GLOBAL
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10690-GH

Republic of Ghana

Coastal Wetlands Management Project

Project Document
August 1992

THE WORLD BANK

GEF Documentation

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THE WORLD BANK

CURRENCY EQUIVALENTS

Currency Unit	=	Cedi (C)
US$1.00	=	C395
C1,000	=	US$2.54

WEIGHTS AND MEASURES

1 metric ton (m ton)	=	2,205 pounds (lb)
1 hectare (ha)	=	2.47 acres (ac)
1 kilometer (km)	=	0.62 miles (mi)
1 meter (m)	=	3.28 feet (ft)

ABBREVIATIONS

DGW	Department of Game and Wildlife
EAP	Environmental Action Plan
EPC	Environmental Protection Council
EPC/TS	Technical Secretariat of the Environmental Protection Council
GEF	Global Environment Facility
GET	Global Environment Trust Fund
GERMP	Ghana Environmental Resource Management Project
IUCN	International Union for the Conservation of Nature
NGO	Non-Governmental Organization
PNDC	Provisional National Defense Council
WCG	Wildlife Clubs of Ghana

GOVERNMENT FISCAL YEAR

January 1 - December 31

REPUBLIC OF GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Grant and Project Summary

Grantee:	The Republic of Ghana
Beneficiary:	Ministry of Lands and Natural Resources
Grant Amount:	SDR 5.0 million (US$7.2 million equivalent)
Terms:	Grant from Global Environment Trust

Financing Plan:

	Foreign	Local	Total
	.....(US$ millions).....		
GET	3.1	4.1	7.2
Government of Ghana	0.1	1.0	1.1
Total 1/	3.2	5.1	8.3

Economic Rate of Return:	Not applicable
Staff Appraisal Report:	No. 10691-GH
Map:	IBRD No. 23746

1/ Includes Duties and Taxes of US$0.5 million.

REPUBLIC OF GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Background

1. A growing concern for environmental issues led the Government of Ghana to initiate the preparation of a National Environmental Policy Statement and a National Environmental Action Plan (EAP). In formulating the Plan, the Environmental Protection Council (EPC), a Government agency established in 1974, secured the active collaboration of a wide range of individuals and institutions in Ghana and among the donor community, including the World Bank. In the process, EPC generated widespread awareness of the importance of the issues involved and a consensus about the need for effective action. The EAP has been completed and has been approved by the Committee of PNDC Secretaries. The major environmental problems identified in the EAP include soil degradation and soil erosion, deforestation and forest degradation, and degradation of the natural and built environment within the coastal zone. The strategy for addressing these environmental problems is based on implementation of programs by sectoral agencies, whilst EPC has the lead responsibility for environmental policy formulation, monitoring and coordination. The development of mechanisms for effective coordination and the relationships between EPC and the sectoral agencies are critical for successful implementation of the EAP. There are designated institutional responsibilities for the management of environmental resources, and long established procedures for the demarcation and gazetting of protected areas in Ghana. More detailed background information is contained in Part II of this Memorandum.

2. The Ghana Environmental Resource Management Project, which includes the Coastal Wetlands Management Project, is designed to assist Government with the implementation of the EAP. As GERMP provides the framework for the management of the coastal wetlands, the objectives of the wider project are discussed first.

3. The Ghana Environmental Resource Management project would aim to strengthen the capacity of both government and people to manage environmental resources. The project would, therefore, focus on improving resource management capability through reorganizing and strengthening the institutions involved in environmental resource management, in particular the Environmental Protection Council and its Technical Secretariat (EPC/TS). The project would aim to support the TS to fulfill its role in environmental management, that is, the coordination of action to ensure that development is consistent with the sustainable use of environmental resources, the monitoring of the environment and the creation of public awareness of environmental issues. In parallel, the project would aim to develop environmental management skills in sectoral and local government agencies through staff training. Development of the management system would be supported through the provision of an improved environmental information system, based on a demand driven approach, and the creation of links between suppliers and users of information. The objective would be to provide a better understanding of environmental relationships, and early detection of environmental pollution or degradation. Dissemination of environmental information would be one other important objective of the project, within public sector agencies at national and district levels and the public at large by means of public information and awareness campaigns. Other project objectives are to assist the users of environmental resources to

invest in the maintenance of environmental assets through adoption of improved practices for the sustainable use of those resources. In particular the project would support the introduction of improved land management practices through community involvement in the planning and implementation of measures to minimize land degradation. Specific attention would be paid to the fragile coastal wetland ecosystems and it is these activities that would constitute the Coastal Wetlands Management Project to be financed by GEF.

Project Objectives

4. The main objective of the project would be to maintain the ecological integrity of key coastal wetland areas, by involving the people who derive their livelihood from these ecosystems in the planning and implementation of management programs. The objective would be to identify and monitor the common resources that benefit human and avian populations, and manage them to maintain critical bird habitat, without unduly restricting the options of people to derive benefit from the resources. The project would aim to develop capabilities at both government and community level for the implementation of the proposed program, to provide for baseline and monitoring studies, and to undertake studies of options for development, that would be compatible with sustainable use of the environment.

Project Description

5. The project is classed as a GEF Type 2 project, that is, although only concessional assistance from GET would make the project attractive in a country context, the project would result in substantial global benefits. The GET contribution of US$7.2 million would represent about 20 percent of the total costs of the wider Ghana Environmental Resource Management Project, of which it forms an integral part.

6. GEF funding would provide for the management of five coastal wetland sites that have been registered under the Ramsar Convention, to which Ghana is a signatory. The five sites are the Muni, Densu Delta, Sakumo, Songor and Anlo-Keta lagoons. Project funding would be targeted at three groups of activities: (i) Program Management - Support would be provided to the Department of Game and Wildlife (DGW) of the Ministry of Lands and Natural Resources for management of the coastal wetlands program. This would include the appointment of a coastal wetlands coordinator, an education officer and site wardens, together with necessary training, field equipment and transport. Funds would also be available for base-line surveys and regular monitoring of ecological and socio-economic conditions in the coastal wetlands, including the status of lagoonal fisheries. This monitoring would be undertaken through local consultancies, using the specialist skills available in the universities and elsewhere, and would be closely linked to the regular monitoring of environmental quality, supported under GERMP. Studies of the environmental implications of various development options in the Volta Basin, including the wetlands below the Akosombo dam, would be financed under GERMP and linked with studies to develop a national wetland conservation strategy. The project would support public awareness programs through provision of training in environmental education to staff of DGW and of the Wildlife Clubs of Ghana (WCG), an NGO. The project would also finance production and dissemination of education materials, sponsor workshops and underwrite extension activities to be organized by WCG. (ii) Site Demarcation and Management - Finance would be available for boundary surveys and demarcation. The project would also finance the construction of observation points, an education and research center at Songor, simple on-site education centers at other

sites, habitat enhancement and community development activities. The wetlands program would be linked to community based land and water management, supported under GERMP, through the promotion of measures to reduce erosion and improve vegetative cover in the immediate catchments of the wetland sites. The project would also provide for an investment support fund to finance developments in the wetlands that are compatible with maintaining the ecology of the wetlands. (iii) Sakumo Effluent Disposal - The Sakumo Lagoon poses special problems. It lies on the western margin of Tema, and present plans for a new sewage treatment plant involve the discharge of treated effluent into the lagoon. The natural outlet of the lagoon is severely restricted by a road and railway embankment. The project would provide funds for the construction of a pipe and marine outfall that would discharge the treated effluent into the sea. This would minimize the risk of nutrient build-up and consequent eutrophication in the lagoon, but there would be no adverse effects in the surf zone due to rapid dilution. The project would also finance a study of the hydrology of the lagoon and possible effects of dredging and of modifying the existing sluice and culvert through the railway and road embankment to restore natural tidal flow and improve habitat and water quality.

Project Implementation

7. The Department of Game and Wildlife, Ministry of Lands and Natural Resources would be responsible for the implementation of this project. A Wetlands Program Coordinator would be appointed with specific responsibility for the program. Implementation arrangements would be fully integrated with those agreed for GERMP, in which the lead agency would be the Technical Secretariat of EPC (EPC/TS). Procurement and disbursement of project funds would, therefore, be undertaken through EPC/TS and a Coastal Wetlands Project Operations Committee would be responsible for inter-agency cooperation. Communities would be closely involved in decisions affecting the management of wetland areas through local site committees established to advise the Wetlands Program Coordinator and the Project Operations Committee. The Wildlife Clubs of Ghana would play an important role in public awareness programs, working with community education officers to develop programs for the local education centers at each site.

Project Sustainability

8. Government has demonstrated a sustained commitment to conservation by including over 5 percent of the national territory within the system of protected areas. Continuing commitment is demonstrated by an action plan to improve management of current protected areas as part of the World Bank financed Forest Resource Management Project. The EAP includes a Coastal Zone Management Plan that demonstrates Ghana's commitment to land use and development planning to maintain the ecological integrity of the coastal region. Project funded studies and investments would increase sustainable economic benefits from developments that are compatible with preserving the ecology of the wetlands.

Lessons from Previous Bank Group Involvement

9. Although there has been no Bank Group lending in Ghana specifically for environmental operations, much of previous IDA lending for sectoral projects has had a direct impact on the environment, through its effect on agriculture, forestry, mining and industry, and urban development. Experience with these lending operations shows the need: to work

within an agreed national policy, with clearly identified priorities, in a stable macro-economic environment; to involve communities in the planning and implementation of sustainable resource use; to provide an institutional focus for the management of environmentally related matters with agreed procedures for effective coordination; to improve environmental management skills at district as well as central levels; and to provide training and support to implementing agencies for procurement and disbursement. This experience is consistent with conclusions drawn from world-wide experience. 2/

Rationale for GEF Involvement

10. The rationale for the use of GET funds to sustain and enhance the ecology of coastal wetlands in Ghana is detailed in the Project Selection Criteria Reference Sheet presented in Appendix 1, Part II of this Memorandum. It could be considered purely from the global point of view, but there are, in addition, important national and local justifications. At the global level the primary importance of these coastal lagoons and estuaries concerns their international significance as habitat for migratory waterbirds. The East Atlantic Flyway, defined by the regular annual transit paths of several million birds shows vividly the biotic interconnection between Africa, North America and Eurasia. The long term viability of the bird populations that connect these diverse landscapes is inextricably linked to the ecosystems in which they find regular sanctuary along their seasonal migration routes. The significance of the Ghana coastal wetlands is illustrated by the fact that they regularly harbor more than one percent of the estimated Atlantic Flyway populations of at least nine species of long distance migrants. They form a network of resting and feeding grounds for more than seventy species of migratory and resident waterbirds and represent the fourth largest concentration of migratory waders and shorebirds along the West African coast. The five principal wetland areas, the Muni, Densu Delta, Sakumo, Songor and Anlo/Keta lagoons, provide sanctuary for over 80 percent of the migratory waterbirds stopping in Ghana. All meet criteria as sites of international importance under the Ramsar Convention but there are no existing arrangements for formal management or protection. The current global registry of Ramsar sites lists no protected wetlands along the entire coast of the Gulf of Guinea - a prominent gap in the existing regional network of conservation areas. The management of these wetlands is, therefore, a high priority for migratory bird conservation on both a regional and global scale. Further, the sites identified under this project include the only presently known nesting sites in Ghana for three species of sea turtles listed as globally threatened by the World Conservation Union (IUCN).

11. A notable gap in the Ghana protected area system, identified in the EAP, is the absence of units that represent coastal wetland ecosystems. Consequently, from a national perspective of sustaining the widest representation of natural biodiversity at the level of ecosystems or natural communities, coastal wetlands have a high priority. At the local level, the Sakumo lagoon and Densu Delta wetlands provide the most accessible sites for outdoor recreation and interaction with the natural environment available to residents of the largest urban district in Ghana in addition to their documented global importance for biodiversity conservation. The majority of people living around the other three lagoons, at Muni, Songor and Anlo/Keta, derive a major part of their livelihood from the lagoons themselves through fishing and/or salt winning, or from industries such as inshore marine fisheries. These

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2/ The World Bank and the Environment. A Progress Report. Fiscal 1991.

depend, at least in part, on the ecological health of the adjacent wetlands, for example, as fish spawning grounds or sources of nutrient input into inshore coastal waters. Both the present way of life and the long term economic prospects of the human populations living near the lagoons and estuaries depend on the ecological health and stability of these wetland ecosystems. The project thus provides an opportunity to support the management of critical conservation sites for an internationally shared resource, whilst encouraging development that is compatible with long term maintenance of the ecological stability of the sites.

Agreed Actions

12. During project negotiations it was agreed that GEF support for the Coastal Wetlands Management Project would be considered as an integral part of GERMP. The following agreements are specifically related to the Coastal Wetlands Project:

Condition of Effectiveness

(a) The IDA Development Credit Agreement would be effective.

Condition of Disbursement

(a) The use of the Investment Support Fund would be subject to IDA approval.

Other Agreements

(a) Formal boundary descriptions of the five coastal wetland sites would be completed by June 1, 1993, and the legal instrument designating the boundaries of the Ramsar sites would be prepared, reviewed by IDA, and approved by December 31, 1993.

(b) Annual work programs for the Coastal Wetlands component would be prepared by the Department of Game and Wildlife and approved by the Project Operations Committee by June of each year, with subsequent review by IDA.

(c) The results of annual monitoring of ecological and socio-economic conditions in the coastal wetlands would be reviewed by the Project Operations Committee in April of each year, with subsequent review by IDA, starting in 1994.

(d) The detailed design and management of the education and research center at Songor would be agreed by June 1995.

Environmental Aspects

13. The primary objective of the project is to improve the management of environmental resources in the coastal wetlands in Ghana, and to introduce programs for the sustainable use of those resources. The project would, therefore, have beneficial effects on the environment. A specific assessment of the environmental impact of discharging treated effluent into Sakumo lagoon and alternatively, through an outlet in the surf zone has been made. Details presented

in Part II, Appendix 3 show that discharge into the lagoon would result in rapid nutrient build-up with consequent eutrophication, whilst discharge in the surf zone would have little effect due to rapid dilution in the open sea.

Benefits

14. The principal benefits of the project would be the maintenance of the ecology of five coastal wetland sites that are of international importance as habitat for migratory waterbirds. The project would improve the management and monitoring of the ecological resources by both government and the people. It would help to identify options for development that would improve the livelihood of local communities, but that would be compatible with sustainable use of the environment. The project would also result in an increased public awareness of environmental matters through both formal education programs at project financed centers, and through informal channels, such as wildlife clubs. Economic rate of return calculations for the project are difficult to interpret and may not be meaningful, as many of the costs and benefits cannot be quantified and the assumptions depend on whether the analysis is based on a national or global accounting stance. Consequently, the results of economic rate of return calculations are not presented.

Risks

15. There is a risk that the objectives of recognizing the five coastal wetland sites under the Ramsar Convention would not be achieved. However, the risk would be minimized because project funds would be available for site management, public awareness campaigns and the participation of local communities in maintaining the ecology of the sites.

Attachments

Schedule A

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Estimated Costs and Financing Plan

ESTIMATED COSTS

Component	Foreign	Local	Total
	(US$ million)		
Program Management	0.6	1.6	2.2
Site Demarcation and Management	1.4	2.2	3.6
Investment Support	0.4	0.1	0.5
Sakumo Effluent Disposal	0.2	0.2	0.4
Total Base Cost	2.6	4.1	6.7
Physical Contingencies	0.2	0.3	0.5
Price Contingencies	0.4	0.7	1.1
TOTAL PROJECT COST 1/	3.2	5.1	8.3

FINANCING PLAN

	Foreign	Local	Total
	US$ million)		
GET	3.1	4.1	7.2
Government of Ghana	0.1	1.0	1.1
Total 1/	3.2	5.1	8.3

1/ Includes US$0.5 million duties and taxes.

Schedule B
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COASTAL WETLANDS MANAGEMENT PROJECT

PROCUREMENT METHOD AND DISBURSEMENT

A. Amounts and Methods of Procurement

Procurement Category	ICB	LCB	Others	Total
	.....(US$ millions).....			
Civil Works				
Total	0.5	2.5	-	3.0
GET	0.4	2.2	-	2.6
Vehicles				
Total	0.3	-	0.2	0.5
GET	0.3	-	0.1	0.4
Equipment and Materials				
Total	0.7	0.2	0.3	1.2
GET	0.7	0.2	0.2	1.1
Technical Assistance				
Total	-	-	1.1	1.1
GET	-	-	1.1	1.1
Training and Public Awareness				
Total	-	-	0.4	0.4
GET	-	-	0.4	0.4
Investment Support and Land Management Fund				
Total	-	-	0.6	0.6
GET	-	-	0.5	0.5
Incremental Recurrent Costs				
Total	-	-	1.5	1.5
GET	-	-	1.1	1.1
TOTALS	1.5	2.7	4.1	8.3
GET	1.4	2.4	3.4	7.2

Schedule B
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COASTAL WETLANDS MANAGEMENT PROJECT

B. Summary Disbursement Schedule

Category	Amount Allocated	% to be Financed	
	...(US$ millions)...	Foreign	Local
Civil Works	2.4	100	70
Vehicles, Equipment and Materials	1.3	100	90
Technical Assistance	1.0	100	100
Training	0.3	100	100
Investment Support Fund	0.4	100	100
Incremental Recurrent Costs	0.9	70% to December 1995, 50% thereafter	
Unallocated	0.9		
TOTAL	7.2		

Schedule C
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COASTAL WETLANDS MANAGEMENT PROJECT

Timetable of Key Processing Events

Time Taken to Prepare:	20 months
Project Prepared by:	Government of Ghana with IDA assistance 3/
First IDA Mission:	June 1991
Appraisal Mission	March 1992
Negotiations:	August 1992
Planned Date of Effectiveness:	January 1993
List of Relevant PPARS and PCRs:	None

Summary Supervison Plan

1. Supervision of the project would be integrated with the wider GERMP. The schedule of supervision missions presented below includes three visits during the first year of the project, to provide close supervision and assistance during the critical start-up period. In subsequent years, one visit by a supervision mission would coincide with the review of the annual plan for the following year's program in the third quarter of the calendar year. The supervision plan also provides for one additional visit in the second quarter of the second, fourth and fifth project years. In the third project year, this visit would coincide with the project mid-term review.

CY	1993	1993	1994	1995	1996
Quarter	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Supervision	* * *	* *	* *	* *	* *
Mid-term review			*		

3/ This project is based on the findings of an appraisal mission that visited Ghana in March, 1992, comprising I. Hill (Mission Leader); Ms. C. Cook (Sociologist); C. Sow (Economist); and K. Creighton (Consultant Ecologist).

Key Indicators

2. The key indicators to assess the progress of the project can be considered in a number of groups. The Technical Secretariat of the EPC would be responsible for collating the following data.

3. Policy and Legislation. The Environmental Action Plan indicates the need for the revision and adoption of a number of policies and legislative measures. Progress towards the adoption of those that relate specifically to project supported activities would be monitored. They include policy and legislation related to:

- Land Management;
- Fisheries and Coastal Zone Management.

4. Coastal Wetlands Management

- Completion of base line studies;
- Progress with management programs;
- Progress with monitoring studies and impact of management programs on the ecology of the wetland sites.

5. Physical

- Physical achievement of civil works or procurement of project finance items as presented in the implementation schedule and detailed cost tables.

6. Financial

- Budget by:
  - Investment;
  - Personnel;
  - Operational expenses;
  - Program budgets.

7. Reporting

- Timeliness of six-monthly reports.
- Publication of results in bulletins or annual reports of participating agencies.

Skills Required for Supervision Missions

8. In addition to the Task Manager responsible for supervising compliance with Bank procedures, supervision missions would need to include personnel with skills in:

- Management Systems;
- Environmental Quality Monitoring;
- Rural Sociology;
- Wetlands Ecology.

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COASTAL WETLANDS MANAGEMENT PROJECT

PART II: APPENDICES

REPUBLIC OF GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

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COASTAL WETLANDS MANAGEMENT PROJECT

APPENDIX 1

GEF Project Selection Criteria Reference Sheet

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COASTAL WETLANDS MANAGEMENT PROJECT

GEF Project Selection Criteria Reference Sheet

Country Eligibility

Per Capita Income - US$390 (1989)

Environmental Action Plans

The Government of Ghana has recently completed the preparation of a National Environmental Policy Statement and a National Environment Action Plan. In March, 198, responsibility for their formulation was given to the Environmental Protection Council (EPC). EPC secured the active collaboration of a wide range of individuals and institutions in Ghana and amongst the donor community, including the World Bank. The process adopted by EPC in preparing these national policy documents has generated widespread awareness of the importance of the issues involved and a consensus about the need for effective action.

Project Type

Type 2. Without GEF support Government would not undertake the systematic inventory and management of coastal wetlands envisaged under the project.

Global Environmental Benefit

The five coastal lagoons, estuaries and adjacent seashores addressed by this project provide regular sanctuary for upward of 100,000 migratory shorebirds annually. Together they harbor nearly 5% of the shorebirds and waders using the East Atlantic Flyway and on a regional scale rank fourth in peak populations of migratory waterfowl. No Ramsar Sites have yet been declared on the coast of the Gulf of Guinea. The wetlands included in this project provide habitat for internationally significant populations of eleven species of migratory shorebirds and include nesting sites for three threatened species of marine turtles.

Form of Innovation

The project will include financing for a study of compatible development options for the communities living adjacent to the lagoons and financing for adaptation and implementation of technologies identified as promising sustainable development options. These may include aquaculture, agro-forestry and improved fisheries

management as well as expansion of the indigenous salt-winning industry adjacent to the lagoons. Pending the outcome of engineering studies, the project may include financing of civil works to mitigate the effects of urban/domestic waste pollution on the two urban lagoons. Management of the Ramsar Sites will be done jointly with responsibility for core zones or sanctuaries under the Department of Game and Wildlife and of the adjacent zones under Site Committees within the Ministry of Local Government involving participation of local people and traditional leaders.

Demonstration Value and Replicability

The goal of the multiple-use management regime proposed for the coastal wetlands is to maintain the ecological balance of these aquatic/terrestrial ecosystems by encouraging development of industries such as fishing, agro-forestry, aquaculture, tourism and salt production that provide options for economic growth to local communities that are compatible with sustaining habitat for the migratory birds which also depend on these areas. In declaring these areas as Ramsar Sites, the Government of Ghana is foregoing certain development options for these sites but, in return receives technical and financial assistance to implement sustainable development activities that are compatible with maintaining bio-diversity of the coastal zone. The model of working with local communities to identify common resource requirements (e.g., water quality, erosion control) for conservation and community development needs, and focusing investment on those common needs is one which may have broader application for conservation outside of traditional protected areas.

Contribution to the GEF Portfolio

The areas to be addressed by this project qualify as Wetlands of International Importance under criteria established by the Ramsar Convention. They are among the most significant sites in West Africa as habitat for migratory waterfowl. The project represents an opportunity to afford protection to critical conservation sites for an internationally shared resource while encouraging development that is compatible with long-term maintenance of the ecological stability of the ecosystems in which the conservation sites occur.

Sustainability

The GOG has demonstrated a sustained commitment to conservation in including over 5% of the national territory within the system of protected areas and consistently providing substantial human and material resources for supervision and management of protected areas. Continuing commitment is evinced by an action plan to improve management of current protected areas financed by the World Bank through the Forest Resource Management Project. The NEAP includes a Coastal Zone Management Plan that demonstrates Ghana's commitment to land use and development planning to maintain the ecological integrity of the coastal region. Inclusion of environmental and public awareness components within this project as well as involvement of local communities in management decisions concerning development within and adjacent to

the project sites will develop a broader grass roots understanding of linkage between long-term economic prospects for the human populations and ecological stability of these wetland ecosystems.

Monitoring Evaluation

Baseline and monitoring studies of key environmental indicators reflecting hydrological cycles, water quality, limnology and fisheries within the wetlands are an integral part of the project. The project includes financing for training, institutional development and improvement of research facilities to carry out long-term ecological monitoring studies of the coastal wetlands included in the project. The project would also finance pilot projects to test and evaluate feasibility of development options identified during the early phase of the project.

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APPENDIX 2

Coastal Wetlands Management

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Coastal Wetlands Management

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COASTAL WETLANDS MANAGEMENT PROJECT

Coastal Wetlands Management

I. INTRODUCTION

1.1 Ghana's 550 km coastline includes over 50 lagoons and estuaries ranging in size from a few dozen hectares to over 300 km2. At present there are no coastal wetlands represented within the national system of parks, reserves and sanctuaries. The recently completed Ghana Environmental Action Plan which incorporates a Coastal Zone Indicative Management Plan (CZIMP), explicitly recognizes this gap. The CZIMP calls for establishment of several coastal wetland protected areas to be developed under a multiple-use management regime with significant local participation in management and administration. The Government of Ghana has indicated its intention to designate five sites as Wetlands of International Importance under the "Ramsar" Convention 1/.

1.2 The five principal sites to be established under this project represent a variety of wetland ecosystems including open and closed brackish lagoons, river deltas and estuaries. Two sites which fall within the greater metropolitan region of Accra-Tema have been designated for green belt/open space/recreation zones under the draft Urban Development Structure Plan 2010. The other three sites represent "rural" areas although human settlements occur adjacent to the wetlands and throughout their catchments. The core wetlands of the project sites range from 3.5 km2 to over 300 km2 in extent and the proposed management zones which include critical catchments range from 35 to 1200 km2. Identification of project sites and documentation of their ecological importance and international significance for migratory birds was accomplished by Dr. Yaa Ntiamoa-Baidu under the Save the Seashore Birds Project sponsored by the Royal Society for the Protection of Birds (UK) in cooperation with the Ghana Department of Game and Wildlife.

