-top exercises, which test the communications and role players' responsibilities defined in the plans, to a full field exercise where the response equipment is actually deployed as part of a simulated response operation. The purpose of these exercises is to evaluate the effectiveness of the plans and the state of readiness of the role players involved, and to address any shortcomings so that these can be addressed, for example, in future amendments to the NOSCP.

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SECTION B:

OPERATIONAL PLAN

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B.1 INTRODUCTION

This Operational Oil Spill Response Plan (the *green pages* of the NOSCP), as well as the Data Directory that follows must be kept up to date and amended as the information it contains becomes outdated as new information becomes available.

The Operational Plan sets out the actions that need to be taken at the time of an oil spill, from the initial reporting of an incident to the termination of clean-up operations. In this respect, the following generic inland oil spill scenarios are covered:

- Road or rail tanker accident on land;
- Road or rail tanker accident on a river bridge or close to a river;
- Spillage at a distribution depot or other commercial storage facility; and
- Crude oil pipeline spill on land or at a river crossing

The first part of the plan describes the main reporting procedures and responses to be instituted over the duration of small Tier 1 spills, and large Tier 2 and 3 spills involving any of the above scenarios. The second part describes the generic response actions that should be employed for each of the described spill scenarios, where reference is made to the oil spill response strategies described in Section A.5.

The Data Directory (Section C) contains contact details of all key role players (Section C.1) It is particularly important that this information is kept up to date and amended as required.

B.2 OBJECTIVE

The primary objective of this section is to minimize loss of time and hence environmental damage in carrying out the appropriate remedial action. This is achieved by clearly stating the functions and responsibilities of the various parties involved in the plan's implementation and by describing the infrastructure to be set up and the responses to be instituted by all parties for the duration of the incident.

B.3 AMENDMENTS

All amendments to this section will be issued by the National Competent Authority (NCA) in the form of new pages, which are to replace the pages requiring amendment. The holders of each copy of this plan, as named in the Distribution List at the front of the NOSCP, will receive a copy of all new pages that are issued from time to time. The amendments are highlighted by a vertical line in the left hand margin.

Holders of the NOSCP are to advise the NCA of any changes of telephone numbers, organisational details or any other relevant information immediately that it comes to their attention.

Upon receipt of an amendment letter from the NCA, the recipient is to verify its completeness and update the copy of the plan accordingly. After completing this update, the recipient is required to return the tear-off slip, that will accompany the amendment, to the NCA by mail.

B.4 REPORTING OF INLAND OIL SPILLS

B.4.1 Tier 1 spill incidents

Tier 1 oil spill incidents cover relatively small spills that may result quite frequently from operational procedures or accidents, the majority of which typically do not pose a significant threat to local socio-economic and/or environmental resources. Such incidents would include, for example, a rail or road tanker accident with light oil spilling onto the soil in an unpopulated area, or a contained spillage at a storage depot (e.g. due to a valve malfunction). It is expected that resources (materials, equipment, personnel) will be available in the vicinity to respond effectively and easily to the incident.

B.4.1.1 Action by the operator responsible for the oil spill

A Tier 1 spill should be reported by the organisation responsible for the spill to the NCA and the Senior Divisional Officer in whose area of jurisdiction the incident occurred (see Section C.1 in the Data Directory for contact details) at the earliest opportunity following the incident – although it is likely that the incident may first be reported to the local fire brigade, for example, in the case of a road tanker accident. This initial report should be telephonic and should include, as a minimum, information on the following:

- Name, affiliation and contact details of the person reporting the spill;
- Date and time of spill;
- Volume and type of oil spilled;
- Source and reason for the oil spill;
- Description of environment into which the oil has spilled;
- Potential threat to any local resources; and
- Response actions being taken.

Following the initial telephonic report to the NCA, the official *Oil Spill Report* (OSR001, contained in Section C.4 of the Data Directory) must be completed in full and submitted to the NCA by means of fax or email (See Section C.1 in the Data Directory for contact details) within 24 hours of the spill occurring. The NCA and Senior Divisional Officer must be kept informed of progress should the situation escalate or should additional response measures be required.

The report OSR 000 (contained in Section C.3 of the Data Directory) must be completed in the case of oil spills reported to the NCA by members of the public or, for example, a local authority. This will apply to incidents where the party responsible for the oil spill is either unknown or has failed to report the incident.

B.4.1.2 Action by the NCA

The NCA must acknowledge, in writing, receipt of the *Oil Spill Report* (OSR001) in the space provided on the report form. This acknowledgement must be directed to the party who submitted the incident report. The report should be distributed to the following authorities:

- Ministry of Mines, Water Resource, and Power (MINMEE),
- Ministry of Livestock, Fisheries and Animal Husbandry (MINEPIA),
- Ministry of Territorial Administration and Decentralization (MINATD),
- Other Authorities, at the discretion of the NCA

If the spill warrants it, the NCA shall despatch an official to assess the situation in the field to ensure that the response actions are commensurate with the level of risk posed by the oil spill and that the actions taken are serving to reduce the potential impact on socio-economic and environmental resources.

The NCA must enter the information contained in the *Oil Spill Report* (OSR001), together with any other relevant information, into the National Oil Spill Database to be created and managed by the NCA.

B.4.2 Tier 2 and Tier 3 spill incidents

Tier 2 and 3 oil spill incidents are typically larger in volume than Tier 1 incidents, as described above, and pose a more significant threat to the country's socio-economic and environmental resources. An example of an incident that could fall into the Tier 2 or 3 category could be a spill resulting from the rupture of the Chad-Cameroon pipeline, where such failure leads to the drainage of a large volume of crude oil into a major river system.

In the case of large oil spills, the resources available in the vicinity of the spill may be insufficient to adequately respond to the scale of the incident. Under these circumstances, additional equipment and material stocks available within the region would, therefore, need to be sourced in order to respond to the incident. Within Cameroon, such oil spill response resources are held by a limited number of operators (mainly COTCO) – the details of which are listed in sections C.1 and C.2 of the Data Directory.

B.4.2.1 Action by operator responsible for the oil spill

A Tier 2 or 3 incident should be reported to the local fire brigade and Senior Divisional Officer in whose area of jurisdiction the incident occurs. Thereafter, the NCA must be informed of the situation using the reporting procedures described for Tier 1 incidents (Section B.4.1.1). A situation update outlining the development of the oil spill incident, the actions taken, the effectiveness of these actions and the actual or potential impact of the oil on the environment should be submitted to the NCA every 24 hours (or at other intervals agreed to by the NCA) using the *Oil Spill Report*, OSR001.

Within one week following the termination of the oil spill response activities, the *Oil Spill Response/Clean-up Review Report*, OSR002 (contained in Section C.5 of the Data Directory) should be submitted to the NCA. This report, which provides an overview of the oil spill and response activities, must also contain proposed terms of reference for a post-spill audit that will need to be conducted in order to establish the socio-economic and environmental impacts caused by the oil spill. Once the terms of reference have been approved by the NCA, the audit must be undertaken by a competent institution (see guidelines for post-spill audits presented in Section C.6 of the Data Directory). An interim audit report, containing the results and conclusions of the assessment, must be submitted within six months of the termination of the oil spill response, and the final audit report (modified where necessary following its review) must be submitted within three months of the NCA's review of the draft report.

B.4.2.2 Action by the NCA and other Authorities

Immediate response to the incident will be taken by the local fire brigade under the command of the office of the National Corps of Firefighters (if in close proximity to the spill). Alternatively, immediate intervention at the national level of response, will be directed through the office of the local Senior Divisional Officer.

The NCA must acknowledge receipt of the oil spill report in writing in the space provided on the *Oil Spill Report*, OSR001. This acknowledgement must be directed to the operator or party who has submitted the report. The NCA must enter the information contained in the report, together with any other relevant information, into the National Oil Spill Database to be created and managed by the NCA.

The NCA must forward the *Oil Spill Report*, OSR001, to other authorities recognised as having an interest in the incident or a responsibility to intervene. These authorities would include, but would not necessarily be limited to, the following:

- The office of the Governor within whose province the spill has occurred;
- Ministry of Defense (MINDEF) – National Corps of Fire Fighters;
- Ministry of Transports (MINT) – Department of Terrestrial Transportation;
- Ministry of Mines, Water Resources and Power (MINMEE);
- Ministry of Territorial Administration and Decentralization (MINATD);
- Ministry of Communication (MINCOM);
- Ministry of Livestock, fisheries, and Animal Husbandry (MINEPIA);
- Ministry of Scientific and Technical Research (MINREST);
- Ministry of Public Health (MINSANTE);
- Ministry of Justice (MINJUSTICE);
- Ministry of Finance and Budget (MINFIB);
- Secretary of Defense (SED);
- General Delegation For National Security (DGSN); and
- SNH.

In a major oil spill situation, the *National Incident Command Team* (NICT) will mobilize to direct the co-ordination of activities related to the oil spill. The Incident Commander will be a representative of the National Corps of Fire Fighters. The activities of the NICT might include:

- Co-ordination of inter-Ministerial activities relating to the oil spill response;
- Liaison with the party responsible for the oil spill, their insurers and legal representatives;
- Facilitation of the needs for local labour to assist with clean-up operations;
- Facilitation for the import of equipment for responding to the spill (if required);
- Facilitation of immigration clearance of foreign experts arriving to assist with response activities (if required);
- Facilitation of the use of State or local authority equipment for responding to the oil spill;
- Co-ordinate record-keeping for compensation claim purposes;
- Co-ordinate claim procedures for costs incurred in responding to the spill or damage suffered; and
- Facilitate communications with local communities regarding the activities surrounding the oil spill response operations and the impact on the communities, particularly relating to health and safety.

The National Competent Authority will liaise with the body responsible for the spill and maintain an overview of the situation. After an assessment of the situation has been carried out, it may be deemed necessary to despatch an audit team to the affected areas to ensure that the national interests are not being unduly compromised by the oil spill and response activities – a function not to be mistaken with the post-spill audit. This audit team will report back to the National Competent Authority.

The NCA shall maintain an up-to-date record of the incident, including details of the actions taken by the operator responsible for the spill as well as any other organisation involved in the response operation. Information on apparent impacts on affected socio-economic and environmental resources shall be accurately recorded (Note: this information may be required to substantiate claims lodged by the government of Cameroon or any other parties for loss or damage incurred as a result of the spill or for recovery of clean-up costs).

Upon termination of the response operations, the NCA shall review the proposed terms of reference for the post-spill audit. In this regard, the NCA shall consult with other Ministries and institutions to ensure that the audit will cover the full scope of potential socio-economic and environmental impacts. The NCA shall also review the draft and final post-spill audit reports and identify any failings in the response actions that were taken, so that improvements can be effected in future. Where necessary, the findings of the audit shall be incorporated into future revisions of the NOSCP.

Table B.5.1 summarizes the response actions to be undertaken by the various parties in the event of Tier 2 and 3 incidents.

Table B.5.1: Actions to be instituted by the NICT, NCA and other government authorities in a Tier 2 and 3 oil spill situation.

Response by Cameroon Government	***Responsible Operators and Authority***
1. Receive first notification of the Tier 2 or 3 spill Receive written notification - Oil Spill Report OSR001	National Corps of Firefighters (immediate notification); MINEF (written notification)
2. Alert *National Incident Command Team* and establish if the incident warrants a full response involving other authorities; i.e. socio-economic or environmental resources are threatened, clean-up action is required.	***National Incident Command Team* (NICT):** ▪ MINDEF – National Corps of Fire Fighters ▪ Ministry of Environment and Forests (MINEF) ▪ Ministry of Communications (MINCOM) ▪ Ministry of Territorial Administration and Decentralization (MINATD)
(a) If full response is not warranted then:	
3. Distribute Oil Spill Report (OSR001) to the following: ▪ MINATD ▪ MINMEE ▪ MINEPIA ▪ SNH ▪ other selected members of the NOSR-SC	MINEF
4. Dispatch an observer/audit team to the site to observe oil spill response activities and clean-up actions.	Observer team may include representatives from MINEF, MINMEE MINEPIA, and others.
5. Receive and review operator's Oil Spill Review Incident Report (OSR002).	MINEF
6. Receive and review Terms of Reference for Post-Spill Audit.	MINEF
7. Review and accept Post-Spill Audit Report.	MINEF
8. Debriefing session with the NOSR-SC.	NICT
(b) If full response is warranted (i.e. Tier 3 or socio-economic or environmental resources are threatened, clean-up action is required):	
3. Assemble *National Incident Command Team* and establish National Command Centre.	***National Incident Command Team* (NICT):** ▪ MINDEF: National Corps of Fire Fighters ▪ Ministry of Environment and Forests (MINEF) ▪ Ministry of Communications (MINCOM) ▪ Ministry of Territorial Administration and Decentralization (MINATD)
4. Coordinate communication with all relevant Government Departments and institutions.	MINEF to contact NOSR-SC, MINMEE, MINEPIA, SNH and others.
5. Coordinate communications with affected communities, the public, media and neighbouring countries if required.	▪ MINCOM to communicate with media, general public and neighbouring countries (if necessary)

Response by Cameroon Government	*Responsible Operators and Authority*
	▪ MINATD through the Provincial Governors Office, to communicate with local communities.
6. Dispatch an observer team to the site to observe oil spill response activities and clean-up actions, if any.	Observer team may include representatives from MINEF, MINMEE MINEPIA, and others.
7. Facilitate implementation of operators' Oil Spill Response Plan (e.g. assist with customs and immigration clearances) if required.	National Corps of Fire Fighters, as the *Incident Commander*, will facilitate this through Customs (Ministry of Finance) and Immigration (Department General delegation for National Security).
8. Receive Spill Report Updates (Report form OSR001).	MINEF responsible for documentation control, filing and database entry.
9. Coordinate Government resources for oil spill <u>response</u> if assistance is requested by the operator (emphasis on human safety). ▪ Record expenses for the following items: – Equipment used for response – Personnel deployed for response	National Corps of Fire Fighters to coordinate use of equipment and personnel that may be required to assist with the oil spill response.
10. Coordinate Government resources for oil spill <u>clean-up</u> actions if assistance is requested by the operator (See Section B.5). ▪ Record expenses for the following items: – Equipment used for clean-up – Personnel deployed for clean-up – Accommodation costs – Travel costs – Material costs	MINATD with the Provincial Governors' Office to coordinate this. Take over control from National Corps of Firefighters.
11. Keep the National Oil Spill Response Standing Committee up-to-date on incident.	NICT through MINEF
12. Receive and review operator's Oil Spill Response/Clean-up Review Report (OSR002).	MINEF
13. If necessary, dispatch an audit team to the site to assess possible socio-economic and environmental damage and collect relevant data to facilitate possible compensation claims.	MINEF, MINEPIA, MINMEE, MINFIB, MINJUSTICE
14. Investigate disposal options for oily waste if necessary.	MINEF, MINMEE
15. Receive and review Terms of Reference for Post-Spill Audit (Tier 2 and 3).	MINEF
16. Review and accept Post-Spill Audit Report.	MINEF
17. Debriefing session with the NOSR-SC.	NICT
18. Record keeping of all equipment and resources deployed by the Government of Cameroon and expenses incurred.	All departments involved in response and clean-up actions. Compensation claims to be coordinated by MINFIB.

B.5 RESPONDING TO OIL SPILLS ON LAND

This Section outlines generic response actions that might be required in dealing with an oil spill from the identified risk sources.

Priorities for both containment and clean-up are indicated in Table B.5.2 by means of the words *high, medium* and *low*. Priorities are established on the grounds of:

- *important* inland socio-economic and environmental features;
- *vulnerability* – i.e. the likelihood of oil stranding in particular areas;
- *environmental sensitivity* – areas where the potential environmental impact of an oil spill would be high (e.g. in protected areas) are given a high priority, whereas non-sensitive environments are given a lower priority; and
- *socio-economic importance* – areas where socio-economic activities are located (e.g. artisanal freshwater fisheries would be negatively impacted by an oil spill) are given a high priority rating.

Specific instructions for the containment and clean-up of inland socio-economic and environmental features are provided in Table B.5.2, and are listed according to the four identified oil spill situations described in Sections B.5.1 to B.5.4. It should be noted that the prescribed containment and clean-up measures are based on available information pertaining to the current situation regarding the inland environment and the availability of oil spill response resources. Should this situation change in future, different approaches to oil spill response may need to be adopted. This highlights the need for the NOSCP to be regularly reviewed and amended where necessary based, for example, on the information derived from post-spill audits that are conducted.

B.5.1 Road or rail tanker accident on land

Light fuel oils, such as petrol and diesel, are delivered from the SONARA refinery in Limbe and the oil terminal in the Port of Douala to various SCDP storage depots and commercial and retail inland sites by both rail and road tankers (see Sections A.2.9 and A.2.10). In the course of fuel transportation, accidents can occur, resulting in spillage of differing amounts of product. It is the responsibility of the operator of the road or rail tanker to initiate an appropriate response and to call on the assistance of local authorities if necessary. In the case of an incident, the following response actions need to be taken, where there is no risk of oil reaching a surface water resource (this situation is dealt with in Section B.5.2):

- Ensure the safety (from fire or explosion) of personnel and the public in the vicinity of the spill site;

- Attempt to stop the flow of product, using any safe and practical means to do so – for example, using a wooden plug to seal small punctures in the tank;
- Determine the location of particularly sensitive environments in the proximity of the spill and ensure that priority action is taken to direct the spill away from such areas. For example, prevent the flow of oil into drains, streams and rivers.
- Block any drains in the area, into which the spilled oil could flow, using sand-filled plastic bags or any other appropriate means;
- Divert free-flowing oil away from sensitive areas (such as streams or rivers) to a less sensitive area by digging trenches or building earth barriers;
- Contain free oil using sand bags, earth structures, trenches, sorbents or other barriers;
- Collect free product from contained areas using either pumps, skimmers or sorbents (where smaller quantities are involved); and
- After removal of the free product, treat any contaminated soil and other material, applying the options described in Section A.5.2.2 and B.6.

In recovering the damaged road or rail tanker, the following factors must be considered:

- Bulk tank cars that need lifting or righting must have their liquid cargoes transferred prior to the lifting operation. The cargoes are not to be discharged to the environment before righting.
- If it is not possible to gain access to the cargo through the bottom valves or manholes without spilling product, then a hole should be cut in the shell in order to pump out the cargo. The hole should not be ground (due to fire hazard) but should be cut using a hydraulic or air-powered hole saw, which is a cup-shaped toothed cutter that fits into a drill. A slow speed should be used, together with a water coolant.

B.5.2 Road or rail tanker accident on a bridge or close to a river

Should a road or rail tanker carrying light fuel oils, such as petrol or diesel, sustain damage on a bridge or close to a river or stream into which oil could flow, then the following course of action should followed:

- Ensure the safety (from fire or explosion) of personnel and the public in the vicinity of the spill site;
- Attempt to stop the flow of product, using any safe and practical means to do – for example, using a wooden plug to seal small punctures in the tank;
- Where appropriate, prevent the flow of oil into the river and contain it by erecting barriers of earth or other materials;
- Collect free product from containment areas using pumps, skimmers or sorbents;
- Where oil has entered a stream or river it should ideally be contained (see Section A.5.2.1) as close to the spill site as possible to prevent the downstream spread of pollutants – an intervention that is particularly important, for example, where

communities use the water for drinking purposes. However, this will not often be possible in practice due to the lightness of the oil and the generally unfavourable conditions for product containment and recovery. The light oils will evaporate and disperse naturally, particularly under turbulent, high-flow conditions.

- Where persistent oils are spilled, cut and remove, for proper disposal, any oiled vegetation along the river banks.

In recovering the damaged road or rail tanker, the guidelines outlined in Section B.5.1 should be followed.

B.5.3 Spillage at distribution depot or other commercial storage facility

Tank leaks or ruptures, tank overfills and valve failures are some of the causes of oil spillages at fuel storage installations. The majority of the larger tank facilities (e.g. SCDP installations) are enclosed in bund areas, which are designed to contain any oil spilled from the tanks. In this respect, the bund structures are usually effective, except under catastrophic circumstances. However, smaller fuel storage facilities may not be bunded, resulting in the escape of spilled oil, thereby increasing the risk to the environment – which, in most cases is of a largely industrial character.

In the case of spills at depots and storage facilities, the following course of action should be followed:

- Ensure the safety (from fire or explosion) of personnel and the public in the vicinity of the spill site. Ensure the readiness of fire-fighting equipment at the facility;
- Attempt to stop the flow of product, using a safe and practical means to do – for example, by closing opened valves, halting the tank filling operation, etc.;
- If the oil has spilled into a bunded area, ensure that any discharge valves (e.g. for draining rainwater accumulation) are closed and that the bund has not been breached at any point. Recover oil from bunded area using pumps, skimmers or sorbents. If the floor of the bund is unsealed, landfarm contaminated soil;
- If oil escapes from bunded area, or where no bund exists, then:
    - Divert free-flowing oil away from sensitive areas (such as streams, stormwater drains, manholes, etc.) to a less sensitive environment by digging trenches or building earth barriers;
    - Attempt to contain the flow of oil by means of sand bags, trenches, earth structures, sorbents or other materials;
    - Block any drains in the area, for example, using sand-filled plastic bags;
    - Collect free product from contained areas using pumps, skimmers or sorbents; ad
    - After removal of the entire free product, any contaminated soil and other contaminated material is to be treated using the options described in Sections A.5.2.2 and B.6.

B.5.4 Crude oil pipeline spill on land or at a river crossing

The Cameroon section of the pipeline conveying crude oil from southern Chad to the Cameroon coast at Kribi, is owned and managed by the Cameroon Oil Transportation Company (COTCO) (see Sections A.2.2 to A.2.7). Other oil pipelines (existing, planned) are (will be) operated by other parties. The response to any oil spillage from pipelines in inland areas, whether the spillage takes place on land or in any of the rivers, is the responsibility of the operators.

In order to effectively respond to an oil spill from the Chad-Cameroon pipeline, COTCO has developed a General Oil Spill Response Plan, which details the overall co-ordination of a response to an oil spill associated with construction and operation of the pipeline and associated infrastructure. This document serves as a general framework and reference document for six Area-Specific Spill Response Plans. These Spill Response Plans provide guidance for emergency response procedures for oil spills from operations associated with the pipeline, as well as area-specific information needed for initial response.
.
The Spill Response Plans make provision for COTCO to report any such spillage to Local Authorities, Local Community Co-ordinators and appropriate government agencies and the Pipeline Steering and Monitoring Committee.

In the event of a Tier 2 spill, the COTCO Operations Manager is identified in the Plans as the person within COTCO who will fill the role of Incident Commander during a spill situation and will be responsible for all activities relating to the spill. A Government Liaison and Permitting advisor, as well as a Public Affairs Advisor will assist the Incident Commander in communicating with government agencies. These provisions should be expanded to meet the requirements outlined in Section B.4.

The area-specific plans outline the oil spill response options that COTCO has available for cleaning up any oil spillages from their facilities and spells out the actions that COTCO personnel need to take in responding to an oil spill. COTCO has established stockpiles of oil spill response equipment at various locations within the country for use in the event of an oil spill from their facilities. A list of the equipment appears in Section C.2, the Data Directory. The area-specific plans also state that they will be revised, if necessary, to be consistent with the NOSCP once it has been finalised. It can, therefore, be expected that all oil spill response activities adopted by COTCO will comply with the strategy presented in the NOSCP.

Although reference is made above to the COTCO oil spill plans, it is the responsibility of other pipeline operators to prepare similar plans, aligned with the strategies, etc. presented in the NOSCP.

Table B.5.2: Oil spill response for the inland region

Ref	*Inland Socio-Economic and Environmental Features*	*Containment and clean-up*	
		Priority rating	*Action (see Section A.5.2)*
Spills associated with road and rail tankers as well as pipelines and ancillary infrastructure on land (away from surface water)			
	Sensitive environments ⊙ Protected area ⊙ Agricultural land ⊙ Above aquifer or near boreholes/wells used for potable water supply ⊙ Built environment/Human settlement area	High	⊙ Ensure safety of personnel and public from fire, explosion and other health risks (e.g. contaminated drinking water) ⊙ Stop flow of product ⊙ Contain free oil using sand bags, earth structures, trenches, sorbents or other barriers ⊙ Collect free product ⊙ Remove contaminated soil (where possible) ⊙ Dispose of waste as per Section B.6
	Non sensitive environments	Low	⊙ Ensure safety of personnel and public from fire, explosion and other health risks (e.g. contaminated drinking water) ⊙ Stop flow of product ⊙ Contain free oil using sand bags, earth structures, trenches, sorbents or other barriers ⊙ Collect free product ⊙ Leave residual product to naturally degrade (except for crude oil and HFO)
Spills associated with road and rail tankers as well as pipelines and ancillary infrastructure close to surface water (wetlands and rivers)			
	Sensitive environments ⊙ Swamp forests ⊙ Seasonally inundated grasslands ⊙ Rivers and streams	High	⊙ Ensure safety of personnel and public from fire, explosion and other health risks (e.g. contaminated drinking water) ⊙ Stop flow of product ⊙ Contain free oil using sand bags, earth structures, trenches, sorbents or other barriers

Ref	*Inland Socio-Economic and Environmental Features*	*Containment and clean-up*	
		Priority rating	*Action (see Section A.5.2)*
			⊙ Collect free product ⊙ Remove contaminated soil (where possible) ⊙ Dispose of waste as per Section B.6 Where product has entered a river or stream the following actions should be undertaken: ⊙ Contain oil using booms where possible and appropriate (see Section A.5.2) ⊙ Remove product using sorbents (light products) and skimmers for Heavy Fuel Oil (HFO) ⊙ Where crude oil or HFO is spilled, cut and remove oiled vegetation from river banks, where possible ⊙ Dispose of waste as per Section B.6 Where product has entered into seasonally inundated grasslands the following actions should be undertaken: ⊙ Contain oil using booms where possible and appropriate (see Section A.5.2) ⊙ Remove product using sorbents (light products) and skimmers for crude oil and HFO ⊙ Where crude oil or HFO is spilled and persists, remove product when/if the grassland area dries out ⊙ Dispose of waste as per Section B.6 Where oil has entered a swamp forest the following actions should be undertaken:

Ref	*Inland Socio-Economic and Environmental Features*	*Containment and clean-up*	
		Priority rating	*Action (see Section A.5.2)*
			• Contain oil using booms where possible and appropriate (see Section A.5.2) • Remove product using sorbents (light products) and skimmers for crude oil and HFO, where possible • Dispose of waste as per Section B.6 • Limited access to swamp forests makes clean-up action within the forested area unfeasible
Spillage at distribution depot or other commercial storage facility			
	Sensitive environment: • Built environment/Human settlement area		• Ensure safety of personnel and public from fire, explosion and other health risks • Stop flow of product where possible • Ensure bunds are secure (drainage valves closed, walls not breached) • Recover oil from bunded area If product escapes from bunded area: • Divert product away from sensitive areas (manholes, stormwater drain or streams) • Contain oil using sand bags, trenches and earth embankments • Block drains, for example, using sand-filled plastic bags • Collect free product • Remediate contaminated soil • Dispose of waste as per Section B.6

B.6 WASTE DISPOSAL

As indicated in Section A.5.2.1 and A.5.2.2, dedicated hazardous waste sites, suitable for the disposal of large quantities of oily waste, are not available in Cameroon. Therefore, decisions regarding the final disposal of oily waste, which might be collected following an oil spill, need to take the current situation into account. The main concern regarding the disposal of oily waste is the potential for hydrocarbon contamination of ground- and surface water resources. Clearly, expert advice will need to be sought in this regard, particularly to ensure that the initial environmental impacts of oiling are not compounded by secondary environmental impacts; e.g. relating to human health.

Once large quantities of oily waste have been collected, options for disposal include the following:

- ***Stabilization with lime***: This approach can be used in the case of oily soil that does not contain large amounts of organic matter. An inorganic substance such as quicklime may be added to bind the material, thus forming an inert product that does not easily permit leaching of pollutant compounds. This enables the waste to be used for such purposes as road foundation or land reclamation. The stabilized product may also be disposed of under conditions that are less stringent than in the case of unstabilized material. Stabilization with lime is an option that should be implemented under the advice of experts in the fields of ground- and surface water contamination.
- ***Co-disposal with municipal waste***: Lightly oiled material may be co-disposed on top of a layer of municipal waste of at least 1,5 metres thick. However, due to the current lack of municipal waste sites in the proximity of the coastline, this is not considered a feasible option.
- ***Burning***: The direct burning of uncontained oily debris is not recommended, except in very remote areas, since it causes atmospheric pollution that can result in a suite of environmental impacts. However, these problems can be overcome through the use of a suitable incinerator. Portable incinerators, such as rotary kilns and open-hearth types are most suitable. Incineration, using this type of equipment, if portable units can be imported and deployed locally, is considered to be a feasible option for waste disposal.
- ***Biodegradation* or *landfarming***: This involves the breakdown of the oil by either natural or introduced micro-organisms under enhanced conditions. This is considered to be one of the most suitable options for disposal of oily debris in Cameroon. Land space is generally available in areas that could experience oiling and the climate is conducive to rapid degradation of oil. Expert advice should be sought in establishing a landfarm; however, the following basic principles apply:
    - Leaching and contamination of groundwater resources must be avoided. This can be done by lining the landfarm area with an impervious material such as an HDPE liner. An open flat area is required onto which to place the liner;

- In most cases, unless rapid degradation is required, it is unnecessary to introduce foreign bacterial or fungal strains. If foreign strains are introduced, this must be done under expert advice;
- The soil should not be saturated with oil. If this is the case initially, fresh soil should be added to the contaminated material to reduce the oil:sand ratio. As a rough indication, free oil should not emerge when the contaminated soil is squeezed manually;
- In its simplest form, landfarming involves the stimulation of naturally-occurring micro-organisms to degrade the oil. To do this, the bacteria require a nutrient stimulus, which can be achieved through the addition of one handful of mono-ammonium phosphate to one cubic metre of oily material. The bacteria require moisture and oxygen to function optimally. It is, therefore, necessary to keep the soil moist, which will be achieved locally through rainfall and high humidity levels. The oily material should be laid out to a thickness of no more than 400 cm. This permits the material to be rotovated periodically to maintain high oxygen levels. The pH of the soil should be maintained between 6.5 and 7.5 and adjusted through the addition of lime if necessary;
- A more sophisticated approach may be adopted if the rate of biodegradation needs to be optimized;
- Monitoring of the hydrocarbon levels within the landfarm must be undertaken to determine when the desired end-point of the breakdown of the pollutant has been reached.

Biodegradation, incineration (if suitable equipment can be made available) and stabilization with lime are considered to be the most feasible options for the disposal of oily waste in Cameroon.

B.7 GUIDELINES FOR MONITORING AND RECORD-KEEPING FOR COMPENSATION CLAIMS

Economic loss and impacts on community livelihoods can result from an oil spill, and high costs can also be incurred in responding to major spills. To ensure the maximum degree of success in obtaining compensation for damages suffered and costs incurred, it is essential that claims should be properly presented and should contain sufficient detail and justification for the claim that is made. In preparing a claim, the following needs to be taken into account:

- Each claim should contain the following basic information:
  - Name and contact details of claimant;
  - The identity of the party responsible for the oil spill;
  - The date, place and specific details of the incident;
  - The type of damage for which compensation is being claimed;
  - The actions taken for which compensation is sought in order to cover incurred costs; and
  - The amount of compensation claimed.
- Claims should be submitted as soon as possible after an incident or damages/costs are incurred
- Claims should be made in writing, detailing the damage (also in monetary terms) on the basis of facts. Each item of a claim must be substantiated with supporting documentation, such as worksheets, explanatory notes, accounts, photographs and an invoice. It is, therefore, essential that affected parties, in particular the NCA, maintain accurate and comprehensive records of all activities that take place in connection with the oil spill response – including records of all labour, equipment, materials and consumables used.
- Claims for *consequential loss* (e.g. a community's loss of earnings due to exclusion from a polluted area) should similarly be backed up with detailed descriptions and evidence of the loss suffered.
- The post-spill audit should be used as a primary source document for providing supporting evidence when lodging a claim for socio-economic and environmental loss and damage.

In the event of a major oil spill, which results in damage and costs, the NCA must coordinate the claims submission procedure – both with respect to the collation of claims and the submission thereof to the liable party and/or the party's insurers.

SECTION C:

DATA DIRECTORY

PNLDAH

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C.1 CONTACT DETAILS OF ALL KEY ROLE PLAYERS

Position	Name	Telephone Fax Mobile E-mail	Postal Address	Comments
Ministry of Environment and Forestry / Permanent Secretariat for the Environment				
Permanent Secretary	**Pr. TCHALA ABINA François**	T: 222 69 09 F: 222 12 25 M: 785 83 26	PO Box Yaounde	
Chief of the Brigade for Environmental Inquiries and Inspections	**Dr EFENDENE Blaise.**	T: 222 69 09 F: 222 12 25 M: 998 53 51 E: fendene@gcnet.cm	PO Box Yaounde	
Ministry of Defence				
1. National Navy				
National Navy Commander	**Vice Admiral N'GOUAH N'GALLY** C.E.M.M.	T: 222 30 16 F: 222 30 43 M: 989 49 98	P.O.Box 11923 Yaoundé	In case E. V. ZOGO FOUDA Abraham; Porte Fanion V.A. CEMM: 999 57 55
Navy commander of Douala station (COMBAND)	**C. V. OYONO MVENG**	T: 343 35 65 F: 343 22 13 M: 960 16 18	PO Box 4951 Douala	
Douala Centre of information Co-ordination and Operations – Commander	**C. V. TINKEU NGATCHOU**	T: 342 68 50 (24h / 24h) T: 343 82 35 (B) M: 739 20 77 / 954 50 50	PO Box 4951 Douala	
2. National Corps of Fire Fighters				
Commander	**Brigadier General BABA SOULEY**	T: 223 39 34/223 55 93 M: 770 12 52	PO Box 6863 Yaounde	
Chief of the Service of Operations	**Captain GARKA GARKA**	T: 223 55 93/223 99 08 M: 995 38 76/789 12 76 E: garka@yahoo.fr	PO Box 6863 Yaounde	
Yaounde Centre of information Co-ordination and Operations		T: 18 M: 118	PO Box 6863 Yaounde	
3. Secretariat of State in charge of National Gendarmerie				
Secretary of State	**Mr. Rémy ZE MEKA**	T: 223 29 79 F: 222 39 98	PO Box Yaounde	
Ministry of Territorial Administration and Decentralization				
Direction of Civil Protection	**Dr NANA Jean Pierre** Director	T: 221 46 06 M: 996 10 50	PO Box Yaounde	
Direction of Civil Protection	**Mr. MBEDY Jacques** Deputy Director	T: 221 46 07	PO Box Yaounde	

Position	**Name**	**Telephone** **Fax** **Mobile** **E-mail**	**Postal Address**	**Comments**
	Dr. ENOUMBA Henri Claude	T: 221 46 07 M: 993 65 85 E:hcenoumba@yahoo.fr	PO Box Yaounde	
Ministry of Communication				
Minister	**Pr. FAME NDONGO Jacques**	T: 223 39 74/222 31 55	PO Box Yaounde	
Director of Public Communication	**Mr. KAMGANG Jacques**	T: 223 02 86 M: 953 63 75	PO Box Yaounde	

Ministry	**Name** **Position**	**Telephone** **Fax** **Mobile** **E-mail**	**Postal address**	**Comments**
Other Relevant National Authorities				
Ministry of Mines, Water Resources, and Power **(MINMEE)**	**Mr ABESSOLO Adolphe** Director of Mines	T: 222 39 70 F: 222 39 70 M: 991 15 82	PO Box Yaounde	
	Mr. NGASSA Célestin	T: 222 39 70 F: 222 39 70 M: 963 78 19 / 993 18 63 E: ngaroza@yahoo.fr	PO Box Yaounde	
Ministry of Livestock, Fisheries, and Animal Husbandry **(MINEPIA)**	**Dr Baba MALLOUM O.** Director of Fisheries	T: 231 60 49 F: 231 30 48	PO Box Yaounde	For updating, M. Mohamadou Nasrou T: 222 33 11 M: 763 48 42
Ministry of Transports **(MINTRANS)** 1. Merchant Navy Department	**Mr EKOUMOU Dieudonné** Director	T: 342 89 56 / 342 43 82 F: 342 89 56	PO Box Douala	
Ministry of Transports **(MINTRANS)** 2. Department of Terrestrial Transportation	**Dr YOUMBA Josué** Director	T: 222 05 47/222 41 15 F: 222 41 15	PO Box Yaounde	
Ministry of Finance and Budget **(MINFIB** - Customs)	**Mr. GONI MAL Adji** Director of Customs	T: 342 70 80/340 76 74 F: 342 32 02	PO Box Douala	
	Mr NGALLE (Information & Communication)	T: 342 70 80/340 76 74 F: 342 32 02 M: 989 05 32	PO Box Douala	To be confirmed as the right contact
Ministry of Justice **(MINJUSTICE)**	**Mr. AHMADOU ALI** Minister of State	T: 222 21 54 F: 223 00 05	PO Box Yaounde	The right contact still to be determined
Ministry of Public Health **(MINSANTE)**	**Mr. OLANGUENA AWONO Urbain** Minister	T: 222 35 25/222 02 33 F: 222 35 25/222 02 33	PO Box Yaounde	The right contact still to be determined
Ministry of Scientific and Technical Research	**Mr. PEREVET Zacharie** Minister	T: 222 13 34 F: 222 13 36	PO Box Yaounde	The right contact still to be determined

Ministry	Name Position	Telephone Fax Mobile E-mail	Postal address	Comments
(MINREST)				
General Delegation for National Security (**DGSN** - Border Police)	**Mme MBASSI née LELE** Director ofBorder Police	T: 220 11 17/221 28 84 F: 221 00 69		
National Institutions				
Hydrocarbons National Corporation **(SNH)** / Pipeline Steering & Monitoring Committee **(CPSP)**	**BROH NDUM Augustine** Permanent Secretary	T: 220 19 10/221 04 30 / 220 98 60 F: 220 46 51 M: 750 64 72	PO Box 955 Yaounde	
SONARA	**Mr. TAKERE Derrick** Director, Risks	T: 342 38 15/333 22 38 F: 342 34 44	PO Box 365 Limbe	
	Mr. TONYE MBOG Eric Chief, Environment	T: 342 38 15/333 22 38 F: 342 34 44 M:	PO Box 365 Limbe	
SCDP	**Dr NGUINI EFFA Jean Baptiste** General Manager	T: 340 37 39/342 09 63 (D) F: 340 47 96 M: 770 32 58	PO Box 2271 Douala	
	LIMBOURG Jean Paul Deputy General Manager	T: 340 27 77/342 01 87(D) F: 340 47 96 M: 770 92 94	PO Box 2271 Douala	
	VOILLARD Marc Deputy Exploitation Director	T: 340 21 98/343 10 65 (D) F: 340 47 96 M: 770 92 95	PO Box 2271 Douala	
Autonomous Port of Douala	**Mr SIEWE Siyam** General Manager	T: 223 35 54 F: 222 34 56	PO Box Douala	
CAMRAIL Division of Health, Safety, & Environment	**Mrs. NDOUGSA MBANG Hélène-M** Manager	T: 340 91 89/340 71 59 F: 340 82 52	PO Box Douala	

Relevant International National Authorities (e.g. Equatorial Guinea, Nigeria, Chad)				
Country	**Name Position**	**Telephone Fax Mobile E-mail**	**Postal address**	**Comment s**
Equatorial Guinea	Ministry of Mines and Energy	T: 240-935 67 F: 240-933 5	Malabo	
	Petroleum National Company (GE Petrol)	T: 240-764 80 / 944 84	Malabo	
	Ministry of transport and communication	T: 240-1-262 23 98 240-9 33 13 / 9 25 15		

Relevant International National Authorities (e.g. Equatorial Guinea, Nigeria, Chad)				
Country	**Name Position**	**Telephone Fax Mobile E-mail**	**Postal address**	**Comment s**
Nigeria	Hon. Minister of Petroleum. Federal Ministry of Petroleum Resources Federal Secretariate Phase I	T: 234-1-262 23 98 01-320 04 40-9	Shehu Shagari Way Abudja	
	Federal Ministry of Environment	T: 234-9 234 74 95 / 523 49 31 F: 234-9 523 49 31	Lagos	
	National Maritime Authority	T: 234-1 580 48 00 / 545 19 43 F: 234-1 545 07 22 / 545 19 44	41 Burma Road, Apapa – Lagos	
Chad	**Mr. YOUSSOUF Abassallah** Ministry of Petroleum, Mines and energy	T: 235-52 38 50 F: 235-52 25 65	P.O. Box 94 N'jamena	
	Petroleum Affairs Manager	T: 235-52 38 50 F: 235-52 25 65		
Gabon	Ministry of Transport and Maritime Affairs	T: 241-03 93 84 / 77 43 82 241-72 58 05 / 72 15 87 F: 241-72 00 42	PO Box 803 Libreville - Gabon	
	Direction Générale de la Marine Marchande	T : 241-74 53 07 / 76 01 85 F : 241-76 06 60 / 74 66 55		

Littoral Province

Position Division	**Name**	**Telephone Fax Mobile E-mail**	**Postal address**	**Comments**
Governors and Senior Divisional Officers				
Governor	**Mr. GOUNOUKO HAOUNAYE**	T: 342 63 71 (B) 342 46 00 (Sec) 342 80 08 (D) M: 997 92 55	Douala	For updating Mr KAMENI Nestor MINAT/DOT/CCC 223 02 63 /735 41 69
Wouri Senior Divisional Officer	**Mr. NDONGO NDONGO**	T: 342 44 56 (B) 342 24 70 (B) M: 778 93 07 / 993 72 46	Douala	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mr. EBEN ABAIA Samuel**	T: 342 63 36/343 05 09 F: 342 91 46/342 74 00 M: 952 65 19	Douala	
MINEPIA Provincial delegate	**Dr TCHOUBIA Antoine**	T: 342 11 13/342 00 10 M: 991 63 94	PO Box 721 Douala	
MINMEE Provincial delegate	**Mr. SAMBA Dieudonné**	T: 342 93 56 M: 959 06 88	Douala	
MINCOM Provincial delegate	**Mr. NANGA ABANDA Jean P**	T: 342 36 30 / 342 35 77 M: 959 06 88	Douala	

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Local ports and airports (For Customs, see MINFIB -- Ministries)				
Douala International Airport		T: 342 36 30 / 342 35 77 F: 342 37 58	PO Box 3131 Douala	
Local fire departments, hospitals and police				
Fire Fighters -- Littoral & S-West Headquarters--	**C. B. OWONO NLEND** Commander	T: 347 26 04/342 52 52 M: 991 85 88	Douala	
	Captain NSOGO BOGLA Daniel 2nd in Command	T: 347 37 94/342 52 52 M: 983 49 45	Douala	
Local hotels and other services				
Hôtel Méridien		T: 342 41 34/343 50 00 F: 342 35 07	Douala	
Hôtel SAWA		T: 342 44 41/342 08 24 F: 342 38 71	Douala	
Hôtel IBIS		T: 342 58 00/342 58 17 F: 342 36 05	Douala	
Hôtel AKWA Palace		T: 342 26 01 F: 342 74 16	Douala	
Sanaga Maritime Division				
Sanaga Maritime Division Senior Divisional Officer	**Mr. ABAKAR AHAMAT**	T: 346 41 48 / 41 15 M: 987 65 43	Edea	
MINEF Divisional delegate	**Mr. MANGA Hilaire**	T: 346 44 11 M: 983 19 14	Edea	
MINCOM Divisional delegate	**Mme ZOGO Suzanne**	T: 346 41 48 M: 956 73 31	Edea	
Local hotels and other services				
Hostellerie de la Sanaga		T: 346 48 86 / 49 62	PO Box Edea	

South West Province

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Governors and Senior Divisional Officers				
Governor	**Mr. EJAKE MBONDA Thomas**	T: 332 26 27 / 332 24 84	Buea	
Fako Division - Limbe Senior Divisional Office	**Mr. OKALIA BILAI Bernard**	T: 333 22 21 / 333 24 17	Limbe	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mr. DJIBRILLA ASSALA**	T: 332 25 77	Buea	
MINEPIA Provincial delegate	**Dr DJAO DAKSALA**	T: 332 21 10 M: 997 38 20	Buea	

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
MINMEE Provincial delegate	**Mr. John N. FONJI**	T: 333 26 15 / 333 21 17 333 26 29	Buea	
Local fire departments, hospitals and police				
Fire Fighters -- Littoral & S-West Headquarters--	**C. B. OWONO NLEND** Commander	T: 347 26 04/342 52 52 M: 991 85 88	Douala	
	Captain NSOGO BOGLA Daniel 2nd in Command	T: 347 37 94/342 52 52 M: 983 49 45	Douala	
Local hotels and other services				
Atlantic Beach Hotel		T: 333 26 89 / 23 32	Limbe	

South Province

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Governors and Senior Divisional Officers				
Governor	**Mr. ENOW ABRAMS EGBE**	T: 228 49 48 / 36 66 / 37 81	Ebolowa	
Ocean Division – Kribi Senior Divisional Officer	**Mr. MVONGO Grégoire**	T: 346 11 96 / &2 31 F: 346 11 96 M: 951 18 78	Kribi	
Some Divisional offices of Ministries				
MINEF Provincial Delegate	**Mr. MEKEDJUE Dieudonnée**	T: 228 44 48	Ebolowa	Kribi divisional offices would be more useful than afar Provincial ones
Kribi Divisional Delegate	**Mr. AKOGO MVOGO Guillaume**	T: 346 12 74 M: 990 51 81	Kribi	
MINEPIA Kribi Divisional delegate	**Dr EBODE Sylvain Blaise**	T: 346 12 53 M: 756 41 39	Kribi	
MINMEE Kribi Divisional delegate	**Mr. NGWA SHUH John**	M: 752 49 76	Kribi	
MINCOM Kribi Divisional delegate	**Mme BOBE Liliane.**	T: 346 10 67 F: 346 11 96 M: 954 17 49	Kribi	
Local fire departments, hospitals and police				
Fire Fighters -- Littoral & S-West Headquarters--	Commander	T: 347 26 04 / 342 52 52 M: 991 85 88	PO Box Douala	Kribi will soon have a National training center with an operational unit Fire Brigade

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Local hotels and other services				
Hôtel Palm Beach Plus		T: 346 14 47 M: 776 10 29	Kribi	
Hôtel Ilomba		T: 346 21 44 / 346 17 44	Kribi	
Hôtel Le Paradis		T: 346 19 93 / 18 39 F: 346 12 47 / 14 38 M: 968 85 67 / 998 54 21 / 785 09 61	PO Box 232 Kribi	
Hôtel Framotel		T: 346 15 41 / 346 13 58 F: 346 15 41 M: 994 82 22 / 994 82 23	PO Box 355 Kribi	
Résidence Jully		T: 346 15 62 / 17 67 / 68 M: 968 75 70	Kribi	

Adamoua Province

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Governors and Senior Divisional Officers				
Governor	Mr. Joseph NOUTSA	T: 225 20 54 (B) 225 17 06 (D) M: 778 34 34 / 971 35 21	Ngaoundere	
Vina Division Senior Divisional Officer	Mr. BABA NGAMDJI	T: 225 23 70 (B) 225 20 81 (Sec) 225 24 50 (D) M: 985 15 52	Ngaoundere	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mr. DAMOU LAMTOING Antoine**	T: 225 25 02 / 11 68 M: 980 29 23	Ngaoundere	
MINEPIA Provincial delegate	**Dr ADAMOU ABBA**	T: 225 10 24 / 225 10 02 M: 997 60 08	Ngaoundere	
MINMEE Provincial delegate	**Mr. FUMTCHOUM Flobert**	T: M: 992 60 08	Ngaoundere	
MINCOM Provincial delegate	**Mr. Louis Claude BAHANE**	T: 225 13 74 / 225 19 71 M: 752 40 64	Ngaoundere	
Local ports and airports (For Customs, see MINFIB -- Ministries)				
Ngaoundere National Airport		T / F : 325 11 57	PO Box 249 Ngaoundere	
Local hotels and other services				
Transcam Hôtel		T: 225 12 52	Ngaoundere	

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
		M: 947 33 45		
Hôtel Relais		T: 225 11 38 F: 225 11 41 M: 967 88 10	PO Box 47 Ngaoundere	
Hôtel du Lac		T: 225 18 2 M: 986 93 74	Ngaoundere	
Hôtel du Rail		T: 225 10 13	Ngaoundere	

Central Province

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Governors and Senior Divisional Officers				
Governor	**Mr. FAI YENGO Francis**	T: 221 38 21/221 18 32 (B) 223 03 55 (D) M: 776 27 19	PO Box Yaounde	
Mfoundi Senior Divisional Officer	**Mr. MANI Pacal**	T: 220 73 73 (B) 220 72 73 (Sec) 231 18 78 (D) M: 742 38 62 / 997 74 92	PO Box Yaounde	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mr. YADJI BELLO**	T: 221 42 11 M: 992 60 47	Yaounde	
MINEPIA Provincial delegate	**Dr OMBEDE OHANDJA T**	T: 231 25 56 M: 993 38 33	Yaounde	
MINMEE Provincial delegate	**Mr. MENGUELE Jean Claude**	T: 223 13 34 F: 223 52 75	Yaounde	
MINCOM Provincial delegate	**Mr. ASSALE Jean Claude**	T: 220 33 99	Yaounde	
Local ports and airports (For Customs, see MINFIB -- Ministries)				
Yaounde Nsimalen International Airport		T: 223 36 02 F: 223 45 20	Yaounde	
Local fire departments, hospitals and police				
Fire Fighters Yaounde Brigade	**Captain MIKAILA** Commander	T: 223 14 79 F: M: 792 57 78	PO Box 6863 Yaounde	
Downtown help Centre Collège de la Retraite Etoudi Mimboman		T: 223 55 93 / 223 99 08 220 32 68 222 22 41	Yaounde	

Position Division	**Name**	**Telephone Fax Mobile E-mail**	**Postal address**	**Comments**
Local hotels and other services				
Hôtel Hilton		T: 223 36 46 / 222 34 16 F: 222 32 10	PO Box 11852 Yaounde	
Hôtel Mt FEBE		T: 220 29 51 /221 40 02 F: 221 60 70	PO Box 711 Yaounde	
Hôtel des Députés		T: 223 63 83 / 22 63 84 F: 223 37 10	PO Box 24 Yaounde	
Hôtel Mercure		T: 222 21 31 / F: 222 21 61 M: 989 02 20 / 989 02 21	PO Box 14304 Yaounde	
Nyong et Kelle Division				
Eseka Senior Divisional Officer	**Mr. NGONG Justin**	T: 228 65 85 (B) 228 64 42 (Sec) 228 60 54 (D) M: 738 54 68	Eseka	
Upper Sanaga Division				
Nanga Eboko Senior Divisional Officer	**Mr. ABANDA Jean Bienvenue**	T: 223 86 22 (B) 223 86 44 (D) M: 771 00 95 / 956 01 67	Nanga Eboko	

West Province

Position Division	**Name**	**Telephone Fax Mobile E-mail**	**Postal address**	**Comments**
Governors and Senior Divisional Officers				
Governor	**Mr. AHMADOU TIDJANI**	T: 344 13 93 / 35 66 (B) 344 36 36 (D) M: 989 06 40 / 776 55 35	PO Box Bafoussam	
Mifi Division Senior Divisional Officer	**Mr. NDJAGA Jules Marcellin**	T: 344 47 85 M: 981 29 78 / 773 65 09	PO Box Bafoussam	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mme MBAH Grace**	T: 344 11 70 M: 750 14 46	PO Box Bafoussam	
MINEPIA Provincial delegate	**Dr NSANGOU CHOUAiBOU**	T: 344 11 50 / 344 14 92 M: 984 06 90	PO Box Bafoussam	
MINMEE Provincial delegate	**Mr.ASSOUMOU Jacob**	T: 344 14 67 / 344 15 63 M: 985 87 54	PO Box Bafoussam	
Local hotels and other services				
Hôtel Le Président		T: 344 13 21 / 11 36	PO Box Bafoussam	
Hôtel Talotel		T: 344 41 85/61 81 / 43 46	PO Box Bafoussam	

OPERATORS IN THE OIL INDUSTRY

Organisation	Name Position	Telephone Fax Mobile E-mail	Postal address	Comments
COTCO	**Mr. E.R. (Ed) CALDWELL** EPI Manager	T: 343 35 00 F: 342 95 96 M: 795 71 72	PO Box 3738 Douala	
SONARA (Limbe Refinery)	**Mr. TAKERE Derrick** Director, Risks	T: 342 38 15/333 22 38 F: 342 34 44	PO Box 365 Limbe	
SCDP (Douala – Head Office)	**Dr NGUINI EFFA Jean Baptiste** General Manager	T: 340 37 39/342 09 63 (D) F: 340 47 96 M: 770 32 58	PO Box 2271 Douala	

C.2 LIST OF FACILITIES (MATERIALS AND EQUIPMENT) AVAILABLE FOR USE IN THE EVENT OF AN OIL SPILL REPORT

C.2.1 COTCO Oil Spill Response Equipment for Tier 1

C.2.1.1 Maintenance Area 2

Tier 1 response equipment

Response equipment for a Tier 1 spill is available at Pump Station 2 (Dompta) and from spill kits on company maintenance vehicles. MA-2 personnel provide the manpower to respond to Tier 1 spills.

The following table lists the equipment for a Tier 1 response.

Table D-1 Tier 1 Response Equipment

EQUIPMENT	UNIT	DOMPTA
Boat		
6m x 2m Jon boat, 60 hp outboard, sump, with trailer	boat	1
6-m Boston Whaler, 40 hp outboard, with trailer	boat	1
Boom		
River boom (50-cm)	meters	600
Shoreseal boom - neoprene	meters	100
Sorbent sweep	meters	750
Snare boom (pom-pom boom)	meters	750
Log boom assembly (materials for)	meters	300
Anchor and mooring systems	system	10
Skimmers		
Portable drum/brush skimmer system	system	1
Portable rope mop skimmer system	system	1
Weir and screw pump skimmer system	system	1
Storage		
Fastanks (23 cubic meters)	tank	2
Shoreline/River Bank Cleanup		
Shovel package (50 in each)	pkg.	2
Rake package (50 in each)	pkg.	2
Portable incinerator	unit	1
Handheld torch	unit	2
Other		
6m enclosed trailer- boom & sorbents	unit	1
Spill Kit (overpack barrel)*	kit	1
Sorbent pads	rolls	5
PPE assemblies for 50 workers	ass.	1
Note: *Spill kits to be located on field inspection trucks.		

C.2.1.2 Maintenance Area 3

Tier 1 response equipment

Response equipment for Tier 1 spills is available at Pump Station 3 (Bélabo) and from spill kits on Project maintenance vehicles. MA-3 personnel provide the manpower to respond to a Tier 1 spill.

The following table lists the equipment for a Tier 1 response.

Table D-1 Tier 1 Response Equipment

EQUIPMENT	UNIT	BÉLABO
BOAT		
6m x 2m Jon boat, 60 hp outboard, sump, with trailer	boat	1
6-m Boston Whaler, 40 hp outboard, with trailer	boat	1
TRUCK		
Hi-rail utility truck, crew cab, with hydraulic crane, dual winches, flatbed	truck	1
BOOM		
River boom (50-cm)	meters	600
Shoreseal boom - neoprene	meters	100
Sorbent sweep	meters	750
Snare boom (pom-pom boom)	meters	750
Log boom assembly (materials for)	meters	300
Anchor and mooring systems	system	10
SKIMMERS		
Portable drum/brush skimmer system	system	1
Portable rope mop skimmer system	system	1
Weir and screw pump skimmer system	system	1
STORAGE		
Fastanks (23 cubic meters)	tank	2
SHORELINE/RIVER BANK CLEANUP		
Shovel package (50 in each)	pkg.	2
Rake package (50 in each)	pkg.	2
Portable incinerator	unit	1
Handheld torch	unit	2
OTHER		
6m enclosed trailer- boom and sorbents	unit	1
Spill kit (overpack barrel)*	kit	1
Sorbent pads	rolls	5
PPE assemblies for 50 workers	ass.	1

Note: *Spill kits to be located on field inspection trucks.

C.2.1.3 Maintenance Area 4

Tier 1 response equipment

Response equipment for a Tier 1 spill is available at the Ngoumou storage yard and rail head, at the Pressure Reducing Station (PRS) in Kribi, and from spill kits on Project maintenance vehicles. MA-4 personnel provide the manpower to respond to Tier 1 spills.

The following table lists the equipment for a Tier 1 response.

Table D-1 Tier 1 Response Equipment

EQUIPMENT	UNIT	Ngoumou	Kribi
BOATS			
6m x 2m Jon boat, 60 hp outboard, sump, with trailer	boat	1	--
TRUCKS			
Hi-rail utility truck, crew cab, with hydraulic crane, dual winches, flatbed	truck	1	--
BOOM			
Inflatable neoprene boom (1-m) on reels	meters	--	150
Curtain boom (50-cm)	meters	--	1,300
River boom (50-cm)	meters	600	--
Shoreseal boom - neoprene	meters	100	100
Sorbent sweep	meters	750	900
Snare boom (pom-pom boom)	meters	750	1,000
Anchor and mooring systems	system	10	20
SKIMMERS			
Portable drum/brush style skimmer system	system	1	1
Portable rope mop skimmer system	system	1	1
Weir and screw pump skimmer system	system	1	1
STORAGE			
Fastanks (23 cubic meters)	tank	2	3
SHORELINE/RIVER BANK CLEANUP			
Shovel package (50 in each)	pkg.	2	4
Rake package (50 in each)	pkg.	2	4
Portable incinerator	unit	1	1
Handheld torch	unit	2	--
OTHER			
6m enclosed trailer- boom & sorbents	unit	1	2
Spill kit (overpack barrel)*	kit	1	1
Sorbent pads	rolls	5	5
PPE Assemblies for 50 workers	assm.	1	1

*Spill kits to be located on field inspection trucks.

C.2.2 COTCO Oil Spill Response Equipment for Tier 2

Response equipment for a Tier 2 spill is provided locally by COTCO and from available Mutual Aid entities. Tier 2 assets for the area specific response plans are staged at various locations along the pipeline.

Table D-2 Tier 2 Response Equipment

Equipment	Unit	FSO	Support Vessel	Supply Vessel	Kribi	Douala	Ngoumou	Belabo	Dompta	OFDA	Total
BOATS											
30' V-hull fast response boats with trailer twin 75HP outboards	FRV					2					2
Pontoon vessel with trailer and twin 40 hp outboards	boat				1						1
18-20' x 6' Jon boat w/ 60 hp outboard; sump; trailered	boat					1	1	1	1	1	5
18' Boston Whaler, 40HP outboard & trailer	boat							1	1	1	3
BOOM											
36" Inflatable neoprene boom on Al reels	ft	500	600	600	500	500					2,700
Hydraulic power packs for reels		1	1	1		1					4
8x12" Curtain boom	ft				4,500	4,500					9,000
8x12" River boom w/ top cable	ft						2,000	2,000	2,000	2,000	8,000
Shoreseal boom -neoprene	ft				300	300	300	300	300	300	1,800
Sorbent sweep	ft				3,000	3,000	2,500	2,500	2,500	5,000	18,500
Snare Boom (Pom Pom Boom)	ft				3,000	3,000	2,500	2,500	2,500	2,500	16,000
Log boom assembly (materials for)	ft							1,000	1,000	1,000	3,000
Anchor systems	system	8	4	4	20	20	10	10	10	10	96

Continued

Table D-2, Continued

Equipment	Unit	FSO	Support Vessel	Supply Vessel	Kribi	Douala	Ngoumou	Belabo	Dompta	OFDA	Total
DISPERSANTS/CLEANERS											
Corexit 9500 (dispersant)	bbls		50	50	50	50					200
Corexit 9580 (cleaner)	bbls				10	10					20
SKIMMERS											
Portable drum/brush style skimmer system (inc. 2" pump and power pack)	system				1	1	1	1	1	2	7
Portable rope mop skimmers w/ hyd. power pack & 2" pump					1	1	1	1	1	1	6
Vessel mount brush (Lori, Lamor) w/ outrigger system			1	1							2
Weir & screw pump skimmer system (DOP 160 Termite w/ MPC power pack)	system				1	1	1	1	1	1	6
STORAGE											
Onboard storage	bbl		500	500		20					1,020
249 bbl Aluminum barge	barge				1	1					2
Fastanks (5000 gall)	tank				3	3	2	2	2	4	16

Continued

Table D-2, Continued

Equipment	Unit	FSO	Support Vessel	Supply Vessel	Kribi	Douala	Ngoumou	Belabo	Dompta	OFDA	Total
SHORELINE/RIVER BANK CLEANUP											
Shovel package (50 in each)	pkg.				4	4	2	2	2	2	16
Rake package (50 in each)	pkg.				4	4	2	2	2	2	16
Portable incinerator	unit				1	1	1	1	1	2	7
Handheld Torch	unit						2	2	2	4	10
OTHER											
18' enclosed trailer- boom & sorbents	unit				2	1	1	1	1	1	7
18' enclosed trailer- Boom & Field Command	unit					1				1	2
Spill Kit (overpack barrel)*	kit				1	2	1	1	1	6	12
Sorbent pads	rolls	5	5	5	5	30	5	5	5	30	95
PPE Assemblies for 50 workers	ass.				1	1	1	1	1	2	7

*Spill kits to be located on MA trucks (and at fields on OFDA)

Continued

Mutual Aid Agreement – Offshore and Maintenance Area 4

Tier 2: Mutual Aid Agreement Mutual aid resources could be used for a Tier 2 or Tier 3 response (Table D-3). These resources comprise additional dispersant capabilities, available through agreement with Mobil Equatorial Guinea.

Table D-3 Spill Response Equipment Available Through Mutual Aid

Mobil Equatorial Guinea, Inc.

Vessel Name	Owner	Type	Dispersant Ready	Home Port/Location
Pacific Supplier	Swire Pacific	AHTS	Yes	Malabo, EQ
Pacific Buccaneer	Swire Pacific	AHTS	Yes	Malabo, EQ
Pacific Barbarian	Swire Pacific	AHTS	Yes	Malabo, EQ

Equipment	Units	Abayak	Zafiro	Malabo Aviation Base
Boat spray system	system	1		
Corexit 9500A	200 liter drums	27		
Corexit 9527	200 liter drums	7	10	4
Helo Simplex Sling Spray	system			2

C.2.3 Communications Equipment

C.2.3.1 Maintenance Area 2

Introduction Communications equipment available immediately for a Tier 1 and Tier 2 spill response is listed in this section.

Table D-3 Communications Equipment for Spill Response

Item	Specifications	Dompta	Bélabo	OFDA	Douala
Hand-held VHF Radio	Make, model, intrinsically-safe			10	10
Hand-held VHF Radio	Make, model				
Mobile VHF Repeater				1	

C.2.3.2 Maintenance Area 3

Introduction Communications equipment available immediately for a Tier 1 and Tier 2 spill response is listed in this section.

Table D-3 Communications Equipment for Spill Response

Item	Specifications	Ngoumou	Douala	Bélabo	
Hand-held VHF Radio	Make, model, intrinsically-safe		10	10	
Hand-held VHF Radio	Make, model				
Mobile VHF Repeater			1	1	

C.2.3.3 Maintenance Area 4

Introduction Communications equipment available immediately for a Tier 1 and Tier 2 spill response is listed in this section.

Table D-4 Communications Equipment for Spill Response

Item	Specifications	Ngoumou	Kribi	Bélabo	Douala
Hand-held VHF Radio	Make, model, intrinsically-safe				10
Hand-held VHF Radio	Make, model				
Mobile VHF Repeater					1

C.3 OIL SPILL REPORT : OSR000

Cameroon National Oil Spill Contigency Plan

Oil Spill Report OSR000

This form should be completed for oil spills that are not reported by the parties responsible for the incidents. In most situations, the National Competent Authority (NCA) will complete the form through reference to information supplied by a member of the public or an authority who may have observed, or been informed of, an incident. It is anticipated that much of the information will be anecdotal.

DO NOT DELAY SUBMITTING THIS REPORT DUE TO INSUFFICIENT INFORMATION.

SEND TO: National Competent Authority **Tel:** **Fax:**

	DD	MM	YY		(24 hr clock)	
Report Date:				**Time of spill:**		
Spill Date (if unknown, estimate date):						

Person reporting spill: ____________________

Telephone: ____________________ **Fax:** ____________________

DESCRIPTION OF OIL SPILL INCIDENT

Location of spill or observed spilled product
(location relative to closest town, village or other locatable feature):

Brief description of spill incident and present status:

Type of oil spilled (unrefined crude oil; petrol; diesel; other):

Spill size (metric units; any other appropriate descriptor):

Apparent cause of spill:

Present situation:

Threats to human safety:

Particulars of any socio-economic or environmental resources threatened/impacted:

Particulars of any socio-economic or environmental resources threatened/impacted:

Actions taken thus far:

Any additional information

For official use only:

Note: National Competent Authority to complete and post (registered) or fax back to person/authority who reported the incident.

Report prepared/acknowledged by:

Name: ______________________ **Signature:** ______________________

Date: ______________________

File Ref No.: ______________________

C.4 OIL SPILL REPORT : OSR001

Cameroon National Oil Spill Contingency Plan

Oil Spill Report 0SR001

This form should be completed and posted (registered) or faxed to the National Competent Authority within 24 hours of any spill. Information provided should be as accurate and complete as possible. This report can also be used to provide updates on the spill, which should also be submitted to the National Competent Authority. In the event of Tier 2 and 3 incidents, Report OSR002 should be completed and submitted to the National Competent Authority on termination of the spill response activities.

DO NOT DELAY SUBMITTING THIS REPORT DUE TO INSUFFICIENT INFORMATION BEING AVAILABLE TO COMPLETE THE REPORT IN FULL

SEND TO: National Competent Authority **Tel:** **Fax:**

Initial Spill Report: ☐
Spill Report Update: ☐
Final Spill Report: ☐
(indicate with a cross, X)

	DD	MM	YY
Report Date:			
Spill Date:			

Time of spill: (24 hr clock) ____ ____

Company/Operator: ____________________

Contact person: ____________________ **Signature:** ____________________
(Person submitting the report)
Telephone: ____________________ **Fax:** ____________________
Radio (type & frequency): ____________________

DESCRIPTION OF OIL SPILL INCIDENT

	Tier 1	Tier 2	Tier 3
Classification of spill:			

Vol of oil spilled (m^3): ____________ **Type of oil spilled:** ____________

Location of initial spill (include Lat and Long coordinates and/or description of location):

Brief description of spill incident and present status:

Actions taken thus far:

Prevailing weather and environmental conditions. Describe predicted movement of oil:

Particulars of any socio-economic or environmental resources threatened/impacted:

Is additional assistance required, and in what form?

Any additional information

For official use only:
Note: National Competant Authority to complete and post (registered) or fax back to operator.

Receipt of report acknowledged by:

Name: ______________________ **Signature:** ______________________

Date: ______________________

File Ref No.: ______________________

C.5 OIL SPILL RESPONSE/CLEAN-UP REVIEW REPORT : OSR002

Cameroon National Oil Spill Contingency Plan

Oil Spill Response/Clean-up Review Report 0SR002

A post-spill audit should be undertaken by the operator after the response and clean-up actions (if any) are terminated. The terms of reference for the post-spill audit should be submitted to the National Competent Authority within one week following the termination of the oil spill response activities.

SEND TO: National Competent Authority	**Tel:**	**Fax:**

Company/Operator: ____________________

Contact person: ____________________ **Signature:** ____________________

Telephone: ____________________ **Fax:** ____________________

Time of spill: (24 hr clock)

	DD	MM	YY
Report Date:			
Spill Date:			
Termination of Oil Spill Response Date			

REVIEW OF OIL SPILL INCIDENT AND RESPONSE AND CLEAN-UP ACTIONS

Description of oil spill incident:

Include reasons for the spill, environmental conditions, volume and type of oil spilled, spill location.

Description of response and clean-up actions

Assessment of the effectiveness of response and clean-up actions:

Initial assessment of environmental and socio-economic impacts

Tier 1: Provide a brief assessment of any environmental and socio-economic impacts. Propose impact mitigation measures, where required.

Terms of reference for Post-Spill Audit

Tier 2 and 3: Provide detailed terms of reference for a post-spill audit (see Data Directory Section C.6, for guidelines).

For official use only:

Note: National Competent Authority to complete and post (registered) or fax back to operator.

National Competent Authority's comments on Review Report

National Competent Authority's comments on Terms of Reference for Post-Spill Audit (Tier 2 and 3)

Post-spill Audit Terms of Reference (Tier 2 and 3) accepted:

Name: ______________________ **Signature:** ______________________

Date: ______________________

File Ref No.: ______________________

C.6 GUIDELINES FOR INCIDENT REVIEW AND POST-SPILL AUDIT

It is a requirement of the NOSCP that an incident review and a post-spill audit be undertaken by the operator responsible for the spill and that this process should be initiated (through the submission of the *Oil Spill Response/Clean-up Review Report*, *OSR002*) within one week following the termination of oil spill response activities. In this respect, the following elements of the process are relevant: (i) the incident review, which is conducted by the operator responsible for the oil spill; (ii) the terms of reference for the post-spill audit, which are prepared by the operator; (iii) the review of these terms of reference by the NCA; (iv) the conduct of the post-spill audit by a competent institution working under the instruction of the operator; and (v) the review of the post-spill audit by the NCA.

The aim of the incident review and audit is to establish the causes of the incident, the effectiveness of the response and clean-up actions (if any) that were instituted and to derive an objective measure of any significant socio-economic and environmental impacts arising from the incident. Underpinning this aim, is the desire to prevent similar incidents from occurring in future and/or to improve the effectiveness of response and clean-up measures. The guidelines presented here are intended to direct the review and audit process so that this aim is achieved.

The following guidelines provide a framework within which the above actions can be undertaken in a consistent manner.

REVIEW OF OIL SPILL INCIDENT RESPONSE AND CLEAN-UP EFFECTIVENESS

The following information should be included in the *Oil Spill Response/Clean-up Review Report, OSR002*, in which the incident, the response and clean-up measures are reviewed and (in the case of Tier 2 and 3 incidents) the terms of reference of a post-spill audit are proposed. As a minimum, the following information must be supplied:

- Description of the incident (reasons for the spill, environmental conditions, volume and type of oil spilled, spill location, etc.);
- Description of response and clean-up actions;
- Assessment of the effectiveness of these actions;
- For a Tier 1 incident, a rapid assessment should be made (and documented) of any environmental and socio-economic impacts arising from the spill. Impact mitigation measures should be proposed, where required; and
- Recommendations should be provided to improve the effectiveness of future response and clean-up actions, which may require a revision of the operators' Oil Spill Response Plan (e.g. COTCO and SCDP plans) and, possibly, the NOSCP.

POST-SPILL AUDIT

In the case of Tier 2 and 3 incidents, the terms of reference for a post-spill audit should include the following:

- Description of the approach that will be used to define the spatial extent of the oil spill and product dispersed onto the land or into a water body; (e.g. based on surveillance information);
- Approach to be adopted for describing the potentially affected natural biophysical and socio-economic components of the environment. Here, it is expected that information contained in the NOSCP will provide one reference source;
- Approach to be adopted to quantitatively measure levels of environmental deterioration (e.g. soil analyses and the use of bio-indicators to establish changes to soil or water quality relative to reference states in areas unaffected by the spill);
- Approach to be used to assess the significance of oil spill impacts on the biophysical and socio-economic environment;
- Approach to be adopted for impact mitigation (in addition to the response interventions already instituted), including, for example:
    - Compensation of affected communities, and
    - Rehabilitation of affected ecosystems
- Approach to be adopted for monitoring residual environmental impacts of the oil spill, including parameters to be measured, frequency of measurements, and how the monitoring data will be interpreted; and
- Action plan for implementing the post-spill audit.

The terms of reference for the post-spill audit shall be reviewed by the NCA, or by any institutions judged by the NCA to be competent to conduct the review. In conducting the review, an assessment should be made of the extent to which the terms of reference of the post-spill audit will deal with (as a minimum) the points listed above. Following the completion of the audit by the operator, the NCA, or any institution judged by the NCA to be competent, shall gauge the extent to which the terms of reference for the audit have been met. Where there are deficiencies in the audit, the review should reveal these, and instructions should be issued to the operator to address these deficiencies.

MARINE AND COASTAL

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Strategy

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A.1 STATUTORY AND PLANNING FRAMEWORK

This section outlines both the international legal instruments that are relevant to the prevention and combating of oil spills in the waters of Cameroon, as well as the local statutes that have a bearing on oil spill response activities within the country and its territorial waters.

International instruments include global conventions and treaties largely initiated by the International Maritime Organisation (IMO) to address issues relating to pollution of the sea by oil, as well as regional agreements devised to facilitate regional response to oil spills. The relevant international and regional conventions and agreements are described here to define the framework within which the National Authorities may act in dealing with an oil spill, or a threat of an oil spill at sea. This background also serves to address the issue of compensation for actions taken and loss and damage incurred during and following an oil spill at sea.

The description of the national regulatory framework provides the background from which the national, provincial and local authorities are structured to fulfil their responsibilities in preparing for and responding to an oil spill at sea. The roles and responsibilities of the various relevant authorities, which are described later, are drawn from the provisions of the national statutes.

A.1.1 International and Regional Conventions and agreements

A.1.1.1 International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969

As a Contracting Party to this Convention, Cameroon "may take such measures on the high seas as may be necessary to prevent, mitigate, or eliminate grave and imminent danger to its coastline or related interests from pollution or threat of pollution of the sea by oil, following upon a maritime casualty or acts related to such a casualty, which may reasonably be expected to result in major harmful consequences." This means that in the event of a casualty situation involving a sea-going vessel (not, for example, an oil production platform) which is, or is likely to spill oil, be it within or outside territorial waters, and is likely to impact on the interests of the State, then the authorities can take whatever proportionate action (including towing away and/or sinking) that is necessary to remove such risk.

A.1.1.2 International Convention on Civil Liability for Oil Pollution Damage, 1992 (CLC '92)

The aim of this convention is to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. Here, it is important to note that the convention does not cover compensation for oil spills resulting, for example, from offshore oil production platforms. In terms of the CLC the ship owner is strictly liable (with a few exceptions) for clean-up costs, preventative measures and pollution damage, including reasonable restoration costs, resulting from a spill of persistent oil (not light oils, such as petrol and diesel) in the territorial waters and exclusive economic zone (EEZ) of a contracting party. This covers a spill of both the cargo and the vessel's bunker fuels. All tankers in the waters of a contracting party need to carry compulsory insurance to cover costs covered by the CLC. The maximum costs payable in terms of the convention are in the order of US$ 86.3 million for tankers over 140 000 DWT, and proportionately less for smaller tankers.

Cameroon has ratified and become a contracting party to the CLC, which came into force locally on 15 October 2002. This means that all tankers entering the EEZ of Cameroon are required to carry adequate insurance to cover their liability for clean-up costs and pollution damage suffered within the EEZ. As a consequence, the Government of Cameroon and its citizens have direct recourse to claim costs for loss and damage suffered as a result of an oil spill from the insurers of the vessel. These claims can include costs for taking preventative measures to stop the oil from impacting resources such as mangrove ecosystems, costs for cleaning up the oil spill, costs for damage to resources such as fishing equipment, costs for loss of earnings such as in the case when fishermen cannot put to sea, reasonable costs for rehabilitating affected areas that have suffered as a result of the oil spill, etc.

A.1.1.3 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992 (FUND '92)

The FUND Convention provides supplementary compensation to the CLC where the costs related to the oil spill exceed the CLC limit as described above, the exemptions specified under the CLC apply, or where the insurance cover under the CLC is insufficient to meet the prescribed limits of the ship owner. The convention provides for the establishment of an international oil pollution fund made up from levies on imported persistent oils or persistent oils moved between the ports of a contracting party. To this effect, companies operating within the area of jurisdiction of a contracting party pay an annual levy to the Fund, proportional to the amount of persistent oil imported (above a minimum amount of 150 000 tonnes) as well as persistent oil moved along the coast between ports. Whereas the ship owner attracts liability under the CLC, the cargo owner attracts liability under the FUND Convention. Claims for clean-up costs and pollution damage are covered up to a maximum of approximately US$ 195 million.

Cameroon has ratified and become a contracting party to the FUND Convention on 10 October 2002. This means that the SONARA refinery at Limbe, which imports approximately 1.5 million tonnes of crude oil via its jetty annually, will pay a levy to the FUND. The government of Cameroon and its citizens may lodge claims for loss and damage against the Secretariat of the FUND for the same issues described in Section A.1.1.2. The Fund Convention Guide to Claims procedures provides an important reference in this regard.

A.1.1.4 International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC '90)

Cameroon is not a contracting party to the OPRC, and in terms of this convention, has not entered into any bilateral or multilateral agreement with neighbouring states regarding co-operation in planning for or responding to oil spills in their waters. Other contracting states or the IMO are not required to render assistance to Cameroon in the event of an oil spill, as would be the case if Cameroon was a contracting party to the convention. However, in practice this does not necessarily mean that assistance would not be forthcoming.

A.1.1.5 Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region and the Protocol concerning co-operation in combating pollution in cases of emergency (Abidjan Convention)

Cameroon is a signatory to Abidjan Convention and Protocol, which aim (*inter alia*) to provide for regional co-operation in dealing with oil spills. However, the convention is currently not being effectively implemented and, therefore, does not provide a proper platform for regional co-operation as originally envisaged by the signatory states. Measures are being instituted to revive the convention in order to provide for co-operation in the region in the future.

A.1.2 National legislation and decrees

A.1.2.1 Introduction

The process whereby a general environmental awareness has been initiated in Cameroon, and environmental legislation has been drafted in support of this, was triggered by the Rio Earth Summit of June 1992. Flowing from this important occasion was the creation in 1992 of a cabinet level department, the Ministry of Environment and Forests (MINEF), through the issuance of Decree n° 92/069 dated 09 April 1992.

MINEF is responsible for the overall formulation and execution of the national environmental policy, the determination of strategies for sustainable management of natural resources and the prevention of pollution. In this regard, a priority for MINEF has been the preparation, and adoption in 1996, of the Cameroon National Plan for Environmental Management (PNGE), which in turn paved the way to the issuance and adoption of the Environmental Framework Law (Law N° 96/12 of 5 August 1996) relating to environmental management.

In 1996, the developing concern for the environment became formally entrenched as a national priority through the emphasis on environmental quality in the preamble of the country's Constitution. This fundamental law prescribes that each person has the right to a clean environment, for which the State is accountable, and that the protection of the environment is the duty of every citizen. During the same year (1996) Law 96/14 dated 5

August 1996 was published, which governs the pipeline transportation of liquid or gaseous hydrocarbons (produced by the other countries) through the territory of the Republic of Cameroon. This law was enacted to enable the realization of the Chad/Cameroon Pipeline Project, a major project with significant potential for environmental impacts. Law 96/14 and its application decree, N° 97/116 issued on 7 July 1997, require from any pipeline operator, adherence to technical norms and best practice regarding the protection of the physical as well as human environment.

In terms of relevance to the NOSCP, the above developments in national environmental legislation are most pertinent.

A.1.2.2 Government institutions administering environmental legislations and regulations

The President of the Republic is the highest authority regarding the formulation of national environmental policy applicable to the Republic of Cameroon. The Government, through various ministries and in collaboration with some specialized national institutions and organizations, is responsible for the implementation of the national environmental policy.

The main Government institution (Competent Authority) tasked with policy implementation and the administration and coordination of environmental management issues at the national scale is the *Ministry of Environment and Forests* (MINEF). This responsibility is vested upon MINEF by the provisions of the Environmental Framework Law. However, it is important to recognise that the notion of Competent Authority, expressed in various other laws (Petroleum Code, Mining Code and others) brings into play other Government institutions and/or organizations in the implementation of environmental policies in specific domains, such as the hydrocarbons sector.

In the case of the hydrocarbons sector, the Ministry in charge of hydrocarbons - i.e. the *Ministry of Mines, Water Resources and Power* (MINMEE) - is assigned responsibility pertaining to various environmental management issues related to petroleum operations. Separate and joint responsibility for the environment therefore exists, illustrated, for example, by the legal requirement for waste management plans, based on an integrated pollution control system, to be submitted to both the Minister in charge of environment and the Minister in charge of hydrocarbons. To illustrate this further, in addition to the responsibilities of the Minister of the environment, it is also the responsibility of the Minister in charge of hydrocarbons (based on the Petroleum Code, Law 99/013) to evaluate and approve the measures taken by holders of petroleum contracts to protect the natural bio-physical and human environment in the execution of their operations. In this regard, the Petroleum Code (Law 99/013) and its application decree require the Minister in charge of hydrocarbons to approve the appointment of experts commissioned by the holders of petroleum contracts to carry out environmental impact assessments.

The Ministry of Mines, Water Resources and Power is the government department in charge of promoting mining and geological activities as well as the follow-up and monitoring of petroleum exploration and exploitation activities. The involvement of this Ministry in environmental matters relates more specifically to:

- Identification of natural risks as well as the surveillance and protection of persons and goods, in collaboration with all other ministries involved with management of risks and catastrophes; and
- The monitoring of industrial and commercial facilities for pollution risks, safety, hygiene and industrial nuisances.

The National Hydrocarbons Corporation (*Société Nationale des Hydrocarbures* – SNH), is the national oil company of Cameroon, placed under the supervision of the Presidency of the Republic, and is the State's secular arm responsible for:

- The management of the State interests in the petroleum sector; and
- The promotion and follow-up of all hydrocarbons activities in Cameroon.

To this effect, SNH represents the State in every oil and gas exploration and production venture. It is entrusted by the State to ensure that there is full compliance by the petroleum companies with the standards and regulations pertaining to the execution of hydrocarbons activities, including those aimed at the protection of the environment.

A.1.2.3 Legislation provisions for oil spill prevention and response

Legislation is in place within Cameroon that provides for general measures to prevent and/or combat pollution of the environment by oil (hydrocarbons). Specific environmental legislation relating to the hydrocarbons sector regarding the prevention and combat of oil spills must still be issued; however, there are general provisions that exist in the Environmental Framework Law that are applicable to the hydrocarbons sector. The following provisions of this law are most pertinent:

ARTICLE 6:

- Public and private institutions shall, within the context of their competence, sensitize all the populations on environmental problems; and
- the institutions shall consequently include programmes in their activities to provide better knowledge of the environment.

ARTICLE 7:

- All persons shall have the right to be informed on the negative effects of harmful activities on man, health, and the environment, as well as on the measures taken to prevent or compensate for these effects.

Some fundamental principles are also applicable.

ARTICLE 9:

- The precautionary principle of precaution, according to which lack of certainty, given the current scientific and technical knowledge, should not retard the adoption of effective and commensurate measures aimed at preventing a risk entailing serious and irreversible damage to the environment at economically acceptable cost;
- The principle of preventative action and correction (through priority at the source) of threats to the environment by using the best available techniques at an economically acceptable cost;
- The principle of liability according to which any person who, through his actions, creates conditions likely to endanger human health and environment shall eliminate or cause said conditions to be eliminated in such a way as to avoid the said effects; and
- The principle of substitution according to which in the absence of a written general or specific rule of law on environmental protection, the identified customary norm of a given land, accepted as efficient for environmental protection, shall apply.

Regarding oil spills, the Environmental Framework Law, without prejudice of international conventions adhered to by the Republic of Cameroon, provides for the protection of the coast and maritime waters by prohibiting, through its article 31-1, any discharge or immersion into the country's maritime waters any substances likely to:

- Endanger human health and maritime biological resources;
- Hinder maritime activities, including navigation, aquaculture and fishing;
- Alter the quality of maritime waters from the point of view of their use; and
- Downgrade the aesthetic value and the touristic potential of the sea and the coast.

Article 32-1 of same law provides that in the event of damages or accidents involving any ship, aircraft, device or platform transporting or carrying hydrocarbons or harmful or dangerous substances in waters under Cameroonian juridiction, which may create a serious or imminent danger for the marine environment and its resources, the owner of such equipment shall be charged to pay for the rehabilitation of the contaminated site by the competent marine authorities, in accordance with the regulations promulgated under the law.

To date Cameroon must still issue the enabling national general regulations, where it will be stipulated what provisions are required for the prevention or combat of marine pollution originating from ships and installations situated at sea and/or on land. In the absence of such regulations, it is implicit that the substitution principle will apply, which relates to the adoption of international custom and/or best practice. In addition to this important principle of substitution, there are other specific regulations issued by the Republic of Cameroon that have application to the NOSCP. These include the laws and decrees of application that have been issued to enable the realization of the Chad-Cameroon Pipeline Project:

- Law 96/14 dated 5 August 1996 relating to transportation by pipelines of hydrocarbons from other countries;
- Decree 97/116 dated 7 July 1997 setting the conditions and modalities of application of Law 96/14; and
- Decree 2000/305 dated 17 October 2000, through which Authorization of Transportation by Pipeline was issued to the Cameroon Oil Transportation Company (COTCO).

The legal texts outlined above collectively provide a framework for the further issuance of national legislations dealing with matters pertaining to spills of hydrocarbon in the country's maritime waters and the hinterland.

A.1.3 Liability and compensation claims procedures

A major oil spill at sea may severely compromise the marine and coastal interests of a state and attract considerable costs – illustrated, for example by the Exxon Valdez oil spill in Alaska, where the intervention costs amounted to many billions of dollars. The following are pertinent to the situation in Cameroon:

- In the event of a large oil spill, attempts to prevent oil from impacting sensitive environmental features, efforts to retrieve spilled oil and the cleaning of contaminated areas, oiled seabirds, etc. would attract significant costs;
- Both industrial and artisanal fisheries may suffer economic loss as a result of the oiling of equipment (for example, nets) and the prevention of access to fishing waters affected by an oil spill; and
- Tourist facilities, such as coastal hotels, may suffer an occupancy reduction, and hence financial loss, due to the presence of oil pollution in their vicinity.

In order to remove the financial burden from coastal states severely impacted by an oil spill, international regimes have been established to apportion liability for these costs to the ship and cargo owner respectively, in situations where an oil tanker is the source of the oil spill. The international conventions that specify the provisions for liability and compensation are described in Section A.1.1; however, these do not cover the liability and compensation issues relating to oil spills resulting, for example, from offshore hydrocarbon exploration and production operations. These issues are covered by individual third party insurance contracts entered into by the oil companies in order to safeguard their interests in the event of an oil spill.

The following section outlines the issues that need to be considered to ensure that claims for compensation meet the expected requirements of claim procedures and are, therefore, settled with a minimum delay. Specific procedures for recording all aspects of the oil spill that are pertinent to seeking compensation for costs incurred or loss and damages suffered are outlined in more detail in the Operational Oil Spill Response Plan (Section B) for the Marine and Coastal Environment (*blue pages*).

A.1.3.1 Liability and claims associated with shipping incidents

A.1.3.1.1 Tanker traffic carrying persistent oils

Tanker traffic carrying persistent oils in Cameroonian waters mainly comprises the movement of vessels loading crude oil from the various offshore production platforms and COTCO's offshore facilities as well as the conveyance of crude oil from various sources to the SONARA refinery at Limbe. Other tanker traffic may also pass through Cameroonian waters, conveying product to and from foreign destinations. Spills of both the crude oil cargo and the bunker oil (whether the tanker was laden or unladen) from these vessels are covered by the two international liability and compensation conventions discussed in Section A.1.1. These vessels would, therefore, need to have compulsory insurance in terms of the CLC Convention and the ship owner would be strictly liable for clean-up costs and loss and damage resulting from a spill, up to a maximum of US$ 86.3 million. If the total costs exceeded this amount, claims could be made against the International Oil Pollution Fund up to the maximum of US$ 195 million as specified in the FUND Convention.

Anyone who has suffered pollution damage resulting from a spill in Cameroonian waters may make a claim for compensation in terms of the CLC and FUND conventions. Claimants may be private individuals, companies, private organisations or public bodies, including local, provincial and national authorities. In the case of the initial claims in terms of the CLC Convention, the claims should be submitted to the tanker owner or the owner's Protection and Indemnity (P&I) insurer. For claims exceeding the CLC limits, which are lodged in terms of the FUND Convention, these should be submitted directly to the London Secretariat of the FUND.

Claims in terms of pollution damage can fall under the following broad categories:

- Preventative measures (including clean-up);
- Damage to property;
- Economic loss; and
- Reinstatement/restoration of impacted environments.

More details of the claims that are admissible under these categories are described in the descriptive text of the International Oil Pollution Compensation Fund (1992) - to which reference can be made at www.iopcfund.org.

In the event of the prospect of significant claims arising from an oil spill, the P&I Insurers or the Secretariat of the 1992 FUND Convention (or both) will appoint technical experts to provide advice and assistance to whoever is in charge of the response operation, with the aim of reaching mutual agreement on the clean-up measures that are technically justified in the particular circumstances. In most cases, an expert from the International Tanker Owners Pollution Federation (ITOPF) will attend the spill to fulfil this role. Such experts are also often involved in the post-spill audit as it relates to the compensation process. It is, therefore, in the best interests of the claimant to work closely with both the insurers and the technical experts to ensure that all actions that are instituted are reasonable – thereby ensuring that the associated costs are not disputed at the time when claims for compensation are submitted.

Since many activities take place simultaneously during an oil spill response situation, it is essential that accurate and detailed records are kept of all actions associated with the response and of the costs incurred so that the claims for compensation can be fully substantiated at the time of the post-spill audit. The procedure for record-keeping to fully substantiate the claims for compensation is covered in more detail in the Operational Oil Spill Response Plan (Section B) for the Marine and Coastal Environment (*blue pages*).

A.1.3.1.2 Tanker traffic carrying non-persistent oils and other cargo vessels

Coastal tankers convey refined products, such as gasoline, diesel and paraffin, between the SONARA refinery at Limbe and the Port of Douala. These and other products may at times also be imported from elsewhere. Oil spills from these vessels are not covered under the CLC and FUND conventions, as the cargo does not comprise persistent oil. Similarly, a spill of bunker oil from a vessel carrying a cargo other than persistent oils would not be covered by these compensation regimes. In these situations, claims for compensation would need to be lodged directly with the P&I insurers of the vessel owner. As with the case of claims from oil tanker spills, it is important to keep detailed records of response and clean-up activities that are undertaken, and also to involve the insurers in the decision-making processes linked to such activities in order to facilitate a common understanding of the justification of the claim at the time of submission. The procedure for record-keeping to fully substantiate the claims for compensation is covered in more detail in the Operational Oil Spill Response Plan (Section B) for the Marine and Coastal Environment (*blue pages*).

A.1.3.2 Liability and claims associated with offshore exploration and production operations

There are no international conventions covering liability and compensation for oil pollution damage arising from a spill from an offshore platform and associated wells and pipelines. Compensation for oil pollution damage in this instance is, therefore, covered by the third party insurance taken out by the operators of these facilities.

In an oil spill situation, claims for compensation would need to be lodged directly with the insurers of the facility operator. As with the case of claims from oil tanker spills, it is important to keep detailed records of activities undertaken and also to involve the insurers in the decision-making process regarding the various interventions that might be taken in order to facilitate a common understanding of the reasonableness of the claim at the time of submission. The procedure for record-keeping, to fully substantiate the claims for compensation, is covered in more detail in the Operational Oil Spill Response Plan (Section B) for the Marine and Coastal Environment (*blue pages).*

A.1.4 Planning Framework

The Republic of Cameroon's neighbouring countries also carry out petroleum activities; i.e. the Federal Republic of Nigeria and the Republic of Equatorial Guinea. Although the Republic of Chad does not share a maritime border with Cameroon, it should, however, be considered in the same context as Nigeria and Equatorial Guinea since it has interests in the COTCO's offshore loading facilities (related to the Chad–Cameroon pipeline project), which is located in Cameroonian territorial waters.

While both the Federal Republic of Nigeria and the Republic of Equatorial Guinea are still in the process of developing their National Oil Spill Contingency Plans, both countries are signatories of, and parties to, most of the major international conventions related to the protection and the pollution of maritime waters (IMO, CLC 69 for Equatorial Guinea; CLC 92 for Nigeria; OPRC 90 for Nigeria; STCW 78, LOAD LINES 66, MARPOL73/78, FUND 71 for Nigeria; and Intervention 69 for Equatorial Guinea).

These conventions, to which Cameroon also has signatory status, specify the rights and obligations of signatory parties with regard to their relations with one another. For example, in case of oil spills originating from Cameroon or from either the Federal Republic of Nigeria or the Republic of Equatorial Guinea, regulations pertaining to the above international conventions will be applicable. In this regard, it is required that the relevant authorities in each country (the *National Competent Authority*, in the case of Cameroon – see Section A.4) should be promptly informed of such situations via the appropriate channels of communication (e.g. Ministries in charge of Foreign Affairs, the State Oil Companies).

Regarding the Chad-Cameroon pipeline project, the Republic of Cameroon and the Republic of Chad have entered into a Bilateral Agreement (on 08 February 1996) that sets the framework of cooperation between the two countries regarding the operation of the Chad–Cameroon oil transportation system, insofar as (*inter alia*) security, environmental protection and risk management are concerned. The two oil transportation companies COTCO (Cameroon) and TOTCO (Chad) are represented on the Commission created by the Chad-Cameroon Bilateral Agreement to oversee the execution of the agreement. Thus, any oil spill issues related to the COTCO's offshore loading facilities would be addressed via the mechanisms provided by the Chad–Cameroon Bilateral Agreement.

A.2 ANALYSIS OF MARINE AND COASTAL OIL SPILL RISK SOURCES

There are a number of oil spill risk sources affecting the marine and coastal environment – a situation that will continually change as new and different risk sources emerge; for example, as a result of an increase in the scale of offshore oil exploration and production operations, shipping, port activities, etc.

In this section of the NOSCP, the existing situation pertaining to the main risk sources associated with the marine and coastal environment will be broadly described in the form of a risk analysis. This characterization of risk sources begins with a description of their physical location, the hydrocarbon products with which they are associated, the probable magnitude and fate of oil spills to which they may give rise (where this can be reasonably defined), which includes, in some cases, determination of the oiling probability of the sea surface and shoreline.

The purpose of characterizing the main oil spill risk sources is, firstly, to derive an understanding of the patterns of risk concentration within the marine and coastal environment. This is done in order to anticipate where environmental and socio-economic impacts associated with potential oil spills are more/less likely to manifest and, therefore, to anticipate where resources for responding to oil spills should be directed in order to prevent or mitigate the impacts. Secondly, the integration of risk source information (location, potential spill magnitude, product type, spill fate) with an understanding of the broad environment within which they are located (the physical metocean environment, ecosystem represented in the region, the regional socio-economic and cultural environment – as described in Section A.3) provides a rational basis from which to prescribe the oil spill response strategies outlined in Section A.5.

Clearly, an important cluster of risk sources is the offshore exploration and production operations of the various oil companies operating in Cameroon. In the discussion that follows, a pattern that emerges is one of concentration of production activity in the Rio del Rey Basin, in the country's north-western coastal sector. This differs from the relatively low concentration of operations presently (January 2003) located offshore of the country's central and southern coast. This gradient in risk source concentration is also created by operations associated with shipping, the national oil refinery at Limbe and the Port of Douala, which are mainly associated with the country's central and north-western coastal sectors.

The future operation of COTCO's offshore facilities, under construction offshore of the country's south coast near Kribi, will change the situation described above and will result in a more even distribution of oil spill risk along the coast. Further change in this regard will result from an expansion of production operations in the central and southern coastal sectors - if this follows the recent exploration activities undertaken by ConocoPhillips

Petroleum Company Cameroon (permit PH-77) and the exploration activities planned by Perenco Cameroon S.A. (permit PH-69).

A.2.1 Offshore Exploration and Production

A.2.1.1 Offshore Exploration Activities

The first oil and gas discoveries in Cameroon date to the 1950s when the Douala Basin, and specifically, the Souélaba and Logbaba oil and gas reserves were the focus of attention and exploration. In the 1960s, exploration activity was diverted towards the Niger Delta and the Rio del Rey Basin in the north-west, which resulted in the discovery of the Betika, Asoma and Kole fields. Attention was focused once again on the Douala Basin during the 1980s – a period of very active hydrocarbon exploration in Cameroon's offshore waters. Over this period, discoveries of gas and condensate within the Douala Basin progressed, in some instances, to development and production - for example, in the case of the shallow water Ebomé fields south of Kribi, which were developed by Perenco Cameroon S.A. in 1997. Exploration operations in both the Rio del Rey and Douala basins continue at present.

A prescribed schedule for exploration drilling is specified in the conditions under which permits are issued to oil industry operators in the country's offshore environment. The current exploration activities of ConocoPhillips Petroleum Company Cameroon and Perenco Cameroon S.A., who respectively hold interests in permits PH-77 and PH-69 within the central and southern offshore environment, are examples of operations conducted under this type of permit condition.

Although the probability of an uncontrolled release (blowout) of hydrocarbon product during exploration (also reservoir appraisal and development) drilling is extremely low, it is nevertheless a source of risk that requires consideration since it represents the greatest environmental concern in drilling operations (Wardley-Smith, 1983). In this regard, an equivalent situation to that in which 224 000 barrels of crude oil were released from the Nigerian Funiwa well in 1980 can be assumed to be a worst case scenario.

Based on a Quantitative Risk Analysis of offshore blowouts carried out by Shell International Exploration and Production (Y. Quillen, Shell Gabon Exploration, pers. comm.), the probability of a blowout in an offshore exploration well is approximately 0.7 %; i.e. approximately one incident is anticipated for every 100 wells drilled. This assessment is based on three published reports detailing some 250 blowouts that occurred between 1965 and 1986. It is interesting to note that the blowout frequency during 1981-1984 was reduced by nearly 50% from the frequency reported during 1970-1980.

The above trend of reduced blowout incidence can be explained through reference to the effectiveness of safety equipment – blowout preventer technology – deployed in the course of drilling operations. This technology has improved in recent years and is one of the major reasons for the current low spill rate from continental shelf operations (National Research

Council, 1985). The other main safeguard against blowouts is the effect of fluids used for exploration drilling, the properties of which, such as its density, can be controlled to balance any abnormal formation pressures within the wells that are drilled.

The physical characteristics of oil released in the event of a blowout during drilling will vary according to the characteristics of the reservoir from which it originates. API values of crude derived from production oilfields in Cameroon's north-west coastal sector range from around 30º in the case of the reservoirs exploited by Perenco and Total E and P to 19º in the case of Pecten's operations in this region. API values of around 31º are associated with the product extracted by Perenco from their Ebomé operations offshore of the country's southern coast.

The fate of oil released at sea in the event of a blowout will be influenced by a number of factors – wind and current forcing, sea state and climate being most important in this regard. Also important are the physical characteristics of the product, which under the influence of the main forcing factors, determine the extent of spreading, evaporation, emulsification and entrainment of oil into the water column.

Oil spill simulation modelling, which uses input data of the type just described (current and wind data, oil API values, etc.), is a tool that is commonly applied to predict the trajectory and fate of spilled oil and to quantify the probability of exposure of the sea surface and coastline to oiling. Although modelling, which can be undertaken in advance of exploration drilling, can enhance the level of response preparedness on a project-by-project basis, uncertainty regarding where exploration drilling may be undertaken within Cameroon's marine and coastal environment in future limits its usefulness for national oil spill contingency planning.

A.2.1.2 Offshore Production Activities

A.2.1.2.1 Introduction

There are currently three oil companies involved in offshore production operations in Cameroon; these include the Cameroonian affiliates of Total E and P, Pecten and Perenco. The centres of oil production, which are operated by these companies, are indicated in Figure A.2.1 (Note, this figure does not reflect the total acreage for which the various companies possess operating licences).

The discussion that follows deals with the various centres of offshore production as individual risk sources, and in each case begins with an overview of some key features of the production operations (location, infrastructure, production volume, etc.). For each production centre, an oil spill scenario is then described, which is based on assumptions regarding the spill location (defined in terms of geographic co-ordinates and the water depth at which oil could be released into the marine environment), spill volume, period over which the spill is likely to occur, and the physical characteristics of the spilled product (API value).

Concluding the risk analysis, oil spill simulation modelling is used to establish the probable trajectory and fate of oil that may be spilled at the various sites in order to quantify water surface and shoreline oiling probabilities. Details of the oil spill simulation model that is used for this purpose are contained in Box A.2.1.

Box A.2.1: Application of the OILMAP oil spill simulation modelling

OILMAP, an oil spill simulation model developed by Applied Science Associates Inc., is used to support the analysis of the risk sources that have been identified.

The model employs repeated simulations of defined spill scenarios, with each simulation carried out under a different set of environmental conditions. The conditions are selected by using random start times sourced from representative data sets defining the region's wind and current regimes. This ensures that the most commonly occurring environmental conditions are selected most often, while more unusual conditions are also represented. OILMAP's multiple simulation, with random-sampling of environmental forcing conditions, ensures that an objective and representative set of possible spill trajectories and fates are modelled.

In addition to the key forcing factors (currents, wind), data inputs to OILMAP include the physical characteristics of the oil types considered. This is done in order to account for the effects of spreading, entrainment into the water column and rates of weathering of the spilled product. OILMAP also incorporates a geographic information system (GIS) for projecting the modelling results, set in the context of the region's coastal environment and shoreline features.

The data used to generate the modelling outputs presented in the NOSCP reflect, in part, oil spill information provided by the various operators (product API values, geographic location of possible spills, water depth at the hypothetical spill sites, etc.). However, in the case of spill size, some standardization is applied in the NOSCP to ensure both consistency in the modelling approach that is adopted and the generation of useful modelling outputs. So, for example, although the various offshore production operations could give rise to a range of possible spill sizes (small, large), the modelling focuses on spills in excess of a certain minimum size in order to generate outputs that have interpretive value regarding sea surface and shoreline oiling probability.

The modelling results are expressed in the form of oiling probability contours. Through reference to these contours, sea surface areas and sections of shoreline that are more or less likely to experience oiling can be identified. The value of this for the NOSCP is the quantitative basis that is provided for planning where resources may need to be directed in advance of oil spills that may occur.

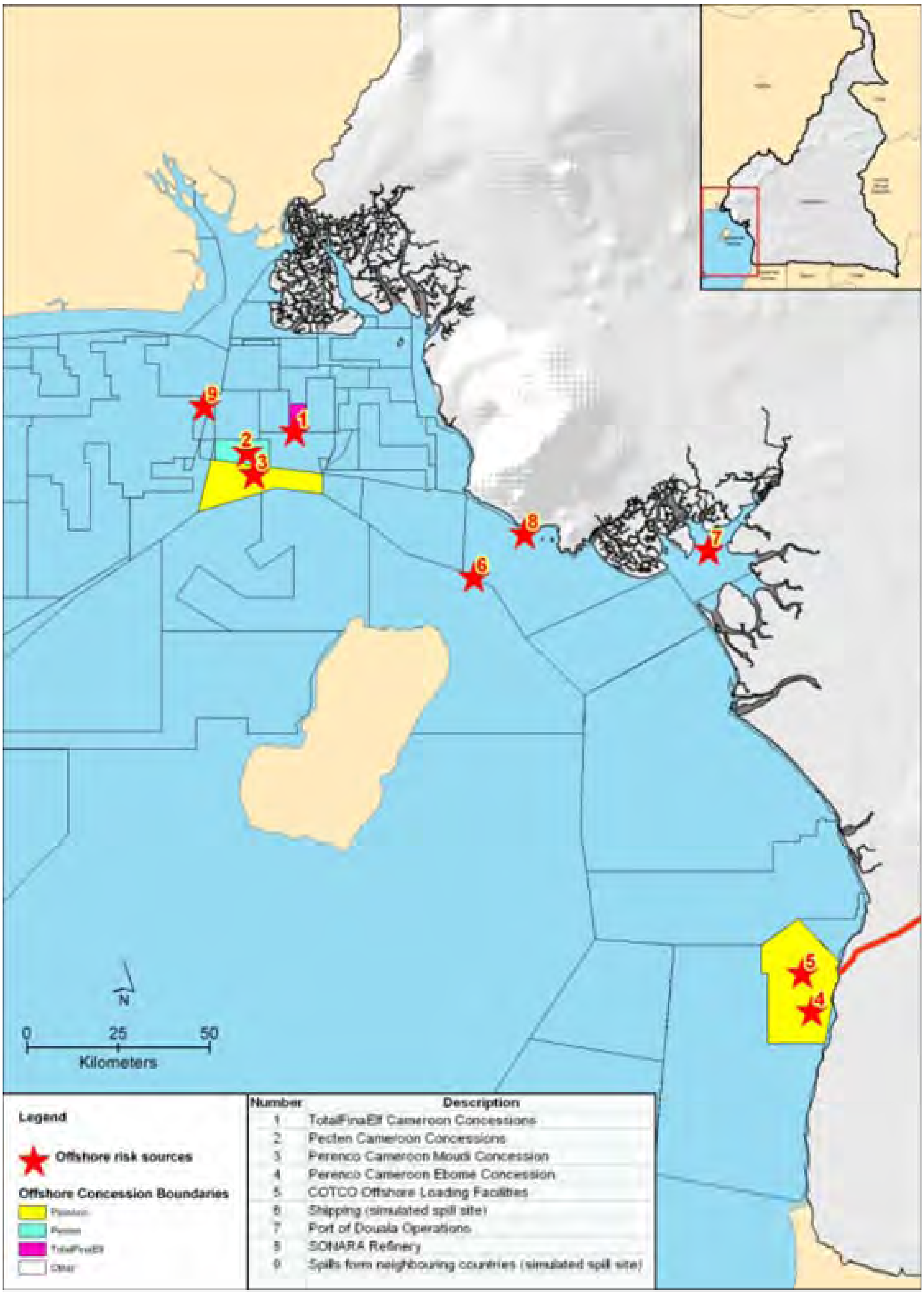

Figure A.2.1: Map showing location of main risk sources (offshore production platforms, COTCO's offshore facilities, etc.).

A.2.1.2.2 Total E and P, Cameroon

The production field of Total E and P is situated on the Nigerian maritime boundary, 40 km offshore in the Rio Del Rey Basin in the north-western sector of Cameroon's coastal environment. The general location of the company's production operations is indicated in Figure A.2.1.

Total operates two production wells that discharge into two floating storage and offloading (FSO) vessels. The production wells are separated by a distance of approximately 17 km and drain a target oilfield of some 35 km in diameter. Daily production is 72 000 barrels of light crude.

Total's's oil spill contingency plan (1996) is out of date and is currently being revised by CEDRE in Brest, France (Mr Billong Bisseck, HSE Total, pers. comm.). However, the most probable spill scenarios recognised by the company are as follows:

- Tier 1: spill volume < 300 m^3;
- Tier 2: 300 m3< spill volume < 3 000 m^3; and
- Tier 3: 3 000 m3< spill volume < 30 000 m^3.

Oil spill simulation modelling, using ASA's OILMAP spill trajectory and fate model, was undertaken using the criteria summarized in Table A.2.1 (see also Box A.2.1). The modelling results are illustrated in Figure A.2.2, which shows the zone of potential oiling to be defined by an arc, centred at the hypothetical source of the spill, extending from the Bakassi Peninsula in the north towards Debunscha in the east. A narrower zone, extending north-eastward from the hypothetical spill site towards the shoreline between Bamusso and Idenao depicts the sea surface most likely to experience oiling (> 50% probability). Oiling is most likely to occur (51-60% probability) along a 10 km stretch of coastline extending from Bamusso towards Idenao. The mangrove shoreline extending from the Bakassi Peninsula to just north of Bamusso is exposed to a relatively low probability of oiling (0-10%), as is the mixed sandy and rocky coastline extending from just north of Idenao to Debunscha.

Table A.2.1: Criteria used for oil spill simulation modelling of a release of oil from Total's Serepca 1 and Bouée KLB2 platforms.

Origin	*Co-ords*	*Depth*	*Spill vol.*	*Spill period*	*Api*
Total: - Serepca 1 / - Bouée KLB2	Lat: 04° 14' 30'' N Lon: 08° 33' 30'' E	Approx 25 m	< 200 m^3 (representing loading buoy accident or small spill off storage facility)	1 to 2 hours	31.7

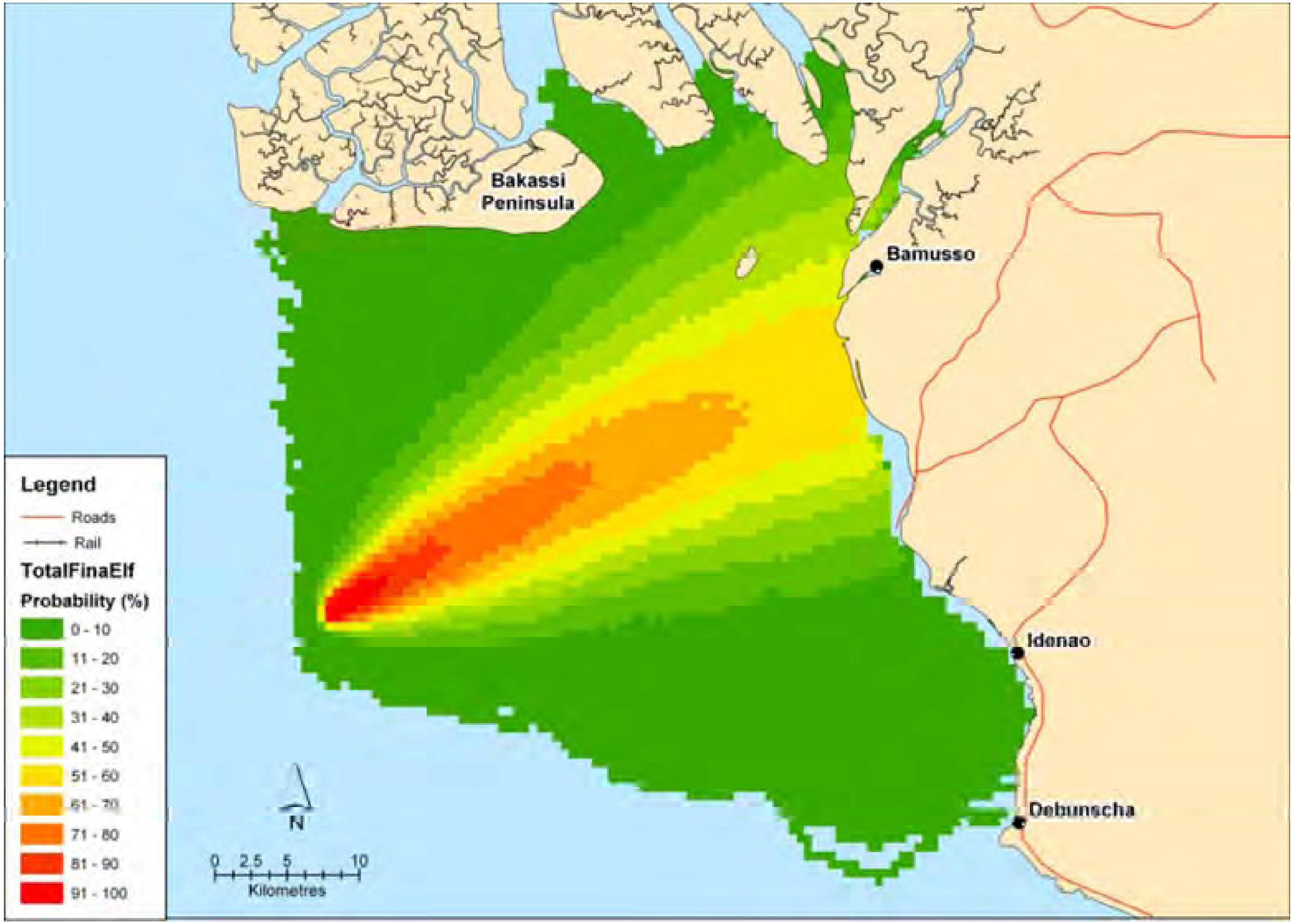

Figure A.2.2: Contour plot showing the predicted probability of exposure to locations from a release of oil from Total's Serepca 1 and Bouée KLB2 platforms.

A.2.1.2.3 Pecten Cameroon Company

Pecten's production operations within Cameroon's Mokoko-Abana field are located in the north-western sector of the country's offshore coastal environment, bordering Nigeria and Equatorial Guinea. The general location of the company's operations is indicated in Figure A.2.1.

Pecten operates 107 producing wells and 12 platforms, one of which is the Juliet central processing platform. The platforms support the oil production operations and the sourcing and well injection of water, and are connected via a system of 30 subsea pipelines that convey wet gas, high pressure gas, wet and treated oil and injection water. The pipeline system is also designed to gather produced oil, water and gas flow from the well platforms and to convey product to the gas/liquid separator on the Juliet central processing platform. Oil dehydration, power generation, gas lift compression and dehydration and flaring of excess gas take place at this installation, which also accommodates the personnel responsible for the operation of the field's production activities.

Stabilised dehydrated crude (Lokele blend) is exported from the Juliet platform via a subsea pipeline (10.2 km) to a 226 560 DWT offshore storage tanker, operated by Perenco within their Moudi concession. An alternative option for evacuating Pecten's Lokele blend crude is via a second subsea pipeline (23.5 km) linked to Total E and P's production installation in their Rio del Rey concession, to the north of the Mokoko-Abana field.

Cumulative production from the Mokoko-Abana field is expected to exceed 30 million metric tons - a production peak of over 50 000 barrels of oil per day having been achieved in 1985/86. Production rates of about 25 000 barrels of oil per day reflect the current situation, with which is associated the daily production of 60 000 barrels of water and 12 million cubic feet of gas.

Continuous development in reservoir management technology has ensured that production levels are maintained at a high rate under conditions of natural decline in the reservoir reserve. Such technologies include electrical submersible pumps, installed to supplement the gas lift that has traditionally been used to assist production from individual wells. In this regard, the produced gas is recycled for gas lift assistance, as is the injection of about 23 000 barrels of water per day. About 2 700 million cubic feet of gas is currently flared (at two platforms) with an additional 1 800 million cubic feet exported to the neighbouring field operated by Perenco to support gas lift crude production at Moudi.

Pecten describes the largest credible spill that could result from their operations to be one associated with the total failure of the subsea pipeline that conveys product from the Juliet Platform to Perenco's Moudi storage tanker (Johnson, 2001). An incident of this kind would result in an estimated spill volume of around 672 barrels.

Oil spill simulation modelling, using ASA's OILMAP spill trajectory and fates model, was undertaken, *inter alia*, using the criteria summarised in Table A.2.2 (See also Box A.2.1). The modelling results are illustrated in Figure A.2.3 which shows the zone of potential oiling to be defined by an arc, centred at the hypothetical source of the spill, extending from the Cross river in the north towards Idenao in the east. A narrower zone, extending north-eastward from the spill site towards the shoreline just north of Bamusso depicts the sea surface most likely to experience oiling (> 50%). Oiling is most likely to occur along a 10 – 20 km stretch of coastline centred around Bamusso. The mangrove shoreline extending from the Bakassi Peninsula to just north of Bamusso is exposed to variable probabilities of oiling.

Table A.2.2: Criteria used for oil spill simulation modelling of a release of oil from Pecten's Juliet platform.

Origin	*Co-ords*	*Depth*	*Spill Vol.*	*Spill Period*	*API*
Juliet Platform	04º11'30" N 08º26'30" E	45 m	150 m^3 (approx. 900 bbls)	6 hours	19º

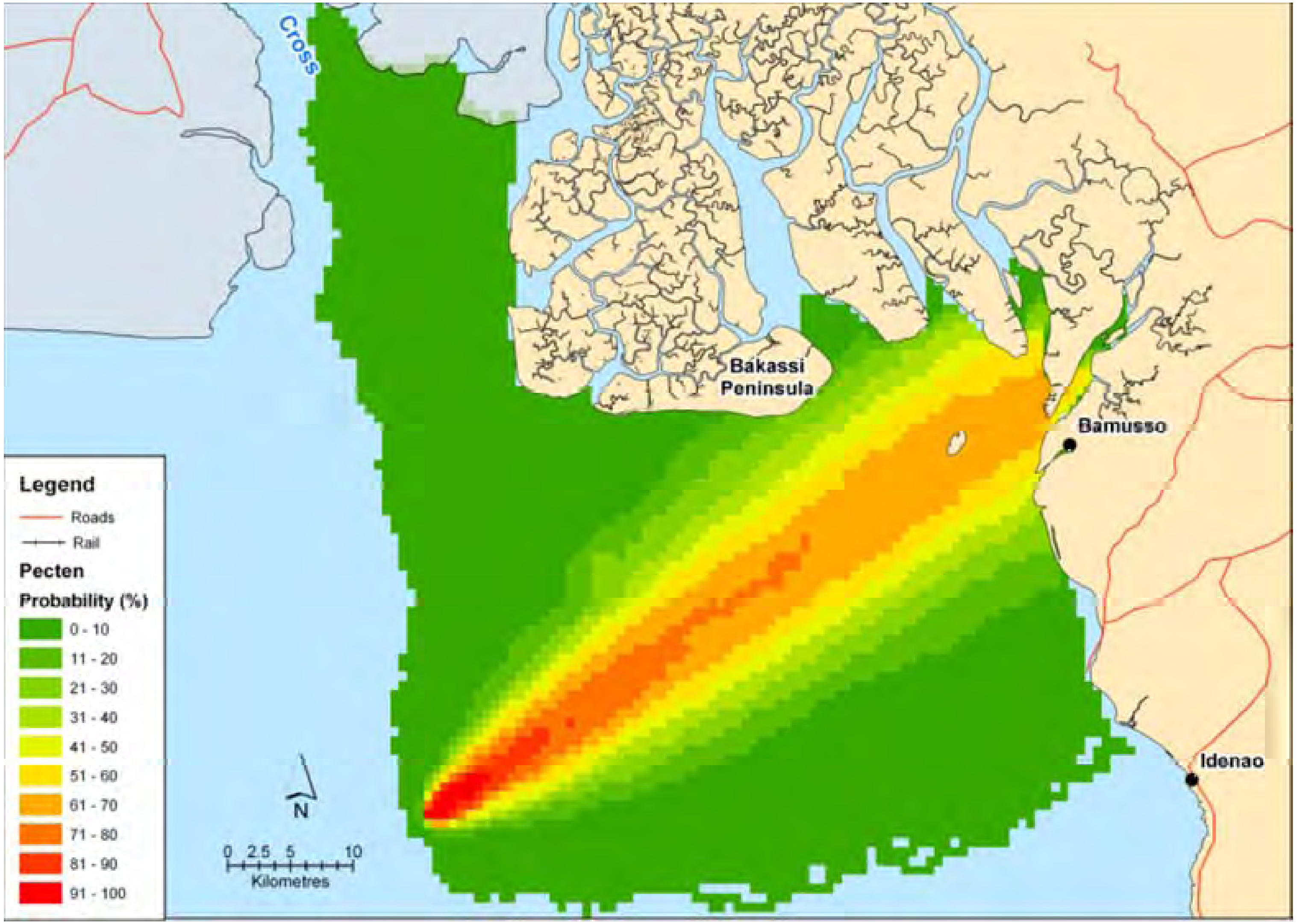

Figure A.2.3: Contour plot showing the predicted probability of exposure to locations from a release of oil from Pecten's Juliet platform.

A.2.1.2.4 Perenco Cameroon S.A.

Perenco's production operations are focussed in two areas: the Moudi concession, which is situated within the country's north-western coastal sector; and the Ebomé concession in the offshore southern coastal sector. The location of these two centres of operation are indicated in Figure A.2.1.

MOUDI CONCESSION

The Moudi production complex includes the following structures:

- Main VT production platform linked to the samller satellite VA well platform, which are supplied by 12 wells;
- VB well platform – decommissioned as a production installation, but used for gas production and routing Pecten's gas product to supply Perenco's energy requirements;
- Pipelines:
  - 10-inch (Peden infrastructure), which conveys crude from Pecten's operations to the Moudi FSU (see below);
  - Gas line linking the VB and VT platforms;
  - 4-inch gas line linking the VT platform and the Moudi FSU;
  - 8-inch crude line linking the VT platform and the Moudi FSU;
  - 18-inch crude line (2 691 m) linking the VT platform and the Moudi FSU;
  - 3-pipeline-bundle conveying gas, injection water and gas, linking the VA and VD platforms; and
  - A water injection line extending from the VA platform.
- A floating storage unit, the FSU Moudi.

As indicated in Section A.2.1.2.3, Perenco operates an offshore loading facility within their Moudi concession. This comprises a permanently moored 226 560 DWT storage tanker (Moudi Terminal - FSU) into which both Perenco's and Pecten's crude oil production is discharged for storage. The tanker has a storage capacity of 1 000 000 barrels of treated crude, which is held in the vessel's centre cargo tanks and two wing tanks.

The Moudi and Lokele crude are periodically transferred to tankers of opportunity, which range in size from 50 000 to 280 000 DWT. The transfer occurs via an SPM, (CALM design), which is moored in 56 m water depth. The buoy is connected to the storage tanker via a single 30-inch sea-line. Transfer of oil from the buoy to the export tankers is made through a single string 20-inch floating hose, which terminates in two 16-inch strings (each 37 m long) for connection to the manifold of the tankers. The system achieves a typical discharge rate of 46 500 barrels per hour and is designed to shut down under an emergency situation within one minute.

The production from the Moudi field is essentially derived from two reservoir depths: the so-called Moudi crude, extracted from about 2 000 m, and the DI crude extracted from about 1 000 m depth. Of the total daily production of about 3 400 barrels, the Moudi product accounts for some 900 barrels, with the DI crude accounting for the balance.

Collinson and Thornborough (2000) describe a range of oil spill scenarios that could result from Perenco's operations. Based on one of these credible scenarios, oil spill simulation modelling, using ASA's OILMAP spill trajectory and fates model, was undertaken, *inter alia*, using the criteria summarised in Table A.2.3 (See Box A.2.1). The modelling results are illustrated in Figure A.2.4, which shows the zone of potential oiling to be defined by an arc, centred at the hypothetical source of the spill, extending from the Bakassi Peninsula in the north towards Batoke in the east. A narrower zone, extending north-eastward from the hypothetical spill site towards the shoreline between Bamusso and Idenao depicts the sea surface most likely to experience oiling (> 50% probability). Oiling is also most likely to occur (41-50% probability) along a 10 km stretch of coastline extending from just south of Bamusso towards Idenao. The mangrove shoreline extending from the Bakassi Peninsula to just north of Bamusso is exposed to a relatively low probability of oiling (0-10%), as is the mixed sandy and rocky coastline extending from Idenao to Batoke.

Table A.2.3: Criteria used for oil spill simulation modelling of a release of oil from Perenco's Moudi concession.

Origin	Co-ords	Depth	Spill Vol.	Spill Period	API
Moudi Concession	04º08'11" N 08º27'32" E	45 m	150 m^3 (approx. 900 bbls)	6 hours	30º

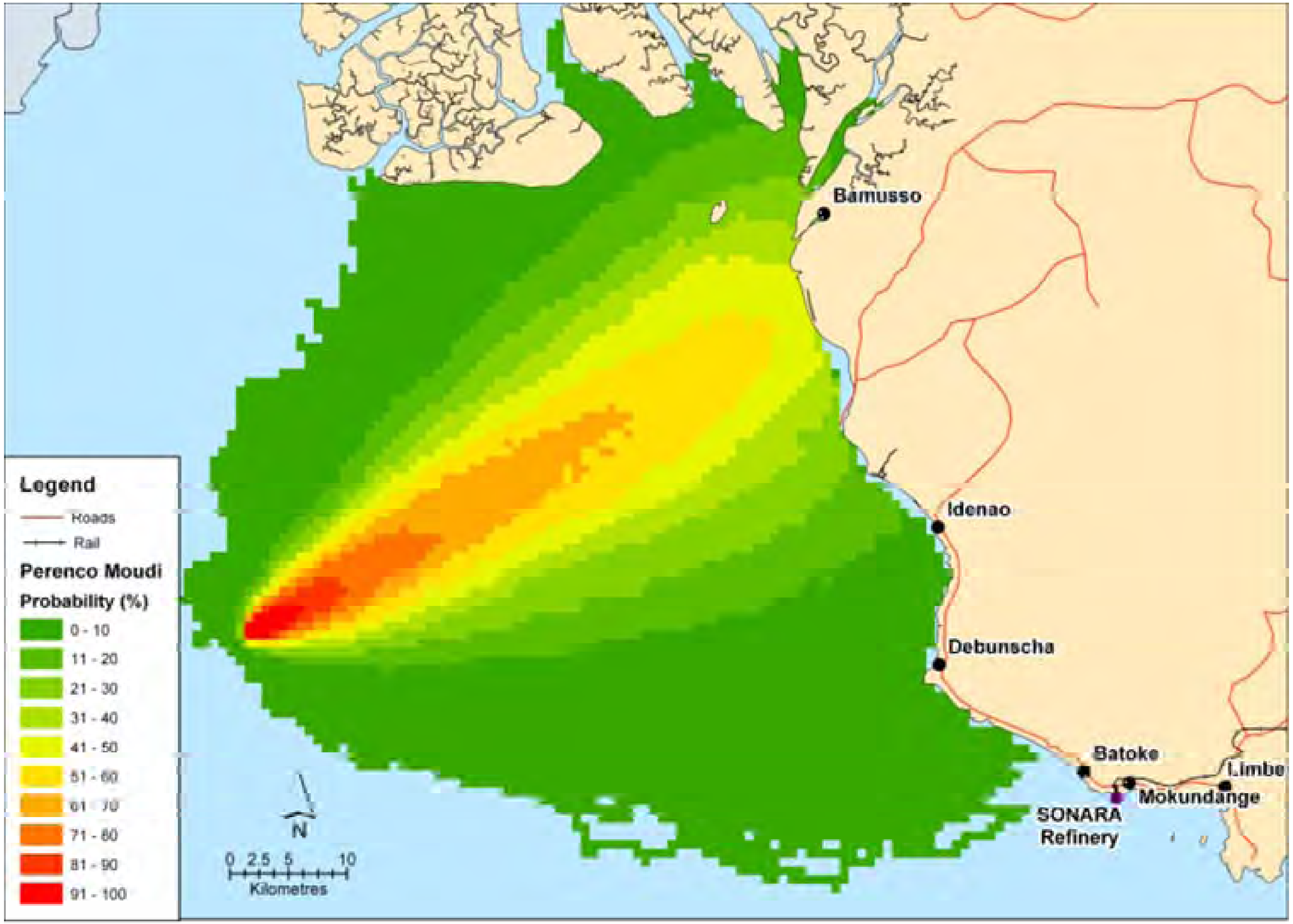

Figure A.2.4: Contour plot showing the predicted probability of exposure to locations from a release of oil from Perenco's Moudi concession.

EBOME CONCESSION

Perenco's Ebomé operations are situated offshore of the country's southern coastline, approximately 15 km south-south-east of Kribi, in 25 to 30 m water depth (Plate A.2.1). The infrastructure associated with the operations includes a single mobile production platform, which is a former drilling jack-up unit that has been transformed into a production unit equipped with all of the requisite utilities. This infrastructure supports the company's production activities, which are centred on the KF wellfield (five operational wells). Daily production is currently around 6 500 barrels.

Plate A.2.1: Perenco's Ebomé platform situated offshore of Cameroon's southern coastline.

The production platform is linked to a permanently moored storage tanker and SPM. The storage tanker is a 72 000 DWT vessel, which is linked to the SPM via a single 24-inch subsea pipeline. The SPM can accept vessels ranging in size from 50 000 to 230 000 DWT. Traditionally, the transfer of product to tankers of opportunity occurs every 2.5 to 3 months.

Cavaye and Collinson (2000) describe a range of oil spill scenarios that could result from Perenco's Ebomé operations. A particular concern relating to these scenarios is the proximity of the production complex to the shore, which permits a very short response time if shoreline oiling is to be prevented. Based on the suite of potential spill scenarios, oil spill simulation modelling, using ASA's OILMAP spill trajectory and fates model, was undertaken, *inter alia*, using the criteria summarised in Table A.2.4 (See Box A.2.1). The modelling results are illustrated in Figure A.2.5, which shows the zone of potential oiling of the marine and coastal environment extending from the mouth of the Nyong river to Lolabé. The sea surface with a relatively high probability of oiling (> 50%) is defined by an arc, centred at the hypothetical spill site, extending from the Lobé river mouth in the north-east towards Eboundja I in the east. Oiling is most likely to occur (50-70% probability) along the coast between these two positions on the coastline, with a decreasing probability of oiling to the north and south.

Table A.2.4: Criteria used for oil spill simulation modelling of a release of oil from Perenco's Ebomé concession.

Origin	*Co-ords*	*Depth*	*Spill Vol.*	*Spill Period*	*API*
Ebomé Concession	02º48'54" N 09º49'54 E	30 m	150 m^3 (approx. 900 bbls)	6 hours	31º

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Figure A.2.5: Contour plot showing the predicted probability of exposure to locations from a release of oil from Perenco's Ebome concession.

A.2.2 COTCO's Offshore Loading Facilities

The offshore facilities associated with the Chad-Cameroon pipeline project, which is operated by COTCO, comprise a floating storage and offloading (FSO) vessel and a submarine pipeline. The facilities are situated in Cameroon's southern coastal zone, approximately 12 km offshore, to the south-west of Kribi (Figure A.2.1). COTCO's facilities are linked to an onland pipeline transportation system, which will convey crude oil from reserves in southern Chad through Cameroonian territory.

The offshore facilities and marine operations comprise the following aspects (COTCO, 2002):

- A Single Point Mooring (SPM) tower;
- Subsea pipeline;
- Floating Storage and Offloading (FSO) vessel;
- Tanker loading operations;
- Support vessel operations; and
- Marine fuel facilities that support operations.

The subsea loading pipeline, which is approximately 12 km in length, links the onland pipeline with the offshore loading facility. The cargo storage capacity of the FSO is approximately 357 000 metric tons. Stored crude will be periodically discharged from the FSO into tankers of opportunity.

A daily production rate of 225 000 barrels of crude is expected to be conveyed into storage through the Chad-Cameroon pipeline. The export product, which is dense, has a typical API value of 20° (APIs of around 17° in the case of the Bolobo product and 24° in the case of the Miandoum product). Other hydrocarbon products likely to be associated with production operations at the FSO include diesel fuel, aviation fuel and lubricating and hydraulic oils.

COTCO has recently published six area-specific oil spill response plans for the Chad-Cameroon Development Project. One of these plans concerns the offshore facilities (COTCO, 2002). In the plan, various crude oil spill scenarios associated with the FSO vessel and the marine support operations (diesel fuel, lubricating oils) are identified and described in terms of a tiered response strategy, which is directed by the spill volumes that might result, spill durations, etc. The plan also draws on the results of oil spill simulation modelling for three probable spill scenarios associated with the FSO vessel, which are defined as follows:

- Grounding of the supply vessel – Scenario 1;
- Rupture of the subsea pipeline – Scenario 2; and
- Ship collision with the FSO – Scenario 3.

For the purpose of the NOSCP, a modelling re-run of Scenario 2 was undertaken using ASA's OILMAP model. The input data presented in Table A.2.5 were used for this purpose:

Table A.2.5: Criteria used for oil spill simulation modelling of a release of oil from COTCO'S FSO vessel.

Origin	*Co-ords*	*Depth*	*Spill vol.*	*Spill period*	*API*
COTCO Scenario 2	02º 54' 30" N 09º 48' 30" E	Approx 35 m	430 m^3	instantaneous	20°

The modelling results are illustrated in Figure A.2.6, which shows the zone of potential oiling of the marine and coastal environment extending from the mouth of the Nyong river to Eboundja I. The sea surface with a relatively high probability of oiling (> 50%) is defined by an arc, centred at the hypothetical spill site, extending from around Bebamboué in the north-east to just south of the Lobé river mouth in the south-east. Oiling is most likely to occur (50-70% probability) along the coast between these two positions on the coast, with a decreasing probability of oiling to the north and south.

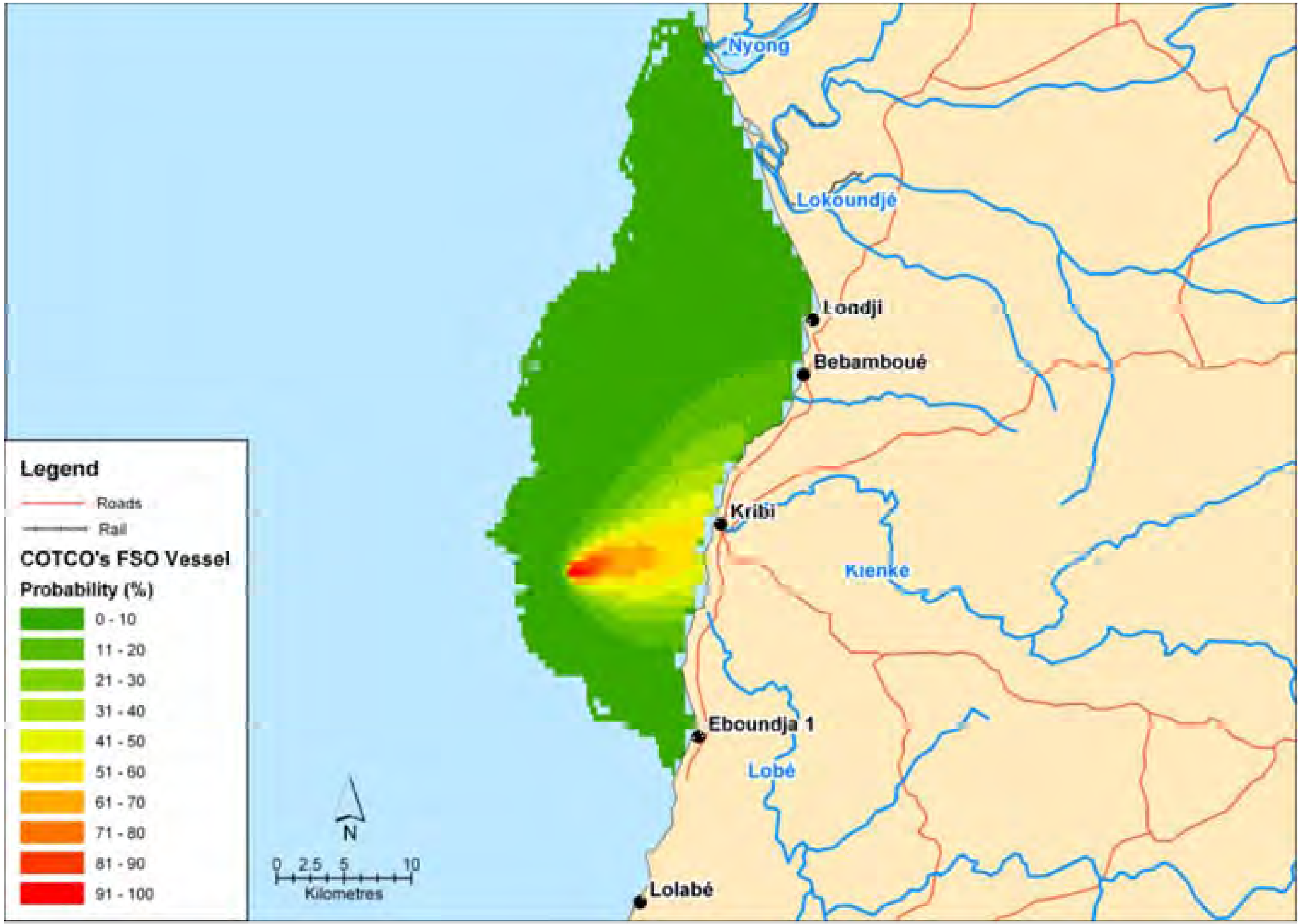

Figure A.2.6: Contour plot showing the predicted probability of exposure to locations from a release of oil from COTCO's FSO vessel (Scenario 2).

A.2.3 Shipping

Statistics on the causes of oil spills from shipping, and particularly tankers, collected over the years by ITOPF indicate that the majority of intermediate sized spills (7 – 700 tonnes) originate during loading and discharging operations (29%) and collisions (23%). Larger spills greater than 700 tonnes result primarily from collisions (28%) and groundings (35%). In Cameroonian waters, grounding would be less significant due to the lack of natural navigational hazards – possibly with the exception of risk associated with the rocky nearshore environment characterizing part of the country's north-western coastal sector. However, collisions and loading operations at the floating storage and offloading (FSO) facilities associated with the offshore crude production centres could be considered to pose the most likely sources of oil spills from shipping incidents.

Four oil spills of between 50 and 5 000 barrels have been recorded in Cameroonian waters prior to 1995. In this respect, the worst-case incident was the grounding of the petroleum tanker PETRO BOUSCA near Kribi in June 1979, spilling 5 600 barrels of oil into the sea. A further two incidents of the same size occurred in Nigerian waters close to the maritime border with Cameroon, as well as one of greater spill magnitude in this region.

The main categories of shipping offshore of Cameroon that collectively constitute this key risk source are described below.

PASSING TANKER TRAFFIC CARRYING CRUDE OIL

Tanker traffic passing offshore of Cameroon includes all crude carriers moving up the west coast of Africa destined for Europe and North America, as well as carriers moving in a southerly direction from Nigeria en route to the Far East (Figure A.2.7). ITOPF (1995) indicates that the risk of oil spills from passing traffic in the West and Central African coastal region is low due to the fact that the major tanker routes lie well offshore. However, a portion of Nigeria's crude oil that is exported to the Far East is conveyed by tanker relatively close offshore of Cameroon's coastline. Nigeria's crude exports have increased by 6% to 104 million tonnes over the past five years (BP Statistical Review of World Energy, 2001) and if the increasing trend continues it would result in an increase in crude tanker traffic moving south through Cameroon's waters.

The prime risk of an oil spill from this source would arise from a tanker carrying Nigerian crude being involved in a collision, or possibly grounding, within Cameroon's territorial waters. The probability of this occurrence is considered to be low; however, should such an event occur, the impact could be high due to the potentially large volume of light crude oil that would be released into the marine environment.

Figure A.2.7: Major tanker rotes traversing the West African Region.

TANKER TRAFFIC CARRYING CRUDE EXPORTS AND IMPORTS

Crude oil is currently exported from the four main offshore production centres operated by Total E and P, Pecten and Perenco (Section A.2.1.2; Figure A.2.1). One or more Floating Storage and Offloading (FSO) facilities are associated with each of these operations and tankers of varying sizes load crude oil from these FSOs.

The prime risk from this source would be related to a spill occurring during berthing and loading at the FSO and during transit to and from the offshore crude production centres in Cameroonian waters. As described in the Foreword of the NOSCP, offshore oil production export volumes from Cameroon have decreased recently, which would suggest that the risk of oil spillage at the FSOs and during transit to and from Cameroon's offshore production areas has diminished. However, this situation could change as new production opportunities are realised.

The SONARA refinery located at Limbe (see Section A.2.5) imports approximately 1.5 million tonnes of crude per annum for processing. In the past, the majority of this crude came from Cameroon's offshore production areas; however, light Nigerian crude (generally Bonny Light with an API Gravity value of 38° to 40°) is now the main product that is imported. The crude is offloaded from tankers at the refinery jetty and is transported via a 500 m pipeline to the installation's storage tanks. In the course of this importation process, the oil spill scenarios of greatest risk include incidents resulting during tanker berthing and during unloading at the jetty.

Once COTCO's FSO is commissioned (Section A.2.2), tankers will regularly arrive to collect crude oil from this export terminal. The oil spill scenario posing the greatest risk from the tankers would be associated with berthing at the FSO and during loading and uncoupling operations.

COASTAL TANKER TRAFFIC

The fuels produced at the SONARA refinery at Limbe are transported to Douala by means of a shuttle coastal tanker. Similar to the process of crude importation, the tanker is backloaded with product exported via the refinery's pipeline jetty infrastructure. The tanker traverses a stretch of coastal water before entering the Estuaire du Cameroun. At the Port of Douala, the product is either offloaded at Quay no. 1 or, more commonly, at a Dolphin Berth 500 metres off the quayside. A range of light products, such as leaded petrol, diesel and paraffin is transported in this way, together with lesser amounts of heavier fuel oils.

The oil spill scenario of greatest risk from the tanker would be during berthing and loading of the tanker at the refinery, navigation of the port entrance channel in the Estuaire du Cameroun and during berthing and product discharge at the Port of Douala. The only spill to have occurred recently in the course of such shipping operations was as a result of the coastal tanker holing a cargo tank during berthing operations and spilling petrol into the harbour waters.

CARGO VESSEL TRAFFIC

The country's main port that handles cargo vessel traffic is Douala. The traffic mainly comprises general cargo vessels and timber carriers, operating mainly between Cameroon and France and Belgium, and thus traverses the country's more northerly waters.

Since the approach channel to the Port has been deepened through dredging, larger ships with deeper drafts have been able to enter the Port (see Section A.2.4). This has resulted in fewer but larger cargo vessels operating within Cameroon's coastal waters. In effect this means that the potential frequency of spills from cargo vessel accidents is decreasing; however, the potential size of any spill may be increasing due to the larger volumes of bunker fuels carried on the larger vessels.

Cargo vessels are considered to pose a relatively low risk of oil spillage, with a collision with another vessel or the quayside resulting in some loss of heavy bunker fuel being the only credible scenario to be considered in the NOSCP.

Clearly there is a suite of potential oil spill scenarios linked to shipping incidents that must be considered. The scenario considered further here is an incident (e.g. vessel collision) within the Europe-bound shipping lane extending westward from Douala, midway between Limbe and Malabo on Bioko Island. The OILMAP spill trajectory and fates model was used to simulate a spill resulting from such an incident, using the criteria summarised in Table A.2.6 (see also Box A.2.1). The modelling results are illustrated in Figure A.2.8, which shows the zone of potential oiling of the marine and coastal environment defined by an arc, centred at the hypothetical spill site, extending from Idenao in the north towards Pointe Souélaba in the east. A much narrower zone, extending north-eastward from the spill site towards Limbe depicts the sea surface most likely to experience oiling (> 50% probability). Oiling is most likely to occur (50-70% probability) along a 15 km stretch of the coastline at Limbe.

Extending the above pattern of oiling probability, associated with the country's offshore shipping lane, it is clear that the north-western sector of Cameroon's coastal environment is exposed to a relatively high probability of oiling in the event of shipping accidents.

Table A.2.6: Criteria used for oil spill simulation modelling of a release of oil from a shipping incident within the shipping lane between Limbe and Malabo.

Origin	*Co-ords*	*Depth*	*Spill Vol.*	*Spill Period*	*API*
Shipping lane west of Douala, midway between Limbe and Malabo (EG)	03º53'00" N 09º00'00 E	55 m	100 m^3	Instantaneous to 6 hours	Bunker-C/IFO-180

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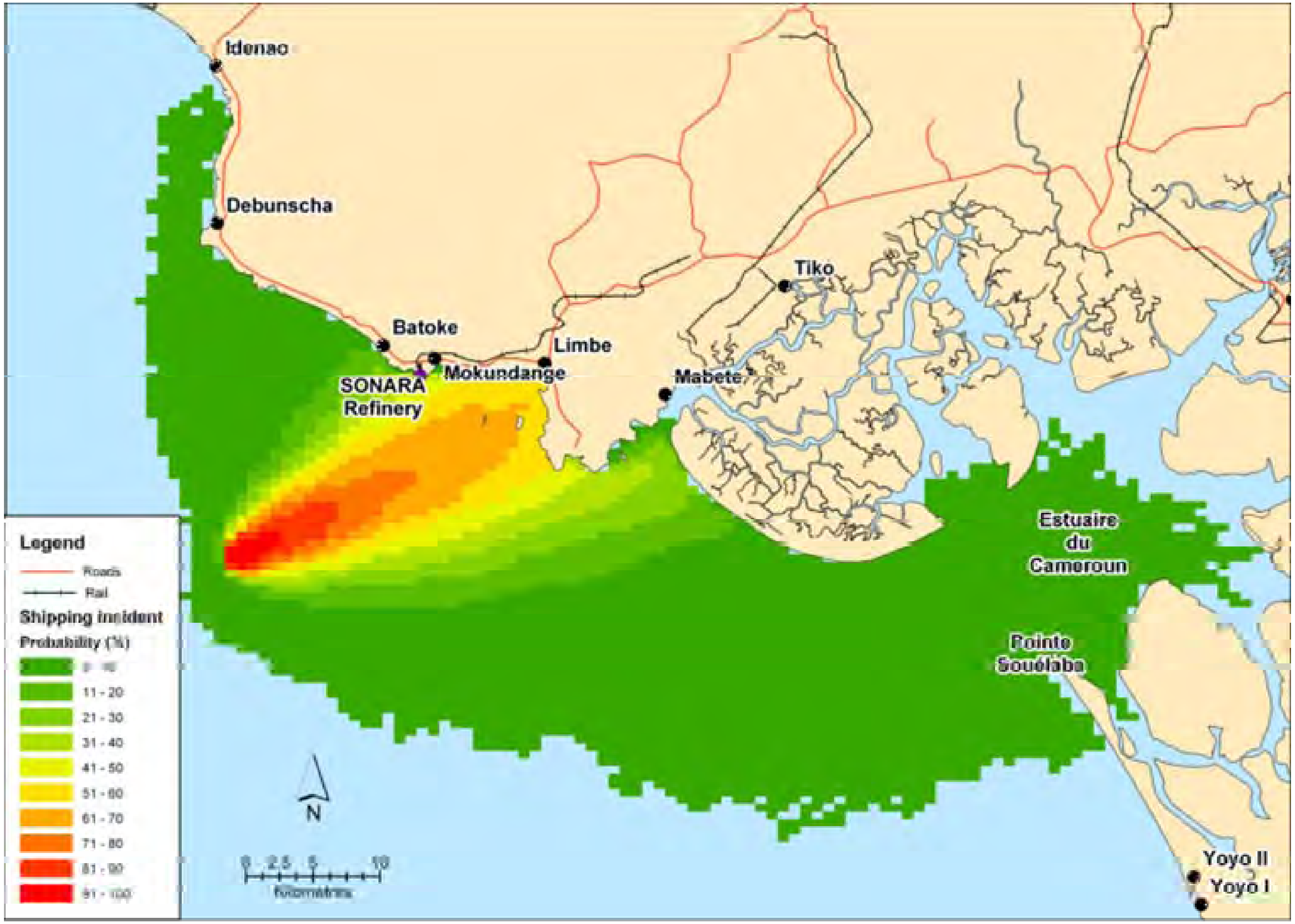


Figure A.2.8: Contour plot showing the predicted probability of exposure to locations from a release of oil from a shipping incident within the shipping lane between Limbe and Malabo (Bioko Island).

A.2.4 Port Operations

A process of transformation and reform within the National Ports Authority (NPA) is currently underway. The Port Reform Law published in 1998 is a development resulting from this process, which describes a new regulatory and port management structure for Cameroon. Important in this regard, is the separation of the regulatory aspects controlling port activities from the port management function, and the autonomy according to which the country's individual ports now function. These include the coastal ports of Douala, Limbe, Kribi, and the inland port of Garoua on the Bénoué river.

PORT OF DOUALA

The Port of Douala is situated on the left bank of the Wouri river close to its point of discharge into the Estuaire du Cameroun. It is situated more than 30 km from the open Atlantic coast, to which it is linked by a dredged channel 25 km in length.

The port is used for the export of timber, cocoa, coffee, bananas, bauxite and fish products, with the main imports being chemicals, cereals, vehicles, and industrial and construction equipment and materials. The port also handles hydrocarbon products, principally refined products received from the SONARA refinery at Limbe, which are conveyed by shuttle tanker between the two centres. From the port, the SONARA products are conveyed by pipeline to the SCDP fuel storage installation situated further upstream, also on the left bank of the Wouri river.

The port infrastructure includes breakbulk, container, drybulk, liquid and RORO facilities. Associated with these are 11 cargo vessel berths as well as 16 berths that service the port's deepwater quay where, for example, container vessels are loaded/offloaded.

The total port area, including both its on- and offshore precinct is approximately 1 000 ha. The port authority does, however, assume responsibility for port-related activities – which includes shipping accidents - over a much larger area, specifically within the Estuaire du Cameroun and the immediately adjacent marine environment. In this regard, the country's coastline is divided into what may be described as three 'port catchments', which separate the responsibilities of the three autonomous coastal ports. The Port of Kribi assumes responsibility for offshore port-related shipping between the Ntem and the Nyong rivers; responsibility for the coastal sector extending from the Nyong river to the northern perimeter of the Estuaire du Cameroun resides with the Port of Douala; and the Port of Limbe covers the remainder of the coast, extending from the Estuaire du Cameroun to the Nigerian border.

The Port of Douala handles about 1 200 ships per year, which accounts for 95 percent of the total shipping volume handled by the country's ports. With the recent deepening of the port entrance channel, the maximum vessel size using the port has increased (deeper draft and longer vessels), and as a result, fewer vessels can be handled simultaneously (16 or 17 vessels). This deviates from the approximately 20 vessels that the port could handle simultaneously prior to dredging. This has not, however, affected the volume of products handled annually, which is increasing. Currently (January, 2003), this is in the order of 6 to 7 million tonnes.

The volume-split between products handled by the port is more or less as follows:

- Timber: 1.8 million tons;
- Container goods: 1.5 million tons; and
- General cargo and other products (including fisheries products): 2.5 million tons.

Most shipping visiting the port originates from, or is destined for, French and Belgian ports. Ports of origin of vessels visiting Douala also include those of the Americas and the Far East. The greatest volume of traffic is routed to or from the port via West Africa, with a relatively small proportion of traffic originating from, or destined for, the south. Shipping centred within the region includes traffic linking the Port of Douala with the ports of Abidjan, Dakar, Libreville and Luanda (Plate A.2.2).

Plate A.2.2: Cargo vessel navigating the entrance channel of the Port of Douala, within the Estuaire du Cameroun

Reference to the past history of oil spill incidents within the Port of Douala provides some indication of what scenarios need to be considered in the context of the NOSCP. In this regard, there has only been one recorded incident involving the berthing of a coastal tanker (Section A.2.3), which resulted in a small spill of petrol from a ruptured tank. This is illustrative of the type of incident for which contingency planning is necessary. To this should be added the probability of small spills of both light and heavy fuels associated with vessel bunkering operations.

Oil spill simulation modelling, using ASA's OILMAP spill trajectory and fates model, was undertaken using the criteria summarised in Table A.2.7 (See also Box A.2.1). The spill scenarios considered assume, firstly, an HFO spill at one of the port berths and, secondly, the collision or grounding of a vessel navigating the port entrance channel midway to the open coast. A near-instantaneous fuel spill is assumed for both scenarios. In the case of the simulated fuel spill at the port (Figure A.2.1.9a), the results show that the water surface of the Wouri estuary, extending from the Bonabéri Bridge to the river's confluence with the greater Estuaire du Cameroun, is exposed to some risk of oiling. This area does, however, represent a relatively small proportion of the total surface area of the Estuaire du Cameroun. High levels of oiling probability (> 50% probability) apply to a relatively small area extending approximately 5 km south-westward from the hypothetical spill site within the port. In the case of a spill in the port entrance channel (Figure A.2.1.9b) there is some probability that a relatively large proportion of the Estuaire du Cameroun will be exposed to oiling. The area with the greatest probability of oiling (> 50%) is defined by an arc, centred at the hypothetical spill site, extending from the north bank of the Wouri at its point of discharge into the Estuaire du Cameroun towards the point of discharge of the Dibamba river in the east. Oiling of the mangrove shoreline is highly probable (50-100%) in this area.

Table A.2.7: Criteria used for oil spill simulation modelling of a release of HFO from a vessel berthed within the Port of Douala and from a vessel collision or grounding in the entrance channel of the Port of Douala.

Origin	*Co-ords*	*Depth*	*Spill Vol.*	*Spill Period*	*API*
At port berth	-	6.5 m	100 m^3	Instantaneous	Bunker-C/IFO-180
Port entrance channel, midway between the port and the open coast	03º57'00" N 09º34'42" E	6.5 m	100 m^3	Instantaneous to 6 hours	Bunker-C/IFO-180

PNLDAH

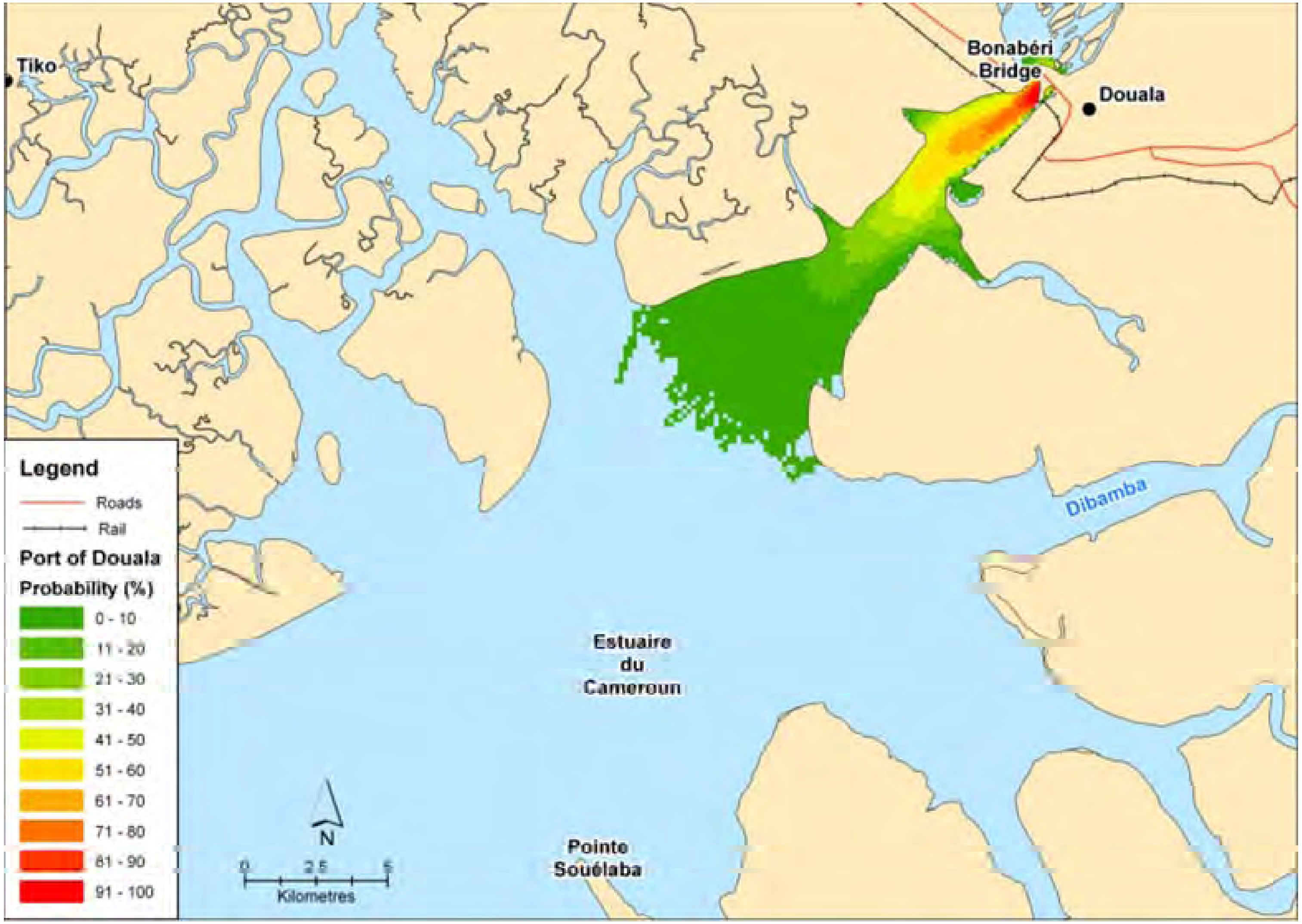


Figure A.2.9 (a): Contour plot showing the predicted probability of exposure to locations from a release of HFO from a vessel berthed within the Port of Douala

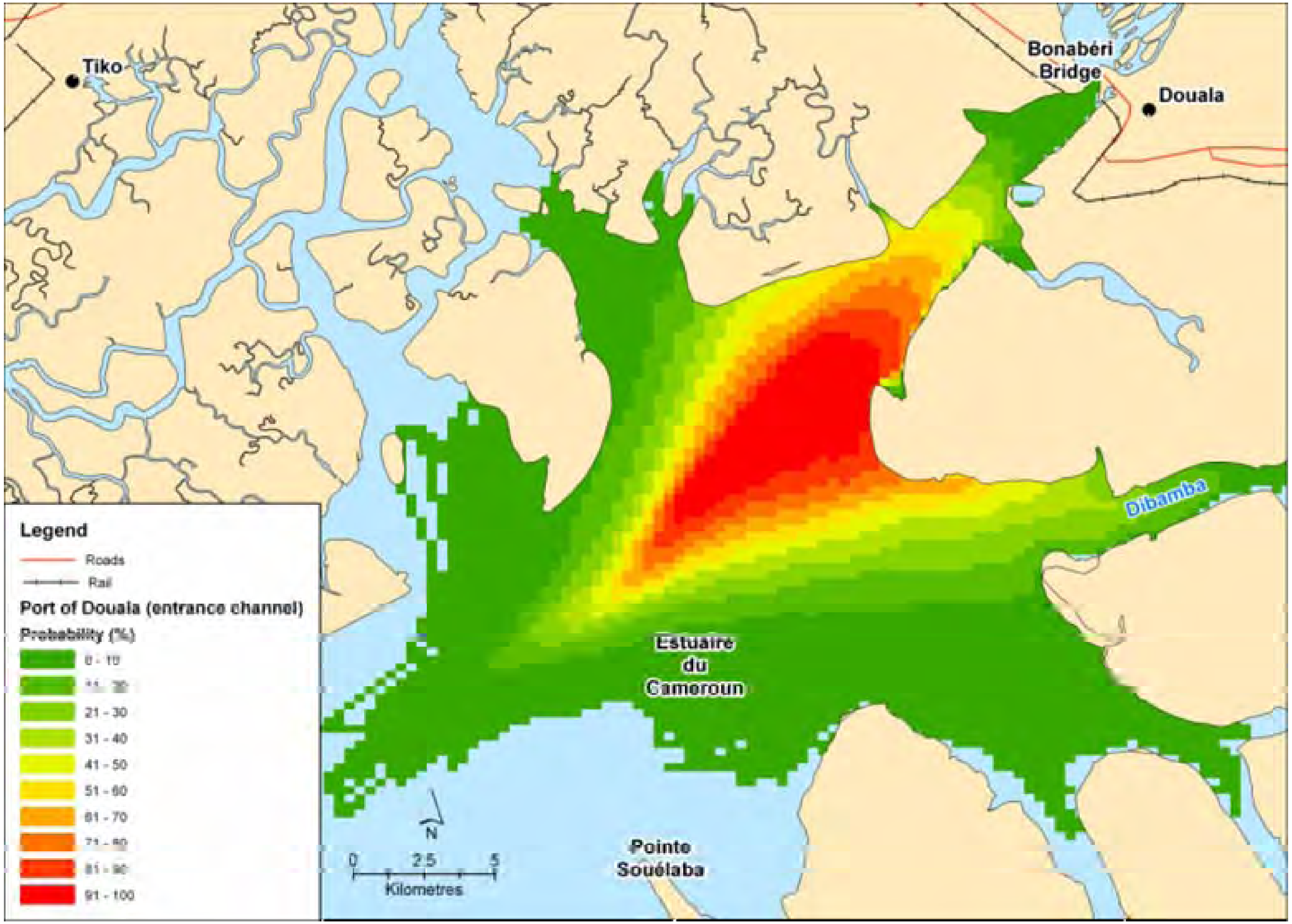


Figure A.2.9 (b): Contour plot showing the predicted probability of exposure to locations from a release of HFO from a vessel collision or grounding in the entrance channel of the Port of Douala

PORT OF LIMBE

The Port of Limbe functions at a significantly smaller scale of operation than the Port of Douala. Situated in close proximity to a deep-sea environment (i.e. different to the Port of Douala), the facility at Limbe handles small-scale regional shipping activities associated with an active local fishery and agricultural production within the region. In this regard, the rejuvenation of the port during the mid 1990s is attributable to the operations of SOCATHAI (Thailando-Cameroon Company). Developments that are planned for Limbe include a ship repair facility and, possibly, its replacement by a major deepwater port.

At its current scale of operation, the Port of Limbe could give rise to spills of relatively small magnitude. The spilled product would typically be diesel or petrol used to power the small vessels utilizing the harbour. Whilst such spills could cumulatively result in the local deterioration of marine water quality – attributable mainly to the effects of polycyclic aromatic hydrocarbons (PAHs) and trace metals associated with these refined products – the volatility of the boat fuels posing a pollution risk would limit the extent of persistent sea surface and shoreline oiling. For this latter reason, oil spill simulation modelling was not undertaken for the Port of Limbe.

PORT OF KRIBI

Similar to the situation at Limbe, the Port of Kribi is small and mainly supports the local fishing industry (Plate A.2.3). Its location within the mouth of the Kienké river, on a predominantly sandy coastline, results in sedimentation within the port entrance channel and the creation of shoals immediately offshore of the port entrance. This creates somewhat of a navigation hazard (i.e. risk in terms of vessel grounding); however, local knowledge of this hazard by vessel operators largely eliminates much of the potential risk in this regard.

Plate A.2.3: Port of Kribi situated within the mouth of the Kienké river

The natural restrictions affecting the potential scale of port operations at Kribi also limit the volume of shipping, size of vessel and magnitude and type of product spill that could occur. As in the case of Limbe, fuel spills would be quite small, and would typically involve diesel or petrol used to power the small vessels utilizing the port. The high turnover of water within the port - attributable to the throughflow of the Kienké river and tidal exchange - is likely to ensure minimal local deterioration of water quality. Transfer of pollutants associated with these fuels (PAHs and metals associated with hydrocarbon products) into the broader coastal zone beyond the port limits would, however, take place. Due to the volatility of the hydrocarbon products likely to be spilled within the port, it is unlikely that the effect of such spills, flushed from the port, would manifest as persistent sea-surface and shoreline oiling. For this latter reason, oil spill simulation modelling was not undertaken for the Port of Kribi.

A.2.5 SONARA Refinery: Jetty and related product transfer operations

The SONARA Refinery, situated in Limbe, in the South-West province of Cameroon, was built in 1979. The main objectives of the refinery are to refine crude oil and supply the finished petroleum products to national markets. Finished products are also exported to other countries along the West African coast, from Senegal to Namibia. Since 1995, when the new SONARA jetty came into operation, the refinery has also been exporting products to Europe, the United States and South America.

Until 1988, the refinery processed exclusively local Kole field crude oil. Between 1988 and 1998, SONARA diversified its sources of crude oil supply (SONARA, 1997-1998). Currently, the refinery imports mostly Nigerian Light Sweet crude (Bonny Light) with an API value of 38° to 40° (Takere Derick, Director Risk Management Division, SONARA, pers. comm.). On average, 1.5 million tons per year of crude oil are imported annually by the refinery.

The crude oil is conveyed to the refinery by pipeline from its point of discharge at the jetty, which extends approximately 500 m from the shore (extended in 1996), and is held in four storage tanks with a total capacity of 250 000 m^3. Most of the refined products are conveyed by pipeline to the jetty for the back-loading of the Douala shuttle tanker (Section A.2.3) and occasional other tankers destined for foreign markets. A small volume of refined product is also loaded directly into road tankers at the refinery's loading gantry.

The refinery produces the following fuels (the percentages reflect December 2002 data obtained from SONARA):

Table A.2.8: Types of fuel produced by the SONARA refinery (December 2002 data).

Refined product	*%*
Fuel gas	2
Butane/propane	1.5
Petrol (leaded 97/98)	5.9
Reformats	16
Kerosene	20.6
Diesel	27
Heavy Fuel Oil	24.2

The largest most probable marine spill that could result from SONARA's operations is likely to be associated with the failure of some component, or system, associated with the jetty pipeline infrastructure. The estimated spill volume would be around 100 m^3 and the period over which the spill would occur is likely to be instantaneous (definitely less than 6 hours).

Oil spill simulation modelling, using ASA's OILMAP spill trajectory and fate model, was undertaken using the criteria summarized in Table A.2.9 (see also Box A.2.1). The modelling results are illustrated in Figure A.2.10, which shows the zone of potential oiling of the marine and coastal environment extending from Batoke south-eastward beyond the Bimbia river. The sea surface with a relatively high probability of oiling (> 50%) is defined by an arc, centred at the hypothetical spill source, extending from the refinery in the north to just south of Limbe in the east. Oiling is most likely to occur (50% probability) along the coast between these two coastal sites, with a decreasing probability of oiling to the west and east.

Table A.2.9: Criteria used for oil spill simulation modelling of a release of oil from SONARA refinery.

Origin	*Co-ords*	*Depth*	*Spill vol.*	*Spill period*	*API*
SONARA Refinery	3º 59 24" N 9º 07' 30" E Loading/offloading	20 m	100 m^3	Instantaneous to 6 hours	20-30, assume 25

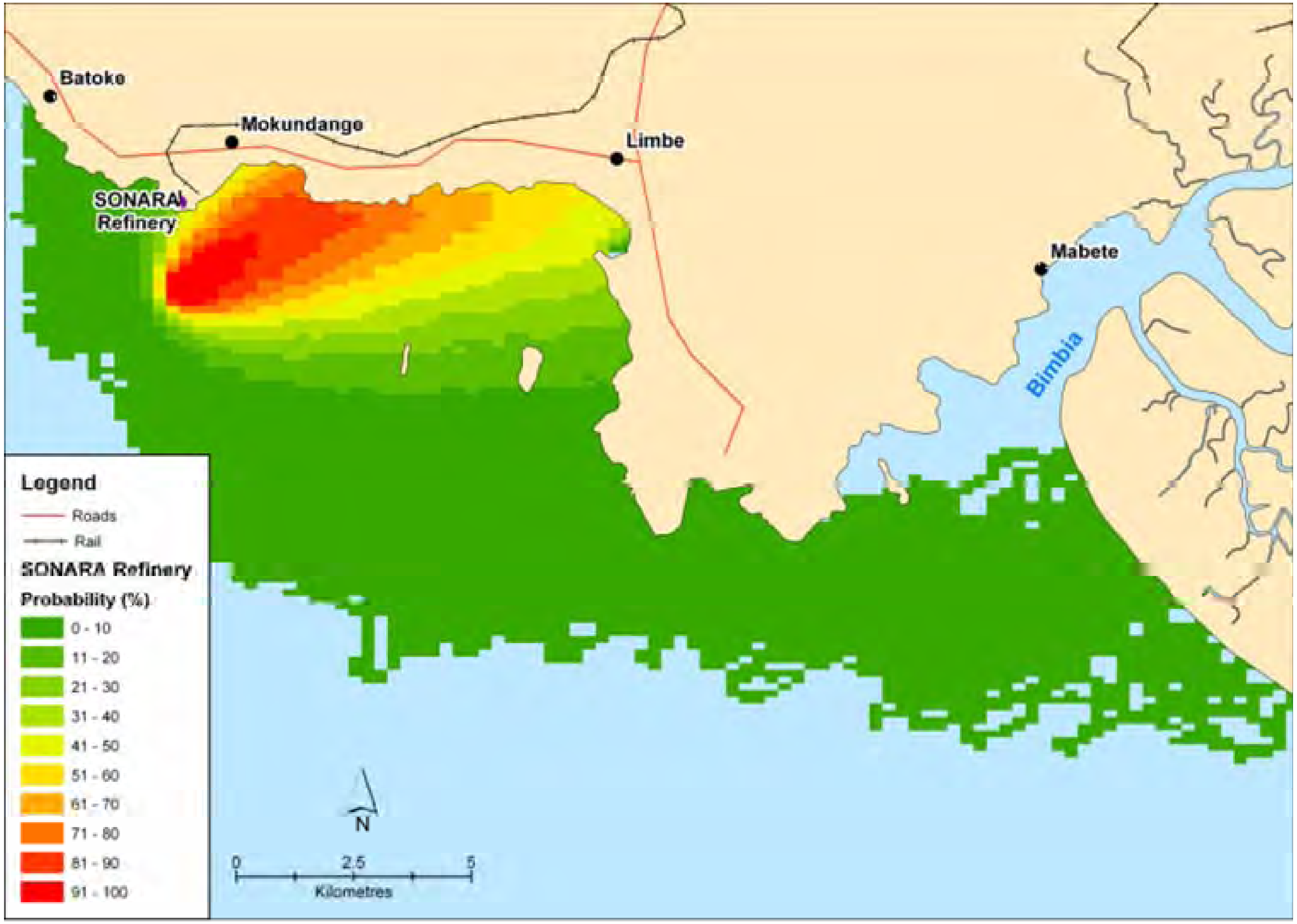


Figure A.2.10: Contour plot showing the predicted probability of exposure to locations from a release of oil from the SONARA refinery.