1.3 The principal management objective for the five key wetlands targeted under this project is to maintain or restore the ecological integrity of these wetland ecosystems. The purpose is to safeguard their continuing value as wildlife habitat and to enhance sustainable productivity in terms of traditional compatible industries and uses such as coastal and lagoon fisheries, salt production, irrigated agriculture, and recreation. This project will address common requirements to establish and manage the coastal wetlands as "Ramsar" sites such as: boundary survey, demarcation and establishment; monitoring of key indicators reflecting water quality, pollution, erosion, and health of the aquatic environment; site management

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1/ The "Convention on Wetlands of International Importance Especially as Waterfowl Habitat" known as RAMSAR after the town in Iran where it was signed by the original parties on 2 February 1971. Ghana has been a party since 1988.

personnel and infrastructure; and local public awareness of environmental issues. The project sites differ appreciably in size and in both the magnitude and nature of present and potential threats to their long term ecological viability. A crucial issue and major component of this project concerns the identification of sustainable development options that meet local community needs and objectives and are compatible with maintaining the long term ecological stability of the wetlands. In the case of the "rural" lagoons, project-financed activities would include socio-economic and technical studies to identify compatible development options such as intensified fisheries management, development of lagoon aquaculture, and possible expansion of the artisanal salt industry. For the urban lagoons, the project would include financing for engineering studies and civil works to mitigate the impact of urban pollution on the wetland ecosystems and to maintain or restore their natural hydrological balance.

1.4 The principal management authority for the project would be a Wetlands Management Unit to be established within the Department of Game and Wildlife (DGW). In addition to routine project administration and technical management, this unit would include a specialist on community relations and public education. A Wetlands Management Committee would be established under the Natural Resources Inter-sectoral Network administered by the Environmental Protection Council to provide technical guidance and a forum for addressing intersectoral technical issues regarding the management of project sites. Each site would have a local Site Management Committee with representation of traditional community leaders and local government as well as appropriate sectoral agencies and interests (e.g., fishermen, market women). On-site management would be done under the administration of a site warden employed by DGW but to the extent practical employing local residents as community rangers for assisting in monitoring studies, border maintenance and other activities. Disbursement of funds for activities that benefit both the environment and the well-being of the human residents such as improvement in sanitation facilities and water supplies, development of fuelwood resources and modest tourism infrastructure would be done under supervision of the DGW but according to priorities set by the local Site Management Committees.

1.5 Public awareness of environmental issues and of the relationship between environmentally sound management and sustainable economic development are crucial to long term program success. This project seeks to develop community awareness by creating and maintaining modest environmental education facilities at each of the sites, supporting the development and dissemination of appropriate environmental education materials and programs and providing resources to enable expansion and further program development of the Wildlife Clubs of Ghana, a non-government organization for schoolchildren that has taken a leading role in promoting environmental awareness in Ghana over the past three years.

II. BACKGROUND

A. Coastal Zone Indicative Management Plan

2.1 The Ghana Environmental Action Plan prepared by the Environmental Protection Council with support from the World Bank includes a major section on coastal zone

management that was prepared in 1990 under the title "Coastal Zone Indicative Management Plan" (CZIMP). Six sites within the coastal zone, including five coastal lagoons or estuaries and their catchments are proposed for establishment as protected areas with principal management objectives listed as conservation of wildlife or wildlife habitat and the encouragement of compatible economic development activities such as fishing and recreation. The single "upland" site (Cape Three Points Forest Reserve) is being addressed under the World Bank financed "Forestry II" project and is not considered further here. The five wetland sites: Muni, Songor, Sakumo and Anlo-Keta lagoons, and the estuary of the Densu River are shown in Annex 9: Figure 1. The CZIMP includes an indicative management plan for the Songor Lagoon and references draft management plans for three other sites (Muni, Sakumo, Densu Delta) which have been prepared by the Save the Seashore Birds Project. Common elements indicated for the implementation of management plans include the legal designation and physical demarcation of site boundaries, establishment of core zones for faunal protection, identification of sustainable and compatible development options within adjacent "buffer" zones and the need for establishing an effective forum for local community involvement.

2.2 The CZIMP identifies the need to reconcile the conservation of the priority lagoon and estuary zones with development under a multiple-use management regime that encourages the maintenance and/or development of compatible economic activities. The importance of community participation in management of the proposed protected zones is emphasized as well as the potential utility of reinforcing traditional strategies (based on cultural and religious customs and beliefs) for regulating exploitation of lagoon resources.

2.3 The Plan also identifies needs for baseline data collection and monitoring of crucial environmental indicators that concern the environmental health and ecological stability of the priority wetlands, as well as the need for development of a spatial database to facilitate planning on a broader scale within the coastal zone. The importance of environmental education at the community level concerning ecological principals of sustainable wetlands management is recognized. The Departments of Game and Wildlife, Forestry and Fisheries are identified as key implementing agencies for the wetland conservation program with formal linkage to local government through the District Administrations at the level of the individual sites.

B. Coastal Wetlands Management Plans

2.4 A study of the coastal wetlands was undertaken as part of preparation for the Ghana Environmental Resource Management Project (GERMP) of which this project forms one component. The resulting report 2/ prepared under sponsorship of the Ghana Environmental Protection Council and the World Bank provides detailed documentation of the concentrations of migratory shorebirds and waders occurring on the Ghana coast; makes explicit recommendations for delineation of the five most ecologically significant coastal wetlands as "Ramsar" sites; outlines requirements for baseline research, monitoring studies and management needs for each of the wetland sites; and provides detailed recommendations

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2/ Coastal Wetlands Management Plans: Ghana (Ntiamoa-Baidu and Gordon, 1991)

for program implementation, administration, management structure and schedule. The rationale, project justification and recommendations for program implementation given in the following sections are based largely on this document and its supporting annexes.

C. Importance of Coastal Wetlands for Migratory Birds

2.5 The ecological importance of Ghana's coastal wetlands has been systematically evaluated with regard to their international significance as habitat for migratory shorebirds and waders by the Save the Seashore Birds Project - Ghana (SSBP-G). Research on bird movements has been undertaken since 1985 by local survey teams sponsored by the Royal Society for Protection of Birds (U.K.) (Ntiamoa-Baidu and Grieve, 1987; Ntiamoa-Baidu and Hepburn, 1988; Ntiamoa-Baidu, 1988; ibid.1991). Eighty sites along the Ghana coast have been surveyed and thirteen sites where large numbers of migrants congregate have been regularly monitored for the past five years. The five coastal wetlands which are the focus of this project provide sanctuary for over 80% of the migratory waterbirds stopping in Ghana. All meet criteria as sites of international importance as waterfowl habitat under the "Ramsar" Convention, in that they regularly harbor more that 1% of the estimated Atlantic Flyway populations of three to nine species of long distance migrants (Table 1). Peak populations of shorebirds and waders recorded at the project sites range from 23,000 to over 111,000 (Table 2).

Table 1

Wetland sites on the Ghana coast qualifying as Wetlands of International Importance by the 1% criterion. Calculations based on Altenburgh, et. al, 1982 and Smit and Piersma, 1989.

		Peak counts recorded at:							
Species	1% of Estimated East Atlantic Flyway Population	Anlo-Keta	Songor	Sakumo	Korle	Densu Delta/Panbros	Muni	Elmina	Esiawa
Spotted Redshank	300	8,330	10,060	3.280	-	550	-	430	-
Greenshank	500	6,900	4,770	1,180	-	-	-	610	-
Ringed Plover	2,000	2,860	3,010	-	3,500	-	-	-	-
Curlew Sandpiper	4,500	14,810	6,920	3,270	7,050	4,700	-	-	-
Sanderling	1,000	-	-	-	-	-	-	-	4,520
Little Stint	2,000	5,790	2,530	2,570	5,780	2,610	-	-	-
Black Tailed Godwit	1,500	-	-	1,500	-	-	-	-	-
Avocet	700	1,560	3,740	-	-	-	-	-	-
Black-Winged Stilt *	60	12,080	4,400	900	450	310	150	230	-

* Partial migrant. Numbers recorded comprise ca. 55% palaearctic; 45% residents.

Table 2

Peak counts and number of species recorded for principal wetland and seashore sites on the Ghana coast. Data from SSBP-G. (June, 1991).

Site	No. of Species Recorded	Minimum Bird Population Estimate 1/
Keta Lagoon 2/	72	109,300
Songor Lagoon 2/	57	111,000
Densu Delta/Panbros Salt Pans 2/	57	35,000
Sakumo Lagoon 2/	66	32,500
Muni Lagoon 2/	42	23,000
Korle Lagoon	31	21,700
Elmina Salt pans	43	8,600
Esiama Beach	43	9,700

1/ Based on peak counts of species recorded at each site.
2/ Proposed for designation as Ramsar site.

2.6 The project sites together form a network of resting and feeding grounds for more than seventy species of migratory and resident waterbirds. On-going studies by SSBP-G indicate that a large number of the birds wintering along the Ghana coast move regularly among the proposed project sites. Together, these lagoons represent the fourth largest known concentration of migratory waders and shorebirds along the West African Atlantic coast (Table 3).

Table 3

Major Concentrations of Migratory Shorebirds and Waders on the West African Atlantic Coast. Data from Smit and Piersman (1989) and SSBP-G (1991).

Country	Site	Estimated Total Bird Population
Mauritania	Banc d'Arguin	2,038,000
Guinea-Bissau	Arguipelago dos Bijagos	980,000
Dem. Republic Guinea	entire coast	400,000
Ghana	Volta delta and coastal lagoons	130,000+
Sierra Leone	Sierra Leone River	50,000
Liberia	entire coast	35,000

2.7 Ringing studies which are conducted to monitor bird movements among roosting or feeding sites have just begun in Ghana over the past two years. This is the only reliable technique for recording bird movements with certainty but it is enormously time consuming

and labor intensive, with a slow rate of data return for time/effort invested. Preliminary data from ring returns and observations indicate movement occurs among the principal sites but the frequency, magnitude, and proximate causes are not yet well understood. There is evidence that major concentrations of birds shift between Songor and Keta lagoons in response to fluctuations of water levels at Keta. During the peak of annual migrations over 60% of migratory shorebirds and waders stopping in Ghana are found in the Songor and Anlo-Keta wetland complexes of the Volta Delta.

2.8 The numbers of birds stopping in passage or wintering on the Ghana coast as reflected in the peak counts reported in the above tables are minimum estimates. Based on known population turnover rates at Mediterranean and other West African sites the actual numbers of birds stopping in the lagoons over the course of an annual migration cycle is likely up to two times greater that the numbers reflected in peak counts. Although most birds wintering or passing through the Ghanaian lagoons are assumed to belong to the East Atlantic Flyway populations, preliminary data from long distance leg-ring returns indicate that the Ghana coast may be important winter habitat for some bird populations using the Mediterranean Flyway as well.

D. International Conventions Relevant to Coastal Wetlands

2.9 Ghana is a signatory to three international conventions that pertain to conservation of wetlands and the fauna and flora that they contain. Titles of the conventions, dates of signing, and relevant abstracts are listed below:

Title: African Convention on the Conservation of Nature and Natural Resources ("African Convention")

Date Signed By Ghana: 1968

Relevant Provisions: This convention obligates signatories to:
"manage aquatic environments, whether in fresh, brackish, or coastal water, with a view to minimizing deleterious effects of any water and land use practice which might adversely affect aquatic habitats." (Art. VII, Sect. 1a)

"In the formulation of all development plans, full consideration shall be given to ecological, as well as economic and social factors." (Art. XIX, Sect. 3)

"The Contracting States recognize that it is important and urgent to accord a special protection to those animal and plant species that are threatened with extinction, or which may become so, and to the habitat necessary to their survival." (Art. VIII, Sect. 1)

Title: Convention on the Conservation of Migratory Species of Wild Animals ("Bonn Convention").

Date Signed by Ghana: 1988

Relevant Provisions: "The Parties acknowledge the need to take action to avoid any migratory species becoming endangered." (Art.II, Sect.2)

" Parties that are Range States of a migratory species listed in Appendix I [endangered] shall endeavor:

(a) to conserve and where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction." (Art. III, Sect. 4)

Title: Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention).

Date Signed by Ghana: 1988

Relevant Provisions: "Each Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance... The boundaries of each wetland shall be precisely described and also delimited on a map and they may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water... lying within the wetlands, especially where these have importance as waterfowl habitat.

"Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included." (Art. II, Sect. 1 and 2)

"The Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory.

"Each Contracting Party shall arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference." (Art. III, Sect. 1 and 2)

"Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening." (Art. IV, Sect. 1)

" The Contracting Parties shall encourage research and the exchange of data and publications regarding wetlands and their flora and fauna.

" The Contracting Parties shall promote the training of personnel competent in the fields of wetland research, management and wardening." (Art. IV, Sect. 3 and 5)

2.10 Subsequent to the initial conference for establishing the "Ramsar" Convention, held in Ramsar, Iran, several subsequent conferences of the Contracting Parties have been held, the most recent in Regina, Saskatchewan during 1987. The Regina Conference adopted criteria for identifying wetlands of international importance under Article 2 of the convention and provided an expanded definition of "wise use" as employed in Article 3, Sect. 1, quoted above.

2.11 Specific criteria for using waterfowl to identify wetlands of importance adopted at the Regina Conference are:

"A wetland should be considered internationally important if: (a) it regularly supports 20,000 waterfowl; or (b) it regularly supports substantial numbers of individuals from particular groups of waterfowl indicative of wetland values, productivity or diversity; or (c) where data on populations are available, it regularly supports 1% of the individuals in a population or subspecies of waterfowl."

2.12 The expanded definition of "wise use" adopted at the Regina Conference is:

" The wise use of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem."

Relevant guidelines for "wise use" adopted at Regina include:

"(d) proper assessment of environmental impact before development projects are approved, continuing evaluation during the execution of projects, and full implementation of environmental conservation measures which take full account of the recommendations of this process of environmental assessment and evaluation; and

"(e) use of development funds for projects which permit conservation and sustainable utilization of wetland resources."

Full texts of the conventions and conference resolutions quoted from above are given in Annexes 3-5 to this working paper.

E. History and Objectives of the Save the Seashore Birds Project

2.13 Nearly all of the data which establish the importance of the Ghana coastal zone as a region of major concentration for migratory waterfowl have been developed over the past five years under a program that is directed by Dr. Yaa Ntiamoa-Baidu of the Zoology Department, University of Legon, Ghana. Financial and technical support have been provided by the Royal Society for the Protection of Birds to assist and sustain a program of avian surveys to identify major concentration areas for migratory birds on the Ghana coast and to regularly monitor populations at key sites on a monthly basis throughout the year. Over the past three years the SSBP has expanded activities in the realm of public awareness of environmental issues and environmental education through the promotion of Wildlife Clubs organized by teachers at the primary and secondary school levels and the publication and distribution of a popular magazine on natural history and conservation for schoolchildren. Through a collaborative program, staff of SSBP and RSPB have developed draft management plans for four of the five sites targeted by this project. Future plans for ongoing collaboration between SSBP and RSPB include expansion of public education programs and development of community level environmental education curricula, as well as continuation of the bird monitoring and ringing program to improve knowledge of bird movements among roosting, feeding and nesting areas. The major constraints on expansion of this program at present are limits on key staff time, shortage of trained personnel, and limited funds for investment in training, curriculum development and capital expenditures (e.g. for construction of education centers).

III. THE PROJECT AREA

A. General Description of the Project Zones

3.1 Five coastal wetland areas are proposed for inclusion in this component of the GERMP. They are: Muni and Sakumo lagoons, the Densu River delta, and the Songor and Anlo-Keta lagoon complexes within the Volta delta. Locations of the sites are shown in Annex 9: Figure 1. The sites include the deltas or estuaries at the mouths of the Volta and Densu rivers and three brackish-water lagoons. All of the sites fall within the "coastal zone" as defined in the Coastal Zone Indicative Management Plan included in the EAP. Two of the sites, Sakumo Lagoon and Densu Delta/Panbros Salt Pans fall within the Greater Accra-Tema Urban Planning District.

3.2 Data on the size of these areas are summarized in Table 4. Each site is divided into estimates of the open water lagoon area, a "core zone" where activities would be strictly regulated to preserve their value as wildlife habitat and a management zone that includes the catchments adjacent to the wetlands that are proposed for inclusion in the Ramsar site designations. The rationale for including the adjacent catchments and thereby bringing them within the planning and management regime of the Ramsar sites is to acknowledge that economic and demographic factors within the catchments have direct and potentially profound bearing on the long term ecological stability of the wetlands they surround.

Table 4

Size of management areas, wetlands and core zone sanctuaries for proposed Ramsar sites.

Site	Management Area (km^2)	Lagoon Area (km^2)	Core Zone (Sanctuary) (hectares)
Anlo-Keta	1,200	300+	2,500
Songor	330	115	500
Densu Delta	70	20	350
Muni	90	3	150
Sakumo	35	3	100
Totals:	1,725	441	3,600

3.3 In Table 5 data are summarized on Ghana's present protected area system and the increase that establishment of the coastal wetlands as Ramsar sites would represent. At present there are no protected wetlands within the coastal zone. Inclusion of the wetlands proposed here which cover approximately 440 km2 would represent an increase of just over 3% in Ghana's protected area system. Classification of the "core zones" (ca. 36 km2) of the five sites as sanctuaries where management will specifically focus on habitat protection would increase by 8% the lands currently managed as wildlife sanctuaries and strict nature reserves.

Table 5

Overview of Ghana protected area system and increase represented by inclusion of Ramsar sites. (Data from IUCN Directory of Afrotropical Protected Areas, 1987).

Category	No. of Sites	Area (hectare)
All protected areas	14	1,288,864
Sanctuaries and strict nature reserves	3	44,817
Wetland areas of proposed Ramsar Sites	5	ca.44,000
Percentage increase in Ghana Protected Area System represented by Ramsar Wetlands	3.5%	
Core zone sanctuaries proposed within Ramsar sites	ca. 8	ca. 3,600
Percentage increase in area classified as sanctuaries and strict nature reserves	8.0%	

3.4 Table 6 compares Ghana with the ten other northern and western African signatories of the Ramsar Convention in terms of the size and number of designated wetland sites. At present, Ghana ranks tenth on the list. Designation of the five sites identified under this project would reflect a major increase in relative commitment to wetland conservation and management.

Table 6

Ramsar sites in northern and western Africa (data from IUCN-WCMC Ramsar list, 1990).

Country	No. of Sites	Total Area (hectares)
Algeria	2	4,900
Egypt	2	46,200
Gabon	3	1,080,000
Guinea-Bissau	1	39,098
Mali	3	162,000
Mauritania	1	1,173,000
Morocco	4	10,580
Niger	1	220,000
Senegal	4	99,720
Tunisia	1	12,600
Ghana (present)	1	7,260
Ghana (proposed)	5	172,500
Total:	6	179,760

B. Site Descriptions, Human Settlement Patterns and Economic Activities within the Project Zones

1. Muni Lagoon Complex

3.5 The Muni site (Annex 9: Figure 1), just west of Winneba encompasses about 90 square kilometers comprising the watershed of the Muni lagoon. Approximately 10% of the drainage area in two parcels is currently classified as Forest Reserve. Within the site, approximately 20 km2 form the traditional hunting grounds of the Efutu people who use this area annually for their Aboakyir Festival, a cultural ceremony that involves the capture of a bushbuck by members of the local Asafo companies.

3.6 Muni has several small settlements within the proposed site. Total population within the proposed site boundaries is less than 2,000, mainly concentrated along the coast and the coast highway. The town of Winneba near the eastern margin of the site is the closest "urban" area with a population of about 30,000. The site falls within two local government Districts.

3.7 The principal economic activity of the people living around Muni lagoon is coastal fishing. Some fishing is done in the lagoon but the local people regard this as marginal to their economy. A small fraction of the catchment is under cultivation for cassava, maize and other crops that are mostly consumed locally. Cattle grazing is not extensive in this region. The nearby town of Winneba is attempting to encourage growth in beach and recreational tourism and some modest tourist facilities have been developed within about 2 km of the eastern margin of the lagoon.

3.8 Proposed zoning would include designation of approximately 0.5 km2 of the lagoon and about 1km2 of the adjacent shoreline as a sanctuary or "core zone" to afford protection for breeding waders and migrants during crucial seasons. The traditional hunting ground and part of the adjacent forest reserve would be designated as a game management area to maintain the population of bushbuck necessary for the Aboakyir Festival to continue.

2. Songor Lagoon Complex

3.9 The Songor site (Annex 9: Figure 1) includes the west bank of the lower Volta River estuary and the Songor lagoon which is a shallow, closed lagoon of about 115 square kilometers in surface area. The entire site falls within a single District of local government. The principal major settlement is the town of Ada-Foah on the west bank of the Volta River. Total population within the site boundaries is over 50,000. Settlements adjacent to the lagoon include several villages along the coast and a number of small villages within one to five kilometers of the inland margin of the lagoon.

3.10 Within the region of the Songor lagoon the town of Ada-Foah is trying to develop a tourist industry based on recreational fishing and beach resort tourism. Along the coastal margin of the lagoon, several villages are involved in coastal fishing and fish-smoking for export to commercial domestic markets through Accra. Fishing for tilapia with cast nets occurs throughout the lagoon but no data on catches are available. Interviews with local people indicate that there was once a crab fishery (Callinectes) within the lagoon which seems to have declined in parallel with the near total elimination of mangroves from the eastern part of the lagoon as wood was harvested for smoking fish. Along the northern (landward) and western margins of the lagoon, extensive natural salt pans occur. The Songor lagoon has been the site of an indigenous artisanal salt industry dating back for over a century. Local correspondents estimate that about 8,000 people are involved in the salt trade. Salt is collected by hand from natural evaporation pools and transported to collection points. The salt is then bagged and shipped out by truck to Accra. Eight local cooperative associations handle the shipping and marketing. The Vacuum Salt Company operates commercial salt pans on the northwest margin of the lagoon. Attempts were made to expand commercial/industrial salt winning operations in the region in the early 1980's but met with strong local resistance and were suspended. Recently the National Minerals Commission undertook a feasibility study for industrial expansion of the salt industry at Songor. Results of the study have not been publicly released but there appears to be some potential for major expansion of the salt winning enterprise within and adjacent to the lagoon. Plans for such expansion should minimally take into account the potential hydrological and ecological impacts on the lagoon and a study of the likely consequences for the 100,000+ birds that congregate there seasonally. A recent FAO study on aquaculture development noted the potential suitability of Songor lagoon for development of up to 200 ha of shrimp ponds.

3.11 The total management area would encompass about 330 km2. Proposed zoning within the site would include designation of a "core zone" or sanctuary of about 5 km2 at the eastern end of the lagoon for protection of migratory bird habitat. A "buffer" zone extending about one kilometer from the lagoon margin would be delineated where development would be restricted to activities compatible with maintaining the ecological stability of the lagoon.

3. Anlo-Keta Lagoon Complex

3.12 The Keta Lagoon (Annex 9: Figure 1), adjacent wetlands and the immediate catchment of this wetland complex, encompass about 1200 km2 including the eastern bank of the Volta estuary and the coastal wetlands between the Volta River and the Togo border. The surface area of the principal lagoons and seasonally flooded mudflats is over 300 km2.

3.13 Approximately 80,000 people live within the site boundaries concentrated principally along the coast and the northern (inland) margins of the lagoon. Coastal erosion is a severe problem effecting the long term viability of the coastal communities. The coast and lagoons of the Anlo-Keta complex may be undergoing long term successional changes due in part to hydrological consequences of damming the Volta river.

3.14 The Keta lagoon complex supports the largest "inland" fishery within the coastal zone of Ghana. The mode of fishing is artisanal employing a variety of methods including cast nets, crab traps, bottle traps, trawl nets and shrimp traps. Traditional methods of habitat manipulation through the construction of "brush-parks" or acadjas to enhance fish catches are employed in the Keta lagoon. Principal species harvested from the lagoon include tilapia (Oreochromis), mullet (Mugilidae), crab (Callinectes) and shrimp (Penaeus and Parapenaeopsis). Catch statistics are unavailable but a recent FAO study (MacPherson, et al., 1990) reported that for Keta as for the other coastal lagoons, "Catches seem small as do the sizes of the individual fish in the catch, a sign of overexploitation." This study noted the potential for culture based fisheries in the lagoons but cautioned that "... a thorough-going survey of the fisheries and environmental conditions is a prerequisite to the design of any stocking program."

3.15 Other principal economic activities affecting the Keta lagoon are irrigated agriculture, principally along the interior margin of the coastal barrier dune west of the town of Keta. The effects of runoff from the irrigated culture of shallots on the lagoon are not well known. Obviously the salinity of the lagoon is an important factor in the viability of irrigated agriculture on the lagoon margin. Some potential for salt pan development has been identified but details are unknown.

3.16 Proposed zoning within the site would include designation of up to five core zones or sanctuaries for the conservation of critical bird habitat. Though several areas of high bird concentrations are known, the precise location and size of these critical areas will require further study before they can be precisely delineated. It is estimated that the combined area of these critical zones will be in the range of 25 km2. As with the other lagoons, a "buffer zone" would be designated to include the areas of the catchment with direct influence on the lagoon ecosystem.

4. Sakumo Lagoon and Densu Delta

3.17 The greater Accra-Tema metropolitan region, the largest urban area in Ghana, has experienced rapid growth and a doubling of population over the past two decades to a current population in excess of 1.5 million. Even without migration, the relatively high intrinsic population growth rate will lead to a doubling again of the urban population in the region surrounding these lagoons over the next twenty years. Sakumo lies between Accra and the Tema township where urban development has approached within a few hundred meters of the eastern margin of the lagoon (Annex 9: Figure 1). The Densu River delta lies just to the west of Accra and urban development has occurred to the eastern margin of the lagoon and along the coast (Annex 9: Figure 1).

3.18 The Sakumo lagoon is still used by artisanal fishermen who catch tilapia, crab and shrimp with cast nets and traps. This area has considerable value as urban "green space" for recreational activities of inhabitants of the metropolitan region. Current development plans for the catchment area include proposals for development of a golf course along the western margin and of a sewage treatment facility for Accra-Tema near the eastern shore. These two proposals highlight potential conflicts concerning development issues within the area surrounding this lagoon. Studies done in the early 1970's indicated there was some potential for fish aquaculture in this lagoon but there has been no attempt to pursue this enterprise (Pauly, 1976). Human waste runoff from housing developments in Tema township adjacent to the lagoon are a current major source of pollution that is leading to eutrophication of the lagoon. Estimates of this pollution and options to mitigate impact on the lagoon of discharge of treated effluent from a planned sewage treatment plant are described in Appendix 3 as well as technical requirements for studies to evaluate options to restore natural tidal flushing of the lagoon.