A.2.6 Spills originating from neighbouring countries

Oil spills of unknown origin have been observed entering Cameroonian waters from neighbouring countries (Paul Johnson, HSE Manager, Pecten Cameroon Company, pers. comm.). The incursion of such oil spills appears to be restricted mainly to the country's north-western coastal sector, offshore of the Rio del Rey system and the Bakassi Peninsula. This is explained by the concentration of oil production activities in Nigeria and Equatorial Guinea and the pattern of surface currents in this region.

Oil spill simulation modelling, using ASA's OILMAP spill trajectory and fates model, was undertaken using the criteria summarised in Table A.2.10 (See also Box A.2.1). The scenario that has been considered assumes the incursion of an oil spill (1-2 day old surface slick) into Cameroon's territorial waters from a position on the international border with Nigeria, midway between the Bakassi Peninsula and the offshore territorial limit of Equatorial Guinea.

The modelling results are illustrated in Figure A.2.11, which shows the zone of potential oiling to be defined by an arc, centred at the hypothetical point of entry of the spill into Cameroon's territorial waters, extending from the Cross river in the north towards Idenao in the east. A much narrower zone, extending north-eastward from the point of incursion of the spill towards the Bakassi Peninsula depicts the sea surface most likely to experience oiling (50-80% probability). Oiling is most likely to occur (>50% probability) along an approximately 25 km stretch of the mangrove coastline of the Bakassi Peninsula.

Table A.2.10: Criteria used for oil spill simulation modeling from the incursion of a surface oil slick into Cameroonian waters from Nigeria

Origin	Co-ords	Depth	Spill Vol.	Spill Period	API
Border with Nigeria, midway between Bakassi Peninsula and offshore territorial limits of Equatorial Guinea	04°18'15"N 08°20'10" E	18 m	200 m^3	1-2 day old surface slick	Nigerian Bonny Crude API 39°

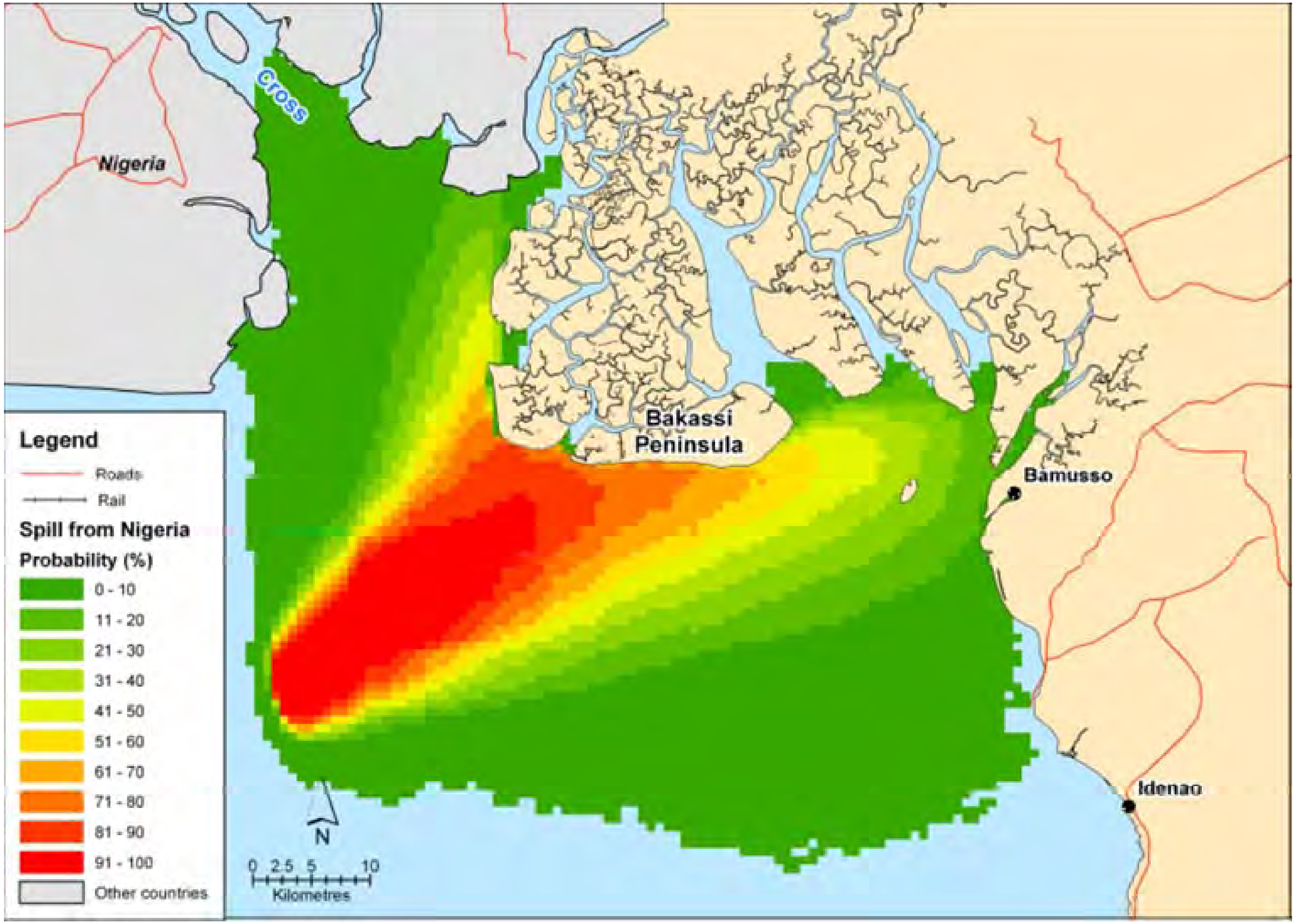


Figure A.2.11: Contour plot showing the predicted probability of exposure to locations from the incursion of a surface oil slick into Cameroonian waters from Nigeria

A.2.7 Discussion

A composite image incorporating the outputs of the modelled analyses of oiling probability associated with the various marine and coastal risk sources is presented in Figure A.2.12. Based on the oil spill scenarios that have been described previously, this figure indicates, on a relative scale (i.e. highest/least probability of exposure), the oiling probability of the various shoreline sectors and water surface within Cameroon's territorial boundaries. In creating this composite image, it is assumed that there is an equal likelihood of oil spills arising from each of the described risk sources; i.e. that there is the same statistical likelihood of an oil spill resulting, for example, from offshore production operations as there is from a shipping accident within the entrance channel of the Port of Douala. Whilst it might be questioned whether this assumption is valid, it does not detract from the purpose of producing a composite image of oiling probability, which is to direct attention - for the purposes of ensuring response preparedness - towards areas most likely to be affected by an oil spill.

It is evident from Figure A.2.12 that there is a clear pattern with respect to oiling probability, which permits some differentiation to be made between the country's various marine and coastal regions. Most important in this regard, is the zone extending offshore from the northern coastal sector of Cameroon (i.e. south of the Bakassi Peninsula, west of Idenao), where there is a particularly high probability of oiling. This is to be anticipated, given the concentration of Cameroon's offshore oil production operations in this region, and the proximity of similar operations in the neighbouring countries of Nigeria and Equatorial Guinea (Bioko Island). Other smaller zones of relatively high oiling probability are distributed along the coast offshore of Limbe, within the Estuaire du Cameroun, and offshore of Kribi.

It can be anticipated that preparedness for oil spill response is most important offshore and along the entire coastline of the Ndian Division. Response preparedness, directed at the central section of coastline within the Fako Division, within the Estuaire du Cameroun (Wouri Division) and along the Kribi-Ebomé coastline within the Océan Division, is also important.

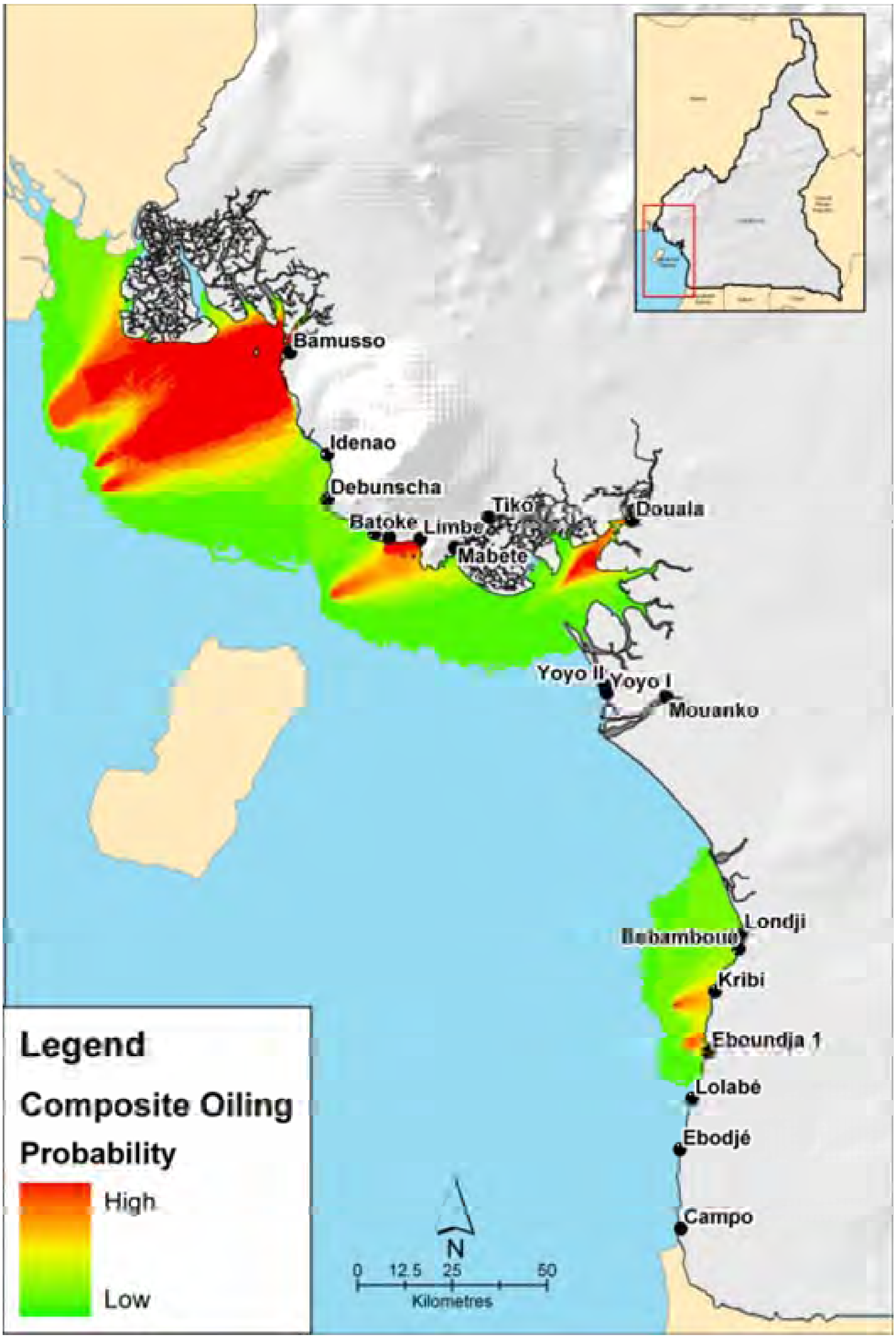


Figure A.2.12: Composite contour plot showing the predicted probability of exposure to locations from the release of oil from the multiple marine and coastal risk sources identified for Cameroon.

A.3 ENVIRONMENTAL DESCRIPTION, IMPACT ASSESSMENT AND SENSITIVITY ANALYSIS

A.3.1 Introduction

The importance of the following environmental description, the accompanying impact assessment and the interpretation of oiling sensitivity analysis is the basis that it provides for the oil spill response strategies (including the prioritisation for oil spill response), which are described in later sections of the NOSCP.

The entire coastline of Cameroon could conceivably be affected by oil spills; however, the greatest likelihood of oiling impacts is associated with the regions where exploration and oil production and other risk sources are most concentrated. As described in Section A.2, these include the Rio del Rey region, the Estuaire du Cameroun and parts of the country's southern coastal region. With this understanding of the distribution of oil spill risk, this section provides an overview of the key characteristics of the potentially affected marine and coastal environment.

Extending from the open sea, the sphere of tidal influence at the shoreline and within the country's major estuaries provides a rough boundary within which the environment is described. The environmental description covers both the key physical processes that largely control the marine and coastal ecosystems as well as the main biological constituents of these ecosystems.

The marine environment is described first, followed by the complex of shoreline ecosystem elements and estuaries. A review of the coastal conservation areas that could be affected by oil spills accompanies this description. Shifting the focus away from the natural environment, the socio-economic environment, including the various fisheries, is then described. A description of the impacts of oiling on both the natural and socio-economic components follows, which provides the basis for the concluding analysis of oil spill sensitivity.

A.3.1.1 Coastal Climate

The climate of Cameroon is controlled primarily by the North and South Atlantic Subtropical high pressure systems and their interaction with the Tropical Oceanic (over the sea) and the Inter-tropical Front (over the land) low-pressure zones situated between them (John and Lawson, 1988; Ibe *et al*., 1998). These systems move seasonally - northwards during boreal summer, and southwards during boreal winter.

The coast of Cameroon is dominated by two climate types, the so-called Cameroon Equatorial climate and the Guinean Equatorial or Coastal Equatorial climate. The coastal region north of the Sanaga river experiences the Cameroon Equatorial climate (Gabche *et al*., 2000), which is characterised by two distinct rainfall seasons, as shown in the rainfall data for Idenau and Douala (Figure A.3.1). This region lies well within the low-pressure zone for most of the year and experiences rain-bearing south-westerly (monsoon) winds from about March/April to October/November. The southward movement of the low-pressure zone during the boreal winter weakens the monsoon winds, bringing a short, relatively dry season that extends from November/December to February/March.

The coastal region south of the Sanaga river falls permanently within the low pressure zone and has a Guinean Equatorial (Neba, 1987) or Coastal Equatorial (Tropenbos/MINEF/SNV, 2002) climate, with rainfall characteristics as shown for Kribi (Figure A.3.1). The rainfall is lower than for the coastal region north of the Sanaga river and is distributed across two wet and two dry seasons: a long dry season from November to March; a rainy season from April to June; a relatively dry July and August; and a second rainy season from mid-August to the end of October.

The rainfall at the coast is greatest in the vicinity of Mount Cameroon, ranging from 6 000 to 10 000 mm on its seaward slopes (Fotso *et al*., 2001). The rainfall decreases north-westwards towards the Rio del Rey (mean annual rainfall of between 3 000 and 4 000 mm), and southwards, where statistics of 4 150 and 3 208 mm have been recorded for Douala and Kribi respectively.

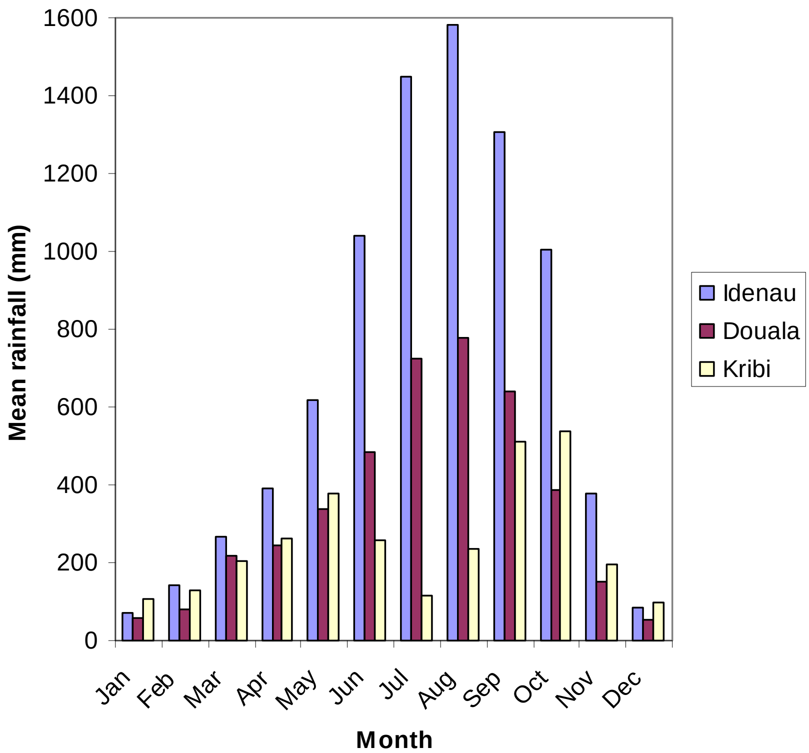


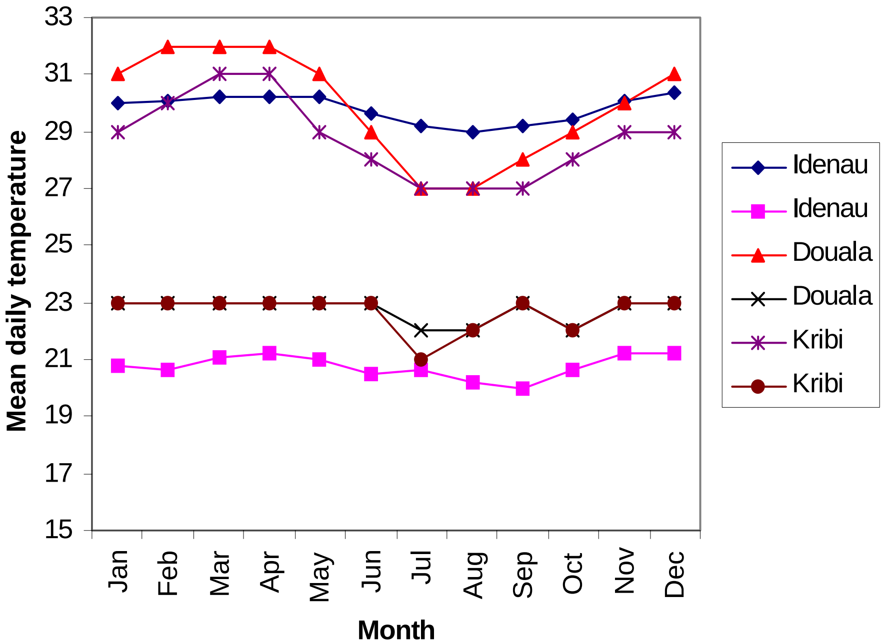
Figure A.3.1: Mean monthly rainfall for three towns in Cameroon: Idenau (northern coastal sector), Douala (central sector) and Kribi (southern coastal sector). Data from Africa Pilot (1977) and Fraser* et al. *(1998).

The mean daily temperatures are typically tropical (Figure A.3.2). The daily range in temperature is about 10°C, which exceeds the annual variation in maximum or minimum temperatures (Ibe *et al*., 1999). The highest mean daily temperature values are recorded during the period from February to April, and the lowest during July and August. There is no clear seasonality with respect to mean daily minimum air temperatures.

The prevailing winds, being south to south-westerly monsoon type winds, cause humidities to be very high (almost always at saturation point) all year round. Typically, the humidity approaches saturation in the early morning and ranges from 96-97% in Douala and 93-95% in Kribi (Africa Pilot, 1977). Values decrease towards midday and late afternoon, when minimum values ranging from 68-83% are recorded in Douala and 77-85% are recorded in Kribi. During the evening the humidity again increases towards saturation.

Other atmospheric observations such as insolation and visibility along the Cameroonian coastline have been summarised by Bertail (1980, 1981). In general, these data show that the insolation is greatly reduced during the wet season and that visibility is less than 11 nautical miles for 90% of the time. Africa Pilot (1977) indicates that visibility off Nigeria is similar to that off Cameroon, and that it increases on moving southwards towards Equatorial Guinea and Gabon. The days of fog recorded decrease southwards (and offshore) along the Cameroonian coastline. The average number of days of fog per annum decreases from 77 days at Calabar, just west of the Bakassi Peninsula, to 36 days at Douala and 2 days per annum at Libreville (Africa Pilot, 1977).

Figure A.3.2: Monthly means of the daily maximum and minimum temperature for three towns in Cameroon: Idenau (northern coastal sector), Douala (central sector), and Kribi (southern coastal sector). Data from Africa Pilot (1977) and Fraser et al. *(1998).*



Typically, in the tropical Atlantic, the winds blow from the North and South Atlantic Subtropical high pressure centres towards the equatorial low pressure belt, with deflection towards the west by Coriolis forces. This creates the north-easterly and south-easterly trade winds. The south-easterly trade winds cross the equator all year round; however, the heating of the eastern region of the continent during the boreal summer drives the formation of a trans-equatorial pressure gradient over the Gulf of Guinea, which introduces a deviation of trade winds to the east, reinforced by the change in sign of the Coriolis force on crossing the equator. In the Gulf of Guinea the trade winds are, therefore, transformed into a warm and humid, south to south-westerly onshore monsoon.

Winds along the Cameroon coast are generally weak and are characteristically from the south to south-westerly sector - almost exclusively so during boreal summer when there is an intensification of southerly winds in the Gulf of Guinea (the African monsoon), coupled with the strengthening of the South Atlantic Subtropical (St Helena) high pressure system. In boreal winter, the winds tend to be weaker and more variable, and dry, warm north-easterly trade winds blowing from the Sahel (called the harmattan) may penetrate to the northern coastal regions for short periods in December and January (Houghton, 1976). These winds are not, however, expected to influence the offshore metocean environment. Consequently, whilst wind speeds vary seasonally, there is no marked seasonality in the offshore wind direction. Voluntary Observing Ships (VOS) data for the continental shelf waters off Cameroon (2°N-5°N; 8°E-10°E) confirm that strongest winds occur during boreal summer while the weakest winds occur during boreal winter (Figure A.3.3).

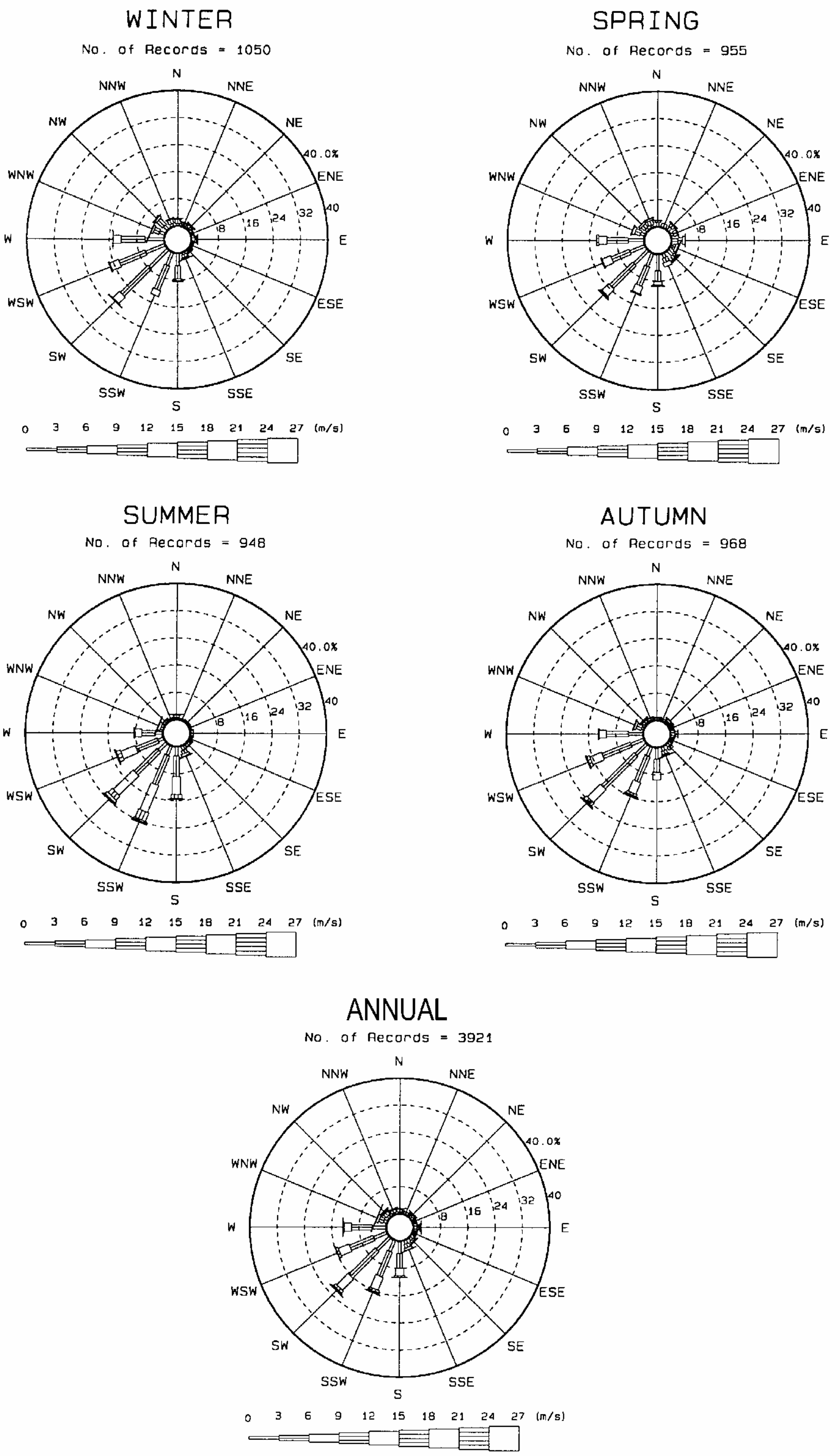


Figure A.3.3: Annual and seasonal (boreal) wind roses based on VOS wind data for the continental shelf region off Cameroon (2°N-5°N; 8°E-10°E) and for the period 1960 to 2001. (Source: South African Data Centre for Oceanography).

Coastal wind data indicate a significant diurnal variability in wind speed, where the winds strengthen during the course of the day from light winds in the morning to moderate winds towards late afternoon. This impacts strongly on the nearshore sea state which, from the perspective of coastal shipping (e.g. small fishing craft), deteriorates somewhat during the day. This diurnal variation in wind speed is not noticeably apparent in the offshore VOS data, since the diurnal variation in the offshore surface winds is typically small; however, offshore winds speeds tend to be greater at night as a result of lower layer atmospheric instability due to radiation cooling. Offshore diurnal variability in the wind, where observed, is most evident during periods of clear skies and reduced trade wind activity.

The wind climate is generally predictable, with little variability, and strong winds are infrequent in the offshore region of Cameroon. The VOS wind data indicate that there is less than 3% occurrence of winds speeds greater than 10 m/s. The only exception to the rather benign wind climate is the generally westward propagating squall lines related to local thunderstorms associated with the Intertropical Convergence Zone, which is a regular feature in the area. These thunderstorm lines (commonly referred to as West African squall lines) are normally orientated north/south and move westwards across the Gulf of Guinea at a speed of 25 knots or more (Africa Pilot, 1982). The greatest frequency of occurrence of thunderstorms (approximately 100 to 150 per annum) is around the equator, extending from Cameroon to southern Gabon; however, the frequency of westward propagating squall lines is seemingly an order of magnitude or so less (Clackson, 1961). These squalls are most frequent at the beginning and end of the wet seasons (May and November) and may significantly disrupt weather-sensitive operations such as oil spill response operations. The high wind speeds (> 40 knots) associated with these squall lines are typically of shorter duration, but have been reported to last for up to an hour or more (Africa Pilot, 1977). Whereas the winds associated with these squalls typically moderate rapidly, the associated rain may persist for a few hours (Africa Pilot, 1982).

A.3.1.2 Physical Oceanography

INTRODUCTION

Knowledge of the physico-chemical characteristics of the marine environment is important in oil spill contingency planning in that they:

- may play a role in causing an oil spill (e.g. incidents attributable to high energy wave conditions, poor visibility, etc.);
- often play a major role in defining the ecological habitats and exert a controlling influence on ecosystem processes that may be impacted by oiling;
- largely determine the transport and fate of spilled oil in the marine environment; and
- are a major factor in determining the strategy and ultimate efficacy of spill containment and clean-up (e.g. there are limits to the wave heights and current speeds at which booming operations remain effective; high wave energies promote the rapid breakdown of spilled oil).

Winds, waves, large-scale and tidal currents, air and water temperatures, salinity, turbidity (i.e. amount of suspended sediment in the water column), the type and amount of nutrients and inorganic substances present and insolation, to a greater or lesser extent, all play a role in the transport and fate of oil in the marine environment. The wind strength and current speeds primarily determine the transport of oil in the marine environment while factors such as wave action and water temperature largely determine the weathering and ultimate fate of spilled oil. For example, water temperature largely determines the extent of evaporation of oil, while wave conditions largely determine the extent of dispersion, dissolution and emulsification of oils in the marine environment. Many of the above environmental parameters are used as input variables for the oil spill simulations that are used to characterise oil spill risk (Section A.2).

BATHYMETRY, SEDIMENTS AND BEDFORMS OFFSHORE OF CAMEROON

Figure A.3.4 shows the major bathymetric features offshore of Cameroon. The continental shelf of Equatorial West Africa is narrow west of the Niger river Delta, widening to approximately 60 to 70 km in the vicinity of the delta where it is gently-sloping. Eastwards, the shelf continues to widen to approximately 80 to 85 km, where there is an extensive shallow region south of the Bakassi Peninsula.

Between Bioko Island and the Cameroonian mainland the water is relatively shallow (typically < 60 m). East of Bioko Island the continental shelf both steepens and narrows to approximately 40 km in width. Southward, offshore of the Cameroon coastline, the continental shelf continues to both steepen and narrow until it reaches a width of approximately 30 km offshore of Campo.

Figure A.3.5 presents a general characterisation of the bottom deposits offshore of the Cameroon coastline (Price *et al*., 2000). Between the upper limits of tidal influence within the country's estuaries and approximately the 100 m depth contour, the deposits comprise a mixture of coastal hard grounds, coral, sand, muddy sand, sandy mud and mud.

Muddy deposits are found in the estuaries of all of the major rivers, particularly in the Estuaire du Cameroun and Rio del Rey system. The coastal deposits are 6 to 16 m thick and the annual sedimentation rates range from 0.03 m to 0.1 m (UNEP, 1984). Terrigenous sands and silts comprise the largest proportion (90%) of these sediments, the remainder comprising ferritic alluvial soils (Gabche and Angwe, 1996). The large volumes of water discharge and sandy-silty sediment loads of the region's rivers are responsible for the formation of extensive coastal mangrove island formations.

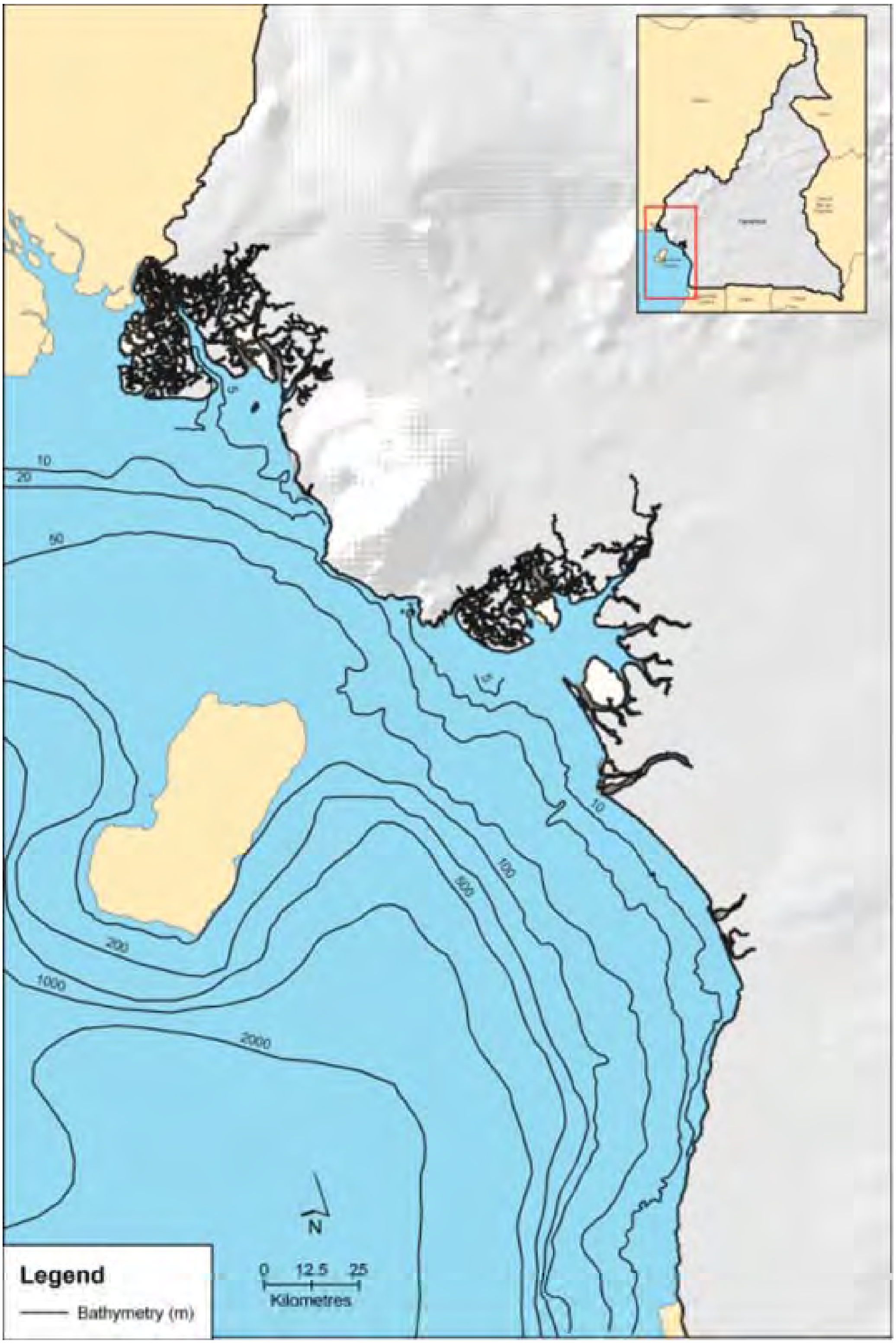


Figure A.3.4: Bathymetry of the offshore region, Cameroon.

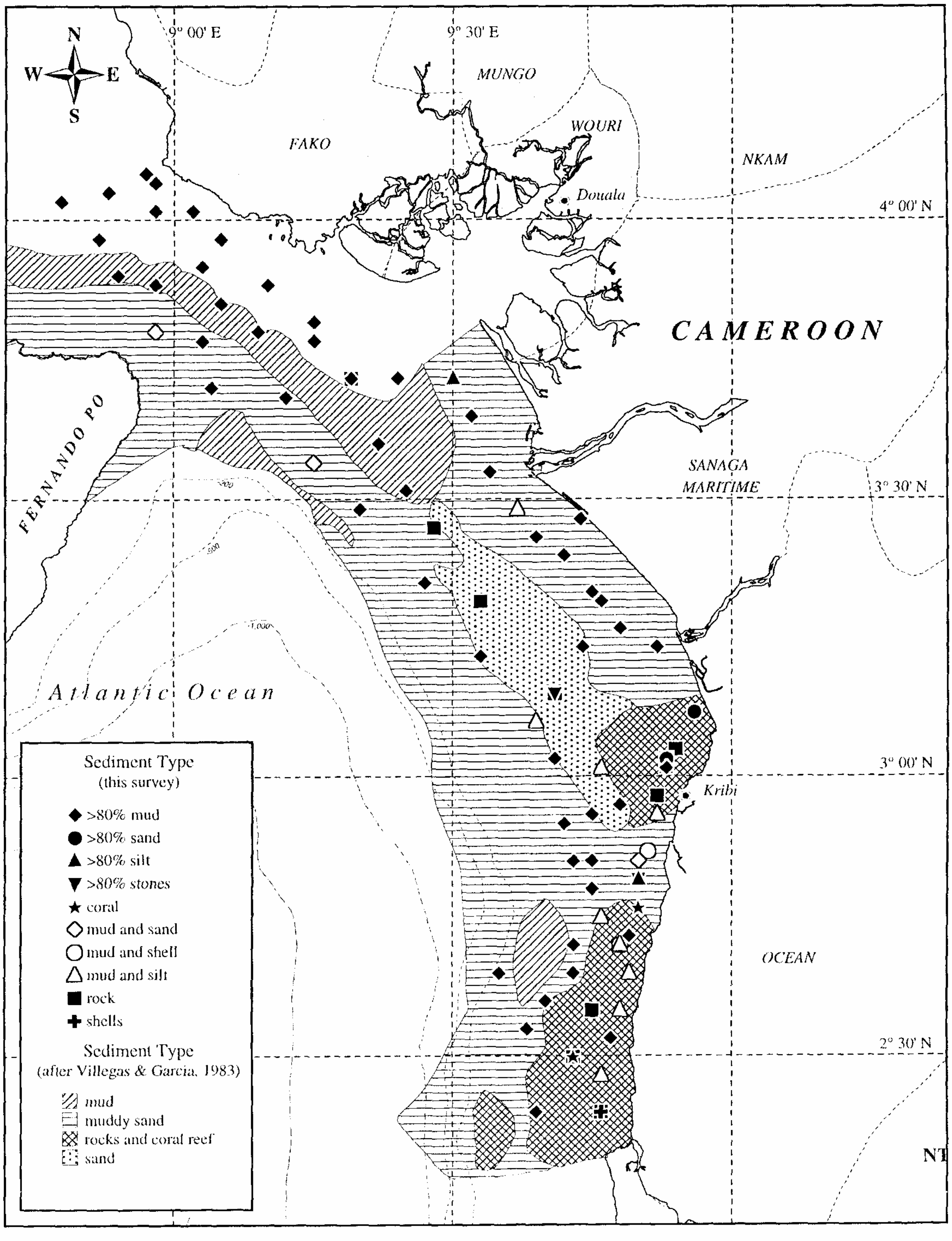


Figure A.3.5: Characterisation of the bottom deposits off Cameroon (Price et al.*, 2000).*

In the offshore region, the bottom sediment type is predominantly mud and muddy sands along most of the continental shelf; however, an offshore belt of sand extends northwards from Kribi to offshore of the Sanaga river mouth. The bottom fishing grounds offshore of the northern coastline are reported to be silty or sandy (Ibe *et al*., 1999) while to the south, off Kribi and Campo, the bottom includes rock outcrops and some coral reef interspersed with muds and silts. The extensive sediment plumes, associated particularly with the Sanaga river during the rainy season, carry sediments far out onto the continental shelf. The sedimentation rates offshore over the shelf have not been determined, but are expected to be appreciable, especially in the vicinity of the mouths of large rivers such as the Sanaga.

WAVES

The waves reaching the West African coast are of two distinct origins; namely, the sea generated by the weak local monsoon and swell generated by high latitude storms linked to eastward migrating low pressure cells in the southern Atlantic (Allersma and Tilmans, 1993).

The locally generated waves (sea) are small short period waves from the south-west that rarely exceed heights of 1.25 m and have a maximum period of between 3 and 4 s. Waves (swell) generated by storms in the "roaring forties" in the South Atlantic Ocean (and south-eastery winds adjacent to the African coast) are observed all year round offshore of Equatorial West Africa, but are most intense in the austral winter (June to August). The periods of the swells generated by these storms vary between 8 and 20 s, with an average period of 12 to 13 s. The average deep water wave height is approximately 1.0 to 1.5 m, although wave heights of 2 to 3 m or more do occur (Allersma and Tilmans, 1993). These swells arrive from directions between south and south-west.

VOS wave data (Figure A.3.6) indicate predominantly south to south-westerly swells offshore of Cameroon, with a 1% exceedance of significant wave height of between 2.5 and 3.0 m (Table A.3.1). However, wave statistics based on hindcast data for a location north-east of the Niger delta indicate that the 1% exceedances of the significant wave height for boreal winter and summer are approximately 1.6 m and 2.3 m respectively. These data also indicate a mean significant wave height varying from 0.8 m during boreal winter to approximately 1.5 m during boreal summer. These wave heights are somewhat less than those derived from the VOS data. Summaries of wave data for an area offshore of Cameroon presented by Bertail (1980, 1981) indicate significant wave heights intermediate to those indicated by the VOS and hindcast data.

Measurements in the vicinity of Kribi indicate that during a 10-month recording period, the maximum significant wave heights did not exceed 1.3 m, and for 85% of the time the significant wave height did not exceed 0.5 m with periods of 7 to 8 s (LCHF, 1985). Maximum wave heights in this region have been estimated at between 2.65 and 3 m (5-year storm) and between 2.8 and 3.25 m (10-year storm). The wave heights were observed to be highest during April to August.

No systematic wave measurements are available for either the central coastal sector or the Estuaire du Cameroun; however, according to local observers, the significant wave height in the Estuaire du Cameroun is generally less than 0.5 m for 85% of the time (LCHF, 1985).

Table A.3.1: Percentage exceedance of swell height offshore of Cameroon, based on VOS wave data for the region (2°N-5°N; 8°E-10°E).

Significant Wave Height (m)	*Exceedance (%)*
> 0	100.0
> 0.5	100.0
> 1.0	70.6
> 1.5	31.4
> 2.0	12.3
> 2.5	3.0
> 3.0	0.6
> 3.5	0.4
> 4.0	0.2
> 4.5	0.1

While the frequency of wave height exceedance along the coast in the Gulf of Guinea indicates a relatively low energy wave regime, the long swells are subject to considerable shoaling and in this way become more prominent in the shallow water near the coast where they form high breakers or surging waves on relatively exposed coastlines (e.g. there can be considerable surf breaking on the rocky headlands, although wave action is generally not very great along the rest of the coast). Alongshore variability in wave heights occurs where waves are attenuated by major offshore islands (e.g. wave sheltering of the Cameroon coastline north-east of Bioko Island) and by major capes and/or rocky headlands and outcrops.

The relatively low wave energy regime will reduce the dispersion of oil in the offshore region as well as the natural clean-up of oil along the shoreline. This is offset to some extent by the effect of local seas and increased wave action at the shore, which are generated by the coastal winds that increase in velocity as the day progresses.

TIDES

The tides in this region are semi-diurnal (tidal form factor = 0.13 to 0.19) with a tidal range in the north (Niger Delta and Cameroon) of approximately 2.0 m at springs and 1.0 m at neaps. The tidal range decreases southwards along the coast and offshore (Gabon, Equatorial Guinea and offshore islands) where the tidal range varies between approximately 1.5 m at springs to 0.6 m at neaps (Table A.3.2).

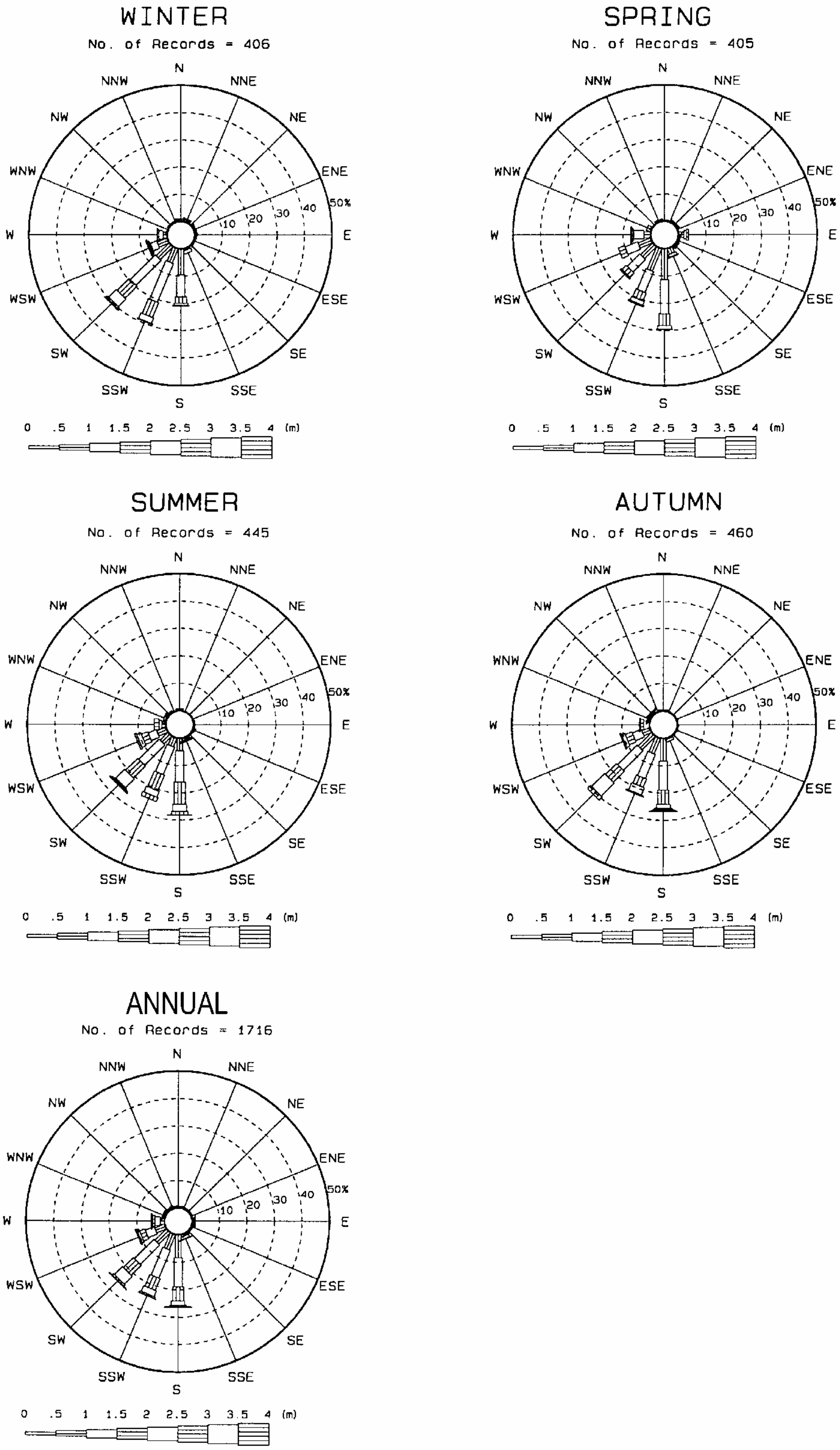


Figure A.3.6: Annual and seasonal (boreal) swell roses based on VOS wind data for the continental shelf region off Cameroon (2°N-5°N; 8°E-10°E) for the period 1960 to 2001. (Source: South African Data Centre for Oceanography).

Knowledge of the tidal currents is important, since the strength of tidal currents will not only determine the rapidity and extent of oiling following a spill, but will also limit the options available for containment and protection and clean-up of environments exposed to the risk of oiling. Tidal currents are generally weak along the open coastline; however, strong tidal streams occur in the various inlets and estuaries along the coast (Allersma and Tilmans, 1993). The strongest currents are observed in the Estuaire du Cameroun, where current speeds can reach around 1.0 m/s in the estuary (LCHF, 1985) and remain strong some distance offshore of the estuary mouth (Bertail, 1981). Tidal currents are also expected to be significant in the Rio del Rey complex and Bimbia Creek.

Table A.3.2: Tidal statistics along the coast and islands of the Gulf of Guinea

Location	*Height differences(1) (m)*					*Time difference(2) (min)*	
	MLWS	*MLWN*	*MSL*	*MHWN*	*MHWS*	*MHW*	*MLW*
NIGERIA							
Bonny Town	0.4	0.9	1.50	1.9	2.3	-	-
Opobo river	0.1	0.7	1.10	1.5	2.0	-4	-11
Kwa Ibo	0.3	0.7	1.13	1.5	1.9	-23	-23
Calabar (Bakassi Bank)	0.2	0.7	1.22	1.7	2.2	no data	no data
CAMEROON							
Rio del Rey Entrance	0.2	0.8	+1.41	1.9	2.4	-8	0
Man O' War Bay	0.4	0,8	+1.2	1.6	1.9	-40	-40
Bimbia river Entrance	no data	no data	+1.1	1.6	2.1	-45	no data
Tiko	no data	no data	+1.2	1.8	2.3	+25	no data
Cap Cameroun	no data	no data	+1.4	1.9	2.3	+25	no data
Douala	0.6	1.1	+1.62	2.2	2.6	+39	+41
Manoca	0.5	1.0	+1.42	2.0	2.5	+21	-14
Malimba	0.9	1.1	+1.32	1.7	2.1	-38	-47
Kribi	0.2	0.5	+1.0	1.5	1.8	+5	no data
EQUATORIAL GUINEA (mainland)							
Bata	0.3	0.7	1.02	1.3	1.7	-52	-52
Rio Benito	0.2	0.6	0.96	1.3	1.6	-32	-42
Rio Muni (Puerto Iradier)			1.49			-8	+7
OFFSHORE ISLANDS							
Bioko Island Malabo (Santa Isabel)	0.2	0.7	1.16	1.4	1.8	-25	-35

(Source: Admiralty Tide Tables, Volume 2, 1998. London, The Hydrographer of the Navy)

(1) The abbreviation used in the above table are as follow:
MLWS Mean low water Spring
MLWN Mean low water Neap
MSL Mean sea level
MHWS Mean high water Spring
MHWN Mean high water Neap

(2) Gives the mean high water times lead/lag and mean low water times lead/lag (in minutes) between the station listed and the standard port of Bonny Town, in Nigeria (Admiralty Tide Tables, 1998). A positive value indicates a lag.

LARGE-SCALE AND NEARSHORE CURRENTS

The large-scale flows offshore of Cameroon are important in that they, together with the local winds, mostly determine the movement of an offshore spill. Nearshore currents are important due to their influence on the extent of oiling and persistence of oil in nearshore and coastal environments.

The Gulf of Guinea is a hydrodynamically complex zone as it encompasses a number of converging and diverging current systems. The larger scale flow in this region has been summarised by Morant and van Ballegooyen (2002). Flow in this region comprises the South Equatorial Current, North Equatorial Current, North Equatorial Countercurrent, South Equatorial Undercurrent, Equatorial Undercurrent and the more local Guinea Current and Guinea Undercurrent in the Bay of Biafra.

The large-scale flows influencing the currents offshore of Cameroon are:

- the eastward flowing *North Equatorial Countercurrent* (NECC) that lies roughly between 3º and 10ºN. The NECC is permanent to the east of 20ºW and is extended into the Gulf of Guinea by the Guinea Current. It is subject to strong seasonal variations.

- the eastward flowing *Equatorial Undercurrent* (EUC) that is centred near the equator at a depth of 50 to 100 m. To the west the EUC is variable, but from 30ºW to near the African coast it is a permanent feature of the equatorial system and flows at speeds of up to 1 m/s (Pickard and Emery, 1982). The core of the EUC decreases in speed towards the African coast, decreasing from 80 cm/s at 12°W, to 40 cm/s at 4°W and to just over 30 cm/s at 4°30' E (Peterson and Stramma, 1991). On reaching the African coastline the EUC is reported to branch into the poleward coastal undercurrents into the Bight of Biafra to the north and off Gabon and Congo to the south (Wacogne and Piton, 1992).

- the *Guinea Current* (GC) and *Guinea Undercurrent* (GUC). The Guinea Current is a continuation of the NECC (Richardson and Reverdin, 1987) and is a very shallow eastward current (extending to depths of 15 to 25 m) that flows along the African coast (5ºN to 2ºN) as far as the Bight of Biafra. The GC flows above a more constant, westward countercurrent, the Guinea Undercurrent (GUC), which flows westward at depths of between 100 and 300 m from the Bight of Biafra, as a return branch of the Equatorial Under Current (EUC). The GC is re-inforced by the south-westerly monsoon to reach peak velocity in boreal summer and may on occasion be modified by the harmattan (Allersma and Tilmans, 1993). This current is typically not in close proximity to the coast, except near promontories (Allersma and Tilmans, 1993).

The surface currents in the Gulf of Guinea offshore of Cameroon are generally fairly weak and reflect a zone of convergence between the eastward flowing Guinea Current and the northwards surface flows from the south. Measurements of surface currents offshore of Cameroon indicate a convergence of surface flows offshore of the Estuaire du Cameroun and a resultant offshore flow of surface waters in a south-westerly direction into the Bight of Biafra just south of Bioko Island (Bertail, 1981). The highly stratified coastal waters allow for a weak coupling between surface and subsurface flows resulting in the highly sheared westward subsurface flows (GUC) and eastward surface flows (GC) reported by Bertail (1981) between Bioko Island and the mainland to the north. It is these eastward surface flows that will result in the Cameroonian coastline being impacted upon by oil spills in the vicinity of the Bakassi Peninsula (see results of the oil spill simulation modelling discussed in Section A.2).

The surface flows offshore of Cameroon (Figures A.3.7a and b) have been summarised by Bertail (1981); however, there is some uncertainty around the indicated northward surface flows in the vicinity of Kribi as near–surface current measurements in this region, both in shallow water off Lobé (Bertail, 1982) and in shallow (13 m) and deeper water (46 m) off Kribi, have indicated fluctuating flows, but with a net southwards residual surface flow and northwards deeper flow (Dames and Moore, 1997).

The southern coastline is characterised by strong northward-flowing nearshore currents (UNESCO, 1989), while the coastline to the west of the Rio del Rey region is characterised by eastward-flowing nearshore currents (Figures A.3.7a and b). Along the coastline between the Nigerian border and Bimbia Creek, the nearshore currents are reported to be more variable and may reverse depending on prevailing waves and winds. More detailed nearshore flows may be inferred from the coastal geomorphology where required.

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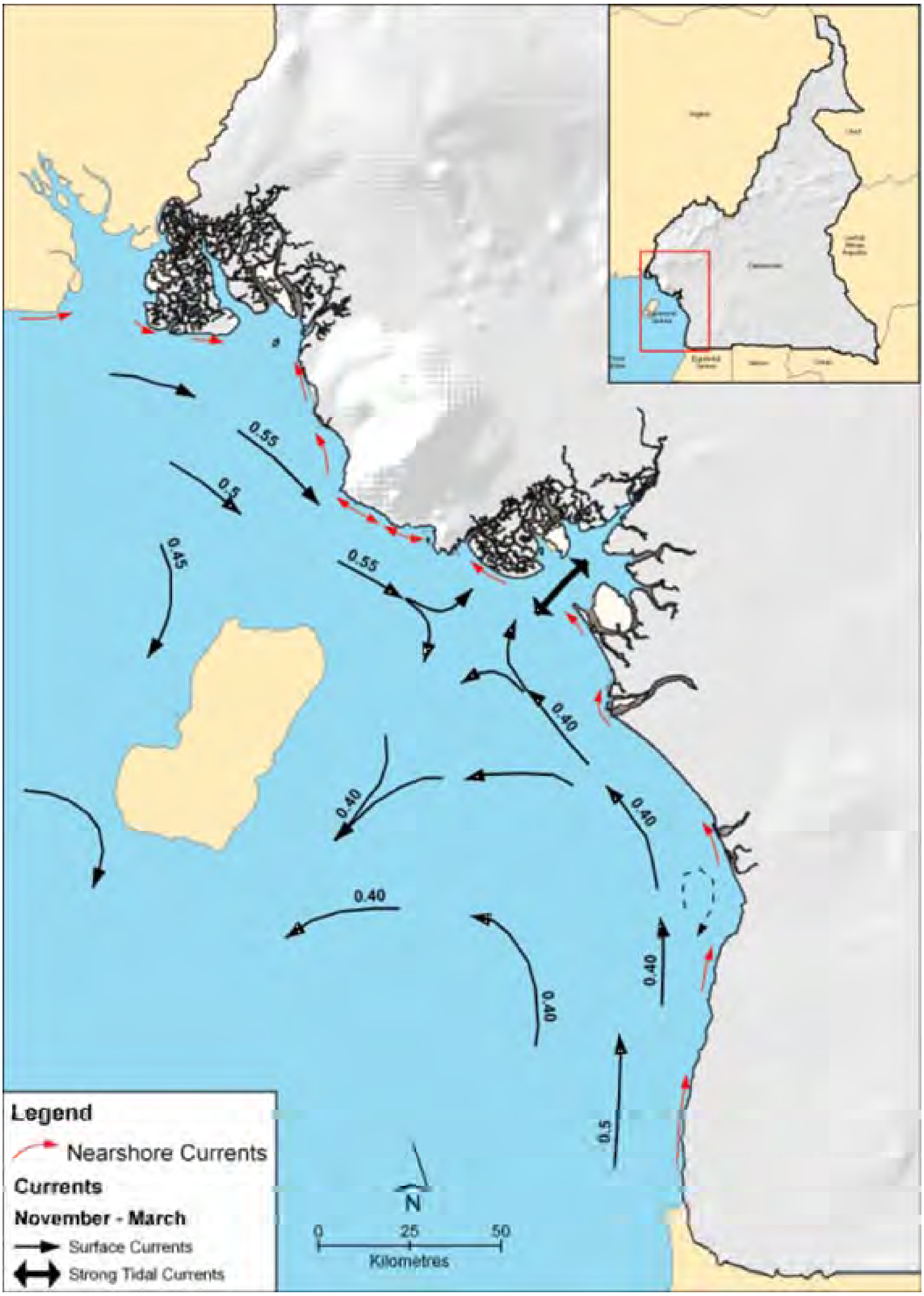

Figure A.3.7a: Schematic of the surface currents offshore of Cameroon for the periods November to March (adapted from Bertail, 1981), including inferred nearshore currents.

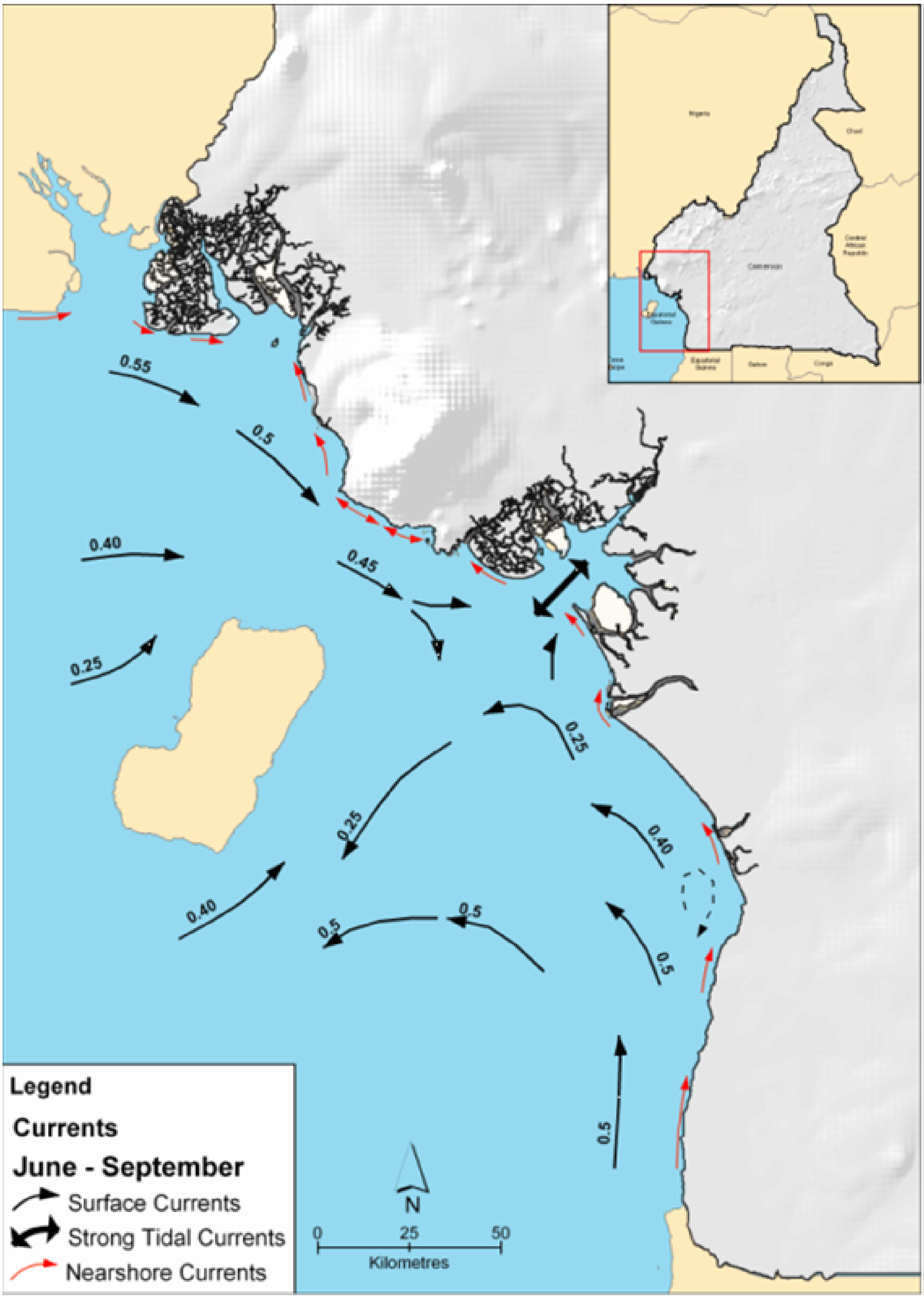

Figure A.3.7b: Schematic of the surface currents offshore of Cameroon for the periods June to September (adapted from Bertail, 1981), including inferred nearshore currents

WATER COLUMN STRATIFICATION, TEMPERATURE AND SALINITY

The abundance of precipitation and the flood of the major rivers in the region (the Niger and Congo rivers particularly) result in a mass of warm and low salinity waters in the Gulf of Guinea. These waters are described as Guinean waters and are mainly produced in two places: the Coast of Graines (Sierra Leone and Liberia) and the Bight of Biafra (Nigeria, Cameroon and Gabon) where they are permanent. The horizontal and vertical extensions of these waters vary substantially during the course of the year. An idea of the spatial extent of low salinity surface waters in this region is given by the Naval Research Laboratory 1/8° Navy Coastal Ocean Model (NCOM) for one day, late in the rainy season (Figure A.3.8).

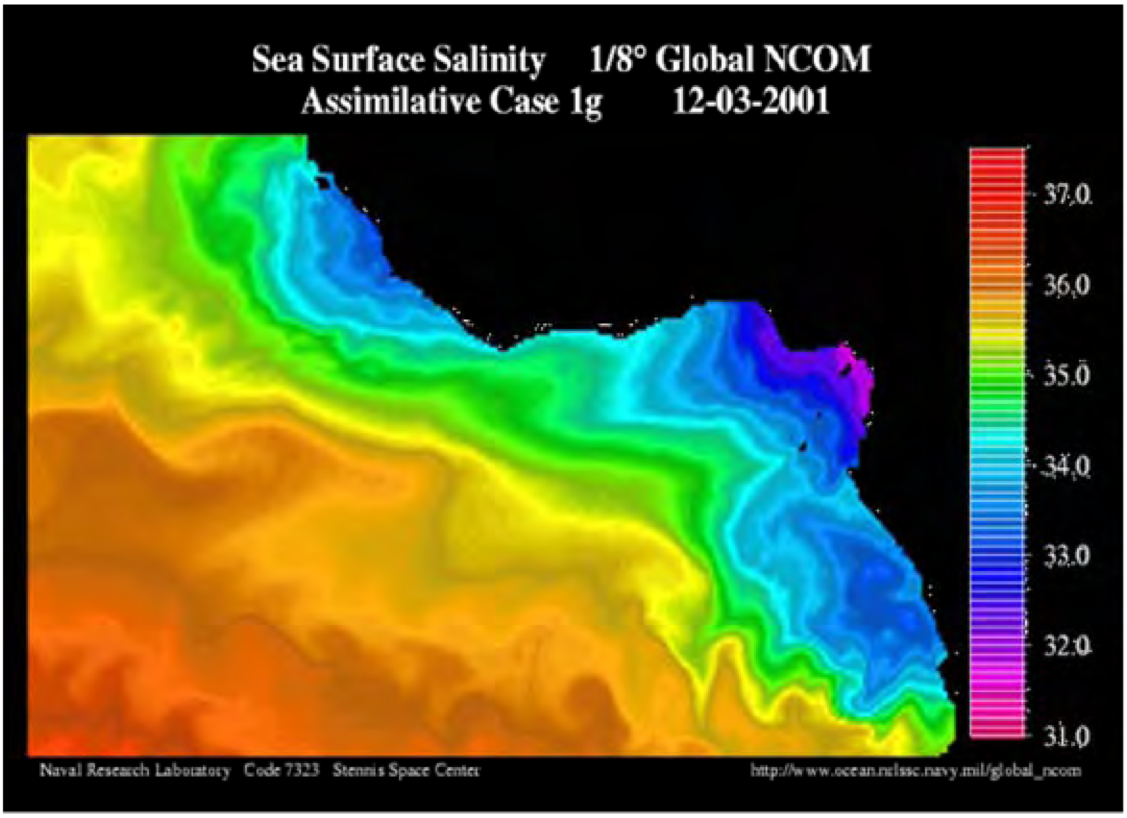

Figure A.3.8: Simulated sea surface salinity using the Naval Research Laboratory 1/8° Navy Coastal Ocean Model (NCOM) for one day late in the rainy season.
http://www.ocean.nrlssc.navy.mil/global_ncom

Cameroon's coastal waters, forming part of the Guinean waters (Berrit, 1966), are typically both warm and fresh throughout the year, with near surface water temperatures always remaining above 24ºC and with offshore surface salinities of approximately 30 practical salinity units (psu), decreasing substantially towards the nearshore. The strongly flowing rivers combined with the substantial groundwater outflow along the coastline explain the particularly low salinities observed in the marine environment offshore of Cameroon (Gabche and Smith, 2000). Surface salinity measurements taken along the southern coastline nearshore zone in October 2002 (the peak rainfall period in this southern coastal region) varied between 5 and 15 ppt at distances of up to 2 km from the shore, suggesting that the freshwater – seawater mixing zone is quite extensive (Burns *et al.*, 2002b). Similar measurements along the northern coastline in December 2002 (the start of the northern dry season) varied between 15 and 22 ppt, indicating a strong freshwater influence on the marine waters even during the dry season. The sea surface temperature in the austral summer is typically about 29ºC, while during the austral winter this falls to approximately 24ºC.

The vertical stratification in the water column in the region is primarily determined by changes in salinity; however, significant temperature stratification also exists. The thickness of the layer of Guinean waters is estimated to be 20 to 30 m, depending on the location and the season (Crosnier, 1964 as reported by Ibe *et al.*, 1999). These low salinity, warm surface waters in the Bight of Biafra are underlain by saline waters in excess of 35 psu and water temperatures of between 18 and 20ºC (Ibe *et al*., 1999). Data extracted from the VOS data base (VOS sea surface temperatures, SST's) and the SADCO marine database (SST's and sea surface salinities) confirm the year-round presence of low salinities in the Bight of Biafra offshore of Cameroon (Table A.3.3).

Table A.3.3: Gulf of Guinea: Seasonal sea surface temperatures and salinities for the region (2°N-5°N; 8°E-10°E)

Season (boreal)	*Sea surface temperature (VOS)*	*Sea surface temperature (SADCO)*	*Surface salinity (SADCO)*
Summer	26.9 (1.7)*	26.1 (0.9)	25.5 (5.7)
Autumn	27.2 (1.3)	28.0 (0.6)	20.2 (2.7)
Winter	28.7 (1.3)	28.3 (0.7)	no data
Spring	29.1 (1.5)	29.0 (1.0)	28.2 (1.7)

* *The figures in brackets are the standard deviations of the SST's and surface salinities.*

In the mangrove estuarine zone, the salinity is even lower than in the nearshore zone along the open coast as it is largely determined by the inputs of fresh water from the rivers, rainfall and groundwater. For example, the salinities measured in the Estuaire du Cameroun during the 2002 dry December period ranged from 4 ppt upstream to 16 ppt near the village of Grand Cap Cameroun.

SUSPENDED MATTER

The quantity of suspended sediments and organic matter may play a significant role in the transport and fate of oils in the marine environment. For example, high levels of suspended sediments in the water column could lead to increased sedimentation of oil from the water column, resulting in bottom settlement.

The turbidity of the offshore environment varies according to season. The sediment plumes from some of the country's rivers are extensive during the rainy season, particularly in the case of the Sanaga River, which is estimated to discharge 2.8 million tonnes of sediment into the ocean annually. Discolouration of the sea water up to 20 to 30 km offshore may occur (Bertail, 1981; Ibe *et al.*, 1999). This suggests that the quantities of suspended sediment in the water column over the shelf off Cameroon are both high and seasonally variable, particularly in the vicinity of the major river inflows to the shelf environment.

The water associated with mangrove estuarine complexes is also typically characterised by high turbidity levels, which extend into the offshore environment. Suspended sediments are particularly high in the vicinity of the Rio del Rey complex and the Estuaire du Cameroun, where suspended sediment concentrations exceeding 400 mg/l have been recorded in the period December to May.

A.3.1.3 Biological Oceanography

INTRODUCTION

The marine and coastal environment of Cameroon largely assumes its character from the influence of the Guinea Current, the dominant feature of the shallow ocean off the coast of West Africa. The current's broad region of influence is described by Longhurst (1998) as the Guinea Current Coastal Province, which has also been classified as one of 50 Large Marine Ecosystems that have been delineated globally. The Guinea Coastal Province, as defined in terms of its bathymetry, hydrography, productivity and trophodynamics, extends from the mouth of the Gambia river eastwards and then southwards along the coast of West Africa to Cape Frio at the Angola/Namibia border. The western boundary of the province, off the Cameroon coast, is taken as an arbitrary line located approximately at longitude 6-8 °W.

Cameroon's coastal waters are situated between the northern subsystem of the Guinea Coastal Province, which is thermally unstable and characterised by intensive seasonal upwelling, and the southern, thermally stable region, where key ecosystem processes are maintained largely by local nutrient inputs originating from land drainage and rivers. Persistent and localised upwelling cells occur in the province's central coastal waters, to the west of Cameroon, and these trigger important biological effects (in particular, phytoplankton blooms). As a source of nutrients, these upwelling cells are likely to have only slight influence on the productivity and biological diversity of the coastal and marine ecosystems represented within Cameroon's offshore environment.

PLANKTON AND MICRONEKTON

Phytoplankton blooms, measured as seasonal chlorophyll maxima, are recorded off the Central African coast within the Guinea Coastal Province mainly during boreal summer months (Binet, 1983). To the west of Cameroon, these blooms are associated with coastal upwellings and fronts that occur in the eastern tropical Atlantic (Binet, 1997). Herbland *et al.* (1983) recorded primary production rates of 70-80 mgC/m^2/hr in these areas, rates that are considerably higher than those recorded in the oceanic waters found further south (Stretta, 1993). Monger *et al.* (1997) also show that horizontal chlorophyll-a distributions extend out from the African coast into the eastern tropical Atlantic, with highest values occurring immediately adjacent to the coast and occasionally elevated concentrations further offshore. These authors estimate production in the eastern tropical Atlantic as 2.3 G tonne C/yr, with a mean daily rate of 980 mg C/m^2/d.

Although it is uncertain (and unlikely) that the above rates of primary production apply to Cameroon's coastal waters, an important feature is the local source of nutrients that control phytoplanktonic production. Nutrient concentrations in the coastal zone appear to be more strongly linked to fluvial inputs from systems such as the Estuaire du Cameroun and the large Sanaga (Gabche *et al.*, 2000) and Ntem rivers, as well as the other smaller rivers in this region, such as the Lokoundjé and Kienké rivers; i.e. upwelling oceanic sources of nutrients appear to be less important in the nearshore coastal zone of Cameroon.

The offshore epiplankton in the region is considered to be typical of tropical seas, and is characterised by diurnal shifts in biomass distribution from high concentrations in the near-surface water column at night, to evenly distributed biomass concentrations during the day. Important genera that adopt this pattern of vertical diurnal migration include *Nanocalanus*, *Paracalanus* and *Neocalanus*.

The seasonal cycle of production in coastal bays within the Guinea Coastal Province tends to be reversed compared to the open coast and offshore environment, with maximum values recorded in the boreal winter dry season (Longhurst, 1998). This is attributed to the comparatively clear condition of estuarine waters at this time of the year, in contrast to the situation during the summer wet season when inshore coastal waters, particularly offshore of the Sanaga river, tend to carry high loads of suspended silt. This situation applies less to the southern coastline of Cameroon, where the waters are relatively non-turbid, even during the high rainfall season.

The growth of large diatoms in concentrated "blooms" that develop in inshore waters supports a large population of phytoplankton-feeding clupeids (*Ethmalosa dorsalis*) in these environments. However, planktonic consumption of inshore blooms is small relative to the total production. Zooplankton data for the study area are sparse, but it is assumed that with the occurrence of planktivorous fish stocks found on the continental shelf, zooplankton biomass attains reasonable levels and that species structure is diverse. This assumption is supported by observations made by Dessier (1985) for Pointe-Noire in the Republic of Congo, and is also based on regional data presented by Le Borgne *et al.* (1983), which indicate a direct relationship between phytoplankton and zooplankton biomass within the Gulf of Guinea marine ecosystem. Gabche *et al*. (2000) describe a high rate of zooplankton production associated with Cameroon's muddy coastal aquatic ecosystems.

The large calanoid copepods (e.g. *Calanoides carinatus*) form the principal food for the West African sardine, *Sardinella aurita,* (Ibe *et al*., 1999). Of the total stock of micronekton that occurs in the eastern tropical Atlantic, crustacea comprise 57% and ichthyoplankton 29% (Roger, 1982). No reports on ichthyoplankton in the study area could be located. However, the region supports a fishery of *Sardinella* sp, which spawns on the continental shelf, and the eggs and larvae of these species at least can be expected to form part of the ichthyoplankton of the shelf waters (Wysokinski, 1986). Other potential contributors are horse mackerel *Trachurus* sp, and demersal species such as the large-eye dentex, *Dentex macrophthalmus*. Tuna species may contribute offshore.

Possibly the most comprehensive study that links the physico-chemical water column processes and biological functioning of the Estuaire du Cameroun, is the nutrient budget estimate undertaken by Gabche and Smith (2000). Considering net ecosystem metabolism, insofar as plankton and other primary producers (e.g. mangroves) play a role, these authors conclude that the system is autotrophic during both the rainy and dry seasons. This situation is unlikely to prevail along much of the coast of Cameroon, where there is little influx of anthropogenic nutrients.

Generally, aspects of primary productivity within the estuaries and coastal zone of Cameroon are quite poorly researched, and have only been described in very broad terms. For example, reference can be made to observations of phytoplankton species including the diatoms *Chaetoceros tortissimus*, *Coscinodiscus*, *Closterium*, *Nitzschia closterium*, *Diatoma vulgare* and *Trachyneis* sp., recorded as the only group of primary producers that were present in the area extending from Tiko to Cap Bimbia. Ibe *et al*. (1999) also refer to a limited number of other observations dealing with phytoplankton, while Folack (1988, 1989) describes phytoplankton distribution in the Kribi region.

BENTHIC ECOSYSTEM

There are few descriptions of the benthic macrofauna associated with Cameroon's offshore coastal environment. Burns *et al.* (2002b) describe the fauna recorded at five sampling stations located offshore of the country's southern coast (Figure A.3.9).

The laboratory identifications and counts of taxa and number of animals retrieved by these authors are summarised in Table A.3.4. The results indicate a relatively diverse complement of typical shallow-water invertebrates, which are present in relatively low numbers. Many of the taxa (particularly the polychaetes) are indicative of fine muddy sediment seabed conditions. However, the presence of amphipods, shrimps, brittle stars, fish, etc., indicate a distinct and stable interface between the seabed and the water column; i.e. although the sediments are muddy, this condition (turbidity) is not transferred into the water column immediately above the seabed. The ecosystem characteristics are, therefore, indicative of low current velocities (low sheer stress at the seabed), which is a condition also evidenced by the high degree of water clarity (Burns *et al,*. 2002b).

Most of the sampled animals were small and the biomass of the macrobenthos is judged to be relatively low. It is speculated that this could be due to controls imposed by nutrient limitations and/or fluctuating salinities. In particular, it would appear that the latter environmental control explains what appears to be a largely euryhaline assemblage of macrobenthic invertebrates (i.e. communities influenced in some way by freshwater conditions). Other benthic environments, for example off the African south-east coast, generally yield far higher diversities, animal abundance and biomass of benthic invertebrates (Burns *et al.,* 2002b).

FISH AND FISHERIES

The sections of the Gulf of Guinea that are permanently covered by a layer of warm surface water, including the Bight of Biafra (i.e. Cameroon's coastal and marine environment), have an equatorial marine fauna that is characterised by a large number of species (Schneider,1990). The respective positions of the two active oceanic fronts that define the northern and southern limits of the extension of the warm water layer, largely determines this assemblage of species and its distribution in Cameroon's coastal waters. As outlined in the section on phytoplankton and micronekton above, primary production associated with marine phytoplankton and the availability of zooplankton provide the nutritional "support base" for the coastal pelagic fishery in Cameroon.

According to UNEP (1999) the complement of marine fish in Cameroon's coastal waters totals some 381 species, with an additional 70 species recorded as being associated with brackish estuarine environments. A total of 57 endemic fish species has been recorded for Cameroon.

Tropenbos/MINEF/SNV (2002) report the occurrence of 249 species of fish (including marine species) within the UTO Campo-Ma'an (see later description of this conservation area). This represents 46% of the total number of fish species recorded in Cameroon. Four species of freshwater fish are reported to be endemic to the UTO Campo-Ma'an area, namely: *Marcusenius conicephalus*, *M. ntemensis*, *Aphyosemion lugens* and *Synodontis tessmannii*.

Activities on the nearshore continental shelf and in the major estuaries of Cameroon include an important artisanal fishery, which targets mainly clupeids (sardines, sardinellas). Cameroon's industrial fisheries are reported to contribute some 0.6% to the country's GDP (Baer, 2001), with the nearshore shrimp fishery (covering an area of approximately 480 km^2) representing a particularly important economic activity.[1] Industrial fishing occurs in the offshore, deeper waters of the maritime zone, stretching from the mouth of the Lokoundjé river to the borders of Cameroon with Nigeria. Important zones of operation include Rio del Rey, Bibundi, South Limbe, Bimbia, Wouri, and on occasion, the estuaries of the Sanaga and Nyong rivers (Neba, 1987).

1 The name *Cameroon* signifies the economic significance of the shrimp fishery, having its origin in an early Portuguese description of the Wouri River as the *Rio do Camaroes*, or the "river of prawns".

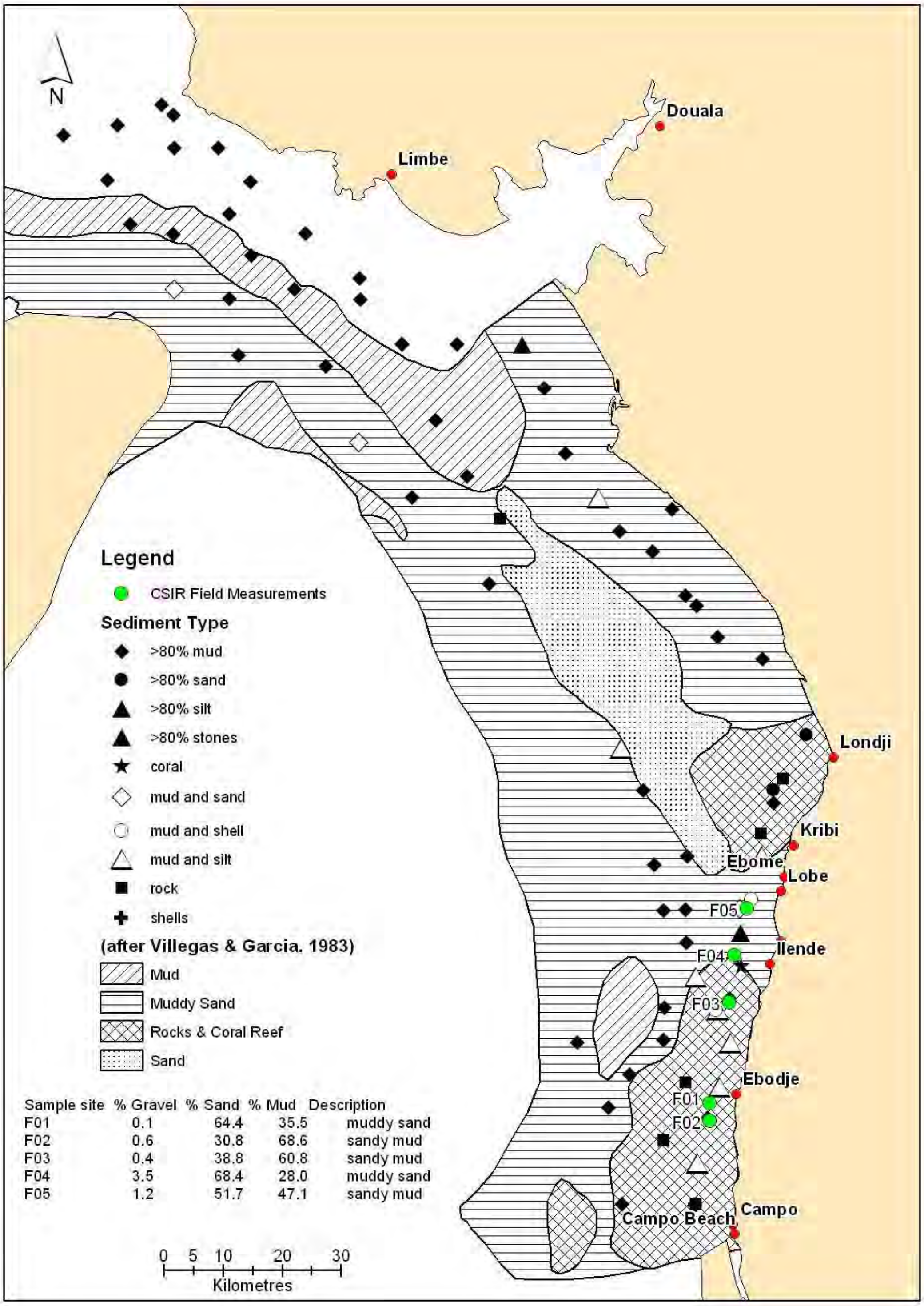

Figure A.3.9: Location of benthic sampling sites situated within the Ebodjé and Ebomé permit areas (CSIR measurements from Burns et al.*, 2002b). Also indicated is the characterization of the bottom sediments within the region (Price* et al.*, 2000).*

Table A.3.4: Ebodjé/Ebomé benthic sampling stations (locations indicated in Figure A.3.9): Taxa and number of sampled benthic invertebrates.

Sampling Station	*F01*	*F02*	*F03*	*F04*	*F05*
ACTINARIA (Anemones)			1		
AMPHIPODA (Amphipods)	6	3			
Ampeliscidae	15	7	2	18	3
Corophiidae	4	4			
Haustoriidae		1			
ANOMURA (Mud Prawns)					
Callianassidae	1			4	2
BRACHYURA (Crabs)	2			2	
CARIDEA (Shrimps)		2	2	1	1
CUMACEA (Cumaceans)	2	2			
OPHIUROIDEA (Brittle Stars)	3	4		5	
OSTEICHTHYES (Fish)					
Bregmaceros			3		
PELECYPODA (Bivalve Molluscs)	2				1
? Donax		2			
? Macoma				1	
POLYCHAETA (Bristle Worms)					
Aphroditidae	2	3		2	
Capitellidae	2			2	
Chaetopteridae	1				
Cirratulidae	3	4			
Eunicidae				1	
Diopatra	2	5	2		
Onuphis	5	3	2	3	3
Lumbrineris	4	5	3		
Glyceridae	1			4	2
Magelonidae				17	
Maldanidae			1		2
Nephtyidae	12	5	3	1	1
Nereidae				2	2
Orbiniidae	4	2		4	
Oweniidae	5	5	4		3
Paraonidae					1
Sternaspidae	3				1
Terebellidae	35	18	5		
Trochochaetidae		1			
SIPUNCULIDA (Peanut Worms)	4	2	3	42	4
TOTAL COUNT	**118**	**78**	**31**	**109**	**26**
NUMBER OF TAXA	**22**	**19**	**12**	**16**	**13**

The focus of the industrial fishery is mainly on sciaenids (e.g. croakers). Economically important species for the regional pelagic fishery include *Ethmalosa fimbriata*, *Sardinella maderensis* and *Ilisha africana*. Demersal species that are targeted include *Pseudolithus elongatus*, *P. senegalensis*, *P. typus*, polynemids (threadfins), *Galeoides decadactylus*, *Polydactylus quadrifilis*, grunters, big eye tuna, *Brachydeuterus auritus*, catfish, *Arius* spp., *Pomadasys* spp., soles and *Cynoglossus* spp. The demersal stocks offshore of the southern Cameroon coast are relatively under-exploited due to the partly rocky nature of the seabed, which makes it unsuitable for bottom trawling.

The pelagic and demersal fisheries account for approximately 63% and 19%, respectively, of the total fishery exploitation. Catches of Palaemonidae (16%) and Penaeids (2%) – white and pink shrimp - account for the balance of exploitation (Ibe *et al*., 1999). The most important species caught (fish and other taxa) are listed in Table A.3.5. Spawning periods for commercially exploited fish and shellfish in the Gulf of Guinea are indicated in Table A.3.6.

Table A.3.5: Important estuarine and mangrove species, many of which are exploited by the artisanal and industrial fishery in Cameroon.

Species	***Common name***	***Habitat***
Crassostrea gasar	Oyster, bivalve	Spat on aerial roots of mangroves and at intertidal levels
Tympanotonus fuscatus	Periwinkle	Mud in swamps
Callinectes marginatus	Crab	Brackish estuarine waters and mangrove swamps
Periopthalmus hoelferi	Mud skipper	Mud in swamps
Mugil spp.	Mullet	Flats in swamps of Rio del Rey and Estuaire du Cameroun
Penaeus notialis	Pink shrimp	Juveniles in brackish waters and muddy deposits
Nematopalaemon hastatus	White shrimp	Juveniles in brackish waters and muddy deposits
Macrobrachium spp.	Giant river prawn	Riverine and brackish waters
Ethmalosa fimbriata	Bonga, an important species targeted by the artisanal fishery	Pelagic - estuarine and mangrove nursery zones
Sardinella maderensis	Strong kanda	Light, sandy-muddy habitats at 6-30 m water depth
Arius heudeloti	Catfish	Demersal, estuaries
Cynoglossus spp.	Sole	Demersal, muddy sediments at 15-100 m water depth
Lutjanus spp.	Snapper	Demersal, estuaries
Polydactylus quadrifilis	Shrine nose	Demersal, estuaries
Sphyraena piscatorium	Barracuda	Demersal, estuaries
Pseudolithus typus and *P. elongatus*	Croaker	Demersal, estuaries

Table A.3.6: Spawning periods for commercially exploited fish and shellfish in the Gulf of Guinea.

Species	*Common name*	*Spawning period*
Sardinella aurita	Gilt sardine	May-June
Sardinella maderensis	Sardine	Year round, peak in September
Ethlomosa fimbriata	Great Sardine	Year round
Palaeomonidae	Shrimp	October-January
Palinurus sp.	Lobster	December-January
Temboidae	Squid	June-August
Sepia sp.	Cuttlefish	June-August

Source: Woodward-Clyde (1998)

Clear trends are evident in the annual statistics for Cameroon's marine fishery catches. The average annual total catch (fish plus shrimp) for the period 1970 to 1978 is described by Gabche *et al*. (2000) as having been fairly constant, at between 30 and 45 x 10^3 metric tonnes. Total annual catches increased dramatically in the years 1979 to 1981 to more than 70 x 10^3 tonnes, peaking at around 75 x 10^3 tonnes in 1982. After 1981, catch data up to 1990 show a constant decrease. Fish of the sciaenidae and clupeidae families are most obviously overexploited (Ibe *et al*., 1999).

Significantly, the decrease in total annual catch is associated with a decrease in fish, rather than shrimp production – which was shown to have remained more or less constant. Other data confirm a general decline in marine fish catches, representing a 13% decrease between 1970 and 1993 (Baer, 2001). Species diversity of catches and the average size of fish that are caught are also decreasing. Gabche *et al*. (2000) attribute the decrease to both increasing fishing effort and ecological degradation. Generally, the fish resources are considered to be at risk of collapse due to over exploitation by local industrial fishing fleets and joint venture operations involving foreign partners. In other words, fish catches throughout the region (not only in Cameroon) are exceeding sustainable yields (Ajaji, 1994). Table A.3.7 lists the fish species occurring within Cameroon's coastal zone (i.e. including non-marine water bodies) that are considered threatened.

Table A.3.7: Threatened fishes of Cameroon's coastal ecosystem, including freshwater species occurring within the coastal zone (after Njock and Bokwe, 1999 cited in UNEP, 1999).

Carcharhinu limbatus (N)	*Sarotherodon linnellii (E)*
Carcharhinu plumbeus (N)	*Sarotherodon lohbergeri (E)*
Carcharias taurus (N)	*Sarotherodon steinbachi (E)*
Carcharodon sp (N)	*Stomatepia mariae (E)*
Carcharias sp (N)	*Stomatepia mongo (E)*
Clarias maclareni (N)	*Stomatepia pindu (E)*
Dalatias licha (N)	*Thunnus obesus (N)*
Epinephelus itajara (N)	*Tilapia bakossiorum (E)*
Hippocampus (E)	*Tilapia bemini (E)*
Konia dikume (E)	*Tilapia bythobates (E)*
Konia eisentrauti (E)	*Tilapia deckerti (N)*
Myaka myaka (N)	*Tilapia flava (E)*
Pristis microdon (N)	*Tilapia gutturosa (E)*
Pristis pectinata (N)	*Tilapia imbriferna (E)*
Pristis pristis (N)	*Tilapia kottae (N)*
Pungu maclareni (E)	*Tilapia snyderae (E)*
Sarotherodon caroli (N)	*Tilapia spongotroktis (E)*
Sarotherodon galilaeus galilaeus (N)	*Tilapia thysi (E)*

(N= native; E= endemic)

PELAGIC AND OFFSHORE BIRDS

Seabird species likely to occur in Cameroon waters are listed in Table A.3.9. With the exception of some data on breeding seabirds on the Tinhosas Islands (Table A.3.10), and in the Democratic Republic of São Tomé and Príncipe (Christy, 2001), there are no data available on the abundance of seabirds in the study area and no studies on bird communities off this coast have been carried out.

A single species-specific study gives some data on the abundance of the Cape Gannet, *Morus capensis,* which occurs as a regular winter (austral) visitor as far north as the Gulf of Guinea (Crawford *et al*., 1983).

Table A.3.9: Seabirds likely to occur in Cameroon waters (compiled from Brown et al. (eds) (1982), Cheke and Walsh (1996), Christy (2001), Dean (2000), Dowsett and Simpson (1991), Elgood et al. (1994), Fotso et al. (2001), Fry et al. (eds) (1988), Grimes (1987), Traylor (1963) and Urban et al. (eds) (1986)).

Common Name	Scientific Name
British Storm-petrel	*Hydrobates pelagicus*
Madeiran Storm-petrel	*Oceanodroma castro*
Manx Shearwater	*Puffinus puffinus*
Great Shearwater	*Puffinus gravis*
Pomarine Skua	*Stercorarius pomarinus*
Arctic Skua	*Stercorarius parasiticus*
Long-tailed Skua	*Stercorarius longicaudus*
Sabine's Gull	*Larus sabini*
Sooty Tern	*Sterna fuscata*
Black Noddy	*Anous minutus*
Brown Noddy	*Anous stolidus*
Cape Gannet	*Morus capensis*
Brown Booby	*Sula leucogaster*
Masked Booby	*Sula dactylatra*
Red-footed Booby	*Sula sula*
Ascension Frigate bird	*Fregata aquila*
Red-billed Tropic bird	*Phaethon aethereus*
White-tailed Tropic bird	*Phaethon lepturus*

Table A.3.10: Seabirds breeding on the Tinhosas Islands, Democratic Republic of São Tomé and Príncipe (Christy, 2001).

Common name	Scientific name	No. of breeding pairs
Sooty Tern	*Sterna fuscata*	100 000
Black Noddy	*Anous minutus*	10 000 – 20 000
Brown Noddy	*Anous stolidus*	4 000 – 8 000
Brown Booby	*Sula leucogaster*	1 500 – 3 000
White-tailed Tropic bird	*Phaethon lepturus*	"small numbers"

CETACEANS AND OTHER MARINE MAMMALS

The West African region supports a diverse marine mammal fauna, including a variety of cetaceans (Jefferson *et al*., 1997; Wells and Bleakley, 2000). At least seven species of baleen whales, nine toothed whales, 18 dolphins and one porpoise are known to occur in the region. Although the terms whales and dolphins relate to the size of cetacean species, the group can be divided into baleen whale (*mysticete*) and toothed whale (*odontocete*) species.

The majority of baleen whales are deep water, migrant species, which seldom venture onto the continental shelf and would in all likelihood be unaffected by oil spills in shallow waters. Large baleen whale species recorded in the Gulf of Guinea include humpback whales (particularly in the south-east where historical catches were high off Gabon), Brydes whales and fin whales. Fin whales are, however, associated with the continental shelf edge and hence tend to be well away from the coastline).

Humpback whales (*Megaptera novaeangliae*) are recorded from the Gulf of Guinea. *En route* between the tropical breeding and Antarctic feeding grounds, this species utilises the extreme coastal waters of Southern Hemisphere continents as migratory corridors. Such migrations made them extremely susceptible to catches from modern land-based whaling operations (Matthews, 1937; Mackintosh, 1942; Dawbin 1956, 1966) and the seasonality of catches off the southern African West Coast suggests Gabon to be the northern limit of the migration. Townsend (1935) mapped 19th century humpback whaling grounds off Gabon. Findlay (2000) notes that the catch history of humpback whales off the coast of Gabon was markedly different to catch histories off Angola, Namibia or the west coast of South Africa, suggesting some stock differentiation along the southern African West Coast.

Little is known of the distribution of minke whales off the west coast of Africa, although Stewart and Leatherwood (1985) describes the species as occurring off the coast of Angola. A dwarf form of minke whales is found in tropical coastal waters elsewhere in the world. The occurrence of this form in the Gulf of Guinea is unknown.

The International Whaling Commission reviewed the known distributions of small cetaceans in the region in 1998 and apart from the literature reviewed then, published records of cetacean distribution or occurrence from the Gulf of Guinea are sparse. Reviews of the distribution patterns of cetaceans elsewhere in the world can provide some information on expected distribution patterns in the Gulf of Guinea.

The majority of toothed whales are offshore oceanic species, which would be unaffected by shallow water oil spills. Species that have been recorded or are expected within the shallow water region of the Gulf of Guinea include:

- Killer whales, *Orcinus orca*, which have a cosmopolitan distribution in all major oceans of the world (Leatherwood and Reeves, 1983). Although there are no records of this species from Cameroon, it has been recorded from Gulf of Guinea waters off Equatorial Guinea, Gabon, São Tomé and Príncipe, Guinea, Liberia, Ivory Coast and Ghana (IWC, 1998).

- Atlantic hump-backed dolphin, *Sousa tuezii,* which occurs on the African west coast between Mauritania and Cameroon, and possibly south to the coast of Angola (Leatherwood and Reeves, 1983). Based on the distributions of *S. chinensis* in the Indian Ocean, it is expected that *S. tuezii* is an extreme coastal species. Cawardine (1995) described the distribution as shallow coastal and estuarine waters of less than 20 m depth.

- Both the long-beaked and short-beaked common dolphin, *Delphinus delphis* and *D. capensis*, have been recorded from the Gulf of Guinea (IWC, 1998), although no distribution patterns are given.

- Bottlenose dolphin, *Tursiops truncatus*, have been recorded from Ivory Coast and are expected to occur in the shallow water regions of Cameroon, based on their distributions elsewhere in the world.

Other species expected from deep waters off the coast of Cameroon (or found in the Gulf of Guinea) include Blainville's beaked whale, *Mesoplodon densirostris,* distributed in tropical and temperate waters elsewhere in the world (Pastene *et al.* 1990), false killer whale, *Pseudorca crassidens*, pygmy killer whales *Feresa attenuata*, melon-headed whale, *Peponocephala electra*, short-finned pilot whale, *Globicephala macrorhynchus*, Risso's dolphin, *Grampus griseus*, long-beaked and short-beaked common dolphin, *Delphinus delphis* and *D. capensis*, Fraser's dolphin, *Lagenodelphis hosei*, long-snouted spinner dolphins, *Stenella longirostris*, short-snouted spinner dolphin, *S. clymene*, striped dolphin, *Stenella coeruleoalba*, pan-tropical spotted dolphin, *S. attenuata*, Atlantic spotted dolphin, *Stenella frontalis* and Rough-toothed dolphin, *Steno bredanensis*.

Recently, a study of humpback whales was conducted in Angolan waters to investigate the degree of population interbreeding (Morais, 1998). It is of relevance to the offshore oil industry, since the preliminary survey showed that humpback whales are still using the Angolan breeding ground, and annually migrate through oil production fields along the West African coastline. Recently released Russian whaling data suggests that the humpback whales occurring off the coast of Gabon and southern Cameroon are members of a population that spends the austral summer on feeding grounds around the Greenwich Meridian at latitude 60°S (Dr Peter Best, pers. comm.).

Apart from the above details no other information on the cetaceans (diversity and animal abundance) occurring specifically in Cameroon's coastal waters could be traced; however, the species most likely to occur are listed in Table A.3.11.

Table A.3.11: Cetacean species likely to occur in the vicinity of the Cameroon coast (Source: Jefferson* et al.*, 1997).

Common Name	*Scientific name*
Killer Whale	*Orcinus orca*
Short-finned Pilot Whale	*Globicephala macrorhynchus*
False Killer Whale	*Pseudorca crassidens*
Pygmy Killer Whale	*Feresa attenuata*
Melon-headed Whale	*Peponocephala electra*
Harbor porpoise	*Phocoena phocoena*
Risso's Dolphin	*Grampus griseus*
Rough-toothed Dolphin	*Steno bredanensis*
Atlantic Hump-backed dolphin	*Sousa teuszii*
Bottle-nosed Dolphin	*Tursiops truncatus*
Pantropical spotted Dolphin	*Stenella attenuata*
Atlantic spotted dolphin	*Stenella frontalis*
Spinner Dolphin	*Stenella longirostris*
Clymene Dolphin	*Stenella clymene*
Striped Dolphin	*Stenella coeruleoalba*
Common Dolphin	*Delphinus delphis*
Fraser's Dolphin	*Lagenodelphis hosei*

The Atlantic hump-backed dolphin (Sousa teuszii) is only found in the coastal waters of West Africa.

A.3.1.4 Coastal and littoral environment

A.3.1.4.1 Introduction

Detailed accounts of the coastal environment of Cameroon can be found in the reports by Allersma and Tilmans (1993), Ibe *et al.*, (1998), Burns *et al*. (2002a) covering the coast between Douala and the Lokundjé river, and Burns *et al*. (2002b) covering the coast between Lokoundjé river and Campo. Dames and Moore (1997) and CEP (1999) provide information on the area from Pointe Souélaba to the Ntem river. This section provides sufficient background information on the ecology of these systems to enable the reader to assess the importance and implications of the impacts of oil spills on the various littoral and coastal environments, which are described in Sections A.3.3 and A.3.4.

The coastal environment of Cameroon can be divided into two distinct parts based on key physical characteristics (Allersma and Tilmans, 1993) and susceptibility to oil spills:

- A low-lying coastal plain, consisting of vegetated beach ridges, lagoons, swamps and estuaries, which is located inland of what can be defined as the general shoreline. Here, the most vulnerable areas are the two very large estuarine and delta system, which have extensive coastlines completely open to the sea:

  - the Rio del Rey extending from the Akwayafé river (Cameroon's border with Nigeria) to Bekumu-Ubenekang, south of Bamusso; and
  - the Estuaire du Cameroun, extending from Bimbia Creek to Pointe Souélaba.
- The shoreline, including the shore face and the active inshore seabed that faces the ocean and which is directly subjected to wave action. This can be divided into three major types:
  - primarily rocky coastline with pockets and stretches of beach ranging from pure sand to boulder beaches, which extend between Idenau and Mabeta at the mouth of Bimbia Creek;
  - primarily sandy beaches with rocky promontories and outcrops, which extend between Bekumu-Ubenekang and Idenau in the north, and between Londji (north of Kribi) and Campo in the south; and
  - almost exclusively sandy beaches, which extend between Pointe Souélaba and Londji.

In the discussion that follows, the coastline extending from the Nigerian border to Bimbia Creek is referred to as the northern coastal sector; the extension of this coastline to Londji is described as the central coastal sector; and the southern extension of this coastline to Campo is described as the southern coastal sector (Table A.3.12).

Table A.3.12: The length of the coastline of Cameroon based on data compiled for this study and by Burns et. al. (2002a,b). The Rio del Rey and Estuaire du Cameroun are described separately due to their very extensive muddy shorelines and vulnerability to oil spills.

Section	*Coastline length (km)*	*Description of main coastline types*
Northern coastal sector	2799	Rio del Rey: mangrove creeks with muddy shoreline and intertidal mudbanks
	127	Non-mangrove, rocky coastline with stretches of beach
	2433	Estuaire du Cameroun: mangrove creeks with muddy shoreline and intertidal mudbanks
Central coastal sector	167	Pointe Souélaba to Londji: sandy coastline with large estuaries (Mbenga-Malimba 14 km of intertidal shoreline; Sanaga 41 km; Nyong 38 km)
Southern coastal sector	134	Londji to Ntem river: sandy coastline with short stretches of rocky coastline; Lokoundjé estuary 59 km of intertidal shoreline; Ntem estuary 78 km of shoreline (up to mangrove limit)

A.3.1.4.2 Sandy beaches

Although sandy beaches characterize much of the coastline of tropical West Africa, their ecology has not been well researched (John and Lawson, 1988). There are a few published accounts of these ecosystems for Ghana (Gauld and Buchanan, 1956), Sierra Leone (Longhurst, 1958) and certain other areas in the region; however, no comprehensive literature could be traced for Cameroon. Descriptions of the beaches of the central and southern coast are provided by GOPA (1995) and Burns *et al.* (2002a,b).

PHYSICAL CHARACTERISTICS

The beaches of Cameroon have relatively steep profiles (John and Lawson, 1988). This is a consequence of both the plunging and spilling type of wave that affects the beaches and the sediment grain size distribution, which includes coarse-grained material towards the upper limit of the beach profile and accumulations of finer grained material, including significant quantities of heavy minerals, towards the subtidal extreme of the profile. These characteristics classify most of the beaches as coarse-grained, reflective beaches (Wright and Short, 1984), which typically have slopes of between 4.1 and 5.5°. Slopes measured during field visits to the central and southern coast have ranged from 5.5° to 13° (Burns *et al.*, 2002a,b). The steepest slopes are found on beaches which lie perpendicular to the prevailing wave direction (Plate A.3.1), with the gentlest slopes occurring in sheltered areas on the northern side of rocky headlands.

Plate A.3.1: Example of a typical steep beach slope near Ebodjé

The littoral transport of sediment within the study area is controlled mainly by the continuous action of waves, especially the Atlantic swells. Southward of Pointe Souélaba, the persistence and energy of these waves, as well as their oblique incident angle of approach, results in very high, northward, longshore sediment transport rates (UNESCO, 1989; Awosika and Ibe, 1998). This transport is responsible for the long sand spits formed on the southern side of river mouths (e.g. the Lokoundjé river) as well as the coastal features of Pointe Souélaba, nearshore sandbars and the prograding sequence of littoral dunes that occurs south of the Sanaga river. The beaches and sand spits shift in response to changes in the pattern of longshore and cross-shore sediment transport as these are influenced by seasonal changes in wave regime, episodic storm events and the influx of fluvial sediment to the coastal zone (Ibe *et al.*, 1999). Plate A.3.2 illustrates an example of an eroding section of sandy beach on the country's southern coastal sector.

Plate A.3.2: Eroding section of beach near Ebodjé

FAUNA

The physical characteristics of the beaches within the Cameroon coastal strip are quite similar to certain beach types encountered in Ghana - in that they are relatively narrow, are quite steeply sloped, and are composed of coarse, roughly stratified sediments. It may, therefore, be expected that there will be similarities between the invertebrate macrofauna of the beaches within the two countries. Based on field observations undertaken in the course of various environmental impact assessments conducted for the offshore oil industry, an apparent similarity in this regard is the ubiquitous presence of the ghost crab, *Ocypoda cursor*, at the uppermost part of the shore, with an impoverished fauna elsewhere across the beach profile. An explanation of this state is provided by John and Lawson (1988), who describe the low water retention capacity of the coarse-grained sediments of such beaches. This creates an inhospitable environment for burrowing animals since, at low water when the beaches dry out rapidly, there is concentration of the interstitial solution due to evaporation.

Taxa such as the sand mussel, *Donax* spp., which favour the finer grained sediments of the beaches along the southern, more temperate coastline of West Africa, are poorly represented in the beach fauna. This does not imply that species such as *Donax puchellus* and *D. rugosus*, which occur in the surf zone and some beach habitats in Ghana, do not occur in similar environments in Cameroon.

A.3.1.4.3 Rocky shores

The total length of the rock-dominated shoreline is relatively short compared with both the country's mangrove coastline and the exclusively sandy beaches; however, rocky outcrops ranging from scattered rocks to rocky promontories occur in places in association with sandy coastlines (Table A.3.12). Rocky substrata are ecologically important because they provide habitat for a variety of organisms that cannot establish on sandy beaches (Plate A.3.3).

Plate A.3.3: Algal turf forming a closed cover on rocky outcrops along the southern Cameroon coast

PHYSICAL CHARACTERISTICS

The rocky shores of the Cameroon coastline range from scattered rocks and rocky outcrops occurring in association with primarily sandy beaches (also gravel, shingle and boulder beaches), through to extensive cliffs, with or without rocky shelves or accumulations of boulders at the cliff base. These different types of shoreline have different degrees of stability and provide different substrata for living organisms. Where the rocks are scattered on primarily sandy beaches, the physical properties and biological attributes are much the same as those of the sandy beaches described in the previous section. Most of the rock-dominated shoreline is found in the section from Idenau to Bimbia Creek, where lava outflows and folded and faulted sedimentary rocks have created cliffs and steep rocky shores. The only comparable situation along the southern coastal sector is near the Rocher du Loup north of Ebodjé. Shingle and boulder beaches and shallow rocky shelves with loose rocks occur along the northern coastal sector, mainly between Idenau and Limbe.

FAUNA AND FLORA

The wide range of rocky shore types supports a variety of marine biota (plants and animal species), which are organised into relatively distinct communities. Although these communities are less diverse than those comprising rocky shore ecosystems elsewhere in Africa, for example those established along the continent's south-western, southern and east coasts, they nevertheless make an important contribution to Cameroon's coastal biodiversity.

The composition and distribution of the rocky shore communities are controlled mainly by exposure to wave action (John and Lawson, 1988) and, to a lesser extent, tidal influence. These factors create both a vertical and horizontal zonation of communities of species that are established within the zone of influence of wave and tidal effects. In wave-sheltered environments, community zonation tends to be telescoped (i.e. the zones are spatially relatively compact), whilst in wave-exposed environments the zonation patterns on the rocky shores are more expanded. The zonation patterns are, however, less prominent than elsewhere along the Gulf of Guinea coast, for example in Ghana, which is largely attributable to the small difference between extremes of wave conditions affecting the coast of Cameroon.

The following discussion is largely based on Stephenson and Stephenson (1972), supported by ecological descriptions applicable to the region provided by John and Lawson (1988). Stephenson and Stephenson (1972) differentiate between three main zones that generally define the distribution of the rocky shore communities within Cameroon.

Supralittoral Fringe

The uppermost limit of the supralittoral fringe, which marks the highest zone of tidal influence and wave splash, is characterised by the presence of small gastropods (littorinids), with barnacles becoming increasingly common at lower elevations. This zone is also characterised by the presence of the top shell, *Tectarius granosus* and, to a lesser extent, the snail, *Nerita senegalensis*. Turf-forming algae, which typically create a closed cover, include

Bostrychia tenella and *Rhizoclonium riparium*. *B. tenella* tends to dominate at the lower extreme of the supralittoral fringe, and is also established in highest densities on vertical rock faces. In more sheltered environments, and in rock cracks and crevices, it occurs in mixed association with *R. riparium*. Another turf-forming alga, *Cladophora camerunica*, also commonly extends into this zone from lower tidal elevations. Some algal species common to the coast of Cameroon are listed in Table A.3.13.

Midlittoral Zone
Generally, the midlittoral zone is dominated by coralline algae and, in places, the barnacle, *Balanus tintinnabulum*. In exposed situations, the midlittoral zone comprises an upper and lower sub-zone. Barnacles, including *Chthamalus dentatus*, typically dominate the upper zone and occur together with various gastropod species (*Nerita* spp.) and the limpet, *Siphonaria*. A relatively common alga that becomes established mainly at the upper limit of the zone is *Centroceras clavulatum*. Crustose calcareous red algae (*Lithothamnion*), dominate the lower sub-zone, which is also characterised by the presence of the oyster, *Crassostrea* cf. *cucullata*, which occurs at mid- to low elevations in association with barnacles.

Table A.3.13: Algal species common to the coast of Cameroon (after Stephenson and Stephenson, 1972).

Algae of the midlittoral zone	*Algae of the infralittoral fringe*
Turf-forming species	Species forming felts on boulders
Gymnogongrus nigricans	*Ceramium tenuissimum*
Herposiphonia densa	*Gigartina acicularis*
Lyngbya majuscula	*Herposiphonia secunda*
Ptercladia pinnata	*Polysiphonia* sp.
Low-level species	Species in wave-sheltered environments
Bryopsis sp.	*Acanthophora spicifera*
Chaetomorpha sp.	*Callithamnion* spp.
Champia parvula	*Dictyota* sp.
Dictyota sp.	*Gigartina acicularis*
Padina sp.	*Hypnea musciformis*
Pocockiella variegata	*Padina* sp.
Struvea anastomosans	*Pocockiella variegata*
	Sargassum vulgare
Deep shade species	*Sphacellaria* spp.
Bostrychia radicans	
Bostrychia tenella	
Lophosiphonia obscura	
Murrayella periclados	

In less exposed environments, the faunal biota described above persist. However, there is a change in algal dominance, with *Centroceras clavulatum* being replaced by species such as *Gymnogongrus nigricans* and *Pterocladia pinnata*.

In moderately sheltered environments animals that inhabit the upper levels are less dominant and are replaced by species such as the small brown mussel *Brachiodontes puniceus* (possibly also *Modiolus* and *Mytillid* spp.) and the alga *Cladophora camerunica*. On open rock surfaces, the red seaweed, *Gelidium pusillum*, tends to form a dense algal turf.

In sheltered areas, the midlittoral zone is dominated by turf-forming seaweeds, such as *Gelidiu*m. A few individuals of *Chthamalus* occur above this algal turf, together with occasional oysters and, more commonly, *Siphonaria* spp., *Nerita senegalensis*, *Littorina punctata* and *L. cinguli*fera are also typical of this zone, although *Nerita* may be absent in wave-sheltered situations.

The Lightfoot Crab, *Grapsus grapsus* (Plate A.3.4), ranges over the entire midlittoral zone. Other crabs observed in mixed sandy and rocky environments include the Spinous Spider Crab, *Maja squinado*, and the Lagoon Crab, *Cardiosoma armatum*.

Plate A.3.4: The Lightfoot Crab, Grapsus grapsus, associated with rocky habitats along Cameroon's coastline

Infralittoral Fringe

John and Lawson (1988) identify the infralittoral fringe by the presence of sea urchins, such as *Echinometra lucunter* and *Arbacia lixula*, which occur in a narrow band over a range of wave exposure environments. In highly exposed environments, crustose calcareous red algae and lower midlittoral turf-forming algae merge to dominate the infralittoral fringe. This zone is also characterised by the presence of the barnacle, *Balanus tintinnabulum*, and several other species, including sponges, hydrozoans and hydroids. The seaweed, *Sargassum vulgare*, occurs in wave-sheltered environments in association with other larger marine algae.

A.3.1.4.4 Estuaries and lagoons

Estuaries and lagoons are essentially created from the interaction between freshwater hydrological systems and key environmental processes affecting the marine environment. As an introduction to the discussion of Cameroon's estuaries and lagoons, brief reference is, therefore, made to some of the hydrological and geohydrological processes that shape these important features of the coastal zone.[2]

COASTAL HYDROLOGY AND GEOHYDROLOGY

There is little published information on the hydrology of Cameroon, particularly with respect to the country's smaller river systems, and some estimation is, therefore, provided here (Table A.3.14) of river flows, based on rainfall and evaporation data (Gabche and Smith, 1999, 2000; Ibe *et al.*, 1999; Djeuda Tchapnga *et al.*, 2001; Sigha-Nkamdjou *et al.*, 2002).

Table A.3.14: Summary of catchment characteristics and flow patterns for thirteen rivers that discharge into the Cameroonian coastal zone. River numbers follow the numbering in Figure A.3.10. Mm³ = millions of m³; "Idenau" River consists of three small rivers that have been grouped together for convenience.

River No.	*River Name*	*Catchment Area (km^2)*	*Total Discharge Volume (Mm^3/Year)*	*Low Flow (m^3/s)*	*High Flow (m^3/s)*	*Seasonal Flow Ratio (High/Low)*
1	Cross	6 810	17 502	185	780	4.22
2	Ndian	2 550	7 253	95	410	4.32
3	Meme	880	3 469	85	380	4.47
4	"Idenau"	680	4 415	55	220	4.00
5	Mungo	4 650	11 511	130	520	4.00
6	Wouri	9 450	19 710	110	920	8.36
7	Dibamba	3 940	8 042	60	520	8.67
8	Sanaga	139 210	65 437	595	5 990	10.07
9	Nyong	26 400	14 664	155	1 015	6.55
10	Lokoundjé	5 100	2 996	30	175	5.83
11	Kienké	1 550	1 419	20	85	4.25
12	Lobé	1 590	1 451	20	90	4.50
13	Ntem	29 600	13 087	110	600	5.45
Total:			**170 087**			

2 The general hydrology of the rivers of Cameroon is also covered in Section A of the Inland Section of the NOSCP.

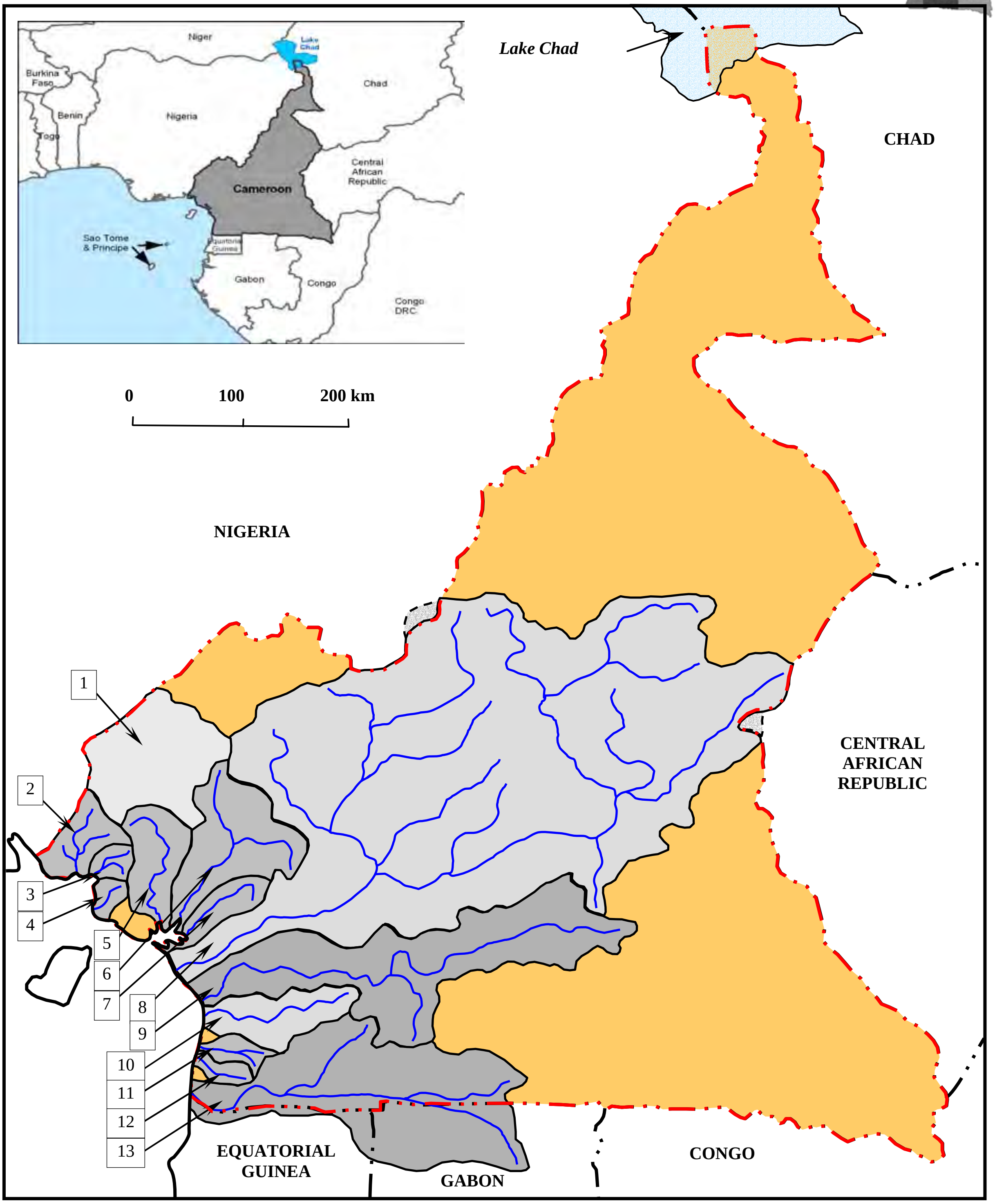

Figure A.3.10: Sketch map of Cameroon, showing the position and extent of the thirteen river basins that drain towards the Bight of Biafra. The rivers are numbered consecutively from north to south and are as follows: Cross, Ndian, Meme, Idenau (includes a number of small rivers), Mungo, Wouri, Dibamba, Sanaga, Nyong, Lokoundjé, Kienké, Lobé and Ntem. Inset shows the position of Cameroon relative to the neighbouring countries.

The catchment of the Cross river is situated mainly in Nigeria and about 45% of the catchment of the Ntem is situated in Equatorial Guinea and Gabon.

The Sanaga river has by far the largest catchment of the major rivers draining into the Atlantic coast of Cameroon (60% of the total) but its annual discharge is only 38% of the total for all thirteen rivers listed in Table A.3.14. The Cross, Wouri, Mungo, Nyong and Ntem rivers, which are also relatively large systems, account for a further 45% of the total. The flows in the Sanaga river are significantly higher than the other rivers, and in the context of the NOSCP even the low flow is judged sufficient, to ensure that oil spills are unlikely to enter the river mouth. The seasonal variability of river flows is highest for the rivers in the central coastline, with similar values for both the northern and southern rivers despite the bimodal rainfall in southern Cameroon.

In general, relatively little is known about the sediment discharges of the rivers feeding the West African coast. Sediments along the coast originate mainly from weathering rock (i.e. the sediments comprise relatively little biogenic material), with the rivers acting as conduits for their discharge into the longshore littoral transport system. Fine sediments are carried for greater distances in suspension, whilst coarser material is deposited to form beaches and to create the near-shore profile of the seabed. Gabche *et al.* (2000) report sediment yield estimates of $1x10^9$ kg/yr and $2.8x10^9$ kg/yr for the Mungo and Sanaga rivers, respectively. The percentage of sand in the total load is estimated to be between 10 and 15% depending on local flow conditions (UNESCO, 1989).

Very little information appears to be available on groundwater in the coastal zone. The water quality generally is good, with a low mineral content and pH values of 4-6. Iron content can be high at 0.7-3.7 mg/litre, as recorded, for example, at Douala (Dames and Moore, 1997). Given the mean annual rainfall of at least 2 250 mm and an average annual evaporation loss of roughly 1 100 mm, about 1 150 mm enters the rivers and groundwater each year (Burns *et al.*, 2002b). The runoff generated in the coastal fringe would amount to some 1.15 Mm^3/km^2/year. This represents a very significant quantity of runoff and accounts for the numerous small streams and lagoons located along the country's southern and northern coastline, as well as the quantities of ground water that flow into the coastal zone.

ESTUARIES

The estuaries and river mouths characterizing the Cameroon coastline can be grouped into three broad groups (adapted from Gabche and Smith, 2000), namely:

- Rio del Rey complex associated with the Cross and Akwayafé rivers, which discharge on the western (Nigerian) side, and the Ndian and Meme rivers, which discharge east of the Bakassi Peninsula.
- The Estuaire du Cameroun complex associated with the Mungo, Wouri and Dibamba rivers, which discharge between Bimbia and Pointe Souélaba.

- The estuaries associated with the Sanaga, Nyong, Lokoundjé, Kienké, Lobé and Ntem rivers (major systems), which discharge into the Atlantic Ocean, and the numerous lagoons and seasonal estuaries associated with the small river systems.

Physical characteristics
Interactions between river flow and tidal exchange within the Estuaire du Cameroun and the Rio del Rey system create a complex of creeks and mangrove islands (Afa, 1985; Din *et al.,* 2001). These depositional features result from the influx of large quantities of sand and finer silts and clays into the estuarine systems (Anon, 1992), with their establishment assisted by the weak circulation patterns in the nearshore marine environment (Gabche and Smith, 2000). The islands and creeks lose their definition as they grade seaward into the open water of the increasingly marine-dominated estuarine embayments. The Rio del Rey system is characterised by a relatively low energy wave and circulation environment, as evidenced by the islands of fine sediments and extensive mudbanks that are continually being created and expanded. A somewhat different energy environment, characterised by deep water channels and steep peripheral banks of many of the mangrove islands within the Estuaire du Cameroun (also characteristic of some of the estuaries of the river systems described below), suggest that the current flows experienced here are of greater velocity than those of the Rio del Rey system.

Similar processes determine, to some extent, the morphology and dynamics of the Sanaga estuary, which discharges to sea through two well-developed mouths, separated by the Isle de Moulengo. The estuaries of the Nyong, Lokoundjé and Ntem rivers also include small creeks and some islands within their lower reaches. These support stands of mangroves and other vegetation types similar to those encountered in the larger estuarine systems.

Salinity distribution in the Estuaire du Cameroun is strongly controlled by the seasonal influx of freshwater. A salinity gradient from 25 ppt near the estuary mouth to 10 ppt at the Port of Douala is described by GOPA (1995). A seasonal variation in salinity at the port of between 9 and 12 ppt is documented by Gabche and Smith (2000). These authors also describe salinity values measured some 15 km offshore of the port, which range from less than 12 ppt during the rainy season to 20 ppt in the dry season. The seasonal shift in salinity regime within this estuary has also been recorded, *inter alia*, by Sogreah (1982, in Anon, 1992).

Salinity data recorded by Burns *et al.* (2002b) indicate that the surface waters within the estuaries distributed along the country's southern coastal sector are less than 5 ppt. The pH values are assumed to be neutral for much of the year, based on measurements of 6.0 – 6.5 taken during high flow periods (Burns *et al.*, 2002b). Brown staining of many of the freshwater inflows to the estuaries signal the presence of dissolved humic and fulvic substances.

Bathymetric measurements indicate that the larger river systems in Cameroon have water depths of between 12 and 16 metres immediately prior to their discharge to sea (Burns *et* *al.*, 2002b). Observations of the wave pattern at the river mouths , and the dynamics of the prevailing longshore drift, also suggest that the rivers are associated with shallow bars offshore of their mouths, which act as partial barriers to the free movement of water into and out of the systems; i.e. tidal exchange is reduced as a result of these physical coastal features.

The Estuaire du Cameroun and the Rio del Rey are the only estuarine systems that have been investigated in any detail in terms of their physico-chemical characteristics (Gabche and Smith, 2000). The Estuaire du Cameroun complex is believed to act as a net sink for dissolved inorganic phosphate (DIP) during both the rainy and dry seasons, and to form a net sink and source for/of dissolved inorganic nitrogen (DIN) in the dry and rainy seasons, respectively. The Rio del Rey complex has lower concentrations of DIN and DIP and functions similar to the Estuaire du Cameroun except that it acts as a net source of DIN in both the wet and dry seasons. The differences are attributed to inflows of pollutants to the Estuaire du Cameroun from the city of Douala – a situation that does not apply to the Rio del Rey. Research indicates that phosphate is bound up in the system (most probably in the bottom sediments), whilst nitrogen remains potentially available as a driver of autotrophic processes (assuming that other factors such as high water turbidity do not prevent this).

Field observations (Burns *et al.*, 2002b), and the limited information available (Ibe *et al.*, 1999), indicate that most of the other estuarine systems function quite differently from the two large estuarine complexes just described. The Sanaga and Nyong rivers, which carry quite large sediment loads, will have lower loadings of nutrients, and sediment fluxes through the estuaries of rivers such as the Ntem and Lokoundjé will also be very different from those in the bigger systems (Burns *et al.*, 2002b). Whilst phosphate in these systems will also be bound up (in the bottom sediments), only a limited amount of nitrogen is thought to be potentially available to drive autotrophic processes. Few data (measured or observational) is available for the Ndian and the Meme rivers; however, judging by the extent of the mangroves and mudflats in their estuaries, they probably carry at least moderate sediment loads, similar to the Ntem river.

The smaller rivers and streams draining the slopes of Mount Cameroon are generally quite untransformed and represent clear water systems that carry low sediment loads. In this respect, their associated lagoons and river mouths are characterised by sedimentary deposits, which are of marine, rather than immediate fluvial, origin. The Kienké and Lobé rivers on the southern coastal sector are also characterised by low sediment loads, with their estuaries dominated by coarse marine sediments (Burns *et al.*, 2002b).

Vegetation
The vegetation represented in association with all of the estuaries is dominated by salt-water mangroves, except in the case of some of the rivers draining the slopes of Mount Cameroon and the small rivers and seasonal lagoons distributed along the southern coastal sector (described below). The mangroves are dominated by stilt-rooted *Rhizophora* species and are described in detail below. Further up the shorelines of the estuaries halophytic

vegetation is replaced by mangrove-associated species and swamp forest (Letouzey, 1985; Tonye and Akono, 1998; Burns *et al.*, 2002a,b).

Fauna

Biological diversity and trophic processes within the estuaries are determined largely by phytoplankton-associated primary production, as well as inputs of organic carbon in the form of mangrove and other plant litter (Gabche and Smith, 2000). This is utilised by a variety of organisms that convert mangrove primary production to detritus. Typical organisms involved in these processes would be polychaete worms (e.g. *Nephtys* sp.), bivalves (e.g. *Arca nuculana*, *Aloidis*, *Nsa* sp.), crustaceans (e.g. crabs belonging to the Grapsidae, Ocypodidae and Portunidae, and shrimps, such as Peneidae and Palaemonidae), oysters (*Crassostrea gasar*), fish and other organisms (Plate A.3.5). Together, these organisms constitute the complex trophic hierarchies (food webs, energy exchange systems) within the mangrove ecosystems, open estuarine water bodies and benthic habitats. Worldwide, mangroves are recognized as highly productive systems that provide important habitats for many commercially valuable organisms, including crabs, prawns and shrimp, fish and several mollusc species (Rönnback 1999; Olsen *et al.*, 2000; Price *et al.*, 2000). Figure A.3.11 illustrates a typical mangrove food chain, including the position of humans in the trophic hierarchy.

Plate A.3.5: Mangrove oyster (Crassostrea gasar)

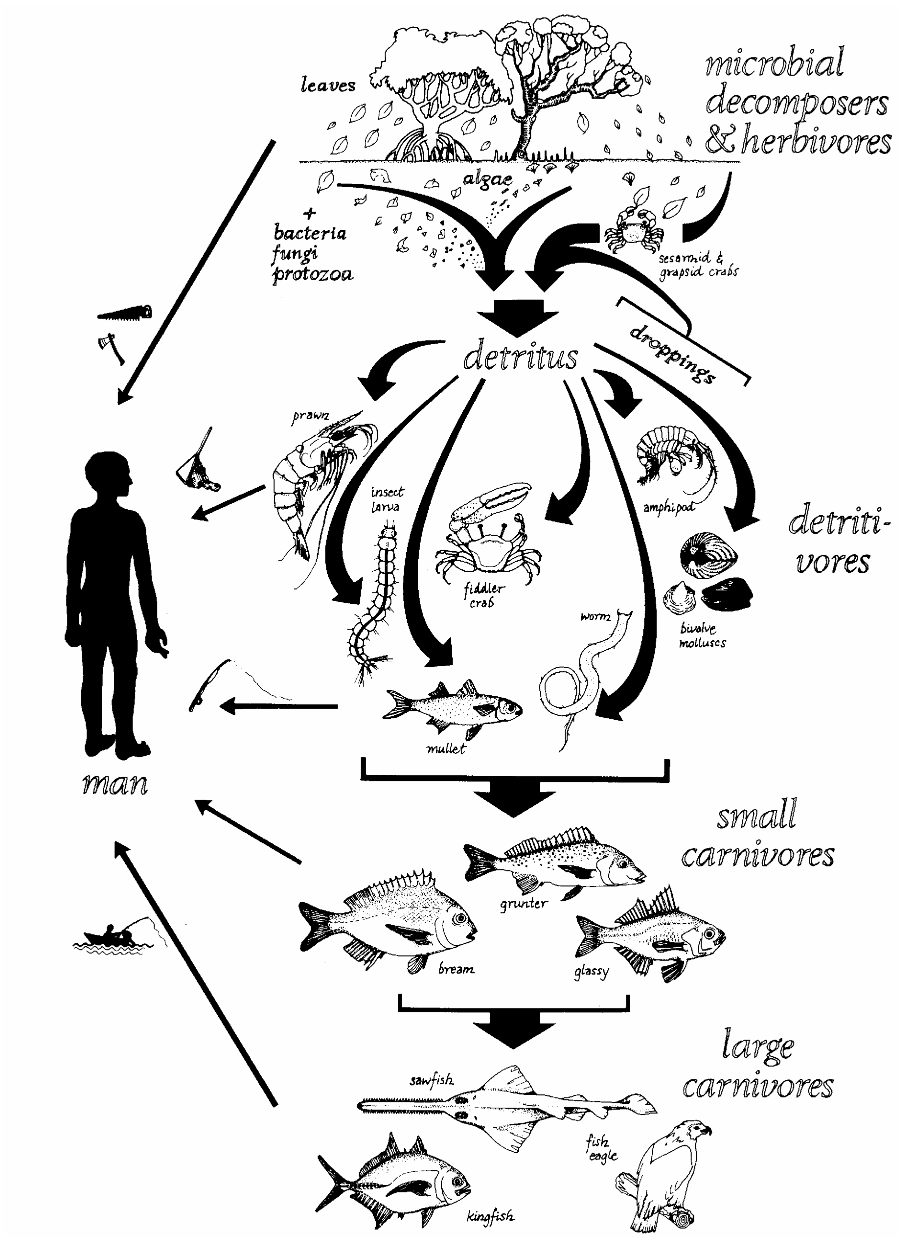

Figure A.3.11: Diagram showing a typical food chain and how humans exploit each of the levels, from the mangrove trees (primary producers) through to the large carnivores (Berjak* et al.*, 1997).

Whilst mangrove systems are generally considered to be highly productive, the suspected phosphate and nitrogen limited conditions within the estuaries of Cameroon explain the relatively low diversity and abundance of invertebrate species recorded by Burns *et al.* (2002b). Of the species present, molluscs are particularly well represented and their population distribution is controlled in terms of composition and abundance by salinity gradients and the type of substratum (Ward and Bunyard, 1992).

The mudskipper, *Periopthalmus* sp., is a relatively common species and, in most of the mangrove habitats, occurs in close association with the fiddler crab, *Uca tangeri,* and the Grapsid mangrove crab, which dominate the exposed sand- and mudflats. The gastropod, *Cerithidea* sp., is a relatively common species that occurs in high densities on the intertidal sand- and mudflats of the estuaries. Unlike the estuarine systems along the central coastal sector, neither *Thais nodosa* nor the *Littorina* sp, which occupy the intertidal niche on the mangrove stilt roots, for example, within the Estuaire du Cameroun and the Nyong estuary, appear to be common to all of the estuarine systems.

The most common molluscs associated with the mangroves include the following 10 species: *Tympanotonus fuscatus* (widespread in the Estuaire du Cameroun at densities of 10-30 individuals per m^2), *P. fusca, P. aurita, Thais callifera, Littorina (Littorinopsis), Scabra angulifera, Melampus liberianus, Nerita* cf. *glabrata, Cyrenoida* cf. *rosea,* and *Ostrea tulipa*. Mollusc diversity and abundance decreases with decreasing salinity, and population densities of these species vary markedly according to season. For example, shells of dead oysters may be found a considerable distance upstream in the Wouri river at the end of the rainy season, indicating that colonization in this environment probably occurs during the dry season when salinity conditions are favourable. A commercially important bivalve, *Venerid* sp, is harvested from the shallow submerged sandflats in the Sanaga river, above the limit of tidal influence.

The appraisal of the epifauna associated with the mangroves (mainly gastropods) as well as other benthic fauna (e.g. crustacea) indicates a relatively low diversity of species and signifies clear differences in environmental conditions between the various estuaries. Differentiating species that indicate ecological differences between the estuarine systems include: the gastropod, *Thais nodosa*, a relatively common species present on the intertidal stilt roots of the mangroves along the creeks of the Estuaire du Cameroun; the gastropod, *Cerithidea* sp., which occurs in relatively high densities on the intertidal sand- and mudflats of the Sanaga estuary and lagoon at Yoyo village; the mussel, *Tagelus adansonii*, which commonly occurs as a filter feeder in the intertidal muddy substratum also of the Mbenga-Malimba lagoon (and possibly in similar habitats in other estuaries); and the *Littorina* sp., which replaces *Thais nodosa* in some estuaries as the dominant species occupying the intertidal niche on the mangrove stilt roots, for example within the Nyong river estuary.

COASTAL LAGOONS

There is an extensive lagoon just north of the Sanaga river called the Lagune de Mbenga-Malimba. This has been formed by cut-off sand bars and sandspits composed of material originating from the Sanaga river. It receives freshwater inflows from a small creek and probably also receives substantial inflows of groundwater. The lagoon has several small openings to the sea that are continually modified by wave action and the longshore transport of sediments (Zogning, 1992 in GOPA, 1995). At least some of these openings close during the dry season. There is only a weak net outflow of water from the lagoon, making it vulnerable to oil spills that could enter the system under rising tidal conditions. The landward-facing side of the lagoon's barrier sandspit supports dune forest species in places. These species cannot tolerate saltwater and therefore indicate the presence of perched lenses of freshwater and percolation of freshwater inflows to the system. A small stand of mangroves is established on the argillaceous clay/muddy substratum near the northern-most mouth of the lagoon.

The southern coastline of Cameroon and sections of the northern coastline are characterised by a number of small rivers with sand bar barrier lagoons at their mouths (Plate A.3.6). Each of these appears to be fed by one or more small streams. The size and low gradient of the small coastal catchments suggests that these streams will flow mainly during the rainy season with little or no surface flow during the dry season - although groundwater flows would persist (Burns *et al.*, 2002b). The lagoons are generally only open to the sea during the rainy season, and close for periods of varying duration. Following closed mouth conditions, the timing of the breaching of the sand bar depends on the rainfall, the size of the catchment and interactions between the river flows and the longhore sediment transport. The same applies to the timing and volumes of seawater that will enter these lagoons, particularly during the transition from the wet to the dry season. The lagoons are also supplied with variable quantities of freshwater entering the coastal zone as groundwater seepage. Most, if not all, of these small lagoons are bordered by mixed fresh and saltwater (true) mangrove vegetation, ranging from a few trees to well developed stands, Dune Forest or Nearshore Forest (Burns *et al.*, 2002b). These vegetation types are described in the next section.

Plate: A.3.6: Small lagoon north of Ebodjé showing an outflow of freshwater during the rainy season

A.3.1.4.5 Littoral vegetation, coastal forest and mangrove ecosystems

The vegetation has been classified for the purposes of the NOSCP on the basis of experience gained from earlier fieldwork (Burns *et al*., 2002a,b), the vegetation classification, maps and descriptions prepared by Letouzey (1985), GOPA (1995) and detailed descriptions and maps of the mangroves by Tonye and Akono (1998) and Din *et al.* (2001). The classes were selected to focus on the sensitive mangrove ecosystems whilst de-emphasising the less sensitive (from the perspective of oiling risk) coastal forest areas associated with sandy beaches and rocky shorelines. The vegetation was mapped using Landsat 7 ETM+ images captured during 2000 and 2001 and classified and digitised as described by Burns *et al*. (2002a,b). The mapped vegetation comprising the coastal zone is presented in Figure A.3.12.

LITTORAL VEGETATION AND COASTAL FOREST

Vegetation types

The coastal vegetation can be divided into the evergreen Atlantic Littoral Forest, Swamp Forest, Mangroves, Swamp and *Raphia* Forest (Letouzey, 1985). The Atlantic Biafran Forest occurs mainly inland and only reaches close to the coast near Eboundja in the south and on the slopes of Mount Cameroon in the north. The main difference between the Biafran and Littoral forms of the Atlantic forest is the greater importance of Azobé, *Lophira alata,* in the latter and Caesalpinaceae in the former (Letouzey, 1985). Letouzey's (1985) Atlantic Littoral Forest has been subdivided into the *Nearshore*, *Dune*, *Swamp* and *Coastal Lowland Forest* types for the classification presented in the NOSCP and the Atlantic Biafran Forest of the lower slopes of Mt Cameroon is described as *Coastal Forest*.

The *Nearshore Forest* [Sandy Offshore Bar Forest, Type No. 266 of Letouzey (1985); Nearshore Forest of GOPA (1995)] grows as a scrub and forest fringe in a narrow strip (10-50 m wide) immediately landward of the beach-head formed by wave run-up, wherever there is sufficent sandy sediment. The vegetation is relatively short (6-10 m) with occasional large trees of ironwood or Azobé, *Lophira alata,* and Ozouga, *Sacoglottis gabonensis,* present beyond the scrub zone. The tree layer often is dominated by a number of introduced species, particularly Beach calophyllum, *Calophyllum inophyllum*, Badamier, *Terminalia catappa,* and Coconuts, *Cocos nucifera*. Indigenous trees include the Wild date palm, *Phoenix reclinata*, Coco-plum, *Chrysobalanus* and African crabwood, *Carapa procera*. The lower layers include annual herbs, grasses (*Sporobolus*, *Paspalum)* creepers (*Ipomoea*, *Canavalia)* and shrubs (*Hibiscus tiliaceus*, *Phyllanthus*). Inland it grades into the *Dune* or *Coastal Lowland Forest*.

Dune Forest [Sandy Offshore Bar Vegetation, Type No. 267 of Letouzey (1985)], occurs between Londji and the Lokoundjé river and between Cap Cameroun and Bimbia Creek on the seaward fringe of the mangrove mudflats. It is found on low, linear dune ridges formed roughly parallel to the coast, with the intervening depressions, often supporting *Raphia* swamp forest. It can be distinguished from the *Coastal Lowland Forest* by textural differences on the satellite imagery caused by the undulating topography.

Swamp Forest [Seasonally Inundated Swamp Forest, Types No. 259 and 260 of Letouzey (1985)] occurs where the topography is flat or gently undulating with high water tables and numerous areas of seasonally or perennially standing (but not stagnant) water. It occurs mainly in the Lokoundjé catchment between the *Dune Forest* and the *Coastal Lowland Forest*. The structure is similar to the *Coastal Lowland Forest* but the understorey is often open. The dominant species are those that favour wet habitats, including *Raphia hookeriana*, *R. vinifera*, *Uapaca* species, *Sacoglottis. gabonensis*, *Guibortia demeusii*, *Hallea* species, *Ficus* species, *Irvingia gabonensis*, *Dalbergia ecastaphyllum*, *Hibiscus* species and floating aquatic plant species.

The *Coastal Lowland Forest* is a tall, evergreen forest (30-40 m) with emergent trees that reach heights of 50-60 m. The flora includes numerous species in the Caesalpiniaceae, and species such as *Sacoglottis gabonensis*, *Lophira alata*, *Cynometra hankei* and Cola nut, *Coula edulis,* are common (White, 1983; Letouzey, 1985; Anon in prep.). The middle layer includes numerous lianes, whilst the ground flora is mainly sedges, ferns and members of the Marantaceae and Zingiberaceae (ginger family). The soils are generally well drained but in the valley bottoms, and relatively low-lying areas, it grades into *Swamp Forest*. *Coastal Forest* is equivalent to Letouzey's Atlantic Biafran Forest described above.

Large areas of the coastal vegetation have been cleared for human settlements (towns and villages) and subsistence agriculture (Figure A.3.12). Timber extraction and commercial plantations of Oil Palms, *Elais guineensis*, Rubber, *Hevea braziliensis,* and other species occur well inland except for the very extensive plantations along the slopes of Mount Cameroun.

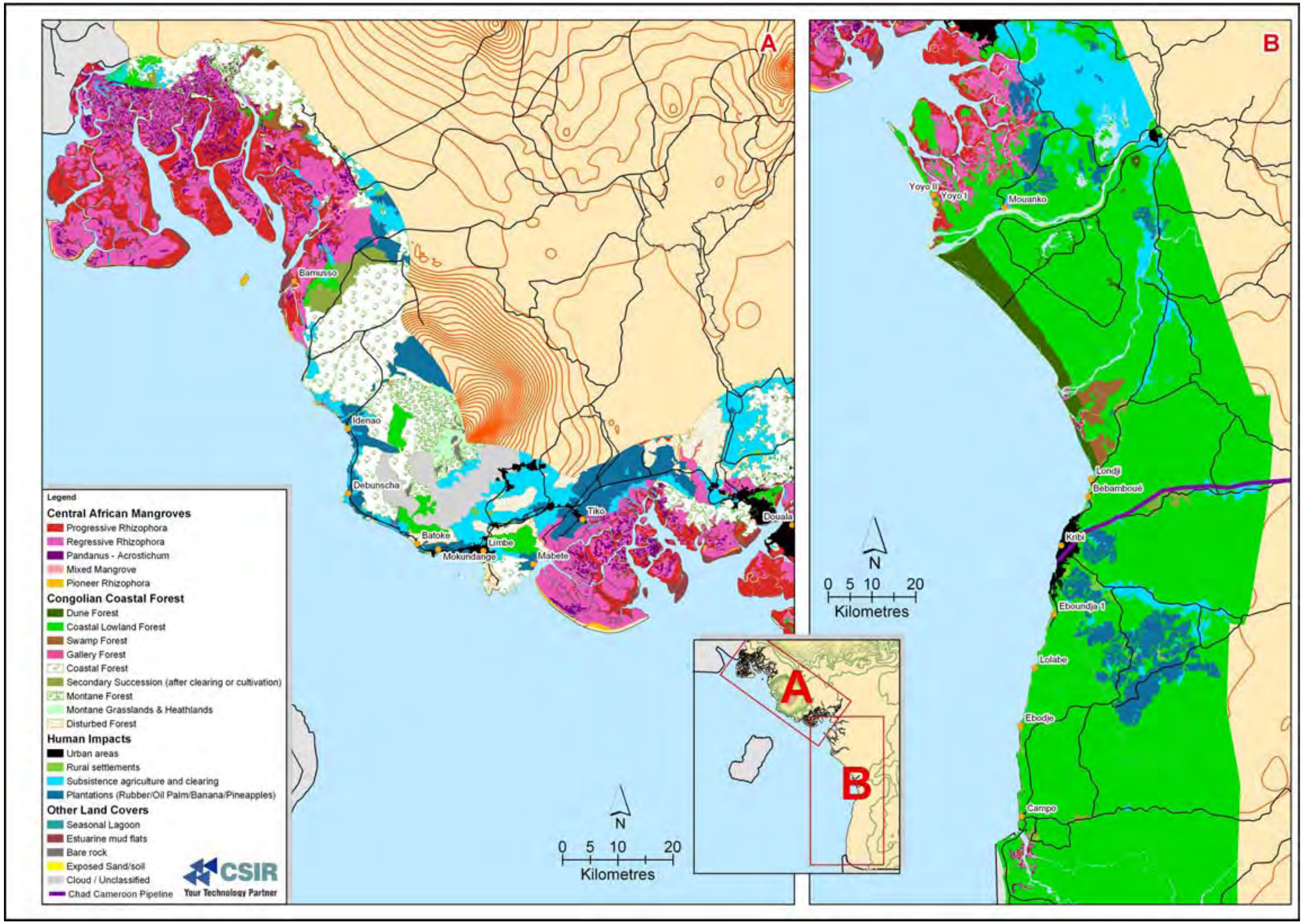

Figure A.3.12: Map indicating the diversity of vegetation types and major land cover classes fringing the Atlantic coastline of Cameroon

Vegetation dynamics

The variation in physical coastline characteristics and the different processes of sand deposition and erosion result in a number of vegetation gradients at the coastline (Letouzey, 1985; Burns *et al.*, 2002a,b). Different patterns of succession are found on rocky promontories, river mouth sand spits and prograding sandy beaches. Primary succession to forest occurs where sand is accumulating, both on the coast and on emergent sediment accumulations in the lower reaches of the major rivers. The sand deposits are first colonised by pioneer grasses, which are then replaced by creepers, such as the sweet potato, *Ipomoea pes-caprae*, followed by the *Neashore Forest* species, beginning with the shrubs (Plate A.3.7). South of Kribi, on rocky promontories, and in hollows and cracks in the rocks, which are located within the range of sea spray, colonizing species include salt-resistant or tolerant species such as *Sesuvium portulacastrum* and grasses such as *Cynodon*, *Sporobolus* or *Paspalum*. A little further landwards, more hardy shrubs and trees such as Beach calophyllum and Wild date palms become established and these are followed by a variety of forest species (Plate A.3.8). Similar vegetation succession is found on rocky shorelines along the northern coastline between Bekumu-Ubenekang and Bimbia Creek.

Plate A.3.7: The progression from coloniser grasses and herbs to the shrub and tree species that fix the back beach sediments along prograding sandy coastlines.

Plate A.3.8: Forest growing on the rocky shore near Rocher du Loup north of Ebodjé

The high rainfall and lack of strong winds off the sea (i.e. reduced salty aerosols) probably explain why mature coastal forest is able to develop within 10-50 m of the beach in many areas or even right on the shoreline where it is rocky. Good examples of this are found between Idenau and Bimbia Creek and at the Rocher du Loup on the southern coast. The 50-60 m tall trees grow within metres of the waves with little or no halophytic ecotone.

Where the coast experiences erosion, the palm fringe and *Nearshore Forest* is eliminated, leaving trees up to 50 m tall with their root systems partly exposed or toppled and lying on the beach. Other stretches of coast, for example between the Lokoundjé and Nyong rivers, are clearly accumulating sand, forming distinct, parallel bands of dune vegetation and progressively advancing the shoreline in a westerly direction.

MANGROVES

Vegetation types

Cameroon has very large areas of mangrove vegetation, probably second only to Nigeria, which form part of the Central African Mangroves system (total area 29 900 km^2). They extend from Ghana to the Congo river mouth and have outliers in Angola. The total area of mangroves in Cameroon is about 2 434 km^2 (Sayer *et al*., 1992 in MINEF, 1997), which is close to the 2 515 km^2 estimated for this study (Table A.3.15). They are recognised as one of the world's terrestrial ecological regions (Olson *et al*., 2001) and are included in the 200 Global ecoregions that are considered critical for conserving global biodiversity (Olson *et al*., 2000).

Table A.3.15: The area, shoreline length and shoreline ratios for the major mangrove areas of Cameroon based on previous work (Burns* et al.*, 2002a,b) and data compiled for the NOSCP.

Estuary or lagoon	*Total area (km^2)*	*Total area (% of sub-total)*	*Shoreline length (km)*	*Shoreline ratio (km/km^2)*
Rio del Rey	1398.65	56	2799	2
Estuaire du Cameroun	1074.13	43	2433	5
Mbenga-Malimba	14.51	1	14	1
Sanaga	4.19	0	8	3
Loté	0.09	0	1	11
Nyong	1.59	0	14	9
Lokoundjé / Lovi	4.59	0	25	6
Ntem	17.69	1	53	3
Total	2515.45		5347	2

The mangrove forests are dominated by *Rhizophora* species (Red mangroves), particularly *R. racemosa* (Plate A.3.9), which occupies the tidal areas and actively growing mudbanks (Keay, 1953; Savory, 1953; Chapman, 1976; Letouzey, 1985; Ward and Bunyard, 1992; Tonye and Akono, 1998). *Rhizophora harrisonii* tends to occur on the inner edge of *R. racemosa* stands, with *R. mangle* being rare and confined to the landward margins of the mangroves. *Rhizophora* species are easily distinguished by their well-developed stilt roots, with *Avicennia germinans* and the other species having subterranean roots with aerial pneumatophores (air-breathing roots). *Rhizophora racemosa* often reaches a height of 15-25 m (maximum about 40 m), and is much taller than *R. mangle* and *R. harrisonii*, which seldom exceed a height of 6 m in West Africa (Keay, 1953). *Avicennia* rarely reaches heights of more than 5 m, and occurs more often as a shrub of up to 3 m in height (Keay, 1953). It appears to favour sandy (White, 1983; Dames & Moore, 1994) or rocky substrata (notes on specimens at Limbe Botanical Garden and David Le Maitre personal observations, 2002). It is relatively rare in the Estuaire du Cameroun but appears to be more common in the Rio del Rey region judging by the very numerous seedlings present in the beach litter west of Limbe near Idenau, and the few seedlings on shorelines in the Estuaire du Cameroun. It is also found in the country's smaller, seasonal estuary and lagoon systems where sandy sediments predominate.

Plate A.3.9: Tall (35-40 m) Rhizophora racemosa *forest actively expanding on an accreting shoreline in the estuary of the Ntem River*

A number of other plant species are associated with the mangrove forests, particularly on the landward margins or elevated areas of mangrove islands (Letouzey, 1985; Tonye and Akono, 1998. These include *Hibiscus tiliaceus*, *Drepanocarpus lunatus*, *Dalbergia ecastaphyllum,* various palms, the mangrove fern, *Acrostichum aureum,* and a number of swamp and coastal forest species. Mangrove forests generally have a poorly developed plant understorey, but the high rainfall and humidity levels in the study areas facilitates colonisation by a variety of epiphytic orchid species (Letouzey, 1985; GOPA, 1995), particularly on the stems and branches of the larger mangrove trees. The flora also includes other shrubs, lianes, sedges (*Cyperus*, *Fiurena*) and grasses (Letouzey, 1985). Mangroves are also known to support a wide range of ferns, mosses, lichens, fungi and marine algae (Lugo and Snedaker, 1974; Chapman, 1984), and some species lists are given by Letouzey (1985). The plant species associated with mangroves are generally quite rare or confined to particular habitats in the Estuaire du Cameroun (Burns *et al*., 2002a), but are much more abundant in smaller systems such as the Ntem river (Burns *et al*., 2002a). Similar mixtures of species are present or dominate most of the seasonal lagoons, which often have extensive areas of coarse sediments exposed in places. Their distribution may be controlled by the salinity of the water and not just by the presence of sufficent sandy sediment. Where occasional deposits of coarse sediments within the mangrove areas are sufficiently deep, the mangroves are replaced by coastal forest communities.

The structure of the mangroves ranges from dense 30-40 m tall stands (usually pure *Rhizophora* species) to 10-20 m stands (dominated by *Rhizophora* with some *Avicennia*) to short (3-5 m) *Rhizophora* which varies from dense pure stands to a sparse canopy with a middle layer dominated by *Pandanus* or *Acrostichum* (Tonye and Akono 1998; Din *et al.*, 2001; Burns *et al*., 2002a,b). Away from the open creeks and with increasing ground elevation, the mangroves grade into Swamp forest or coastal forest depending on the sediment type and the depth of the water table. These different community types have characteristic signatures on satellite imagery and have been distinguished in the mapping (Figure A.3.12) as follows:

- Pioneer *Rhizophora* - in some areas there are extensive unvegetated mud banks; when large areas of these sediment deposits become shallow enough, a dense cover of seedlings develops with a distinctive signature.
- Progressive *Rhizophora* – this includes areas of active sediment deposition with tall, vigorous *Rhizophora* (*R. racemosa* with some *R. harrisonii*) and *Avicennia* (where present) along the tidal frontage and areas where there is secondary, vigorous *Rhizophora* growing as a narrow fringe along open creeks. This type is similar to Letouzey's (1985) Vegetation Type No 264 – "Tall exterior mangrove of large *Rhizophora racemosa* and *Pandanus candelabrum*, on the edges of estuaries", but without the *Pandanus*, and includes areas of Vegetation Type No 265 – "Tall Mangrove with leafy canopy perforated by depressions".
- Regressive *Rhizophora* – this includes areas with windfalls of the senescent progressive *Rhizophora,* colonisation by secondary *Rhizophora* and *Avicennia* and may include a low density of other species such as *Acrostichum* or *Pandanus*. This type includes Letouzey's (1985) Vegetation Type No 262 – "Low-growing internal mangroves of small *Rhizophora racemosa* and *Pandanus satabiei*".
- *Pandanus* - *Acrostichum* - with either or both species, 20-50% canopy cover and an open *Rhizophora* overstorey; the ground layer has sparse sedges (Plate A.3.10). This replaces the regressive stage once the overstorey thins out. *Rhizophora mangle* is said to occur in these areas on the landward fringe of the mangroves (Tonye and Akono 1998; Din *et al.*, 2001). The final stage in the regression is to open mud flats with sparse vegetation except in areas where there is sufficient freshwater flushing for its replacement by Swamp Forest. This type is comparable with Letouzey's (1985) Vegetation Type No 263 – "Low-growing stunted mangrove in the interior on ferruginous deposits" and includes areas of Vegetation Type No 262 (see above).
- Mixed Mangrove – a transition between the salt water (true) mangrove species (e.g. *Rhizophora*) and associated, freshwater preferring, mangrove species; it occurs in various situations where the salinity of the water and sediments is low enough to allow freshwater-dependent species to compete with the true mangroves.

Plate A.3.10: Stand of short Rhizophora (3-4 m tall) and mangrove fern (Acrostichum aureum) growing on calcified argillaceous clay deposits in the estuary of the Lokoundjé River

It is difficult to differentiate consistently between the Regressive *Rhizophora* and the *Pandanus* and *Acrostichum* communities, so the indicated boundaries shown in Figure A.3.12 and data on the areas should be treated with caution. Other species that occur on the landward fringe include *Laguncularia racemosa* and *Conocarpus erecta* and *Paspalum* in the understorey (Anon, 1992; Tonye and Akono, 1998). Communities dominated by *Avicennia* may also develop on shallow mud and sand flats (GOPA, 1995; Tonye and Akono, 1998). A unique community was found on the eastern side of the very sheltered bay where the SONARA Refinery Club is situated. It is dominated by a mixture of *Avicennia* and *Languncularia* with occasional *Rhizophora* and the higher lying areas have a mossy ground layer (evidence of significant freshwater flushing). The substratum was formed from rocks with fine sediment accumulated in the gaps between them and on the surface in some areas. It occurs adjacent to the mouth of a stream and beach of fine sand with a very shallow slope. A similar community occurs at another site to the west of the refinery and may occur at other locations, including Man O' War and Dikulu bays. Specimens of *Avicennia* at the Limbe Botanical Gardens had habitat notes which recorded that they were found in areas with rocky substrata.

Vegetation dynamics
The general succession pattern in the mangrove communities of Cameroon has been described by Chapman (1976), Afa (1985) and in greater detail by Tonye and Akono (1998) and Din *et al.*, (2001). The primary colonising species on new islands deposits of argillaceous clay and silt, along the shoreline or in the tidal areas of creeks, is *Rhizophora racemosa*. Other species include occasional *Avicennia germinans.* The elevation of the sediments relative to the tidal range is a key factor determining the distribution of mangrove species (Lugo and Snedaker, 1974; Thom *et al.*, 1975; Chapman, 1976; White, 1983; Tomlinson, 1986; Tonye and Akono, 1998).

The seedlings of *Rhizophora* species develop on the parent tree and can reach a length of a metre or more at the time they drop into the water. The sharp tip of the root penetrates new sediment deposits once they are shallow enough to allow the seedlings to keep their leaves above at least the mid-tide line. The growing and mature trees can colonise deeper lying sediments by sending down new stilt roots from their branches. The tall forest trees then senesce, are blown or fall down and are replaced by the shorter trees of the regressive stage. The regressive stage, in turn, senesces and is replaced by a dense community of short *Rhizophora*, with some *Avicennia* in areas where there is still some sediment deposition. The final stage is the *Pandanus-Acrostichum* community in areas where there is no sediment deposition or active erosion of the surface and banks. During this progression the sediments become consolidated and anoxic and are bound together by chemical processes and the accumulation of organic matter from root systems (Letouzey 1985; Tonye and Akono 1998). In dry situations these deposits appear to become calcretised (Burns *et al.*, 2002a). *Avicennia* seedlings apparently are able to germinate in seawater, but are short and can only establish where the water depth does not exceed about 40-50 mm. Establishment is thus limited to areas that are close to the high tide line, which seems to be the main factor limiting its abundance in the larger estuaries where the conditions favour *Rhizophora.*

From observations during field work (Burns *et al.*, 2002a,b) it is clear that the rate of turnover of sand on the open coast beaches is too rapid for mangroves to establish themselves. It is also generally too dry for them to colonise landward of the beachhead unless there are local depressions with high water tables or surface water at least during high tide. Mangrove species do not seem to be able to compete with the pioneer nearshore or coastal forest (non wetland forest types) on deposits of coarse sands, whether behind the head of the beach or in more sheltered situations within the estuaries. However, they are successful where there is an accumulation of finer sediments or underlying clayey soils, even where they are in relatively dry situations.

Some authors have argued that mangroves trap sediment which they then colonise, so forming a prograding community as discussed by Hom *et al.*, (1975), Tomlinson (1986), GOPA (1995) and Ukpong (1995). This does not appear to be the typical process in Cameroon, where observations (Burns *et al.*, 2002a,b) suggest that sediment deposition precedes the establishment of *Rhizophora*. A good example is the formation of a new island of sediment and its colonisation by mangroves in the Rio del Rey during the last three years. The subsequent accumulation of further sediment raises the elevation of the surface allowing *Avicennia* and others to establish and trap more sediment with their dense arrays of pneumatophores. There is some stabilisation but the strength of the river and tidal currents is such that their interactions with the coast and creeks effectively determines where there will be deposition and erosion.

A.3.1.4.6 Large vertebrate fauna

COASTAL, ESTUARINE AND TERRESTRIAL BIRDS

There are 300 species of birds recorded for the southern coastal area of Cameroon (in the UTO Campo-Ma'an). This inventory is, however, considered to be an incomplete record. Based on the BirdLife International classification system, this diversity of species identifies the area as an "important zone for the conservation of birds". In this context, this status highlights the general importance of the coastal, estuarine and terrestrial environment.

Coastal surveys (e.g. Burns *et al.*, 2002 a,b) have recorded a generally sparse beach avifauna, which tends to be concentrated at the estuaries and river mouths. A list of coastal bird species likely to occur along the Cameroon coast and in the estuaries is presented in Table A.3.16. The list is not exhaustive but is intended to provide an indication of the variety of birds utilising the coast. In the event of an oil spill these species would be denied feeding and roosting areas, but generally would be expected to seek clean areas in the vicinity for the duration of the impact of the spill. The numbers of birds affected would be generally low except when the Palaearctic migrants are on passage in the boreal autumn (September – November) and spring (late February – April).

Table A.3.16: Coastal and estuarine birds likely to occur along the coast of Cameroon. List compiled from Cheke and Walsh (1996), Dean (2000), Elgood* et al. *(1994), Fotso* et al. *(2001), Grimes (1987) Urban* et al. *(1986), Van Gelder* et al. *(1992) and Burns* et al. *(2002b).

Common Name	*Scientific Name*
White Pelican	*Pelecanus onocrotalus*
Reed Cormorant	*Phalacrocorax africanus*
Darter	*Anhinga rufa*
Grey Heron	*Ardea cinerea*
Black-headed Heron	*Ardea melanocephala*
White-backed Night Heron	*Gorsachius leuconotus*
Palm-nut Vulture	*Gypohierax angolensis*
Grey Plover	*Pluvialis squatarola*
Ringed Plover	*Charadrius hiaticula*
Black-tailed Godwit	*Limosa limosa*
Spotted Redshank	*Tringa erythropus*
Greenshank	*Tringa nebularia*
Sanderling	*Calidris alba*
Little Stint	*Calidris minuta*
Curlew Sandpiper	*Calidris ferruginea*
Black-winged Stilt	*Himantopus himantopus*

Common Name	*Scientific Name*
Avocet	*Recurvirostra avosetta*
White-crowned Plover	*Vanellus albiceps*
Lesser Black-backed Gull	*Larus fuscus*
Black-headed Gull	*Larus ridibundus*
Grey-headed Gull	*Larus cirrocephalus*
Grey Phalarope	*Phalaropus fulicarius*
Little Tern	*Sterna albifrons*
Royal Tern	*Sterna maxima*
Damara Tern	*Sterna balaenarum*
Common Tern	*Sterna hirundo*
Arctic Tern	*Sterna paradisaea*
Sandwich Tern	*Sterna sandvicensis*
Caspian Tern	*Sterna caspia*
Black Tern	*Chlidonias niger*
White-winged Black Tern	*Chlidonias leucoptera*

Two locally occurring terrestrial bird species, the forest swallow, *Hirundo fulginosa,* and Rachel's malimbe, *Malimbus racheliae*, whose distribution is limited to the Atlantic forests of northern Gabon and south-western Cameroon, are threatened with extinction.

AMPHIBIANS AND REPTILES

Folack *et al.* (1997 cited in UNEP, 1999) describe the occurrence of some 200 species of amphibians in Cameroon's coastal ecosystems, one of the most noteworthy being the World's largest frog, the Goliath frog, *Rana goliath*. Tropenbos/MINEF/SNV (2002) document 23 species of amphibians (frogs, toads and salamanders) occurring within the northern part of the UTO Campo-Ma'an.

The inventory of reptiles for the area (including snakes, lizards, chameleons, tortoises, crocodiles and the monitor lizard) includes 122 species, six of which have been first described in the UTO Camp-Ma'an (Tropenbos/MINEF/SNV, 2002). In terms of reptiles, the area rates as one of the most important centres in Africa. Of the approximately 150 species of snakes (Ophidians) in the region, common species include *Bitis gabonica*, *Boulangerina annulata*, and *Dendroaspis viridis*. The 85 species of reptile recorded within the coastal ecosystems include three species of crocodile, which represent the larger vertebrates associated with the country's estuaries in the study area. These crocodile species, which are listed as threatened according to the IUCN classification system, are the African crocodile, *Crocodylus niloticus*, Slender-snouted crocodile, *C. cataphractus*, and the West African dwarf crocodile, *Osteolaemus tetraspis tetraspis*. The African monitor lizard also occurs in the area, and other noteworthy Saurians are represented by species such as *Rampholeum spectrum*, *Chameleo quadricornis* and *C. montium*.

TURTLES

Five species of turtles - the Green, *Chelonia mydas*, Leatherback, *Dermochelys coriacea*, Loggerhead, *Caretta caretta*, Olive Ridley, *Lepidochelys olivacea,* and Hawksbill turtles, *Eretmochelys imbricata* - are found in the Gulf of Guinea. Two of these (the green and hawksbill) have IUCN Red List Critically Endangered status, while the remaining three have Endangered status.

Four species of marine turtles have been observed along the southern coast of Cameroon, and the Leatherback and the Olive Ridley turtle have been recorded nesting on the beaches in this area (Tropenbos/MINEF/SNV, 2002). These species, as well as the Green and Hawksbill turtles, utilise the rocky coastal habitats in the region and feed on the macrophytes associated with this environment.

Although Green turtles nest along the southern coast of Bioko Island (Price *et al.*, 2000), there are no records of Green or Hawksbill turtles nesting along the southern coast of Cameroon. However, there are records of shells of young specimens of these species having been found along this coastline, and both species have been recorded offshore in the region. In this regard, there are records of animals that have been treated for injuries resulting from (*inter alia*) boat strikes and net and longline capture. Animals that have been treated include hatchlings of the Green turtle, small pelagic juveniles of the Hawksbill turtle and adult females of the Leatherback turtle (http://www.seaturtle.org/mtrg/firstaid/56.shtml).

Freshwater terrapins are relatively common where there is suitable habitat such as rivers, streams, lakes and pans.

MAMMALS

The mangrove fauna is relatively poorly represented by mammals. Species associated with this habitat include sitatunga, *Tragelaphus spekei*, otters, water or marsh mongoose, *Atilax paludinosus*, Cape clawless otter, *Aonyx capensis* Schinz, species of mice (e.g. *Dasymys incomtus*), as well as *Cephalophus* spp, which include the small duiker antelope (http://www.chez.com/gefgclme/english/background.htm).

The coastal forest fauna is much more diverse than that of the mangroves, and includes many endemic and rare species. Tropenbos/MINEF/SNV (2002) describe the fauna of the UTO Campo-Ma'an, which is representative of the onshore environment and the following summary is extracted from this reference source.