3.19 The Densu River delta/estuary lies on the coastal floodplain below the Weija Dam. About half of the surface area of open water has been developed as a commercial salt producing operation with an extensive system of evaporation ponds. The pattern of water release from the Weija Dam is a major factor effecting the dynamics of the ecosystem as well as the salt production industry. Pollution with human waste from Accra is a problem of increasing concern. Some artisanal fishing occurs within the lagoon and along the coast. A recent FAO study of development potential for aquaculture in Ghana noted the potential feasibility of developing shrimp aquaculture in conjunction with the salt pond facilities there.

3.20 The proposed management area for Densu Delta (Annex 9: Figure 1) encompasses roughly 70 km2 covering the estuary and immediate drainage below the Weija Dam and the Panbros salt pans and adjacent lagoon (frequently referred to as "Sakumo I"). The Sakumo lagoon site (sometimes called Sakumo II), located between the urban centers of Accra and Tema would include approximately 35 km2 of the adjacent, undeveloped drainage area in the management zone. The areas of open water represented in these two wetlands are approximately 20 km2 and 3 km2 for Densu Delta and Sakumo Lagoon, respectively. The "core zone" or sanctuary areas proposed for Densu Delta and Sakumo Lagoon are approximately 3.5 km2 and 1.0 km2, respectively.

IV. RATIONALE

4.1 Global. The justification or rationale for considering the use of GEF funds to sustain and enhance the ecological health of coastal wetlands in Ghana can be viewed at three levels: global, national and local. At the global level the primary importance of these coastal lagoons and estuaries concerns their international significance as habitat for migratory shorebirds. The mudflats, sand bars and brackish lagoons of Ghana lie at the apex of a vast inverted triangle spanning at its widest point over 240 degrees of latitude from the frozen fjords of Ellesmere Island to the shores of the East Siberian Sea. The East Atlantic Flyway, defined by the regular annual transit paths of several million birds shows vividly (and realistically) the biotic interconnection among the continents of Africa, North America and Eurasia. The long term viability of the bird populations that connect these diverse landscapes is inextricably linked to the health of the ecosystems in which they find regular sanctuary along their seasonal migration routes. The magnitude of the distances travelled and the seemingly vast numbers of individuals involved seem to defy the reduction of the problems of shorebird conservation to a simple equation of the form: x hectares of habitat conserved = y number of birds preserved. The regional significance of the Ghana coastal wetlands is illustrated by the following statistics:

(a) overall, close to 5% of the shorebirds and waders of the entire East Atlantic Flyway find refuge for part of each year on a few dozen square kilometers of wetlands on the Ghana coast;

(b) for 11 of the 42 species of long distance migratory waterfowl that regularly frequent the coast, the concentrations within these individual lagoons represent greater than 1% (up to 30% for some species) of the entire estimated flyway populations (Table 1); and

(c) together these five lagoons and estuaries annually harbor the fourth largest known concentration of Atlantic coastal migrants in West Africa. (Table 3)

Of the major roosting and feeding areas for migrants on the West African Atlantic coast, the Ghana lagoons are noteworthy for the absence of any formal management or protection. Effecting management of these wetlands would be a top priority investment for migratory bird conservation on both a regional and global scale. The current global registry of Ramsar sites (IUCN, 1991) lists no protected wetlands along the entire coast of the Gulf of Guinea - a prominent gap in the existing regional network of conservation areas.

4.2 National. Ghana's record of commitment to conservation of biodiversity is praiseworthy: over 5% of the national territory is currently represented in the system of parks, reserves, sanctuaries and game management areas. Evidence of continuing commitment is shown through inclusion of an action plan to improve management of the existing protected area system under the Forest Resource Management Project using credit funds supplied by the World Bank. A notable gap in the Ghana protected area system (identified in the Ghana EAP) is the absence of units that represent coastal wetland ecosystems. From a national perspective of sustaining the widest representation of natural biodiversity at the level of ecosystems or natural communities, coastal wetlands are a top

priority. Further, the sites identified under this project include the only presently known nesting sites in Ghana for three species of sea turtles listed as globally threatened by IUCN.

4.3 Local. The coastal zone of Ghana includes both the region with the highest density of human habitation and most rapid growth (greater Accra), and rural districts that are within the lowest national stratum of personal or household income. In the first instance the Sakumo lagoon and Densu Delta wetlands provide the most accessible sites for outdoor recreation and interaction with the natural environment to residents of the largest urban district in Ghana in addition to their documented global importance for biodiversity conservation. In the instance of the rural lagoons - Muni, Songor and Keta - the majority of people living around the lagoons derive a major fraction of their livelihood from the lagoons themselves (via fishing and/or salt winning) or from industries such as inshore marine fisheries that depend, at least in part, on the ecological health of the adjacent wetlands (e.g., as fish spawning grounds or sources of nutrient input into inshore coastal waters). Both the present way of life and the long term economic prospects of the human populations living near the lagoons and estuaries depend on the ecological health and stability of these wetland ecosystems.

4.4 The basic rationale for the program that is described in the following section is that the "international" or "global" value that is placed on these wetlands by the world community can only be realized or maintained if this value can be reconciled with the values and needs of the people that live in and derive their livelihood from these wetland ecosystems, and if these values are perceived at the national level where critical decision making occurs. The crucial link is the identification of common resources that benefit human and avian inhabitants jointly. In the case of these coastal wetlands, traditional "protection" is not an option to maintain critical bird habitat if it implies undue restriction of the options of people to derive benefit from the resources that effect both the birds and their own lifestyle and livelihood (e.g., clean water, stable or predictable hydrological cycles, and sustained harvestable aquatic food resources). The section that follows describes the program proposed to identify and reinforce these common values - at local, national and global levels - and to maintain the common resources upon which all living components of these ecosystems (human and biotic) depend. Working Paper # 9, prepared for the associated project (GERMP) provides further discussion of the economic considerations of wetland values.

4.5 Present Ecological/Economic Status. Long term viability of the coastal wetlands depends ultimately on accurate assessment of their sustainable potential productivity of goods and services (e.g., food, fuel, fibre, recreation, salt, flood control, pollution sinks, etc.) to communities living within and adjacent to the catchments. Acceptance of the conservation program by local communities may depend on the actions taken to enable them to appreciate and realize profits from improvements in wetland management. At present the principal direct products of the lagoons are fish, crabs, salt, and firewood (from harvesting of mangroves). There are no reliable long-term data on fisheries productivity of the lagoons but interviews with residents indicate a decline in fish harvests over the past two decades. At Songor lagoon, long time residents noted the decline of the crab fishery in parallel with the near elimination of mangroves from the lagoon margin. The salt industry is dependant on the salinity of water entering the lagoons (or pumped from the ocean) and the amount of freshwater inflow from natural floods or the water release cycle of upstream dams. Several of the lagoons (Songor, Keta, Densu) which were formerly open to the sea (and thus potentially significant nursery grounds for inshore fish stocks) are now closed. Sakumo lagoon, formerly open to the sea across much of its width, is now reduced to modest tidal

flow through a pair of narrow culverts. The relationship between changes in the lagoons over the past 20-40 years and inshore marine fish catches is not well understood. Data on inshore marine fisheries show a recent decline in average length of fish taken, suggesting that present exploitation is beyond sustainable levels (M. A. Mensah, pers. comm.). The former productivity of these lagoons and estuaries is unknown but indications are that their present production of fish is likely below their previous potential. Likewise, actual and potential production of salt within these brackish lagoons is certainly below former potential when the lagoons were subject to inflow of seawater. The absence of data on annual hydrological cycles, salinity, fish population dynamics, nutrient cycles, and pollution levels in the lagoons (though see Biney, 1982) makes it difficult to estimate potential sustainable productivity of fish, crabs, shrimp or salt; to determine what nature and extent of interventions might enhance productivity of the lagoon or inshore marine environments; or to determine what the costs and benefits of interventions might be. One major aspect of the project described below is a program to develop the requisite data base on biological and physical parameters to identify long term sustainable development options and identify potential interventions.

V. THE PROPOSED PROJECT

A. Project Description

5.1 The objectives of the coastal wetlands management program are to bring the five key coastal wetlands identified in the EAP and proposed for designation as "Ramsar" sites under an effective management regime, to ensure their long term ecological viability, to encourage appropriate economic development that is consistent with these goals, and to promote public awareness of environmental issues and conservation values. The proposed program has four principal elements: site establishment and management; research and monitoring; community-based development; and environmental education/public awareness. These are first discussed below, followed by more detailed discussion of project-financed activities at each site.

5.2 Survey and Demarcation. The project would finance the survey and demarcation of site boundaries including designation of "core zones" for critical habitat conservation, and "land management zones" for protecting their watersheds. Activities to be financed by the project would include border planting and pillaring; establishment of firebreaks; erosion control and amenity planting; construction of trails and observation posts for monitoring bird populations and other wildlife.

5.3 Local Site Management. The project would finance management of the sites including staffing with appropriate personnel from the Department of Game and Wildlife (DGW). Management activities such as maintenance of boundaries and trail systems, monitoring of wildlife populations, habitat management and erosion control planting will be undertaken under DGW supervision with staff recruited locally and provided with training in basic principals of conservation and wildlife management. Activities to be financed under the program include training for community rangers/wardens, construction and furnishing of offices and lodging for DGW site wardens, construction and staffing of community education facilities. Management of the upland areas within the project sites to enhance productivity

and reduce land degradation (and negative impact on the aquatic environment) would be undertaken following methods and principles developed under the Land Management Component of the GERMP. The project would also finance engineering studies and civil works to mitigate detrimental impacts of identified problems, e.g., proposed sewerage-treatment plant effluent discharge into Sakumo Lagoon and the identification and analysis of options for improving tidal flushing of the lagoon (see Appendix 3).

5.4 Research and Monitoring. The project would finance the necessary baseline studies to determine the current status of the aquatic ecosystems and surrounding catchments and to carry on regular monitoring of key hydrological, limnological and biological indicators for the duration of the project. A research station/laboratory would be established within the Songor site under the administration of DGW with links to appropriate academic and research institutes to serve as a base for long term studies of aquatic biology within the Volta River delta. The general requirements and management structure for the proposed studies are provided in Annex 8. The project would also finance the development of a National Wetlands Conservation Strategy. This would be undertaken during year three of the project to build on the knowledge, information and experience developed under the Coastal Wetlands program, and utilizing information developed under the Volta Basin Environment and Development Options Study to be undertaken under the associated project (GERMP), and the study of development options for coastal wetlands described below (Terms of Reference are given in Annex 8). Additional studies to be financed under the GERMP would include environmental impact assessment of any proposed development schemes effecting the wetlands.

5.5 Community Development. The project would support development that is compatible with maintaining the ecological balance of the wetlands through financing of socio-economic and technical studies of compatible development options such as intensified fisheries management, development of lagoon aquaculture and expansion of salt production. The project would also establish an investment fund to finance pilot schemes and infrastructure that would enable the options identified to be realized. These would include enterprises that both benefit the environment and promote well-being of local communities such as construction of sanitation facilities, improvement of local water supplies, development of alternative fuelwood resources and improvements in infrastructure for water management and tourism development.

5.6 Environmental Education and Public Awareness. The project would finance the construction and staffing of community education facilities at each of the project sites and provide training in environmental education to personnel of the DGW and the Wildlife Clubs of Ghana (WCG). A major facility for visitors would be constructed adjacent to the Sakumo Lagoon which would also provide headquarters and office space for the DGW management and educational staff. The Sakumo center located in the heart of the major metropolitan district of Accra-Tema would have exhibit, classroom and auditorium facilities that would cater to school field trips and provide regular programs on environmental themes for the general public. The center would be maintained by the DGW but would share programming with the environmental education unit of the EPC. Development of curricula and educational materials, organization of special events, and promotion of environmental awareness in the general public would be done by WCG personnel.

5.7 The project would also provide financial support to the Wildlife Clubs of Ghana, a non-government organization focussed on developing environmental awareness in school

children. The project would finance production and dissemination of educational materials, sponsor training workshops for volunteer Wildlife Club leaders and underwrite extension activities such as field trips, camps and environmental/conservation projects. WCG would train and supervise community education officers to work with local communities and develop programs for the local education centers at each of the wetland sites.

B. Site Plans

5.8 Details of boundary establishment and habitat enhancement for all of the sites are summarized in Table 8.

Table 8

Boundary establishment and habitat enhancement activities for Ramsar sites.

			Coverage				
Activity	Unit	Unit Cost (Cedis)	Muni	Songor	Anlo-Keta	Sakumo/ Densu	Total
Boundary survey	km	162,500	48	112	250	50	460
Boundary clearance	km	6,700	40	50	160	20	270
Border planting	km	187,500	40	50	160	45	295
Firebreaks	km	60,000	15	0	0	0	15
Nature trails	km	6,700	5	10	20	15	50
Survey pillars	unit	100,000	40	60	100	90	290
Signboards	unit	50,000	80	100	150	200	530
Habitat imp pltg	ha	37,600	200	100	200	0	500
Erosion control pltg	ha	37,600	200	100	300	60	660
Roosting islands	unit	2,000,000	0	2	8	6	16
Boundary maint.	km	6,700	48	112	250	50	
Firebreak maint.	km	60,000	15	-	-	-	

1. Muni Lagoon Complex

5.9 Management of the traditional hunting grounds involves habitat enhancement planting, modest restocking of the bushbuck population and construction of firebreaks along the perimeter. Observation posts will be constructed to facilitate management and monitoring of game populations.

5.10 Capital works include the construction of a modest education center, housing and office facilities for the Site Warden. This will also require upgrading of the coastal road for about 2.5 km west from Winneba to the proposed site of the education/office complex.

5.11 Baseline and monitoring studies for the Muni site will include an initial biological survey of the bushbuck management area as well as assessment of hydrological, limnological and biological parameters of the lagoon.

5.12 Use of community infrastructure funds are anticipated for construction of sanitation facilities and purchase of a dump truck for refuse removal.

2. Songor Lagoon Complex

5.13 Delineation of the bird sanctuary and buffer zones will follow recommendations of studies done by the Save the Seashore Birds Project that are currently in progress.

5.14 In addition to the "routine" baseline and monitoring studies of hydrology, limnology, aquatic biology, and erosion effects on the lagoon (Table 11), proposed expansion of the salt industry within and adjacent to the lagoon will require an environmental impact assessment of effects on the lagoon ecology and their implications for the migratory birds which concentrate there in numbers that regularly exceed 100,000 individuals. Results of the EIA may identify engineering studies that would be required to define options to mitigate detrimental effects resulting from expansion of the salt-winning industry. Through the Investment Support Fund to be established under this project financing of these studies and/or civil works to reduce or mitigate impacts on the bird sanctuary zone could be provided should the proposed expansion of the salt industry occur.

5.15 Capital works proposed include the construction and equipping of a field research center for the study of wetland ecology of the lagoon and the lower Volta River delta. The DGW would administer the center in collaboration with the University of Ghana at Legon. To provide reliable access to the proposed field center and the eastern margin of the lagoon it will be necessary to upgrade about 10 km of roadway along the coast east of the town of Ada Foah. Funding is included for the construction of observation towers to facilitate monitoring of bird populations and for construction of roosting islands to enhance use of the sanctuary zones during high water episodes.

5.16 Anticipated uses of community infrastructure funds include the construction of sanitation facilities and improvement of fresh water supplies to villages on the margin of the lagoon and possible construction of aquaculture ponds and works to better control water flow to the salt pans.

3. Anlo-Keta Lagoon Complex

5.17 The cost estimate for survey and border demarcation for this large area is based on the intention of adopting certain pre-existing boundaries such as national highways and shorelines as the "official" site boundaries where this is practical. Nonetheless, there is an anticipated need for demarcating "internal" boundaries of buffer zones and core/sanctuary areas as the data for identifying these areas are acquired.

5.18 Baseline and monitoring studies concerning the hydrology, limnology, aquatic biology and fisheries of the principal lagoons are proposed to be undertaken at the same level of effort as for Songor Lagoon. A direct "scale up" based on lagoon surface area would require several times the effort for Songor. The purpose of these studies is to develop an understanding of the key indicators that reflect the health and stability of the wetland ecosystem so the emphasis is on defining a survey and monitoring protocol that can be realistically sustained over time rather than a comprehensive "research" regime. Studies concerning long term hydrological changes resulting from construction of the Akosongo Dam and related erosion problems are included in the Volta Basin environmental assessment to be undertaken under the associated Bank project.

5.19 Capital works proposed, include the construction of a modest community education center at Keta and offices and housing for management personnel from the DGW. About 15 km of road upgrading will be necessary to provide access for monitoring use of wetlands and beaches along the western margin of the site by birds and nesting sea turtles. Regions of the Keta complex experience appreciable fluctuations in water level that periodically result in roosting areas being inundated to levels that preclude their use by wading birds. Funds have been reserved for construction of roosting islands in key areas once these have been identified.

5.20 Anticipated uses of community infrastructure development funds include the construction of improved public sanitation facilities in villages adjacent to the lagoon and possibly maintenance of canals used for bringing water to irrigated crops at the lagoon margin and improved fisheries management.

4. Sakumo Lagoon and Densu Delta Complex

5.21 The project would finance survey, delineation and demarcation of site boundaries and amenity planting of borders and other areas. In addition to baseline and monitoring studies of lagoon hydrology, limnology, aquatic biology and ornithology the project would finance necessary engineering studies to define options for improved regulation of water flow and water quality within the lagoons and the Densu River estuary (see Annex 8).

5.22 The location of Sakumo Lagoon in the center of the Accra-Tema metropolitan region and the easy access and recreational opportunities it thereby affords for the large nearby urban populations, make this site the logical choice for an environmental education center that would serve both the metropolitan school districts and the general public. The project would finance construction of a visitor/nature center that will present regular educational programs for schoolchildren and the public to develop and enhance public awareness about the ecology of coastal wetlands and environmental issues in general.

5.23 A major capital expenditure associated with establishment of the Sakumo site concerns construction of an ocean outfall for treated effluent from the Tema sewage treatment plant to be constructed near the eastern margin of the Sakumo Lagoon. Engineering details and costing of the outfall are presented in Appendix 3.

C. Organization and Management

5.24 Program Coordination and Supervision. The project would provide funds to establish a Wetlands Management Unit (WMU) within the Department of Game and Wildlife consisting of a Principal Wildlife Officer/ Wetlands Specialist, an Environmental Education/ Community Relations Specialist and appropriate support personnel. A senior technical advisor with knowledge of Ghanaian coastal ecosystems and conservation issues within this region would be recruited by DGW to assist the WMU program coordinator in program planning, design and execution. The WMU would be the principal executing agency for the project. Local on-site management activities would be carried out by DGW site wardens supervised by the WMU and locally recruited community wardens or rangers. Although initially the WMU would primarily focus on the coastal wetlands, this unit should be established at an appropriate administrative level to take responsibility for wetlands conservation and management nationwide as capacity and experience with wetland management grows and other priority areas are identified.

5.25 Intersectoral participation in policy decisions affecting the project sites would be accomplished through oversight by the Natural Resources Inter-sectoral Network, a standing committee to be administered by the EPC Technical Secretariat. Routine administrative supervision and program review would be provided by the Coastal Wetland Management Project Operations Committee (CWMPOC), the composition of which is outlined in Table 9. The Natural Resources Inter-sectoral Network would deal with major policy issues affecting the Coastal Wetlands Program, provide a forum for identifying and resolving intersectoral conflicts concerning management of the sites and provide oversight and review of major project components such as the development options study. The CWMPOC would operate as a standing operational group to plan and review program activities. For special needs such as the design and periodic review of the research and monitoring studies described below (Table 11 and Sections 5.28 - 5.29) membership would be expanded to bring in special expertise as required.

Table 9

Coastal Wetland Management Project Operations Committee

Chair:	Director, Department of Game and Wildlife
Secretary:	Wetlands Management Unit Coordinator, DGW
Members:	Deputy Director, Inter-sectoral Networking, EPC-TS; Wetlands Program Technical Advisor

5.26 Survey and Demarcation. External boundary surveys would be done during the first year of the project and reviewed or supervised by the Survey Department. The establishment, posting and maintenance of external boundaries as well as demarcation of "internal" boundaries within the sites, border planting, and firebreak establishment would be carried out under DGW supervision with locally recruited labor.

5.27 Local Site Management. Local Site Management Committees would be established for each site that would include representation by local government, traditional councils,

district sectoral officers, as well as representatives of local industry/artisan cooperatives. Table 10 illustrates the proposed composition of the Site Committee for Songor Lagoon. Site Management Committees would participate in development of management plans for the areas and approve disbursement of community infrastructure funds. The WMU with input from local site committees, the senior technical advisor and relevant sectoral agencies will develop management plans for each of the sites. A resident DGW warden would be responsible for overseeing routine operations and management activities at each site including habitat enhancement, monitoring of wildlife populations, maintenance of trails and boundaries, etc.

Table 10

Site Management Committee for Songor Lagoon

Chairman:	CWMU Technical Advisor
Secretary:	CWMU Coordinator
Members:	Resident DGW Game Warden
	Representative of SSBP-G
	District Secretary
	Representative of Traditional Council
	District Forestry Officer
	District Fisheries Officer
	Presiding Member, Ada District Assembly
	Representative of Ministry of Health
	Representative, Ghana Water and Sewerage Corporation
	Representative of Fisherman's Cooperative
	Representative of salt miner's cooperatives

5.28 Research and Monitoring. Design and execution of the studies summarized in Table 11 would be done under supervision of the CWMPOC augmented with expert members drawn from relevant agencies such as the Institute of Aquatic Biology (IAB), the Fisheries Research Institute (FRI), the Water Resources Research Institute and the Institute for Statistics, Social and Economic Research (ISSER). General terms of reference for baseline and monitoring studies are given in Annex 8. Table 11 provides an estimate of overall research requirements for each site in terms of "person-months" of effort. The Senior Technical Advisor will be the person with principal responsibility for planning, design, execution and overall coordination, supervision and review of the research and monitoring study program.

5.29 Baseline and monitoring studies will begin in the first year and continue throughout the duration of the project. Specific studies will be carried out by: the Water Resources Research Institute (hydrology); the Institute of Aquatic Biology (limnology, water quality, lagoon fisheries); and the University of Ghana (Legon), Zoology and Botany Departments (birds and other terrestrial vertebrates, plant ecology and ethnobotany). Studies will focus on key indicators for monitoring the health of the wetland ecosystems or important elements such as migratory bird populations, fishery stocks and economically useful plants. The overall requirements for studies will be developed by a working group formed by the CWMPOC and chaired by the Senior Technical Advisor. The working group will also regularly review

results of the monitoring studies and advise CWMPOC on the need for modifications to study design or requirements for further research.

Table 11

Baseline and monitoring studies for Ramsar sites

Study Type	Minimum (months)	Maximum (months)	No. of Sites (Min + Max)	Total (months)
Baseline				
Water quality, Limnology, Aquatic biology	2	3	3 + 2	12
Hydrology	2	2	3 + 2	10
Lagoon fisheries	1	2	3 + 2	7
Water birds	1	2	3 + 2	7
Terrest. ecology	1	2	3 + 2	7
Erosion/land degradation	1	2	3 + 2	7
Sociology	1	4	3 + 2	11
Total	9	17	27 + 34	61
Annual Monitoring				
Water quality, Limnology, Aquatic biology	1	1		5
Hydrology	1	1		5
Lagoon fisheries	1	1		5
Water birds	1	1		5
Terrest. ecology	1	1		5
Erosion/land degradation	1	1		5
Sociology	1	1		
Total			5	35

"Minimum" Sites: Muni, Densu Delta, Sakumo
"Maximum" Sites: Songor, Keta

5.30 Community Development. Project financed studies to identify development options within the Ramsar sites that are compatible with maintaining their ecological value would be undertaken under the administration of the EPC/TS. Terms of reference would be drawn up by the Studies and Investigations Project Operations Committee (SIPOC) administered by the EPC, and reviewed by the CWMPOC. Studies would be executed by a team of local and international consultants minimally including specialists in resource economics, fisheries, agronomy, wetland ecology, hydrology/limnology and rural sociology. Results and recommendations would be reviewed by the SIPOC and CWMPOC. Use of the Investment

Support Fund for identified developments within the coastal wetland sites would be subject to approval by CWMPOC and IDA. Local Site Committees would participate in decisions concerning disbursement of community development funds (for infrastructure such as sanitation facilities, water supplies, etc.) to be administered by the WMU under CWMPOC supervision.

5.31 Environmental Education and Public Awareness. Development of curricula and community education/awareness programs will be coordinated by the education officer within the WMU in collaboration with the Wildlife Clubs of Ghana. The WMU education officer and WCG staff will plan and conduct educational activities to foster awareness of environmental issues affecting the coastal region. An assistant education officer will be in charge of operating the environmental education center at Sakumo Lagoon with responsibility for developing public information programs there. Support to the Wildlife Clubs of Ghana to foster environmental awareness among schoolchildren will be administered through the WMU. Project support to WCG will finance publication of a children's magazine on conservation and the environment, training and orientation of Wildlife Club Leaders, organization of special events to promote community awareness of environmental issues, training and posting of community relations/environmental awareness specialists at each of the community education centers (Muni, Songor, and Keta) developed under the project.