Eighty species of medium and large mammals occur in the UTO Campo-Ma'an, including what are described as the "forest big six": the forest elephant, *Loxodonta africana cyclotis*, buffalo, *Syncerus caffer nanus*, gorilla, *Gorilla gorilla*, chimpanzee, *Pan troglodytes*, leopard, *Panthera pardus,* and the giant pangolin, *Manis gigantean*. Of the 80 mammals recorded, 23 are listed Red Data species and are grouped into the following categories:

- Endangered species include taxa threatened with extinction as a consequence of human exploitation. The lowland gorilla, chimpanzee and forest elephant are included in this category;
- Vulnerable species are described as potentially endangered in the near future. The mandrill, *Mandrillus sphinx,* black colobus, *Colobus satanus,* and spot-necked otter, *Lutra maculicollis,* are classified as species falling within this category;
- Not yet vulnerable, but potentially so in the near future. Species grouped in this category include the red-capped mangaby, *Cercocebus torquatus*, the Angwantibo, *Arctocebus calabarensis*, the southern needle-clawed bushbaby, *Galago elegantulus*, Allen's squirrel galago, *G. alleni*, the water chevrotain, *Hyemoschus aquaticus*, the sitatunga, *Tragelaphus spekei*, Bates' pygmy antelope, *Neotragus batesi*, Peter's duiker, *Cephalophus callipygus*, the bay duiker, *C. dorsalis*, the black-fronted duiker, *C. nigrifons*, the white-bellied duiker, *C. leucogaster*, the yellow-backed duiker, *C. sylvicultor*, the forest buffalo, the giant pangolin, *Smutsia gigantea*, the African tree pangolin, *Manis tricuspis,* and the long-tailed pangolin, *Uromanis tetradactyla;* and
- Threatened but of indeterminate status. Species included in this category are considered threatened on the basis of the paucity of related information. The Congo clawless or swamp otter, *Aonyx congica,* is classified into this category.

Twenty nine species of primate are recorded for Cameroon, 18 of which occur within the UTO Campo-Ma'an. The National Park within the UTO is the only area in Cameroon where the mandrill and its habitat are protected. The area is also an important habitat for the lowland gorilla.

There are 28 species of bat recorded for the UTO Campo-Ma'an, two of which are endemic to Cameroon (the slit-faced bat, *Nycteris major* and the leaf-nosed bat, *Hipposiderus curtus*).

MANATEES

The West African manatee, *Trichechus senegalensis,* is an aquatic herbivore that occurs in the rivers, estuaries, lakes and lagoons of West Africa between Senegal and the Kwanza river in Angola (Dorst and Dandelot, 1972; Haltenorth and Diller, 1986). The species also occurs in Cameroon, and is recorded as being most abundant in the Korup region (Grigione, 1996). Its distribution includes estuarine environments, having been recorded within the lower reaches and estuary of the Sanaga river, the Dihende and Dipompe, rivers (which are associated with the Sanaga and Nyong river systems), Lake Ossa and Lake Tissongo, and within the Estuaire du Cameroun. There are no reports of manatee occurring in the Kribi region, for example, in the Lokoundjé, Kienké, Lobé and Ntem rivers; however, this does not necessarily imply that the species does not occur within the Kribi-Campo coastal zone.

Elsewhere within its area of distribution, the manatee is periodically killed in collisions with fast-moving small craft (Dowsett-Lemaire and Dowsett, 1991). Whilst this has not been reported as a threat to the species in Cameroon, the local population of manatee is apparently declining, in particular within the Douala-Edéa Fauna Reserve, due to hunting and other pressures (MINEF, Douala, pers, comm.). This concern is also expressed in IUCN literature, where the species is described as being in danger of extinction. Of interest is the contradictory view presented by Grigione (1996), who concludes that the manatee is not under threat, for example due to hunting by Cameroonians – due, *inter alia,* to the offensive smell and flavour of its meat. However, the author does indicate that unlicensed hunting by Nigerian residents of coastal villages in the study area may be a problem. Such unpermitted hunting is prohibited by law.

The West African manatee has IUCN Red List status of Vulnerable. Nishiwaki (1984) estimated the total population at between 9 000 and 15 000 animals.

A.3.1.5 Conservation Areas

There are only two conservation areas in Cameroon, which include sections of the coastline. These are:

- The Douala-Edéa Fauna Reserve, which was proclaimed as a faunal conservation area in 1932 (WCMC, 1992), with its status upgraded to an IUCN Category IV Reserve in 1986 (GOPA, 1995), i.e. a reserve that has been set aside for the protection of particular habitats or species (IUCN, 1994). The reserve includes the Reserve De Chasse (Sanaga Wildlife Reserve), which covers the floodplain of the Sanaga river from Edéa to the coast. It extends from Pointe Souélaba to the Nyong river and includes important mangrove areas, an extensive creek and lagoon system as well the estuaries of the Sanaga and Nyong rivers. The open coastline comprises mainly sandy beaches, with a total length of about 80 km. The protected fauna that potentially would be vulnerable to oil spills include: sitatunga, manatees, small carnivores, crocodiles, turtles, other reptiles, amphibians and a range of waterbirds.
- The Réserve de Faune de Campo, which was established in 1932 (WCMC, 1992), comprises an extensive area of the coastal zone and the mangroves in the Ntem river mouth. This reserve was deproclaimed when the Campo-Ma'an National Park was established in January 2000 (Anon, 2000). The Park covers the core areas of the former reserve and measures some 260 000 ha in extent (Table A.3.17). The Park currently only includes a small section of mangroves within the Ntem river mouth and is unlikely to be directly affected by oil spills (Burns *et al.,* 2002b). The park authorities plan to include areas of the coast in the park but this will probably take several years to materialise. The remainder of the management unit (Unité Technique Opérationnelle, UTO) - about 420 000 ha, and including all the coastline from the Ntem river to Kribi and much of the former fauna reserve - is managed as a multiple-use area with support from the Global Environmental Facility project (Plate A.3.11).

Plate A.3.11: Promotion of ecotourism activities at Ebodjé within the Campo-Ma'an UTO

The coastal forests falling outside conservation areas are managed by the relevant District authorities. A variety of human activities of both a subsistence and commercial nature are permitted, including the harvesting of natural resources by local communities, small-scale agriculture and commercial forestry within defined zones, with conditions set out in the forestry permits that are issued. In practice, the authorities lack the resources to ensure that these conditions are met.

Table A.3.17: Details of the conservation areas that include portions of the Cameroonian coastline (adapted from Foahom, 2001)

Project Name	*Objectives and Legal Status*	*Location (Province)*	*Forest area covered (ha)*
Douala-Edéa Fauna Reserve	Protected area as fauna reserve	Littoral	160 000
Réserve de Faune de Campo	Deproclaimed, now a multiple-use management area (UTO)	Littoral	300 000
Lokoundjé-Nyong Project	Protected area for a sustainable forest management (SFM) project	Littoral	327 500
GEF Campo-Ma'an Project (UTO)	Protected area for biodiversity conservation, tourism (NP) and SFM	South	771 000

A.3.1.6 Socio-economic and cultural environment

The following sections describe those aspects of the socio-economic and cultural environment that would be affected by and are most vulnerable to an oil spill.

A.3.1.6.1 Population demographics and settlement patterns

The coastal population of Cameroon is unevenly distributed along the coast, with the population densities greatest in the vicinity of the main coastal city, Douala, and the larger coastal towns such as Idabato, Bamusso, Idenau, Limbe, Kribi and Campo. Table A.3.18 provides an overview of the population (number of residents) within the coastal provinces and divisions based on 1987 census data (Ibe *et al.,* 1999). The census data are outdated; however, the overall pattern of distribution probably will not have changed significantly. The data show that the population in the South and South-West Province is predominantly rural, with a different situation within the Littoral Province, which is dominated by the urban population of Douala. The population of the South-West province is shown to be generally greater than that in the South Province.

Table A.3.18: Population of the Cameroon Coastal Zone in 1987 [according to the General Population Census of 1987 reported by Ibe* et al. *(1999)].

Province	*Division or Sub Division*	*Total Population*	*Rural Population*	*% of Rural*
South	Kribi	40 737	19 206	47
	Campo	3 978	2 886	72.5
	Akom II	18 291	17 272	94.4
Total for South		**63 006**	**39 364**	**62.4**
Littoral	Edéa	68 794	18 185	26.4
	Dizangué	14 792	7 096	47.9
	Mouanko	7 872	5 386	68.4
	Douala	834 471	24 619	3.0
	Dibombari	28 871	26 080	90.3
Total for Littoral		**954 800**	**81 366**	**8.0**
South-West	Buéa	65 853	32 982	50.0
	Limbe	64 878	20 317	31.0
	Tiko	48 772	25 213	51.7
	Muyuka	52 823	39 852	75.4
	Bamusso	17 558	16 920	96.3
	Ekondo-Titi	38 246	33 310	87.0
	Isangele	4 517	3 379	75.0
	Kombo-Ebundi	3 761	3 618	96.0
	K. Abedimo	796	796	100.0
	Mudemba	19 307	15 700	81.0
	Idabato	3 250	2 851	88.0
Total for South-West		**319 762**	**194 938**	**60.9**
GRAND TOTAL		**1 337 568**	**315 668**	**23.6**

Apart from areas that are made accessible by the coastal road connecting Idenau, Limbe and Douala and the secondary coastal road linking Kribi and Campo, large stretches of the country's coastline are inaccessible by road. Coastal villages in these areas are, therefore, dependent on sea transport for access to villages. Consequently, coastal villages between the Nigerian border and Bamusso, as well as those between Tiko and Douala and Douala and Kribi, are predominantly subsistence-orientated due to the limited access to, and availability of, markets for their products (Plate A.3.12).

Plate A.3.12: Isolated coastal village situated at an estuary mouth along the southern coastal sector of Cameroon

A large proportion of the coastal population originates from neighbouring West African countries such as Nigeria, Benin and Ghana (Table A.3.19; Figure A.3.13). It is estimated that approximately 78% of the country's artisanal fishing community is Nigerian. There is, therefore, a large degree of mobility and migration amongst the coastal communities, in particular the artisanal fishing communities.

Table A.3.19: Breakdown of the artisanal fishing activity in Cameroon by nationality

Divisions	*Cameroon*	*Nigeria*	*Benin*	*Ghana*	*Other*	*No. of Fishermen*	*Fish Merchants*
Ndian	84	9 303	0	0	0	9 387	1 391
Fako	813	3 344	397	332	22	4 908	1 344
Wouri	1 182	5 128	0	174	0	6 484	2 009
Sanaga-Maritime	1 321	860	101	133	0	2 415	117
Océan	751	165	25	0	1	942	656
Total	**4 151 (17.19%)**	**18 800 (77.89%)**	**523 (2.16%)**	**639 (2.63%)**	**23 (0.09%)**	**24 136 (100%)**	**5 571**

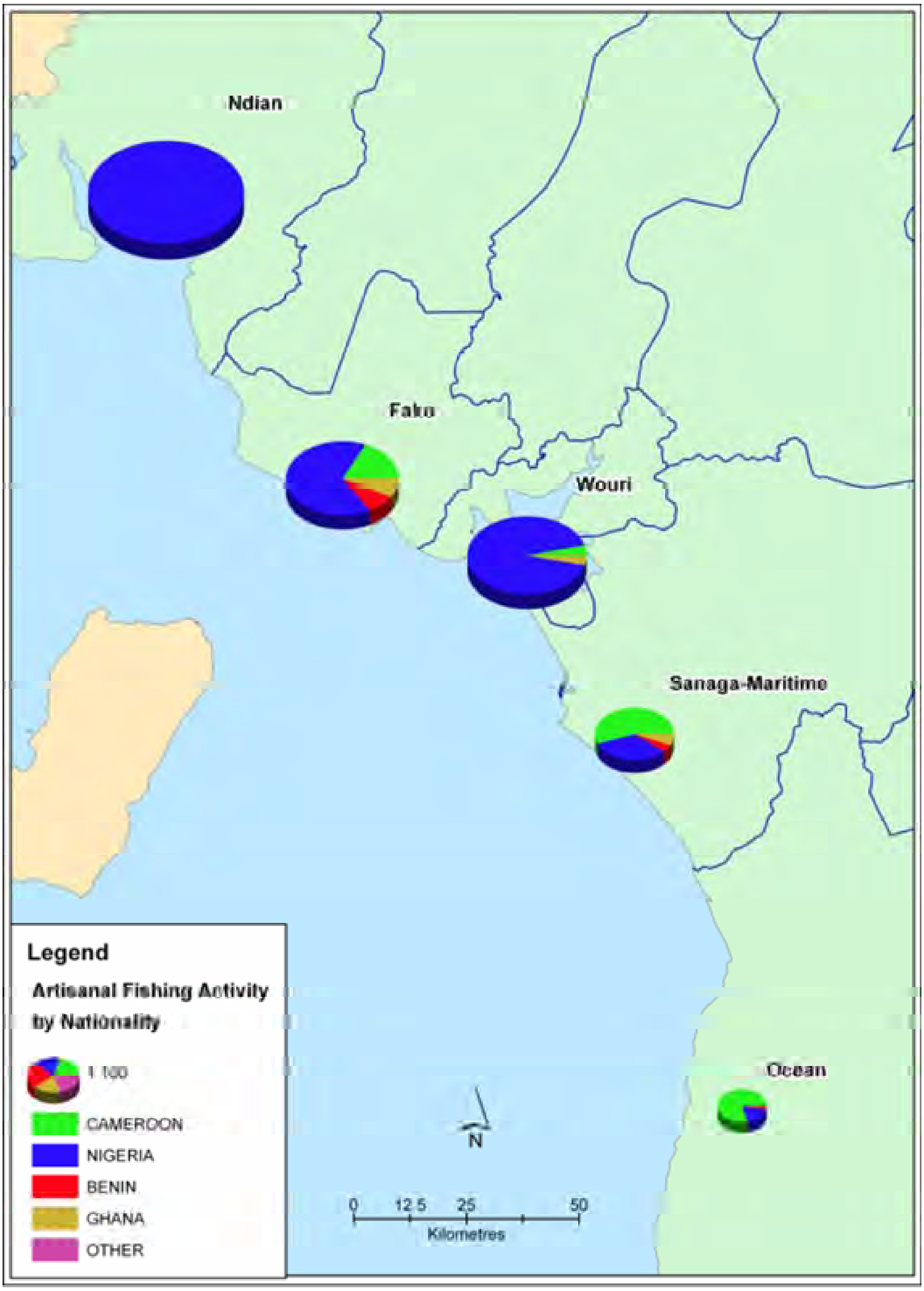

Figure A.3.13: Artisanal Fishing Activity by Nationality.

A.3.1.6.2 Cultural characteristics

Despite the growing influence of western religion, respect is still paid by most coastal communities to traditional deities such as the Miengu (Jengu in the singular). The Miengu sea deities or goddesses are spirits that can take human or inanimate form and are believed to protect the people against epidemics, curses and poverty by ensuring the abundance of food, in particular fish. It is believed that the Miengu can be offended if their sanctuary is disturbed through human action, with the resultant retribution being severe. The sea, as the home of the Miengu is, therefore, considered a sacred site. Desecration of sacred sites is believed to be a source of serious disruption and hardship in the lives of the villagers. Sacrifices are regularly offered to the sea by believers in the Miengu, to calm their wrath or to honour them.

The importance of these cultural deities is evident through the traditional ceremonies, dances and songs held and performed in their honour. Dialogue with the Miengu is conducted during carefully directed ceremonies through drums and songs.

A.3.1.6.3 Access to and use of coastal and marine resources

Although the coastal population is made up of numerous different tribes and nationalities, the majority of the coastal communities derive their primary source of livelihood from, and have strong religious and cultural ties to, the coastal and marine environment.

Coastal communities are dependent almost entirely on this environment for their main source of protein, as well as income, which is derived from fishing. While there has traditionally been no limit on access to the sea, the fishing ban around oil platforms has recently resulted in a reduction in fishing areas, which affects the ability of these communities to practice their livelihoods.

As described in the previous section, the sea provides the main source of inspiration for the traditions of tribes such as the Batanga and Iyassa, and is the home of sacred deities such as the Miengu. The sea is also valued for its therapeutic properties, in particular the protection it provides against skin diseases such as scabies. Beach sand is used for the construction of local buildings.

The attraction of pristine beaches has resulted in a growth in tourism in coastal regions in the vicinity of Limbe, Kribi and Ebodjé. This provides both employment and income to the local population.

Due to poor road connections between many coastal towns and intermediate villages, the sea serves as an important transport corridor for the movement of people and goods along the coast.

A.3.1.6.4 Economic livelihoods and activities

Economic livelihoods and production systems in the country's coastal region include both traditional subsistence production activities (such as fishing, farming, hunting, small-scale stockbreeding and fruit picking) as well as more formalised, commercial activities associated with the "modern economy" (including industrial fishing, logging, tourism, ecotourism, transport and small-scale trading).

A characteristic of the traditional production activities is the gradual shift away from artisanal to commercial production, although most communities are still dependent on artisanal fishing as their primary form of livelihood. A second important trend is the weakening distinction between tribes in terms of the activities that they are predominantly involved in. For example, in the Océan Division of Cameroon, the Batanga and the Iyassa tribes were in the past characterised as fishing communities while the Mabi and the Mvaé were generally involved in farming, hunting and small-scale stockbreeding. This distinction is now less noticeable and trading and interaction between different villages and tribes and concerns about the ability to sustain livelihoods are prompting communities to increasingly diversify their production activities.

The following sections will describe, and focus, on the characteristics of the different production systems and activities that the coastal communities are engaged in, and which would be affected by oil spills. These include fishing, small-scale trading and tourism.

FISHING

Fishing takes place offshore, along the coastline and in the open water bodies along the coast, such as in creeks, mangrove areas and in the major estuaries such as the Rio del Rey complex, the Estuaire du Cameroun complex, and the estuaries associated with the Sanaga, Nyong, Lokoundjé, Kienké, Lobé and Ntem rivers.

Industrial fishing occurs in the offshore, deeper waters of the maritime zone, stretching from the mouth of the Lokoundjé river to the Nigerian border. Important zones of operation include Rio del Rey, Bibundi, South Limbe, Bimbia, Wouri, and on occasion, the estuaries of the Sanaga and Nyong rivers (Neba, 1987). Industrial fishing is estimated to contribute approximately 0.6% to Cameroon's GDP.

Outside of the major towns and cities, artisanal and semi-commercial fishing is the primary livelihood activity and source of income for the majority of coastal communities. Most of the activities that take place in the coastal villages are centred around fishing; for example: maintenance and repairing fishing equipment and boats; fishing; smoking and drying of fish; and marketing and selling. Fish and crustaceans provide the primary source of protein for these communities, as well as income. For example, it is estimated that 90% of the crustaceans and fish caught in the Rio del Rey system are sold, with the remaining 10% being retained for own consumption. It is estimated that the cash value of artisanal fishery output in 1993 was 16 700 million FCFA compared to 5 400 million FCFA for industrial fisheries (Ibe *et al.*, 1999).

The main species that are targeted include:

- Pelagic species (*Ethmalosa fimbriata, Sardinella maderensis* and *Illisha africana*);
- Demersal species, mainly of the *Sciaenidae* (*Pseudotolithus* spp.), the Ariidae (*Arius* spp.), the Polymenidae (*Galoides decadactylus*) families as well as *Polydactylus quadrifilis*, grunters, big eye tuna, *Brachydeuterus auritus*, catfish, *Arius* spp., *Pomadasys* spp., soles and *Cynoglossus* spp. ;
- Crustaceans (lobsters, prawns, shrimps and crabs); and
- Freshwater species (carp, Nile perch, pike).

A range of stakeholders are involved in the fishing industry. These include:

- Fishermen;
- Boat owners;
- Patrons (business operators who invest capital into the purchase of fishing gear or into the fishing units);
- Women who process (smoke and dry) and sell fish;
- Canoe-makers;
- Motor mechanics; and
- Equipment suppliers (net fitters, net loaders, ice suppliers)

There is a fairly strong division of labour between men and women in terms of fishing and associated activities. The men are traditionally involved in the boat preparations and fishing, whereas the women are responsible for smoking, drying, storing, marketing and distributing the fish products.

Fishing is usually undertaken from pirogues - canoes that may either be in the form of "dug-outs" carved from a single tree trunk, or assembled from planks (Plate A.3.13). Based on a survey of fishermen in the southern coastal region between Kribi and Campo, 76% of fishermen operate using unmotorised pirogues. A further 32% of the fishermen have motorised boats, which allow fishermen access to areas further offshore and more extensive stretches of coastline. This situation appears to be similar in the central and northern parts of the Cameroonian coastline.

Fishing equipment consists of surface nets, beach seine, bottom nets, fish and prawn traps, hoists, hooks, sinkers, anchors, floats and lines. Although the fishing methods that are practised are often seasonal, the diversity of methods used, and species targeted, results in fishing activities taking place year round. The peak fishing season in the southern coastal region, from Kribi to Campo, is usually from September-October to March-April. During July-August it is difficult to go out to sea in some areas as a result of rough seas. In the Rio del Rey region in the northern coastal region, prawning and fishing takes place year round, although the peak season for *Ethmalosa* spp. is June- January. The seasonal nature of some fisheries results in temporary migrations of fishermen in search of year-round fishing.

Plate A.3.13: Pirogues and fishing equipment. Ebodjé, southern Cameroon

It is estimated that fish production in the Océan Division is 1 600 – 3 000 tonnes annually. This is relatively low when compared to the estimated 22 530 tonnes and 43 000 tonnes caught in the Ndian and Fako divisions, respectively. The volume of catches depends on the type of equipment used, the time of year and the number of fishing excursions that are undertaken. Daily boat catches can vary from 6 kg, where rudimentary fishing gear is used, to 170 kg, where motorised boats and more sophisticated gear are employed.

Of the total catch caught in the Kribi to Campo region, 60% is sold in the major cities of Douala and Yaoundé. Similarly, catches from the Fako division are sold in Douala, Yaoundé and Limbe. In the north, approximately 95% of the fish and prawn catch in the Ndian Division is sold to Nigeria.

The revenues derived from artisanal fishing vary considerably depending on the type of equipment used, the season and the type of professional category. As reported in GOPA (1995), the monthly income per fisherman can vary between CFA 15 000 and CFA 150 000. Generally the owners of the fishing unit (the patrons) are the wealthiest amongst the stakeholders in the fishing sector.

SMALL-SCALE TRADING AND TRANSPORTATION

Small-scale trading and transportation is considered to be the third most important economic activity after fishing and agriculture. Trading is an activity mainly undertaken by the women, whereas men are involved in transport related activities.

Commodities that are traded include:

- Food and agricultural produce (cassava, pepper, palm oil) and gathered products (coconut, honey);
- Beverages (beer and wine);
- Fish products (fresh and dried fish) and sometimes hunted products (fresh or dried bush meat); and
- Various manufactured goods (cigarettes, soap, matches, kerosene and pharmaceuticals like aspirin, paracetamol and quinine).

Due to the poor condition of the roads and the inaccessibility of many coastal villages by road, pirogues and barges provide the means for transporting people and tradable goods by sea along the coast.

TOURISM AND ECOTOURISM

The pristine beaches and the rich biodiversity of the Cameroonian coastal region offer great potential for coastal tourism and ecotourism (Plate A.3.14). Limbe, Kribi and Ebodjé, in particular, are developing as important and popular tourism centres.

Plate A.3.14: Ebodjé, a developing ecotourism centre on the southern coastline of Cameroon

A.3.1.6.5 Relationship between communities and the oil industry

Amongst the coastal fishing communities there is a fear that the growth of the offshore oil industry will increase the risk of oil spills and pollution, and will pose an increasing threat to their livelihoods, which are largely dependent on the sea. There is a perception amongst the fishing community that the scarcity of fish is related to the disturbances created by the oil activities, such as noise and the permanent presence of oil platforms.

There is some concern that access by communities to the sea will be further restricted and will impact on their ability to perform their cultural activities. Some communities believe that the scarcity of fish is proof of the anger of the Miengu at the desecration of the sea by the oil companies.

A.3.2 Impact Assessment

Impact assessment involves a series of logical steps aimed at identifying and quantifying the potential effects of an oil spill on the environment. The impact assessment permits the prioritisation spill response and clean-up activities towards those components of the environment where impacts of greatest significance are anticipated.

In this section, the potential interactions between spilled oil and the key environmental components are described, and the negative environmental impacts that are predicted are assessed and rated. The assessment conventions that are used to rate the impacts of an oil spill (*intensity*, *temporal scale* and *significance*) are explained in Boxes A.3.1 and A.3.2 for the ecological and socio-economic systems that are appraised.

The spatial scale of an impact can only be assessed for a particular oil spill scenario. In this respect, the extent of the coastline, for example, that will be affected depends mainly on three factors: the location of the oil spill relative to the coastline and to special features such as estuaries, which have extensive shorelines; the amount and type of oil that is spilled; and the currents and winds that disperse the oil and drive it (in the case of Cameroon) towards the coast. Spatial scale can be divided into the following extreme categories: *localised* – where a small percentage (<5%) of a shoreline or an ecosystem type is expected to be affected; and *extensive* – a high percentage (>50 %) of the shoreline or an ecosystem type is expected to be affected. Between these category extremes, a class of *intermediate* is recognised.

An analysis of the oil spill scenarios, including reference to the results of the oil spill simulation modelling (Section A.2) suggests that Tier 2, and certainly Tier 3, spills will potentially have spatially *extensive* effects. In contrast, Tier 1 spills will typically have *localised* effects.

Box A.3.1: Rating system for ecological impacts

Intensity: Concerns the expected change in ecosystem structure and functioning, where: *high* intensity implies a measurable/marked change in ecosystem structure and functioning and *low* represents a barely measurable change. A rating of *intermediate* implies some degree of change that is measurable, but not to the extent that this is marked and permanent. Although spatial scale will affect the intensity of the impact, this can only be assessed for a particular spill or spill scenario.

Temporal scale: Short-term, where effects last a few days, perhaps as long as two weeks*; Medium-term,* where effects last more than one month, but less than a year; *Long-term*, where effects last more than one year.

Significance: An impact of *high ecological significance* is one that could, for example, result in the extinction of rare/threatened species. It could also result in the permanent deterioration of ecosystem structure and functioning, measurable on an extensive spatial scale and in the long-term. The ability of affected ecosystems to revert to their pre-impacted state would be severely compromised. An impact of *low* ecological significance implies that there would be no measurable deterioration in ecosystem structure and functioning beyond, perhaps, some transient (short-term) perturbation; i.e. there would be no diminished delivery of important ecosystem services beyond the short-term; the significance would also be affected by the spatial scale, which will be specific to a particular spill event. An impact of *intermediate* significance would be judged to be intermediate between *high* and *low* significance.

In socio-economic terms the spatial scale of an impact would be based on the effect of an oil spill on the local population, tourists, industries, etc. established at, or having a dependency on, the coast. A *localised* impact would involve a small proportion of the inhabitants and tourists (e.g. a single village) or a small fraction of one or more economic sectors (e.g. artisanal and commercial fisheries) and, thus, the general livelihoods of affected coastal communities. An *extensive* impact would involve several villages, or a large town, or a large proportion of one or more economic sectors that sustain the coastal communities. An *intermediate* impact would lie between these extremes. As noted above, an analysis of the oil spill scenarios suggests that Tier 2 and certainly Tier 3 spills will result in an *extensive* socio-economic impact. Tier 1 spills will generally have *localised* effects, except possibly in areas associated with large estuaries, where relatively large villages are typically situated.

A summary of the rating of the impacts of oiling on the different ecological components of the environment is presented in Table A.3.20. The impacts are described further in the sections that follow.

Table A.3.20: Summary of the ecological impact assessment, based on the criteria described in Box A.3.1 and the environmental impact descriptions provided in the text. Spatial scale has been assessed based on the assumption of a large oil spill.

Impacted component	*Impact intensity*	*Spatial scale of impact*	*Temporal scale of impact*	*Impact significance*
Plankton	Low	Localised	Short-term	Low
Benthic ecosystem	Intermediate	Localised	Long-term	Intermediate
Fish	Intermediate	Intermediate	Medium-term	High
Pelagic/offshore birds	High	Intermediate-extensive	Short-term	High
Cetaceans/other marine mammals	Low	Localised	Short-term	Low
Sandy beach ecosystems	High	Potentially extensive	Medium-term	Intermediate
Rocky shore ecosystems	High	Potentially extensive	Medium-term	Intermediate
Estuary and coastal lagoon ecosystems	High	Potentially extensive	Long-term	High
Mangrove ecosystem	High	Potentially very extensive	Long-term	High
Littoral vegetation and coastal forest	Low	Localised	Short-term	Low
Large vertebrates	Low	Localised	Short-term	Low

A.3.2.1 Marine environment

The environmental impact of oil released into the marine environment depends on many factors. The chemical composition of the petroleum, local weather and sea state conditions and ocean currents will greatly control the transport and fate of the released petroleum product. The volume of oil that is released and its proximity to vulnerable marine ecosystems will also influence the resulting environmental impact. Most of the toxic effects of oil are associated with the monoaromatic compounds and low molecular weight polycyclic hydrocarbons, because they are the most water-soluble components. Physical transport and chemical weathering are the dominant processes that determine the spatial extent of oil contamination and the degree to which the environment will be exposed to toxic constituents of the released product.

The impact of a major spill could be locally severe should onshore winds prevail during an incident since these are the dominant winds (see Figure A.3.3). Environmental impacts on the lagoons, estuaries, mangroves and open coast shorelines will, therefore, have a high probability of occurrence (see oiling probability maps presented in Section A.2). Where these and other ecosystem components experience oiling, the resultant impacts are likely to be attributable mainly to the following (Volkman *et al.,* 1994):

- Direct lethal toxicity (usually due to the water soluble fraction);
- Sub-lethal disruption of physiological and behavioural activities;

- Direct coating by oil; and
- Incorporation of hydrocarbons within organisms and consequently into food webs.

A.3.2.1.1 Plankton

Plankton (made up of both phytoplankton and zooplankton) consists of a complex and dynamic assemblage of floating organisms. This pelagic community, comprising diatoms, the spores of algae, permanent pelagic zooplankton, eggs and larvae of a great variety of benthic invertebrates and the eggs and larvae of fish and zooplankton appears to be the marine ecosystem components least at risk to the effects of petroleum releases (Volkman *et al.,* 1994). This is primarily due to the extensive but dynamically patchy distributions of these organisms.

The vast majority of benthic invertebrates (including the commercially important pink shrimp, *Penaeus.notialis*), algae and many fish species spend the early part of their life histories as planktonic organisms. Furthermore, primary production by plankton forms the basis of most marine food webs including a number of commercially important fisheries. Hence, although this component is at relatively less risk than, for example, some shoreline habitats, its exposure to risk of oiling is of concern from both an ecological and economic perspective (Volkman *et al.,* 1994).

A.3.2.1.2 Benthic ecosystem

Recovery of subtidal habitats impacted by oil spills usually takes longer than for exposed shorelines since, particularly those in deeper water, are generally contaminated only by sedimentation of oiled particulate material for which there are no practical clean-up strategies that can be applied (Kingston, in press).

A wide range of effects of oil on benthic invertebrates has been recorded in the scientific literature. According to Volkman *et al.* (1994) much of the work has focused on the various life stages of polychaetes, molluscs and crustaceans. Tolerances and sensitivities vary greatly, such that few generalisations are valid or are likely to be consistent. Some species show high tolerances to oils, which specifically applies to infauna such as burrowing invertebrates such as polychaetes and copepods. This is due to weathered oils being a source of organic material suitable for food and some taxa, such as polychaetes, can take advantage of such bioturbation and degradation of oiled sediments (Scholtz *et al.,* 1992). This in itself can result in highly modified benthic communities with "knock-on" effects for predators (e.g. fish and birds) and other links in the food chain.

Volkman *et al.* (1994) suggest that some epifauna produce complex responses to oiling and, in some cases, bioaccumulation of petroleum hydrocarbons readily occurs. Attached and surface feeding molluscs such as mussels and crustaceans (barnacles, crabs) are frequent victims of direct oiling or coating. Many of these organisms are filter-feeders and are thus susceptible to ingestion of oil in solution, dispersion or adsorbed on fine particles filtered from the water column as food. Chronic oiling is known to cause a multitude of sub-lethal responses in taxa at different life stages, variously affecting their survival and potential to re-colonise impacted areas. Tolerances to oil vary between life stages, with larvae and juvenile stages generally being more sensitive to water-soluble fractions of oil than adults (Volkman *et al.,* 1994).

A.3.2.1.3 Impacts of oil pollution on commercially-fished shrimp resources

As the southern pink shrimp, *P. notialis,* is by far the most important component of the country's commercial fishery focused on the continental shelf (in terms of revenue earned), it deserves separate attention with regard to the impacts of oil spills. The shrimp are fished in depths of less than 50 m (Holthuis, 1980) and are thus target species for the artisanal fishery. Significant in this regard, is the situation described by FAO (1992), which indicates that the shrimp populations are heavily exploited through competition between industrial and artisanal fisheries for the resource.

P. notialis is restricted to the continental shelf area north of Cap Lopez in Gabon. The species is associated with large estuaries, as these are important nursery areas for post larvae and juveniles. Sub-adults and adults are distributed on the continental shelf on sandy mud and/or muddy sand sediments (FAO 1979), usually in the 20-50 m depth zone (i.e. inner shelf). Shrimp are fished either in this zone or during their migrations out of estuaries. Commercial catches of *P. notialis* are related to river discharge and rainfall (le Reste, 1978; Garcia, 1985; Dall *et al.*, 1990) further emphasizing the importance of the estuarine function in the operations of the fishery.

In most shelf penaeids, spawning occurs at sea, at distances and depths that vary according to the species. The first three larval stages of the shrimp are planktonic in habit and are, therefore, transported passively in ocean currents as these are influenced (*inter alia*) by winds and tides, particularly in the nearshore environment. In the early postlarval stage some individuals are dispersed into the shelter of bays, estuaries and river mouths.

In these brackish backwater environments, or penaeid nursery areas, the postlarvae become omnivorous bottom feeders, feeding on epiphytic algae, small worms, crustacea and molluscs as well as decomposing matter. The postlarvae soon change into juvenile shrimp and grow rapidly until they are finally large enough to once again migrate out to deep water as adults, finally reaching the spawning grounds.

The toxicity of petroleum products is closely related to the aromatic hydrocarbon content, especially the napthalenes and related hydrocarbons (Tatem *et al.*, 1978). Rather surprisingly, these authors found that post larval and young penaeid shrimp are more resistant to petroleum hydrocarbons than older, larger individuals. Generally, larvae and juvenile stages of decapod crustaceans are more sensitive to water-soluble fractions of oil than adults (Tatem *et al.*, 1978; Malan, 1988; Volkman *et al.*, 1994).

The 1991 Gulf War provided a clear indication of the effects of oiling on a penaeid prawn fishery, where the spawning biomass of the main Saudi Arabian prawn, *Penaeus semisulcatus*, stock was reduced to 1-2% of pre-war (1988-89) levels and landings fell from 3 700 tonnes in 1989 to 25 tonnes in February 1992 (Matthews *et al.*, 1993). It is, therefore, conceivable that a major oil spill in Cameroonian waters could result in impacts on the local shrimp fishery of equivalent magnitude.

A.3.2.1.4 Fish

The following discussion of the effect of oil spills on fish, and their eggs and larvae has been extracted from Volkman *et al*. (1994), and also has its context in the baseline environmental information presented in Section A.3.

Mortalities among pelagic fish and their larvae due to oil spills tend to be limited in extent and usually have no measurable impacts on fish stocks (Neff, 1991). However, there can be heavy local losses of pelagic eggs and fish larvae in the immediate proximity of an oil spill, although this is rarely observed directly (Baker *et al.*, 1990). Wind stress causes mixing of the water column, which can bring eggs and larvae (also of demersal species) to the surface and thus into contact with oil. Consequently, eggs and larvae may encounter high concentrations of the toxic aromatic fractions and can, therefore, be expected to be particularly vulnerable at a localised spatial scale. Impacts are primarily associated with exposure to fresh (unweathered) oils (Teal and Howarth, 1984), with few mortalities attributable to exposure to weathered product (Neff, 1991).

Whether significant sub-lethal effects occur among pelagic fish populations (important species in Cameroon's waters include *Ethmalosa fimbriata*, *Sardinella madarensis* and *Ilisha africana*) is unknown, but available evidence suggests this is rare (e.g. Baker *et al*., 1990). In general, adult pelagic fish are considered less at risk from exposure to oil spills than benthic or inshore species because of their mobility and ability to avoid floating oil masses and the associated hydrocarbon contamination.

Spilled oil may contaminate sediments, impacting demersal, nearshore and estuarine fish stocks, either directly or indirectly through their prey items, and in this respect, species residing in nearshore and shallow water habitats are relatively more exposed to risk than those associated with deeper water environments. Prime species at risk include soles and some mullet species, which feed on the sediment surface. For example, populations of the commercially important flatfish, *Pleuronectes platessa* (plaice), along the north coast of Brittany were adversely affected for at least two years following the Amoco Cadiz oil spill (Haensly *et al.*, 1982). Bioaccumulation of petroleum hydrocarbons by fish from oil-contaminated waters, dietary organisms (and sediments), and the depuration of hydrocarbons from tissues and body fluids, which occurs in "clean" seawater, are well-described phenomena.

The spawning seasons of fish species usually extend over long periods of time and large quantities of eggs tend to be produced. Thus, localised mortalities resulting from oil spills probably would have very little effect on fish stocks in general. Theoretically, such an effect could assume greater significance in the event of an oil spill coinciding with the spawning period of a commercially important species such as *Sardinella* spp., where mortalities of eggs and larvae could result. However, overall spawning and recruitment success of such species is subject, to a far greater extent, to variability in environmental conditions, and is unlikely to be influenced markedly by an oil spill.

A.3.2.1.5 Pelagic and offshore birds

Birds both at sea and along the coast, are vulnerable to oil spills.

Little is known of the numbers and distribution of pelagic seabirds in the near- and off-shore waters of the Cameroon coast (Dean, 2000). Pelagic seabirds appear to be mainly seasonal visitors that spend the austral winter in the region. These include juvenile Cape Gannets, *Morus capensis*, which disperse into the Gulf of Guinea from their natal colonies along the coasts of Namibia and South Africa (Crawford *et al.*, 1983).

Oil spills will have a variety of effects on birds including and/or resulting from:

- fouling of plumage;
- ingestion of oil;
- effects on reproduction; and
- physical disturbance.

Individual pelagic seabirds that become oiled almost certainly will die as a result of even moderate oiling, which damages plumage and eyes. Loss of the waterproofing function of plumage also results in the exposure of the bird's skin to water and reduced thermoregulation and/or insulation. Oiled birds tend to become hypothermic and either drown at sea or die ashore (Cooper, 1996). Direct observations of such bird mortalities probably reflect between 10 and at most 60% of actual mortalities (Dunnet, 1982). Poor success rates have been achieved with cleaning and rehabilitation of oiled seabirds (Frink, 1987).

Relative to seabirds, charadriid wading species and non-marine waterbirds are rarely oiled, probably because they spend little time swimming on the sea surface. Also, oiled waders have been noted to spend more time preening than conspecifics unaffected by oil, and it is believed that birds are able survive low levels of oiling as a result of this behaviour. Palaearctic migrant waders may be affected indirectly by a reduction in their marine invertebrate prey, which might be affected by oiling of intertidal areas, thereby affecting the birds' ability to migrate (Cooper, 1996). A major spill could have a high impact on any coastal birds should the oil reach the environs of feeding grounds and breeding colonies.

The loss of wildlife communities (e.g. birds) due to an oil spill usually represents a small percentage of the total individuals of a given affected species. Generally, adverse impacts do not persist for long because of recruitment from nearby populations. However, species with small populations and/or restricted distributions may be extremely vulnerable to the effects of a large spill.

A.3.2.1.6 Turtles

Worldwide, marine turtle populations are under pressure. Four species of marine turtle are likely to occur along the Cameroon coast (Section A.3.1.4). Much of the country's southern coastline comprises sandy beaches and is thus suitable for turtle nesting (Leatherback and Olive Ridley turtles).

According to local opinion, nesting occurs throughout the year, with a peak between November and January. Breeding female turtles bury their eggs above the highwater mark. Thus, the nests should be beyond the reach of spilled oil unless a spill coincides with a severe storm. The most critical period in which a spill could occur is when the hatchlings emerge under conditions where an oil slick extends alongshore, thereby interfering with their seaward migration. It is probable, although not specifically proven, that the presence of an oil slick will disorientate the hatchlings, which would lengthen their exposure to predators on the beaches and/or interfere with their swimming abilities. Hatchling survival is not high in any case (Bjorndal, 1982) and increased mortalities, attributable to oil spills, would be reflected in the overall population. Should a spill coincide with the emergence of hatchlings the impact on regional populations could therefore be severe and have a long-term effect.

A.3.2.1.7 Cetaceans and other marine mammals

DOLPHINS AND WHALES (CETACEANS)

Seventeen species of cetaceans may occur off the coast of equatorial West Africa. None of the cetacean populations of the area is monitored; thus, the impact of an oil pollution incident on their number cannot be predicted with a high degree of certainty.

Direct oiling of cetaceans is not considered a serious risk to the thermoregulatory capabilities of these animals (Geraci, 1990 cited in Scholz *et al*., 1992). Apparently cetacean skin contains a resistant dermal shield that acts as a barrier to the toxic substances in oil. Baleen whales may experience fouling of the baleen plates, and in this respect, Geraci and St. Aubin (1990) suggest that oil (and tar balls) could adhere to the haired fringes of these structures. Limited experimental evidence suggests that heavy oil accumulation can temporarily obstruct the flow of water between the plates and, consequently, reduce feeding efficiency.

Field observations record few, if any, adverse effects among cetaceans from direct contact with oil. Bottlenose dolphins have been recorded swimming through oil slicks with no apparent effect. Humpback, fin, right and minke whales have all been observed swimming, feeding and surfacing amongst heavy concentrations of oil (Scholz, *et al*., 1992) with no consequent impacts having been documented.

Geraci (1990, cited in Scholz *et al.*, 1992) suggests that inhalation of volatile hydrocarbons that escape from oil pose a greater threat to whales and dolphins than the oil residue. Inhalation of volatile, toxic benzene fractions by cetaceans could occur when the oilslick is fresh and unweathered (Geraci and Smith, 1976; Engelhardt *et al.*, 1977). Consequently, the threat from inhalation is likely to be greatest during the first few days after an oil spill occurs. Geraci and St Aubin (1990) state the common effects on marine mammals that are attributable to the inhalation of such compounds to include:

- Absorption into the circulatory system; and
- Mild irritation to permanent damage to tissues such as the sensitive membranes of eyes, mouth and respiratory tract.

In extreme circumstances, a large spill could reach the coast where some species of whales and dolphins enter shallow water to breed and calve. However, the impact is likely to be low since the whales appear to detect and avoid oil slicks. Only during the act of giving birth when mobility is greatly reduced could spilled oil pose a threat to whales and calves. Depending on migration patterns and breeding seasons, an oil spill might possibly, therefore, have a low short-term impact on whales and dolphins.

MANATEES

Manatees, *Trichechus senegalensis*, are known to occur in inshore waters, estuaries and lagoons on the Cameroon coastline. Worldwide manatee and dugong populations have been severely reduced by hunting, habitat degradation, collision with power craft and general disturbance.

No information on the effect of oil on manatees could be located. However, direct impacts could include fouling of eyes and the respiratory tract and ingestion of oil, the last of which could be fatal. Indirect impacts include loss of habitat, disturbance during clean-up operations and ingestion of oil on fouled aquatic plant material as well as vegetation overhanging the water (e.g. mangrove foliage) on which manatees feed (Dorst and Dandelot 1978).

A.3.2.2 Intertidal environment

The intertidal zone between the limits of high and low water spring tides includes sandy beaches along the open coastline, sections of rocky shore, and mangrove ecosystems in estuarine environments (described below). The intertidal community is the marine community most vulnerable to adverse impacts from an oil release into the marine environment because it is composed largely of sessile organisms and vegetation (IPIECA 2000 a,b). Organisms such as filter-feeders (oysters, mussels) and detritivores (crabs, snails) cannot escape the impacts of oiling – a situation that is aggravated by the typical persistence of stranded oil within the intertidal zone.

A.3.2.2.1 Sandy beach ecosystems

The relatively steep beaches that characterise much of the country's coastline and eroding sections of beach are less vulnerable to oil spill impacts than shallow-gradient, sheltered sandy beach environments. Strong wave action, the typically reflective profiles of the beaches and the high rates of longshore sediment transport along the open coastline tend to counteract the persistence of oiling on sandy beaches (see Section A.3.1.4.2). Many of the beaches are characterised by the outwelling of fresh groundwater that occurs along much of the coast. This would also tend to prevent oil from penetrating deeply into the sands, at least for the section of beach below the mean tidal elevation, which will approximate the mean elevation of the groundwater table within the sediments at the shoreline. Partly offsetting these natural systems of protection, is the potential for penetration of (fresh) oil into coarse-grained beach sediments (IPIECA, 2000a). However, the local wave regime typically results in a high turnover of beach sediment, and oil that is buried is also likely to be turned over and weather quite rapidly.

On fine-grained beaches not situated on the open coastline, which are shoreline features of certain seasonal lagoons, estuaries and sheltered bays, stranded oil is unlikely to penetrate deeply into the beach substratum. Whilst this mitigates to some extent the potential impacts of oiling, such beaches also occur in low wave energy environments where their recovery is assisted relatively little by the effects dispersion and weathering of oil attributable to wave effects. Consequently, they are particularly sensitive to oil spills in the medium- to long-term. Gently-sloping cobble beaches, of which there are few examples in Cameroon, are also vulnerable to oiling, in that pollutants penetrate between the cobbles and are not easily weathered.

In the short-term, the effect of an oil spill on the intertidal and immediate supratidal biota of sandy beaches could be severe. However, the beach fauna is relatively depauperate and, given the dynamic nature of beaches, re-colonisation following oiling is rapid. Sandy beaches on exposed coasts that experience high wave and solar energy will be the least impacted and will recover most rapidly.

A.3.2.2.2 Rocky shore ecosystems

Cameroon's rocky coastline generally experiences a moderate wave energy regime, which facilitates the weathering and dispersal of stranded oil and reduces its impact on the intertidal rocky shore ecosystems. However, some mortality attributable to oiling is expected amongst rocky shore organisms and degradation of the communities to which they contribute (IPIECA, 2000b). Typical oil residence times on rocky shores can be quite variable, the residence time increasing rapidly with reduced exposure to wave and currents in sheltered environments (IPIECA, 2000b), where gradual leaching of trapped oil gives rise to persistent low-level pollution of the immediate environs.

Rocky shorelines generally display a vulnerability to oiling of intermediate intensity. Whilst exposed rocky headlands may be more easily and relatively more extensively oiled, the high degree of exposure to waves (and currents) will limit the persistence of oil in these environments, giving them a vulnerability of low intensity. Oil is commonly held offshore by waves reflecting off the steep shoreline, which also explains this low vulnerability.

Cliffs with small rocky shelves or accumulations of boulders at the cliff base have a vulnerability to oiling of intermediate to low intensity. While the oil easily penetrates between the boulders and rocks, their exposure to wave action ensures that the oil does not persist in this environment. Both exposed and more sheltered rocky shorelines, especially where there are gullies, crevasses, rock pools and wave-cut platforms are vulnerable to oiling at an intermediate level of intensity because oil may become trapped and/or accumulate in such environments. Of the rocky shoreline types, gently-sloping boulder or cobble beaches are the most vulnerable to oiling, in that oil may penetrate between the boulders or cobbles and is not easily removed in sheltered environments. Shorelines that are predominantly rocky, but include short sections of beach, vary from low (rocky) to medium (cobble and sandy beaches) in terms of vulnerability.

Significant changes in the structure of rocky shore ecosystems may occur following oiling, with a variety of intertidal life likely to be affected – as occurred following the Torrey Canyon disaster (Clark 1986). The intensity of the impacts will vary according to the degree of weathering of the oil before it strands on the shore. Unweathered oil, which is relatively toxic, will give rise to impacts of greater significance than those attributable to weathered oil (IPIECA, 2000b). Such impacts will include the loss of intertidal animals (herbivores), which in turn usually results in the development of an algal bloom. Affected species gradually re-establish themselves and full recovery can be expected, with fluctuations of dominant species occurring before stability is reached (Southward and Southward, 1978; Brown, 1985; IPIECA, 2000b). The length of time to recovery is variable.

A.3.2.3 Estuary and coastal lagoon ecosystems

There are numerous estuaries and lagoons that could potentially be affected by an oil spill. These include very large estuarine complexes, medium to small estuaries, river mouths and seasonal lagoons and, possibly, limited areas of swamp (as opposed to mangrove) forest.

COASTAL LAGOONS

Coastal lagoons are low energy environments, supporting mangroves, swamp forest, emergent aquatic vegetation, typically bordered by coastal forests (Burns *et al.*, 2002a,b). The fringing vegetation provides shelter and foraging and breeding areas for a wide range of organisms, particularly within the mangrove stilt-root zone. The importance of these lagoons to the local fishery is not known; however, they are probably important nursery areas for the larvae and juveniles of several fish species and other marine organisms. They are also considered important for freshwater river prawns, *Macrobrachium* spp., that require brackish water for successful breeding and completion of their life cycles. Lagoons are thus important for the long-term sustainability of artisanal and other coastal fisheries.

ESTUARIES

In assessing the impacts of oil spills on tropical and sub-tropical coastlines, it is recognised that the most sensitive environments occur within low wave energy situations, part of which incorporates coastal lagoons and estuaries and their associated mangrove ecosystems. Should oil enter these systems in any quantity, it can be anticipated that the environmental impacts will be of high significance and of long-term duration.

Little is known about the ecological importance of the country's estuaries (GOPA, 1995; Dames and Moore, 1997; Burns *et al.*, 2002a,b). However, as already emphasized for coastal lagoons, estuaries typically play an important role in providing sheltered nursery areas for fish and invertebrates and feeding grounds for birds that forage along shorelines, particularly those adjacent to mudflats and mangroves (discussed below).

The volume of run-off of many of the rivers that drain into Cameroon's coastal zone reduces the likelihood that oil will enter the mouths and estuaries of these rivers; i.e. where the freshwater outflow is of sufficient magnitude to prevent this during the rainy season. There are, however, many systems that would not be protected by this hydraulic mechanism, and an oil slick that is driven onshore by wind- and/or tide-induced currents would enter certain estuaries, particularly under low river flow conditions.

The ecological consequences of oiling of estuarine habitats such as mangroves and mudflats would be severe for affected biota and the structure of the communities to which they contribute. Due to the dependence of the artisanal and industrial fisheries on key estuarine resources, for example pink shrimp, the socio-economic consequences of an oil spill affecting an estuary can also be severe.

Volkman *et al.* (1994) in a scientific review of the impacts of oil spills, estimate recovery times of low energy inter-tidal communities such as mangroves as being about 10 to 15 years after the spill. Persistence of oil residues to over 20 years is also reported, which illustrates the potential scope of associated environmental impacts.

A.3.2.4 Intertidal mudflats

Extensive intertidal mudflats occur in the Rio del Rey and Estuaire du Cameroun, and also occur as narrow fringes to the many creeks comprising these systems. Mudflats are also found in some of the smaller estuaries (e.g. the Lokoundjé) and coastal lagoons (e.g. the Mbenga-Malimba Lagoon north of the estuary of the Sanaga river).

Intertidal mudflats are gently-sloping areas of fine sediment that are typically inundated and exposed over each tidal cycle. Sedimentation of oil introduced through tidal processes and its incorporation into the surface sediments is likely to affect biota associated with this habitat, in particular, algae that cover extensive areas of mudflat in the larger estuarine systems. Although the high water content in the sediments would typically prevent oil from penetrating, this would be promoted where there are animal burrows and root channels, thereby establishing a long-term source of pollution.

A.3.2.5 Mangrove ecosystems

As described previously, mangrove ecosystems are well represented within Cameroon and their typical creek and island structure extends the length of the country's coastline significantly. Mangroves represent a globally and regionally important ecosystem warranting special conservation measures (Olson *et al.*, 2000; Anon, in prep). Although the most extensive mangrove communities occur within the Rio del Rey and Estuaire du Cameroun systems, important communities are also represented, for example in the Ntem river and other smaller estuaries.

Mangrove forests are very important socio-economically (see Figure A.3.11) for the following reasons:

- they are highly productive, producing a large proportion of the organic matter that forms the basis of the food chains within the estuarine and nearshore coastal environment;
- they provide a sheltered nursery aquatic environment and habitat for many fish, prawn, crab and invertebrate species;
- they stabilise the coastline and trap sediments that would otherwise enter the sea, at least in some situations; and
- they provide an important source of wood for construction, fuel (e.g. for fish-smoking) and tannin.

More detailed information on the importance of mangroves can be found in the following sources: Tomlinson (1986), Fisilier (1990), IPIECA (2000c), Twilley *et al.* (1996), MINEF (1997), Rubin *et al*. (1998), Rönnbäck (1999), Price *et al.* (2000), and Ellison and Farnsworth (2001).

Oil slicks typically enter mangrove environments with the rising tides. For the larger estuarine systems, a considerable volume exchange of water occurs due to the extensive scale of the mangrove areas. In the event of an oil spill this exposes the mangroves to a high level of vulnerability to oiling over an extensive area. Once oil has penetrated a mangrove environment it becomes deposited within sheltered environments – a factor that slows down the loss of volatile compounds, oxidation and degradation of pollutants.

Mangroves are highly sensitive to oiling and to oil residues (Jernelöv and Lindén, 1983; Lewis, 1983; IPIECA, 2000c; GOPA, 1995; Ellison and Farnsworth, 1996, 2001; Suprayogi and Murray, 1999; Orge *et al*., 2000; McFarlane and Burchett, 2002; Youssef and Ghanem, 2002; Zheng *et al.*, 2002). There is an increasing body of research that has shown that oil pollution affects mangroves in a number of ways. The oil itself can have direct physical effects (smothering), whilst components of the oil (e.g. volatiles and metals) can have significant plant physiological effects, many of which are not fully understood. The consequences of the impacts of oiling on mangroves also result in knock-on effects on human livelihoods.

Large areas of mangroves have died following oiling incidents and these have typically taken several years to recover (Lewis, 1983; Kingston, in press). Die-back occurs when oil covers and clogs the airways supplying oxygen to the roots of the mangrove trees.

Rhizophora species have stilt roots and appear to be less sensitive than species with pneumatophores, such as *Avicennia* and *Laguncularia*. Stilt-rooted species have lenticels (openings in the bark) that are smaller, and are distributed higher up the roots relative to the tidal range, than the openings of pneumatophores. The fact that the lenticels are less likely to become blocked by oil or to provide routes of entry into the trees for toxic compounds associated with oil, largely explains this variation in sensitivity to oiling. The different sensitivities may also be partly due to differences between species in their tolerance of hydrocarbons and in their biochemical pathways. The differences are important in the case of mangroves in Cameroon because the dominant species along the shoreline and in the tidal zone is *Rhizophora racemosa*, while the more vulnerable species are found in the interior of mangrove stands where clean-up operations are definitely not practically feasible.

There are important secondary effects of oil deposition on mangroves. Toxic compounds in the oil, especially the lower molecular weight aromatic compounds, are particularly problematic (Kingston, in press). These damage cell membranes in the subsurface roots, impairing the normal salt exclusion and excretion processes. The resulting influx of salt puts the plants under stress, resulting in the death of immediately affected tissues and, potentially, the entire plant. When the trees die, the protective canopy they provide to other ecosystem elements is lost and the habitat becomes unsuitable for species such as epiphytic plants and the various fauna associated with the mangroves. Seedlings, in particular, are very sensitive to hydrocarbons, while young trees are more sensitive than mature trees. The ability of *Rhizophora mangle* seedlings to establish, survive and grow normally can be adversely affected by oil pollution (Ellison, 2000; Orge *et al*., 2000) and effects on survival and growth have been reported for other species and situations (Lewis, 1983). The effects of different compounds in oil on microbes (bacteria, fungi) associated with mangroves are not well understood, but could be significant (Holguin *et al.*, 2001).

Oil spills may coat the surface of the mud underlying the mangroves and penetrate the burrows and other voids created by the mangrove roots (where plants have died naturally) and numerous organisms that live in the mud (Lewis, 1983; IPIECA, 2000c; GOPA, 1995; Suprayogi and Murray, 1999; Orge *et al.,* 2000). This can result in the mass die-off of these organisms through the absorption of volatile compounds, coating effects and the exclusion of oxygen. The result is a die-off of biota (worms and other invertebrates) that consume plant litter and incorporate it into the soil, breaking a critical link in the nutrient cycling process that is the key to the high productivity of mangrove communities. Recent research has shown that microbes such as bacteria and fungi play important roles in the nutrient and carbon cycles in mangroves; however, the impacts of oil pollution on these organisms is not well understood (Holguin *et al*., 2001; Bashan and Holguin, 2002). Oiled sediments result in strongly reducing conditions and increased salinity and pH (Suprayogi and Murray, 1999).

The most vulnerable mangroves are those situated within the large estuarine complexes of the Rio del Rey and Estuaire du Cameroun, which are extensive, shallow, completely open to the marine environment and have large tidal exchanges. The Wouri river, where it discharges into the Estuaire du Cameroun, has a wide mouth, but flows strongly even in the dry season (see Table A.3.14), which limits the potential influx of spilled oil upstream of its mouth. A similar situation applies to the Mungo river; however, the smaller Dibamba river is more vulnerable to oiling.

Compared to the Estuaire du Cameroun, the rivers draining into the Rio del Rey are relatively small except for the strongly flowing Cross river. This decreases the protection against oiling provided by freshwater hydraulic processes; i.e. the mangroves may be more vulnerable to oil spills than those of the Estuaire du Cameroun. The Sanaga, Nyong and Ntem rivers are relatively strong-flowing (see Table A.3.14), which reduces the risk of oil entering upstream of the river mouths. The dynamics of tidally driven water interchange in the estuaries are not well understood, but in these rivers there will be a net outflow of fresh water all year, reducing the risk of oil entering the estuaries. The estuarine character of these systems is created by the penetration of seawater in the form of a wedge beneath the low density surface freshwater outflow. The estuary of the Lokoundjé river is considered to be vulnerable to oiling because it has an extensive mangrove shoreline, the tidal zone of the mangroves is extensive, there is significant tidal interchange and the freshwater outflows are relatively small, particularly in the dry season.

A.3.2.6 Littoral vegetation and coastal forest

The littoral and coastal vegetation, except for swamp forest, is unlikely to be affected by all but the most severe oil spills where pollutants could infiltrate into the upper part of the beach in close proximity of the forest ecotone. Here, the oil is unlikely to be flushed off the beach by the discharge of groundwater, which occurs along much of the southern coastline of Cameroon. In some cases the vegetation on sandspits may be affected by oil washed over these areas during high and spring high tides; however, these are highly dynamic pioneer communities and the effects are unlikely to be persistent.

There are areas where Swamp Forest could be affected by oil spills. However, these forest areas are situated relatively far upstream in estuaries and are very unlikely to be affected. The more vulnerable situations are where the Swamp Forest is associated with the small coastal lagoons which are seasonally (or perhaps perennially) open to the sea, thereby permitting spilled oil to enter in the course of tidal inflows. Oil that enters the lagoons under these conditions could remain within these systems for an extended period, especially if the lagoon is closed off by longshore sediment transport shortly after the oil enters. The vulnerable areas include the small lagoons that occur at intervals all along the northern coast between Bekumu-Ubenekang and Batoke and between the Lokoundjé river and Campo. There are also two larger lagoons that support substantial areas of Swamp Forest: the Lagune de Mbenga-Malimba, north of the Sanaga river (which may have some perennially open mouths), and the Loté and Mpée systems between the Sanaga and Nyong rivers. Oil that enters these low energy environments could also remain there for long periods of time and have significant impacts on the vegetation.

A.3.2.7 Large vertebrate fauna

The impacts of an oil spill on large vertebrate fauna (other than the taxa already covered) occurring in littoral habitats would largely be incidental and would relate more to disturbances as a result of clean-up operations than to the immediate impact of the oil itself. Species that forage in mangroves and other littoral habitats, such as the water mongoose, *Atilax paludinosus*, which feeds on crustaceans and molluscs found at the water's edge in mangrove forests, as well as other mangrove and swamp forest related fauna would, in all likelihood, be capable of avoiding the consequences of a localised oil spill.

A.3.2.8 Socio-economic elements of the coastal environment

There is a high probability that an oil spill from either an offshore or land-based risk source would result in the contamination of the marine and coastal environment. As described in Section A.3.1.6, Cameroon's coastal communities are heavily dependent on the marine and coastal environment as a source of income, livelihood and food, as well as cultural and religious inspiration. An oil spill would, therefore, negatively impact on the livelihood strategies, economic activities and cultural sensitivities of communities resident within the affected areas. The following section assesses the significance of the impact of a potential oil spill on coastal communities and offshore industrial fishing activities.

A summary of the rating of the impacts of oiling on the different socio-economic and cultural components of the environment is presented in Table A.3.21. The conventions, or rating system, applied in the impact assessment are described in Box A.3.2.

Box A.3.2: Rating system for socio-economic impacts

Intensity: An impact of *high* intensity indicates that the effect of oiling on coastal communities would be measurable, for example, in terms of changed cultural traditions and livelihood strategies (undesirable, unsolicited), and a diminished quality of life in the long term. An impact of *low* intensity would indicate some effect on cultural traditions and livelihoods, more in terms of nuisance effect (transient) than holding serious consequences for communities. A rating of *intermediate* implies that there would be consequences for affected communities that would be measurable somewhere along the continuum between being of nuisance value at the one extreme and being socially severely disruptive at the other. Although intensity will vary with the spatial scale of the impact, the scale cannot be assessed without information on a specific spill or spill scenario (see also Section A.3.1).

Temporal scale: *Short-term*: effects lasting a few days, perhaps as long as two weeks; *Medium-term*: effects lasting more than one month, but less than a year; *Long-term*: effects lasting more than one year.

Significance: An impact of high socio-economic significance would manifest in the form of long term changed (undesirable and unsolicited) cultural traditions and livelihood strategies, probably resulting in the breakdown in established social and economic structures. Quality of life of affected communities would deteriorate in the long term as a result of the permanent diminishment in the delivery of important ecosystem services upon which affected communities are dependent; i.e. the impact would be of high intensity, could be spatially extensive and would persist in the long term. An impact of *low* socio-economic significance implies that affected communities would experience no measurable change in cultural traditions and established socio-economic structures and patterns following, perhaps, some minor, transient (short term) perturbation; i.e. in the absence of any serious diminishment in important ecosystem services, socio-economic impacts would be barely measurable. An impact of *intermediate* significance would be judged to be intermediate between high and low significance.

A.3.2.8.1 Impacts on offshore industrial fishing

As described in sections A.3.1.3 and A.3.1.6.4, industrial fishing occurs in the offshore, deeper waters of Cameroon's maritime zone, mainly extending from the mouth of the Lokoundjé river to the border of Cameroon with Nigeria. Important zones of operation include Rio del Rey, Bibundi, South Limbe, Bimbia, Wouri, and on occasion, the estuaries of the Sanaga and Nyong rivers (Neba, 1987). The impact of an oil spill in these areas on industrial fishing operations will be of *low intensity* given the *localised impact* of the spill and the ability of fishing vessels to temporarily relocate their fishing activities beyond the area affected by a spill. The significance of the impact of an oil spill on industrial fishing operations is, therefore, assessed to be of *low significance*, regardless of the duration of the spill and clean-up operations.

It should, however, be noted that the relocation of industrial fishing vessels to fishing areas unaffected by the spill may potentially increase the pressure on fish stocks in these areas, as well as increasing competition with other industrial and artisanal fishing operations. The indirect effect of an oil spill on neighbouring artisanal fishing communities beyond the spill zone may potentially be of *intermediate* to *high significance* (depending on the duration of the encroachment of industrial fishing vessels in artisanal fishing areas), if these industrial fishing vessels limit the ability of artisanal fishermen to practice their livelihoods. Long-term impacts could occur if an oil spill killed large areas of mangroves, since this would deprive fish or prawn stocks of important nursery areas and general habitat for a number of years while the mangroves recovered. This in turn, could result in the diminished delivery of ecosystem services (e.g. fish stocks) to affected communities.

A.3.2.8.2 Impacts on coastal villages

Artisanal fishing provides the primary source of protein and income for a large proportion of Cameroon's coastal communities, and also supplies the markets in centres such as Yaoundé, Douala and Limbe, as well as in Nigeria (Plate A.3.15). An oil spill could, therefore, have a serious negative impact on the livelihoods of coastal communities and their ability to sustain themselves. Negative impacts will arise as a result of fishing areas becoming temporarily inaccessible for fishermen for the duration of the spill and clean-up operation – with the negative effects of oiling effects likely to be felt over the longer-term after clean-up has been completed. There is a risk that fishing gear (mainly nets), which may be in the water at the time of an oil spill, will become fouled within the area of impact and may need to be replaced at a high cost to small-scale fishing operations. As described above, long-term impacts could occur if an oil spill killed large areas of mangroves due to a diminished supply of ecosystem services.

Plate A.3.15: Coastal communities are highly dependent upon fish for their protein requirements

Due to the close relationship between fishing activities and local trading (as this economic activity is largely focussed around the trade in fish, fish products, fishing accessories, etc.), an oil spill may also negatively impact on the small-scale trading sector.

In the event that an oil-spill results in fishing communities needing to adopt an alternative livelihood strategy temporarily or over a longer-term (e.g. greater emphasis placed on hunting or gathering), this may strain relationships with neighbouring villages, whose customary resource base would be encroached upon. This tension will be exacerbated if the village communities affected by oil spills are unable to pay, or exchange goods, for food.

In addition to the negative impacts on economic livelihoods, oil spills will also affect those communities who make use of the sea and estuaries to undertake their daily activities such as cleaning and washing of foodstuff in the lagoon areas, bathing and ablutions in these lagoons and estuaries and associated rivers and streams, and washing and cleaning of clothes, for example. There are also potential negative implications for gender relations if the men's main daily activity is disrupted or threatened for a long period.

The effect of an oil spill on the cultural sensitivities of the local communities must be taken into account in the assessment of potential negative impacts. According to traditional Cameroonian belief systems, the sea is a sacred site and the home of deities and goddesses such as the Miengu. Therefore, an oil spill would be perceived as an action that would anger the Miengu, resulting in disharmony between the local population and the deities.

In light of the above assessment, the potential for a spill to force a change in the primary livelihood activities of affected communities represents a potential impact of *high intensity* and would, therefore, be of *high significance*. This rating will be influenced by the spatial and temporal scale of the oil spill.

A.3.2.8.3 Impacts on coastal cities and towns

Coastal tourism and ecotourism is a growing economic activity in the Kribi-Campo region and around Limbe. Many of the country's beaches are popular recreation destinations for both local holiday-makers and international tourists. This sector would, therefore, be adversely affected by an oil spill.

The significance of oil spills on tourism and ecotourism operations at towns such as Kribi and Limbe depends on the severity of the spill, its spatial and temporal scale and the success of the clean-up operation. However, the potential for a spill to affect local livelihoods leads to an assessment of the potential impact being of *intermediate intensity* and *intermediate significance*, irrespective of the spatial and temporal scale of the spill.

Table A.3.21: Summary of the socio-economic impact assessment, based on the criteria described in Box A.3.2 and the environmental impact descriptions provided in the text

Impacted Component		*Impact Intensity*	*Spatial Scale of Impact*	*Temporal Scale of Impact*	*Impact Significance*
Socio-economic elements					
	Industrial Fisheries	Low	Localised – extensive	Short-long term	Low
	Coastal cities (Douala)	Low	Localised – extensive	Short-medium term	Low
	Coastal towns (e.g. Limbe, Kribi)	Intermediate	Localised – extensive	Short-long term	Intermediate
	Coastal villages	High	Localised - extensive	Short-long term	High

PNLDAH

A.3.3 Sensitivity Analysis

The vegetation map presented in Section A.3.1.4.5 (Figure A.3.12) is used together with other sources of environmental information pertaining to the coastline (e.g. Burns *et al.,* 2002a,b), to create a map and sensitivity classification of the country's main coastal features. In developing this classification, reference is also made to other sensitivity classifications that support oil spill response planning in countries such as Congo Republic (PNIU, 1996) and Gabon (Elf, 1996), and classifications that have previously been proposed for Cameroon (Price *et al.*, 2000; Burns *et al.*, 2002a,b). Reference is also made to approaches to sensitivity mapping described by Gundlach and Hayes (1976), IPIECA (2000d), Nansingh and Jurawan (1999) and Abdel Kader *et al.* (1998).

Clearly, an important sensitivity classification to which reference needs to be made is the approach adopted by Price *et al.* (2000) for the COTCO project, which combines geomorphological, ecological and socio-economic features in a single classification. For the NOSCP it is, however, considered appropriate to differentiate between these categories of environmental sensitivity, and a somewhat different approach is adopted.

The classes that are described below have been specifically developed and customised for the Cameroonian coastline and accommodate specific environmental features that define its unique character. Each of the sensitivity classes are expressed in terms of *high*, *medium* and *low* sensitivity to oiling – a convention that is depicted on the sensitivity maps presented in Section A.3.3.4.

A.3.3.1 Geomorphological criteria

In terms of geomorphological criteria, the sensitivity of a coastline to oiling is determined primarily by the expected *persistence of oil that is stranded* on the various geomorphological features of the coastline (sandy beaches, rocky outcrops, etc.). Geomorphological sensitivity is influenced by:

- *type and stability of the substratum*, which determines both the lateral extent of oiling and penetration of pollutants into the substratum as influenced by physical coastal process such as waves and currents. Oil is generally held offshore by waves that reflect from a cliffed rocky shore, and where oiling does occur, there is little penetration of pollutants into the rock substratum – thereby reducing the persistence of (and, therefore, sensitivity to) oiling. Conversely, mixed sand and gravel or cobble beaches can become extensively oiled due to penetration of pollutant into this substratum; and

- *exposure to waves and currents* that determine both the initial exposure to oiling and the energy available to remove or break down deposited oil. In the case of rocky cliffs that are oiled, the persistence of pollutants is generally of short duration due to the exposure of the environment to wave action and, at times, strong currents. In contrast, the persistence of oil on gently-sloping beaches and mangrove mudflats in sheltered environments is typically long-term due to reduced exposure to physical processes that promote its break-down.

Also of significance to the classification of geomorphological sensitivity to oiling is the *ease of clean-up* of the various physical coastal features that are oiled. This relates to issues such as:

- the *extent of penetration of the oil into the substratum* (e.g. the extent to which oil mixes with and/or is covered by beach sediment, which can dramatically increase the amount of oily material to be removed); and
- *accessibility* (e.g. cliffed coastlines and mangrove forests, which are inherently inaccessible).

Table A.3.22 presents a classification and an assessment of sensivitiy to oiling of key geomorphological features represented along the coastline of Cameroon. The classification is expanded upon in the text that follows.

Table A.3.22: Geomorphological classification of key features of the Cameroon coastline and assessment of oiling sensitivity

No.	*Category*	*Sentivity*	*Score*
1	Exposed, cliffs and rocky headlands	Low	1
2	General rocky shoreline	Low-Medium	2
3	Exposed steep sandy beaches (reflective shoreline)	Medium	2
4	Primarily rocky shoreline with short sections of rocky or sandy beach	Medium	2
5	Sheltered, gently sloping beaches (dissipative shoreline)	Medium-High	3
6	Intertidal mud flat	Medium-High	3
7	Muddy shoreline (mangroves)	High	3

A.3.3.1.1 Rocky shores

Rocky shores, which assume their character from the occurrence of geological formations, vary in structure from exposed steep cliff formations and rocky headlands to sheltered rocky coastlines and boulder beaches. Although scattered rocks may occur in association with primarily sandy, gravel or shingle beaches, these latter coastlines are classified as sandy shores (described later). The classification of the rocky shoreline of Cameroon includes: (i) exposed cliffs and rocky headlands; (ii) rocky shorelines; and (iii) rocky shorelines (predominant) with short sections of boulder or sandy beach.

EXPOSED CLIFFS AND ROCKY HEADLANDS

Most of Cameroon's rock-dominated shoreline occurs between Idenau and Bimbia Creek, where lava outflows and folded and faulted sedimentary rocks have created coastal cliffs and steep rocky shores. Examples of exposed cliff environments are the caved sea cliffs near Mokundange (Plate A.3.16), the rock stacks offshore of these cliffs near Mokundange (Plate A.3.17) and the cliffs at Cape Debundscha (Plate A.3.18). Exposed rocky headlands also occur at Cape Nachtigal (Plate A.3.19). The only similar major exposed headlands along the country's southern coastal sector occur at the Rocher du Loup, north of Ebodjé (Plate A.3.20). The small exposed rocky headlands occurring both to the north of Idenau and along the southern coastline (Plate A.3.21) are not considered to have a predominant rocky shore character and are included in the steep sandy beach category (described later).

ROCKY SHORELINE

The geomorphological category described as rocky shoreline includes rocky cliffs that occur in association with narrow rocky platforms and/or accumulations of boulders at their base. Examples of such shorelines occur along the country's northern coastal sector, near Idenau (Plate A.3.22). Also included in this category are the relatively exposed (Plate A.3.23) and sheltered (Plate A.3.24) narrow rocky shorelines that occur between Idenau and Bimba Creek, and wave-cut rocky platforms and seawalls fronted by boulder (and occasional sandy) pocket beaches (Plate A.3.25). Examples of more sheltered rocky shorelines occur between Limbe and Bimbia Creek.

There are no extensive stretches of rocky shore along the country's southern coastline.

PRIMARILY ROCKY SHORELINE WITH SHORT SECTIONS OF GENERALLY STEEP ROCKY OR SANDY BEACH

This geomorphological category of shoreline is common south of Idenau (Plate A.3.26) and between Cape Debundscha and Limbe (Plates A.3.27 and A.3.28).

Plate A.3.16: Sea cliffs and caves near Mokundange

Plate A.3.17: Offshore rock stacks offshore of the sea cliffs near Mokundange.

Plate A.3.18: Steep cliffs at Cape Debundscha

Plate A.3.19: Exposed rocky headland at Cap Nachtigal

Plate A.3.20: Rocky headland near the Rocher du Loup north of Ebodjé

Plate A.3.21: Headlands along the coastline between Idenau and Bamusso

Plate A.3.22: Cliffs with rocky shelves and accumulations of boulders at the cliff base near Idenau

Plate A.3.23: Relatively exposed rocky coastline approaching the headland near Njonji, north of Cap Debundscha

Plate A.3.24: Sheltered rocky coastline near Dikulu Point

Plate A.3.25: Pocket of sandy beach on a rocky shoreline near Pegel Point

Plate A.3.26: Rocky coast with steep rocky beach south of Idenau

Plate A.3.27: Sandy beach along the predominantly rocky coastline east of Cape Debundscha

Plate A.3.28: Steep rocky beach along a predominantly rocky coastline in the vicinity of Batoke

A.3.3.1.2 Sandy shorelines

The country's sandy shorelines occur mainly in wave-exposed situations, where they are typically steeply-sloping (occasionally of intermediate slope) and are characterised by coarse sediments. Gently-sloping beaches are confined to a few areas, mainly along the northern coastline (see below). There are also a few situations where sandy shorelines occur within low wave-energy estuarine environments (see Section A.3.3.2).

STEEP SANDY BEACHES (REFLECTIVE SHORELINE)

Steep, predominantly sandy beaches occur extensively along the country's southern coastline, between Pointe Souélaba and Campo (Plates A.3.29 and A.3.30). Similar beaches occur along the northern coastline between Bekume-Ubemekang and the Onge river (Plate A.3.31). These examples of steep beaches are characterised by coarse to medium sands accumulated within the intertidal zone and upper beach and finer sediments comprising a more gently-sloping beach profile within the lower intertidal zone – fitting the description of classic reflective beaches (Wright and Short, 1984).

In terms of oiling potential, these beaches are somewhat protected by their slope, which tends to prevent the stranding of oil. Oil that might become stranded would be turned over rapidly with the beach sediments without becoming permanently buried within the beach profile. Stretches of steep beaches of dark volcanic sands also occur between Bakingili and Batoke (Plate A.3.32). However, they are relatively less exposed to wave action due both to the orientation of the coastline relative to the incident wave regime and the sheltering effect of Bioko Island, and consequently, are more vulnerable to oiling.

Beaches that are subjected to periodic erosion are expected to display a lower vulnerability to oiling. There is strong evidence of erosion of the southern beaches particularly between Point Souélaba and the Lokoundjé river (Plate A.3.33), in the vicinity of Kribi (Ibe *et al.*, 1999) and along the coastline north of the mouth of the Onge river, near Bakanje (Plate A.3.34).

Plate A.3.29: Steep beach between the Lovi and Nyong rivers

Plate A.3.30: Steep beach near the rocky headland at the Rocher du Loup.

Plate A.3.31: Steep beach of the sand bar south of the mouth of the Onge river lagoon

Plate A.3.32: Sandy beach at the New Seme Beach Hotel between Bakingili and Batoke

Plate A.3.33: Advanced stage of beach erosion along the coastline north of the Nyong river.

Plate A.3.34: Eroding coastline north of the Onge river mouth near Bakanje.

GENTLY SLOPING BEACHES (DISSIPATIVE SHORELINE)

Gently-sloping sandy beaches display a significantly higher vulnerability to oiling than exposed, steep sandy beaches. Although this type of beach generally comprises fine sediments that limit the penetration of stranded oil into the beach profile, the generally sheltered environment within which they occur ensures a long residence time of stranded product. Gently-sloping cobble beaches are also vulnerable to oiling, in that pollutants penetrate between the cobbles and are not easily removed and weathered.

Gently-sloping beaches occur mainly along the country's northern coastline, within the shelter of rocky headlands. They are generally limited in extent, with the best developed example occurring at Limbe (Plate A.3.35). Examples of smaller beaches are those at Isolwe (Plate A.3.36), south of Idenau, and the beach just north of the SONARA refinery (Plate A.3.37). Gently-sloping cobble beaches occur in the sheltered bays in the immediate vicinity of, or co-incident with, gently-sloping sandy beaches, for example, at Isolwe (Plate A.3.38) and just west of the main beach at Limbe (Plate A.3.39). These cobble beaches have a relatively high vulnerability to oiling due to the sheltered wave environments within which they occur.

Plate A.3.35: Extensive, gently-sloping, fine sandy beach at Limbe, in Ambas Bay

Plate A.3.36: Gently-sloping sandy beach at Isolwe, south of Idenau.

Plate A.3.37: Gently-sloping sandy beach just to the west of the SONARA refinery.

Plate A.3.38: Gently-sloping cobble beach at Isolwe, south of Idenau.

Plate A.3.39: Gently-sloping cobble beach in Ambas Bay, Limbe.

A.3.3.1.3 Muddy shorelines

Muddy shorelines typically comprise a range of habitats. However, these are combined into two categories for the NOSCP, including: (i) intertidal mudflats; and (ii) muddy shorelines with mangroves. The latter category is particularly vulnerable due to the sensitivity of mangroves to oiling and the difficulties associated with the clean-up of spills within these environments.

INTERTIDAL MUDFLATS

The mudflats along the Cameroonian coastline are restricted mainly to the Estuaire du Cameroun (Plates A.3.40 and A.3.41) and the Rio del Rey, both being extremely turbid environments. Intertidal mudflats also occur within some of the smaller estuarine environments (Plate A.3.42).

MUDDY SHORELINES (MANGROVES)

Muddy shorelines include flat to gently-sloping deposits of soft muds (Plate A.3.43) and consolidated muddy deposits, which are invariably colonised with successionally advanced mangrove ecosystems. The interface between the sediment deposits and the open water may be eroded to form steep banks (Plates A.3.44 and A.3.45).

In the event of a spill, oil is transported by tidal currents across the muddy shorelines and into the mangrove ecosystems, where it is deposited on the sediment surface and aerial roots of the mangroves. The result is a patchy distribution of oil and associated environmental impacts. The vulnerability of these environments to oiling is considered high, mainly due to the susceptibility of mangroves to oiling as well as the difficulties (inaccessibility and ecological risk) associated with clean-up operations.

While muddy shores with mangroves occur in estuaries and lagoons distributed along the coastline, the main areas where muddy shorelines occur include the mangroves habitats within the Estuaire du Cameroun, Bimbia Creek and the Rio del Rey.

Plate A.3.40: Mudbank near the south-eastern extremity of Ile Miandjou

Plate A.3.41: Close-up view of the mudbank near the south-eastern extremity of Ile Miandjou showing drainage channels and algae growing on the mudflat

Plate A.3.42: Mudflat inside the lagoon at Yoyo II

Plate A.3.43: Soft gently-sloping muddy bank near Monkey Kombo in Bimbia Creek

Plate A.3.44: Mudbank in the vicinity of Mikandjé Creek in the Estuaire du Cameroun

Plate A.3.45: Consolidated mud banks near Manoca in the Estuaire du Cameroun

A.3.3.2 Ecological criteria

The information in this section is intended to complement the information provided in Section A.3.3.1, which describes the geomorphological shoreline classes.

For the purposes of this classification, the ecological sensitivity of the various shoreline habitats is based on the three aspects:

- the productivity of the habitat;
- the biological diversity of the organisms in that habitat; and
- the overall ecological importance of that habitat. Ecologically important habitats include those that serve as breeding areas for species that may complete the rest of their life-cycle in other environments or act as refugia for certain kinds of organisms (e.g. turtle breeding beaches, estuaries used as nursery areas by fish).

Shorelines can be divided into three major ecological classes in terms of the main substrata they provide for dependent organisms:

- rocky shorelines with stable rock surfaces to which organisms can attach themselves;
- sandy, unstable shorelines into which organisms can burrow or bury themselves; and
- muddy shorelines, which are confined to environments with little wave or current movement, supporting both surface-dwelling and burrowing organisms.

Although mapped as abruptly distinctive habitats, in reality divisions between these substrata are not precisely defined; rather, stretches of shoreline are typically dominated by one type of habitat, and it is on the basis of such dominance that the classification has been undertaken. For example, much of the shoreline along the country's southern coastal sector comprises sandy beaches with occasional small rocky headlands; the dominant habitat is sandy beach and it is through reference to this category that the southern shorelines will be mapped.

- *Rocky shorelines:* On rocky shorelines, such as small headlands and cliffs that are subject to strong wave action, currents and high turbulence, there is a relatively limited range of organisms adapted for survival in such habitats (Section A.3.1.4.3). Where rubble and boulder deposits occur at the base of the cliffs, wave energy is dissipated and relatively sheltered habitats are provided, which support a wider range of organisms (Plate A.3.46). Recovery rates from oiling of rocky shore ecosystems depend largely on how exposed the affected environments are to wave action and the extent of brokenness of the rock substrata (Section A.3.2.2.2).

- *Sandy shorelines:* On exposed sandy shorelines the interaction between strong wave induced turbulence and the coarse sediments creates steep beaches (Plate A.3.47), which support a relatively low diversity of sand-dwelling organisms (Section A.3.1.4.2). Recovery of these habitats from oiling depends largely on the steepness of the beach profile and rate of sediment turn-over; however, this tends to be rapid (Section A.3.2.2.1).
- *Estuaries:* Estuaries in their lower reaches and interface with the open coast, are dynamic in terms of their physico-chemical characteristics (currents, salinity), and consequently support a relatively low diversity of biota (Plate A.3.48). In contrast, more sheltered estuarine environments are typically highly productive and provide a range of habitats for organisms. Estuarine shorelines are generally muddy in the case of the larger river systems, but include sandy shorelines, particularly in the small, seasonally open lagoon systems (Plate A.3.49). Ecological sensitivity depends largely on which estuarine components are affected by oil spills (Section A.3.2.3).
- *Mangrove and swamp forest:* These vegetation types are typically associated with estuaries and seasonal lagoons (Burns *et al.*, 2002a,b). Swamp forest is associated with relatively fresh water environments, has a range of both freshwater swamp and mangrove associated plant species (Plate A.3.50; Letouzey, 1985) and provides shelter and breeding habitat for invertebrates, fish and birds that prefer brackwater habitats (Dames and Moore, 1997; CEP, 1999). Mangrove ecosystems are highly productive, support a range species and provide a nursery habitat for many faunal species that complete their life-cycles at sea (see Section A.3.1.4.5). The effects of oil spills on mangrove and swamp forest are typically severe and long lasting (Section A.3.2.5). Shorelines with extensive mudflats are associated with mangroves (see Plate A.3.41) - except for some of the smaller, seasonal lagoons - and are ecologically relatively more sensitive because they include a wider range of habitats and probably support more species than the mangroves themselves.

Plate A.3.46: Sheltered rocky shoreline near Isolwe showing littoral fringe vegetation and palm plantation growing near sea level

Plate A.3.47: Exposed rocky shoreline near Cap Nachtigal showing the upper inter-tidal zone, typically rough rocks and extensive inlets and gulleys

Plate A.3.48: Steep sandy beach with occasional rock outcrops near Grand Batanga showing the typical waves observed at high tide with an onshore breeze typical of the late afternoon

Plate A.3.49: Typical estuary mouth on the southern coastline; a highly dynamic environment with mixing of fresh and seawater and strong river and tidal current flow.

Plate A.3.50: Typical seasonally open lagoon with a sandy shoreline and open mouth. The dark brown colour of the water indicates a dominance of fresh water over salt water

Plate A.3.51: Swamp and coastal forest growing on a sandy shoreline near Mbiako in the Sanaga river mouth

In the following classification (Table A.3.23) the ecological categories that are recognised are arranged in order of their increasing vulnerability to oiling through reference to the ecological attributes described above. A qualitative scale is used to score their sensitivity as low, medium or high.

Table A.3.23: Ecological classification of the coastline of Cameroon with the classes arranged according to their sensitivity to oil pollution (Section A.3.2).

No.	*Category*	*Sensitivity*	*Score*
1	Exposed, rocky headlands and cliffs	Low	1
2	Estuary – open river mouth, sandy shore	Low	1
3	Rocky shoreline with short stretches of steep beach	Medium	2
4	Steep sandy beach	Medium	2
5	Rocky shoreline with rock rubble and boulders at base	Medium	2
6	Gently sloping sandy beach	Medium	2
7	Estuary – sandy shoreline	Medium	2
8	Estuary - seasonally open lagoon	High	3
9	Rocky shoreline and short stretches of gently sloping beach	High	3
10	Swamp forest/wetland	High	3
11	Mangrove forest, muddy shoreline	High	3
12	Mangrove forest, muddy shoreline with extensive intertidal mud flats	High	3

There are important differences between the estuaries in terms of their sensitivity to oil spills that may or may not be able to enter their mouths (Table A.3.24). There are two main factors that determine this difference in sensitivity:

- strength and seasonal variation of river flow, which, for small lagoons, also determines when the mouth is open; and
- volume of tidal interchange, which is determined largely by the physical configuration of the estuary and thus the volumes of water that move in and out of the system with each tide, balanced against river outflow.

Oil is unlikely to enter the estuaries of river systems that have a strong freshwater outflow all year round. These include the Sanaga, Nyong and Ntem rivers, and probably the Wouri and Mungo rivers above their points of discharge into the Estuaire du Cameroun. Other estuaries would be more vulnerable to oil penetration, with seasonally open systems being most vulnerable during periods of low freshwater outflow prior to mouth closure. The most vulnerable systems are the Rio del Rey and Estuaire du Cameroun, where tidal interchange is significant and the river flow, relative to the volume of water transported into (and out of) the systems by tides, is low. The Lokoundjé river also falls into this sensitive group, especially during low flow periods.

Table A.3.24: Classification of the different kinds of estuaries in Cameroon according to their sensitivity to oil pollution.

No	River or estuary	Open to the sea	Strength of outflow	Tidal interchange	Sensitivity	Score
1	Sanaga, Ntem Nyong, Wouri, Mungo, Onge and other small rivers draining from Mt Cameroon	Permanent	Strong even at low flow periods	Low	Low	1
2	Kienké, Lobé	Permanent	Weak at low flow	Low	Low	1
3	Small streams draining from Mt Cameroon and small streams and rivers on the southern coastline	Seasonal	Weak at low flow, too little to maintain an open mouth	Low	Low	1
4	Seasonal lagoons occurring all along the coastline	Seasonal	Weak at low flow, too little to maintain an open mouth	High	High (seasonally)	3
5	Rio del Rey, Estuaire du Cameroun, Lokoundjé, Ndian, Meme, Dibamba, Mbenga-Malimba lagoon	Permanent	Weak at low flow	High	High	3

A.3.3.3 Socio-economic criteria

Considering the results of the composite oil spill simulation modelling, which depict the probability of exposure of the environment to potential spills resulting from a number of coastal and marine risk sources (Figure A.2.12), the coastal areas at medium to high risk of oil spill contamination are predominantly located in the north-western coastal sector. High probabilities of oiling are identified for the offshore environment, extending into the Rio del Rey complex, and the Estuaire du Cameroon. A smaller region of relatively high oiling probability occurs in the southern coastal sector offshore of the coastline south of Kribi. These zones of relatively high oiling probability coincide with both industrial and artisanal fishing waters and areas inhabited by communities whose livelihoods and culture are centred around the coastal and marine environment. They also coincide with certain areas of key tourism and ecotourism activity in the vicinity of Limbe and Kribi .

The sensitivity of industrial fishing to oil spills is assessed to be medium, based on the consideration that the operations are mobile and can easily relocate, temporarily, to waters unaffected by spills. On the other hand, given the dependence of the livelihoods of the majority of coastal communities on the coastal and marine environment, and the importance of the sea in local culture and religion, all coastal villages are assessed to be highly sensitive to the impacts of an oil spill. Within each community there are, however, a number of factors that influence the severity of the impact and the sectors of the community that would potentially be most negatively affected by a spill. These factors are discussed below:

MOBILITY OF THE AFFECTED COMMUNITY

Migratory communities of fishermen (e.g. Nigerians and Ghanaians) who work along the coastline are potentially less sensitive to the negative impacts of a localised oil spill than communities living in stable, permanent villages due to their ability to move to unaffected areas to continue practicing their livelihoods.

MOBILITY OF FISHING OPERATIONS

Fishing operations conducted from motorised pirogues would be less sensitive to the negative impacts of an oil spill than those operating from non-motorised boats, as the latter operators are less likely to be able to continue fishing during the spill period if they cannot move beyond the affected area. As it is generally the poorer fishermen who do not have access to motorised pirogues, it is the poorer sector of the community who would be most severely affected by, and most sensitive to, oil spills.

DEPENDENCE ON FISHING AS A FORM OF LIVELIHOOD

Communities whose primary source of income, food and livelihood are derived from fishing activities will be more sensitive to the negative impacts of an oil spill than communities or towns whose economic activities are more diversified. Outside of the larger towns that have more diversified economic activities, most of the communities living along the Cameroonian coastline are heavily dependent on artisanal fishing and are, therefore, highly sensitive to the impacts associated with oil spills. The population in towns such as Douala, Kribi and Limbe would be less directly affected by an oil spill as they are less dependent on the sea as a primary source of livelihood.

DEPENDENCE ON TOURISM AS A SOURCE OF LIVELIHOOD

Coastal towns and areas that are establishing themselves as tourism and ecotourism centres are more sensitive to the negative impacts of an oil spill than those centres (excluding artisanal fishing communities) that do not currently derive income from tourism.

TIMING OF THE OIL SPILL

Fishing communities are most vulnerable to negative impacts of oil spills that coincide with peak fishing seasons, as a reduction in fishing activities during this time would have serious implications for a community's ability to sustain itself in the off-peak period if income earnings are affected and no fish products can be stored for consumption and sale in the off-peak season.

STRUCTURE OF THE ECONOMIC SYSTEM

Villages that are more entrenched in a monetary exchange system may be more sensitive to the negative impacts of an oil spill than those villages still reliant on a more traditional system of exchange of goods and services. This is argued on the basis that impacts may be more severe if communities have become dependent on the monetary income provided by fishing to purchase basic goods and services, and to repay debtors.

A.3.3.4 Sensitivity maps

This section presents in map format the classifications of the coastal features in terms of their sensitivity to oil spills (see above sub-sections of A.3.3). The first three maps (Figures A.3.14a, A.3.14b and A.3.14c) show the major geomorphological, ecological and socio-economic features of the coastline respectively. The fourth map (Figure A.3.14d) shows a combined classification of sensitivity, where each section of coastline has been mapped as being of *high*, *medium* or *low* sensitivity based on the highest score assigned to it in any of the three individual classifications. For example, if a section of the coast is rated as being of *low* sensitivity both geomorphologically and ecologically, but is rated as *high* socio-economically, it will be indicated as being of *high* sensitivity. Estuaries are very prominent features of the Cameroonian coastline and are, therefore, assigned a separate vulnerability score, which is shown on the combined sensitivity map (Figure A.3.14d) as well.

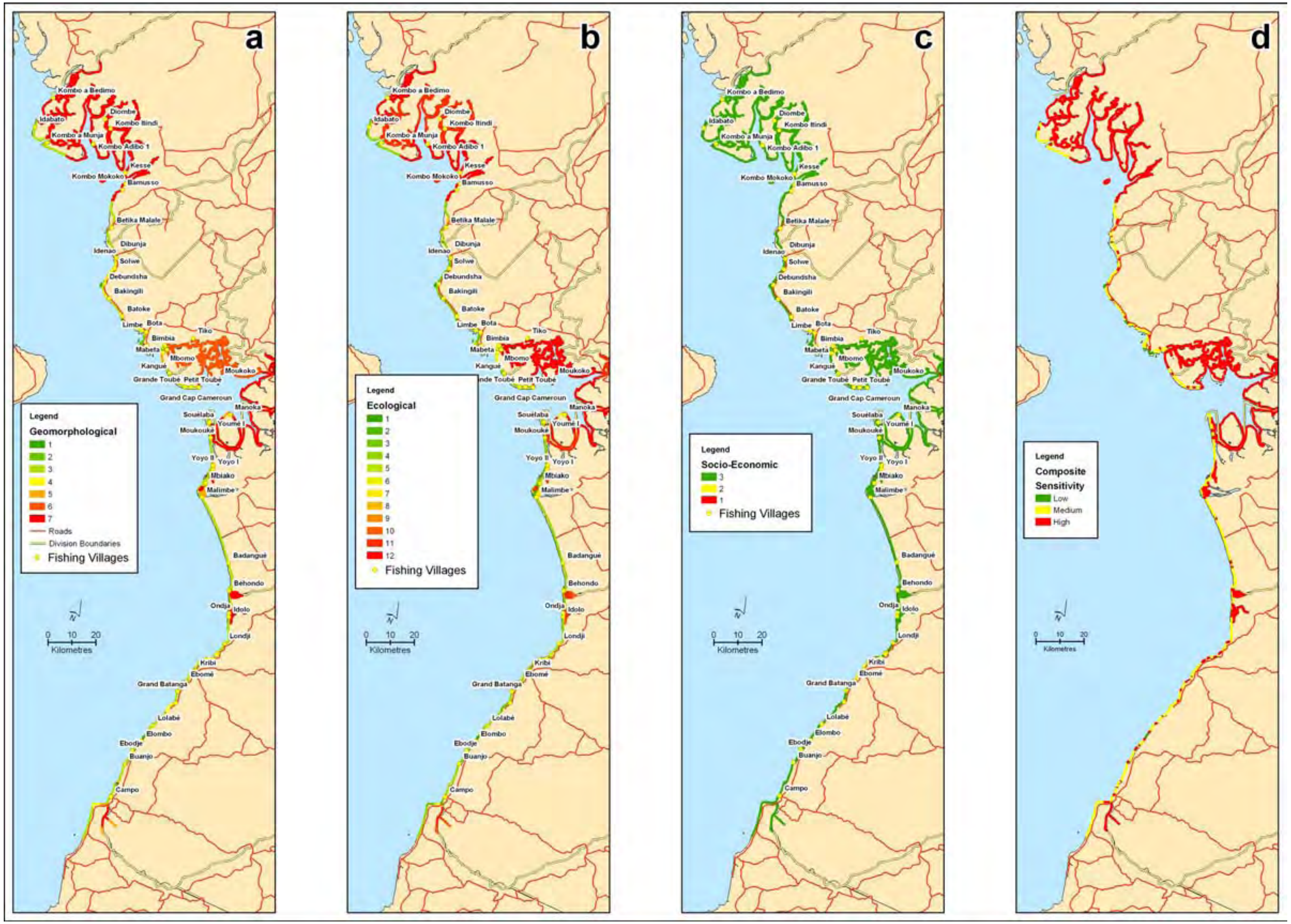

Figure A.3.14: Geomorphological (a) ecological (b) and socio-economic (c) features of the Cameroon Coastline. Refer to Tables A.3.22 and A.3.23 for a description of the legends. (d) Combined classification of sensitivity to oiling of the Cameroon Coastline

A.4 ORGANIZATIONAL STRUCTURES, ROLES AND RESPONSIBILITIES

A.4.1 Introduction

A predetermined organizational structure to respond to oil spill incidents is essential to ensure both a clear understanding of roles and responsibilities related to oil spill incidents and the rapid transition from reactive to proactive management of such incidents. An important element of this organizational structure is the command structure that is activated in the event of an oil spill, and the constitution of this command structure which is determined by the level of the oil spill incident; i.e. Tier 1, 2 or 3.

This section of the NOSCP outlines and illustrates the structure of the national oil spill response organization (applicable to the government, rather than the oil industry operators) for each of the three tiers of oil spill incident; it identifies the key parties constituting the structure; and it describes the roles and responsibilities of these parties. With this organizational structure in place, and the roles and responsibilities of the governmental parties defined, this allows the oil industry operators to understand where the point-of-contact is located with regards to reporting an oil spill incident and how government coordination of, and contribution to, the response effort will proceed, particularly in the event of Tier 3 incidents.

Each oil industry operator in Cameroon is responsible for determining their own internal command structure for responding to oil spills. The description provided here indicates the linkage between these separate command structures and the national organizational and command structures.

A.4.2 Command structures

The command structures described below aim to clearly indicate the contributions that will be made by various government institutions (Ministries, the military, etc.) that have a role to play in planning and responding to oil spill incidents. Separate command structures are indicated for Tier 1, 2 and 3 incidents, where the main difference in structure applicable, for example, to Tier 2 and 3 incidents, is based on the judgement made by the *National Competent Authority* and the *National Incident Command Team* regarding the need for various authorities and institutions to be informed of an incident and, if so, what contributions are required of them in terms of responding to the incident.

Marine Emergency Response Organization (Tier 1)

A.4.2.1 National Oil Spill Response Standing Committee

As indicated in the organizational diagram that follows (Figure A.4.1), the National Oil Spill Response Standing Committee (NOSR-SC) is the body designated by the Government of Cameroon as having overall responsibility for oil spill planning at the national level, defining the response policies, playing a lead role in certain oil spill response operations, investigating the causes of oil spills and the related environmental and socio-economic impacts and evaluating the effectiveness of oil spill response interventions.

The activities of the NOSR-SC are coordinated by the Ministry of Environment and Forests (MINEF) by virtue of Decree N° 2001/718/PM of 3 September 2001, which assigns to this Ministry a role for the general coordination of environmental matters such as "the prevention and management of environmental emergency situations".

There are no specific restrictions on which parties should be represented on the NOSR-SC; however, it is expected that there will be representation at least by the following:

- Ministry of Environment and Forests (MINEF);
- Ministry of Defense (MINDEF): National Navy and National Corps of Fire Fighters;
- Ministry of Transports (MINT) - Merchant Navy and the Department of Terrestrial Transportation (Important in terms of contact with IMO);
- Ministry of Mines, Water Resources, and Power (MINMEE);
- Ministry of Territorial Administration and Decentralization (MINATD);
- Ministry of Communication (MINCOM;
- Ministry of Livestock, Fisheries, and Animal Husbandry (MINEPIA);
- Ministry of Scientific and Technical Research (MINREST);
- Ministry of Public Health (MINSANTE);
- Ministry of Justice (MINJUSTICE);
- Ministry of Finance and Budget (MINFIB);
- Secretary of Defense (SED);
- General Delegation for National Security (DGSN);
- National oil industry organizations (SNH, SCDP, and SONARA);
- Oil companies (Total E and P, Pecten, Perenco, COTCO, Phillips and others);
- National Ports Authority, the Autonomous Port of Douala and CAMRAIL; and
- The office of the Provincial Govenors.

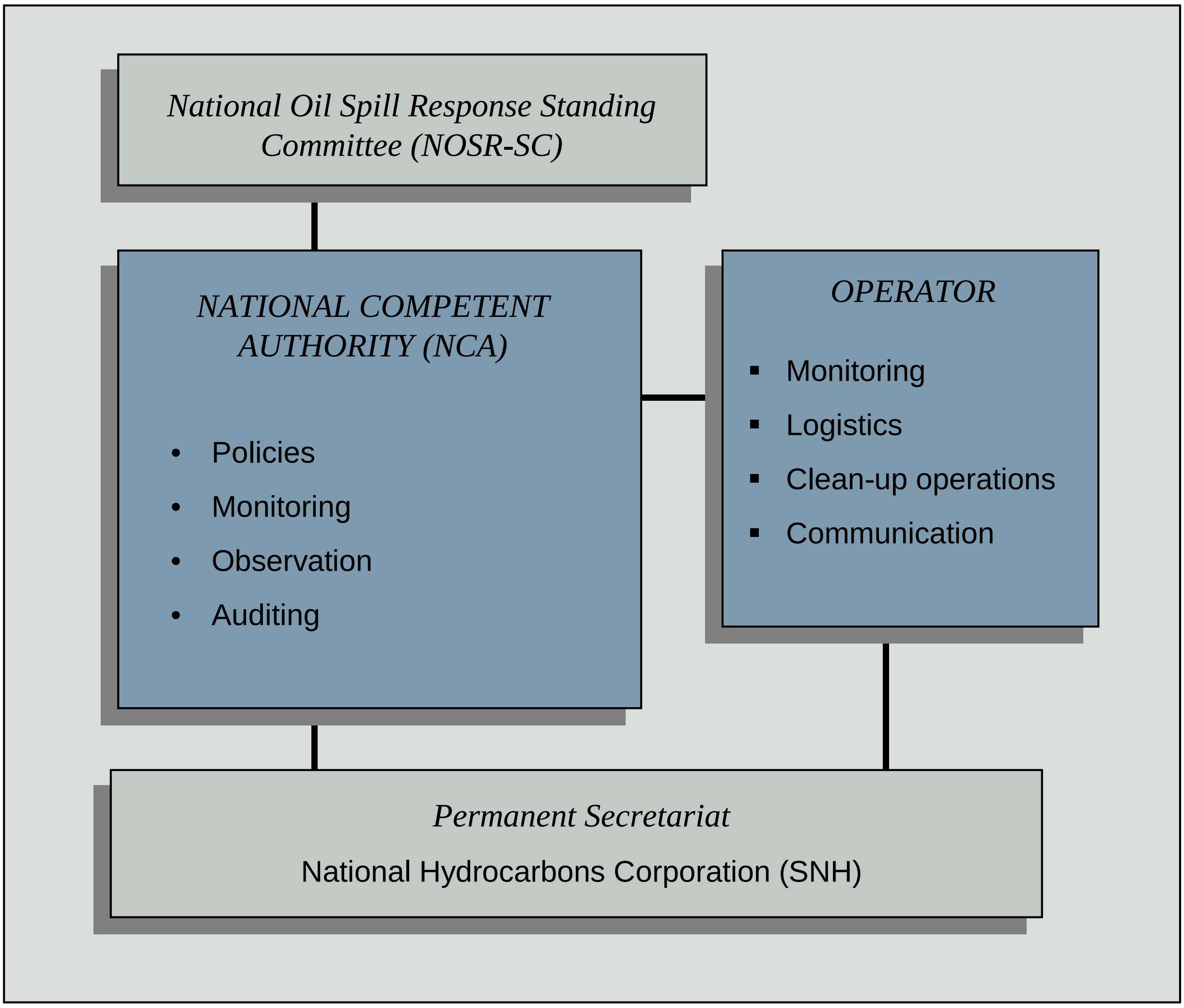

Figure A.4.1: Marine Emergency Response Organisation (Tier 1)

In the case of Tier 1 oil spills (see Section A.5.1 for definition), the command structure for response activities is located within the operator's organizational structure. There is a responsibility for reporting to the National Competent Authority (discussed later in Section B, Operational Plan).

Marine Emergency Response Organization (Tier 2 and 3)

A.4.2.2 The National Crisis Committee

In case of offshore oil spills that are likely to reach and pollute the coastal zone, posing a high risk of catastrophe (Tier 2 and 3 incidents), the terms of Decree N° 98/031 dated 09 March 1998, which relates to emergency planning and aid will apply. According to this decree it is the responsibility of the competent administrative authority to direct the emergency plan (Figure A.4.2). To this effect, the competent administrative authority will:

- Make the alert
- Immediately engage emergency aid,
- Inform the hierarchy of authorities
- Mobilize the necessary human, equipment and financial resources,
- Immediately notify the National Crisis Committee
- Inform the public

In situations where the oil spill is at sea, the National Crisis Committee will not intervene and the National Incident Command Team (NICT) for oil spill response will take control of the situation.

A.4.2.3 National Incident Command Team (NICT)

The National Incident Command Team (NICT) is a body comprising members drawn from the NOSR-SC, which will be constituted in the event of oil spill incidents (Tier 3, possibly Tier 2 incidents). The team will have expert representation in the field of oil spill response drawn from both the civil and military spheres of authority.

For oil spills in the marine environment, the National Navy will lead and coordinate the National Incident Command Team.3 It will do so by virtue of Presidential Decree N° 36 of February 4, 2002, which gives the Navy "the power to coordinate and lead all government actions at sea," notably "the fight against pollution". In addition to the Ministry of Defence (National Navy), the National Incident Command Team will include representation by at least the following authorities:

- Ministry of Environment and Forests (MINEF);
- SNH (HSE Division);
- Ministry of Territorial Administration and Decentralization (MINATD);
- Ministry of Communications (MINCOM);

[3] Note: For oil spills on land, the National Corps of Fire Fighters substitutes the National Navy in leading and coordinating the *National Incident Command Team*. Where there is no local representation of the Corps of Fire Fighting, the National Gendarmerie will assume the lead role of the NICT.

- Ministry of Public Health;
- Ministry of Livestock, Fisheries and Animal Husbandry (MINEPIA);
- Ministry of Mines, Water Resources and Power (MINMEE); and
- Ministry of Transport (MINT).

It is the responsibility of the NICT to deploy the resources (equipment, personnel) necessary to fulfill the national mandate with respect to oil spill response, specifically concerning the following:

- Coordination of the national effort in emergency oil spill situations, communication with all affected parties, including the media and counterpart institutional structures in neighboring countries (where this may be required), monitoring of key aspects of oil spill response and clean-up activities, record-keeping (e.g. for the purpose of compensation claims), and reporting progress to the NOSR-SC; and
- Facilitation with the implementation of oil spill response operations conducted by oil industry operators, for example, by arranging immigration and customs clearance for foreign equipment and personnel commissioned to respond to Tier 3 incidents.

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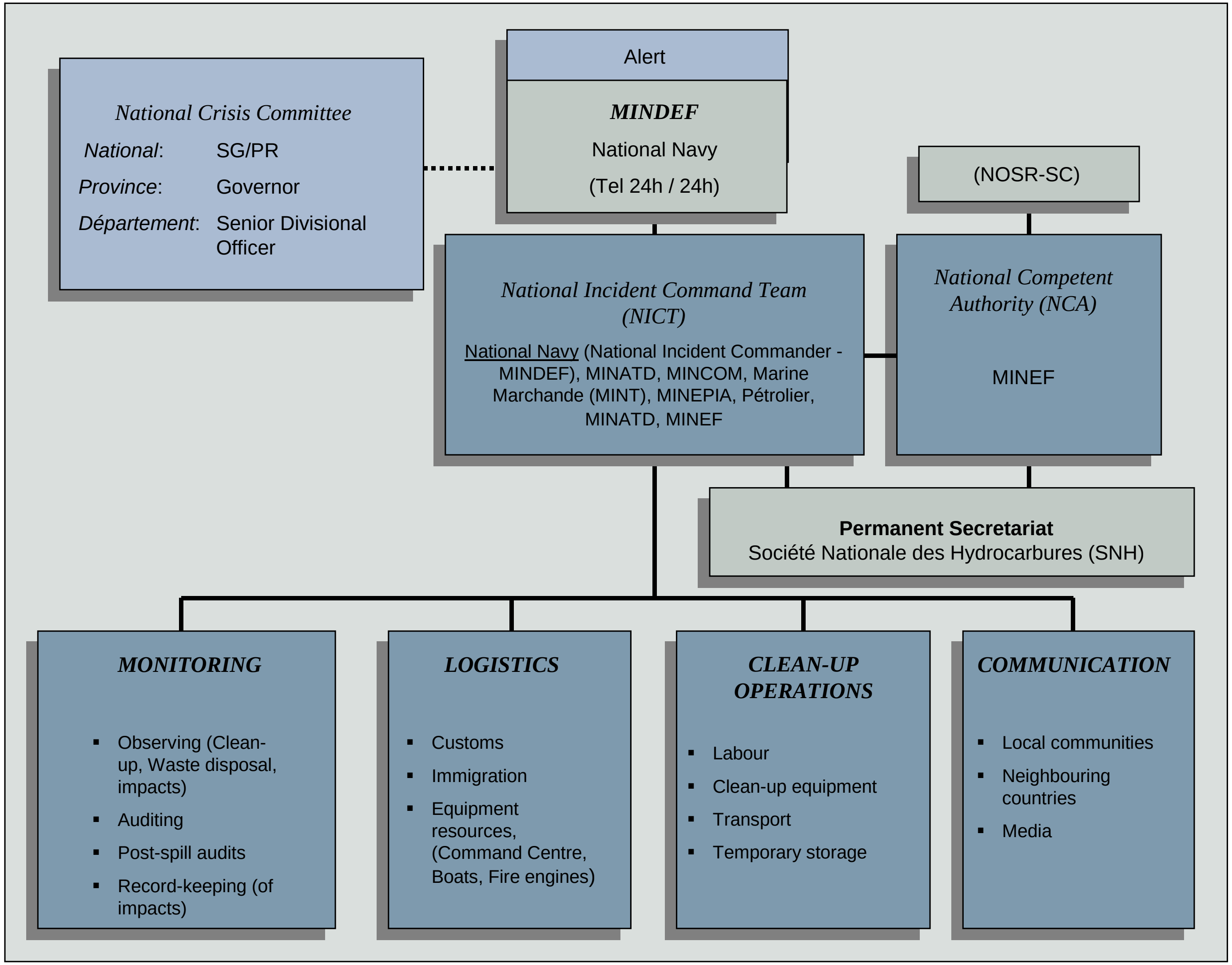

Figure A.4.2: Marine Emergency Response Organisation (Tier 2 and 3)

A.4.3 Roles and responsibilities

The roles and responsibilities of the ministries and other authorities that may be involved in oil spill response at the national level are discussed below.

Ministry of Environment and Forests (*MINEF*): The Ministry of Environment and Forest's main function is to coordinate the activities of the National Oil Spill Response Standing Committee (NOSR-SC) and, in fulfilling this function, is recognized as the National Competent Authority (NCA). As the NCA, a key function of MINEF is to convene meetings of the NOSR-SC from time to time, for example to review the National Oil Spill Contingency Plan and the oil spill contingency plans drafted by the various oil industry operators.

MINEF will have the following responsibility:

- To receive and to respond to notifications of oil spill incidents as these are reported by parties responsible for the incidents [initial Oil Spill Report, Oil Spill Report updates, final Oil Spill Report (Report No. OSR001)].
- To coordinate the activities of monitoring certain oil spill incidents, which are undertaken by various government institutions (e.g. MINEPIA and MINREST).
- To approve the terms of reference of post-spill audit reports for Tier 2 and 3 incidents.
- To receive and review the Oil Spill Incident Review Report (Report No. ORS002) submitted by oil industry operators.
- To receive and review post-spill audit reports.
- To coordinate debriefing sessions involving the National Oil Spill Response Standing Committee following Tier 2 and 3 incidents.
- To record and file all reports received from operators during an oil spill incident and any other relevant information to be entered into the National Oil Spill Database, which must be established by MINEF.

MINEF will also play a key role as a member of the National Incident Command Team (NICT).

National Hydrocarbons Corporation (*SNH*): The National Hydrocarbons Corporation (Société Nationale des Hydrocarbures, SNH) as the State's secular arm in charge of the management of the State interests in the petroleum sector is ideally placed to make a significant contribution to oil spill preparedness and response at the national level. Important in this regard, are the direct links that SNH has with the activities of essentially all participants in the hydrocarbons sector, typically through partnership and shareholder affiliations. All upstream operators in sector are required to systematically provide up-to-date industry data to SNH, which places the organization in a well-informed position regarding the sector. Thus, SNH will always be one of the first institutions to be alerted, as a matter of course, in the event of oil spills.

Given its well-informed position with regard to the hydrocarbon sector and the resources to which it has access, SNH through its Health, Safety and Environment (HSE) Division will act as the permanent secretariat for the National Competent Authority (NCA), the National Oil Spill Response Standing Committee (NOSR-SC) and the National Incident Command Team (NICT). In this regard, the organization will assume the following responsibilities:

- Assist the NCA in updating of the National Oil Spill Database, making available to the NCA all information it receives regarding oil spills (Database to reside within SNH offices);
- Assist the NCA in assembling the NICT in the event of Tier 3 (possibly some Tier 2) oil spill incidents;
- Assist the NCA to monitor all activities related to oil spills that are undertaken by technical ministries such as MINMEE, MINT, MINEPIA and MINREST;
- Assist the NCA in responding to all notifications of oil spill incidents that are reported to the NCA by the parties responsible for the incidents;
- Assist the NCA with the review of the Oil Spill Reports that are submitted by oil operators – including the review of both the terms of reference for post-spill audits, in the case of Tier 2 and 3 incidents, and the audit reports that are submitted;
- Where required, recommend to the NCA the establishment of appropriate technical sub committees to address issues pertaining to oil spill incidents (monitoring, report reviews, etc.);
- In collaboration with the oil industry operators, prepare the terms of reference for post–spill audits (Tier 2 and 3 incidents);
- Provide communications material to the NCA and NICT required for public debriefing sessions;
- Ensure that the NOSCP strategy is incorporated into the oil spill response plans of oil industry operators (including those of parastatal organizations);
- Ensure that operators have appropriate equipment available and hold sufficient stocks of consumables for responding to oil spills - for which they may be responsible - and to keep all parties (other operators, the NCA) updated with regard to their inventories;
- Foster the establishment of formal agreements between oil operators in Cameroon with regard to collaboration in responding to Tier 2 and 3 incidents;
- Assist the NCA in developing a capacity building plan for all role players involved in the implementation of the NOSCP;

- Organize, under the authority of the NCA, all desk-top exercises conducted to evaluate the effectiveness of the NOSCP with regard to communication between, and the response preparedness of, all key role players.

Ministry of Defence (**MINDEF*****):*** The two key administrations within this Ministry include the National Navy and the National Corps of Fire Fighters. Apart from being members of the National Oil Spill Response Standing Committee, these two administrations will play a key lead role as Incident Commanders of the National Incident Command Team for marine and inland spills respectively. As previously stated, for oil spills in the marine environment, the National Navy will lead and coordinate the National Incident Command Team by virtue of Presidential Decree N° 36 of February 4, 2002, which grants the Navy the power to commandeer and mobilize civil and military forces as well as maritime equipment. For oil spills on land, the National Fire Fighting Corps substitutes the National Navy to lead and coordinate the National Incident Command Team.

As Incident Commanders, the National Navy and the National Corps of Fire Fighters will have the following responsibilities for marine and inland oil spill incidents respectively:

- To coordinate the activities of the National Incident Command Team.
- In emergency situations (probably only Tier 3 incidents), to set up a National Incident Command Centre, which should be equipped with all of the NOSCP documentation and necessary communications equipment.
- To coordinate customs and immigration clearance for foreign nationals and equipment, imported to assist with the response to Tier 3 incidents, through liaison with the relevant authorities.
- To make available appropriate equipment, such as naval vessels (e.g. for the spraying of dispersant under expert direction and the deployment of clean-up equipment), fire engines and other emergency response equipment and personnel. Where necessary, the oil spill response activities of the National Navy will be centred at the Douala Naval Base (other centres may also be used for this purpose), while the activities of the National Corps of Fire Fighters will be centred at a fire station located closest to the oil spill incident.
- If required, to participate in the incident debriefing sessions once the emergency response and clean-up actions have been terminated.

Ministry of Territorial Administration and Decentralization (**MINATD*****):*** MINATD is in a position to coordinate clean-up actions through liaison with the offices of the Provincial Governors. By virtue of Law N° 86/016 of 6 December 1986, relating to the organization of civil protection, and Decree N° 98/031 of 9 March 1998, relating to emergency plans for crisis situations, MINATD is best suited to coordinate the logistics and mobilization of resources required for oil spill clean-up, including labour, transport, minor equipment (shovels, buckets, etc.) and temporary waste storage facilities - through the offices of the Provincial Governors and Senior Divisional Officers. Communication with affected communities will be the responsibility of MINATD, also through liaison with the offices of the Govenors and Senior Divisional Officers.

Ministry of Communication (*MINCOM*): By virtue of the Ministry's statutory mandate, MICOM's main function is to coordinate all Government communication with third parties (excluding local communities) during a spill incident. This will entail communication with the following groups:

- The general public
- Neighboring countries
- The media

Communication initiatives should also involve the National Communication Commission (NCC), which should assist MINATD in disseminating reliable and consistent information. The NCC comprises the Director of Public Communication, the Provincial Delegates for Communication, and the Chiefs of the Communication Units at the ministries represented on the National Oil Spill Response Standing Committee.

Ministry of Mines, Water Resources, and Power (*MINMEE*): An important function of MINMEE is to ensure that all oil industry operators have in place an Oil Spill Response Plan, which must be submitted for approval by the National Oil Spill Response Standing Committee on which MINMEE is represented. MINMEE is also likely to be included in any monitoring activities initiated during and after oil spills and to observe the response and clean-up actions that are undertaken.

Ministry of Justice (*MINJUSTICE*): The main function of this authority is to assist with the formalization of claims for compensation that may be submitted, for example, in accordance with the provisions of the Civil Liability Convention and the Fund Convention.

Ministry of Finance and Budget (*MINFIB*): The Customs Department, which falls under MINFIB, will play a critical role in the event that oil spill response equipment is commissioned from international sources to respond to a Tier 3 oil spill incident. The Customs authorities will need to assist with prompt temporary importation clearance in this situation. MINFIB will also be responsible for tracking the costs of deploying Government personnel and resources to assist with oil spill response and clean-up actions.

General Delegation for National Security (*DGSN*): Similar to the function of the Customs authorities, the DGSN will be required to process immediate immigration clearances for foreign nationals who are commissioned to assist with Tier 3 incidents. This role is defined as per Decree N° 298/2000 of 12 October 2000, promulgating the law regulating the entry to Cameroon, residence and exit of foreign nationals.

Ministry of Transports (*MINT*): The Merchant Navy may be required to assist the National Navy with the provision of vessels and other equipment required to respond to oil spills at sea. The Department of Terrestrial Transportation may assist MINATD with the logistical aspects of moving clean-up equipment to areas where it is required. MINT also provides a key link with the International Maritime Organization (IMO).

Ministry of Livestock, Fisheries, and Animal Husbandry (**MINEPIA*****):*** MINEPIA's main contribution is to liaise with the industrial and artisanal fishing sectors in the event of oil spills and to monitor and assess the associated impacts. This should be undertaken in collaboration with MINEF and MINREST (see below).

Ministry of Scientific and Technical Research (**MINREST*****):*** MINREST's main function is to assist MINEF and MINEPIA with the research on marine pollution, and seafood quality.

Secretary of Defence (**SED*****):*** SED's responsibility is to ensure the readiness of the corps of gendarmes to respond to in-land oil spills in cases where there is no local Fire-Fighting Brigade. Charge shall be taken of the situation until representatives from the National Corps of Fire Fighters are available to take over this function.

Ministry of Public Health (**MINSANTE*****):*** MINSANTE will help with the identification of health hazards associated with marine pollution.

National Oil Industry Organizations (**SNH, SCDP, and SONARA*****):*** The main task of these institutions will be to provide expert input on oil-related issues.

Oil companies* (Total E and P, Pecten, Perenco, COTCO, Phillips and others*): In terms of their operating licenses, oil companies are required to maintain adequate stocks of equipment and materials and to have in place Oil Spill Response Plans to deal with oil spill incidents arising from their operations. In this regard, they are a key resource for responding to oil spills under a variety of situations and are in the position to provide expert advice and assistance to the Government of Cameroon in the event of incidents where the party responsible for the oil spill does not have the capability to respond (e.g. in the event of a shipping incident).

Others parties (**National Ports Authority, Autonomous Ports, and CAMRAIL*****):*** Institutions such as these can be called upon to assist in various ways in dealing with oil spill incidents.

A.5 OIL SPILL RESPONSE STRATEGIES

A.5.1 Philosophy and objectives of oil spill response

The prime objective of any oil spill response strategy is to minimise damage to environmental and socio-economic resources in the area of the spill. This is done by selecting the most appropriate response options that are best suited to the particular set of circumstances prevailing at the time of the spill. The purpose of any oil spill contingency plan is to decide upon as many of the required actions as possible before the time of the spill and to provide the required information to facilitate rapid decision-making at the time of an incident so as to avoid any delays in response, which could result in greater environmental damage.

The potential or actual magnitude of impact of an oil spill on environmental and socio-economic resources is dependent on a variety of different factors. These include the volume of oil spilled, the type of oil spilled, the sensitivity of the environment in which the oil has been spilled or moves into, the sea state, weather conditions at the time of the spill, etc. A number of different techniques, methodologies are available to clean-up oil spills at sea and on the coastline. No one technique is suitable under all circumstances and it is, therefore, necessary to have recourse to a number of different techniques (and the materials and equipment associated with these techniques) under different sets of prevailing circumstances. These techniques, as they pertain to the situation in Cameroon, are discussed in Section A.5.2.

A three-tiered oil spill response approach has been developed and generally adopted in order to structure oil spill response activities, which can be escalated as a spill incident may increase in magnitude and or potential severity of environmental consequences (IPIECA, 2000a). This approach allows for easier identification of resources required to address spills of different magnitudes:

- ***Tier 1: Small local spills***. This covers operational releases (e.g. oily waste water) and accidental spills that are generally not large and can be cleaned up using resources and equipment that can be rapidly deployed from the facility or installation from where the spill originates. These types of spills would include, for example, those resulting from a burst hose during loading at an FSO unit, unloading of crude oil at the jetty of the SONARA refinery and product transfers at the Port of Douala.
- ***Tier 2: Medium spills that extend beyond the clean-up capabilities of the facility operator***. In this case, the volume of oil spilled and the physical area of dispersion exceeds the response capabilities of the individual operator. Additional resources would need to be called in from other operators in the area. This type of incident might include a spill resulting from a shipping

collision in the approach channel to the Port of Douala or a subsea pipeline rupture, involving a significant leak at one of the offshore production operations.

- ***Tier 3: Major spill that exceeds national capacity to effectively respond.*** This involves a major oil spill where national oil spill response resources are inadequate to effectively respond to a spill, which is likely to have a significant impact on the country's environmental and/or socio-economic resources. In this case, international oil industry equipment and personnel would be brought in from centres specifically established for this purpose, such as the FOST base in Marseille, or the Oil Spill Response Ltd base in Southampton, England. National government co-ordination of response activities might be required in this situation. This type of oil spill could include a major shipping accident in Cameroonian waters involving, for example, a fully laden oil tanker.

The general criterion for selecting the most suitable response under the prevailing circumstances is that the response actions should not be more damaging to the environment or the socio-economic activities than would be the case if the oil were to be left to breakdown naturally. In selecting the most appropriate response, the option that has the greatest chance of success in removing the oil with the least overall impact on the environment, within reasonable cost constraints, needs to be selected. A "net environmental benefit analysis" (NEBA) needs to be undertaken to identify the most suitable option (IPIECA, 2000b).

A.5.2 Oil spill response strategies applicable to Cameroon

This section describes the different options available for responding to an oil pollution incident both at sea and once the oil has impacted the shoreline. Those options that have specific application to the situation in the country are described in more detail, and arguments are presented for those options not considered to be appropriate for the circumstances prevailing in Cameroon.

A.5.2.1 Response options whilst oil is on water

A.5.2.1.1 Surveillance and monitoring:

Once oil has been spilled at sea it spreads under the influence of gravity and moves according to the direction of the winds and surface currents. The general movement of the oil can be calculated by means of a vector diagram using the wind induced effect as being 3% of the wind velocity and the current effect as 100% of the current velocity. More sophisticated modelling options, as described in Section A.2, can also be used to predict the transport and fate of oil on water. Under offshore wind and current conditions, spilled oil will move away from the coast and out to sea. If there are no sensitive resources (such as bird breeding islands) present in the track of the oil, it is usually not necessary to undertake any response options and the oil can be left to the natural processes of dispersion and weathering. It is still, however, necessary to monitor the movement of the oil to ensure that it continues to move away from the coast and does not change course and return to impact sensitive coastal resources.

This approach is generally not considered to be a viable option in Cameroonian waters as it can be expected that any oil spilled in the Bight of Biafra or within the Estuaire du Cameroun will move towards the coast or shoreline and not out to sea under the normally prevailing wind and surface current conditions – a trend evidenced in the various results of the modelled oil spill simulations presented in Section A.2. An oil slick could initially be seen to be moving away from the coast under the influence of local conditions, but ultimately, the regional environmental conditions will drive the oil towards the coastline. If no action is taken under these circumstances, valuable response time could be lost.

A.5.2.1.2 Chemical dispersion

The application of chemical dispersants is a viable option for the effective combating oil pollution at sea in order to prevent oil slicks stranding on sensitive coastlines or impacting, for example, seabirds and mammals at sea. Dispersants applied to a slick at sea cause the oil to break up into tiny droplets, which disperse throughout the water column and are readily broken down by naturally occurring bacteria.

If the decision is taken to apply dispersants to a particular oil slick, this should be done as soon as possible after the oil has spilled. Within a relatively short period, hydrocarbon product begins to weather as spreading, evaporation, dilution and emulsification take place. Dispersants are most effective when applied to fresh oil rather than weathered product that has been at sea for some time. It is, therefore, necessary to decide whether dispersant application is a desirable option to be used in advance of an incident so that time is not lost in an emergency situation when deciding whether to use this option or not.

Two methods of applying dispersants to oil at sea can be used – one using surface vessels (ITOPF, 1982a) and the other using either helicopters or fixed wing aircraft (ITOPF, 1982b). The disadvantage of using surface vessels is that the application rate is slower than with aircraft, and that it is difficult to determine where the greatest concentrations of oil are on the water surface. For this reason, it is important that aerial surveillance is available during surface vessel spraying operations to direct the operations to areas of highest oil concentrations and to monitor the effectiveness of the dispersant application. Rig tender vessels are generally fitted with dispersant spraying equipment and are stocked with dispersant, and can respond rapidly to a spill from an offshore production site since they are constantly on site. Aerial application can cover a larger area where the oil is thickest. Service helicopters that are available to service the offshore production facilities can sling a dispersant application pod (heli-bucket) underneath the aircraft for rapid application. Crop spraying aircraft, which are available in the region, can also be rapidly adapted for dispersant application and are most effective, particularly where the spill has a localised spread.

A number of different brands of dispersant are available on the market. In order to ensure that the dispersants used in Cameroon are effective and not inherently (i.e. unacceptably) toxic to marine organisms, it is recommended that only dispersants that have been approved for use in either the USA, UK or France be considered for Cameroon. Generally the available dispersants are not effective on viscous oils, such as heavy bunker fuels, or oils that have been at sea for some time and have become weathered and emulsified. A well known dispersant that is more effective on these heavier oils is Corexit 9500, manufactured by Nalco/Exxon Energy Chemicals. In all applications the manufacturers' instructions and dosing rates need to be strictly adhered to ensure maximum efficiency. Concentrate dispersants, which can either be applied neat from the air or mixed with water before application on a spray vessel, are recommended.

Dispersants would only be applied to persistent oils and not to lighter products such as petrol, diesel and paraffin as these disperse naturally and enhancing such dispersal using chemicals is unnecessary.

In the past there has been some strong opposition to the use of dispersants and some debate still exists on the subject. This has been due to the fact that earlier dispersant formulations have been inherently toxic to marine organisms. This has been largely overcome, with the majority of dispersants now being of low toxicity. The fact that the action of dispersants introduces larger quantities of oil into the water column in small particulate form, exposing the subsurface organisms to higher concentrations of oil than would be the case if the oil floats as a slick on the surface, has also been an argument against the use of dispersants. However, the use of dispersants can be fully justified under certain circumstances where it has been shown that the consequences of not using dispersants and allowing the oil to impact sensitive resources are more detrimental to the environment. Decisions in this regard need to be informed by the principle of "net environmental benefit analysis".

In situations where chemical dispersants are not available and/or the spill involves light oils, such as petrol or diesel, it is often practical to disperse the oil slick mechanically, or physically, without chemical assistance. This may be achieved by using techniques such as the propeller wash or bow wave of a vessel or by towing floating breaker boards behind a vessel. This method is often a preferred option in harbour areas where light oil has spilled and it is difficult to recover by means of skimmers or sorbents.

The application of oil spill dispersants is considered to be the most practical and effective response option for combating oil spills in Cameroonian waters. This is due to the fact that it is likely that any oil spilled in the Bight of Biafra or the Estuaire du Cameroun is likely to strand on the shoreline. Mangrove ecosystems occur along extensive stretches of the country's coastline, for example, the Estuaire du Cameroun and the Rio del Rey systems (Table A.3.15). They are ecologically significant and are also highly sensitive to oil contamination, it is, therefore, essential to prevent oil from contaminating such shorelines. When considering the net environmental benefit of dispersant usage under these circumstances, it is apparent that this option offers the least chance of causing significant environmental damage. However, only approved dispersants should be used, and they should be applied wherever possible in deep (as opposed to shallow) water.

It is important to note that the effectiveness of certain oil spill dispersants may be reduced in waters of low salinity, as is the case of environments such as within the Estuaire du Cameroun, Ntem and other large river estuaries - particularly during the rainy season. However, the use of dispersants should still be considered as the main form of intervention since the products that are available in Cameroon will be moderately effective in low salinity situations, resulting in overall environmental benefits that exceed those associated with the non-use of dispersants. It is advisable that the effectiveness of dispersants should be tested under low salinity conditions before any full-scale dispersant spraying operation is launched.

A.5.2.1.3 Offshore mechanical containment and recovery

Under certain circumstances, it is possible to contain spills at sea using floating booms, and to recover a certain portion of the oil using skimmers. This involves a boom being strung between two tow vessels, which then steam at a slow speed through the oil slick, concentrating the oil at the apex of the boom configuration. The oil is then recovered from the water surface using a skimmer, which is either deployed from one of the vessels or a third independent vessel. The oil is pumped aboard and stored on one of the vessels or in a support barge.

This operation requires a high level of training and co-ordination between the masters of the different vessels and other parties leading the oil spill response, and ideally, dedicated teams are needed to put this response strategy into effect. Mechanical containment and recovery of oil at sea has a low degree of success under strong winds and currents and severe sea conditions.

It is considered that this technique is not practical for use off the Cameroon coast. This is due primarily to the fact that the required equipment and trained personnel are not available locally. Additionally, the offshore production areas are relatively near to the coast, which would not allow sufficient time to deploy the equipment, even if it was available within the region, before it impacted the coast. Dispersant spraying is considered to be a more practical option.

A.5.2.1.4 Burning

In situ burning of oil on the water surface is considered to be a viable option for removing oil in some situations. This strategy does, however, create smoke plumes that can contaminate coastal areas where these are situated downwind and in relatively close proximity to the spill. Tarry dense residues may also result from incomplete combustion, which tend to sink to the sea bottom affecting, for example, benthic ecosystems and fishing in the area. Oil can be burned either after being contained within fire-resistant booms or on the open sea. The latter method is more difficult to manage as the oil needs to be sufficiently concentrated to ignite, and when alight, floating rafts of oil may drift into areas where they can present a safety hazard.

Burning is not recommended in Cameroonian waters due to the fact that dedicated equipment to ignite the oil or to contain the burning oil on the sea surface is not available, and the circumstances do not warrant the acquisition of this equipment.

A.5.2.1.5 Booming for protection of coastal resources

Floating containment booms can be used to good effect in deflecting oil away from sensitive coastal features to areas of lower sensitivity where it can be easily recovered. They can also be used to protect sensitive resources by forming a barrier between the resource and the oil, preventing, for example, the incursion of oil into small tidal creeks, river mouths and lagoons where mangroves may be established.

The use of booms is constrained by high velocity currents and, as a general rule, is not effective where the velocity incident to the boom is greater 0.3 m/sec. This constraint can be partially overcome by placing the booms at an angle relative to the current direction, thereby reducing the incident velocity.

Rivers with a fast outflow of freshwater would not need protection using booms as the outflows, particularly during the rainy season, are sufficient to prevent oil entering the river mouths. The Sanaga river is a pertinent example in this regard. In areas where there are very extensive mangrove forests, it is not possible to provide sufficient length of boom to protect the whole area (stretches of mangrove forest, for example, within the Estuaire du Cameroun cover over 2 000 km, as indicated in Table A.3.15). In these areas it would not be feasible to attempt this type of protection, and the application of dispersant before the oil reaches shorelines regarded as highly sensitive needs to be adopted. Boom protection of mangrove areas within the smaller tidal lagoons situated along the coast, for example between Kribi and Campo, is, however, considered feasible. Booms can also be used to good effect in certain other situations to contain spilled oil for recovery, for example, at the area at the base of the SONARA jetty and in areas within the Port of Douala.

The use of booms in Cameroonian offshore waters is not considered practical. However, they do have application, together with the use of skimmers to collect the

contained oil, in inshore waters to protect certain features such as mangrove forests established along small tidal creeks, in lagoons and in some estuarine environments.

A.5.2.1.6 **Sorbents**

Many different types of sorbent materials are commercially available, which absorb or adsorb oils as they float on the water surface. These materials include treated wood fibres, peat moss, cotton waste and synthetic materials. Sorbent materials of opportunity, such as dry grass can also be successfully used. The material can be applied to the oil in loose fibre or granular form or contained in porous fabric in the form of floating booms or pillows.

Sorbent materials are generally only used on small spills of lighter oils or for mopping up once the bulk of a larger slick has been collected by other means. They are best suited for use in contained areas, such as within a port precinct or, possibly, some of the small seasonal lagoon systems that occur along the country's southern coastline.

A.5.2.2 Response options once oil has stranded on shoreline

A.5.2.2.1 **Mangrove forest areas**

Mangroves are considered to be particularly sensitive to oil and it is accepted that they are priority areas for protection due to their ecological significance. Dispersing the oil at sea has been identified as the main protection strategy for mangroves and experience has shown that oil that has not been treated with dispersant is far more damaging to mangroves than oil that has been treated (IPIECA, 1993). Should dispersant application, together with localised booming, fail to stop the oil from impacting mangrove environments, further response will be required. Possible options include: localised containment and skimming, pumping of bulk oil trapped in depressions and channels, water-flushing of oil from between roots and trees for remote containment and collection and application of sorbent materials and subsequent removal. However, these approaches are often impractical due to difficulty of access into the dense forest, particularly in the case of the stilt-rooted mangroves that dominate in Cameroon. Additionally, these techniques may cause greater physical damage to the forests as well as causing the oil to be mixed into the sediments to a greater degree than if the oil was left *in situ*.

A high priority must be given to preventing any oil from impacting mangroves, primarily through the use of dispersants. If oil does impact mangroves a "net environmental benefit analysis" must be conducted to ensure that any actions taken are less harmful than leaving the oil alone. In practice, in can be expected that the best option will be to take no action in the case of oil that has penetrated mangrove areas apart from trying to minimise its spread where this is possible.

A.5.2.2.2 Sandy shoreline clean-up

The clean-up of sandy shorelines is usually a straightforward operation and does not normally require specialised equipment. However, the use of inappropriate techniques and inadequate organisation can aggravate the damage caused by the oil itself (ITOPF, 1983). Techniques will differ according to the beach substratum and wave action in the area. For example, oil will strand easily on the gently sloping volcanic fine sediments comprising the sandy beaches in the vicinity of Limbe. This is relatively easy to remove from the sand surface by means of flat wooden planks on handles and spades and to transfer it into waste collection bags, buckets or front-end loaders. On the other hand the oil would not strand as easily on the higher energy, relatively steeply sloping beaches that characterise much of the country's non-mangrove coastline, particularly along the central and southern coastal sectors. In this case, no clean-up is required if the oil cannot strand. Should the clean-up of beaches be considered as a response strategy, a number of general rules apply:

- Care needs to be taken when moving personnel and machinery around on an oiled beach that such movement, as far as possible, takes place on un-oiled or cleaned sections, so that the oil is not mixed into the sediment. A system of working from one end of the beach to the other or from top to bottom of the beach profile will avoid this.
- Care should be taken not to remove larger quantities of un-polluted sand than is necessary. This can lead to localised erosion of affected beaches and will also require the disposal of unnecessarily large volumes of waste.

A.5.2.2.3 Rocky shoreline clean-up

Oil will tend to be deposited on gently sloping rocky shorelines and will also become trapped in gullies and intertidal pools. It is important to remove such oil, wherever possible, particularly where local communities rely on intertidal organisms as a food source – which is the case along the country's southern coastline, where there is harvesting of oysters. This can best be done by physically removing the oil using shovels and buckets or sorbent materials of opportunity such as dry grass. The collected material should be bagged and removed for proper disposal.

A.5.2.2.4 Disposal of oily waste

Most oil spill clean-up operations, particularly those on shore, result in the collection of substantial quantities of oil and oily debris, which must be disposed of (ITOPF, 1984). If not done properly, this material will present a persistent source of pollution risk, for example, by contaminating groundwater resources. Very often it is necessary to provide temporary storage facilities to hold the waste until a final disposal option has been identified. These temporary storage facilities may include plastic-lined storage pits excavated close to the site of collection. Plastic bags or open oil drums can be used for the storage of smaller quantities of collected waste.

Dedicated hazardous waste sites are not available in Cameroon for disposal of large quantities of oily waste. Other options that must, therefore, be considered, include:

- Processing the waste though a refinery or an oil recycling plant if the debris and salt content is not too high and the oil is not heavily weathered. This option is rarely possible to implement;
- Stabilisation with lime for use in land reclamation or road foundation construction;
- Co-disposal with municipal waste;
- Destruction by incineration; and
- Biodegradation or landfarming.

The option selected will depend on a variety of different factors. Expert opinion should be sought to determine the most acceptable approach under the prevailing circumstances.

A.5.3 Framework for decision-making, underpinned by NEBA

As with any other emergency plan, an oil spill contingency plan needs to attempt to identify as many appropriate courses of action as possible prior to an incident so as to avoid loss of time involved in decision-making under a crisis situation. However, certain decisions concerning appropriate courses of response action can only be taken once all the prevailing circumstances are taken into account at the time of the incident. These include size and duration of spill, sea state and weather conditions at the time, limitations of response under these conditions, movement of spilled oil, etc. In this decision-making process, the principles of "net environmental benefit analysis" (NEBA) need to be taken into account to ensure that the potential environmental consequences of different actions – including no action - are properly taken into account in the formulation of the decision. The following decision-making tree will assist in this process in an offshore spill scenario:

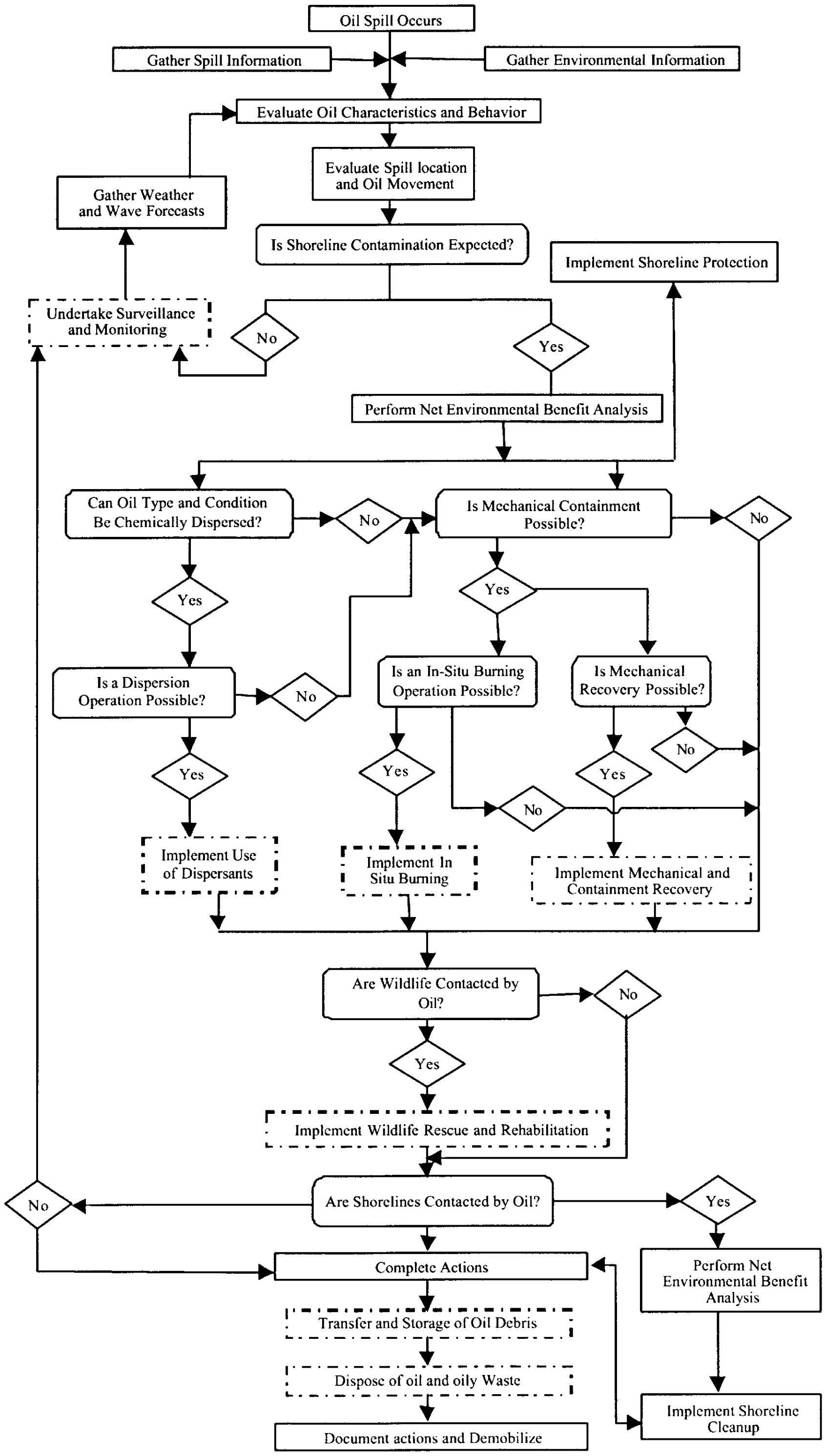

Figure A.5.1: Oil Spill Response Decision Tree

A.5.4 Conclusions and Recommendations

The application of oil spill dispersants is the most favoured option in responding to an oil spill in Cameroon's offshore marine environment. Offshore containment and recovery is not a viable option at this stage due to the lack of available resources within the region. The likelihood of oil released within the Bight of Biafra reaching the shoreline is high (see predicted fate of oil spills described in Section A.2). Extensive mangrove areas are present in the coastal region, which are ecologically rich and sensitive to oil pollution damage. It is considered that these have a high priority for protection and that dispersant application has the highest chance of success in preventing oil from impacting these areas. Protection using booms to prevent oil from entering the mangrove areas is not considered a practical option on a large scale due to the extent of the shoreline occupied by mangroves, particularly within the Estuaire du Cameroun and Rio del Rey systems, and the impracticality of providing sufficient boom lengths to protect such shorelines. Only localised areas of mangroves, such as in the smaller tidal lagoons that characterise the coastline for example, particularly between Kribi and Campo, and some of the low energy tidal creeks within the Estuaire du Cameroun could be protected on a limited scale.

Extensive stretches of coastline comprising rocky and sandy shorelines are inaccessible for equipment and would be extremely difficult to clean-up. The only option for preventing oil from impacting these areas would be the application of dispersants offshore.

It is, therefore, recommended that the use of oil spill dispersants that have been approved for use in the USA, UK or France, be considered as the prime option for responding to oil spills offshore, as well as within the Estuaire du Cameroun and certain other large estuarine systems, to prevent damage to mangroves and other sensitive coastal features.

A.6 OIL SPILL RESPONSE RESOURCE INVENTORY AND COLLABORATION AGREEMENTS

The only dedicated oil spill response equipment and materials in Cameroon are owned and held by the individual oil companies and the SONARA refinery. Certain informal agreements exist between these companies providing for the sharing of resources should one company require equipment and materials additional to their own stocks in order to respond to an oil spill at one of their own facilities. In the event of a large Tier 3 incident, additional equipment and manpower can be mobilised at short notice from the oil industry response centres situated, for example, in Southampton or Marseille.

Due to the limited risk associated with oil spills originating from sources other than the oil operators e.g. from vessels passing the coastline of Cameroon, and because of SNH's percentage ownership of the offshore operations it is not recommended that the Government of Cameroon acquire any national oil spill response equipment. In the event of a Tier 2 or 3 incident originating from a passing vessel (that does not have access to equipment to respond to an oil spill) it is recommended that the Government of Cameroon request assistance from the offshore operators with regards to responding to the spill. In the event of the Government of Cameroon making such a request of the offshore operator, appropriate compensation would have to be made by the Government. The details of such a collaborative agreement would have to be formalised between the Government of Cameroon and the offshore operators.

In the case of Tier 3 incidents of this type (e.g. shipping incidents) it will be the responsibility of the NICT to call on international assistance – e.g. OSRL. This will require prior negotiation of an agreement between the government of Cameroon and a service provider such as this.

An industry oil spill response center has recently (October 2003) been established at Malabo, Equatorial Guinea, where surveillance aircraft and stocks of aerial dispersant and application equipment are held for use within the region. The establishment of a second base at Port Gentil, Gabon, is also under consideration, where stocks of mechanical equipment such as booms, skimmers, pumps, etc. will be held.

A.6.1 Existing equipment

The lists of existing equipment currently located in Cameroon are contained in Section C.2 of the Data Directory. These lists should be regularly updated by the various operators and distributed to all relevant parties.

A.7 COMMUNICATIONS AND LOGISTICS

A.7.1 Framework for communication

Effective and efficient communication is central to a rapid response to oil spill emergencies and the minimisation of damage to the natural and social environment. Two main forms of communication need to be employed at the time of a spill. Firstly, communication procedures must be initiated by the operator (or party responsible for the oil spill) in order to initiate immediate and ongoing emergency response operations; secondly, communication must be initiated with the National Competent Authority to other parties, who may need to become involved with (or who may be affected by) a spill following the initial emergency response being implemented.

The National Competent Authority is responsible for co-ordinating communication via The National Incident Command Team with all involved Government authorities, organizations, affected local communities and, potentially, the neighbouring countries in the event of a spill being reported. The level of communication will vary according to the type and scale of the incident. The framework within which communication is conducted is illustrated in Figure A.7.1.

In the event of a Tier 1 or 2 oil spill incident, an operator is responsible for internal communications for the purpose of implementing the organization's oil spill response plan, which includes communication with the National Competent Authority. Such communication will be co-ordinated from the Operator's *Command Centre* and will include communication with the offices of the National Competent Authority.

In the event of a Tier 3 oil spill incident, an operator will immediately communicate with the offices of the National Competent Authority. Thereafter, further communication will be undertaken with the identified *National Incident Commander* who will put into operation the *National Command Centre* within the Naval Base at Douala (National Navy).

A.7.2 Command and control

Command and control centres function as communications hubs through, and around, which information flows and technical and logistical support can be co-ordinated. There are two types of command centres that will be established in the event of an oil spill, namely, the Operator's *Command Centre* and the *National Command Centre*.

NOSCP Cameroon: Communication Network for Marine Oil Spill Response

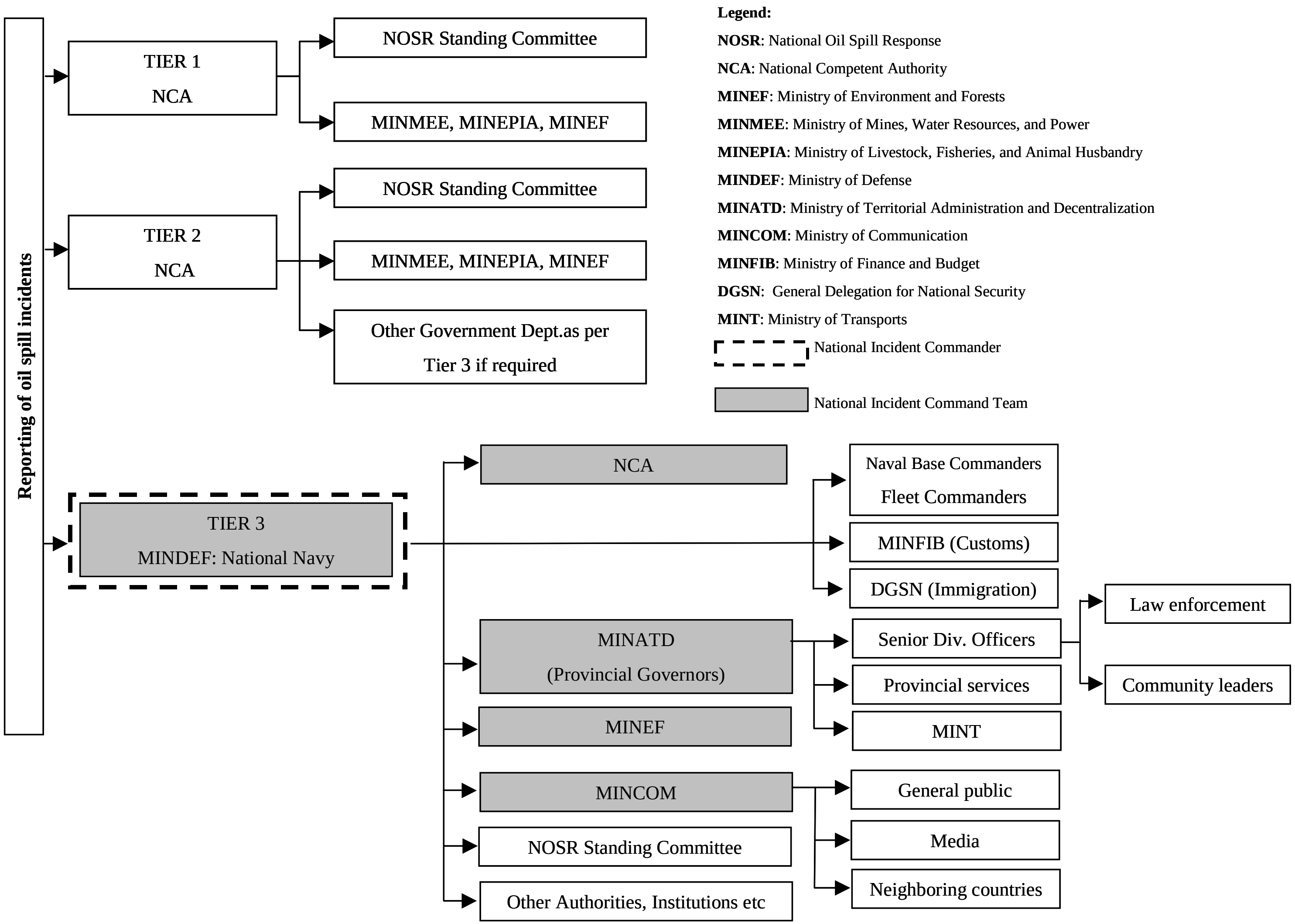

Figure A.7.1: Framework for communication between the National Competent Authority and other involved or affected parties

A.7.2.1 Operator's command and control

Operators are required to identify a *Command Centre* from which their emergency response will be co-ordinated in the event of an oil spill. Appropriate resources (personnel and communications equipment) are required to be available at these centres in order to make them properly functional.

A.7.2.2 National command and control

The *National Command Centre* at the Douala Naval Base will be used as a 24-hour facility for co-ordinating the response activities surrounding a Tier 3 oil spill incident, if the need arises. Communications with the operator (or party responsible for the oil spill) will take place through the operator's *Command Centre*. Communication with provincial and local authorities (who may be affected by and become involved in coordinating coastal clean-up operations) and with public bodies, such as the police and Port Authorities will be conducted from the *National Command Centre*.

A.7.3 Communications involving local communities

The importance of developing an effective strategy for communicating with local communities regarding oil spills is illustrated by a recent disaster involving a road tanker accident in Cameroon that resulted in the loss of human life and damage to property. Although this was not a marine oil spill, there are two factors that have an important bearing on the NOSCP – irrespective of the environment at risk – which explain why this tragedy occurred, and highlight what needs to be done in terms of developing a communication strategy in order to prevent such incidents in future. Firstly, villagers are not generally sensitized to the health and safety risks posed by oil spills and cannot immediately anticipate what action should be taken in emergency situations. Secondly, the *language* in which communication is conducted is critical in terms of ensuring that the communicated message is understood by local communities, where both the narrow (literal) and broader meaning of *language* (how the communication process is conducted) is important.

Clearly, the issue of advanced community awareness and preparedness regarding the risks of oil spills is a priority to be addressed in the NOSCP, in particular with respect to immediate measures to be taken by affected communities, prior to expert intervention in an emergency situation. This issue has also emerged through the expression of public opinion regarding the Chad-Cameroon pipeline project – i.e. that a general awareness must be created amongst local communities regarding oil spill risks and that specific communication strategies must be in place to permit local communities to protect themselves in situations of risk. In response to this need, some general recommendations are provided here, which should be put into effect during the implementation phase of the NOSCP.

A.7.3.1 Cross-cutting communication strategy

The local languages of communities who may be exposed to the various risk sources described in the NOSCP must be established and should be used in the various communication campaigns that are initiated to raise the level of community awareness regarding the responses to be taken in emergency situations. These campaigns should first be directed at the broad public using the electronic (national radio and television) and printed media (newspapers). Thereafter, a more focused strategy should be initiated to promote awareness within the various communities most exposed to the risk of oil spills (e.g. coastal fishing communities). This could be achieved, for example, by employing mobile teams to conduct the communication campaign in villages, for example, during festive gatherings – which would be an extension of a communication tradition deeply rooted in the customary discussion-and-consensus tree. Important in this regard, is the identification of community leaders and representatives (e.g. local teachers, retired civil servants) to serve as the conduit for ongoing communication. It is important that use is made primarily of audio-visual and oral communication techniques, since the target audience is typically not familiar with printed communication media.

A.7.3.2 Focused communication strategy

Fishing communities, and communities whose livelihoods are closely dependent on the marine environment (e.g. a dependency on tourism and eco-tourism) represent a sector of the population that is potentially highly exposed to the impacts of oil spills (Section A.3.2).

The NOSCP presents an organizational structure, and defines the roles and responsibilities of lead agencies, that will become effective in the event of an oil spill – including the responsibility for communication with local communities who may be judged to be at risk from oiling. However, this basic organizational aspect of the plan must be re-enforced with a pro-active communication strategy that focuses specifically on the coastal communities. The application of the communication campaigns, to which reference has already been made, must ensure the sensitization of communities to the risks posed by oil spills to livelihoods (contamination of fish and fishing equipment) and to what needs to be done in the event of an oil spill (e.g. that fishing activities should be halted). Importantly, the recourse that affected parties will have to compensation and the claims procedure to qualify for compensation will need to be explained.

A.7.4 Communications equipment

As a minimum, the *National Command Centre* should be equipped with the communications equipment identified in Table A.7.1 to ensure that communications can be maintained with the command centres of the operators, the provincial and local authorities and public bodies, such as the police and Port Authorities. The communications network must be adequate for geographical coverage of the country's entire coastal and marine environment within which oil spills could occur.

Table A.7.1: Communications equipment identified for the National Command Centre.

Type	*Use*	*Range*
UHF-FM Marine	Inter-vessel communication	Line of sight
VHF-AM Aircraft	Ground-to-air communication	Line of sight
UHF-Oil Spill	Oil company frequencies for communication with individual oil companies	Line of sight
High Frequency Radio	Single side band for distances over 30 miles offshore	30 to 50 miles
Cellular Phones	Mobile communication where network is available	Within network area
Satellite Telephones	Voice, data and facsimile offshore or remote locations where approved	Worldwide
Telephone and Facsimile equipment	Transmission system to cover the geographical are of the spill	Not mobile

A detailed list of equipment, radio frequencies, telephone, facsimile numbers and email addresses of all parties likely to be involved in oil spill incidents is contained in the Data Directory (Section C) of the Marine and Coastal (*blue pages*).

A.7.5 Logistical support

Each operator will be responsible for the logistical arrangements for mobilising equipment, company personnel and international assistance that may be involved in oil spill response and clean-up following an incident. In the event of a Tier 3 incident the *National Incident Commander* (National Navy), as part of the National Incident Command Team will be responsible for facilitating some of the logistical arrangements that may be required by an operator, for example, involving Customs and Immigration, for rapid customs clearance of oil spill response equipment that might be imported and immigration clearance of foreign nationals who may be commissioned to assist with an oil spill response.

The National Incident Command Team will also be responsible for co-ordinating logistical arrangements involving other authorities in the event of an oil spill. In this respect, examples of the response and logistical support that may be required from the authorities are listed in Table A.7.2 below:

Table A.7.2: Examples of the response and logistical support required from the authorities.

Level of oil spill	*Response by the authorities*	*Logistical support required*
Tier 1	Audit team may be required to visit the site on one occasion	Transport (vehicle and boat) Accommodation Equipment required for environmental data collection and analysis
Tier 2	Audit team may be required to visit the site on more than one occasion	Transport (vehicle and boat) Accommodation Equipment required for environmental data collection and analysis
Tier 3	An observer will be required to monitor response and clean-up actions during and after the spill	Transport (vehicle and boat) Accommodation Equipment required for environmental data collection and analysis
	An audit team will be required to visit the affected environments on more than one occasion	Transport (vehicle and boat) Accommodation Equipment required for environmental data collection and analysis
	The import of foreign personnel and equipment will need to be facilitated to ensure rapid customs clearance	Custom clearance certificates Immigration clearance
	Contracting of local labour to assist with oil spill clean-up of coastline	Procurement/contracting Transport (vehicle and boat) Accommodation Clean-up equipment Temporary waste storage sites Waste disposal

It should be noted that in the event of an oil spill where the authorities are required to mobilise resources as indicated above, detailed records of the equipment used, vehicle and boat hire, accommodation expenses, etc. should be maintained for possible claims at a later stage. Detailed records of the impact of the oil spill (i.e. audit results) must also be maintained in order to facilitate later compensation claims that may be processed (see Section B.7).

A.8 CAPACITY BUILDING AND TRAINING EXERCISES

A.8.1 Training

Any oil spill contingency plan has little value if the identified role players do not have the capacity or adequate training to properly activate and implement the actions identified in the plan. It is, therefore, essential that all role players, including top managers down to site supervisors, in central, provincial and local government as well as the oil industry receive proper training in oil spill response activities. The international community has recognised the need for oil spill preparedness and response training, which has lead to model training courses being developed by the International Maritime Organisation (IMO). These courses provide a clear framework for the provision of support and guidance to countries in developing their oil spill preparedness and response arrangements. They are intended to encompass a wide range of oil spill related matters at various levels and are designed for a combined audience of government and industry representatives. The suite of courses comprise three different levels:

Level 1: First responder. This course is designed for field supervisory personnel responsible for undertaking on-site clean-up operations and provides them with a complete overview of the various techniques available for recovering oil spilled at sea and cleaning polluted shorelines.

Level 2: Supervisors and On-Scene-Commanders. The responsibility of an On-Scene Commander (OSC) is to co-ordinate and manage the response to an oil spill. This includes developing and implementing a response organisation, deciding the response strategies to be used and coordinating all the activities involving the various parties. This course prepares the OSC for these responsibilities and is designed for those who already have some experience in oil spill response.

Level 3: Administrators and Senior Managers. This course is designed for those with little experience in oil spill response but who have a responsibility for ensuring that an oil spill response strategy is effective. It is suitable for government and industry representatives and covers all aspects of oil spill response preparedness and implementation.

These courses are held at various locations and can be held in specific areas on request. They are presented by accredited training organisations, such as Oil Spill Response Ltd in Southampton. A number of additional training courses, tailored for specific needs, are also presented by this organisation. In many cases, sponsorship to attend these courses is available.

Additional capacity building opportunities exist. This includes attendance of the International Oil Spill Conferences which are held in the USA/Canada every second year.

These conferences, where the leading international experts gather, cover a wide range of topics relating to oil spill response. Additionally, an exhibition of the main international oil spill response equipment and material suppliers is held, together with an on-water demonstration of some of this equipment. Sponsorship is available for attendance of delegates from developing countries.

It is the responsibility of all operators in Cameroon to ensure that their personnel are trained to be able to appropriately respond to an oil spill. The Government of Cameroon is responsible for training Government personnel that may be involved in oil spills. In this regard, it is recommended that senior managers and provincial delegates receive appropriate training first, allowing them to understand the full context of oil spill response and clean-up. This will enable them to appoint the appropriate personnel to undertake more detailed and intensive training.

TRAINING OF SENIOR MANAGERS AND PROVINCIAL DELEGATES

It is recommended that senior managers in the following Government Departments complete the IMO Level 3 course.

- Ministry of Environment and Forestry (MINEF)
- Ministry of Defense (MINDEF) - National Navy and National Corps of Fire Fighters
- Ministry of Transports (MINT) - Merchant Navy and The Department of Terrestrial Transportation
- Ministry of Mines, Water Resources, and Power (MINMEE)
- Ministry of Territorial Administration and Decentralization (MINATD)
- Ministry of Communication (MINCOM)
- Ministry of Livestock, Fisheries, and Animal Husbandry (MINEPIA) Ministry of Scientific and Technical Research (MINREST)
- Ministry of Public Health (MINSANTE)
- Ministry of Justice (MINJUSTICE)
- Ministry of Finance and Budget (MINFIB)
- Secretary of Defense (SED)
- General Delegation for National Security (DGSN)
- National Oil Organizations (SNH, SCDP, and SONARA)
- Others (National Ports Authority, Autonomous Ports, and CAMRAIL)
- Provincial Governor's office

TRAINING OF PERSONNEL WHO WILL BE DIRECTLY INVOLVED IN OIL SPILL RESPONSE AND CLEAN-UP

Once the senior managers have completed the IMO Level 3 course, they will be in a better position to identify the personnel in their relevant departments that would play a more hands-on role during an oil spill. These personnel must receive IMO Level 1 and Level 2 training. Other groups that will benefit from Level 1 and 2 training may include:

- Officials from municipalities of Douala, Kribi, Limbe etc;
- Fire departments;
- SONARA;
- SNH; and
- Oil companies

A.8.2 Exercises

Once the oil spill response role players have been trained and an oil spill contingency plan has been compiled, it is important that the plans themselves be properly exercised. This can range from a desktop exercise, which tests the communication and role player responsibilities described in the plans, to a full exercise where the response equipment is actually deployed in the field. The purpose of these exercises is to evaluate the effectiveness of the plan and readiness of the role players, and to amend the plan where shortcomings are identified. Guidelines for conducting such exercises are contained in IMO/IPIECA Report Series Volume 2: Guide to Oil Spill Exercise Planning.

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SECTION B:

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B.1 INTRODUCTION

This Operational Oil Spill Response Plan (the *blue pages* of the NOSCP), as well as the Data Directory that follows (Section C), must be kept up to date and amended as the information it contains becomes outdated and as pertinent new information becomes available.

The Operational Plan sets out the actions that need to be taken at the time of an oil spill, from the initial reporting of an incident to the termination of clean-up operations. The first part of the plan describes the main reporting procedures and the responses to be instituted over the duration of Tier 1, 2 and 3 spills at sea. Important in this regard, is the response to be initiated by the National Competent Authority (Ministry of Environment and Forestry, see Section A.4 for the discussion of roles and responsibilities) in situations where an oil spill either can or cannot be immediately linked to a responsible party, and/or where this party does/does not have the capability to respond to the incident. A major oil spill arising from maritime shipping operations, where neither the ship nor cargo owners have the capability to respond to the spill is clearly an example of a situation that differs from an oil spill arising from offshore oil production operations.

Figure B.1.1 presents a summary of the response strategies to be applied by the National Competent Authority in a variety of situations. Included in this strategy is the option for the National Competent Authority to instruct one or more offshore oil industry operators to respond to an incident where the party responsible for the spill either cannot be immediately identified or does not have the capability to respond. Whilst the primary responsibility for effecting the oil spill response will remain vested with the National Competent Authority in some situations, this responsibility will not extend to the level of deployment of equipment procured and held by the Government of Cameroon (see Section A.6.1).