D. Project Costs

5.32 Tentative estimates of the costs of the Coastal Wetlands Management Program amount to approximately US$ 8.3 million of which $0.5 M is allocated for the Investment Support Fund to be administered under CWMPOC supervision. The approximate breakdown of proposed expenditures within general categories is:

Site survey and demarcation	10%
Site improvement/management	40%
Community development	18%
Mitigation and restoration	6%
Research and monitoring	19%
Education and public awareness	7%

5.33 Financial Implications. The principal elements of recurrent costs for management of the Ramsar Sites are associated with personnel, maintenance of equipment and facilities, and environmental monitoring. Estimates for the annual costs (for Project Year 5) in these categories are:

Personnel	US$ 34,900
Maintenance of Equipment and Facilities	232,800
Environmental Monitoring	76,500
TOTAL	333,500

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COASTAL WETLANDS MANAGEMENT PROJECT

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APPENDIX 2
Annex 3

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COASTAL WETLANDS MANAGEMENT PROJECT

African Convention on the Conservation of Nature and Natural Resources

AFRICAN CONVENTION ON THE CONSERVATION OF NATURE AND NATURAL RESOURCES, 1968

PREAMBLE:

We the Heads of State and Government of Independent African States,

FULLY CONSCIOUS that soil, water, flora and faunal resources constitute a capital of vital importance to mankind;

CONFIRMING, as we accepted upon declaring our adherence to the Charter of the Organization of African Unity, that we know that it is our duty "to harness the natural and human resources of our continent for the total advancement of our peoples in spheres of human endeavour";

FULLY CONSCIOUS of the ever-growing importance of natural resources from an economic, nutritional, scientific, educational, cultural and aesthetic point of view;

CONSCIOUS of the dangers which threaten some of these irreplaceable assets;

ACCEPTING that the utilization of the natural resources must aim at satisfying the needs of man according to the carrying capacity of the environment;

DESIROUS of undertaking individual and joint action for the conservation, utilization and development of these assets by establishing and maintaining their rational utilization for the present and future welfare of mankind;

CONVINCED that one of the most appropriate means of achieving this end is to bring into force a convention;

HAVE AGREED as follows:

Article I

The Contracting States hereby establish an African Convention on the Conservation of Nature and Natural Resources.

Article II

FUNDAMENTAL PRINCIPLE

The Contracting States shall undertake to adopt the measures to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due regard to the best interests of the people.

Article III

DEFINITIONS

For purposes of the present Convention, the meaning of the following expressions shall be as defined below:

1. "Natural Resources" means renewable resources, that is soil, water, flora and fauna.

2. "Specimen" means an individual example of a species of wild animal or wild plant or part of a wild plant.

3. "Trophy" means any dead animal specimen or part thereof whether included in a manufactured or processed object or otherwise dealt with, unless it has lost its original identity; also nests, eggs and eggshells.

4. "Conservation area" means any protected natural resource area, whether it be a strict natural reserve, a national park or a special reserve;

a) "strict nature reserve" means an area:

(i) under State control and the boundaries of which may not be altered nor any portion alienated except by the competent legislative authority,

(ii) throughout which any form of hunting or fishing, any undertaking connected with forestry, agriculture or mining, any grazing, any excavation or prospecting, drilling, levelling of the ground or construction, any work tending to alter the configuration of the soil or the character of the vegetation, any water pollution and, generally, any act likely to harm or disturb the fauna or flora, including introduction of zoological or botanical species, whether indigenous or imported, wild or domesticated, are strictly forbidden.

(iii) where it shall be forbidden to reside, enter, traverse or camp, and where it shall be forbidden to fly over at low altitude, without a special written permit from the competent authority, and in which scientific investigations (including removal of animals and plants in order to maintain an ecosystem) may only be undertaken by permission of the competent authority;

b) "national park" means an area:

(i) under State control and the boundaries of which may not be altered or any portion alienated except by the competent legislative authority,

(ii) exclusively set aside for the propagation, protection, conservation and management of vegetation and wild animals as well as for the protection of sites, land-scapes or geological formations of particular scientific or aesthetic value, for the benefit and enjoyment of the general public, and

(iii) in which the killing, hunting and capture of animals and the destruction or collection of plants are prohibited except for scientific and management purposes and on the condition that such measures are taken under the direction or control of the competent authority;

(iv) covering any aquatic environment to which all of the provisions of section *(b)* (i-iii) above are applicable.

The activities prohibited in "strict nature reserve" under the provisions of section *(a)* (ii) of paragraph (4) of this article are equally prohibited in national parks except in so far as they are necessary to enable the park authorities to implement the provisions of section (ii) of this paragraph, by applying, for example, appropriate management practices, and to enable the public to visit these parks; however, sport fishing may be practised with the authorization and under the control of the competent authority;

c) "special reserve" means other protected areas such as:

(i) "game reserve" which shall denote an area

a) set aside for the conservation, management and propagation of wild animal life and the protection and management of its habitat,

b) within which the hunting, killing or capture of fauna shall be prohibited except by or under the direction or control of the reserve authorities,

c) where settlement and other human activities shall be controlled or prohibited;

(ii) "partial reserve" or "sanctuary" which shall denote an area

a) set aside to protect characteristic wildlife and especially bird communities, or to protect particularly threatened animal or plant species and especially those listed in the Annex to this Convention, together with the biotopes essential for their survival,

b) in which all other interests and activities shall be subordinated to this end;

(iii) "soil", "water" or "forest" reserve shall denote areas set aside to protect such resources.

Article IV

SOIL

The Contracting States shall take effective measures for conservation and improvement of the soil and shall in particular combat erosion and misuse of the soil. To this end:

a) they shall establish land-use plans based on scientific investigations (ecological, pedological, economic, and sociological) and, in particular, classification and land-use capability;

b) they shall, when implementing agricultural practices and agrarian reforms,

(i) improve soil conservation and introduce improved farming methods, which ensure long-term productivity of the land,

(ii) control erosion caused by various forms of land-use which may lead to loss of vegetation cover.

Article V

WATER

1. The Contracting States shall establish policies for conservation, utilization and development of underground and surface water, and shall endeavour to guarantee for their populations a sufficient and continuous supply of suitable water, taking appropriate measures with due regard to:

(i) the study of water cycles and the investigation of each catchment area,

(ii) the co-ordination and planning of water resources development projects,

(iii) the administration and control of all water utilization, and

(iv) prevention and control of water pollution.

2. Where surface or underground water resources are shared by two or more of the Contracting States, the latter shall act in consultation, and if the need arises, set up inter-State Commissions to study and resolve problems arising from the joint use of these resources, and for the joint development and conservation thereof.

Article VI

FLORA

1. The Contracting States shall take all necessary measures for the protection of flora and to ensure its best utilization and development. To this end the Contracting States shall:

a) adopt scientifically-based conservation, utilization and management plans of forests and rangeland, taking into account the social and economic needs of the States concerned, the importance of the vegetation cover for the maintenance of the water balance of an area, the productivity of soils and the habitat requirements of the fauna;

b) observe section *(a)* above by paying particular attention to controlling bush fires, forest exploitation, land clearing for cultivation, and over-grazing by domestic and wild animals;

c) set aside areas for forest reserves and carry out afforestation programmes where necessary;

d) limitation of forest grazing to season and intensities that will not prevent forest regeneration; and

e) establish botanical gardens to perpetuate plant species of particular interest.

2. The Contracting States also shall undertake the conservation of plant species or communities, which are threatened and/or of special scientific or aesthetic value by ensuring that they are included in conservation areas.

Article VII

FAUNAL RESOURCES

1. The Contracting States shall ensure conservation, wise use and development of faunal resources and their environment, within the framework of land-use planning and of economic and social development. Management shall be carried out in accordance with plans based on scientific principles, and to that end the Contracting States shall:

a) manage wildlife populations inside designated areas according to the objectives of such areas and also manage exploitable wildlife populations outside such areas for an optimum sustained yield, compatible with and complementary to other land uses; and

b) manage aquatic environments, whether in fresh, brackish or coastal water, with a view to minimising deleterious effects of any water and land use practice which might adversely affect aquatic habitats.

2. The Contracting States shall adopt adequate legislation on hunting, capture and fishing, under which:

a) the issue of permits is properly regulated;

b) unauthorized methods are prohibited;

c) the following methods of hunting, capture and fishing are prohibited:

(i) any method liable to cause a mass destruction of wild animals,

(ii) the use of drugs, poisons, poisoned weapons or poisoned baits,

(iii) the use of explosives;

(iv) the following methods of hunting and capture are particularly prohibited:

(1) the use of mechanically propelled vehicles;

(2) the use of fire;

(3) the use of fire arms capable of firing more than one round at each pull of the trigger;

(4) hunting or capture at night;

(5) the use of missiles containing detonators;

d) the following methods of hunting or capture are as far as possible prohibited:

(i) the use of nets and stockades,

(ii) the use of concealed traps, pits, snares, set-gun traps, deadfalls, and hunting from a blind or hide;

e) with a view to as rational use as possible of game meat, the abandonment by hunters of carcasses of animals, which represent a food resource, is prohibited.

Capture of animals with the aid of drugs or mechanically propelled vehicles, or hunting or capture by night if carried out by, or under the control of, the competent authority shall nevertheless be exempted from the prohibitions under *(c)* above.

Article VIII

PROTECTED SPECIES

1. The Contracting States recognize that it is important and urgent to accord a special protection to those animal and plant species that are threatened with extinction, or which may become so, and to the habitat necessary to their survival. Where such a species is represented only in the territory of one Contracting State, that State has a particular responsibility for its protection. These species which are, or may be, listed according to the degree of protection that shall be given to them are placed in Class A or B of the Annex to this Convention, and shall be protected by Contracting States as follows:

(i) species in Class A shall be totally protected throughout the entire territory of the Contracting States; the hunting, killing, capture or collection of specimens shall be permitted only on the authorization in each case of the highest competent authority and only if required in the national interest or for scientific purposes; and

(ii) species in Class B shall be totally protected, but may be hunted, killed, captured or collected under special authorization granted by the competent authority.

2. The competent authority of each Contracting State shall examine the necessity of applying the provisions of this article to species not listed in the annex, in order to conserve the indigenous

flora and fauna of their respective countries. Such additional species shall be placed in Class A or B by the State concerned, according to its specific requirements.

Article IX

TRAFFIC IN SPECIMENS AND TROPHIES

1. In the case of animal species to which Article VIII does not apply the Contracting States shall:

a) regulate trade in and transport of specimens and trophies;

b) control the application of these regulations in such a way as to prevent trade in specimens and trophies which have been illegally captured or killed or obtained.

2. In the case of plant and animal species to which Article VIII paragraph (1) applies, the Contracting States shall:

a) take all measures similar to those in paragraph (1);

b) make the export of such specimens and trophies subject to an authorization-

(i) additional to that required for their capture, killing or collection by Article VIII,

(ii) which indicates their destination,

(iii) which shall not be given unless the specimens or trophies have been obtained legally,

(iv) which shall be examined prior to exportation,

(v) which shall be on a standard form, as may be arranged under Article XVI;

c) make the import and transit of such specimens and trophies subject to the presentation of the authorization required under section *(b)* above with due provision for the confiscation of specimens and trophies exported illegally, without prejudice to the application of other penalties.

Article X

CONSERVATION AREAS

1. The Contracting States shall maintain and extend where appropriate, within their territory and where applicable in their territorial waters, the Conservation areas existing at the time of entry

into force of the present Convention and, preferably within the framework of land-use planning programmes, assess the necessity of establishing additional conservation areas in order to:

(i) protect those ecosystems which are most representative of and particularly those which are in any respect peculiar to their territories,

(ii) ensure the conservation of all species and more particularly of those listed or which may be listed in the annex to this Convention;

2. The Contracting States shall establish, where necessary, around the borders of conservation areas, zones within which the competent authorities shall control activities detrimental to the protected natural resources.

Article XI

CUSTOMARY RIGHTS

The Contracting States shall take all necessary legislative measures to reconcile customary rights with the provisions of this Convention.

Article XII

RESEARCH

The Contracting States shall encourage and promote research in conservation, utilization and management of natural resources and shall pay particular attention to ecological and sociological factors.

Article XIII

CONSERVATION EDUCATION

1. *a)* The Contracting States shall ensure that their peoples appreciate their close dependence on natural resources and that they understand the need, and rules for, the rational utilization of these resources.

b) For this purpose they shall ensure that the principles indicated in paragraph (1):

(i) are included in educational programmes at all levels,

(ii) form the object of information campaigns capable of acquainting the public with, and winning it over to, the idea of conservation.

2. In order to put into effect paragraph (1) above, the Contracting States shall make maximum use of the educational value of conservation areas.

Article XIV

DEVELOPMENT PLANS

1. The Contracting States shall ensure that conservation and management of natural resources are treated as an integral part of national and/or regional development plans.

2. In the formulation of all development plans, full consideration shall be given to ecological, as well as to economic and social factors.

3. Where any development plan is likely to affect the natural resources of another State, the latter shall be consulted.

Article XV

ORGANIZATION OF NATIONAL CONSERVATION SERVICES

Each Contracting State shall establish, if it has not already done so, a single agency empowered to deal with all matters covered by the Convention, but, where this is not possible a co-ordinating machinery shall be established for this purpose.

Article XVI

INTERSTATE CO-OPERATION

1. The Contracting States shall co-operate:

a) whenever such co-operation is necessary to give effect to the provisions of this Convention and

b) whenever any national measure is likely to affect the natural resources of any other State.

2. The Contracting States shall supply the Organization of African Unity with:

a) the text of laws, decrees, regulations and instructions in force in their territories, which are intended to ensure the implementation of this Convention,

b) reports on the results achieved in applying the provisions of this Convention, and

c) all the information necessary for the complete documentation of matters dealt with by this Convention if requested.

3. If so requested by Contracting States, the Organization of African Unity shall organize any meeting which may be necessary to dispose of any matters covered by this Convention. Requests for such meetings must be made by at least three of the Contracting States and be approved by two-thirds of the States which it is proposed should participate in such meetings.

4. Any expenditure arising from this Convention, which devolves upon the Organization of African Unity shall be included in its regular budget, unless shared by the Contracting States or otherwise defrayed.

Article XVII

PROVISION FOR EXCEPTIONS

1. The provisions of this Convention shall not affect the responsibilities of Contracting States concerning:

(i) the paramount interest of the State,

(ii) "force majeure",

(iii) defence of human life.

2. The provisions of this Convention shall not prevent Contracting States:

(i) in time of famine,

(ii) for the protection of public health,

(iii) in defence of property,

to enact measures contrary to the provions of the Convention, provided their application is precisely defined in respect of aim, time and place.

Article XVIII

SETTLEMENT OF DISPUTES

Any dispute between the Contracting States relating to the interpretation or application of this Convention which cannot be settled by negotiation, shall at the request of any party be submitted

to the Commission of Mediation, Conciliation and Arbitration of the Organization of African Unity.

Article XIX

SIGNATURE AND RATIFICATION

1. This Convention shall be open for signature immediately after being approved by the Assembly of Heads of State and Government of the Organization of African Unity.

2. The Convention shall be ratified by each of the Contracting States. The instruments of ratification shall be deposited with the Administrative Secretary General of the Organization of African Unity.

Article XX

RESERVATIONS

1. At the time of signature, ratification or accession, any State may declare its acceptance of this Convention in part only, provided that such reservation may not apply to the provisions of Articles II-XI.

2. Reservations made in conformity with the preceding paragaph shall be deposited together with the instruments of ratification or accession.

3. Any Contracting State which has formulated a reservation in conformity with the preceding paragraph may at any time withdraw it by notifying the Administrative Secretary General of the Organization of African Unity.

Article XXI

ENTRY INTO FORCE

1. This Convention shall come into force on the thirtieth day following the date of deposit of the fourth instrument of ratification or accession with the Administrative Secretary General of the Organization of African Unity, who shall inform participating States accordingly.

2. In the case of a State ratifying or acceding to the Convention after the depositing of the fourth instrument of ratification or accession, the Convention shall come into force on the thirtieth day

after the deposit by such State of its instrument of ratification or accession.

3. The London Convention of 1933 or any other Convention on the conservation of flora and fauna in their natural state shall cease to have effect in States in which this Convention has come into force.

Article XXII

ACCESSION

1. After the date of approval specified in Article XIX paragraph (1), this Convention shall be open to accession by any independent and sovereign African State.

2. The instruments of accession shall be deposited with the Administrative Secretary General of the Organization of African Unity.

Article XXIII

DENUNCIATION

1. Any Contracting State may denounce this Convention by notification in writing addressed to the Administrative Secretary General of the Organization of African Unity.

2. Such denunciation shall take effect, for such a State, one year after the date of receipt of its notification by the Administrative Secretary General of the Organization of African Unity.

3. No denunciation shall, however, be made before the expiry of a period of five years from the date at which for the State concerned this Convention comes into force.

Article XXIV

REVISION

1. After the expiry of a period of five years from the date of entry into force of this Convention, any Contracting State may at any time make a request for the revision of part or the whole of this Convention by notification in writing addressed to the Administrative Secretary General of the Organization of African Unity.

2. In the event of such a request the appropriate organ of the Organization of African Unity shall deal with the matter in accordance with the provisions of section 3 of Article XVI of this Convention.

3. (i) At the request of one or more Contracting States and notwithstanding the provisions of paragraph (1) and (2) of this Article, the annex to this Convention may be revised or added to by the appropriate organ of the Organization of African Unity.

(ii) Such revision or addition shall come into force three months after the approval by the appropriate organ of the Organization of African Unity.

Article XXV

FINAL PROVISIONS

The original of this Convention of which both the English and the French texts are authentic, shall be deposited with the Administrative Secretary General of the Organization of African Unity.

IN WITNESS WHEREOF we the Heads of State and Government of Independent African States, assembled at Algiers, Algeria, on 15 September 1968, have signed this Convention.

Author's note: The list of species included in Class A and B of the Annex, which is subject to periodic changes, is not reproduced here but may be obtained from the Organization of African Unity, PO Box 3243, Addis Ababa, Ethiopia.

APPENDIX 2
Annex 4

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Convention on the Conservation of Migratory Species of Wild Animals ("Bonn Convention")

CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS, 1979

The Contracting Parties,

RECOGNIZING that wild animals in their innumerable forms are an irreplaceable part of the earth's natural system which must be conserved for the good of mankind;

AWARE that each generation of man holds the resources of the earth for future generations and has an obligation to ensure that this legacy is conserved and, where utilized, is used wisely;

CONSCIOUS of the ever-growing value of wild animals from environmental, ecological, genetic, scientific, aesthetic, recreational, cultural, educational, social and economic points of view;

CONCERNED particularly with those species of wild animals that migrate across or outside national jurisdictional boundaries;

RECOGNIZING that the States are and must be the protectors of the migratory species of wild animals that live within or pass through their national jurisdictional boundaries;

CONVINCED that conservation and effective management of migratory species of wild animals require the concerted action of all States within the national jurisdictional boundaries of which such species spend any part of their life cycles;

RECALLING Recommendation 32 of the Action Plan adopted by the United Nations Conference on the Human Environment (Stockholm, 1972) and noted with satisfaction at the Twenty-seventh Session of the General Assembly of the United Nations;

HAVE AGREED as follows:

Article I

INTERPRETATION

1. For the purpose of this Convention:

a) "Migratory species" means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries;

b) "Conservation status of a migratory species" means the sum of the influences acting on the migratory species that may affect its long-term distribution and abundance;

c) "Conservation status" will be taken as "favourable" when:

(1) population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems;

(2) the range of the migratory species is neither currently being reduced, nor is likely to be reduced, on a long-term basis;

(3) there is, and will be in the foreseeable future, sufficient habitat to maintain the population of the migratory species on a long-term basis; and

(4) the distribution and abundance of the migratory species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management;

d) "Conservation status" will be taken as "unfavourable" if any of the conditions set out in sub-paragraph (c) of this paragraph is not met;

e) "Endangered" in relation to a particular migratory species means that the migratory species is in danger of extinction throughout all or a significant portion of its range;

f) "Range" means all the areas of land or water that a migratory species inhabits, stays in temporarily, crosses or overflies at any time on its normal migration route;

g) "Habitat" means any area in the range of a migratory species which contains suitable living conditions for that species;

h) "Range State" in relation to a particular migratory species means any State (and where appropriate any other Party referred to under sub-paragraph (k) of this paragraph) that exercises jurisdiction over any part of the range of that migratory species, or a State, flag vessels of which are engaged outside national jurisdictional limits in taking that migratory species;

i) "Taking" means taking, hunting, fishing, capturing, harassing, deliberate killing, or attempting to engage in any such conduct;

j) "AGREEMENT" means an international agreement relating to the conservation of one or more migratory species as provided for in Articles IV and V of this Convention; and

k) "Party" means a State or any regional economic integration organization constituted by sovereign States which has competence in respect of the negotiation, conclusion and application of international agreements in matters covered by this Convention for which this Convention is in force.

2. In matters within their competence, the regional economic integration organizations which are Parties to this Convention shall in their own name exercise the rights and fulfil the responsibilities which this Convention attributes to their member States. In such cases the member States of these organizations shall not be entitled to exercise such rights individually.

3. Where this Convention provides for a decision to be taken by either a two-thirds majority or a unanimous decision of "the Parties present and voting" this shall mean "the Parties present and casting an affirmative or negative vote". Those abstaining from voting shall not be counted amongst "the Parties present and voting" in determining the majority.

Article II

FUNDAMENTAL PRINCIPLES

1. The Parties acknowledge the importance of migratory species being conserved and of Range States agreeing to take action to this end whenever possible and appropriate, paying special attention to migratory species the conservation status of which is unfavourable, and taking individually or in co-operation appropriate and necessary steps to conserve such species and their habitat.

2. The Parties acknowledge the need to take action to avoid any migratory species becoming endangered.

3. In particular, the Parties:

a) should promote, co-operate in and support research relating to migratory species;

b) shall endeavour to provide immediate protection for migratory species included in Appendix I; and

c) shall endeavour to conclude AGREEMENTS covering the conservation and management of migratory species included in Appendix II.

Article III

ENDANGERED MIGRATORY SPECIES: APPENDIX I

1. Appendix I shall list migratory species which are endangered.

2. A migratory species may be listed in Appendix I provided that reliable evidence, including the best scientific evidence available, indicates that the species is endangered.

3. A migratory species may be removed from Appendix I when the Conference of the Parties determines that:

a) reliable evidence, including the best scientific evidence available, indicates that the species is no longer endangered, and

b) the species is not likely to become endangered again because of loss of protection due to its removal from Appendix I.

4. Parties that are Range States of a migratory species listed in Appendix I shall endeavour:

a) to conserve and, where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction;

b) to prevent, remove, compensate for or minimize, as appropriate, the adverse effects of activities or obstacles that seriously impede or prevent the migration of the species; and

c) to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species.

5. Parties that are Range States of a migratory species listed in Appendix I shall prohibit the taking of animals belonging to such species. Exceptions may be made to this prohibition only if:

a) the taking is for scientific purposes;

b) the taking is for the purpose of enhancing the propagation or survival of the affected species;

c) the taking is to accommodate the needs of traditional subsistence users of such species; or

d) extraordinary circumstances so require;

provided that such exceptions are precise as to content and limited in space and time. Such taking should not operate to the disadvantage of the species.

6. The Conferences of the Parties may recommend to the Parties that are Range States of a migratory species listed in Appendix I that they take further measures considered appropriate to benefit the species.

7. The Parties shall as soon as possible inform the Secretariat of any exceptions made pursuant to paragraph 5 of this Article.

Article IV

MIGRATORY SPECIES TO BE THE SUBJECT TO AGREEMENTS: APPENDIX II

1. Appendix II shall list migratory species which have an unfavourable conservation status and which require international agreements for their conservation and management, as well as those which have a conservation status which would significantly benefit from the international co-operation that could be achieved by an international agreement.

2. If the circumstances so warrant, a migratory species may be listed both in Appendix I and Appendix II.

3. Parties that are Range States of migratory species listed in Appendix II shall endeavour to conclude AGREEMENTS where these would benefit the species and should give priority to those species in an unfavourable conservation status.

4. Parties are encouraged to take action with a view to concluding AGREEMENTS for any population or any geographically separate part of the population of any species or lower taxon of wild animals,

members of which periodically cross one or more national jurisdictional boundaries.

5. The Secretariat shall be provided with a copy of each AGREEMENT concluded pursuant to the provisions of this Article.

Article V

GUIDELINES FOR AGREEMENTS

1. The object of each AGREEMENT shall be to restore the migratory species concerned to a favourable conservation status or to maintain it in such a status. Each AGREEMENT should deal with those aspects of the conservation and management of the migratory species concerned which serve to achieve that object.

2. Each AGREEMENT should cover the whole of the range of the migratory species concerned and should be open to accession by all Range States of that species, whether or not they are Parties to this Convention.

3. An AGREEMENT should, wherever possible, deal with more than one migratory species.

4. Each AGREEMENT should:

a) identify the migratory species covered;

b) describe the range and migration route of the migratory species;

c) provide for each Party to designate its national authority concerned with the implementation of the AGREEMENT;

d) establish, if necessary, appropriate machinery to assist in carrying out the aims of the AGREEMENT, to monitor its effectiveness, and to prepare reports for the Conference of the Parties;

e) provide for procedures for the settlement of disputes between Parties to the AGREEMENT; and

f) at a minimum, prohibit, in relation to a migratory species of the Order Cetacea, any taking that is not permitted for that migratory species under any other multilateral agreement and provide for accession to the AGREEMENT by States that are not Range States of that migratory species.

5. Where appropriate and feasible, each AGREEMENT should provide for but not be limited to:

a) periodic review of the conservation status of the migratory species concerned and the identification of the factors which may be harmful to that status;

b) co-ordinated conservation and management plans;

c) research into the ecology and population dynamics of the migratory species concerned, with special regard to migration;

d) the exchange of information on the migratory species concerned, special regard being paid to the exchange of the results of research and of relevant statistics;

e) conservation and, where required and feasible, restoration of the habitats of importance in maintaining a favourable conservation status, and protection of such habitats from disturbances, including strict control of the introduction of, or control of already introduced, exotic species detrimental to the migratory species;

f) maintenance of a network of suitable habitats appropriately disposed in relation to the migration routes;

g) where it appears desirable, the provision of new habitats favourable to the migratory species or reintroduction of the migratory species into favourable habitats;

h) elimination of, to the maximum extent possible, or compensation for activities and obstacles which hinder or impede migration;

i) prevention, reduction or control of the release into the habitat of the migratory species of substances harmful to that migratory species;

j) measures based on sound ecological principles to control and manage the taking of the migratory species;

k) procedures for co-ordinating action to suppress illegal taking;

l) exchange of information on substantial threats to the migratory species;

m) emergency procedures whereby conservation action would be considerably and rapidly strengthened when the

conservation status of the migratory species is seriously affected; and

n) making the general public aware of the contents and aims of the AGREEMENT.