Response Strategy Decision Flowchart

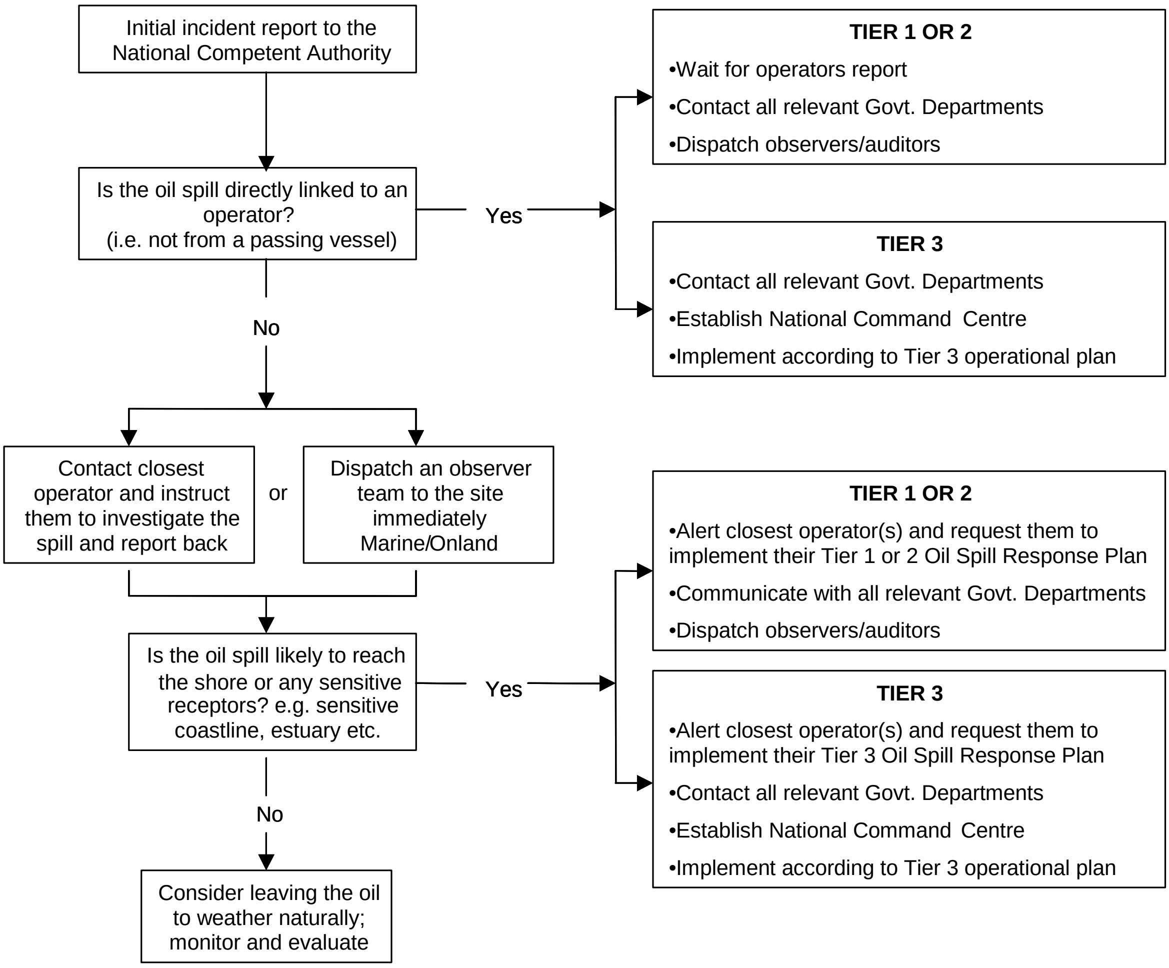

Figure B.1.1: Response Strategy Decision Flowchart

The second part of this Operational Plan deals with clean-up procedures once oil has impacted the shore. For this purpose, the coastline has been divided into five units corresponding to the country's five coastal Divisions. The priority for protection and clean-up of various coastal features (mangroves, sandy beaches, rocky shores, small lagoons, etc.), which occur within the defined units, is described as well as response actions to be instituted. Maps depicting these coastal features and the sensitivity of the coastal environment in which they are situated are contained in this Operational Oil Spill Response Plan. The Data Directory (Section C) contains contact details of all key role-players (Section C.1) and lists facilities (materials and equipment) available for use in the event of an oil spill (Section C.2).

B.2 OBJECTIVE

The primary objective of the Operational Oil Spill Response Plan is to minimize loss of time, and hence environmental damage, in carrying out the appropriate remedial action. This is achieved by clearly stating the functions and responsibilities of the various parties involved in the plan's implementation and by describing the infrastructure to be set up and the responses to be instituted by all parties for the duration of the incident.

B.3 AMENDMENTS

All amendments to this Operational Oil Spill Response Plan will be issued by the National Competent Authority (NCA) in the form of new pages, which are to replace the amended pages. The holders of each copy of this plan, as named in the Distribution List at the front of the NOSCP, will receive a copy of the new pages. The amendments are highlighted by a vertical line in the left hand margin.

Holders of the NOSCP are to advise the NCA of any changes of contact details (e.g.. telephone numbers), organisational details or any other relevant information immediately that it comes to their attention.

Upon receipt of an amendment letter from the NCA, the recipient is to verify its completeness and update the copy of the plan accordingly. After completing this update, the recipient is required to return to the NCA the tear-off slip that will accompany the amendment.

B.4 RESPONSE TO OIL SPILLS AT SEA

B.4.1 Tier 1 spill incidents

Tier 1 oil spill incidents cover relatively small spills that may result quite frequently from operational procedures at particular facilities situated within the marine and coastal environment (i.e. the risk sources described in Section A.2) and which do not pose an immediate significant threat to local socio-economic or environmental resources. These may include operational spills associated with offshore production operations, loading or unloading of product at the SONARA refinery oil jetty, loading of tankers at the COTCO offshore facilities and unloading of refined SONARA product from the coastal tanker in the Port of Douala.

B.4.1.1 Reporting of Tier 1 oil spills

In the event of a Tier 1 oil spill, the operator of the facility where the spill has occurred must report the incident to the National Competent Authority (see Section C.1 in the Data Directory for contact details) at the earliest opportunity following the incident. This initial report should be telephonic and should include, as a minimum, information on the following:

- Name and contact details of person reporting the spill;
- Date and time of spill;
- Volume and type of oil spilled;
- Source and reason for oil spill;
- Weather and wind conditions;
- Movement of oil slick – direction of travel;
- Potential threat to any local resources; and
- Response actions being taken.

Following the initial telephonic report to the NCA, the official *Oil Spill Report* (OSR001, contained in Section C.4 of the Data Directory) must be completed in full and submitted to the NCA by means of fax or e-mail (see Section C.1 in the Data Directory for contact details) within 24 hours of the spill occurring. The NCA must be kept informed should the situation escalate or should additional response measures be required.

The report OSR 000 (contained in Section C.3 of the Data Directory) must be completed in the case of oil spills reported to the NCA by members of the public or, for example, a local authority. This will apply to incidents where the party responsible for the spill is either not known or has failed to report the incident.

B.4.1.2 Action by National Competent Authority (NCA)

The NCA must acknowledge, in writing, receipt of the *Oil Spill Report* (OSR001) in the space provided on the report form. This acknowledgement must be directed to the operator who has submitted the report.

If the spill incident warrants it, the NCA must dispatch an official to assess the situation in the field to ensure that response actions are commensurate with the level of risk posed by the oil spill and that the actions taken are serving to reduce the potential impact on socio-economic and environmental resources. The NCA must monitor progress with the response activities.

The NCA must enter the information contained in the *Oil Spill Report* OSR001, together with any other relevant information, into the National Oil Spill Database to be created and managed by the NCA.

The NCA must forward *Oil Spill Report* OSR001, together with any other relevant information, to other parties represented on the National Oil Spill Response Standing Committee (NOSR-SC) who may have an interest in the incident or a responsibility to intervene. These authorities would include, but would not necessarily be limited to, the following:

- Ministry of Defense (MINDEF) – National Navy;
- Ministry of Mines, Water Resources and Power (MINMEE);
- Ministry of Livestock, Fisheries and Animal Husbandry (MINEPIA);
- SNH; and
- Any other Authority that the NCA may consider.

The actions to be instituted by the National Competent Authority and other government authorities are summarized in Table B.5.1.

Table B.5.1: Actions to be instituted by the NCA and other government authorities in a Tier 1 oil spill situation

Response by Cameroonian Government	*Responsible Authority*
1. Receive notification of oil spill incident from operator (Oil Spill Report OSR001)	MINEF
2. Distribute to relevant members of the NOSR-SC	MINEF
3. Despatch an audit team to visit the site if necessary	MINEF to coordinate. The team could include representatives from MINMEE, MINEPIA and MINREST.
4. Report to NOSR-SC as required	MINEF

B.4.1.3 Response by operator of facility responsible for oil spill

The response to an oil spill of this nature is considered to be the sole responsibility of the operator of the particular facility where the spill has occurred. In each of the identified operations that might result in a Tier 1 spill, possibly with the exception of the Douala Port Authority, the operators have sufficient resources to respond to a Tier 1 spill originating from the facility under their control. If for some reason the resources are depleted at the time of the spill, assistance shall be sought from neighbouring operators.

As discussed in Section A.5.2.1, the only feasible response option to a spill at sea is the application of approved oil spill dispersants. Facility operators are expected to launch this response with the minimum delay so as to minimize the chances of any oil reaching the coast. The offshore oil industry, as well as COTCO and the SONARA refinery, have dispersant stocks at hand and sea- and/or airborne applicators to respond to a Tier 1 spill at their facilities.

In the case of a light fuel spill in the Port of Douala, tugboats and other service vessels in the port must be used to break up and promote the natural dispersion of any slicks of petrol or diesel using bow waves and propeller wash. Sorbent materials must also be used to retrieve small spills of light oils that are contained in calm areas within the Port.

B.4.2 Tier 2 spill incidents

Tier 2 oil spill incidents are typically larger in volume than the Tier 1 incidents described above, and may pose a more significant threat to local resources. In Tier 2 situations, the oil spill response resources of the operator responsible for the facility from which the spill originates are unlikely to be sufficient to adequately respond to the scale of the incident. Additional equipment and material stocks available within the region must, therefore, be sourced to respond to the incident. Within Cameroon, such oil spill response resources are held by other operators within the region (the resources that are currently available are listed in Section C.2 of the Data Directory). Neither the NCA nor other government institutions hold dedicated stocks of oil spill response equipment and materials. An informal agreement between the current operators within Cameroon facilitates the sharing of resources in the event of a Tier 2 type incident.

Tier 2 spill incidents may arise from a shipping accident, for example, in the port entrance channel within Estuaire du Cameroun or in the offshore shipping lanes. Such incidents could also result from offshore drilling and oil production operations, the operation of COTCO's offshore facility and oil spills occurring in a neighbouring state (Nigeria, Equatorial Guinea) that drift into Cameroon's territorial waters.

B.4.2.1 Reporting of Tier 2 oil spills

In the event of a Tier 2 oil spill, the operator of the facility where the spill has occurred must report the incident to the National Competent Authority (see Section C.1 in the Data Directory for contact details) at the earliest opportunity following the incident. Operators are also required to report the presence of an oil slick within the vicinity of their facility, which has originated from a source other than their own. Note, that this action does not bind the operator making the report to take any immediate response action unless specifically requested to do so by the NCA. The initial report should be telephonic and should include, as a minimum, information on the following:

- Name and contact details of person reporting the spill;
- Date and time of spill;
- Volume and type of oil spilled;
- Source and reason for oil spill;
- Weather and wind conditions;
- Movement of oil slick – direction of travel;
- Potential threat to any local resources; and
- Response actions being taken.

Following the initial telephonic report to the NCA, the official *Oil Spill Report* (OSR001, contained in Section C.4 of the Data Directory) must be completed in full and submitted to the NCA by means of fax or e-mail (see Section C.1 in the Data Directory for contact details) within 24 hours of the spill occurring. The NCA must be kept informed of progress should the situation escalate or should additional response measures be required. In this regard, a situation update outlining the development of the oil spill incident, the actions taken, the effectiveness of these actions and the actual or potential impact of the oil on any socio-economic or environmental resources, should be submitted to the NCA every 24 hours (or at other intervals agreed to by the NCA) using the *Oil Spill Report* OSR001.

The NCA must acknowledge, in writing, receipt of the *Oil Spill Report* (OSR001) in the space provided on the report form. This acknowledgement should be directed to the operator who has submitted the report. The NCA must enter the information contained in the *Oil Spill Report* OSR001, together with any other relevant information, into the National Oil Spill Database to be created and managed by the NCA.

The NCA must forward the *Oil Spill Report* OSR001, together with any other relevant information, to other authorities and members of the NOSR-SC, recognized as having an interest in the incident or a responsibility to intervene. These parties would include, but would not necessarily be limited to, the following:

- The office of the Governor within whose province the oil has stranded;
- Ministry of Defense (MINDEF) – National Navy;
- Ministry of Transports (MINT) – Merchant Navy and the Department of Terrestrial Transportation;
- Ministry of Mines, Water Resources and Power (MINMEE);
- Ministry of Territorial Administration and Decentralisation (MINATD);
- Ministry of Communications (MINCOM);
- Ministry of Livestock, Fisheries and Animal Husbandry (MINEPIA);
- Ministry of Scientific and Technical Research (MINREST);
- Ministry of Public Health (MINSANTE);
- Ministry of Justice (MINJUSTICE);
- Ministry of Finance and Budget (MINFIB);
- Secretary of Defense (SED);
- General Delegation for National Security (DGSN); and
- SNH.

Within one week following the termination of the oil spill response activities, the *Oil Spill Response/Clean-up Review Report OSR002* (contained in Section C.5 of the Data Directory) should be submitted to the NCA. This report, which provides an overview of the oil spill and response activities, must also contain proposed terms of reference for a post-spill audit that will need to be conducted in order to establish the impacts of the oil spill on Cameroon's socio-economic and/or environmental resources. Once the terms of reference have been approved by the NCA, the audit must be undertaken by a competent institution (see the guidelines for post-spill audits presented in Section C.6 of the Data Directory). An interim audit report, containing the results and conclusions of the assessment, must be submitted within six months of the termination of the oil spill response and the final audit report (modified where necessary) must be submitted within three months of the NCA's review of the draft report.

B.4.2.2 Action by National Competent Authority (NCA), National Incident Command Team (NICT) and other government authorities

The Ministry of Environment and Forests (MINEF) as the National Competent Authority (NCA) is responsible for receiving initial notification of all oil spill incidents in Cameroon and is, therefore, responsible for initiating the Government of Cameroon's response in the event of a Tier 2 incident. MINEF, together with the National Navy, the Ministry of Territorial Administration and Decentralisation (MINATD) and the Ministry of Communications (MINCOM) constitute the *National Incident Command Team*, with the National Navy assuming overall command in the case of Tier 3 incidents at sea (see discussion of Tier 3 incidents). If an oil spill remains classified as a Tier 2 incident, there is no requirement for the *National Incident Command Team* (NICT) to mobilize. However, the

NCA should immediately alert the NICT to Tier 2 incidents and keep the team informed of developments. In the event that a situation elevates to Tier 3 status the NICT will be well prepared to mobilize. The number of other authorities and institutions involved in the response and clean-up actions will depend on the nature, size and potential impact of the oil spill.

Table B.5.2 outlines the response that the various authorities involved in National Oil Spill Response must initiate in the event of a Tier 2 incident. The authority responsible for implementing the action is indicated in the right hand column of the table.

Table B.5.2: Actions to be instituted by the NCA, NICT and other government authorities in a Tier 2 oil spill situation

Response by Cameroon Government	*Responsible Authority*
1. Receive verbal and written notification of Oil Spill Report OSR001	MINEF
2. Alert *National Incident Command Team* and establish if the incident warrants a full response involving other authorities; i.e. socio-economic or environmental resources are threatened, clean up action is required or the situation could elevate to a Tier 3 incident.	MINEF ***National Incident Command Team* (NICT):** ▪ National Navy ▪ Ministry of Territorial Administration and Decentralization (MINATD) ▪ Ministry of Environment and Forests (MINEF) ▪ Ministry of Communications (MINCOM)
(a) If full response is not warranted then:	
3. Distribute Oil Spill Report (OSR001) to the list of authorities below: ▪ National Navy ▪ MINATD ▪ MINMEE ▪ MINEPIA ▪ SNH ▪ other selected members of the NOSR-SC	MINEF
4. Despatch an observer/audit team to the site to observe oil spill response activities and clean-up actions, if required.	Observer team from MINEF and, where appropriate, representatives from MINMEE, MINEPIA, and other authorities.
5. Receive and review operator's Oil Spill Response/Clean-up Review Report (OSR002).	MINEF
6. Receive and review Terms of Reference for Post-Spill Audit.	MINEF
7. Review and accept Port-Spill Audit Report.	MINEF
8. Debriefing session with the NOSR-SC.	MINEF
(b) If full response is warranted then:	
3. Mobilise *National Incident Command Team* and establish National Command Centre.	MINEF to assemble NICT ***National Incident Command Team* (NICT):** ▪ National Navy assumes command of NICT ▪ Ministry of Territorial Administration and Decentralization (MINATD) takes over command of NICT as/if response operations become shore-based ▪ Ministry of Environment and Forests

Response by Cameroon Government	*Responsible Authority*
	(MINEF) ▪ Ministry of Communications ***National Command Centre:*** Establish 24hr Operations Room at Douala Naval Base.
4. Coordinate communication with all relevant Government Departments and institutions.	MINEF to contact NOSR-SC, MINMEE, MINEPIA, SNH and others.
5. Coordinate communications with affected communities, the public, media and neighbouring countries if required.	▪ MINCOM to communicate with media, general public and neighbouring countries (if necessary) ▪ MINATD through the Provincial Governors Office, to communicate with local communities.
6. Despatch an observer team to the site to observe oil spill response activities and clean-up actions, if any.	Observer team may include representatives from MINEF, MINMEE MINEPIA, and others.
7. Facilitate implementation of operator's Oil Spill Response Plan (i.e. assist with customs and immigration, etc) if required.	National Navy, as the *Incident Commander*, will facilitate this through Customs (Ministry of Finance) and Immigration (Department General delegation for National Security).
8. Receive Spill Report Updates (Report form OSR001).	MINEF responsible for documentation control, filing and database entry.
9. Coordinate Government resources for oil spill response if assistance is requested by the operator. ▪ Record expenses for the following items: – Equipment used for response – Personnel deployed for response	National Navy to coordinate use of vessels and other equipment and personnel that may be required to assist with the oil spill response at sea. As response effort focuses on shoreline clean-up, responsibility for coordination shifts to MINATD.
10. Coordinate Government resources for shoreline clean-up actions if assistance is requested by the operator (See Section B.5). ▪ Record expenses for the following items: – Equipment used for clean-up – Personnel deployed for clean-up – Accommodation costs – Travel costs – Material costs	MINATD to coordinate, in collaboration with the Provincial Governor's office; i.e. control shifts from the Navy to MINATD.
11. Keep the NOSR-SC informed of incident.	MINEF
12. Receive and review operator's Oil Spill Response/Clean-up Review Report (OSR002).	MINEF
13. If necessary, dispatch an audit team to the site to assess possible socio-economic and environmental damage and collect relevant data to facilitate possible compensation claims.	MINEF, MINEPIA, MINMEE, MINFIB, MINJUSTICE
14. Investigate waste disposal options for oily waste if necessary.	MINEF, MINMEE
15. Receive and review Terms of Reference for Post-Spill Audit.	MINEF
16. Review and accept Post-Spill Audit Report.	MINEF
17. Debriefing session with the NOSR-SC.	NICT
18. Record keeping of all equipment and resources deployed by the Government of Cameroon and expenses incurred.	All departments involved in response and clean-up actions. To be coordinated by MINFIB.

B.4.2.3 Response by operator of facility responsible for oil spill

As with Tier 1 spills, the response to Tier 2 spills is the responsibility of the operator of the particular facility from where the oil spill originates. It is the responsibility of the operator to ensure that the release of oil is stopped as soon as possible, that own resources are deployed without delay and that additional resources are sourced from operators within the area to assist in responding to the spill.

As with Tier 1 spills, the application of approved dispersants is considered to be the prime response option at sea, particularly if the oil slick is expected to move towards sensitive coastal features, such as the mangrove ecosystems occurring within the Estuaire du Cameroun and the Rio del Rey. The application of dispersants shall be carried out in accordance with the individual operator's oil spill contingency plans.

Should it not be possible to successfully disperse all of the spilled oil at sea, or within large coastal water bodies such as the Estuaire du Cameroun, and there is a likelihood of oil impacting the shoreline, then the preventative and clean-up measures described in Section B.5 of this Operational Oil Spill Response Plan shall be implemented.

Situations might arise where oil spills emanate from sources other than those facilities under the responsibility of local operators; e.g. offshore shipping incidents, spills from neighbouring states, etc. Here, operators, who have a response capability may be instructed by the NCA to respond to the spill until such time as the spill source and responsible party has been identified. The operators will be entitled to compensation for clean-up efforts, which shall be to the account of the party responsible for the oil spill. The NCA shall, with the assistance of the NOSR-SC, recover the oil spill response costs from the responsible party, and shall reimburse the operators for costs incurred in responding to the oil spill.

B.4.3 Tier 3 spill incidents

Tier 3 incidents usually occur less frequently than Tier 1 and 2 incidents and are generally characterized by the release of large quantities of oil that may have a significant impact on the environment. In these situations, the local response capability is exceeded and additional oil spill response resources need to be brought in from other countries. These resources (equipment, materials) would typically be sourced from one of a number of international oil industry-owned response bases around the world.

Tier 3 situations may develop when an incident originally categorized as a Tier 2 situation escalates in severity, either due to increasing quantities of oil being released or in situations where the spilled oil moves into sensitive areas, which require additional oiling prevention and clean-up measures. They may also arise as a result of a catastrophic situation where large quantities of oil are released, for example, in the case of a well blow-out or a tanker collision.

B.4.3.1 Reporting of Tier 3 oil spills

In the event of a Tier 3 oil spill, the operator of the facility where the spill has occurred, or any other party responsible for the spill, must immediately report the incident to the commander of the *National Incident Command Team* (NICT). Thereafter, an incident report must be submitted to the National Competent Authority (see Section C.1 in the Data Directory for contact details). The Commander of the NICT will represent the office of the *National Navy* (MINDEF), i.e. first contact should be made with the National Navy. In the case of a Tier 2 spill escalating into a Tier 3 situation, the update reporting procedure (using *Oil Spill Report OSR001*) must clearly indicate that the incident has escalated in scale.

If the spill has not previously been reported, the initial report which shall be telephonic, should include, as a minimum, information on the following:

- Name and contact details of person reporting the spill;
- Date and time of spill;
- Volume and type of oil spilled;
- Source and reason for oil spill;
- Weather and wind conditions;
- Movement of oil slick – direction of travel;
- Threat to local resources;
- Response actions being taken and planned;
- Details of assistance and additional equipment that will be brought into Cameroon to assist with the response; and
- Details of any additional assistance that may be required from the authorities in Cameroon.

Following the initial telephonic report to the Commander of the NICT, contact should be made with the NCA the official *Oil Spill Report* (OSR001, contained in Section C.4 of the Data Directory) must be completed in full and submitted to the NCA by means of fax or e-mail (see Section C.1 in the Data Directory for contact details) within 24 hours of the spill occurring. The NCA must be kept informed of progress, and in this regard, a situation update outlining the development of the oil spill incident, the actions taken, the effectiveness of these actions and the actual or potential impacts of the oil on socio-economic and environmental resources, should be submitted to the NCA every 24 hours (or at other intervals agreed to by the NCA) using the *Oil Spill Report* OSR001.

The NCA must acknowledge, in writing, receipt of the *Oil Spill Report* (OSR001) in the space provided on the report form. This acknowledgement should be directed to the operator, or party responsible for the oil spill, who has submitted the report. The NCA must enter the information contained in the *Oil Spill Report* OSR001, together with any other relevant information, into the National Oil Spill Database to be created and managed by the NCA.

The NCA must forward *Oil Spill Report* OSR001, together with any other relevant information, to members of the NOSR-SC recognized as having an interest in the incident or a responsibility to intervene. These parties would include, but would not necessarily be limited to, the following:

- The office of the Governor within whose province the oil has stranded;
- Ministry of Defense (MINDEF) – National Navy;
- Ministry of Transports (MINT) – Merchant Navy and the Department of Terrestrial Transportation;
- Ministry of Mines, Water Resources and Power (MINMEE);
- Ministry of Territorial Administration and Decentralisation (MINATD);
- Ministry of Communications (MINCOM);
- Ministry of Livestock, Fisheries and Animal Husbandry (MINEPIA);
- Ministry of Scientific and Technical Research (MINREST);
- Ministry of Public Health (MINSANTE);
- Ministry of Justice (MINJUSTICE);
- Ministry of Finance and Budget (MINFIB);
- Secretary of Defense (SED);
- General Delegation for National Security (DGSN); and
- SNH.

Within one week following the termination of the oil spill response activities (or upon instruction of the NCA), the *Oil Spill Response/Clean-up Review Report OSR002* (contained in Section C.5 of the Data Directory) should be submitted to the NCA by the party responsible for the oil spill, or by the party instructed to do so. This report, which presents an overview of oil spill and response activities, shall also contain proposed terms of reference for a post-spill audit to be conducted in order to establish the impacts of the oil spill on Cameroon's socio-economic and/or environmental resources. Once the terms of reference have been approved by the NCA, the audit must be undertaken by a competent institution (see the guidelines for post-spill audits presented in Section C.6 of the Data Directory). An interim audit report, containing the results and conclusions of the assessment, must be submitted within six months of the termination of the oil spill response, and the final audit report (modified where necessary) must be submitted within three months of the NCA's review of the draft report.

B.4.3.2 Action by the National Incident Command Team (NICT), the National Competent Authority (NCA) and other government authorities

The National Incident Command Team will receive immediate notification of the Tier 3 incident and will assume control of the National response activities for the at sea aspects of operation.

The Ministry of Environment and Forests (MINEF) as the National Competent Authority (NCA) is responsible for receiving notification of all oil spill incidents in Cameroon and is, therefore, responsible for the administrative aspects of the Government of Cameroon's response in the event of a Tier 3 incident. MINEF, together with the National Navy, the Ministry of Territorial Administration and Decentralisation (MINATD) and the Ministry of Communications (MINCOM) constitute the *National Incident Command Team*, with the National Navy assuming overall command. Each of the *National Incident Command Team* members have specific roles and responsibilities to fulfill. While the National Navy, MINTAD and MINCOM will be involved for the duration of the incident, MINEF, as the National Competent Authority, will ensure overall administrative co-ordination during and after the incident. The number of other authorities and institutions involved in the response and clean-up actions will depend on the nature, size and potential impact of the oil spill.

Table B.5.3 outlines the response that the various authorities involved in National Oil pill Response must initiate in the event of a Tier 3 incident. The authority responsible for implementing the action is indicated in the right hand column of the table.

Table B.5.3: Actions to be instituted by the NICT, the NCA and other government authorities in a Tier 3 oil spill situation

Response by Cameroon Government	*Responsible Authority*
1. Receive first notification of the Tier 3 spill 2. Receive verbal and written notification of Oil Spill Report OSR001	National Navy (MINDEF) MINEF
3. Immediately assemble *National Incident Command Team* and establish National Command Centre.	***National Incident Command Team* (NICT):** ▪ National Navy (incident commander) ▪ Ministry of Environment and Forests (MINEF) ▪ Ministry of Communications ▪ Ministry of Territorial Administration and Decentralization (MINATD), ***National Command Centre:*** Establish 24hr Operations Room at Douala Naval Base.
4. Coordinate communication with all relevant Government Departments and institutions.	MINEF to contact NOSR-SC, MINMEE, MINEPIA, SNH and others.

Response by Cameroon Government	*Responsible Authority*
5. Coordinate communications with affected communities, the public, media and neighbouring countries if required.	▪ MINCOM to communicate with media, general public and neighbouring countries (if necessary) ▪ MINATD through the Provincial Governors Office, to communicate with local communities.
6. Despatch an observer team to the site to monitor oil spill response activities and clean-up actions.	Observer team may include representatives from MINEF, MINMEE MINEPIA, and others.
7. Facilitate implementation of operator's Oil Spill Response Plan (i.e. assist with customs and immigration, etc) if required.	National Navy, as the Incident Commander, will facilitate this through Customs (Ministry of Finance) and Immigration (Department General delegation for National Security) *.
8. Receive Spill Report Updates (Report form OSR001).	MINEF responsible for documentation control, filing and database entry.
9. Coordinate Government resources for oil spill <u>response</u> if assistance is requested by the operator. ▪ Record expenses for the following items: – Equipment used for response – Personnel deployed for response	National Navy to coordinate use of vessels and other equipment and personnel that may be required to assist with the oil spill response.
10. Coordinate Government resources for oil spill <u>clean-up</u> actions if assistance is requested by the operator (See Section B.5). ▪ Record expenses for the following items: – Equipment used for clean-up – Personnel deployed for clean-up – Accommodation costs – Travel costs – Material costs	MINATD with the Provincial Governor's Office to coordinate and take over control from the National Navy.
11. Keep the NOSR-SC informed of incident.	MINEF
12. Receive and review operator's Oil Spill Response/Clean-up Review Report (OSR002).	MINEF
13. Dispatch an audit team to the site to assess possible socio-economic and environmental damage and collect relevant data to facilitate possible compensation claims.	MINEF, MINEPIA, MINMEE, MINFIB, MINJUSTICE
14. Investigate disposal options for oily waste, if required.	MINEF, MINMEE
15. Receive and review Terms of Reference for Post-Spill Audit.	MINEF
16. Review and accept Post-Spill Audit Report.	MINEF
17. Debriefing session with the NOSR-SC.	NICT
18. Record keeping of all equipment and resources deployed by the Government of Cameroon and expenses incurred.	All departments involved in response and clean-up actions. Compensation claims to be coordinated by MINFIB.

* For Tier 3 spills attributable, for example, to a shipping incident, NICT to request international assistance

B.4.3.3 Response by operator of facility responsible for oil spill

As with Tier 1 and 2 spills, the response to Tier 3 spills is the responsibility of the operator of the facility from where the oil spill originates. In most cases involving large Tier 3 spills, the party responsible for the spill is readily identifiable. It is the responsibility of this party to ensure that the release of oil is stopped as soon as possible, that own resources are deployed immediately and that additional international resources are sourced and mobilized with minimum delay. Equipment and materials brought into the country to assist with the response could include dispersant stocks and application equipment, booms and skimmers for protecting sensitive coastal areas and equipment for cleaning impacted areas of shoreline. Equipment such as that used for mechanical recovery of oil at sea would not be considered.

Situations might arise where oil spills emanate from sources other than those facilities under the responsibility of local operators (e.g. a major offshore shipping incident). Here, operators, who have the capability to respond initially, prior to the arrival of international support, may be instructed by the NCA to respond to the spill. The operators will be entitled to compensation for their intervention efforts, which shall be to the account of the party responsible for the oil spill. The NCA, with the assistance of the NOSR-SC, shall recover the oil spill response costs from the responsible party and shall reimburse the operators.

The application of approved dispersants is considered to be the prime response option at sea, particularly if the oil slick is expected to move towards sensitive coastal features, such as the mangrove ecosystems occurring within the Estuaire du Cameroun and the Rio del Rey. The application of the dispersants shall be carried out in accordance with the individual operator's oil spill contingency plans and/or international best practice.

Should it not be possible to successfully disperse all of the spilled oil at sea, or within large coastal water bodies such as the Estuaire du Cameroun, and there is a likelihood of oil impacting the shoreline, then the preventative and clean-up measures described in Section B.5 of this Operational Oil Spill Response Plan shall be implemented.

B.5 SITE-SPECIFIC OIL SPILL RESPONSE ACTIONS FOR COASTAL AREAS

This section of the Operational Oil Spill Response Plan sets out the coastal protection measures that are to be put into immediate effect when the efforts to disperse spilled oil offshore have not been effective and the oil is likely to impact the shoreline. Shoreline clean-up measures that are to be implemented are also described.

In the event of a major spill, large stretches of the coastline may be threatened, and ultimately impacted by oil. Given that oil spill response resources are limited, prioritization for protection and clean-up is, therefore, important. The significance of the environmental sensitivity analysis, which is presented in Section A.3, is apparent in the prioritization that is prescribed below for clean-up. The sensitivity maps covering the five zones are presented here to illustrate the correlation in this regard (Figures B.5.1 to B.5.5). For each of the five zones described below, coastal features meriting priority attention are identified in order to direct activities to the protection and clean-up of these areas (Figures B.5.6 to B.5.10). The system used to classify and identify the coastal features on these maps follows the classification system applied in Tables B.5.4 to B.5.8, which are discussed next.

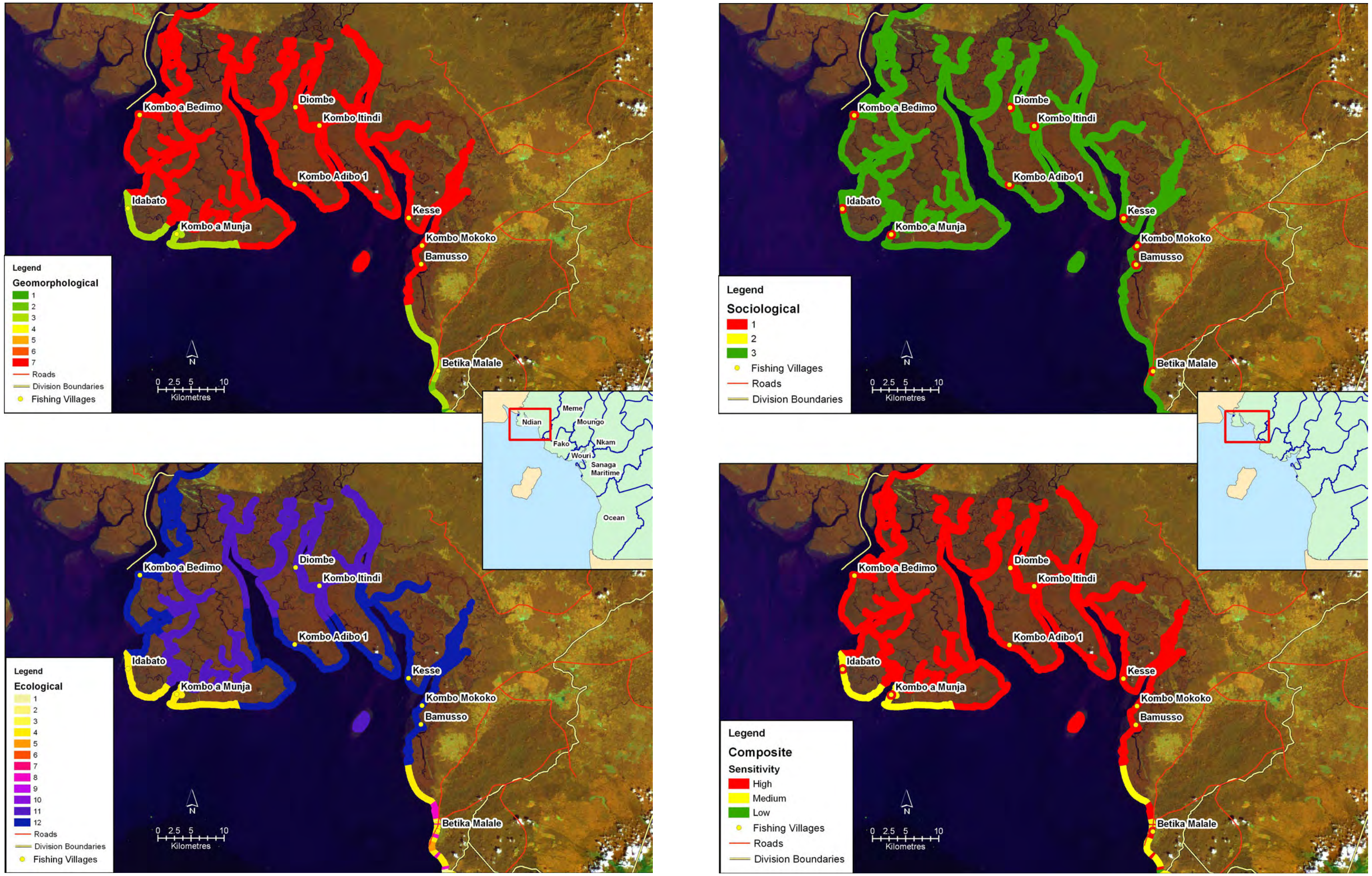

Figure B.5.1: Geomorphological, ecological and socio-economic features of the Ndian Division coastline as well as the combined classification of sensitivity to oiling. See Tables A.3.22 and A.3.23 for a description of the figure legends.

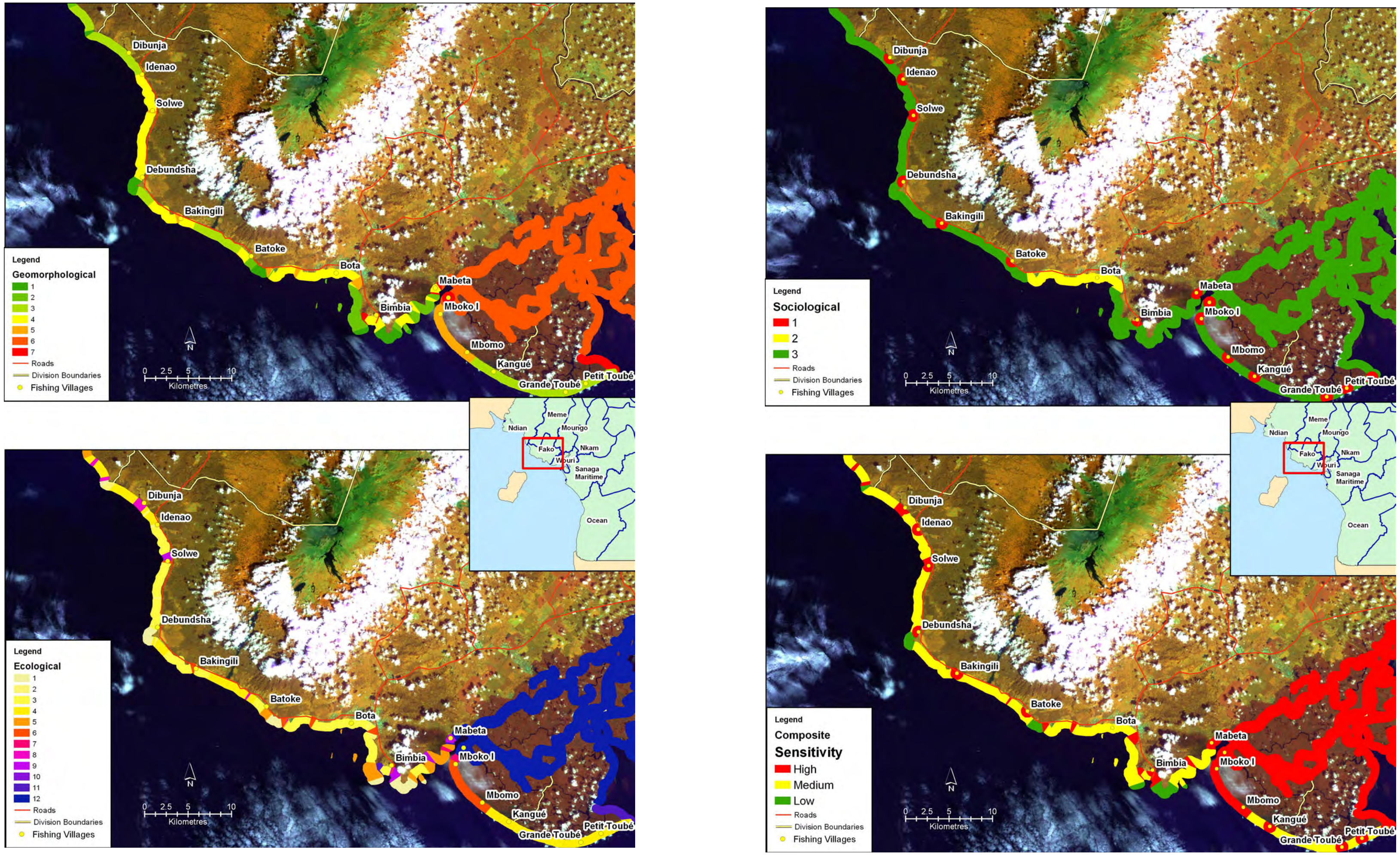

Figure B.5.2: Geomorphological, ecological and socio-economic features of the Fako Division coastline as well as the combined classification of sensitivity to oiling. See Tables A.3.22 and A.3.23 for a description of the figure legends.

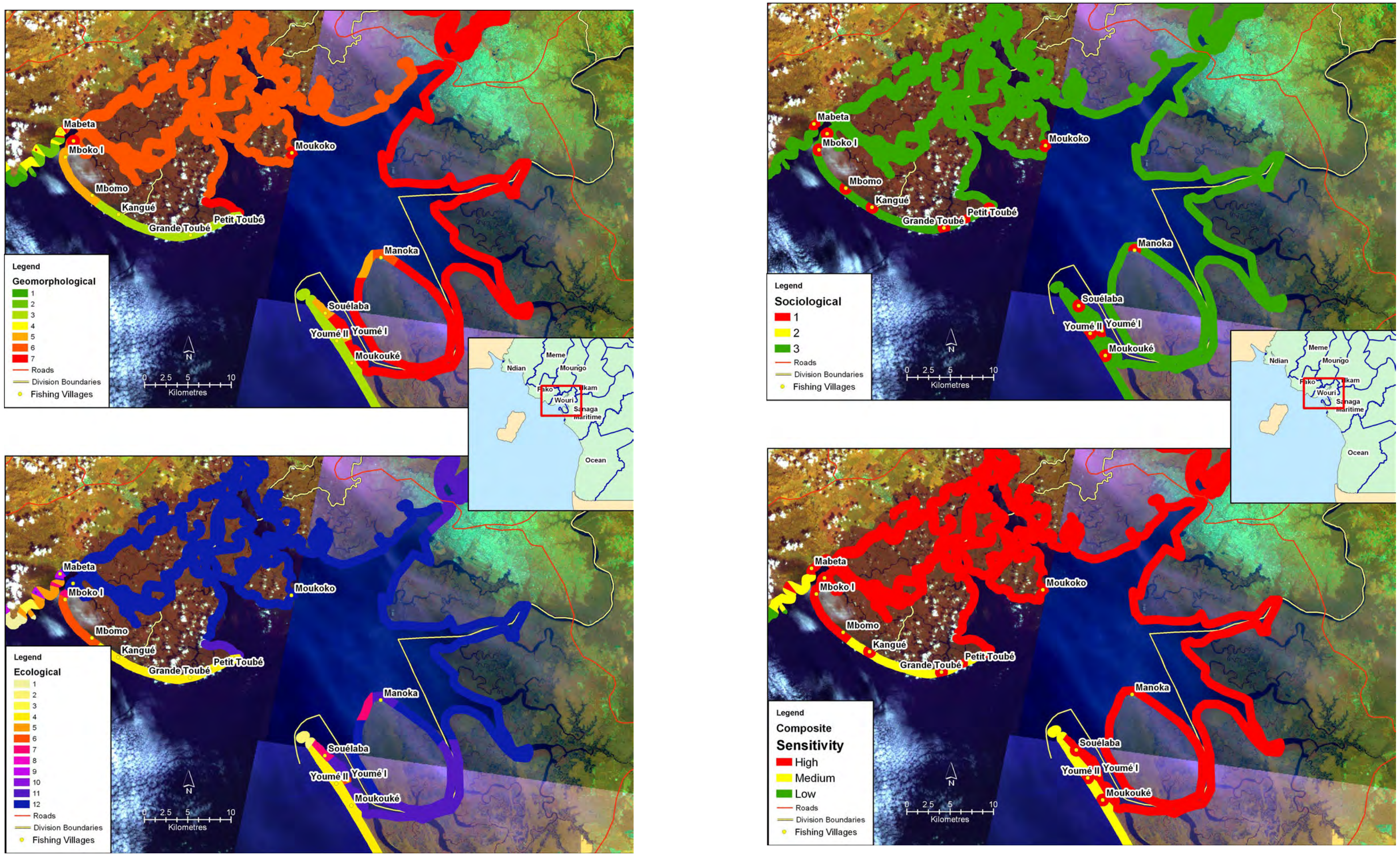

Figure B.5.3: Geomorphological, ecological and socio-economic features of the Wouri Division coastline as well as the combined classification of sensitivity to oiling. See Tables A.3.22 and A.3.23 for a description of the figure legends.

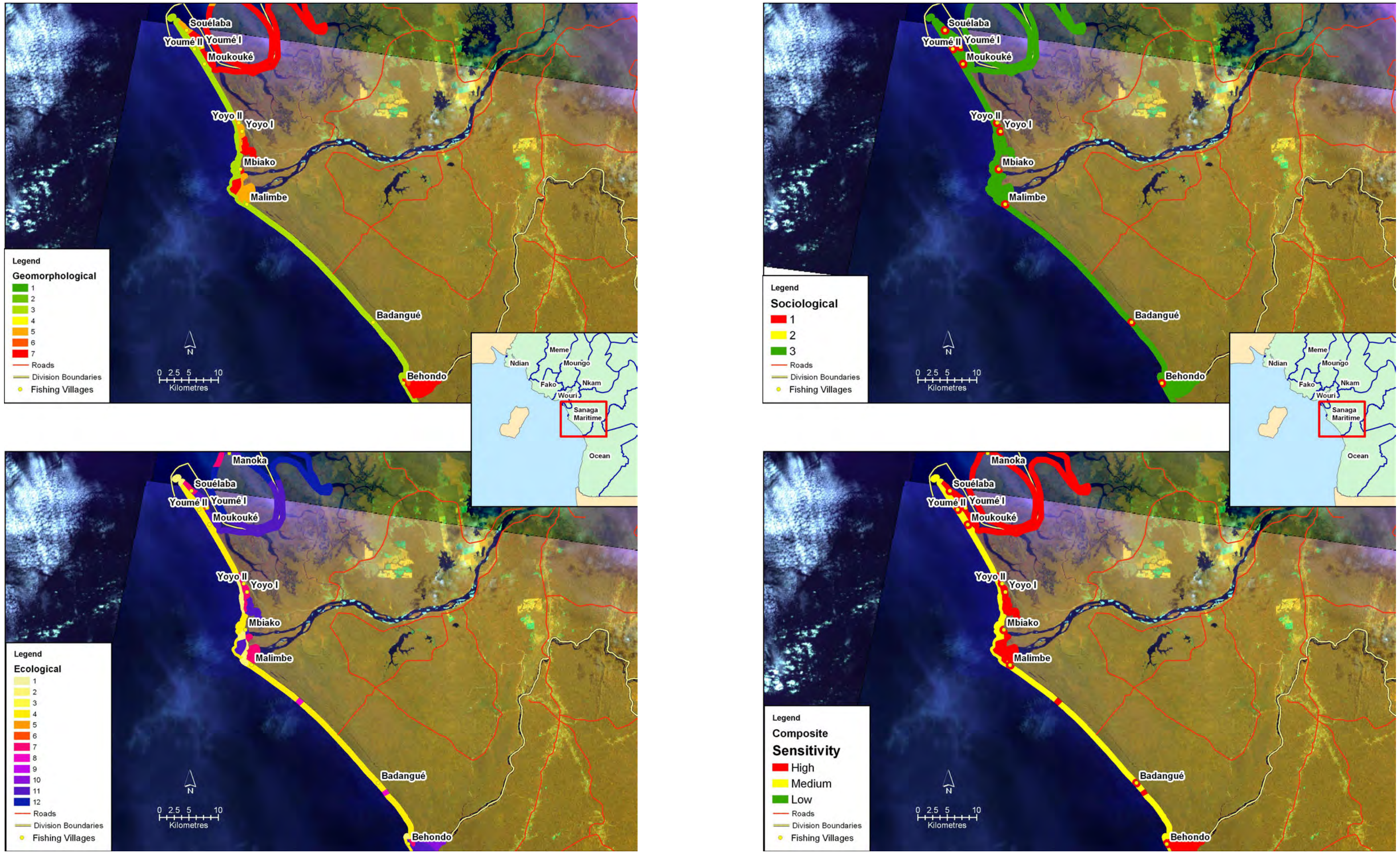

Figure B.5.4: Geomorphological, ecological and socio-economic features of the Sanaga-Maritime Division coastline as well as the combined classification of sensitivity to oiling. See Tables A.3.22 and A.3.23 for a description of the figure legends.

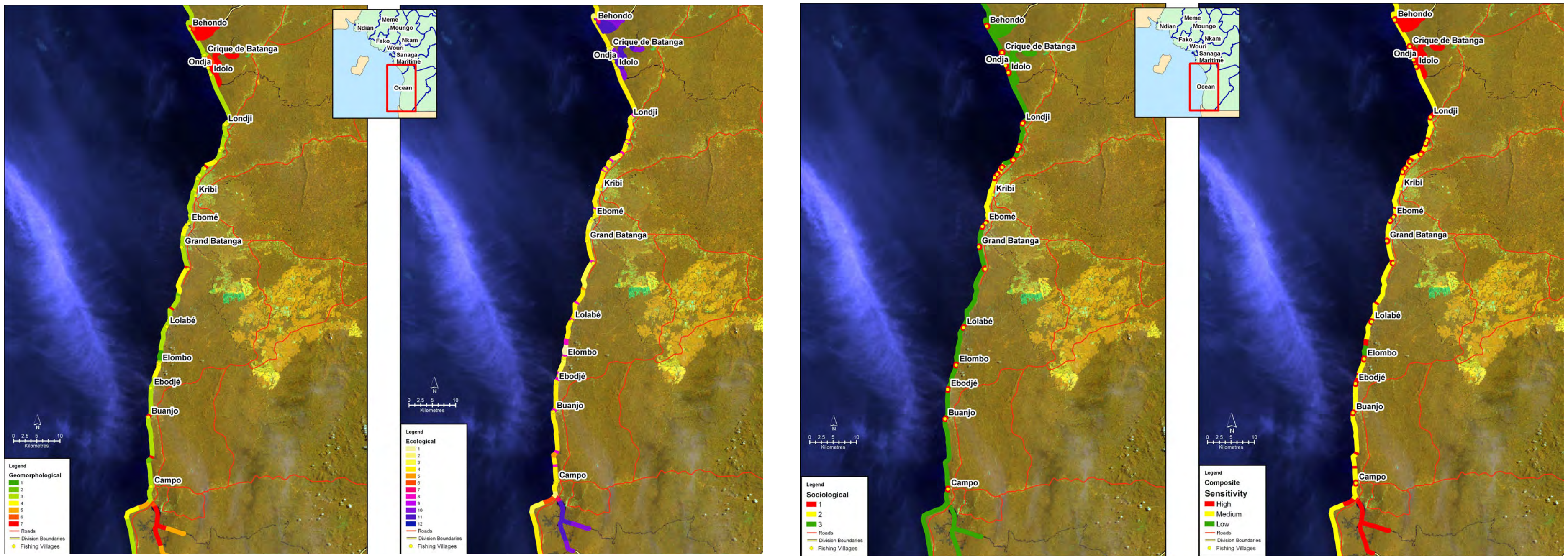

Figure B.5.5: Geomorphological, ecological and socio-economic features of the Océan Division coastline as well as the combined classification of sensitivity to oiling. See Tables A.3.22 and A.3.23 for a description of the figure legends.

For the purpose of assigning area-specific responsibilities for certain aspects of oil spill response, the coastline has been divided into five zones, based on the areas of Divisional jurisdiction within the country's three coastal Provinces (South-West Province, Littoral Province and South Province). This information is presented in Tables B.5.4 to B.5.8. For each zone, reference is made to the Provincial Governors and Senior Divisional Officers who will be responsible for the administration of certain aspects of oil spill response (see Sections C.1 in the Data Directory). In this respect, the main areas of support that will be provided by these authorities will include the supply of information applicable to oil spill response (e.g. information on access to affected areas) and the deployment of local labour, equipment and materials of opportunity that may be needed in the course of response operations. Communication with local communities, who may be affected by oil pollution and/or the oil spill response operations, and the initial coordination of claims for loss and damage suffered by communities as a result of oil spills, is also an important area of support that will be provided by these authorities.

Priorities for both protection and clean-up are indicated in Tables B.5.4 to B.5.8 by means of the words *high*, *medium* and *low*. Priorities are established on the grounds of:

- *Important coastal features* located within each of the five zones;
- *vulnerability* – the likelihood of oil stranding in particular areas; e.g. oil is more likely to strand in low energy, sheltered areas, such as mangrove environments, than in steep rocky cliff areas exposed to high wave energies;
- *environmental sensitivity* – areas where the potential environmental impact of an oil spill would be high (e.g. in ecologically diverse mangrove forests), are given a high priority, whereas areas of low ecological diversity (e.g. dynamic beach systems consisting of coarse sediments, supporting a low diversity of fauna) are given a lower priority; and
- *socio-economic importance* – areas where socio-economic activities are located (e.g. artisanal fisheries that would be negatively impacted by an oil spill) are given a high priority rating.

Specific instructions for the protection and clean-up of coastal features are provided in Tables B.5.4 to B.5.8, and are listed in geographic sequence from north to south for the five zones (Coastal Divisions) that are distributed along the coastline. It is important to note that for certain areas, no clean-up measures are recommended - where, for example, exposure to surf action combined with a steeply sloping beach profile would promote natural cleansing. There are also stretches of the coastline that are relatively inaccessible, where clean-up is to be initiated only if there are compelling reasons for doing so (e.g. due to the ecological significance of small lagoons or the presence of a fishing village).

It should be noted that the prescribed protection and clean-up measures are based on available information pertaining to the current situation regarding the coastal environment and the availability of oil spill response resources. Should this situation change in future, different approaches to oil spill response may need to be adopted. This highlights the need for the NOSCP to be regularly reviewed and amended where necessary, based, for example, on the information derived from post-spill audits that are conducted.

Table B.5.4: Oil Spill Response, Area A: South West Province: Ndian Division (from the Akwayafé River to Onge River)

Authorities:

Governor of South-West Province and Senior Divisional Officer
See Data Directory for contact details

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
A1: Akwayafé River to Bamusso					
A1.1	Primarily muddy shorelines with mangroves and intertidal mudflats in the Rio del Rey Basin where there are no special features as listed below	High	Off-shore dispersant application Application of dispersants in the open water body of the Rio del Rey using helicopter/ small boats Deployment of booms across threatened small creeks where possible	High	• Recover floating contained oil with skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels • Limited access to extensive mangroves makes clean-up action unfeasible inside the mangroves • Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)
A1.2	Sandy beaches on the western and southern shores of the Bakassi Peninsula	Low	Off-shore dispersant application	Low	No action required; there are no confirmed records of turtles nesting on these shores at present, this needs to be verified by consulting the experts when there is a spill
A1.3	Occasional fishing villages e.g. Idabato, Kombo Itindi	High	Off-shore dispersant application	High	Remove stranded oil manually from sandy and muddy shorelines at fishing villages

Ref	Coastal features	Protection		Clean-up	
		Priority rating	Action	Priority rating	Action (see section A.5.2.1 and A.5.2.2)
A2: Bamusso to Onge River					
A2.1	Primarily steep sandy beaches with rocky outcrops and headlands from Bekume-Ubemekang to Onge River where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required; there are no confirmed records of turtles nesting on these shores at present, this needs to be verified by consulting the experts when there is a spill
A2.2	Muddy shorelines with mangroves and intertidal mudflats from Bamusso to Bekume-Ubemekang	High	Off-shore dispersant application Deployment of booms across threatened small creeks where possible	High	• Recover floating contained oil with skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels • Limited access to extensive mangroves makes clean-up action unfeasible inside the mangroves • Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)
A2.3	Occasional fishing villages e.g. Njenda, Inodo, Betika Madalé	High	Off-shore dispersant application	High	Remove stranded oil manually from sandy and rocky shorelines at fishing villages
A2.4	Seasonally open lagoons along the coast (north of Njagassa, between Njagassa and Betika Point, between Betika Point and Onge River)	High	Off-shore dispersant application Boom within lagoon, when open, to protect mangrove/swamp forest fringe if possible	High	• Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used • Collect stranded oil from sandy lagoon shoreline manually

Table B.5.5: Oil Spill Response, Area B: South West Province: Fako Division (from Onge River to Kangué)

Authorities:

Governor of South-West Province and Senior Divisional Officer
See Data Directory for contact details

Ref	*Coastal feature*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
B1: Onge River to Limbe					
B1.1	Primarily rocky shoreline interspersed with a few sandy beaches where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required; there are no confirmed records of turtles nesting on these shores at present, this needs to be verified by consulting the experts when there is a spill
B1.2	Occasional fishing villages e.g. Solwe, Debundscha, Bakingili; towns at Idenau, Batoke, Bota, Limbe; small harbours at Limbe and Idenau	High	Off-shore dispersant application	High	⊙ Remove stranded oil manually from sandy and rocky shorelines at fishing villages ⊙ Remove stranded oil manually from harbour shoreline and facilities
B1.3	Tourist and amenity centres e.g. New Seme Beach Hotel, SONARA Refinery Club, Atlantic Beach Hotel	High	Off-shore dispersant application	High	Remove stranded oil manually from sandy and rocky shorelines at tourist and amenity centres
B1.4	Seasonally open lagoons along the coast (northwest of Idenau, near Bakingili)	High	Off-shore dispersant application Boom within lagoon, when open,	High	⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used ⊙ Collect stranded oil from sandy lagoon shoreline manually

Ref	*Coastal feature*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
			to protect mangrove/swamp forest fringe if possible		
B1.5	Small river mouths (e.g. Onge, Idenau, rivers draining into the sea at Limbe)	Low	Off-shore dispersant application	Low	No action required
B1.6	SONARA Refinery Club mangroves	High	Off-shore dispersant application	High	⊙ Recover pools of oil manually amongst mangroves ⊙ Use sorbent pads for mopping up ⊙ Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)
B2: Limbe to Mabeta					
B2.1	Primarily rocky shoreline interspersed with a few sandy beaches, where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required; there are no confirmed records of turtles nesting on these shores at present, this needs to be verified by consulting the experts when there is a spill

Ref	*Coastal feature*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
B2.2	Muddy shorelines with mangroves in Man 'O War and Dikulu Bay	High	Off-shore dispersant application Deployment of booms to protect mangrove shoreline if sea conditions permit	Low	• Recover floating contained oil with skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels • Limited access to mangroves makes clean-up action difficult within the mangroves • Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)
B2.3	Military bases	High	Off-shore dispersant application	High	Remove stranded oil manually from accessible shoreline areas and boat launching facilities
B2.4	Occasional fishing villages e.g. Bimbia, Mabeta	High	Off-shore dispersant application	High	Remove stranded oil manually from shorelines at fishing villages
B2.5	Offshore islands (e.g. Mondole Island, Nicol Isle)	Med	Off-shore dispersant application	Low	No action required
B3: Mabeta to Kangué					
B3.1	Primarily muddy shorelines with mangroves in Bimbia Creek	High	Off-shore dispersant application Application of dispersants in	High	• Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels • Limited access to extensive mangroves

Ref	*Coastal feature*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
			Great Bay by helicopter/small boats, upstream as far as the confluence of the Matumal and Bimbia Creeks Deployment of booms across threatened small creeks where possible		makes clean-up action unfeasible within the mangroves • Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)
B3.2	Gently sloping beaches from Mboko I to Kangué	High	Off-shore dispersant application	High	Remove stranded oil manually from the sandy shoreline areas to prevent remobilization and entry into mangrove areas; there are no confirmed records of turtles nesting on these shores at present, this needs to be verified by consulting the experts when there is a spill
B3.3	Occasional fishing villages e.g. Mbomo, Mboko I; and a town at Tiko	High	Off-shore dispersant application	High	Remove stranded oil manually from shorelines at fishing villages and Tiko

Table B.5.6: Oil Spill Response, Area C: Littoral Province: Wouri Division (from Kangué to Dibamba River, including Ile Manoka)

Authorities:

Governor of Littoral Province and Senior Divisional Officer
See Data Directory for contact details

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
C1: Wouri Division from Kangué to Dibamba River, including Ile Manoka					
C1.1	Primarily muddy shorelines with mangroves and extensive intertidal mudflats where there are no special features such as those listed below	High	Off-shore dispersant application Application of dispersants in Estuaire du Cameroun by helicopter/small boats, upstream as far as Bonabéri Bridge Deployment of booms across threatened small creeks where possible	High	• Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels • Limited access to extensive mangroves makes clean-up action unfeasible within the mangroves • Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
C1.2	Steep sandy beaches from Kangué to Cap Cameroun	High	Off-shore dispersant application	High	Remove stranded oil manually from the sandy shoreline areas to prevent remobilization and entry into mangrove areas; there are no confirmed records of turtles nesting on these shores at present, this needs to be verified by consulting the experts when there is a spill
C1.3	Occasional fishing villages e.g. Kangué, Grand Toubé, Petit Toubé	High	Off-shore dispersant application	High	Remove stranded oil manually from sandy and muddy shorelines at fishing villages
C1.4	Port of Douala and urban waterfront of Douala and Bonabéri	High	Off-shore dispersant application Application of dispersants in Estuaire du Cameroun by helicopter/small boats, upstream as far as Bonabéri Bridge Mechanical dispersion of light oil slicks	High	⊙ Remove stranded oil manually from the muddy shoreline areas (e.g. Banc Jos, Banc du Cameroun) ⊙ Recover floating contained oil with skimmers ⊙ For small spills use sorbents for mopping up

Table B.5.7: Oil Spill Response, Area D: Littoral Province: Sanaga-Maritime Division (from Dibamba River to Nyong River Estuary)

Authorities:

Governor of Littoral Province and Senior Divisional Officer
See Data Directory for contact details

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
D1: Southern Bank of the Estuaire du Cameroun between the Dibamba River and Pointe Souélaba (excluding Ile Manoka)					
D1.1	Primarily muddy shorelines with mangroves and extensive intertidal mudflats where there are no special features such as those listed below	High	Off-shore dispersant application Application of dispersants in Estuaire du Cameroun by helicopter/small boats, upstream as far as the Baie de Manoka Deployment of booms across threatened small creeks where possible	High	⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels ⊙ Limited access to extensive mangroves makes clean-up action unfeasible within the mangroves ⊙ Seek expert advice on the potential for rehabilitation (see Section A.5.2.2)

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
D1.2	Gently sloping sandy beaches from Pointe Souélaba to Joneta Kombo	High	Off-shore dispersant application Application of dispersants in the outer part of Malimba Creek by helicopter/small boats	High	Remove stranded oil manually from the sandy shoreline areas to prevent remobilization and entry into mangrove areas
D1.3	Occasional fishing villages e.g. Souélaba, Youmé I	High	Off-shore dispersant application Application of dispersants in the outer part of Malimba Creek by helicopter/small boats	High	Remove stranded oil manually from sandy and muddy shorelines at fishing villages
D2: Pointe Souélaba to Mombo (coastal boundary of the Douala-Edéa Fauna Reserve)					
D2.1	Steep sandy beaches from Pointe Souélaba to Yoyo II and from Mbenga-Malimba lagoon complex to Mbiako	Low	Off-shore dispersant application	Low	No action required

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
D2.2	Mbenga-Malimba lagoon complex	High	Off-shore dispersant application Deployment of booms across entrance channels where possible Deployment of booms across threatened small creeks	High	⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels ⊙ Limited access to extensive mangroves makes clean-up action unfeasible within the mangroves ⊙ Seek expert advice on the potential for mangrove rehabilitation (see Section A.5.2.2)
D2.3	Sanaga River Mouth	High	Off-shore dispersant application Application of dispersants in estuary by helicopter/small boats in the lower reaches Deployment of booms across	High	⊙ Remove stranded oil manually from the sandy shoreline areas ⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels ⊙ Limited access to extensive mangroves makes clean-up action unfeasible ⊙ Get expert advice on the potential for mangrove rehabilitation (see Section A.5.2.2)

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
			threatened small creeks where possible		
D2.4	Occasional fishing villages e.g. Yoyo I and II, Mbiako, Mombo	High	Off-shore dispersant application	High	Remove stranded oil manually from the sandy shoreline areas and boat launching areas in front of villages
D2.5	Turtle nesting beaches (all year, with peak from November to January)	High	Off-shore dispersant application	High	• Consult authorities and experts • Identify turtle nesting sites • Assist with conveying hatchlings to clean water
D3: Mombo to Nyong River Estuary (coastal boundary of the Douala-Edéa Fauna Reserve)					
D3.1	Steep sandy beaches	Low	Off-shore dispersant application	Low	No action required
D3.2	Seasonally open mouth of the Loté Stream and other lagoons along the coast (south of Stand, south of Myépé Badangué)	High	Off-shore dispersant application Boom within lagoon, when open, to protect mangrove/swamp forest fringe if possible	High	• Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used • Collect stranded oil from sandy lagoon shoreline manually

Ref	***Coastal features***	***Protection***		***Clean-up***	
		Priority rating	***Action***	***Priority rating***	***Action (see section A.5.2.1 and A.5.2.2)***
D3.3	Occasional fishing villages e.g. Bobo, Djongo, Stand, Badangué	High	Off-shore dispersant application	High	Remove stranded oil manually from beaches at fishing villages
D3.4	Turtle nesting beaches (all year, with peak from November to January)	High	Off-shore dispersant application	High	⊙ Consult authorities and experts ⊙ Identify turtle nesting sites ⊙ Assist with conveying hatchlings to clean water

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Table B.5.8: Oil Spill Response, Area E: South Province: Océan Division (from Nyong River to Ntem River)

Authorities:

Governor of South Province and Senior Divisional Officer
See Data Directory for contact details

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
E1: From Nyong River to Londji					
E1.1	Primarily steep sandy beach where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required
E1.2	Nyong River Estuary	High	Off-shore dispersant application Application of dispersants in estuary by helicopter/small boats in the lower reaches Deployment of booms across threatened small creeks	High	• Remove stranded oil manually from the sandy shoreline areas • Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels • Limited access to extensive mangroves makes clean-up action unfeasible within the mangroves • Seek expert advice on the potential for mangrove rehabilitation (see Section A.5.2.2)

Ref	Coastal features	Protection		Clean-up	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
E1.3	Lokoundjé River Estuary	High	Off-shore dispersant application Application of dispersants in estuary by helicopter/small boats in the lower reaches Deployment of deflection booms to direct oil to sacrificial sandy beaches at the river mouth	High	⊙ Remove stranded oil manually from the sandy shoreline areas ⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels ⊙ Limited access to extensive mangroves makes clean-up action unfeasible within the mangroves ⊙ Seek expert advice on the potential for mangrove rehabilitation (see Section A.5.2.2)
E1.4	Occasional fishing villages; e.g. Behondi, Maoué, Eboudavoyé.	High	Off-shore dispersant application	High	Remove stranded oil manually from beaches and rocks at fishing villages
E1.5	Turtle nesting beaches (all year, with peak from November to January)	High	Off-shore dispersant application	High	⊙ Consult authorities and experts ⊙ Identify turtle nesting sites ⊙ Assist with conveying hatchlings to clean water

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
E2: Londji to Kribi					
E2.1	Primarily steep sandy beach with rocky outcrops and headlands where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required
E2.2	Seasonally open lagoons along the coast to Kribi (Londji, North of Mebouokou, between Mebouokou and Elabé, at Kribi)	High	Off-shore dispersant application Boom within lagoon, when open, to protect mangrove/swamp forest fringe if possible	High	• Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used • Collect stranded oil from sandy lagoon shoreline manually
E2.3	Artisanal fishing and amenity beach at Londji	High	Off-shore dispersant application	High	Remove stranded oil manually from the beach and rocky outcrops
E2.4	Occasional fishing villages between Londji and Kribi; e.g. Bébambloué, Mebouokou and Elabé	High	Off-shore dispersant application	High	Remove stranded oil manually from beaches and rocks at fishing villages
E2.5	Turtle nesting beaches (all year, with peak from November to January)	High	Off-shore dispersant application	High	• Consult authorities and experts • Identify turtle nesting sites • Assist with conveying hatchlings to clean water
E3: Kribi and surrounds to Grand Batanga I					
E3.1	Primarily steep sandy beach with rocky outcrops and headlands where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required

Ref	*Coastal features*	*Protection*		*Clean-up*	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
E3.2	Kienké Estuary and Kribi harbour	High	Off-shore dispersant application	High	• Remove stranded oil manually from the shoreline and harbour facilities • In the case of light oil in the river mouth, sorbent booms and pads to be used
E3.3	La Lobé Falls and river mouth	High	Off-shore dispersant application	High	• Remove stranded oil manually from the shoreline, rocky outcrops and amenity beach • In the case of light oil in the river mouth, sorbent booms and pads to be used
E3.4	Seasonally open lagoons along the coast from Kribi to Grand Batanga I (in Kribi, at Bongandwé, north and south of Ebomé, near Mbeka'a)	High	Off-shore dispersant application Boom within lagoon, when open, to protect associated vegetation/urban facilities if possible	High	• Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used • Collect stranded oil from sandy lagoon shoreline manually
E3.5	Amenity beaches, urban waterfront and beachfront hotels	High	Off-shore dispersant application	High	Remove stranded oil manually from the shoreline, rocky outcrops and amenity beaches
E3.6	Occasional fishing villages between Kribi and Grand Batanga I; e.g. Bongandwé, Ebomé, Mbeka'a	High	Off-shore dispersant application	High	Remove stranded oil manually from beaches and rocks at fishing villages

Ref	Coastal features	Protection		Clean-up	
		Priority rating	Action	Priority rating	Action (see section A.5.2.1 and A.5.2.2)
E3.7	Turtle nesting beaches (all year, with peak from November to January)	High	Off-shore dispersant application	High	• Consult authorities and experts • Identify turtle nesting sites • Assist with conveying hatchlings to clean water
E4: Grand Batanga I to Campo Beach (coastal boundary of the UTO Campo-Ma'an)					
E4.1	Primarily steep sandy beach with rocky outcrops and headlands where there are no special features such as those listed below	Low	Off-shore dispersant application	Low	No action required
E4.2	Amenity beaches extending from Grand Batanga I to Eboundja I	High	Off-shore dispersant application	High	Remove stranded oil manually from the shoreline, rocky outcrops and amenity beaches
E4.3	Occasional fishing villages; e.g. Eboundja I, Lolabé and Campo Beach	High	Off-shore dispersant application	High	Remove stranded oil manually from beaches and rocks at fishing villages
E4.4	Rocky cliff coastline at Rocher du Loup (of cultural and amenity value)	High	Off-shore dispersant application	Low	No action possible
E4.5	Turtle nesting beaches (all year, with peak from November to January)	High	Off-shore dispersant application	High	• Consult authorities and experts • Identify turtle nesting sites • Assist with conveying hatchlings to clean water

Ref	Coastal features	Protection		Clean-up	
		Priority rating	*Action*	*Priority rating*	*Action (see section A.5.2.1 and A.5.2.2)*
E4.6	Seasonal lagoons including those near Niendé Dibé, south of Boussibelika, north of Lolabé, between Lohéngué and Beyo, between Beyo and Ebodjé, near Doum Essmedjang, near Zong	High	Off-shore dispersant application Boom within lagoon, when open, to protect mangrove/swamp forest fringe if possible	High	⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used ⊙ Collect stranded oil from sandy lagoon shoreline manually
E4.7	Artisanal fishing and ecotourism amenity centre at Ebodjé.	High	Off-shore dispersant application	High	Remove stranded oil manually from the beach and rocky outcrops
E4.8	Ntem River Estuary	High	Off-shore dispersant application Application of dispersants in estuary by helicopter/small boats, upstream as far as Ipano Deployment of booms across threatened small creeks where possible	High	⊙ Remove stranded oil manually from the sandy shoreline areas and from the boat launching area and ferry point at Campo Beach ⊙ Recover floating contained oil with small skimmers; in the case of light oil, sorbent booms and pads to be used; oil to be pumped into floating tanks or vessels ⊙ Limited access to extensive mangroves makes clean-up action unfeasible within the mangroves ⊙ Seek expert advice on the potential for mangrove rehabilitation (see Section A.5.2.2)

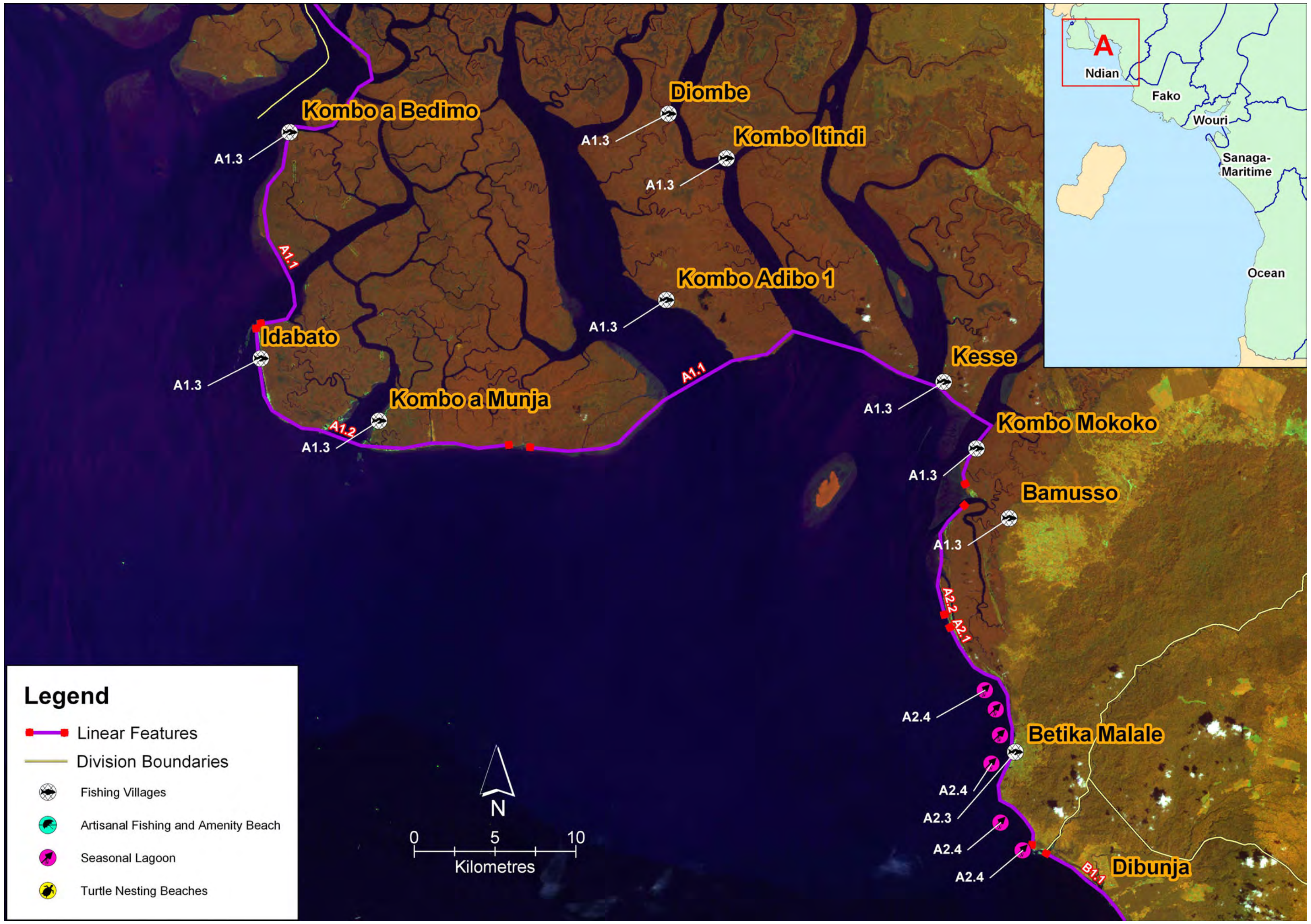

Figure B.5.6: Coastal features of the Ndian Division meriting priority attention in the event of an oil spill.

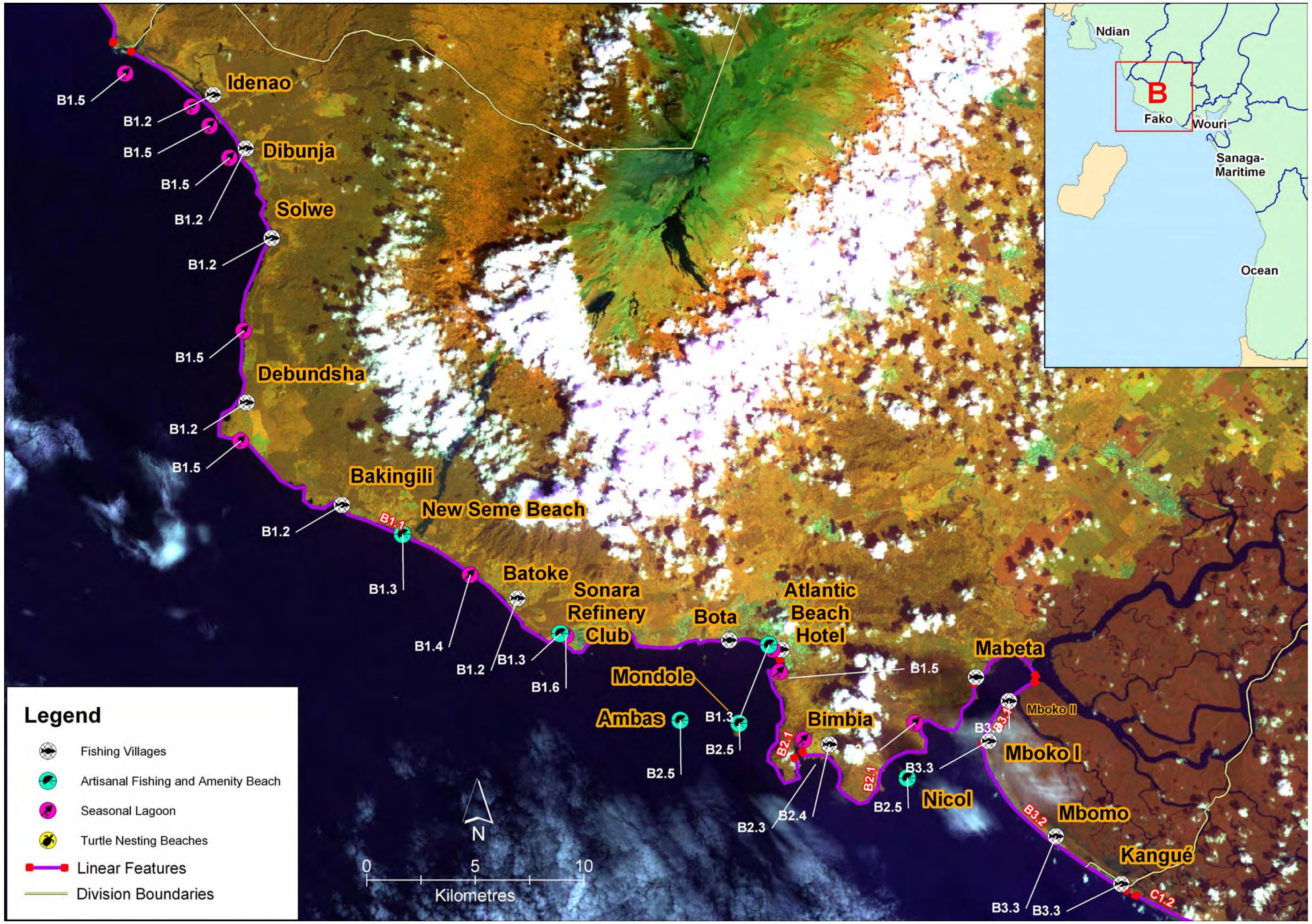

Figure B.5.7: Coastal features of the Fako Division meriting priority attention in the event of an oil spill.

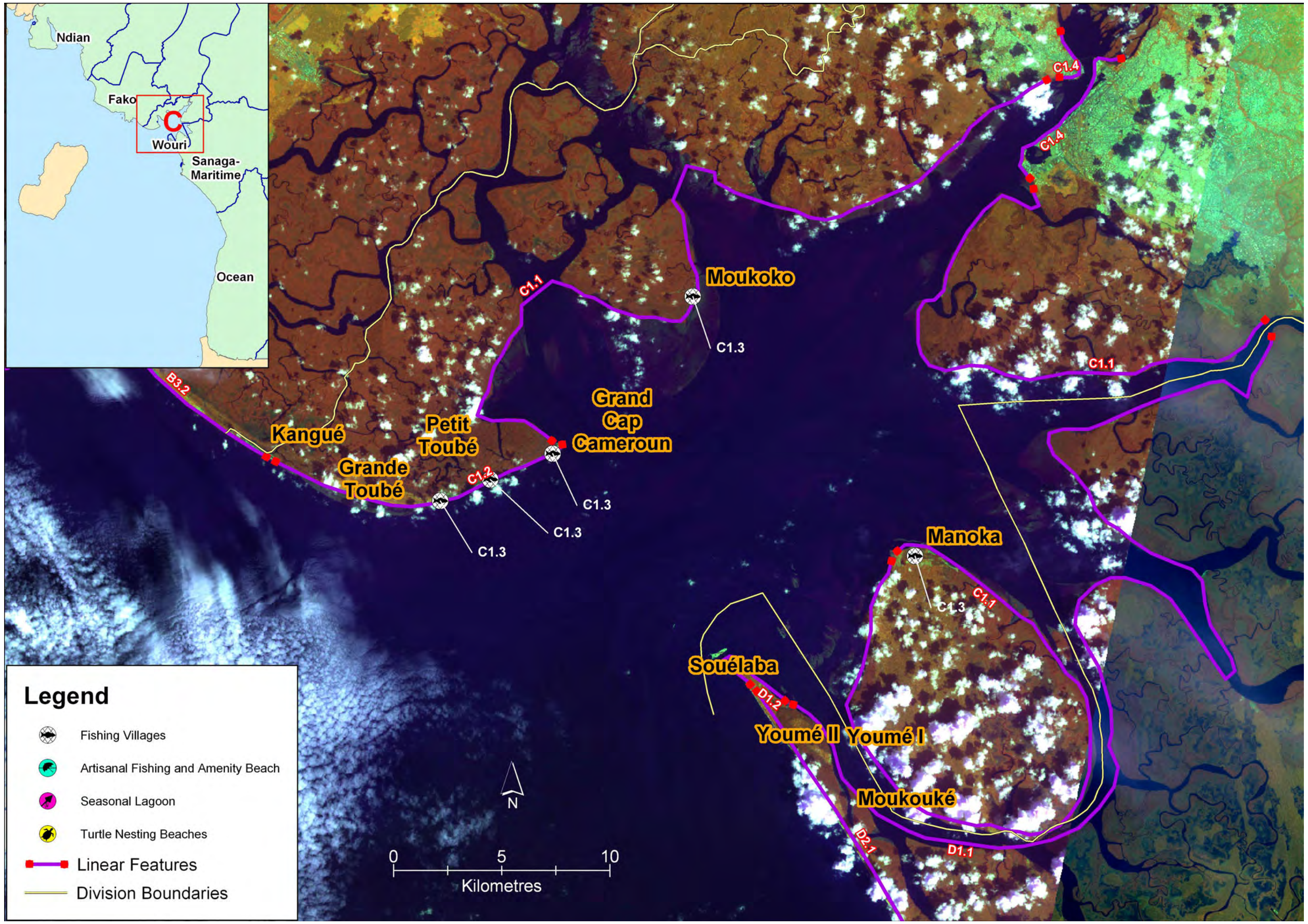

Figure B.5.8: Coastal features of the Wouri Division meriting priority attention in the event of an oil spill.

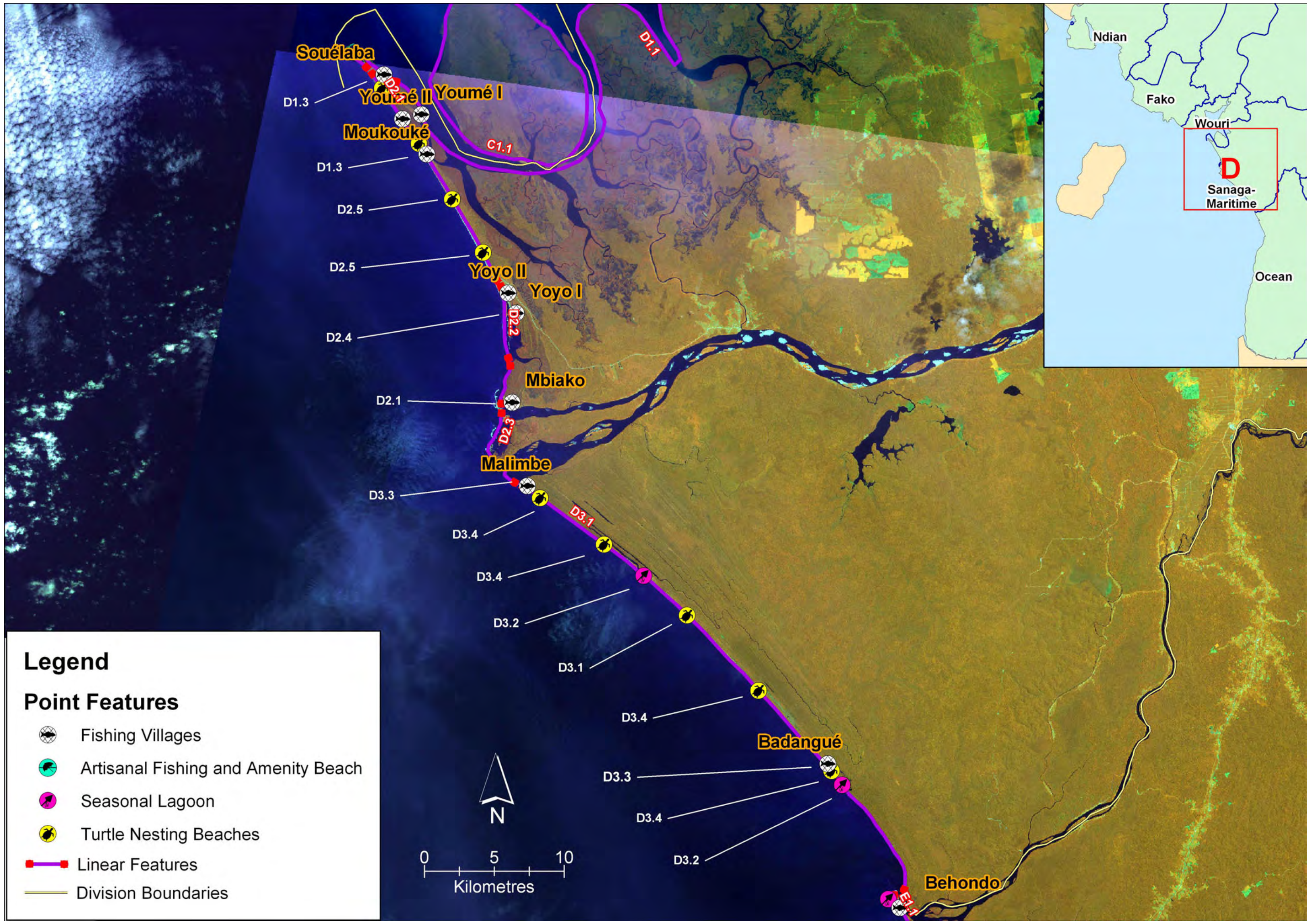

Figure B.5.9: Coastal features of the Sanaga-Maritime Division meriting priority attention in the event of an oil spill.

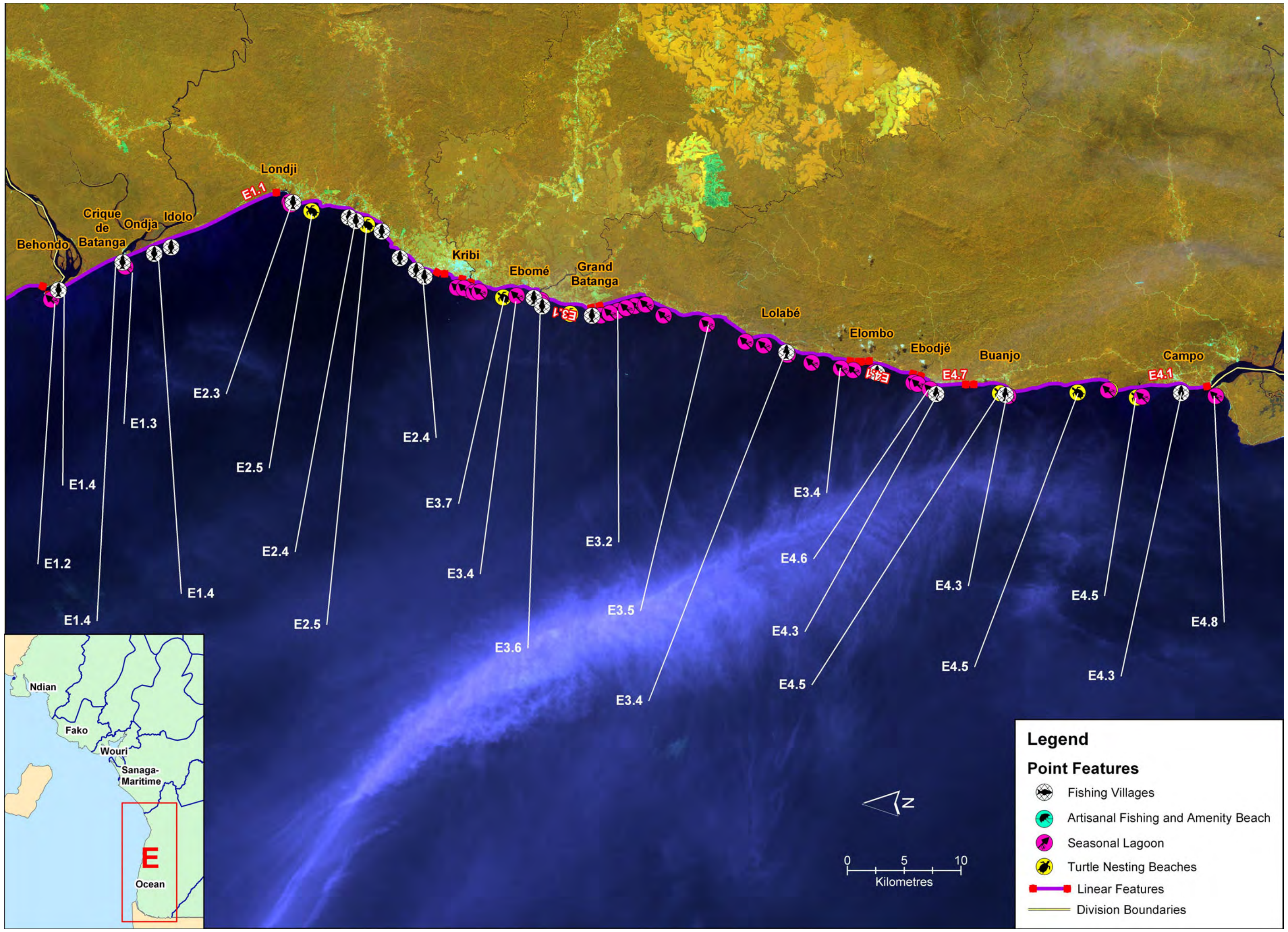

Figure B.5.10: Coastal features of the Océan Division meriting priority attention in the event of an oil spill.

B.6 WASTE DISPOSAL

As indicated in Section A.5.2.2, dedicated hazardous waste sites, suitable for the disposal of large quantities of oily waste, are not available in Cameroon. Therefore, decisions regarding the final disposal of oily waste, which might be collected following an oil spill, need to take the current situation into account. The main concern regarding the disposal of oily waste is the potential for hydrocarbon contamination of ground- and surface water resources. Clearly, expert advice will need to be sought in this regard, particularly to ensure that the initial environmental impacts of oiling are not compounded by secondary environmental impacts; e.g. relating to human health.

Once large quantities of oily waste have been collected, options for disposal include the following:

- ***Reprocessing at the SONARA refinery***: This option may only be feasible if shoreline oiling occurs in relatively close proximity to the refinery and the recovered oil is relatively clean. It is, likely, however, that the oil will be contaminated with debris and salt making it unsuitable for reprocessing; i.e. this will not be a feasible option for waste disposal following most spill incidents.
- ***Stabilization with lime***: This approach can be used in the case of oily sand that does not contain large amounts of drift-wood and seaweed, for example. An inorganic substance such as quicklime may be added to bind the material, thus forming an inert product that does not easily permit leaching of pollutant compounds. This enables the waste to be used for such purposes as road foundation or land reclamation. The stabilized product may also be disposed of under conditions that are less stringent than in the case of unstabilised material. Stabilization with lime is an option that should be implemented under the advice of experts in the fields of ground- and surface water contamination.
- ***Co-disposal with municipal waste***: Lightly oiled material may be co-disposed on top of a layer of municipal waste of at least 1,5 metres thick. However, due to the current lack of municipal waste sites in the proximity of the coastline, this is not considered a feasible option.
- ***Burning***: The direct burning of uncontained oily debris is not recommended, except in very remote areas, since it causes atmospheric pollution that can result in a suite of environmental impacts. However, these problems can be overcome through the use of a suitable incinerator. Portable incinerators, such as rotary kilns and open-hearth types are most suitable. Incineration, using this type of equipment, if portable units can be imported and deployed locally, is considered to be a feasible option for waste disposal.
- ***Biodegradation* or *landfarming***: This involves the breakdown of the oil by either natural or introduced micro-organisms under enhanced conditions. This is considered to be one of the most suitable options for disposal of oily debris in Cameroon. Land space is generally available in areas that could experience oiling and the climate is

conducive to rapid degradation of oil. Expert advice should be sought in establishing a landfarm; however, the following basic principles apply:

- Leaching and contamination of groundwater resources must be avoided. This can be done by lining the landfarm area with an impervious material such as an HDPE liner. An open flat area is required onto which to place the liner;
- In most cases, unless rapid degradation is required, it is unnecessary to introduce foreign bacterial or fungal strains. If foreign strains are introduced, this must be done under expert advice;
- The soil should not be saturated with oil. If this is the case initially, fresh soil should be added to the contaminated material to reduce the oil:sand ratio. As a rough indication, free oil should not emerge when the contaminated soil is squeezed manually;
- In its simplest form, landfarming involves the stimulation of naturally-occurring micro-organisms to degrade the oil. To do this, the bacteria require a nutrient stimulus, which can be achieved through the addition of one handful of mono-ammonium phosphate to one cubic metre of oily material. The bacteria require moisture and oxygen to function optimally. It is, therefore, necessary to keep the soil moist, which will be achieved locally through rainfall and high humidity levels. The oily material should be laid out to a thickness of no more than 400 cm. This permits the material to be rotovated periodically to maintain high oxygen levels. The pH of the soil should be maintained between 6.5 and 7.5 and adjusted through the addition of lime if necessary;
- A more sophisticated approach may be adopted if the rate of biodegradation needs to be optimized;
- Monitoring of the hydrocarbon levels within the landfarm must be undertaken to determine when the desired end-point of the breakdown of the pollutant has been reached.

Biodegradation, incineration (if suitable equipment can be made available) and stabilization with lime are considered to be the most feasible options for the disposal of oily waste in Cameroon.

B.7 GUIDELINES FOR MONITORING AND RECORD-KEEPING FOR COMPENSATION CLAIMS

Significant economic loss and impacts on community livelihoods can result from an oil spill (e.g. costs attributable to the contamination of fishing gear, diminished industrial and artisanal fish catches), and high costs can also be incurred in responding to major spills. In this regard, there are compensation mechanisms to which affected parties have recourse. As described in Section A.1, under specified conditions, damages and costs may be claimed from those responsible for the spill and their insurers.

To ensure the maximum degree of success in obtaining compensation for damages suffered and costs incurred, it is essential that claims should be properly presented, containing, for example, sufficient detail and justification for the claim that is made. In preparing a claim, the following needs to be taken into account:

- Each claim should contain the following basic information:
  - Name and contact details of claimant;
  - The identity of the ship or spill source involved in the incident;
  - The date, place and specific details of the incident;
  - The type of pollution damage for which compensation is claimed;
  - The actions taken for which compensation is sought in order to cover incurred costs; and
  - The amount of compensation claimed.
- Certain compensation schemes limit the period in which claims can be made. For example, in terms of the 1992 Fund Convention, claimants will lose their right to compensation unless they bring action within three years following the date on which the damage occurred. Claims should, therefore, be submitted as soon as possible after an incident or damages/costs are incurred.
- Claims should be made in writing, detailing the damage (also in monetary terms) on the basis of the facts and supporting documentation. Each item of a claim must be substantiated with supporting documentation, such as work sheets, explanatory notes, accounts, photographs and an invoice. It is, therefore, essential that affected parties, in particular the NCA, maintain accurate and comprehensive records of all activities that take place in connection with the oil spill response - including records of all labour, equipment, materials and consumables used.
- Claims for *consequential loss* (e.g. a fisherman's loss of income as a result of his nets becoming polluted) and *pure economic loss* (e.g. a fisherman's loss of earnings due to exclusion from a polluted area) should similarly be backed up with detailed descriptions and evidence of the loss suffered.

- The post-spill audit should be used as a primary source document for providing supporting evidence when lodging a claim for socio-economic and environmental loss and damage.

In the event of a major oil spill, which results in damage and costs, the NCA must co-ordinate the claims submission procedure – both with respect to the collation of claims and the submission thereof to the liable party and/or the party's insurers. Assistance in this regard shall be provided to the NCA by the *National Oil Spill Response Standing Committee (NOSR-SC)*.

SECTION C:

DATA DIRECTORY

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C.1 CONTACT DETAILS OF ALL KEY ROLE PLAYERS

Position	Name	Telephone Fax Mobile E-mail	Postal Address	Comments
Ministry of Environment and Forestry / Permanent Secretariat for the Environment				
Permanent Secretary	**Pr. TCHALA ABINA François**	T: 222 69 09 F: 222 12 25 M: 785 83 26	PO Box Yaounde	
Chief of the Brigade for Environmental Inquiries and Inspections	**Dr EFENDENE Blaise.**	T: 222 69 09 F: 222 12 25 M: 998 53 51 E: fendene@gcnet.cm	PO Box Yaounde	
Ministry of Defence				
1. National Navy				
National Navy Commander	**Vice Admiral N'GOUAH N'GALLY** C.E.M.M.	T: 222 30 16 F: 222 30 43 M: 989 49 98	P.O.Box 11923 Yaoundé	In case E. V. ZOGO FOUDA Abraham; Porte Fanion V.A. CEMM: 999 57 55
Navy commander of Douala station (COMBAND)	**C. V. OYONO MVENG**	T: 343 35 65 F: 343 22 13 M: 960 16 18	PO Box 4951 Douala	
Douala Centre of information Co-ordination and Operations – Commander	**C. V. TINKEU NGATCHOU**	T: 342 68 50 (24h / 24h) T: 343 82 35 (B) M: 739 20 77 / 954 50 50	PO Box 4951 Douala	
2. National Corps of Fire Fighters				
Commander	**Brigadier General BABA SOULEY**	T: 223 39 34/223 55 93 M: 770 12 52	PO Box 6863 Yaounde	
Chief of the Service of Operations	**Captain GARKA GARKA**	T: 223 55 93/223 99 08 M: 995 38 76/789 12 76 E: garka@yahoo.fr	PO Box 6863 Yaounde	
Yaounde Centre of information Co-ordination and Operations		T: 18 M: 118	PO Box 6863 Yaounde	
3. Secretariat of State in charge of National Gendarmerie				
Secretary of State	**Mr. Rémy ZE MEKA**	T: 223 29 79 F: 222 39 98	PO Box Yaounde	
Ministry of Territorial Administration and Decentralization				
Direction of Civil Protection	**Dr NANA Jean Pierre** Director	T: 221 46 06 M: 996 10 50	PO Box Yaounde	
Direction of Civil Protection	**Mr. MBEDY Jacques** Deputy Director	T: 221 46 07	PO Box Yaounde	

Position	Name	Telephone Fax Mobile E-mail	Postal Address	Comments
	Dr. ENOUMBA Henri Claude	T: 221 46 07 M: 993 65 85 E:hcenoumba@yahoo.fr	PO Box Yaounde	
Ministry of Communication				
Minister	**Pr. FAME NDONGO Jacques**	T: 223 39 74/222 31 55	PO Box Yaounde	
Director of Public Communication	**Mr. KAMGANG Jacques**	T: 223 02 86 M: 953 63 75	PO Box Yaounde	

Ministry	Name Position	Telephone Fax Mobile E-mail	Postal address	Comments
Other Relevant National Authorities				
Ministry of Mines, Water Resources, and Power **(MINMEE)**	**Mr ABESSOLO Adolphe** Director of Mines	T: 222 39 70 F: 222 39 70 M: 991 15 82	PO Box Yaounde	
	Mr. NGASSA Célestin	T: 222 39 70 F: 222 39 70 M: 963 78 19 / 993 18 63 E: ngaroza@yahoo.fr	PO Box Yaounde	
Ministry of Livestock, Fisheries, and Animal Husbandry **(MINEPIA)**	**Dr Baba MALLOUM O.** Director of Fisheries	T: 231 60 49 F: 231 30 48	PO Box Yaounde	For updating, M. Mohamadou Nasrou T: 222 33 11 M: 763 48 42
Ministry of Transports **(MINTRANS)** 1. Merchant Navy Department	**Mr EKOUMOU Dieudonné** Director	T: 342 89 56 / 342 43 82 F: 342 89 56	PO Box Douala	
Ministry of Transports **(MINTRANS)** 2. Department of Terrestrial Transportation	**Dr YOUMBA Josué** Director	T: 222 05 47/222 41 15 F: 222 41 15	PO Box Yaounde	
Ministry of Finance and Budget **(MINFIB** - Customs)	**Mr. GONI MAL Adji** Director of Customs	T: 342 70 80/340 76 74 F: 342 32 02	PO Box Douala	
	Mr NGALLE (Information & Communication)	T: 342 70 80/340 76 74 F: 342 32 02 M: 989 05 32	PO Box Douala	To be confirmed as the right contact
Ministry of Justice **(MINJUSTICE)**	**Mr. AHMADOU ALI** Minister of State	T: 222 21 54 F: 223 00 05	PO Box Yaounde	The right contact still to be determined
Ministry of Public Health **(MINSANTE)**	**Mr. OLANGUENA AWONO Urbain** Minister	T: 222 35 25/222 02 33 F: 222 35 25/222 02 33	PO Box Yaounde	The right contact still to be determined
Ministry of Scientific and Technical Research	**Mr. PEREVET Zacharie** Minister	T: 222 13 34 F: 222 13 36	PO Box Yaounde	The right contact still to be determined

Ministry	Name Position	Telephone Fax Mobile E-mail	Postal address	Comments
(MINREST)				
General Delegation for National Security (**DGSN** - Border Police)	**Mme MBASSI née LELE** Director ofBorder Police	T: 220 11 17/221 28 84 F: 221 00 69		
National Institutions				
Hydrocarbons National Corporation **(SNH)** / Pipeline Steering & Monitoring Committee **(CPSP)**	**BROH NDUM Augustine** Permanent Secretary	T: 220 19 10/221 04 30 / 220 98 60 F: 220 46 51 M: 750 64 72	PO Box 955 Yaounde	
SONARA	**Mr. TAKERE Derrick** Director, Risks	T: 342 38 15/333 22 38 F: 342 34 44	PO Box 365 Limbe	
	Mr. TONYE MBOG Eric Chief, Environment	T: 342 38 15/333 22 38 F: 342 34 44 M:	PO Box 365 Limbe	
SCDP	**Dr NGUINI EFFA Jean Baptiste** General Manager	T: 340 37 39/342 09 63 (D) F: 340 47 96 M: 770 32 58	PO Box 2271 Douala	
	LIMBOURG Jean Paul Deputy General Manager	T: 340 27 77/342 01 87(D) F: 340 47 96 M: 770 92 94	PO Box 2271 Douala	
	VOILLARD Marc Deputy Exploitation Director	T: 340 21 98/343 10 65 (D) F: 340 47 96 M: 770 92 95	PO Box 2271 Douala	
Autonomous Port of Douala	**Mr SIEWE Siyam** General Manager	T: 223 35 54 F: 222 34 56	PO Box Douala	
CAMRAIL Division of Health, Safety, & Environment	**Mrs. NDOUGSA MBANG Hélène-M** Manager	T: 340 91 89/340 71 59 F: 340 82 52	PO Box Douala	

Relevant International National Authorities (e.g. Equatorial Guinea, Nigeria, Chad)				
Country	**Name** **Position**	**Telephone** **Fax** **Mobile** **E-mail**	**Postal address**	**Comments**
Equatorial Guinea	Ministry of Mines and Energy	T: 240-935 67 F: 240-933 5	Malabo	
	Petroleum National Company (GE Petrol)	T: 240-764 80 / 944 84	Malabo	
	Ministry of transport and communication	T: 240-1-262 23 98 240-9 33 13 / 9 25 15		
Nigeria	Hon. Minister of Petroleum. Federal Ministry of Petroleum Resources Federal Secretariate Phase I	T: 234-1-262 23 98 01-320 04 40-9	Shehu Shagari Way Abudja	
	Federal Ministry of Environment	T: 234-9 234 74 95 / 523 49 31 F: 234-9 523 49 31	Lagos	
	National Maritime Authority	T: 234-1 580 48 00 / 545 19 43 F: 234-1 545 07 22 / 545 19 44	41 Burma Road, Apapa – Lagos	
Chad	**Mr. YOUSSOUF Abassallah** Ministry of Petroleum, Mines and energy	T: 235-52 38 50 F: 235-52 25 65	P.O. Box 94 N'jamena	
	Petroleum Affairs Manager	T: 235-52 38 50 F: 235-52 25 65		
Gabon	Ministry of Transport and Maritime Affairs	T: 241-03 93 84 / 77 43 82 241-72 58 05 / 72 15 87 F: 241-72 00 42	PO Box 803 Libreville - Gabon	
	Direction Générale de la Marine Marchande	T : 241-74 53 07 / 76 01 85 F : 241-76 06 60 / 74 66 55		

Littoral Province (and the "Douala Maritime Area")

Position **Division**	**Name**	**Telephone** **Fax** **Mobile** **E-mail**	**Postal address**	**Comments**
Governors and Senior Divisional Officers				
Governor	**Mr. GOUNOUKO HAOUNAYE**	T: 342 63 71 (B) 342 46 00 (Sec) 342 80 08 (D) M: 997 92 55	Douala	For updating Mr KAMENI Nestor MINAT/DOT/CCC 223 02 63 /735 41 69
Wouri Senior Divisional Officer	**Mr. NDONGO NDONGO**	T: 342 44 56 (B) 342 24 70 (B) M: 778 93 07 / 993 72 46	Douala	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mr. EBEN ABAIA Samuel**	T: 342 63 36/343 05 09 F: 342 91 46/342 74 00 M: 952 65 19	Douala	
MINEPIA	**Dr TCHOUBIA**	T: 342 11 13/342 00 10	PO Box 721	

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
Provincial delegate	**Antoine**	M: 991 63 94	Douala	
MINMEE Provincial delegate	**Mr. SAMBA Dieudonné**	T: 342 93 56 M: 959 06 88	Douala	
MINCOM Provincial delegate	**Mr. NANGA ABANDA Jean P**	T: 342 36 30 / 342 35 77 M: 959 06 88	Douala	
Local ports and airports (For Customs, see MINFIB -- Ministries)				
Douala International Airport		T: 342 36 30 / 342 35 77 F: 342 37 58	PO Box 3131 Douala	
Local fire departments, hospitals and police				
Fire Fighters -- Littoral & S-West Headquarters--	**C. B. OWONO NLEND** Commander	T: 347 26 04/342 52 52 M: 991 85 88	Douala	
	Captain NSOGO BOGLA Daniel 2nd in Command	T: 347 37 94/342 52 52 M: 983 49 45	Douala	
Local hotels and other services				
Hôtel Méridien		T: 342 41 34/343 50 00 F: 342 35 07	Douala	
Hôtel SAWA		T: 342 44 41/342 08 24 F: 342 38 71	Douala	
Hôtel IBIS		T: 342 58 00/342 58 17 F: 342 36 05	Douala	
Hôtel AKWA Palace		T: 342 26 01 F: 342 74 16	Douala	
Sanaga Maritime Division				
Sanaga Maritime Division Senior Divisional Officer	**Mr. ABAKAR AHAMAT**	T: 346 41 48 / 41 15 M: 987 65 43	Edea	
MINEF Divisional delegate	**Mr. MANGA Hilaire**	T: 346 44 11 M: 983 19 14	Edea	
MINCOM Divisional delegate	**Mme ZOGO Suzanne**	T: 346 41 48 M: 956 73 31	Edea	
Local hotels and other services				
Hostellerie de la Sanaga		T: 346 48 86 / 49 62	PO Box Edea	

South West Province (and the "Limbe Maritime Area")

Position **Division**	**Name**	**Telephone** **Fax** **Mobile** **E-mail**	**Postal address**	**Comments**
Governors and Senior Divisional Officers				
Governor	**Mr. EJAKE MBONDA Thomas**	T: 332 26 27 / 332 24 84	Buea	
Fako Division - Limbe Senior Divisional Office	**Mr. OKALIA BILAI Bernard**	T: 333 22 21 / 333 24 17	Limbe	
Some Provincial offices of Ministries				
MINEF Provincial delegate	**Mr. DJIBRILLA ASSALA**	T: 332 25 77	Buea	
MINEPIA Provincial delegate	**Dr DJAO DAKSALA**	T: 332 21 10 M: 997 38 20	Buea	
MINMEE Provincial delegate	**Mr. John N. FONJI**	T: 333 26 15 / 333 21 17 333 26 29	Buea	
Local fire departments, hospitals and police				
Fire Fighters -- Littoral & S-West Headquarters--	**C. B. OWONO NLEND** Commander	T: 347 26 04/342 52 52 M: 991 85 88	Douala	
	Captain NSOGO BOGLA Daniel 2nd in Command	T: 347 37 94/342 52 52 M: 983 49 45	Douala	
Local hotels and other services				
Atlantic Beach Hotel		T: 333 26 89 / 23 32	Limbe	

South Province (and the "Kribi Maritime Area")

Position **Division**	**Name**	**Telephone** **Fax** **Mobile** **E-mail**	**Postal address**	**Comments**
Governors and Senior Divisional Officers				
Governor	**Mr. ENOW ABRAMS EGBE**	T: 228 49 48 / 36 66 / 37 81	Ebolowa	
Ocean Division – Kribi Senior Divisional Officer	**Mr. MVONGO Grégoire**	T: 346 11 96 / &2 31 F: 346 11 96 M: 951 18 78	Kribi	
Some Divisional offices of Ministries				
MINEF Provincial Delegate	**Mr. MEKEDJUE Dieudonnée**	T: 228 44 48	Ebolowa	Kribi divisional offices would be more useful than afar Provincial ones
Kribi Divisional Delegate	**Mr. AKOGO MVOGO Guillaume**	T: 346 12 74 M: 990 51 81	Kribi	
MINEPIA Kribi Divisional delegate	**Dr EBODE Sylvain Blaise**	T: 346 12 53 M: 756 41 39	Kribi	

Position Division	Name	Telephone Fax Mobile E-mail	Postal address	Comments
MINMEE Kribi Divisional delegate	**Mr. NGWA SHUH John**	M: 752 49 76	Kribi	
MINCOM Kribi Divisional delegate	**Mme BOBE Liliane.**	T: 346 10 67 F: 346 11 96 M: 954 17 49	Kribi	
Local fire departments, hospitals and police				
Fire Fighters -- Littoral & S-West Headquarters--	Commander	T: 347 26 04 / 342 52 52 M: 991 85 88	PO Box Douala	Kribi will soon have a National training center with an operational unit Fire Brigade
Local hotels and other services				
Hôtel Palm Beach Plus		T: 346 14 47 M: 776 10 29	Kribi	
Hôtel Ilomba		T: 346 21 44 / 346 17 44	Kribi	
Hôtel Le Paradis		T: 346 19 93 / 18 39 F: 346 12 47 / 14 38 M: 968 85 67 / 998 54 21 / 785 09 61	PO Box 232 Kribi	
Hôtel Framotel		T: 346 15 41 / 346 13 58 F: 346 15 41 M: 994 82 22 / 994 82 23	PO Box 355 Kribi	
Résidence Jully		T: 346 15 62 / 17 67 / 68 M: 968 75 70	Kribi	

OPERATORS IN THE OIL INDUSTRY

Organisation	Name Position	Telephone Fax Mobile E-mail	Postal address	Comments
COTCO	**Mr. E.R. (Ed) CALDWELL** EPI Manager	T: 343 35 00 F: 342 95 96 M: 795 71 72	PO Box 3738 Douala	
SONARA (Limbe Refinery)	**Mr. TAKERE Derrick** Director, Risks	T: 342 38 15/333 22 38 F: 342 34 44	PO Box 365 Limbe	
SCDP (Douala – Head Office)	**Dr NGUINI EFFA Jean Baptiste** General Manager	T: 340 37 39/342 09 63 (D) F: 340 47 96 M: 770 32 58	PO Box 2271 Douala	

C.2 LIST OF FACILITIES (MATERIALS AND EQUIPMENT) AVAILABLE FOR USE IN THE EVENT OF AN OIL SPILL REPORT

C.2.1 SONARA Refinery

Contact person:	Mr Derick TAKERE, Director: Risk Asssessment Alt: Mr Eric TANYEMBOG, Environment Officer
Location:	Limbe refinery
Response resources:	400m *Arazur* rigid boom 400m *Vikoma* inflatable boom 1 x *Vikoma Komara* 12k disc skimmer 4 000 litre *Gamlen* concentrate dispersant Tender vessel with dispersant applicator.

C.2.2 Port Authority of Douala

Contact person:	Thompson ASA'NA N-M, Engineer in charge of Special Duties
Contact numbers:	Tel: (237) 420 133/427 322 Fax: (237) 426 797
Location:	Port of Douala
Response resources:	6 tugboats 4 service boats (Also 1 Police and 1 Gendarmerie boat)

C.2.3 Total E and P

Contact person:	Samuel Billong BISSECK, Chef Unite Securite – Environnement
Contact numbers:	Tel: (237) 340 7620 Fax: (237) 340 0020 Mobile: (237) 771 3381
Location:	At 2 production platforms and FSO in Rio del Rey field
Response resources:	4 000 litres of Inipol IP90 concentrate dispersant (planned to be increased to 20 000 litres by Feb 2003) *Dauphine* helicopter (shared with Pecten) 600 litre helicopter pod for dispersant application. Tender vessel with dispersant applicator 250m *Bal*ear rigid boom (to divert spilled oil away from hazard areas)

C.2.4 Pecten

Contact person:	Paul JOHNSON, HS&E Manager
Contact numbers:	Tel: (237) 342 6699 Fax:: (237) 343 2723 Mobile: (237) 992 0355
Location:	PCC Base, Platforms & field boat
Response resources:	5 000 litres *Corexit* 9527 concentrate dispersants Field boat with dispersant applicator Perenco helicopter dispersant spray pod is available for use by Pecten.

C.2.5 Perenco Cameroon: Oil Spill Response Equipment for Moudi and Ebome Platforms

Reference: Perenco Cameroon Moudi (revision 1) and Ebomé (revision 2) oil spill contingency plans

Type	*Detail*	
Safety	**Hard hats, steel toed, oil resistant, non-skid foot wear, coveralls, and life vests**	
Maps & navigational charts	BA 1357	Benin River to Rivière Cameroun, Inc. the Mouths of the River Niger
	BA 1860	Bonny River to Estuaire du Cameroun
	BA 1888	Ile Malimba to Cabo San Juan
	Africa Pilot Volume 2 with Supplement	
Communications	**Radio room on the USF 1** Motorola GM 350 radio system operating on 300 Mhz with a GR 500 repeater station on Mount Cameroon	
	Incident Response Centre will be established in the Conference Room at the Perenco Cameroon Office, Avenue Ahidjo, Douala Portable VHF radios: use Channel 13 for export operations Satellite communication	
Logistics	**Field Support Vessel (FSV) 'Mike Tide'** L.O.A. 186' which has twin screw fixed blade props with Kort nozzles and a Bow thruster The FSV has two small boats aboard: 1. Zodiac with 25 HP outboard 2. GRP Dory	
	Dauphine SA365C[3] Helicopter	
	Delta model semi-rigid on USF 1 with 2 x 40HP Yamaha outboards	
	Aluminium boat (name: Jose) with 40HP Mercury Outboard	

Type	*Detail*
Containment & Recovery	USF 1: 40' x absorbent boom and 1 bale of absorbent pads FSV: DRIZIT Oil Spill Kit x 4 each containing: cushions, pads, seals, disposal bags and ties
Temporary Storage	SlopTank (6Port) on the USF 1
Spray Equipment	USF 1: Simplex Helicopter Spray Bucket stored in the Heli-deck Hanger FSV: Type 2 vessel spray system
Dispersants	**Field Support Vessel Inventory** Sewage tank converted to dispersant tank, capacity 2,522 USG **USF 1 Inventory** Brand: ZT-10 x 9 drums Brand: Gamlen x 1 drum **Note:** This stock will be replaced by a new stock of 6,000 litres of Type 2/3 dispersant

Transport & Cargo Handling

	Remarks
Douala	**Size, capacity, road conditions, supplier etc.**
Cranes	
Trucks	
Forklift	1* 2T Hyster for Warehouse
Pickup	3* 1.5T Pick up cars
Trailer	

Helicopter Flight Times and Cargo

Day		AS 365 C		AS 365 N		AL III	
		Cargo kg	Time min	Cargo kg	Time min	Cargo kg	Time min
Moudi	Douala			850	45		
Moudi	Ebome			767	60		
Ebome	Douala			901	35		
Night		AS 365 C		AS 365 N		AL III	
Moudi	Douala			705	50		
Moudi	Ebome			598	65		
Ebome	Douala			700	40		

Communications Equipment

Equipment	Description	Quantity	Location
VHF Radios	Portable	25	Offshore & Ashore
VHF Aerials	Fixed	2	Offshore & Ashore
Satellite Phones	Mobicq sat	1	Offshore

Support Vessels

Located on the USF-1 is the Delta Rigid Inflatable Boat with twin Yamaha 40 HP outboards. This vessel is ideal for sorbent boom towing or transporting personnel with dispersant spray packs to the leading edge of spills.

Located on the Jack Up Rig is a small aluminium boat with one 40HP outboard engine.

This boat could be used for towing sorbent boom at the leading edge of a spill, or deploying personnel with manual dispersant spray backpacks.

Field Support Vessel 'Mike Tide'. The vessel has dispersant capability and permanently mounted spray arm systems. This vessel usually resides at the Moudi Terminal, but can be called in for Tier 1b or 2 incidents. The capacity of the dispersant is 2522 US Gallons.

Also on board the vessel are a Zodiac inflatable boat with one 25HP outboard engine and a GRP Dory boat (<3m long).

Oil Spill Response Equipment

Equipment / Material	Description	Quantity	Location
Absorbents	Sorbent Booms	10	Ebome
Absorbents	Sorbent Pads		
Spray Set	Backpack	9	Moudi / Ebome
Spray Set	FSV	1	Mike Tide
Spray Bucket	Helicopter	1	Ebome
Dispersant	EC9500A	7800L	Moudi / Ebome
Booms			
Recovery Devices			
Breathing Apparatus			
Protective Clothing			
Beach Cleaning Tools			

C.2.6 COTCO

C.2.6.1 Offshore response equipment (Tier 1)

Tier 1 response equipment

Response equipment for a Tier 1 spill is available aboard the FSO and on the supply vessels. Personnel aboard the FSO and supply vessels provide the manpower to respond to Tier 1 spills.

The following table lists the equipment for a Tier 1 response.

Table D-1 Tier 1 Response Equipment for the Offshore

EQUIPMENT	UNIT	FSO	SUPPORT VESSEL	SUPPLY VESSEL
BOATS				
Fire monitors (installed for dispersant application)	system	--	Yes	Yes
BOOM				
Inflatable neoprene boom (1-m) on reels	meters	150	200^	200^
Anchor and mooring systems	system	8	4^	4 ^
DISPERSANTS				
Corexit 9500 (dispersant)	drums*	--	50	50
SKIMMERS				
Side-mount brush belt skimmer	system	--	1	1
STORAGE				
Onboard storage	cu. m.	--	80	80
OTHER				
Sorbent pads	rolls	5	5	5
Deck spill kits	kits	2	--	--
Personal Protective Equipment	per person	25	--	--
Off-spray back packs	packs	2	--	--

^Staged aboard the FSO for transfer to use onboard the supply and support vessels, as needed.

*Each drum is approximately 150 liters.

Tier 1 response equipment, Continued

Specifications for deck spill kits, PPE, and off-spray back packs are given below.

ITEM	SPECIFICATIONS
Deck spill kits	▪ 2 packs Drizit cushions ▪ 1 Drizit roll ▪ 1 Drizit mini-roll ▪ 1 pack Drizit oil seals ▪ 7x50 no. oil absorbent pads ▪ 2 sets spare sorbents ▪ 2 – 200-liter drums of cleaner ▪ Non-sparking hand scoops, shovels, and buckets
PPE (for 25 workers)	▪ Rubber gloves ▪ Carbon filter respirators ▪ Eye protection ▪ Decontamination tub(s) ▪ Sponges, hand cleaner, and soap for decontamination ▪ Full body PVC suits ▪ Sea boots [wellingtons]
Off-spray back packs	For the application of Corexit dispersant on the ship

C.2.6.2 COTCO Oil Spill Response Equipment (Tier 2)

Response equipment for a Tier 2 spill is provided locally by COTCO and from available Mutual Aid entities. Tier 2 assets for the area specific response plans are staged at various locations along the pipeline.

Table D-2 Tier 2 Response Equipment

Equipment	Unit	FSO	Support Vessel	Supply Vessel	Kribi	Douala	Ngoumou	Belabo	Dompta	OFDA	Total
BOATS											
30' V-hull fast response boats with trailer twin 75HP outboards	FRV					2					2
Pontoon vessel with trailer and twin 40 hp outboards	boat				1						1
18-20' x 6' Jon boat w/ 60 hp outboard; sump; trailered	boat					1	1	1	1	1	5
18' Boston Whaler, 40HP outboard & trailer	boat							1	1	1	3
BOOM											
36" Inflatable neoprene boom on Al reels	ft	500	600	600	500	500					2,700
Hydraulic power packs for reels		1	1	1		1					4
8x12" Curtain boom	ft				4,500	4,500					9,000
8x12" River boom w/ top cable	ft						2,000	2,000	2,000	2,000	8,000
Shoreseal boom -neoprene	ft				300	300	300	300	300	300	1,800
Sorbent sweep	ft				3,000	3,000	2,500	2,500	2,500	5,000	18,500
Snare Boom (Pom Pom Boom)	ft				3,000	3,000	2,500	2,500	2,500	2,500	16,000
Log boom assembly (materials for)	ft							1,000	1,000	1,000	3,000
Anchor systems	system	8	4	4	20	20	10	10	10	10	96

Continued

Table D-2, Continued

Equipment	Unit	FSO	Support Vessel	Supply Vessel	Kribi	Douala	Ngoumou	Belabo	Dompta	OFDA	Total
DISPERSANTS/CLEANERS											
Corexit 9500 (dispersant)	bbls		50	50	50	50					200
Corexit 9580 (cleaner)	bbls				10	10					20
SKIMMERS											
Portable drum/brush style skimmer system (inc. 2" pump and power pack)	system				1	1	1	1	1	2	7
Portable rope mop skimmers w/ hyd. power pack & 2" pump					1	1	1	1	1	1	6
Vessel mount brush (Lori, Lamor) w/ outrigger system			1	1							2
Weir & screw pump skimmer system (DOP 160 Termite w/ MPC power pack)	system				1	1	1	1	1	1	6
STORAGE											
Onboard storage	bbl		500	500		20					1,020
249 bbl Aluminum barge	barge				1	1					2
Fastanks (5000 gall)	tank				3	3	2	2	2	4	16

Continued

Table D-2, Continued

Equipment	Unit	FSO	Support Vessel	Supply Vessel	Kribi	Douala	Ngoumou	Belabo	Dompta	OFDA	Total
SHORELINE/RIVER BANK CLEANUP											
Shovel package (50 in each)	pkg.				4	4	2	2	2	2	16
Rake package (50 in each)	pkg.				4	4	2	2	2	2	16
Portable incinerator	unit				1	1	1	1	1	2	7
Handheld Torch	unit						2	2	2	4	10
OTHER											
18' enclosed trailer- boom & sorbents	unit				2	1	1	1	1	1	7
18' enclosed trailer- Boom & Field Command	unit					1				1	2
Spill Kit (overpack barrel)*	kit				1	2	1	1	1	6	12
Sorbent pads	rolls	5	5	5	5	30	5	5	5	30	95
PPE Assemblies for 50 workers	ass.				1	1	1	1	1	2	7

*Spill kits to be located on MA trucks (and at fields on OFDA)

Continued

Tier 2: Mutual Aid Agreement Mutual aid resources could be used for a Tier 2 or Tier 3 response (Table D-3). These resources comprise additional dispersant capabilities, available through agreement with Mobil Equatorial Guinea.

Table D-3 Spill Response Equipment Available Through Mutual Aid

Mobil Equatorial Guinea, Inc.

Vessel Name	Owner	Type	Dispersant Ready	Home Port/Location
Pacific Supplier	Swire Pacific	AHTS	Yes	Malabo, EQ
Pacific Buccaneer	Swire Pacific	AHTS	Yes	Malabo, EQ
Pacific Barbarian	Swire Pacific	AHTS	Yes	Malabo, EQ

Equipment	Units	Abayak	Zafiro	Malabo Aviation Base
Boat spray system	system	1		
Corexit 9500A	200 liter drums	27		
Corexit 9527	200 liter drums	7	10	4
Helo Simplex Sling Spray	system			2

C.2.6.3 Communications Equipment

Introduction Communications equipment available immediately for a Tier 1 and Tier 2 spill response is listed in this section.

Table D-4 Communications Equipment for Spill Response

Item	Specifications	FSO	Douala	Kribi
Handheld VHF Radio	Make, model, intrinsically-safe			10
Handheld VHF Radio	Make, model			
Mobile VHF Repeater			1	

C.3 OIL SPILL REPORT : OSR000

Cameroon National Oil Spill Contigency Plan

Oil Spill Report OSR000

This form should be completed for oil spills that are not reported by the parties responsible for the incidents. In most situations, the National Competent Authority (NCA) will complete the form through reference to information supplied by a member of the public or an authority who may have observed, or been informed of, an incident. It is anticipated that much of the information will be anecdotal.

DO NOT DELAY SUBMITTING THIS REPORT DUE TO INSUFFICIENT INFORMATION.

SEND TO: National Competent Authority Tel: Fax:

	DD	MM	YY		(24 hr clock)	
Report Date:				**Time of spill:**		
Spill Date (if unknown, estimate date):						

Person reporting spill: ______________________

Telephone: ______________________ **Fax:** ______________________

DESCRIPTION OF OIL SPILL INCIDENT

Location of spill or observed spilled product
(location relative to closest town, village or other locatable feature):

Brief description of spill incident and present status:

Type of oil spilled (unrefined crude oil; petrol; diesel; other):

Spill size (metric units; any other appropriate descriptor):

Apparent cause of spill:

Present situation:

Threats to human safety:

Particulars of any socio-economic or environmental resources threatened/impacted:

Particulars of any socio-economic or environmental resources threatened/impacted:

Actions taken thus far:

Any additional information

For official use only:
Note: National Competent Authority to complete and post (registered) or fax back to person/authority who reported the incident.

Report prepared/acknowledged by:

Name: ______________________________ **Signature:** ______________________________

Date: ______________________________

File Ref No.: ______________________________

C.4 OIL SPILL REPORT : OSR001

Cameroon National Oil Spill Contingency Plan

Oil Spill Report 0SR001

This form should be completed and posted (registered) or faxed to the National Competent Authority within 24 hours of any spill. Information provided should be as accurate and complete as possible. This report can also be used to provide updates on the spill, which should also be submitted to the National Competent Authority. In the event of Tier 2 and 3 incidents, Report OSR002 should be completed and submitted to the National Competent Authority on termination of the spill response activities.

DO NOT DELAY SUBMITTING THIS REPORT DUE TO INSUFFICIENT INFORMATION BEING AVAILABLE TO COMPLETE THE REPORT IN FULL

SEND TO: National Competent Authority **Tel:** **Fax:**

Initial Spill Report: [ ]
Spill Report Update: [ ]
Final Spill Report: [ ]
(indicate with a cross, X)

	DD	MM	YY
Report Date:			
Spill Date:			

Time of spill: (24 hr clock) [|]

Company/Operator: ______________________________

Contact person: ____________________ **Signature:** ____________________
(Person submitting the report)
Telephone: ____________________ **Fax:** ____________________
Radio (type & frequency): ____________________

DESCRIPTION OF OIL SPILL INCIDENT

	Tier 1	Tier 2	Tier 3
Classification of spill:			

Vol of oil spilled (m^3): __________ **Type of oil spilled:** ____________________

Location of initial spill (include Lat and Long coordinates and/or description of location):

Brief description of spill incident and present status:

Actions taken thus far:

Prevailing weather (Marine spills): wind, current and sea state. Describe predicted movement of oil:

Particulars of any socio-economic or environmental resources threatened/impacted:

Is additional assistance required, and in what form?

Any additional information

For official use only:
Note: National Competant Authority to complete and post (registered) or fax back to operator.

Receipt of report acknowledged by:

Name: ______________________________ **Signature:** ______________________________

Date: ______________________________

File Ref No.: ______________________________

C.5 OIL SPILL RESPONSE/CLEAN-UP REVIEW REPORT : OSR002

Cameroon National Oil Spill Contingency Plan

Oil Spill Response/Clean-up Review Report 0SR002

A post-spill audit should be undertaken by the operator after the response and clean-up actions (if any) are terminated. The terms of reference for the post-spill audit should be submitted to the National Competent Authority within one week following the termination of the oil spill response activities.

SEND TO: National Competent Authority Tel: Fax:

Company/Operator: ______________________________

Contact person: ____________________ **Signature:** ______________

Telephone: ____________________ **Fax:** ______________

Time of spill: (24 hr clock)

	DD	MM	YY
Report Date:			
Spill Date:			
Termination of Oil Spill Response Date			

REVIEW OF OIL SPILL INCIDENT AND RESPONSE AND CLEAN-UP ACTIONS

Description of oil spill incident:

Include reasons for the spill, environmental conditions, volume and type of oil spilled, spill location.

Description of response and clean-up actions

Assessment of the effectiveness of response and clean-up actions:

Initial assessment of environmental and socio-economic impacts

Tier 1: Provide a brief assessment of any environmental and socio-economic impacts. Propose impact mitigation measures, where required.

Terms of reference for Post-Spill Audit

Tier 2 and 3: Provide detailed terms of reference for a post-spill audit (see Data Directory Section C.6, for guidelines).

For official use only:

Note: National Competent Authority to complete and post (registered) or fax back to operator.

National Competent Authority's comments on Review Report

National Competent Authority's comments on Terms of Reference for Post-Spill Audit (Tier 2 and 3)

Post-spill Audit Terms of Reference (Tier 2 and 3) accepted:

Name: ____________________ **Signature:** ____________________

Date: ____________________

File Ref No.: ____________________

C.6 GUIDELINES FOR INCIDENT REVIEW AND POST-SPILL AUDIT

It is a requirement of the NOSCP that an incident review and a post-spill audit is undertaken by the operator responsible for the spill and that this process should be initiated (through the submission of the *Oil Spill Response/Clean-up Review Report, OSR002*) within one week following the termination of oil spill response activities. In this respect, the following elements are relevant: (i) the incident review, which is conducted by the operator responsible for the oil spill; (ii) the terms of reference for the post-spill audit, which are prepared by the operator; (iii) the review of these terms of reference by the NCA; (iv) the conduct of the post-spill audit by a competent institution working under the instruction of the operator; and (v) the review of the post-spill audit by the NCA.

The aim of the incident review and audit is to establish the causes of the incident, the effectiveness of the response and clean-up actions (if any) that were instituted and to derive an objective measure of any significant socio-economic and environmental impacts arising from the incident. Underpinning this aim, is the desire to prevent similar incidents from occurring in future and/or to improve the effectiveness of response and clean-up measures. The guidelines presented here are intended to direct the review and audit process so that this aim is achieved.

The following guidelines provide a framework within which the above actions can be undertaken in a consistent manner.

REVIEW OF OIL SPILL INCIDENT AND RESPONSE AND CLEAN-UP EFFECTIVENESS

The following information should be included in the *Oil Spill Response/Clean-up Review Report: OSR002*, in which the incident, and the response and clean-up measures are reviewed and (in the case of Tier 2 and 3 incidents) the terms of reference of a post-spill audit are proposed. As a minimum, the following information must be supplied:

- Description of the incident (reasons for the spill, environmental conditions, volume and type of oil spilled, spill location, etc.);
- Description of response and clean-up actions;
- Assessment of the effectiveness of these actions;
- For a Tier 1 incident, a rapid assessment should be made (and documented) of any environmental and socio-economic impacts arising from the spill. Impact mitigation measures should be proposed, where required; and
- Recommendations should be provided to improve the effectiveness of future response and clean-up actions, which may require a revision of the operators' Oil Spill Response Plan and, possibly, the NOSCP.

POST-SPILL AUDIT

In the case of Tier 2 and 3 incidents, the terms of reference for a post-spill audit should include the following:

- Description of the approach that will be used to define the spatial extent of the oil spill and product dispersed into the water column (affected sea surface area, sea bottom and shoreline oiled); e.g. based on surveillance information, shoreline inspection, spill simulation modelling, etc.;
- Approach to be adopted for describing the potentially affected natural biophysical and socio-economic components of the environment. Here, it is expected that information contained in the NOSCP will provide one reference source;
- Approach to be adopted to quantitatively measure levels of environmental deterioration (e.g. the use of bio-indicators or sediments to establish changes in marine water quality relative to reference states in areas unaffected by the spill);
- Approach to be used to assess the significance of oil spill impacts on the biophysical and socio-economic environment;
- Approach to be adopted for impact mitigation (in addition to the response interventions already instituted), including, for example:
    - Compensation of affected communities; and
    - Rehabilitation of affected ecosystems.
- Approach to be adopted for monitoring residual environmental impacts of the oil spill, including parameters to be measured, frequency of measurements, and how the monitoring data will be interpreted; and
- Action plan for implementing the post-spill audit.

The terms of reference for the post-spill audit shall be reviewed by the NCA, or by any institutions judged by the NCA to be competent to conduct the review. In conducting the review, an assessment should be made of the extent to which the audit terms of reference of the post-spill audit will deal with (as a minimum) the points listed above. Following the completion of the audit by the operator, the NCA, or any institution judged by the NCA to be competent, shall gauge the extent to which the terms of reference for the audit have been met. Where there are deficiencies in the audit, the review should reveal these, and instructions should be issued to the operator to address these deficiencies.

C.7 LIST OF MAPS AVAILABLE FOR USE IN THE EVENT OF AN OIL SPILL

The following maps are available in A3 format within this report, as well as on the NOSCP website.

- Diversity of vegetation types and major land cover classes fringing the Atlantic coastline of Cameroon. (Marine and Coastal, Section A, Strategy, Figure A.3.12)

- Geomorphological, ecological, socio-economic features and combined classification of sensitivity to oiling of the Cameroon coastline. (Marine and Coastal, Section A, Strategy, Figure A.3.14)

- Coastal features of the Cameroon coastline meriting priority attention in the event of an oil spill. (Marine and Coastal, Section B, Operational Plan, Figure B.5.1 – B.5.10)

CONCLUSIONS AND RECOMMENDATIONS

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1. CONCLUSIONS

The National Oil Spill Contingency Plan (NOSCP) sets a precedent by placing Cameroon in a state of potential preparedness to respond, at the national level, to oil spills that might occur within the country – a situation in which few countries within the sub-region find themselves. The NOSCP also sets a precedent, possibly in a global sense, in terms of its dual emphasis on spills affecting *both* the country's marine/coastal *and* inland environments – this, in contrast to the traditional focus of such plans on the marine/coastal environment only.

The general approach that has been adopted in compiling the NOSCP, which is based largely on the IPIECA guideline series dealing with various aspects of oil spill contingency planning, has proved very effective. The following contributed significantly in this regard:

- Consultation with key stakeholders (authorities, operators, etc.)
- An in-depth understanding of the statutory and institutional complexities pertinent to the NOSCP – essential for assigning roles and responsibilities for its implementation;
- Inventorization of the main oil spill risk sources and response capability within the country;
- An in-depth understanding of the diversity and functioning of the bio-physical, cultural and socio-economic elements of the environment that either influence, or are exposed to, the risk of oil spills;
- Quantitative risk analysis (stochastic oil spill simulation modeling, in the case of the marine/coastal component of the plan), from which an indication of exposure to the risk of oiling of target areas could be established – this, in the absence of historical data pertaining to oil spill incidents in Cameroon;
- Environmental impact assessment, which informed the processes of environmental sensitivity analysis and response prioritization;
- A pragmatic approach to developing oil spill response strategies, including the control of oil spills at sea, shoreline clean-up, and response to inland spill situations.

1.1 STRATEGY

1.1.1 Statutory Framework

The review of the statutory framework within which the NOSCP is embedded reveals a complex situation of overlapping statutory responsibilities pertaining to the hydrocarbon sector that are held by various government institutions (e.g. MINEF, MINMEE, MINATD, SNH). Whilst this presents several options in terms of models that can be proposed for organizational structures for putting the NOSCP into effect – i.e. structures supported by the requisite statutory powers – MINEF emerges as the best candidate institution to serve as *National Competent Authority* (NCA) for directing policy formulation and coordinating preparedness and the response to oil spills, at the national level. Interpretation of the statutory framework also reveals important roles for other government institutions, in particular for SNH in a technical support role for the NCA.

In terms of key international conventions pertaining to external assistance and compensation for oil spills, Cameroon has signatory status regarding (and has also ratified) important instruments such as CLC '92 and FUND '92. An exception is the country's non-contracted status regarding OPRC '92, which implies that contracted states, and the IMO, are not automatically required to render assistance to Cameroon in the event of an oil spill – assistance that would be provided if the country was a contracted party to the convention. The terms of these conventions only apply to certain risk sources and not, for example, to offshore oil production operations, where mechanisms for compensation are directed towards the P&I insurers of the individual operators.

The above situation also applies to some extent to oil spill contingency planning affecting the inland environment. Given the significance of the Chad-Cameroon Pipeline Project as a potential source of oil spill risk, the Bilateral Cooperation Agreement entered into by the two countries, which calls for a joint effort in the protection of the environment at risk, is a supporting instrument of considerable significance.

1.1.2 Analysis of oil spill risk sources

The analysis of marine and coastal oil spill risk sources, which focuses on offshore exploration and production operations, shipping, etc. permits some differentiation to be made between the country's marine and coastal *regions* in terms of risk exposure. Highlighted in this regard, is the zone extending offshore of the country's northern coastal region (south of the Bakassi Peninsula, west of Idenao), where there is a particularly high probability of oil spill incidence. This is to be anticipated, given the concentration of Cameroon's offshore oil production operations in this region and the proximity of similar operations in the neighboring countries of Nigeria and Equatorial Guinea (Bioko Island). Other smaller zones of relatively high oiling probability are distributed along the coast offshore of Limbe, within the Estuaire du Cameroun, and offshore of Kribi. Preparedness for oil spill response is, therefore, most important offshore, and along the coastline, of Cameroon's Ndian Division.

For the inland environment, the analysis of risk sources focuses mainly on the Chad-Cameroon Pipeline Project, the SCDP hydrocarbon storage facilities and the major transport routes (road and rail) used for the conveyance of product throughout the country. For each risk source, the analysis considers the probable fate of oil spilled into the receiving environments exposed to potential risk – terrestrial ecoregions (including protected areas) and surface and groundwater environments at risk of oiling. It is concluded from the analysis that the risk sources are mainly clustered in the western and central areas of Cameroon, coinciding with the 'footprints' of the country's more developed areas. The less developed eastern and northern regions are exposed to fewer sources of risk, with the exception of the Chad-Cameroon pipeline transect, which traverses two of the northern provinces and the East Province.

1.1.3 Environmental sensitivity analysis

The environmental sensitivity analysis, which is based on an understanding of the functioning of key ecosystems and contributing elements (physical processes, habitat types and biota such as plankton, fish, birds, etc.) reveals a range of sensitivities to the impacts of oiling. For the coastal environment, the most sensitive ecosystem is the mangrove shoreline, which is concentrated along the country's northern and central coastal regions (in particular, the mangroves comprising the large Rio del Rey and Estuaire du Cameroun systems, but also mangroves occurring in the smaller lagoons along the southern coastal region). Least sensitive (on a relative scale) are the rocky shore ecosystems, which are exposed to high wave energies, and the steep-profiled sandy beaches south of Point Souélaba.

With respect to specific taxa, the impact significance of oiling, for example, on fish and pelagic birds is judged to be high - which contrasts the relatively low sensitivity to oiling of, for example, cetaceans, which are known to avoid surface oil slicks. With regard to socio-economic considerations, residents of coastal villages whose livelihoods are closely linked to artisanal fishing activities are most sensitive to the effects of oiling (i.e. relatively more sensitive than communities associated with the larger coastal centres, such as Douala). Also highly sensitive in this regard are coastal tourism and eco-tourism centres, including, for example, Kribi and Ebodjé.

Whilst highly sensitive environments are distributed offshore and along the entire coastline of Cameroon, the coincidence of extensive mangrove ecosystems – which sustain many other ecosystem components and dependent activities (e.g. the offshore fishery) – with the zone of highest oiling probability along the northern and central coastal regions is highly relevant to the oil spill strategies and priorities for response that are proposed in the NOSCP.

Informing the sensitivity analysis of the inland environment is a discussion of the physico-chemical effects of oiling on sensitive terrestrial, surface and groundwater environments. For the terrestrial environment, impacts of high significance are predicted for inundated grasslands and swamp forests (i.e. ecosystem components of high sensitivity to oiling). Standing water bodies, rivers and streams, the Garoua sandstone aquifer and the Douala sedimentary basin aquifers are similarly judged to be highly sensitive to the effects of oiling. Within a socio-economic context, the impacts of oil spills on the health of humans and livestock are judged to be highly significant.

1.1.4 Organizational structures, roles and responsibilities

MINEF is identified in the NOSCP as the *National Competent Authority* (NCA) – a role that is strongly supported by the obligations that are imposed on this institution by key statutory instruments, such as the Environmental Framework Law. In fulfilling these obligations, support from other lead institutions will be essential – in particular the support that will be provided by SNH and the *National Incident Command Team* (NICT) (e.g. the role of the National Navy as *Incident Commander* in the case of marine/coastal Tier 3 spill situations). In the case of inland oil spills, the *National Fire Fighting Corps* substitutes the National Navy in leading and coordinating the *National Incident Command Team*. Where there is no local presence of the *Fire Fighting Corps*, the *National Gendarmerie* will assume the lead role within the NICT.

1.1.5 Oil spill response strategies

The NOSCP outlines a range of oil spill response strategies - for dealing with oil whilst it is either on the water, stranded on the shoreline (of both fresh and marine water bodies) or spilled into the terrestrial environment - that are suitable for implementation under a range of conditions. It is concluded that certain strategies are inappropriate for application within Cameroon; e.g. the option of surveillance and monitoring of marine oil spills (with no other intended intervention), which is inappropriate given the vectors (wind, currents) for onshore transport of spilled oil, the short travel times of oil to shore and the generally high sensitivity of the coastal environment at risk to oiling.

It is also concluded that the application of dispersants at sea (approved for use according to specification, in countries such as France and the UK) is an appropriate option for situations where other at-sea response strategies are unlikely to be effective. Although dispersants and dispersed oil present certain risks to the receiving environment, the consequences of not using dispersants – in particular, where oiling of mangrove ecosystems is predicted - are considered to outweigh these risks. Whilst certain ecosystem elements will be at risk from dispersed product, the survival of the mangrove forest structure due to the use of dispersant, is expected to promote rapid ecosystem recovery – a process that is unlikely to materialize if there is extensive mortality of mangrove forest.

Strategies for responding to oil that is stranded on the shoreline range from an essentially 'do nothing' approach (e.g. where oil penetrates into mangrove systems; where oiled rocky shorelines are exposed to high wave energy; where the pollutant is non-persistent oil) to the manual collection and removal of stranded product using shovels and buckets (e.g. where low energy beaches are affected or where oiled beaches are situated in close proximity to artisanal fishing villages and tourism/ecotourism developments.

In the absence of a hazardous waste disposal facility in Cameroon, it is proposed that the technique of 'land-farming', which promotes the natural breakdown of hydrocarbon product, is the most appropriate option for dealing with recovered oil and oily waste. An exception in this regard, is the disposal option (incineration) that is proposed for incidents associated with the Chad-Cameroon pipeline project.

1.1.6 Oil spill response inventory and collaboration agreements

The government of Cameroon does not own any oil spill response equipment, and it is a recommendation of the NOSCP that such equipment should not be procured by the state to support the national oil spill preparedness and response initiative. The various industry operators within the country (oil companies, SONARA refinery, COTCO, etc.) hold sufficient stocks of appropriate equipment and consumables to respond to Tiers 1 and 2 incidents.

In the case of Tiers 2 and 3 incidents, it is concluded that the current practice, whereby operators pool resources to respond to emergencies, works effectively. However, it will be recommended that the existing informal collaboration agreements between the operators should be formalized. Similarly, it will be recommended that this process should also extend to the formalization of cooperation agreements between the *National Competent Authority* and the individual operators to cover the incidence of oil spills originating from sources other than those under the control of the operators (e.g. shipping incidents). It is also concluded that the recently established regional oil spill response centre (spill surveillance and aerial dispersant application) at Malabo, Bioko Island, for dealing with Tiers 2 and 3 incidents, is an essential initiative to be encouraged, which will dramatically improve the effectiveness of oil spill response in Cameroon and its neighboring countries.

Equipment described in the proposed strategies for the containment and recovery of oil spilled on land is not envisaged as being specialised or dedicated oil spill response equipment; rather, it is advocated that materials and equipment that are commonly available, for example, at construction sites, maintenance yards, etc, which are distributed throughout the country, should be used.

1.1.7 Communication

The establishment of effective communication systems is a priority for the successful implementation of the NOSCP. The historic situation, where there has been uncertainty regarding reporting of oil spill incidents and the coordination of response effort, is addressed in the NOSCP through the identification of MINEF as the *National Competent Authority* (NCA) and the formalization of communication lines between, for example, operators, the NCA and the *National Incident Command Team* (NICT). In the case of marine spills, the designation of the existing Douala Naval Base (currently operational on a 24 hr basis) as the *National Command Centre* for communication, coordination and response to Tier 3 oil spills eliminates confusion regarding the locus for centralized communication and response in emergency situations. For both the NICT and NCA to function effectively, it will be recommended that the necessary communications equipment (radios, cellular phones, etc.) should be procured.

The NOSCP also identifies the need for communication programmes designed to raise the level of community awareness concerning oil spills (e.g. pertaining to health and safety considerations and incident reporting). To this effect, the NOSCP advocates the formulation and implementation of an in-depth communication strategy.

1.1.8 Capacity building and training

A key conclusion of this NOSCP is that its successful operationalization requires considerable investment in capacity building and training. This is expanded upon in the recommendations that follow.

1.2 OPERATIONS

The Operational Plans (*marine/coastal* and *inland*) set out the actions that need to be taken at the time of an oil spill - from the initial reporting of an incident to the termination of clean-up operations – which, for Tiers 2 and 3 incidents, are concluded with post-spill audits. The objective of the Operational Plans is to minimize loss of time and, hence, environmental damage, in carrying out remedial action. This is achieved by clearly stating the functions and responsibilities of the various parties involved in the implementation of the plans and by describing the infrastructure to be set up and the responses to be instituted for the duration of an incident.

A response strategy decision flowchart clearly directs the essential communication and response measures that apply to different tiers of incident and different origins/causes of oil spills (e.g. spills originating from a production platform versus shipping incidents or inland spills).

The oil spill response actions that are presented in the plans are largely informed by the environmental sensitivity analyses – with priority responses proposed to protect highly sensitive environments. For both the *marine/coastal* and *inland* plans, the strategies are also informed by a strong measure of pragmatism. These focus on easily implementable approaches to protection and clean-up that can be effected through mustering and deployment of resources that are controlled at the Divisional and local authority level – with coordination provided by the NCA and NICT (for Tier 3 incidents). In the case of the marine/coastal operational plan, classification and mapping of each of the country's five coastal Divisions into logical units, based on key coastal features (mangrove shorelines, sandy beach shorelines, estuaries, coastal villages, etc.), and the linkage of this classification with tabulated instructions for protection, clean-up actions and waste disposal, makes the implementation of the plan straightforward.

Given the need to recover from the responsible parties, the costs incurred in the course of protection and spill clean-up operations and compensation for damage suffered, the operational plans provide clear guidelines for the preparation and submission of claims. In this regard, the coordinating role of the NCA is clearly explained.

1.3 DATA DIRECTORY

The data directories of the operational plans contain inventories of resources that may be required for responding to oil spills, as well as the contact details of parties with roles and responsibilities in emergency situations. It is emphasized in the NOSCP that the accuracy of these details can only be guaranteed if attention is given to the regular update of the operational plans.

The oil spill report templates included in the data directories provide an essential mechanism for the controlled reporting and, ultimately, review and analysis of oil spills that occur within the country. The incorporation of this information into the proposed National Oil Spill Database will, for the first time, permit quantitative and objective analysis of the oil spill situation within the country. The data may also inform decisions regarding the need to adapt oil spill response strategies, transfer roles and responsibilities, improve communication, etc. As a basis for defending compensation claims, the reports and guidelines for incident review and post-spill audit, which are also contained in the data directory, are essential.

2. RECOMMENDATIONS

The *publication of the NOSCP* report (Revision #0) represents no more than the *first step* in the process of elevating Cameroon to a state of preparedness for responding to oil spills at the national level.[1] In no way does this guarantee the successful implementation of the plan. The following recommendations are, therefore, proposed as a 'road-map' for what might be termed, the operationalization of the NOSCP.

In presenting the recommendations, the initial emphasis on formalizing the legal status of the plan is intended to highlight the importance of this statutory initiative – it is an essential requirement for the plan's operationalization. Thereafter, the 'road-map' describes the terrain to be traversed in order to communicate the content of the NOSCP to key role-players and to build capacity and secure the resources necessary for its implementation. Implicit in the recommendations that follow is the need for expert consultancy services to be retained to direct the process of operationalizing the plan – as a minimum, for the first two years of its implementation.

1 The NOSCP deals only with situations pertaining to oil spills. Ideally, the plan should be integrated with other aspects of disaster management within the hydrocarbon sector – involving, for example, the uncontrolled release of hazardous petrochemical gaseous emissions.

2.1 SECURING LEGAL STATUS FOR THE NOSCP

In order for the NOSCP to become an official policy document that directs oil spill preparedness and response at the national and operator level, its legal status must be secured. In this regard, a statutory initiative to be pursued without delay is the *promulgation of a decree of application* putting the NOSCP into effect. As discussed in Section A.1 of both Marine and Coastal and Inland sections of the NOSCP, there are a variety of statutory platforms from which such a decree can be promulgated; however, the Environmental Framework Law (Law no. 96/12 of 5 August 1996) is judged to be most suitable for this purpose.

The NOSCP must be formally signed into effect by the Minister of Environment and Forests following the promulgation of the decree of application (see title page of the NOSCP). Similarly, commitments by the various government institutions to the roles and responsibilities assigned to them in the NOSCP must also be secured; i.e. commitments grounded in the statutory foundation provided by the decree of application (see the NOSCP Distribution List and Record of Commitment).

<u>It is recommended</u> that the process whereby a decree of application will put the NOSCP into legal effect should be initiated in the course of 2004.

2.2 CAPACITY BUILDING PROGRAMME

Currently, there is little capacity within Cameroon to put the NOSCP into effect. This issue applies not so much to the oil industry operators as it does to government institutions that are key to the implementation of the plan. It is with respect to this latter target group that a significant effort at communication and capacity building is required.

Capacity building must be developed in oil spill preparedness and response (general familiarization) at various levels in the organizational structure that is proposed for implementing the NOSCP (*National Competent Authority*, *National Oil Spill Response Standing Committee*, *National Incident Command Team*, etc.). Beyond this, capacity needs to be developed in many specific (mostly technical) areas that are essential for the plan's proper implementation. Although a comprehensive capacity-building plan will need to be developed in due course, the following *outline plan* covers three phases that are designed to incrementally build capacity, from an initial platform of basic institutional sensitization (Phase 1 of the outline plan) towards a state of full technical preparedness (Phases 2 and 3).

2.2.1 Phase 1: Top-level training

Through reference to the organizational structure that is described in the NOSCP, the focus must initially be directed at the key institutions tasked with its implementation. These institutions must be informed of the general content of the NOSCP and must gain a

clear appreciation of the roles and responsibilities that the plan assigns to them. Clearly, the National Competent Authority (NCA), select members of the National Oil Spill Response Standing Committee and the National Incident Command Team (NICT) are the groups within the NOSCP organizational structure that should be constituted without delay and briefed regarding the NOSCP-related work programmes (schedule of meetings, agendas, etc.). Included in these programmes must be top-level training initiatives.
Courses accredited by the International Maritime Organization (IMO) are offered that are well suited to this phase of capacity development (top-level training). The courses provide a clear framework for support and guidance in oil spill preparedness and response. The course designed for *Administrators and Senior Managers* covers all aspects of oil spill response preparedness and implementation, and is designed for candidates assigned the responsibility for ensuring that an oil spill response strategy is effective.

It is recommended that, in parallel with the process of promulgation of the decree of application (i.e. during 2004), the IMO course for *Administrators and Senior Managers* should be organized and attended by representatives from both the Directorate and senior technical officer levels of the target institutions responsible for the *de facto* implementation of the NOSCP; i.e. individuals appointed to perform the responsibilities of the *National Competent Authority* (NCA), and to serve on the *National Oil Spill Response Standing Committee* (NOSR-SC) and the *National Incident Command Team* (NICT). The NOSCP will comprise essential reference material for this course.

It is further recommended that immediately following the above course, three workshops should be conducted, at which the separate roles and responsibilities of the *National Competent Authority* (NCA), the *National Oil Spill Response Standing Committee* (NOSR-SC) and the *National Incident Command Team* (NICT) can be clarified with the affected institutions (SNH, MINEF, MINDEF, MINMEE, MINATD, etc.). The workshop participants will be the same as those selected for attendance of the IMO course.

2.2.2 Phase 2: Technical competency development: Immediate priority

Following the first phase of top-level training, attention must be directed at the development of full technical capability within the three organizational structures identified above (the NCA, select members of the NOSR-SC and the NICT). In this regard, the following two IMO accredited courses are considered most appropriate:

Level 1: First responder. This course is designed for field supervisory personnel responsible for undertaking on-site clean-up operations and provides them with a complete overview of the various techniques available for recovering spilled oil and cleaning polluted environments.

Level 2: Supervisors and On-scene-Commanders. This course prepares the on-scene commander for responsibilities such as: developing and implementing a response organization (i.e. putting an Operational Plan into effect), deciding the response strategies to be used and coordinating the various activities of involved parties. Candidates selected for capacity building in this area will include managers and senior technical officers representing the NCA and serving on the NICT.

It is recommended that the Levels 1 and 2 IMO courses should be organized in the course of 2004 (to follow Phase 1 of the capacity development programme), and that they should be attended by managers and senior technical officers of institutions representing (or represented on) the NCA, NOSR-SC and the NICT (representation from both the central and provincial government offices).

2.2.3 Phase 3: Ongoing technical capacity development

Whilst Phases 1 and 2 of the capacity development plan are essential to put the NOSCP into effect in its basic form, various other capacity development initiatives must be undertaken to raise the level of national oil spill preparedness and response to the highest level. Examples of these initiatives are listed below:

- In-country *training of operators* regarding the management of oil spill response activities (deployment of equipment, etc.).
- *Environmental auditing*: The NOSCP places considerable emphasis on post-spill auditing (for Tiers 2 and 3 incidents). Through training, the NCA must develop the requisite capacity: firstly, to review and ensure the appropriateness of terms of reference (proposed by operator responsible for oil spills) for post-spill audits; and secondly, to review, confirm the adequacy of, and extract key information (e.g. learning points regarding the effect of dispersant usage on the affected environment; the efficacy of shoreline clean-up techniques that are employed, etc.), from audits that are undertaken.
- *Environmental baseline monitoring*: Auditing of the environmental effects of oil spills assumes that there is knowledge of the pre-spill baseline condition of the environment exposed to the risk of oil spills. Marine water quality is an important parameter in this respect. A body of marine water quality data exists as a consequence of Environmental Impact Assessments conducted for the offshore oil industry in Cameroon and it is recommended that this (the data and current approach to monitoring of water quality) should form the basis for a long-term marine water quality monitoring programme. It is recommended that the NCA, or an appropriate institution represented on the NOSR-SC, should receive training in this regard in order to coordinate the initiative.
- *Establishment and maintenance of the National Oil Spill Database*: Capacity will need to be developed within the NCA regarding the establishment and maintenance of the National Oil Spill Database – into which information on reported oil spill incidents will be entered and from which important statistical and non-statistical outputs will be extracted. Long-term environmental monitoring data (pertaining to marine water quality and, ultimately, other environmental parameters) should also be archived within this database. It is anticipated that a standard PC-based database system will be installed on hardware to be procured by the NCA, and that training will be provided regarding the use of the software, data interpretation and reporting, data back-up procedures, etc.

- *Impact valuation and cost reparation claims process*: The monetary valuation of oil spill impacts (environmental, socio-economic, etc.) and the accounting of costs incurred as a result of oil spills is a highly specialized activity that will probably be outsourced in the case of most major oil spills. Local capacity within the NCA must, however, be developed in some aspects of the valuation and cost reparation claims process (e.g. for dealing with smaller incidents).
- In addition to the above capacity building initiatives, maintenance of an awareness regarding *global developments in the field of oil spill preparedness and response* can be achieved through the introduction of a core group of officials, affiliated with the NCA and NOSR-SC, to the international oil spill conference circuit. The biennial US International Oil Spill Conference is the most significant event of this kind, for which support for attendance by delegates from developing countries is provided by IPIECA and IMO.

It is recommended that a programme is developed and resources secured to promote the above capacity building initiatives.

2.2.4 Training exercises

Training exercises must be conducted to test the effectiveness of the operational aspects of the NOSCP. These should be initiated once the key role players for implementing the NOSCP have advanced through Phases 1 and 2 of the capacity building programme and understand both their roles and responsibilities in the context of the NOSCP and the theoretical aspects of oil spill preparedness and response.

Through 'table-top' exercises (i.e. no equipment is deployed), the NOSCP communication network should be tested – from the moment a simulated incident (e.g. a Tier 2 spill) is reported to the NCA by an operator (or a local authority), the NICT is alerted to the situation by the NCA, and the local authority (at least to the level of Chief Divisional Officer) is placed on the alert and advised of steps to be taken regarding communication with local communities and environmental protection and clean-up measures. The exercises should also test the efficacy of the various reporting procedures (i.e. the completion of the oil spill report templates) for a variety of simulated situations (Tiers 1, 2 and 3 incidents).

NCA staff should also gain experience as observers of the response taken in the case of major oil spills that occur internationally. In this respect, staff should be sent to selected oil spill scenes to observe the on site response teams at work.

Training in the deployment of equipment, the application of measures to combat oil spills at sea and clean up of polluted environments should be mandatory for all operators. Training at the national level must focus primarily on the technical aspects of shoreline clean up – where officials affiliated to the NCA and NICT must have the requisite knowledge and supervisory experience to properly instruct a workforce, mustered at the local authority level. Whilst the Level 1 and 2 IMO accredited training courses will provide a level of experience in this regard, this needs to be put into practice on a regular basis as part of an overall programme of training exercises.

It is recommended that reference should be made to the IMO/IPIECA report 'Guide to oil spill exercise planning' for guidance in planning and executing these types of exercises. The first training exercise, at the national level of response, should be scheduled for 2004. Thereafter, repeat (and expanded) training exercises should be scheduled to take place annually.

It is further recommended that staff of the NCA should be sent as observers to major oil spill incidents to gain experience in the management of spills in crisis situations.

2.3 COMMUNICATION PROGRAMME

A comprehensive communication programme must be developed that deals with the multiple aspects of the NOSCP, targeting a variety of audiences.

Capacity building and training initiatives, such as those described above will inevitably be to the immediate benefit of a relatively small (albeit key) audience (NCA, NICT, etc.). The production of a series of technical brochures (other communication media can also be employed) covering various aspects of the NOSCP can significantly expand the sphere of capacity building in this regard. Topics covered should include, for example: locally applicable approaches to spill containment and shoreline clean up; incident reporting and communication; post-spill auditing; etc.

Recognizing the controversies regarding the use of dispersants in managing oil spills, a communication programme dealing with the national policy for their use should be initiated – targeting, in particular, the industry operators. This should address the strict conditions under which the use of dispersants may be considered, and the situations in which usage is prohibited.

As a priority there should be communication with communities that are most exposed to the risk of oil spills (safety, health, livelihoods) – specifically regarding actions to be taken in the event of oil spills (avoidance, reporting). Well-established communication hierarchies exist throughout the country that can be exploited for this purpose.

It is recommended that a communication programme should be initiated during 2004 targeting, as a priority, local communities most exposed to the risks of oil spills. The publication of various brochures should follow, with priority directed at the national policy regarding the use of dispersants.

2.4 ALIGNMENT OF LOCAL AND REGIONAL PLANS WITH THE NOSCP

There are a number of mandatory implications for operators that will flow from the NOSCP decree of application. For example, operators within Cameroon will need to adapt their individual oil spill response plans to conform with the NOSCP strategy - with regard to reporting procedures, response actions, post-spill audits, etc. An important aspect of this process is the formalization of the loose arrangement whereby there is collaboration at present between operators with regard to assistance in the event of Tier 2 and 3 incidents. This should extend to the formalization of collaboration arrangements between operators and the NCA for responding to incidents attributable to third parties (e.g. shipping) and Cameroon's access to the aerial spill surveillance and dispersant application service operating out of Malabo, Equatorial Guinea.

Currently, Cameroon's neighboring countries do not have national oil spill contingency plans in place, which reduces the potential for alignment in strategy within the region and effectiveness of communication in the event of incidents that have trans-boundary implications. As an interim response to this situation, there should be early communication with the International Maritime Organization (IMO) regarding the NOSCP, in order to promote the establishment of bilateral and regional oil spill response assistance agreements.

Also important, is the introduction of a compulsory requirement for operators to provide proof of adequate insurance against oil spill damage; i.e. this must be a pre-requisite for the issuance/renewal of permits.

It is recommended that specific reference should be made in the NOSCP decree of application that all oil spill response plans and collaboration agreements negotiated between operators within Cameroon (and the implementation thereof) must conform to the NOSCP strategy. As a permitting condition linked to the decree, proof of insurance (sufficient to cover costs and damages), must be required from all operators.

It is further recommended that as Cameroon's neighbors develop national oil spill plans, alignment in strategy and collaboration agreements must be secured. During 2004, the IMO must be informed of developments regarding the NOSCP and agreements regarding institutional assistance should be negotiated with this body. In this vein, access to the regional oil spill surveillance and response service established at Malabo must be negotiated.

2.5 MONITORING AND RESEARCH

Reference has previously been made to environmental monitoring programmes, and the need to establish these as reference platforms for the NOSCP.

2.5.1 Marine water quality

Given the importance of marine water quality for maintaining ecosystem functioning and the livelihoods of coastal communities, a long term monitoring programme focusing on marine water quality is proposed.

Chemical analysis of biological tissue (e.g. of marine filter feeder organisms) and beach sediments can provide a good indication of water quality experienced in an area over the long term. Filter feeders such as mangrove and other oysters tend to accumulate hydrocarbon and associated metals, which they extract from the water column. Based on this rationale, it is recommended that samples of filter feeders and other beach fauna should be collected on an annual basis from predetermined sampling locations distributed along the coastline. Tissue samples should be analyzed for traces of pollutants, from which a quantitative indication of marine water quality along the coast (also, changes over time) can be established. The methodology already established for recent EIAs for the oil industry should be adopted and adapted for the purpose of establishing a long-term data set.

2.5.2 Mangrove vitality

Mangrove ecosystems, which are extremely important components of the marine and coastal environment, are highly sensitive to the effects of oil spills. In terms of environmental monitoring priorities, maintenance of a long-term record of the distribution and vitality of the country's mangroves is important.

Spilled oil that spreads into mangrove systems tends to coat and impede the airways (lenticels, pneumatophores) that supply the mangrove roots and can also seal and pollute surrounding mud surfaces. The net result of this, in the long term, is a decline in the growth and health (productivity) of affected mangrove forest, which becomes evident in the form of changes in the density and general vitality of the forest canopy. Satellite imagery interpretation (of spectral signals) and leaf area index measurements are two indicators of mangrove vitality that can be monitored over time.

It is recommended that a long-term marine water quality monitoring programme should be established.

It is further recommended that baseline and follow-up assessments of mangrove distribution and vitality should be undertaken.

2.5.3 Progress reporting

In order to gauge the effectiveness of the NOSCP it is imperative that there is monitoring and periodic review of the implementation process in general, and more specifically, it effectiveness where there have been oil spill incidents.

It is recommended that an annual report should be prepared by the NCA (commencing at the end of 2004), covering all key aspects of the NOSCP, as it has been put into effect. As a priority, the report must review the implementation of the recommendations that are presented here.

2.6 BUDGET FOR THE OPERATIONALIZATION OF THE NOSCP

As the plan is brought into effect through decree, the NCA must be mandated to operationalise it (also update/modify the plan) with respect to judicial and budgetary issues.

In parallel with the commitments that are made by the relevant government institutions to put the NOSCP into effect (i.e. commitments to the roles and responsibilities that the plan specifies), budgets must be prepared and funding sourced to cover salaries, running expenses, capital equipment purchases/leases and other financial obligations that stem from these commitments.

Consideration should, therefore, be given to the establishment of appropriate financial mechanisms to support the implementation of the NOSCP (see, for example, article 83 of the Environmental Framework Law, which refers to pollution penalties that could be invoked to assist in this regard).

The following *one-year budget* assumes the appointment of three MINEF staff members to permanent positions within the NCA structure, and the appointment of ten staff members from other government institutions to part time positions (20% of their time) within the other NOSCP structures (NOSR-SC, NICT). Motivation for other budget items (procurement of capital equipment, capacity building, etc.) is provided in various sections of the NOSCP.

Budget item	*Units*	*Unit Cost (US$)**	*Total (US$)**
Salaries			
NCA structure NOSR-SC and NICT structure	3 persons 10 persons	25 000 5 000	75 000 50 000
Overhead expenses			
Telephones, electricity, building rents and maintenance, etc.	diverse	15 000	15 000
Operating (running) expenses			
Subsistence and transport (in-country travel) Subsistence and transport (regional travel) Subsistence and transport (international conference)	diverse diverse diverse	20 000 10 000 6 000	20 000 10 000 6 000
Training			
IMO Level 1 course IMO Level 2 course IMO Level 3 course IMO Inland spill course IMO Claims & compensation course Top-level training Table top exercises	3 persons 4 persons 4 persons 2 persons 1 person 3 courses 1 exercise	6 000 6 500 6 000 5 000 5 000 3 000 5 000	18 000 26 000 24 000 10 000 5 000 9 000 5 000
Capital equipment: purchase and leasing			
Computer and software, radios, digital camera and video, etc	Diverse	10 000	10 000
Communications			
Brochure production	3 brochures	10 000	30 000
Monitoring			
Marine water quality	Baseline sampling	40 000	40 000
Mangrove vitality	Baseline assessment	20 000	20 000
Consultants fees			
Coordination of NOSCP roadmap initiative; competency transfer	Diverse	250 000	250 000
TOTAL:			623 000

* 2003 US$ Values

<u>It is recommended</u> that the resources necessary to put the NOSCP into effect must be specified (in greater detail than presented in the NOSCP) and budgets associated with these resources secured. As a minimum, funding to meet the above budget must be secured.