Article VI

RANGE STATES

1. A list of the Range States of migratory species listed in Appendices I and II shall be kept up to date by the Secretariat using information it has received from the Parties.

2. The Parties shall keep the Secretariat informed as to which of the migratory species listed in Appendices I and II they consider they are Range States, including provision of information on their flag vessels engaged outside national jurisdictional limits in taking the migratory species concerned and, where possible, future plans in respect of such taking.

3. The Parties which are Range States for migratory species listed in Appendix I or Appendix II should inform the Conference of the Parties through the Secretariat, at least six months prior to each ordinary meeting of the Conference, on measures that they are taking to implement the provisions of this Convention for these species.

Article VII

THE CONFERENCE OF THE PARTIES

1. The Conference of the Parties shall be the decision-making organ of this Convention.

2. The Secretariat shall call a meeting of the Conference of the Parties not later than two years after the entry into force of this Convention.

3. Thereafter the Secretariat shall convene ordinary meetings of the Conference of the Parties at intervals of not more than three years, unless the Conference decides otherwise, and extraordinary meetings at any time on the written request of at least one-third of the Parties.

4. The Conference of the Parties shall establish and keep under review the financial regulations of this Convention. The Conference of the Parties shall, at each of its ordinary meetings, adopt the budget for the next financial period. Each Party shall contribute to this budget according to a scale to be agreed upon by the Conference. Financial regulations, including the provisions on the budget and the scale of contributions as well as their modifications, shall be adopted by unanimous vote of the Parties present and voting.

5. At each of its meetings the Conference of the Parties shall review the implementation of this Convention and may in particular:

a) review and assess the conservation status of migratory species;

b) review the progress made towards the conservation of migratory species, especially those listed in Appendices I and II;

c) make such provision and provide such guidance as may be necessary to enable the Scientific Council and the Secretariat to carry out their duties;

d) receive and consider any reports presented by the Scientific Council, the Secretariat, any Party or any standing body established pursuant to an AGREEMENT;

e) make recommendations to the Parties for improving the conservation status of migratory species and review the progress being made under AGREEMENTS;

f) in those cases where an AGREEMENT has not been concluded, make recommendations for the convening of meetings of the Parties that are Range States of a migratory species or group of migratory species to discuss measures to improve the conservation status of the species;

g) make recommendations to the Parties for improving the effectiveness of this Convention; and

h) decide on any additional measure that should be taken to implement the objectives of this Convention.

6. Each meeting of the Conference of the Parties should determine the time and venue of the next meeting.

7. Any meeting of the Conference of the Parties shall determine and adopt rules of procedure for that meeting. Decisions at a meeting of the Conference of the Parties shall require a two-thirds majority of the Parties present and voting, except where otherwise provided for by this Convention.

8. The United Nations, its Specialized Agencies, the International Atomic Energy Agency, as well as any State not a party to this Convention and, for each AGREEMENT, the body designated by the parties to that AGREEMENT, may be represented by observers at meetings of the Conference of the Parties.

9. Any agency or body technically qualified in protection, conservation and management of migratory species, in the following categories, which has informed the Secretariat of its desire to be represented at meetings of the Conference of the Parties by observers, shall be admitted unless at least one-third of the Parties present object:

a) international agencies or bodies, either governmental or non-governmental, and national governmental agencies and bodies; and

b) national non-governmental agencies or bodies which have been approved for this purpose by the State in which they are located.

Once admitted, these observers shall have the right to participate but not to vote.

Article VIII

THE SCIENTIFIC COUNCIL

1. At its first meeting, the Conference of the Parties shall establish a Scientific Council to provide advice on scientific matters.

2. Any Party may appoint a qualified expert as a member of the Scientific Council. In addition, the Scientific Council shall include as members qualified experts selected and appointed by the Conference of the Parties; the number of these experts, the criteria for their selection and the terms of their appointments shall be as determined by the Conference of the Parties.

3. The Scientific Council shall meet at the request of the Secretariat as required by the Conference of the Parties.

4. Subject to the approval of the Conference of the Parties, the Scientific Council shall establish its own rules of procedure.

5. The Conference of the Parties shall determine the functions of the Scientific Council, which may include:

a) providing scientific advice to the Conference of the Parties, to the Secretariat, and, if approved by the Conference of the Parties, to any body set up under this Convention or an AGREEMENT or to any Party;

b) recommending research and the co-ordination of research on migratory species, evaluating the results of such research in order to ascertain the conservation status of migratory species and reporting to the Conference of the Parties on such status and measures for its improvement;

c) making recommendations to the Conference of the Parties as to the migratory species to be included in Appendices I or II, together with an indication of the range of such migratory species;

d) making recommendations to the Conference of the Parties as to specific conservation and management measures to be included in AGREEMENTS on migratory species; and

e) recommending to the Conference of the Parties solutions to problems relating to the scientific aspects of the implementation of this Convention, in particular with regard to the habitats of migratory species.

Article IX

THE SECRETARIAT

1. For the purposes of this Convention a Secretariat shall be established.

2. Upon entry into force of this Convention, the Secretariat is provided by the Executive Director of the United Nations Environment Programme. To the extent and in the manner he considers appropriate, he may be assisted by suitable inter-governmental and non-governmental, international or national agencies and bodies technically qualified in protection, conservation and management of wild animals.

3. If the United Nations Environment Programme is no longer able to provide the Secretariat, the Conference of the Parties shall make alternative arrangements for the Secretariat.

4. The functions of the Secretariat shall be:

a) to arrange for and service meetings:

(i) of the Conference of the Parties, and

(ii) of the Scientific Council;

b) to maintain liaison with and promote liaison between the Parties, the standing bodies set up under AGREEMENTS and other international organizations concerned with migratory species;

c) to obtain from any appropriate source reports and other information which will further the objectives and implementation of this Convention and to arrange for the appropriate dissemination of such information;

d) to invite the attention of the Conference of the Parties to any matter pertaining to the objectives of this Convention;

e) to prepare for the Conference of the Parties reports on the work of the Secretariat and on the implementation of this Convention;

f) to maintain and publish a list of Range States of all migratory species included in Appendices I and II;

g) to promote, under the direction of the Conference of the Parties, the conclusion of AGREEMENTS,

h) to maintain and make available to the Parties a list of AGREEMENTS and, if so required by the Conference of the Parties, to provide any information on such AGREEMENTS;

i) to maintain and publish a list of the recommendations made by the Conference of the Parties pursuant to sub-paragraphs (e), (f) and (g) of paragraph 5 of Article VII or of decisions made pursuant to sub-paragraph (h) of that paragraph;

j) to provide for the general public information concerning this Convention and its objectives; and

k) to perform any other function entrusted to it under this Convention or by the Conference of the Parties.

Article X

AMENDMENT OF THE CONVENTION

1. This Convention may be amended at any ordinary or extraordinary meeting of the Conference of the Parties.

2. Proposals for amendment may be made by any Party.

3. The text of any proposed amendment and the reasons for it shall be communicated to the Secretary at least one hundred and fifty days before the meeting at which it is to be considered and shall promptly be communicated by the Secretary to all Parties. Any comments on the text by the Parties shall be communicated to the Secretariat not less than sixty days before the meeting begins. The Secretariat shall, immediately after the last day for submission of comments, communicate to the Parties all comments submitted by that day.

4. Amendments shall be adopted by a two-thirds majority of Parties present and voting.

5. An amendment adopted shall enter into force for all Parties which have accepted it on the first day of the third month following the date on which two-thirds of the Parties have deposited an instrument of acceptance with the Depositary. For each Party which deposits an instrument of acceptance after the date on which two-thirds of the Parties have deposited an instrument of acceptance, the amendment shall enter into force for that Party on the first day of the third month following the deposit of its instrument of acceptance.

Article XI

AMENDMENT OF THE APPENDICES

1. Appendices I and II may be amended at any ordinary or extraordinary meeting of the Conference of the Parties.

2. Proposals for amendment may be made by any Party.

3. The text of any proposed amendment and the reasons for it, based on the best scientific evidence available, shall be communicated to the Secretariat at least 150 days before the meeting and shall promptly be communicated by the Secretariat to all Parties. Any comments on the text by the Parties shall be

communicated to the Secretariat not less than 60 days before the meeting begins. The Secretariat shall, immediately after the last day for submission of comments, communicate to the Parties all comments submitted by that day.

4. Amendments shall be adopted by a two-thirds majority of Parties present and voting.

5. An amendment to the Appendices shall enter into force for all Parties 90 days after the meeting of the Conference of the Parties at which it was adopted, except for those Parties which make a reservation in accordance with paragraph 6 of this Article.

6. During the period of 90 days provided for in paragraph 5 of this Article, any Party may by notification in writing to the Depositary make a reservation with respect to the amendment. A reservation to an amendment may be withdrawn by written notification to the Depositary and thereupon the amendment shall enter into force for that Party 90 days after the reservation is withdrawn.

Article XII

EFFECT ON INTERNATIONAL CONVENTIONS AND OTHER LEGISLATION

1. Nothing in this Convention shall prejudice the codification and development of the law of the sea by the United Nations Conference on the Law of the Sea convened pursuant to Resolution 2750 C (XXV) of the General Assembly of the United Nations nor the present or future claims and legal views of any State concerning the law of the sea and the nature and extent of coastal and flag State jurisdiction.

2. The provisions of this Convention shall in no way affect the rights or obligations of any Party deriving from any existing treaty convention or agreement.

3. The provisions of this Convention shall in no way affect the right of Parties to adopt stricter domestic measures concerning the conservation of migratory species listed in Appendices I and II or to adopt domestic measures concerning the conservation of species not listed in Appendices I and II.

Article XIII

SETTLEMENT OF DISPUTES

1. Any dispute which may arise between two or more Parties with respect to the interpretation or application of the provisions of this Convention shall be subject to negotiation between the Parties involved in the dispute.

2. If the dispute cannot be resolved in accordance with paragraph 1 of this Article, the Parties may, by mutual consent, submit the dispute to arbitration, in particular that of the Permanent Court of Arbitration at The Hague, and the Parties submitting the dispute shall be bound by the arbitral decision.

Article XIV

RESERVATIONS

1. The provisions of this Convention shall not be subject to general reservations. Specific reservations may be entered in accordance with the provisions of this Article and Article XI.

2. Any State or any regional economic integration organization may, on depositing its instrument of ratification, acceptance, approval or accession, enter a specific reservation with regard to the presence on either Appendix I or Appendix II or both, of any migratory species and shall then not be regarded as a Party in regard to the subject of that reservation until ninety days after the Depositary has transmitted to the Parties notification that such reservation has been withdrawn.

Article XV

SIGNATURE

This Convention shall be open for signature at Bonn for all States and any regional economic integration organization until the twenty-second day of June 1980.

Article XVI

RATIFICATION, ACCEPTANCE, APPROVAL

This Convention shall be subject to ratification, acceptance or approval. Instruments of ratification, acceptance or approval shall be

deposited with the Government of the Federal Republic of Germany, which shall be the Depositary.

Article XVII

ACCESSION

After the twenty-second day of June 1980 this Convention shall be open for accession by all non-signatory States and any regional economic integration organization. Instruments of accession shall be deposited with the Depositary.

Article XVIII

ENTRY INTO FORCE

1. This Convention shall enter into force on the first day of the third month following the date of deposit of the fifteenth instrument of ratification, acceptance, approval or accession with the Depositary.

2. For each State or each regional economic intergration organization which ratifies, accepts or approves this Convention or accedes thereto after the deposit of the fifteenth instrument of ratification, acceptance, approval or accession, this Convention shall enter into force on the first day of the third month following the deposit by such State or such organization of its instrument of ratification, acceptance, approval or accession.

Article XIX

DENUNCIATION

Any Party may denounce this Convention by written notification to the Depositary at any time. The denunciation shall take effect twelve months after the Depositary has received the notification.

Article XX

DEPOSITARY

1. The original of this Convention, in the English, French, German, Russian and Spanish languages, each version being equally authentic, shall be deposited with the Depositary. The Depositary shall transmit certified copies of each of these versions to all States and all regional economic integration organizations that have signed the Convention or deposited instruments of accession to it.

2. The Depositary shall, after consultation with the Governments concerned, prepare official versions of the text of this Convention in the Arabic and Chinese languages.

3. The Depositary shall inform all signatory and acceding States and all signatory and acceding regional economic integration organizations and the Secretariat of signatures, deposit of instruments of ratification, acceptance, approval or accession, entry into force of this Convention, amendments thereto, specific reservations and notifications of denunciation.

4. As soon as this Convention enters into force, a certified copy thereof shall be transmitted by the Depositary to the Secretariat of the United Nations for registration and publication in accordance with Article 102 of the Charter of the United Nations.

IN WITNESS WHEREOF the undersigned, being duly authorized to the effect, have signed the present Convention.

DONE at Bonn, this 23rd day of June 1979.

Author's note: The Appendices I and II, which are subject to periodic changes, are not reproduced here but may be obtained from the Federal Ministry of Food, Agriculture and Forestry, Bonn, Federal Republic of Germany.

APPENDIX 2
Annex 5

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Convention on Wetlands of International Importance, especially as Waterfowl Habitat

Convention on Wetlands of International Importance especially as Waterfowl Habitat

Ramsar, 2.2.1971

as amended by the Paris Protocol of 3.12.1982

The Contracting Parties,

Recognizing the interdependence of Man and his environment;

Considering the fundamental ecological functions of wetlands as regulators of water regimes and as habitats supporting a characteristic flora and fauna, especially waterfowl;

Being convinced that wetlands constitute a resource of great economic, cultural, scientific, and recreational value, the loss of which would be irreparable;

Desiring to stem the progressive encroachment on and loss of wetlands now and in the future;

Recognizing that waterfowl in their seasonal migrations may transcend frontiers and so should be regarded as an international resource;

Being confident that the conservation of wetlands and their flora and fauna can be ensured by combining far-sighted national policies with co-ordinated international action;

Have agreed as follows:

Article 1

1. For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.
2. For the purpose of this Convention waterfowl are birds ecologically dependent on wetlands.

Article 2

1. Each Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance, hereinafter referred to as "the List" which is maintained by the bureau established under Article 8. The boundaries of each wetland shall be precisely described and also delimited on a map and they may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands, especially where these have importance as waterfowl habitat.
2. Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included.
3. The inclusion of a wetland in the List does not prejudice the exclusive sovereign rights of the Contracting Party in whose territory the wetland is situated.
4. Each Contracting Party shall designate at least one wetland to be included in the List when signing this Convention or when depositing its instrument of ratification or accession, as provided in Article 9.
5. Any Contracting Party shall have the right to add to the List further wetlands situated within its territory, to extend the boundaries of those wetlands already included by it in the List, or, because of its urgent national interests, to delete or restrict the boundaries of wetlands already included by it in the List and shall, at the earliest possible time, inform the organization or government responsible for the continuing bureau duties specified in Article 8 of any such changes.
6. Each Contracting Party shall consider its international responsibilities for the conservation, management and wise use of migratory stocks of waterfowl, both when designating entries for the List and when exercising its right to change entries in the List relating to wetlands within its territory.

Article 3

1. The Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory.
2. Each Contracting Party shall arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference. Information on such changes shall be passed without delay to the organization or government responsible for the continuing bureau duties specified in Article 8.

Article 4

1. Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening.
2. Where a Contracting Party in its urgent national interest, deletes or restricts the boundaries of a wetland included in the List, it should as far as possible compensate for any loss of wetland resources, and in particular it should create additional nature reserves for waterfowl and for the protection, either in the same area or elsewhere, of an adequate portion of the original habitat.
3. The Contracting Parties shall encourage research and the exchange of data and publications regarding wetlands and their flora and fauna.
4. The Contracting Parties shall endeavour through management to increase waterfowl populations on appropriate wetlands.
5. The Contracting Parties shall promote the training of personnel competent in the fields of wetland research, management and wardening.

Article 5

The Contracting Parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by Contracting Parties. They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna.

Article 6[1]

1. The Contracting Parties shall, as the necessity arises, convene Conferences on the Conservation of Wetlands and Waterfowl.
2. The Conferences shall have an advisory character and shall be competent, inter alia:
   (a) to discuss the implementation of this Convention;
   (b) to discuss additions to and changes in the List;
   (c) to consider information regarding changes in the ecological character of wetlands included in the List provided in accordance with paragraph 2 of Article 3;
   (d) to make general or specific recommendations to the Contracting Parties regarding the conservation, management and wise use of wetlands and their flora and fauna;
   (e) to request relevant international bodies to prepare reports and statistics on matters which are essentially international in character affecting wetlands;

3. The Contracting Parties shall ensure that those responsible at all levels for wetlands management shall be informed of, and take into consideration, recommendations of such Conferences concerning the conservation, management and wise use of wetlands and their flora and fauna.

Article 7[1]

1. The representatives of the Contracting Parties at such Conferences should include persons who are experts on wetlands or waterfowl by reason of knowledge and experience gained in scientific, administrative or other appropriate capacities.
2. Each of the Contracting Parties represented at a Conference shall have one vote, recommendations being adopted by a simple majority of the votes cast, provided that not less than half the Contracting Parties cast votes.

Article 8

1. The International Union for Conservation of Nature and Natural Resources shall perform the continuing bureau duties under this Convention until such time as another organization or government is appointed by a majority of two-thirds of all Contracting Parties.
2. The continuing bureau duties shall be, inter alia:
   (a) to assist in the convening and organizing of Conferences specified in Article 6;
   (b) to maintain the List of Wetlands of International Importance and to be informed by the Contracting Parties of any additions, extensions, deletions or restrictions concerning wetlands included in the List provided in accordance with paragraph 5 of Article 2;
   (c) to be informed by the Contracting Parties of any changes in the ecological character of wetlands included in the List provided in accordance with paragraph 2 of Article 3;
   (d) to forward notification of any alterations to the List, or changes in character of wetlands included therein, to all Contracting Parties and to arrange for these matters to be discussed at the next Conference;
   (e) to make known to the Contracting Party concerned, the recommendations of the Conferences in respect of such alterations to the List or of changes in the character of wetlands included therein.

Article 9

1. This Convention shall remain open for signature indefinitely.
2. Any member of the United Nations or of one of the Specialized Agencies or of the International Atomic Energy Agency or Party to the Statute of the International Court of Justice may become a Party to this Convention by:
   (a) signature without reservation as to ratification;
   (b) signature subject to ratification followed by ratification;
   (c) accession.
3. Ratification or accession shall be effected by the deposit of an instrument of ratification or accession with the Director-General of the United Nations Educational, Scientific and Cultural Organization (hereinafter referred to as "the Depositary").

Article 10

1. This Convention shall enter into force four months after seven States have become Parties to this Convention in accordance with paragraph 2 of Article 9.
2. Thereafter this Convention shall enter into force for each Contracting Party four months after the day of its signature without reservation as to ratification, or its deposit of an instrument of ratification or accession.

Article 10 bis

1. This Convention may be amended at a meeting of the Contracting Parties convened for that purpose in accordance with this article.
2. Proposals for amendment may be made by any Contracting Party.
3. The text of any proposed amendment and the reasons for it shall be communicated to the organization or government performing the continuing bureau duties under the Convention (hereinafter referred to as "the Bureau") and shall promptly be communicated by the Bureau to all Contracting Parties. Any comments on the text by the Contracting Parties shall be communicated to the Bureau within three months of the date on which the amendments were communicated to the Contracting Parties by the Bureau. The Bureau shall, immediately after the last day for submission of comments, communicate to the Contracting Parties all comments submitted by that day.
4. A meeting of Contracting Parties to consider an amendment communicated in accordance with paragraph 3 shall be convened by the Bureau upon the written request of one third of the Contracting Parties. The Bureau shall consult the Parties concerning the time and venue of the meeting.
5. Amendments shall be adopted by a two-thirds majority of the Contracting Parties present and voting.
6. An amendment adopted shall enter into force for the Contracting Parties which have accepted it on the first day of the fourth month following the date on which two thirds of the Contracting Parties have deposited an instrument of acceptance with the Depositary. For each Contracting Party which deposits an instrument of acceptance after the date on which two thirds of the Contracting Parties have deposited an instrument of acceptance, the amendment shall enter into force on the first day of the fourth month following the date of the deposit of its instrument of acceptance.

Article 11

1. This Convention shall continue in force for an indefinite period.
2. Any Contracting Party may denounce this Convention after a period of five years from the date on which it entered into force for that Party by giving written notice thereof to the Depositary. Denunciation shall take effect four months after the day on which notice thereof is received by the Depositary.

Article 12

1. The Depositary shall inform all States that have signed and acceded to this Convention as soon as possible of:
   (a) signatures to the Convention;
   (b) deposits of instruments of ratification of this Convention;
   (c) deposits of instruments of accession to this Convention;
   (d) the date of entry into force of this Convention;
   (e) notifications of denunciation of this Convention.
2. When this Convention has entered into force, the Depositary shall have it registered with the Secretariat of the United Nations in accordance with Article 102 of the Charter.

IN WITNESS WHEREOF, the undersigned, being duly authorized to that effect, have signed this Convention.

DONE at Ramsar this 2nd day of February 1971, in a single original in the English, French, German and Russian languages, all texts being equally authentic[2] which shall be deposited with the Depositary which shall send true copies thereof to all Contracting Parties.

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1 These articles have been amended by the Conference of the Parties on 28.5.1987; these amendments are not yet in force (see separate document).

2 Pursuant to the Final Act of the Conference to conclude the Protocol, the Depositary provided the second Conference of the Contracting Parties with official versions of the Convention in the Arabic, Chinese and Spanish languages, prepared in consultation with interested Governments and with the assistance of the Bureau.

CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE
ESPECIALLY AS WATERFOWL HABITAT

Third Meeting of the Conference of the Contracting Parties
27 May to 5 June 1987
Regina, Saskatchewan, Canada

Recommendation 3.3

Wise use of wetlands

RECALLING that Contracting Parties to the Convention on Wetlands of International Importance especially as Waterfowl Habitat "formulate and implement their planning so as to promote ... the wise use of wetlands in their territory";

EMPHASIZING the need to develop a definition of wise use, in order to guide Contracting Parties in their implementation of the Convention;

NOTING that Recommendations 1.5 of the First Meeting and 2.3 of the Second Meeting of the Conference of the Contracting Parties referred to the need for national wetland policies in order to promote wise use;

TAKING NOTE of the deliberations and conclusions of the Workshop on Wise Use at the present Meeting;

THE CONFERENCE OF THE CONTRACTING PARTIES

RECOMMENDS that the Contracting Parties adopt the definition of wise use established by the Conference of the Contracting Parties at its Third Meeting, held at Regina, and included in the Annex to the Regina Recommendations;

FURTHER RECOMMENDS that the Contracting Parties give particular attention to the wise use of wetlands by promotion of wetland policies containing elements (a) to (f) from the first part of the Guidelines on wise use included in the Annex to the Regina Recommendations; and

FURTHER RECOMMENDS that, while detailed policies are being established, immediate action be taken to stimulate wise use, including actions (a) to (d) from the second part of the Guidelines on wise use included in the Annex to the Regina Recommendations.

INFORMATION ON WISE USE OF WETLANDS SPECIFIED UNDER ARTICLE 3 OF THE RAMSAR CONVENTION

Definition of wise use:

"The wise use of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem".

Sustainable utilization is defined as "human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations".

Natural properties of the ecosystem are defined as "those physical, biological or chemical components, such as soil, water, plants, animals and nutrients, and the interactions between them".

Guidelines

Wise use involves the promotion of wetland policies containing the following elements:

(a) a national inventory of wetlands;

(b) identification of the benefits and values of these wetlands;

(c) definition of the priorities for each site in accordance with the needs of, and socio-economic conditions in, each country;

(d) proper assessment of environmental impact before development projects are approved, continuing evaluation during the execution of projects, and full implementation of environmental conservation measures which take full account of the recommendations of this process of environmental assessment and evaluation;

(e) use of development funds for projects which permit conservation and sustainable utilization of wetland resources;

(f) regulated utilization of wild fauna and flora, such that these components of the wetland systems are not over-exploited;

When detailed policies are being established, action should be taken on:

(a) interchange of experience and information between countries seeking to elaborate national wetland policies;

(b) training of appropriate staff in the disciplines which will assist in the elaboration of such policies;

(c) pursuit of legislation and policies which will stimulate wetland conservation action, including the amendment as appropriate of existing legislation;

(d) review of traditional techniques of sustainable wetland use, and elaboration of pilot projects which demonstrate wise use of representative national and regional wetland types.

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Indicative Equipment Lists Appearing in Cost Tables

Table 1

Office Furniture and Equipment (Set)

Item	Quantity	Unit Cost (₵)	Total Cost (₵)
Manual Typewriter	1	250,000	250,000
Filing Cabinets	2	100,000	200,000
Office Furniture			
1. Desks	2	55,000	110,000
2. Chairs	6	8,000	50,000
3. Book Shelves	2	20,000	40,000
		Grand Total	650,000

Table 2

Computer Equipment (Set)

Item	Quantity	Unit Cost ($)	Total Cost ($)
UPS	1	1,000	1,000
Computer	1	5,000	5,000
Printer	1	1,500	1,500
Software	-	1,500	1,500
Supplies	-	1,000	1,000
		Grand Total	10,000

Table 3

Training Equipment (Set)

Item	Quantity	Unit Cost ($)	Total Cost ($)
Film Projector Unit and Public Address System	1	6,000	6,000
Slide Project	1	1,700	1,700
Screen	1	300	300
Generator	1	1,500	1,500
Binoculars	20	100	2,000
Telescopes	5	350	1,750
Photocopier	1	1,700	1,700
Camera	1	850	850
Education Books	100	20	2,000
Sundries	-	-	300
		Grand Total	18,100

Table 4

Training/Education Equipment (Muni)

Item	Quantity	Unit Cost (₡)	Total Cost (₡)
Display Shelving	4	20,000	80,000
Display Cabinets	2	100,0000	200,000
Desk	1	55,000	55,000
Chairs	30	8,333	250,000
		Grand Total	585,000

Table 5

Field Equipment (Set)

Item	Quantity	Unit Cost ($)	Total Cost ($)
Cutlass	1	10	10
Boots	1	40	40
Water bottle	1	10	10
Boiler/Utensils	1	40	40
Haversack	1	100	100
Telescope	1	350	350
Binoculars		100	100
		Grand Total	650

Table 6

Muni: Boundary Demarcation

Item	Quantity (km)	Unit Cost (₡)	Total Cost (₡)
Boundary Description and	48.5	162,500	7,881,250
Survey	40.0	100,000	4,000,000
Pillars	48.5	6,700	324,950
Boundary Clearance	10.0	50,000	500,000
Sign Boards	13.5	60,000	810,000
Fire Break			
		Grand Total	13,516,200

Table 7

Habitat Enhancement/Management (Muni)

Item	Quantity	Unit Cost (₡)	Total Cost (₡)
Nature Trails	5 km	7,000/km	35,000
Border Planting	24 km	187,500/km	4,500,000
Traditional Hunting Grounds	200 ha	38,000/ha	7,600,000
		Grand Total	12,135,000

Table 8

Boundary Maintenance

Item	Quantity (km)	Unit Cost (₡)	Total Cost (₡)
Boundary Clearance	48	7,000	336,000
Fire Break	15	60,000	900,000
		Grand Total	1,236,000

Table 9

Monitoring Equipment

Item	Quantity	Unit Cost ($)	Total Cost ($)
Salinity Meter	1	200	200
Water Level Gauge	1	10	50
Weather Station	1	300	600
Sample Bottles	300	.50	150
		Grand Total	1,000

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Department of Game and Wildlife

Grade	Range	Salary
Principal, G.W.	A. 67,69	649,543-719,650
Senior, G.W.	A. 61, 63	579,848-649,500
Game Warden	A. 53, 58	492,384-591,434
Ass't. Game	A. 40, 43	379,481-435,120
Warden	A. 47, 53	435.481-435,120
Sr. Game Prod.	A. 38, 40	364,038-410,364
Officer	A. 34, 36	334.038-410,364
Game Prod.	A. 27, 32	287,631-348-595
Officer	A. 21, 25, 30	320,891-364.038
Sr. Game Ranger	A. 12	252,468-334,038
Game Ranger	A. 5	206,715-226,288
Principal Tech.	A. 5	169,354-190,531
Assistant	A. 5	164,354-190,531
Sr. Tech. Assistant		
Tech. Assistant		
Camp Supervisor		
Skilled Laborer		

Plus 20 percent as risk allowance.
Salaries as of May 1991

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Terms of Reference

Environmental Baseline and Monitoring Studies for Coastal Wetlands

1. Introduction. Long term management of the coastal wetland ecosystems addressed by this project will require development of an information base on the physical parameters of the system (hydrology, sedimentology, limnology) and the status of its biotic components (fisheries, aquatic and terrestrial ecology of flora and fauna), as well as the socio-economic status of its human inhabitants. The multiple-use management goals for the project sites call for preserving the ecological viability of the sites as bird habitat, maintaining or enhancing the recreational value of the areas, and seeking options to improve the economic return from compatible industries such as fisheries, aquaculture and salt production. Consistent with World Bank policy, these goals also include the maintenance or improvement of the welfare of the local population. To achieve these ends it is necessary to identify the current status of the ecosystems, identify major factors affecting their status, develop an understanding of natural cycles of hydrodynamics and biological productivity, identify long term trends in succession or change induced or influenced by human interventions (e.g., dams, agricultural runoff and urban pollution), and to develop models for understanding the ecological interactions among the biotic and physical elements of the systems. These terms of reference outline the studies that are needed to establish a technical information base upon which realistic management goals for the wetland systems can be set and against which success in achieving them can be measured.

2. Objectives. The overall objectives of these studies are to: identify the major factors (natural and human induced) that are acting on these coastal ecosystems; develop data on the present (ecological and economic) productivity of the systems; identify options to mitigate negative impacts from present or potential future human/industrial activities; develop models of the principal factors that affect the stability of the systems; and provide a basis for determining interventions to improve the economic productivity of the wetland systems that are consistent with maintaining their ecological integrity and environmental quality. Table 8.1 provides a simplified "generic" systems model for the coastal wetlands and summarizes indicators and parameters for regular monitoring.

3. Organization and Management. Funds for the studies would be administered by the Department of Game and Wildlife through the Coastal Wetlands Management Unit to be established under the project. Planning, design, supervision and review of the overall research program would be done by the Coastal Wetlands Management Project Operations Committee (CWMPOC) augmented with technical experts from participating institutions such as the Fisheries Research Institute, the Institute of Aquatic Biology, the Water Resources Research Institute, and the Botany and Zoology Departments, University of Ghana at Legon. The Project Operations Committee (CWMPOC) would be the formal body for review and

consideration of study protocols and approval of terms of reference. Senior participants in the technical studies would meet periodically, not less frequently than twice annually, to present and review study results and identify necessary changes and adjustments to study protocols or needs for specialized studies. The Senior Technical Advisor would be responsible for overall planning, design, coordination, supervision and review of the research studies. A detailed study plan would be prepared and reviewed by the CWMPOC and IDA by April 1993.

Table 8.1. COASTAL WETLANDS - ENVIRONMENTAL INDICATORS

Generic Systems Model For Coastal Lagoon Ecosystems

Inputs	Indicator(s)
Fresh water inflow	water level/salinity
Seawater inflow	water level/salinity
Runoff sediments	turbidity/transparency
Agricultural runoff	nitrates/sulphates/phosphates
Human/animal wastes	coliform bacteria count
Industrial wastes	trace metals,hydrocarbons etc.

Outputs	Indicator(s)
Fish, crabs, shrimp	catch statistics, size/frequency data
Salt	temperature & rainfall evaporation potential
Water outflow	water level/salinity contaminant levels

Checklist of General Environmental Quality Monitoring Parameters

Hydrological	Limnological
* water levels	* pH
inflow/outflow rates	* transparency/turbidity
sediment transport	* dissolved oxygen
	* conductivity (salinity)
	* biological/chemical oxygen demand (BOD)

Biological	Miscellaneous
* algae	* lagoon and seashore
phytoplankton	water temperatures
macrophytess (plants)	evapotranspiration
zooplankton	trace elements in
* invertebrates	flora/fauna/sediments
* fish	petroleum hydrocarbons
crustaceans & molluscs	
* birds	

* Routinely monitored parameters.

4. Terms of Reference. Detailed terms of reference for the studies would be drawn up by the Senior Technical Advisor in close consultation with the Wetlands Management Unit Coordinator and reviewed and approved by the CWMPOC. Detailed terms of reference would vary among individual study components but the objectives of all would concern documentation of current status and natural cycles and trends, identification of intrinsic and extrinsic factors effecting the systems and design, development and execution of long term monitoring protocols. Specific studies would address:

- hydrology
- limnology and aquatic biology of plants and invertebrates
- lagoon fisheries
- shorebird and wader population monitoring
- terrestrial animal and plant ecology
- erosion and land degradation
- socio-economic conditions and cultural practices of local communities

5. The results of baseline studies would be presented in the form of a report with maps, diagrams and data tables as necessary. These studies would also define requirements for annual monitoring and formats for annual reporting of results. Based on this initial assessment the CWMPOC with appropriate consultation with senior scientists participating in the studies, would define terms of reference for the annual monitoring studies to be carried out for the duration of the project. The results of the annual colloquia would be summarized in an appropriate document and transmitted to the Natural Resources Sectoral Network through the CWMPOC Chairperson and the EPC/TS.

Baseline Hydrological Studies

6. For each of the wetland catchments, basic data are required on water flow, ground water tables and annual fluctuations in water levels within the lagoons themselves. The goal

of the baseline study is to describe and analyze the hydrology of the catchments surrounding each lagoon and to design a regular monitoring program to routinely record data on water levels, flow volumes and ground water tables at key locations within the sites.

7. Baseline studies for Muni, Sakumo and Densu Delta will be completed during the first 15 months of the project and for Songor and Anlo-Keta by the end of Project Year 2. For each site, a report will be prepared describing the results of findings in terms of a preliminary hydrological model of the catchment. The report will define an annual monitoring program and describe the methods to be employed, locations of sampling stations, and required frequency of sampling/monitoring. The report will define a format for annual reporting of monitoring results.

8. Muni Lagoon. The drainage basin surrounding the Muni Lagoon is approximately 96.5 km2. The lagoon is fed by two rivers, the Muni and Pratu which show large seasonal fluctuations in water flow volume. Salinity of the lagoon varies seasonally and spatially. The baseline study will develop a model of water flow patterns within the catchment area and define requirements for monitoring annual cycles of:

- water flow volumes from the Muni and Pratu rivers
- water level of the lagoon
- salinity gradients within the lagoon
- sediment transport within the river/lagoon system
- ground water levels in appropriate areas of the catchment

9. Sakumo Lagoon. This lagoon and its catchment fall almost entirely within the greater Accra-Tema urban metropolitan region. The lagoon receives discharge from two rivers, the Gbagbla-Ankonu and Mamahuma with a total catchment area of approximately 222 km2. The lagoon is tidal and connected to the sea by a culvert passing under the Accra-Tema coast highway and railroad embankment. Freshwater and tidal inflow volumes fluctuate seasonable and the salinity gradient within the lagoon varies both daily and seasonally.

10. The baseline study will develop a model of water flow patterns within the lower catchment area and define requirements for monitoring annual cycles of:

- discharge volumes into the lagoon from the Gbagbla-Ankonu and Mamahuma rivers
- water level of the lagoon
- salinity gradients within the lagoon
- sediment and effluent transport within the river/lagoon system
- ground water levels in appropriate areas of the catchment
- tidal flow volumes through the culvert

11. In defining the monitoring regime the study will also take into account recommendations for improving tidal flushing of the lagoon resulting from engineering studies to be undertaken that concern potential modification of the outfall culvert and determine whether such modifications should be undertaken.

12. Densu Delta. The lagoon and salt pan complex of the lower Densu river lies in the valley formed by the Aplaku-Takuse and Weija McCarthy Hills. Freshwater inflow is from runoff within the immediately adjacent catchment and from the Densu River below the Weija Dam.

13. The baseline study will develop a model of water flow patterns within the adjacent catchment area and define requirements for monitoring annual cycles of:

- water level of the lagoon
- salinity gradients within the lagoon
- sediment and effluent transport within the river/lagoon system
- ground water levels in appropriate areas of the catchment
- flow volumes through the Densu River channel at appropriate stations below the Weija Dam

14. Songor Lagoon. Songor lagoon lies just west of the Volta River estuary. Freshwater input is principally from runoff of the adjacent catchment and discharge from three streams, two of which (Sege and Zano) originate north of the Sege-Kase road. The seasonally flooded area covers approximately 115 km2. At present the lagoon has no outlet to the sea and salinity varies over a broad range throughout the year.

15. The baseline study will develop a model of water flow patterns within the adjacent catchment area and define requirements for monitoring annual cycles of:

- water level of the lagoon
- salinity gradients within the lagoon
- sediment and effluent transport within the river/lagoon system
- ground water levels in appropriate areas of the catchment

16. In defining the monitoring regime, the study will take into account potential effects on the lagoon of modifications of seawater inflow patterns associated with potential expansion of the salt winning industry.

Anlo-Keta Lagoon. The Anlo-Keta lagoon, river, marsh and mangrove complex covers an area of more than 300 km2 between the Volta River and the Togo border. The hydrological regime is closely linked to the Volta River and has been strongly effected by changes resulting from construction of the Akosombo Dam. Baseline studies should be geared to establishing a monitoring regime to detect long term patterns of change or succession that are occurring with the objective of estimating their expected impact on present use of the lagoon by waterfowl and local human populations.

17. The baseline study will develop a model of water flow patterns within the adjacent catchment area and define requirements for monitoring appropriate parameters to detect and describe annual cycles of:

- water levels within key areas of the wetland
- salinity gradients within the Keta Lagoon

- sediment and effluent transport within the river/lagoon system including coastal erosion/deposition patterns
- ground water levels in appropriate areas of the catchment

Baseline Limnological and Aquatic Biological Studies

18. For each of the lagoons and estuaries data are required on basic parameters and indicators of water quality as listed in Table 8.1 (above). Baseline studies would include assessment of water characteristics, aquatic productivity, an inventory of the aquatic invertebrate fauna and establishment of reference collections, identification of invertebrate prey species of migratory water birds, and definition of a regular monitoring regime for tracking water quality and aquatic productivity. Studies would include an inventory and assessment of aquatic vegetation including mapping of plant community types. Botanical studies would particularly focus on elements of importance for habitat management and harvesting by local human communities.

19. The baseline studies would also identify needs for more detailed studies on life cycles and population dynamics of invertebrate fauna and the interactions of biotic productivity with abiotic factors such as fluctuations in salinity, turbidity and nutrient input from freshwater runoff. The baseline studies would be designed to develop a preliminary systems model for tracking biological productivity of the lagoons and identifying critical levels of key indicators to be monitored.

20. Baseline studies for Muni, Sakumo and Densu Delta will be completed during the first 15 months of the project and for Songor and Anlo-Keta by the end of Project Year 2. For each site, a report will be prepared describing the results of findings with specific reference to the preliminary hydro-biological models developed for each catchment. The report will define an annual monitoring program and describe the methods to be employed, locations of sampling stations, and required frequency of sampling/monitoring.

21. The studies will attempt to identify and quantify specific sources of pollution and nutrient input into the lagoons and provide assessment of impacts on biological productivity and stability. The studies will result in specific recommendations for management of the lagoon systems to enhance their resilience or stability and increase sustainable harvesting of useful animal and plant products. The report will define a format for annual reporting of monitoring results.

Baseline Lagoon Fisheries Studies

22. For each of the lagoons, baseline data are required on the species, population dynamics, growth patterns, productivity, and limiting factors of harvestable vertebrate and invertebrate fishery resources. These studies are necessarily closely linked with the limnological studies described above, particularly as these relate to sustainable productivity. Fisheries studies must also be closely integrated with those concerning socioeconomic and

cultural practices of local communities as these relate to harvesting practices and utilization patterns of fish, crab, snails, and shrimp. Studies should include data collection on fishing methods and gera employed and catch data per-unit-effort.

23. Fishery studies should seek to determine the status of present stocks and develop models for potentially increasing harvestable productivity under various management scenarios. Such scenarios would include evaluation of potential enhancement of present fisheries output through habitat manipulation and/or regulation of harvesting patterns.

24. The proximate goal of the fisheries baseline study is to determine present diversity and abundance of harvestable fish stocks and define a monitoring regime for tracking productivity over the next few years. This should provide a rigorous basis for identifying potentially promising (and locally acceptable) management interventions and for assessing the results of such interventions in quantitative terms.

25. Baseline studies completed during the first two years of the project would be summarized in a report defining an annual monitoring program for each of the wetlands and a format for reporting results. To the extent possible baseline studies should attempt to evaluate current productivity, sustainability of present harvest levels, and identify potential management options to sustainably improve harvests.

Ornithological Studies

26. Data on use of the lagoons by migratory shorebirds and resident waterfowl have been developed over the past six years by studies undertaken by the Save the Seashore Birds Project in collaboration with the Department of Game and Wildlife. These regular monitoring studies would be continued both within the Ramsar sites and elsewhere in Ghana to better understand seasonal patterns of movement and habitat use by migratory birds.

27. Within the Ramsar sites, detailed studies would be undertaken to identify and document seasonal and spatial patterns of wetland use by individual species for roosting, feeding and nesting. These studies would provide more precise data than are currently available to define boundaries of necessary core areas or sanctuaries and the temporal patterns for their use. For the larger sites (Songor and Anlo-Keta) aerial surveys would be undertaken at appropriate intervals and periods to provide more accurate data on total abundance and spatial distribution of birds within the wetlands than can be acquired from terrestrial surveys alone.

28. Banding studies to determine movements of birds among the Ramsar sites and other wetlands in Ghana would be continued and expanded as appropriate.

29. Baseline studies undertaken during the first two years of the project would be summarized in the form of a report with appropriate maps to identify areas of significant bird concentrations and temporal patterns of use of the wetlands by migrants and resident waterfowl. These data will form the basis for delineating core areas and sanctuaries, and

development of management guidelines and policies to afford effective protection for migrant and resident species during critical periods and stages of their life cycles (e.g., breeding, nesting, moulting).

30. The summary report of baseline studies will define an annual monitoring regime required for tracking use of the wetlands by waterfowl and provide a format for annual reporting of survey and monitoring results.

Terrestrial Plant and Animal Ecology Studies

31. Basic survey and inventory data are required on the faunal and floral composition of the catchment areas of the three rural lagoons (Muni, Songor, Anlo-Keta) so that rational development and management plans can be devised. In the case of culturally significant animals such as bushbuck at Muni and economically important bushmeat species such as duikers and grasscutter, assessment of local abundance, population dynamics and carrying capacity is needed to develop rational conservation plans or promote programs to encourage sustainable harvesting.

32. Similarly, botanical surveys are required to identify significant endemic or rare elements occuring within the sites as well as to identify and document those plants that are useful for habitat management or important to local communities for food, fuel, medicine or other traditional uses. Habitat associations of upland birds (resident and migrant) small mammals, reptiles and amphibia will be identified by field surveys with specimen documentation as appropriate to assess the biological importance of these coastal savannahs for rare elements of the vertebrate biota.

33. Rapid field surveys will be undertaken for birds, mammals, reptiles and amphibians in upland areas adjacent to the lagoons at Muni, Songor and Anlo-Keta. These will involve capture and preparation of voucher specimens of mammals, reptiles and amphibians as necessary for accurate taxonomic determination and documentation. Studies will be coordinated with botanical surveys to link known vertebrate distributions with described vegetation formations.

34. Field botanical surveys will be undertaken to identify rare and endemic forms as well as to determine the distribution and abundance of economically useful or culturally significant plants. Natural vegetation cover mapping will be done for each of the three sites, as a basis for determining management and development plans.

35. Results of the faunal and floral surveys will be incorporated in the formulation of land management plans to reduce erosion impacts on the lagoons and maintain or enhance harvesting of useful plant and animal products through habitat management, planting, and promulgation of appropriate local harvesting regulations.

36. Baseline studies will be summarized in the form of a report with appropriate maps to identify areas of particular biological significance within the Ramsar sites and outline

monitoring requirements for rare or threatened taxa occuring within the sites. The baseline report will also indicate needs for more detailed studies on distribution, demographics or population dynamics of endangered, economically or culturally important taxa.

Sea Turtle Assessment and Recovery Plan

37. Preliminary studies undertaken during the 1970's indicated that beaches within the Songor and Anlo-Keta sites are important nesting sites for three species of threatened or endangered sea turtles. DGW authorities confirm that unregulated exploitation of turtles continues to be a problem along the Ghana coast.

38. Studies would be undertaken to identify turtle nesting beaches within the Ramsar sites and elsewhere on the coast. Initial data on nesting sites would be compiled from interviews with coastal residents. Nesting areas so identified would then be visited by DGW personnel and monitored during the nesting season to identify their spatial extent and provide information on the species and number of individuals using a site. Information on local exploitation of turtles and eggs would also be gathered. On the basis of these studies, DGW would identify requirements for protection of nesting beaches and for regulation of turtle harvesting during critical periods.

39. Based on the study results, DGW would formulate a protection/recovery plan and enter into a dialog with local residents to negotiate implementation of appropriate controls on harvesting of turtles and eggs. It is expected that implementation of such a plan involving monitoring of nesting success on certain beaches and restriction of turtle harvesting during critical periods would be implemented gradually with appropriate community education/sensitization programs undertaken in advance of any enforcement intervention.

Soil Erosion and Land Degradation

40. Surveys would be undertaken within the catchment areas of each of the lagoons to map general land use patterns and identify any acute problems of erosion or agricultural or industrial runoff contributing to siltation, pollution or nutrient loading of the lagoons. This study would also identify sensitive areas where intensified agricultural or industrial uses would likely impact directly on the lagoons. Based on these preliminary assessments a report with appropriate maps would be prepared indicating areas where improved soil/land conservation measures would be recommended and areas where intensification of current land use would potentially present a direct threat to the aquatic ecosystem(s).

Socio-economic Status of the Local Population

41. Preliminary work carried out by staff of the Sociology Department, University of Ghana, indicates that approximately 50,000 people live in the area of Songor Lagoon; about 31,000 in the area of Muni Lagoon (if the population of the town of Winneba, about 27,000, is included); some 180,000 in the area of Sakumo Lagoon (including the municipality of Tema, Tema New Town, and Ashiaman, and inland urban center); and perhaps 75,000 in the area of the Densu Delta (excluding the city of Accra). The Anlo-Keta lagoon area is also densely populated, although no estimate has yet been made of the size of the project affected population. If urban residents are excluded, however, the number of people directly affected by project activities becomes much smaller.

42. Socio-economic studies will, therefore, focus on the relatively small farming and fishing communities scattered along the sand bar between the lagoons and the ocean, or living in the lower catchment area of the lagoons. Initially, a census will be taken at each site of the population actually living within the site boundaries, identified through aerial photos. This census will provide basic data on demographic characteristics, residence and employment patterns. Based on this sample frame, a panel of households will be drawn for annual project monitoring activities. More extensive baseline data will be collected on this sample of households, including assets (e.g., boats, trees), income, education, health, sanitation, water supply, land ownership, land use, and uses of the lagoon ecosystem. To ensure adequate representation of women's concerns, men and women in the selected sample households will be separately interviewed.

43. Household surveys will be complemented by informal group and community interviews organized as part of the program of public participation in planning for each of these sites. These discussions would identify traditional uses of different elements of the lagoon ecosystem and traditional beliefs and practices which may affect its sustainability. Reasons for the breakdown of traditional management systems will also be explored with the communities concerned. These discussions will also provide a forum through which the project can share technical information with the people, and gain the benefit of indigenous knowledge concerning the functioning of the lagoon ecosystem.

44. A report on the initial census, panel selection criteria, and survey instruments for each site except Anlo-Keta will be prepared for review by the Site Committees and CWMPOC within six months of project start-up. Baseline data collection will be completed by the end of Project Year 1 and annual surveys will be conducted, therefore, to monitor changes in the welfare of the project affected population. Socio-economic reconnaissance of the Anlo-Keta area will be completed by the end of Project Year 2. Census and baseline surveys will be carried out after the site boundaries are identified.

Technical Advisor - Coastal Wetlands Management Project

45. Qualifications and Experience. The Technical Advisor will have an advanced degree and post-graduate training in an appropriate technical field related to wildlife management or conservation of biodiversity. The Advisor should have good knowledge of and personal familiarity with ecological conditions within the coastal zone of Ghana including issues concerning human ecology of the region within and around the wetland sites.

46. The Advisor should have at least five years experience in the design, execution and assessment of research programs concerning the utilization of coastal wetland habitats by wildlife. Experience with monitoring and assessment of the status of migratory waterfowl and shorebirds is especially important because of the profound importance of the coastal wetlands for migratory bird populations on a regional and global scale.

47. The Advisor should be familiar with the operational procedures, policies and practices of the implementing agency for the project (Department of Game and Wildlife) and of the mandates and technical capabilities of sectoral agencies and research institutions participating in the project.

48. The Advisor should have proven experience in development of education or public awareness programs for local communities. The Advisor should have demonstrated experience in working with local level political authorities, commissions, development councils, traditional leaders and other elements of local communities to achieve appreciation and awareness of and consensus on resource management or conservation issues.

49. The Advisor should have experience in working with international organizations involved with biodiversity conservation. The Advisor should have demonstrated his/her capacity to maintain effective liason with the scientific community on matters relevant to conservation on the national and international levels.

50. Duties and Responsibilities. The Technical Advisor will be responsible to the Coordinator of the Wetlands Management Unit of DGW and will be a member of the Executive Committee of the Coastal Wetlands Management Project Operations Committee (CWMPOC). The Technical Advisor will have principal responsibility for the planning, design, execution and overall coordination, supervision and review of the research and monitoring studies described above (Annex 8). In addition, working closely with the Wetlands Management Unit Coordinator the Advisor will assist to:

- establish the CWMPOC with appropriate representation of sectoral agencies, research institutes, political institutions and traditional leaders;

- establish and serve as chairperson of a technical working group with appropriate representation from academia, research institutes, and other units to plan, design and review results of research and monitoring studies to be undertaken under the project;

- plan and develop community awareness and public education programs concerning environment and conservation issues within the coastal zone and elsewhere;

- act as liaison with national and international NGO's concerned with environmental awareness and conservation of the coastal wetlands;

- establish local Site Committees for the principal project sites and work to ensure adequate representation of all segments of the communities living within and adjacent to the Ramsar sites;

- plan and coordinate development of a National Wetlands Conservation Strategy in cooperation with the EPC/TS and other appropriate national planning agencies;

- plan and organize appropriate fora for the presentation of research findings and other events to promote public awareness of wetland values;

- develop an overall research program plan and schedule for carrying out the research and monitoring studies described above;

- monitor and review disbursement of funds for community infrastructure improvements approved by the site committees;

- develop annual work plans and research programs, prepare periodic reports;

- liaise with IDA/GEF supervision missions and participate in mid-term project review and preparation of mid term and project completion reports.

National Wetlands Conservation Strategy

51. Introduction. Ghana's 550km coastline includes more than 50 lagoons and estuaries ranging in size from a few dozen hectares to more than 300 km2. The Volta Lake, an impoundment created by the Akosombo Dam covers an area of nearly 8,500 km2 which extends through all of the major inland ecological zones of the country. Together, natural and manmade wetlands cover nearly 10,000 km2 of territory and are of critical economic importance to the country as a whole and to adjacent communities. Studies concentrated principally along the coast document the regional and global importance of Ghanaian wetlands as habitat for migratory waterfowl with eight presently known coastal sites qualifying as Wetlands of International Importance under the 1% criterion of the Ramsar Convention. In recognition of the national and international significance of its wetland resources the Government of Ghana became a party to the Ramsar Convention in 1988 and has formally registered or expressed its intent to register with the Ramsar Secretariat six wetland sites (including catchments) totalling more than 1500 km2 in area. In line with the commitment of contracting parties to the Convention to develop national wetland policies promoting "wise

use" of these resources the Government of Ghana would utilize funds provided by the Global Environment Facility under the Wetlands Management component of the GERMP to develop the necessary information base to define a national wetland conservation strategy and action plan.

52. Objectives. The first objective of this study would be to review existing data on wetland resources and systematically identify gaps in knowledge of critical factors effecting wetlands as these represent constraints to improving management practices. The goal would be to summarize existing information on coastal and inland wetlands including: hydrodynamics; present uses and projected future demands; water quality and pollution problems; fisheries productivity and potential; and status of natural flora and fauna (including resident and migratory species). This study would bring together information gathered on coastal wetlands under the Coastal Wetlands Management Program and on inland wetlands under the Volta Basin Study undertaken as part of the GERMP to define conservation priorities and options, evaluate the multiple use management potential of principal wetlands, and identify present constraints to realizing the economic potential of wetlands resources. This study would identify specific needs for data collection and analysis and recommend a specific plan of actions to meet them.

53. Organization and Management. Funds for the study would be administered by the EPC/TS. The project would finance local consultancies to review and summarize existing information, limited local field data collection, sponsorship of necessary meetings, workshops and colloquia, preparation and dissemination of reports and documents, and technical assistance from outside specialists as required. Draft terms of reference and an implementation plan and schedule for the study would be prepared by the Senior Technical Advisor to the Wetlands Management Unit of DGW and reviewed and approved by the SIPOC. Specific elements enumerated below would be addressed by specialist working groups under the general coordination of the Wetlands Technical Advisor. Results would be prepared in the form of a technical report with accompanying maps as required. Development of specific strategies and action plans would be the responsibility of the Wetlands Technical Advisor in collaboration with the EPC/TS with review and approval by the Executive Council of EPC.

54. Terms of Reference. Detailed terms of reference would be prepared, reviewed and approved as noted above. Specific activities to be undertaken in the course of the study would include:

- review of the current status of information on wetland resources including, size, location, biological and hydrological characteristics, human uses, classification of wetland types and assessment of conservation status and representativeness of present conservation units;

- review of legislation and legal basis for wetland management;

- identification of education, training and public awareness requirements related to wetlands management;

- identification of specific research requirements to obtain necessary data to objectively define conservation priorities;

- identify major threats to wetlands in Ghana and constraints to effective wetlands management;

- identify sites suitable for development of multiple-use wetland management projects that build on experience gained under the coastal wetlands management program to improve wetlands management practices in other ecological zones;

55. The study would make recommendations for priority actions in the development of a national wetlands policy and strategy. Such priority actions might include: undertaking a national wetlands inventory; expansion of the coastal wetlands management unit to include management of inland wetlands; management of additional critical sites within the coastal zone; development of specific site based project proposals. The Ghana national strategy would also take into account wetland conservation priorities on a regional scale by maintaining communication and cooperative linkages with international organizations concerned with wetlands conservation such as IWRB, ICBP and IUCN.

Study of Development Options in Coastal Wetlands

56. Objectives. The main purpose of these studies would be to examine options for development within the coastal wetland sites designated as of special ecological significance under the Ramsar Convention. Such recognition does not preclude development but any development should be compatible with maintaining the ecology of the area. The objective of the studies would, therefore, to develop proposals for development that are consistent with the status of the sites under the Ramsar Convention. The studies would be a precursor to the use of the Investment Support Fund, designed to underwrite pilot development initiatives in the coastal wetlands.

57. Organization and Management. Funds for the studies would be administered by EPC/TS as the principal project implementation agency. However, NDPC and MFEP would be amongst the users of the results of the studies and should play an important role in formulating the terms of reference for the studies. The Project Operations Committee responsible for Studies and Investigations (SIPOC) would be the formal body for consideration of study proposals and approval of terms of reference. As all these studies would require inputs from socio-economists, it is proposed that the Institute for Statistics, Social and Economic Research (ISSER), University of Ghana, should be involved and the staff member who would sit on the Committee could, where appropriate, coordinate team formation and the implementation of the proposed study.

58. Terms of Reference. The preparation of the detailed terms of reference for the studies would be coordinated by the secretary of SIPOC, who would be the Deputy Director

for Inter-Sectoral Networking, EPC/TS, in close consultation with members of SIPOC, who would approve them. Details would vary but the studies would include examination of:

- Existing natural resources;
- Population;
- Socio-economic framework;
- Technical development proposals;
- Financial and economic analysis of development proposals;
- Assessment of the impact of potential developments on the ecology of the lagoon.

The results of the studies would be presented in a report with accompanying maps as necessary.

APPENDIX 2
Annex 9

GHANA

COASTAL WETLANDS MANAGEMENT

Maps of Proposed Ramsar Sites*

Figure 1. Map of Coastal Ghana showing locations of sites.*

* Proposed boundaries and zoning patterns within sites are from Ntiamoa-Baidu, Y. and C. Gordon. 1991. Coastal Wetlands Management Plans: Ghana. Environmental Protection Council, Ghana. 140pp.

GHANA
COASTAL WETLANDS MANAGEMENT PROJECT

Coastal Wetlands Program Implementation Schedule

Activity	1992 1 2	1993 1 2	1994 1 2	1995 1 2	1996 1 2	1997 1 2
I. SITE ESTABLISHMENT						
Boundary surveys and legal descriptions for all sites	.....	*****				
Boundary Demarcation/Sites:						
Muni	.....	**********				
Sakumo		**********				
Densu		**********				
Songor			**********			
Keta				**********		
Border Planting/Sites:						
Muni			**********			
Sakumo		******	******			
Densu		.....	**********			
Songor				**********	**********	**********
Keta				*****	**********	**********
II. ADMINISTRATION						
Establish CWMPOC (including technical working group for research and monitoring studies)	.....	******.....	.....	.....	.....	.....>
Establish Site Management Committees:						
Muni	.....	**********	.....	.....	.....	.....>
Sakumo/Densu	.....	**********	.....	.....	.....	.....>
Songor	.....	**********	.....	.....	.....	.....>
Keta			.....	********...	.....	.....>
III. RESEARCH AND MONITORING						
Baseline Studies:						
Muni		******.....				
Sakumo		******.....				
Densu		******.....				
Songor		******	.....			
Keta		******	******			
Monitoring Studies:						
Muni		******	**********	**********	**********	**********>
Sakumo		******	**********	**********	**********	**********>
Densu		******	**********	**********	**********	**********>
Songor			**********	**********	**********	**********>
Keta			******	**********	**********	**********>
IV. COMMUNITY DEVELOPMENT STUDY AND INVESTMENTS						
Development Options Study		.....	**********			
Investment support for pilot projects (e.g. aquaculture, fisheries, artisanal salt)				**********	**********	**********
Community Infrastructure Investment Support:						
Muni		******	**********	**********	**********	**********
Songor		******	**********	**********	**********	**********
Keta				.....	**********	**********
V. EQUIPMENT PURCHASES		.....******	**********	*****		
VII. VEHICLE PURCHASES		**********	**********	**********		

Activity	1992 1 2	1993 1 2	1994 1 2	1995 1 2	1996 1 2	1997 1 2
VII. SITE PREPARATION AND BUILDING CONSTRUCTION						
Sites:						
Muni						
Staff Housing		******	******			
Education Center/Office			**********			
Observation Posts		******	******			
Sanitation Units		******	**********	**********		
Sakumo/Densu						
Staff Housing		******				
Education Center/Office			**********			
Observation Posts		******	**********			
Songor						
Staff Housing				**********		
Education/Office/Lab				**********		
Observation Posts				*****		
Sanitation Units		.....	**********	**********	**********	
Keta						
Staff Housing				****	*******	
Observation Posts				******	**********	
Sanitation Units				**********	**********	****!
VIII. ROAD CONSTRUCTION/UPGRADING						
Sites:						
Muni			**********			
Songor			**********			
Keta					**********	
IX. HABITAT ENHANCEMENT/FAUNAL MANAGEMETN/SITE IMPROVEMENT						
Sites:						
Muni						
Game stocking		******	**********	**********	**********	*********!
Planting		******	**********	**********	**********	*********!
Access trails		******	**********			
Sakumo/Densu						
Planting			**********			
Roosting islands			**********	**********		
Access trails			**********			
Keta						
Planting				***	**********	*********!
Roosting islands				***	**********	*********!
Access trails				***	**********	*********!
X. PUBLIC AWARENESS AND COMMUNITY EDUCATION						
Wildlife Clubs	.....	**********	**********	**********	**********	*********>
Community Education	.....	**********	**********	**********	**********	*********>
Education Center Operations						
Muni				**********	**********	*********>
Sakumo				**********	**********	*********>
Songor				**********	**********	*********>
Keta					**********	*********>
XI. STAFF TRAINING						
Coordinator			*****	*****	*****	
Education Officer		*****				
Wardens		**********	**********	**********		
Education Extension Staff		**********	**********	**********		
Community Rangers			*****	*****	*****	

***** period of peak activity ..... period of lead-in or follow-up activities ****> indicates ongoing activities

KC:db
b:trgeah
March 26, 1992

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

APPENDIX 3

Sakumo Lagoon

Effluent Disposal and Hydrological Studies

GHANA

COASTAL WETLANDS MANAGEMENT PROJECT

Sakumo Lagoon
Effluent Disposal and Hydrological Studies

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I. INTRODUCTION

1.1 In 1989 a report was published on behalf of Tema District Council and Tema Development Corporation by Watertech Consulting Engineers, on the redevelopment of the Tema sewerage system which had by that time, fallen into disuse. The report concluded that the original sea disposal system was inadequate to serve the future needs of Tema and that a sewage treatment works was required which would need to be sited adjacent the Sakumo lagoon and should discharge effluent to sea. The preferred site of the treatment works later proved to be unavailable and it was therefore proposed to relocate the treatment works away from the coast and discharge into the Sakumo lagoon.

1.2 This study was instigated to check the design of the treatment works; to determine the environmental impact on the lagoon of the new proposals; to consider alternative effluent disposal options, and to cost them.

II. SAKUMO LAGOON

A. Background

2.1 The lagoon lies to the west of Tema and is connected to the sea by twin 1800 mm diameter culverts under the coast road. At the time of the appraisal, late October 1991, the free water surface was approximately 60 ha with probably a similar area covered with aquatic plants in very shallow water. The depth of water was estimated from observation of fishermen wading in the lake and appeared everywhere to be less than 1200 mm deep averaging approximately 500 mm. The body of open water is thus estimated to contain of the order of 0.30 Mm^3 with probably another 0.05 Mm^3 of water in the beds of vegetation and water channels.

2.2 The surrounding area is a sandy basin extending over 100 ha to the higher land above possible flood level. The basin is covered in grassy scrub land, on the western side and around the northern edge. To the east housing development has encroached to within a few hundred meters of the lagoon and low lying floodable area. In the south eastern zone is an area of open land as yet undeveloped, which has been identified as the preferred site of the proposed sewage treatment plant.

2.3 The Sakumo lagoon is a site of conservation interest for migratory shorebirds identified as being of importance under criteria outlined under the Ramsar convention, and has been proposed for registration as a Ramsar site. The lagoon is fished extensively but the fish yield is not of great commercial significance, though several dozen fishermen earn their living from the lagoon. Elsewhere the basin is used for cattle grazing, production of tomatoes, wood cutting and sand extraction though none of these uses is extensive. At the northern edge there has been some fly tipping and dumping of septic tank sludges and cesspit wastes.

2.4 The lagoon has a catchment area of approximately 350 km^2 and there are four major surface water channels flowing into the Sakumo basin, two from the north and two from the west. At the time of the appraisal, the most westerly of the drains from the north was dry; this serves a large undeveloped area to the south of the motorway. The second of the northern drains was flowing with partially treated sewage from the Ashaiman settlement to the north of the motorway; the sewage passes through a series of irrigated plots which effects some improvement in quality and reduces the quantity discharged into the basins.

2.5 The two drains from the west are both heavily polluted with domestic sewage. The drains are partially silted and the velocity of flow is quite low. The majority of suspended solids are finally divided but agglomeration of algae are common. There appear to be no large faecal solids by the time the surface channels discharge into the lagoon. There are several sullage/surface water channels discharging from the new housing developments but none of significance. Most if not all of the new houses appear to be provided with soakaways and although sub surface seepage may reach the lagoon the polluting effects are likely to be insignificant when compared to the effect of the surface discharges. Tema residential Area 12 and part of Area 11 each drain to a large septic tank but the effluent is used for irrigation and insignificant flow reaches the lagoon.

B. Present Condition of the Lagoon

2.6 Survey of the Lagoon. It should be noted that the survey work was carried out over a limited period and there may be seasonal fluctuations in the condition of the lagoon which cannot be assessed. Many of the hypotheses made could not be verified due to inadequate time and resources. A sampling program of the lagoon was undertaken 30 October 1991. Samples were taken at three locations (Figure 1):

A - approximately 15 m offshore from the Golf Club swimming pool;
B - midway across the narrow point of the lagoon halfway from point A to the outlet;
C - at the outlet just upstream of the culvert.

Two samples from each location were taken for analysis and two further samples from each location were tested for temperature pH and dissolved oxygen alone. Subsequent samples were taken over the following three weeks.

2.7 All analytical work was carried out by the Institute of Aquatic Biology (IAB) of CSIR. Because of the limitations of the laboratory in terms of equipment, working environment and experience of this type of work, the absolute accuracy of the results cannot

be guaranteed. Every endeavor was made to ensure accuracy and where errors were suspected, repeat analyses were performed. Allylthiourea was not available at the IAB and nitrification suppression of the BOD test could not be undertaken. The results of the analyses are presented in Annexure 1.

2.8 Temperature. The temperature of the lagoon water dropped from 31°C in the middle of the lagoon to 27°C by early evening

2.9 pH. The pH of the lagoon water ranged from 9.4 in the morning to 8.6 by early evening, except at the outlet from the lagoon. The pH of the lagoon water was not the same at the two locations in the lagoon proper but the changes in pH were similar. As the sky became overcast and the temperature dropped, the pH also dropped, indicating the influence of algal actively. The sample at the outlet had a much lower pH at 1100 h than the other two probably reflecting the localized influence of the tide. At the time, the tide was on the ebb, but from marks on the outfall structure the water level had dropped by 200 to 300 mm. The low pH at point B reflects the naturally lower pH of the sea water and also the buffering and diluting effects of the sea water mixed in with the lagoon water. As the sea water intrusion was flushed out, the pH rose to 9.0 prior to dropping late in the afternoon.

2.10 Dissolved Oxygen. The diurnal pattern of dissolved oxygen (DO), although not verified at night, is typical of waters with high algal activity. The supersaturation levels attained were unexpectedly high, particularly at points B and C where concentration of 15 mg/l were recorded. As with pH, the DO levels at point A were consistently lower than at point C, indicating a lower level of algal activity at point A. The drop in DO during the afternoon was very marked at point C. However, due to inaccessibility, sample C was taken close to the shore line and wave action may have suspended benthos in the area causing a higher oxygen demand than created by algal actively alone. It is unlikely that DO levels drop to zero except at the margin of the lagoon where the mud was noticeably black and has a typical but faint odor of hydrogen sulphide.

2.11 Nitrogen and Phosphorus. Apart from at the outlet, ammonia nitrogen was not detected in the lagoon. Nitrate nitrogen was 0.14 mg/l as N at points A and C, while the orthophosphate level was 0.05 mg/l as P at point A, 0.62 mg/l at Point C and averaged 0.26 mg/l at the outlet. Subsequent sampling confirmed the absence of ammonia nitrogen but gave nitrate concentrations of 0.014 mg/l and phosphate levels of 0.03 mg/l in the lagoon. On 18th November, 1991, the orthophosphate and total phosphorus levels at point B were 0.04 mg/l and 0.06 mg/l respectively.

2.12 There is no explanation for the large difference in phosphate levels between sample points A and C on 31st October, 1991. It was expected that the levels would have been almost identical in a well mixed lagoon, as were the nitrogen concentrations. The much lower values recorded on 18th November could be as a result of the tidal dilution by the high tides between those dates and/or utilization by algae during a significant growth spate in the intervening period, with subsequent washout or settlement. However it was noted on 30th October that Pumping Station No. 1 was not operating and sewage was being by passed to the lagoon. The discharge would have entered the lagoon near point C and mixing in the lagoon to the north may have been inhibited in the short term by wind action and the general flow pattern in the lagoon; point A is in effect in a dead area.

2.13 The nitrogen to phosphorus ratio is much lower than the ratio found in sewage, considered to be the major source of nutrients entering the lagoon, but this is not uncommon in eutrophic waters as algae and plants absorb nitrogen in larger amounts than phosphate; the low soluble nitrogen concentrations possibly reflect the level of assimilation by algae. Phosphate levels of 0.03 mg/l are adequate to permit blooms of several algal species and concentration of 0.6 mg/l would sustain blooms of most types of algae. The soluble nitrogen levels are probably too low to sustain blooms of many algae but blue green algae do not require soluble nitrogen as they are able to utilize atmospheric nitrogen. Nitrogen concentration is not a reliable indicator of eutrophic potential.

2.14 Previously quoted figures for nutrients in the Sakumo lagoon are probably of little relevance without a knowledge of the volume of the lagoon and tidal water exchange. The concentration are likely to vary due to dilution at periods of high tide or high rainfall, and during periods of high algal activity.

2.15 BOD. The figures for BOD for lagoon water are not particularly relevant because of the influence of algae present in the samples. Filtered samples gave a soluble BOD of 5mg/l on 6th November, 1991.

2.16 Solids. The total dissolved solids measured on 18th November, 1991, were 21,300 mg/l. The suspended solids content is high and erratic due to the algae and suspended fine sand in the lagoon. Measured values ranged from 1200 mg/l to over 7000 mg/l.

2.17 Benthos. The upper Benthos layer was found to contain 1.36 mgP/gm, and its oxygen uptake was measured at 460 mgDO/m^2.d. This is equivalent to 1 mg/l oxygen uptake for the lagoon water and is surprisingly low. While the lagoon water at the time of the study was apparently innocuous, the bottom deposits appeared to contain significant quantities of organic matter. This possibly is derived from decomposing algal sediments but much could result from the flushing out of all the polluted surface water drains whenever there is rainfall. The low oxygen uptake tends to suggest that deposition may be seasonal and decomposition was well advanced when the samples was taken. Previous studies have indicated that there is little heavy metal pollution either in the water or the benthos of the lagoon.

C. Tidal Mixing

2.18 The tidal influx to the lagoon is not controlled by the culverts connecting the lagoon to the sea, but by a sand bar across the outlet end of the lagoon and the channel from the bar to the culverts. The twin 1800 mm dia concrete culverts under the road are in fair structural condition except at the discharge point where the invert of one culvert has been broken off and the other pipe is leaking. There are signs of superficial damage to the structure and the rock on which it was founded is being eroded away extensively. Hydraulically the structure currently offers some impedance to flow into the lagoon and the water level on the lagoon side may be assumed to be at most 0.08 m below tide level at spring high tides. During the rainy season the culvert severely restricts discharge to sea.

2.19 The meandering outlet channel is irregular in cross section and its route is unlikely to be stable. At an assessed length of some 180 m, the channel creates a hydraulic control on

the flow of water into the lagoon, but at low tide is unlikely to affect the discharge to sea as this will be controlled by the sand bar at the head of the channel. The discharge through the culvert was measured using floats on 6th November at low tide and was approximately 0.57 m3/s.

2.20 At high tide on 9th November the influx through the culvert was measured at 0.74 m3/s for a tide level of 1.58 m. A crude hydraulic assessment of the channel feeding to the culvert indicated a head loss along the channel of approximately 0.075 m. A comparative assessment of the tidal influence indicate that at a spring high tide of 1.91 m the maximum influx to the lagoon could be approximately 1.05 m^3/s. It is also assessed that there would be negligible tidal influx at tide levels below 1.50 m during the highest spring tides and below 1.40 m at neap tides when the lagoon level could be expected to be lower.

2.21 Over the tidal cycle at spring tides inflow could be expected for 5-1/4 h per tidal cycle giving an approximate influx of 23000 m^3. This would raise the level in the lagoon by approximately 25 mm and increase the surface area of the water by some 3 m along the western side of the lagoon. Observation of the shoreline adjacent to the golf club confirm a tidal variation in lagoon water levels of this order during spring tides. It would appear that during spring tides the flux does not initially match the influx and there would be a gradual increase in the volume of the lagoon. It is estimated that the monthly total inflow is approximately 530,000 m^3 giving a tidal turn over of approximately 20 days.

D. Contributing Flows and Loads

2.22 An accurate assessment of the flows and loads entering the Sakumo lagoon is hampered by the fact that Pumping Station No. 1 is occasionally not operated. On 23rd October, 1991, a problem with the power supply necessitated discharging raw sewage into the lagoon and on 18th November, 1991, the station had been closed down completely (and unnecessarily) while one pump was being repaired. It is not known how frequent such occurrences are.

2.23 The three major flows into the lagoon were monitored over 6th and 7th November, 1991. Three samples were taken on 7th November from surface water drainage channels (Western Drain from Area 5, point D and Mid Western Drain from Area 10, point E) and a single sample from the drain from the Ashaiman settlement, point F. An assessment of the flow was made at each point to enable an estimate of the contributing pollution loads to be made. It should be noted that the flows were made using floats over a relatively uniform section of the drains and an existing concrete on another. The absolute accuracy cannot be guaranteed but the flows are considered to be reliable enough to enable mean balances of loads to be assessed. The average flows past each point over the day of the sampling were estimated to be: point D 29 l/s point E 65 l/s point F 86 l/s a total of 180 l/s. This would indicate a retention period in the lagoon of some 22 d, ignoring tidal effects and evaporation.

2.24 Over the same period the quantity of orthophosphate entering the lagoon from these sources was approximately 22.3 kg/d as P ammonia was 189 kg/d as N, and nitrate was 3 kg/d as N. On 18th November orthophosphate and total phosphate entering from the two drains discharging from Tema (points D and E) were computed to be 6.3 and 41 kg

respectively. The orthophosphate levels were much lower than previously measured but the algal content of the flows was noticeably higher. The best estimate of total phosphorus entering the lagoon is 50 kg/d.

2.25 The current continuous areal loading of phosphorus into the lagoon is estimated to be of the order of 15.5 g/m^2.a. This is very high for a shallow lagoon and would normally be associated with eutrophic conditions. The mean residence time in the lagoon, taking into account tidal exchange, is approximately 10 to 11 days. Ignoring benthic phosphorus transfer and periodic rainfall loadings, the steady state phosphorus concentration should be of the order of 1.5 mg/l. However because of assimilation by algae the orthophosphate levels would be lower than total phosphorus. The measured concentration of phosphorus is much lower than the loading would suggest. Significant quantities must be assimilated by macrophytes in the margin of the lagoon and by precipitation in the lagoon. Fish would also account for a small reduction in phosphorus levels.

2.26 The measurement of BOD was hampered by the presence of algae in the samples from the drains but a best estimate made on 18th November, 1991, was 660 kg/d from points D and E. However an estimated load of 2300 kg/d was also entering from Pumping Station No. 1.

2.27 An allowance of 10 percent of the measured loadings is considered adequate to account for sullage water and minor flows into the lagoon. It should be noted that the effluent from the two large septic tanks in Areas 10 and 11 is used for irrigation and little if, any, reaches the lagoon. The measured loads do not account for settleable solids which are deposited along all the surface water drains feeding into the lagoon nor do they account for cess pool and septic tank sludges which are currently deposited along the banks of the drain from Ashaiman. During heavy rainfall, considerable amounts of septic sludge could be resuspended and washed into the lagoon.

2.28 Taking into account settlement of organic matter in the drains, reduction of soluble BOD during transit in the drains and assuming a low per capita phosphorus discharge it appears that the sewage from a contributing population of approximately 30,000 is entering the drainage system discharging into the lagoon from Tema.

2.29 In addition to the flows entering the lagoon in dry weather on the rainy season it can be expected that significant quantities of deposited organic matter would be resuspended and carried into the lagoon along with the normal sediment load from the catchment. The latter has been estimated at 6000 T/a.

2.30 The shoreline of the lagoon in the vicinity of the golf club is covered by skeletal remains of marine molluscs indicating a diverse benthic fauna some time in the past. This is in direct contrast to the present time as researchers report finding no molluscs over large parts of the lagoon. Fresh shells of one species indicated that there are molluscs in the lagoon but no great variety. There must also be food of some type for the waders. The lagoon benthos does not appear to be totally devoid of life but the lack of diversity of life forms is an indication of an ecologically stressed environment. The water supports a healthy fish population but one species of tilapia appears to predominate. Previous work has also indicated that at times the algal population has been restricted to one species only, again indicating an undesirable situation. Thus, the lagoon is unable to support a healthy diverse

ecology which, it appears, used to be the case. It is assumed that the transition took place as a consequence of closing the natural outlet to the sea and restricting the tidal movement.

III. REVIEW OF TEMA SEWERAGE REHABILITATION PROPOSALS

A. Outline of Proposals

3.1 The original design of the Tema sewerage system incorporated three pumping stations ultimately discharging through a syphon to a long sea outfall some distance to the east of Tema fishing harbor. A balancing tank was provided at the head of the outfall to store flows in excess of the capacity of the outfall until they could be discharged. The Watertech design proposals for rehabilitation of the sewerage system account for the much greater flows which will pertain when the sewerage system is renovated. The design report states that the capacity of the outfall is only adequate for gravity flows from East Tema up to 1990 and all flows from West Tema shall be conveyed separately for treatment and disposal.

3.2 The design proposals envisage that Pumping Station No. 3 would be renovated to pump increased flows to the outfall which itself would be repaired where broken and rehabilitated together with the balancing tank. Pumping Stations Nos. 1 and 2 would likewise be renovated but with new pumping mains laid to convey almost all sewage from West Tema to a new treatment facility situated at the edge of the Sakumo lagoon, with effluent being discharged into the lagoon. All flows which currently drain to the two communal septic tanks in communities 11 and 12 would continue to do so in future. Additional proposals included the concrete lining of several unlined surface water drains and general improvements to surface drainage in Tema.

B. Treatment Works Performance Predictions

3.3 Removal of Organic Matter (BOD). The latest design is based upon the following parameters for 2005 adopted by Watertech.

Population equivalent	163 500	- 1
Per capita BOD	0.050 kg/h.d	- 1
BOD load	8175 kg/d	- 2,3
Per capita flow	139 l/h.d	- 4
Infiltration	3880 m^3/d	- 2
Dry flow weather	26616 m^3 d	- 3
Design temperature	25 °C	- 2
First series ponds capacity	87516 m^3 for 2 Nos.	- 3
First series ponds area	2.50 ha	- 3
Second stage ponds capacity	24080 m^3 for 1 No.	- 3
Second stage ponds area	1.25 ha	- 3
Facultative/Maturation ponds capacity	169 870 m^3 for 4 Nos.	- 3
Facultative/Maturation ponds area	9.43 ha	- 3

Notes: 1. Stated in letter of 16th May, 1991
2. Stated in calculation appended to letter of 16th May, 1991
3. Stated in design calculations disclosed 25th October, 1991
4. Inferred

3.4 The above pond sizes were queried as they do not comply with the original design statement with respect to water depth, nor does the phasing of development appeared logical as the second stage pond is apparently the same size as the first stage pond but operated at half depth. It was confirmed that the calculation sheet was in error and that the aerated lagoon depth should have been 3 m, not 4.5 as implied. It was also confirmed that current proposals include for one aerated lagoon initially with two similar sized lagoon operating as facultative ponds at 2 m depth. The intention is that as the flow builds up and aerated lagoons are demonstrated to be effective, the other two would be converted to aerated lagoons. The anaerobic ponds were only considered to demonstrate that should the aeration plant fail, then the aerated lagoon would function satisfactorily as anaerobic ponds, as a temporary measure.

3.5 Assessments of the performance of the works have been carried out for 2005 flows and loads for the following options for first stage treatment:

(a) three anaerobic ponds;
(b) two anaerobic and one facultative pond for 10 percent of the flow;
(c) three aerated lagoons; and
(d) two aerated lagoons plus one facultative pond for 10 percent of the flow.

It should be noted that the depths of these ponds has been corrected to 3 m.

3.6 The assessments indicate that the aerated lagoons should produce a marginally better effluent quality in terms of soluble BOD than would anaerobic ponds. They also show that the use of one of the first stage ponds as a facultative pond is a sensible concept with the use

of aerated lagoons. The effluent quality would be marginally worse but the savings in investment costs and operating costs would be significant. The effluent BOD predicted for each of the four options is:

(a) 15 mg/l
(b) 15 mg/l
(c) 10 mg/l
(d) 15 mg/l

3.7 There is little to choose between either anaerobic ponds or aerated lagoons in terms of performance as the actual quality of the effluent discharged will be influenced to a great extent by the algal population in the final lagoon. The BOD strengths determined above would be representative of the soluble BOD of the effluent. With algae present the total BOD is likely to be of the order of 50 to 75 mg/l. These predictions are similar to those quoted by Watertech (11.9 mg/1 BOD, following anaerobic treatment and 10.1 mg/1 following aeration) although no statement was made of the BOD contributed by the algae.

3.8 Removal of Pathogenic Bacteria. Oxidation ponds are effective in removing pathogenic bacteria, viruses and ova of parasitic worms. Inactivation is by a combination of settlement and the effects of UV light and elevated pH values. The pond system as designed if operated in a series of 4 stages should remove over 99.99 percent of coliform bacteria and a similar percentage of other pathogenic bacteria. With an average feed containing 1.5×10^8 E coli/100 ml, the effluent could be expected to contain approximately 6300 E coli/100 ml. The figure compares with an E. coli count measured at 1.0 x 106/100 ml within the Sakumo lagoon, and predicted to lie within a range of 0.5 to 1.5×10^6/100 ml.

3.9 Nutrient Removal. With respect to nutrient removal the performance of the pond system is more difficult to predict. Reports of up to 45 percent phosphorus removal have been noted for pond system removing over 90 percent BOD. The principle mechanism of removal appears to be precipitation and accumulation as mineralized phosphate. Precipitation may be via algal body mass or as calcium phosphate at the elevated pH levels found in the ponds during daylight. In the case of the Sakumo treatment plant a removal of 30 percent might be a realistic figure to adopt for the purpose of assessing eutrophic effects on the lagoon. This equates to a phosphorus load of 230 kg/d assuming a per capita contribution of 2 g/d. Nitrogen removal is predominantly by precipitation of organic nitrogen and volatilization of ammonia in facultative and maturation ponds during periods of elevated pH levels. Removal predictions are not easy but up to 80 percent removal has been recorded in well operated plants and at least 50 percent removal could be expected.

3.10 Whatever type of treatment ponds are adopted there will be a need to remove sludge from them regularly but infrequently. With aerated lagoons, the sludge produced would tend to settle out in the first of the facultative ponds which would need to be desludged every few years. If anaerobic ponds were to be used, it is likely that each anaerobic pond would need desludging every 4-1/2 years. It is unlikely that the facultative or maturation ponds would need desludging but if they did, it would probably be at over ten year intervals.

C. East Tema Sewage Disposal

3.11 The Detailed Design Report quotes the capacity of the outfall as being 305 l/s using a Manning n of 0.015. This capacity is actually below the average flow predicted for pumping station No. 3 in 1990 (336 l/s) but the report states that there is capacity in the balancing tank to permit, discharge over the day as with a head over the bell mouth and at low tide the discharge can exceed 305 l/s by a significant amount. The hydraulics have been checked and are essentially correct for the assumption made. However, it will be difficult to achieve a roughness coefficient of 4.5 mm which is equivalent to a Manning n of 0.015. A fully mature and otherwise clean concrete main operating at a velocity of 0.8 m/s could be expected to have a ks value of 3.0 mm. It is to be expected that an outfall with no non-return value at the outlet will always suffer to some extent from sand and mollusc intrusion along the saline wedge which is likely to form at the pipe outlet. The outfall should have a capacity of 345 l/s after renovation with the balancing tank operating at a TWL of 7.54 m.

3.12 Although there is no mention in the report of recommendation for post 1990 flows, calculations are presented which indicate that a new 900 dia outfall is required to duplicate the renovated outfall to meet 2005 flows. However, this may not be strictly necessary. The capacity of the existing outfall may be increased by pumping through it. The original concrete coated steel pipe should be able to sustain a reasonable pressure head, though details of the pipe section are not available. If the pipe could be thoroughly cleaned, a working pressure of less than 1.5 bar would permit discharge to sea of up to 950 r/s. Arrangements could be made to permit gravity discharge when the pumps are not in operation.

3.13 If the outfall after renovation could not be operated to pass 950 l/s if would be possible to use a flow balancing tank to reduce the peak flow to approximately 800 l/s (1.23 x average predicted flow) but if the renovated outfall could not pass this flow then it is unlikely to be cost effective to provide a duplicate pipe for the short fall only. The material cost of an outfall is a small part of the total cost and it would be worthwhile considering installing a larger pipe fitted with non-return diffuser outlets to cater for flows beyond 2005. The use of a larger outfall to cater for all Tema sewage has already been discounted on cost grounds in the Detailed Design Report.

3.14 The problem with the disposal of the sewage from East Tema is inextricably linked to the condition of the outfall and the potential for effective renovation. Should it not be possible to repair the outfall beyond the break point, then consideration could be given to installing a treatment works and discharging the treated effluent down the outfall to discharge at the break point, which should be suitably modified.

IV. THE FUTURE PROSPECTS FOR THE SAKUMO LAGOON

A. Impact of the Treatment Works

4.1 The projected nutrient load in the effluent from the proposed treatment works (230 kg P/d) is significantly greater than that currently entering the lagoon outside the rainy season (50 kg P/d). It is certain that the discharge of the effluent into the lagoon could sustain a much greater algal population than currently possible, and probably would. It is also highly probable that there would be an increase in deposition of organic matter in the lagoon with a consequent depression of the dissolved oxygen levels at the bottom of the lagoon. The retention time in the lagoon would be reduced because of the greater inflow of effluent but this would be inadequate to mitigate the situation to a significant extent. Under present circumstances, the discharge of effluent into the lagoon would be detrimental to the ecology of the lagoon, and the risk of periodic oxygen depletion and resulting fish kills would have to be considered to be high.

4.2 The treatment works proposed would be screened by trees and because of the flat terrain, would not impose visually on the environment. Odor production should not be a problem with a well operating treatment works of the type envisaged. With anaerobic ponds there is a potential problem of odor if the surface scum layer which normally builds up quite readily, is removed or destroyed. This could happen with long lagoons with their axis along the direction of the prevailing wind. With careful siting of anaerobic ponds, as remote from residential properties as possible, the potential problems may be minimized. Straw may be used to provide a scum layer if the natural one is lost. Sludge dredging and drying should not give rise to odor problems provided that the sludge is fully stable when removed. On an anticipated cycle of 4 years this would be the case. During sludge disposal operations there would be a significant volume of traffic to and from site. This could create a nuisance when passing through residential areas. Restrictions on working hours should be considered with no heavy vehicles operating before 0800 h nor later than 1800 h.

B. Effluent Discharge

4.3 There are three options for the discharge of effluent from the treatment works;

- balance the flow and discharge on the ebb tide into the lagoon outlet;
- discharge the effluent onto the foreshore; and
- discharge the effluent beyond the surf zone.

4.4 The predicted effluent quality of approximately 6300 coliform bacteria per 100 ml compares with coliform count of 1×10^6 per 100 ml found in a single sample at the lagoon outlet. This would be of the order of magnitude expected from a single pond of 10 days retention allowing for tidal dilution, i.e., 98.9 percent removal from an input of 1×10^9 coliform /100 ml. The bacteriological effluent quality from the treatment plant is expected to be better than that of the lagoon water in which fishermen currently wade. The discharge of

effluent to the foreshore should pose less of a health risk to the fishermen than they currently experience, providing that sewage is not permitted to bypass the treatment works.

4.5 The discharge of fresh water into the sea will usually form a visible slick if not adequately diluted. However, in the wave surf zone this will not be noticeable. There is no need to discharge the treated effluent beyond the surf zone and a channel or pipe to beyond the low water line will be satisfactory.

C. Recommendations

4.6 Effluent Discharge. The effluent from the proposed Tema sewage treatment works should be discharged to sea into the surf zone as close inshore as can be practically accomplished. The outfall design should be reviewed with a view to raising the invert level of the outfall to minimize its length, and the route should be revised to increase cover over the pipe and avoid laying through the lagoon.

4.13 Study of Hydrology. Increasing the tidal influence on the lagoon might benefit the ecology of the lagoon as it would increase the inter-tidal zone, flush out nutrients and pollutants more rapidly and provide easier access for breeding sea fish. Hydraulic dredging could be one option for increasing tidal influence, but it is recommended that a study be undertaken to examine the effects of dredging to lower the bed of the lagoon and increase the size of the tidal channel.

4.14 Tema Resewerage Scheme. Consideration should be given to constructing at least one anaerobic pond of 4.5 m depth. It is known that the tender documents are almost finalized for 3 m deep ponds, one of which is to be fitted with aerators. It is considered that anaerobic ponds would be much more cost effective and if operated correctly should not cause an odor nuisance.

4.15 The need for sludge removal should be reviewed as it appears that no such facilities have been provided. The existing outfall should be re-examined to determine the feasibility of renovation and to confirm that corrosion of the outfall pipe is not severe. Provided that the outfall is sound and may be renovated consideration should be given to augmenting its capacity by pumping to sea.

D. Cost Estimates

4.16 The costs of works to discharge treated effluent in the surf zone are summarized below. They are additional to those already included in the cost of the sewage treatment works.

4.17 Land Pipeline. 900 m long, 900 mm diameter reinforced concrete pipe across former salt works, across railway and road to foreshore.

	Cost $'000	Foreign Exchange
Pipe supply	70	15%
Trenching and laying	7	55%
Chambers	5	15%
Re-installment	5	10%

4.18 Marine Outfall. 100 m long, 900 mm diameter GRP pipe surrounded in mass concrete, laid in trench in rock

	Cost $'000	Foreign Exchange
Pipe supply	30	95%
Trenching and laying	56	5%
Temporary works	140	15%
Design and Supervision	17	0%
Total	363	

Recurrent costs are not included as they are assumed to be included in the operating cost for the treatment works.

4.19 Hydrological Study. The study and outline design of any modifications to the outlet would be undertaken by an internationally recruited engineer with support from a local consultant who would continue with the detailed design and contract documentation.

	Cost $'000	Foreign Exchange
Engineer (2 months)	30	100%
Local consultant (6 man months)	15	0%
Total	45	

E. Cost Benefits

4.20 Relocating the effluent discharge point to the foreshore will benefit the local fishing activities as the quality of the lagoon water will not deteriorate and could improve. It is estimated that for eight months of the year, for five days per week approximately 40 fishermen regularly fish in the lagoon. Based on a catch value of ¢1400 per day per fisherman, net of outlay for equipment, the value of the fishing equals to ¢9.7 M/a. It is unlikely that all fish would be completely killed off by discharging effluent to the lagoon but

fishing could become uneconomic because of reduced and erratic yields. Assuming that 75 percent of the fishing industry would be lost, the discounted loss over 20 years at 10 percent discount rate would equate to ¢61.9 M, i.e., $165000.

4.21 The cost of the outfall is likely to be less than $360,000 as it should be possible to reduce the length of the sea outfall by careful redesign of the treatment works hydraulics. It is apparent that only a small value need be given to the benefit of maintaining, or improving, the ecology of the lagoon and retaining the lagoon as a habitat for birds for the relocation of the effluent discharge pipeline from the treatment works to have a positive benefit cost ratio.

4.22 As an alternative to relocating the point of discharge away from the lagoon, the phosphorus could be removed from the sewage effluent either by using a more sophisticated form of treatment of by treating the effluent with chemicals. Both of these options would increase the capital cost of the treatment plant more than the relocation of the outfall. The operating costs would be high, probably over $175,000 per year for chemicals and power for chemical treatment and sludge disposal. Relocating the effluent discharge point is the most cost effective way of preventing the effluent of the proposed sewage treatment works causing further serious degradation of the Sakumo lagoon.

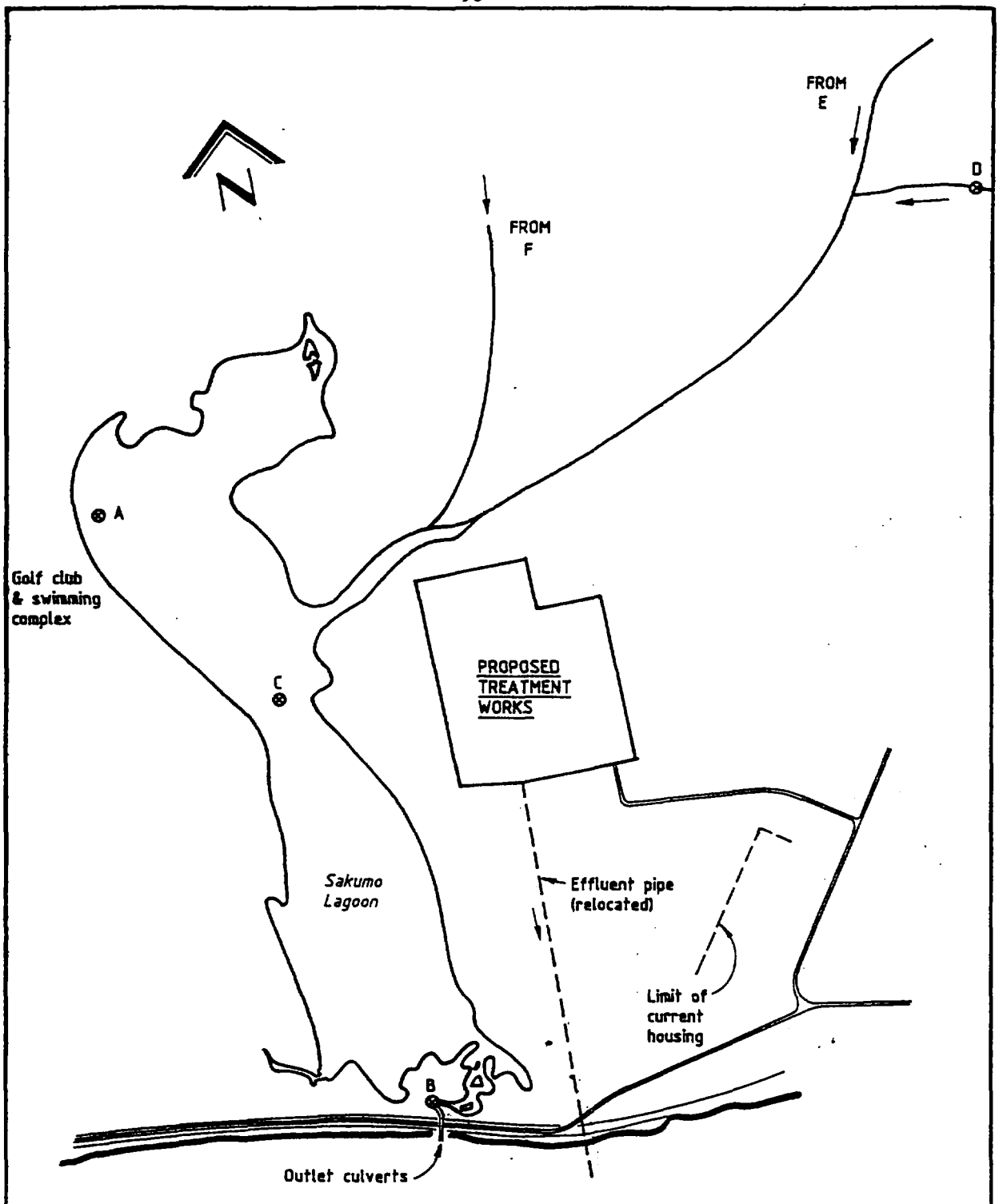

Fig. 1 Plan of Sakumo Lagoon
Showing survey sample points
1 : 12500

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Sakumo Lagoon
Effluent Disposal and Hydrological Studies

Analytical Results

TABLE 1. SAMPLES TAKEN ON OCTOBER 30, 1991, FROM SAKUMO LAGOON

Sample Location	Time	pH	DO	PO_4-P	NH_3-N	NO_3-N
A	10.15	9.2	10.6	0.06	0.00	0.14
A	12.50	9.2	13.0	-	-	-
A	15.40	8.8	5.1	0.05	0.00	0.14
B	11.15	8.2	9.0	0.27	0.06	0.08
B	14.00	8.85	15.2	-	-	-
B	15.55	9.0	10.9	0.25	0.06	0.11
B	19.00	8.9	6.4	-	-	-
C	10.40	9.4	13.6	0.62	0.00	0.14
C	13.10	9.4	14.7	-	-	-
C	15.30	9.2	9.1	0.62	0.00	0.14
C	18.20	8.6	1.6	-	-	-

Notes:

1 High tide was 1.48 m GPHA datum at 0901. At 1015, the tide was on the ebb and flow was passing out of the lagoon but it is estimated that some tidal inflow had taken place.

2 BOD results were invalid due to excessive oxygen uptake. All BOD values of unfiltered samples exceeded 9 mg/l.

3 Samples were analyzed for suspended solids and total dissolved solids but the results were rejected.

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Analytical Results

TABLE 2. SAMPLES TAKEN FROM DRAINS FEEDING INTO SAKUMO LAGOON AND THE SEA, NOVEMBER 6-7, 1991

Sample Location	Time	Date	PO_{4-P} (mg/l)	NH_3-N (mg/l)	NO_3-N (mg/l)	Filtered BOD (mg/l)	Estimated Flow -
D	16.30	6.11	0.79	2.66	2.16		
D	09.15	7.11	2.64	2.16	0.06		31
D	12.00	6.11	1.46	2.56	0.30		27
D	15.35	7.11	0.86	3.26	0.00		29
E	15.46	7.11	1.98	1.96	0.03		-
E	10.00	6.11	2.86	2.36	0.08		73
E	12.30	7.11	2.60	2.66	0.06		66
E	16.00	7.11	1.21	2.16	0.03		55
F	17.10	7.11	0.60	2.76	0.25	4	86
F	16.30	7.11	0.78	2.67	0.03		-
A	15.00	6.11	0.03	0.00	0.014	4	
C	15.30	6.11	0.03	0.00	0.014	6	
SEA	16.00	6.11	0.00	0.00	0.002		

Notes: Bod results on the samples from the drains (location D, E and F) ranged from 220 to over 700 mg/l and were rejected.

Observations: Samples from D and E were in appearance very much more turbid than samples from F which were clear. The flows past points D and E contained finely divided solids and agglomerations of algae but no noticeable faecal matter. The beds of both drains were heavily silted. Where dry, the silt/sand was sandy colored but it was black under the dry crust.

A sample of bottom mud from the edge of the lagoon adjacent point C contained 1.36 mg P/g and had an approximate oxygen uptake of 480 mg/m^2.d as measured in a 750 ml capacity bottle. The sediment was initially disturbed but left sumberged overnight before testing.

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Analytical Results

TABLE 3. SAMPLES TAKEN FROM THE DRAINS FEEDING INTO SAKUMO LAGOON, AND THE LAGOON, NOVEMBER 18, 1991.

Sample Location	Time Taken	PO4-P (mg/l)	TOTAL-P (mg/l)	TDS (mg/l)	BOD (mg/l)	FLOW (l/s)
B	10.50	0.04	0.06	21300	-	-
D_a	11.30	0.67	3.70	160	125	13
D^b	11.40	1.14	1.20	920	30	19
D^d	11.50	1.40	-	580	210	130
E	13.30	0.83	5.50	500	75	73

Note: Pumping Station No. 1 was inoperative and sewage was flowing into the drain from where previous samples had been taken. Samples were taken upstream of the confluence of the two drains D_a and D_b and also from PS No. 1 bypass manhole, D_c.

Observations: Sample B was very green - more so than on previous occasions. Sample D_a was stronger than D_b, which was fairly clear with occasional gross solids and algal clumps. Sample D_c was a pale straw odor and contained no gross solids. It is presumed that these had been removed by settlement in the surcharged sewerage system. The sample was not typical of raw sewage but probably was typical of settled sewage.

The total flow past sample point D was assessed very crudely and the flows past sample points D_a and D_b subtracted to obtain the flow of sewage from D_c.

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Treatment Performance Predictions

A. *Operation of Anaerobic Ponds*

	(i) for 100% Flow	(ii) for 90% Flow
First Stage Anaerobic Ponds:		
Average flow (105% dwf) (m^3/d)	28000	25200
Retention (d)	4.60	3.47
Expected BOD reduction (%)	78	74% +
Effluent BOD (kg/d)	1799	1913
Effluent BOD (mg/l)	64	76
First Stage Facultative Ponds:		
Areal loading (kg BOD/ha d)	-	440 *
Expected BOD reduction (kg BOD/ha d)	-	330
Residual BOD (kg/d)	-	110
Second State Ponds:		
Total BOD to facultative ponds/maturation ponds (kg BOD/d)	1799	2323
Area of ponds (ha)	9.43	9.43
Areal loading (kg BOD/ha d)	191	215
Anticipated removal (kg BOD/ha d)	149	190
Residual BOD (kg/d)	396	538
Residual BOD (mg/l)	14	19

\+ Based upon work by J.P. Arthur (1982) IBRF Technical Notes

* At 25°C the normal design loading limit would be given by Lm = 20T - 60, i.e., 440 kg/ha d. The ponds are adequately sized for this duty.

B. *Operation of Aerated Lagoons.*

First Stage Aerated Lagoons:		
BOD load (kg BOD/d)	1875	7358
Retention (d)	4.60	3.47
Residual (%)	17	22
Residual BOD (kg/d)	1390	1619
First Stage Facultative ponds:		
Facultative ponds as before residual BOD (kg/d)	-	110
BOD onto facultative ponds/maturation ponds (kg BOD/d)	1390	1729
Loading (kg BOD/ha d)	147	183
Anticipated removal (kg BOD/ha d)	117	143
Residual soluble BOD (kg/d)	203	377
Residual soluble BOD (mg/l)	10	13

In four stage ponds the removal of faecal coliform bacteria is taken to be in accordance with the following:

$$Ne = \frac{Ni}{(KtR1+1)\ (Kt\ R2+1)\ (KtR3+1)\ (KtR4+1)}$$

where Ni, Ne are concentrations of faecal coliform bacteria in the influent and effluent
R1, R2 are the retention times in days in ponds 1 and 2.

Kt is the die-off coefficient for coliform bacteria
Reported values of Kt for E. coli range from:
$Kt = 2.0\ (1.0\ 72)^{T-20}$
to $Kt = 2.6\ (1.9)^{T-20}$

A mid range value of Kt = 4.5 at 25° has been adopted.

The layout proposed by Watertech would be initially aerobic or anaerobic ponds; facultative pond 1, facultative pond 2; facultative ponds 3+4.

The areas of facultative ponds 1 to 4 as presented in calculations are 2.39 ha; 3.65 ha; and 1.41 ha each for ponds 3 and 4 with corresponding retention times of 1.7 d; 2.6 d; and 2.0 d.

Assuming all three first stage ponds are operated in parallel (not actually stated by Watertech but inferred from site layout), the retention period in the these ponds would be 4.6 days.

The reduction in coliform bacteria would be approximately:

$$\frac{Ne}{Ni} = 4.2 \times 10^{-5}$$

i.e.: almost 99.996 % removal.
For Ni = 1.5×10^8/100 ml
Ne = 6300/100 ml

Within the Sakumo lagoon the bacterial die off or removal is affected by the tidal dilution and by the retention period of 10 days. The removal of coliform bacteria should be approximately:

$$Ne = \frac{Ni}{2(Kt\ R1\ +1)}$$

For Kt = 4.5 at 25° C, Ri = 9d, Ne = 0.012 Ni

For an E. coli concentration of 1.5×10^8/1000 ml in the surface water drains, and a lower concentration in the drain from Achaiman, the concentration in the lagoon in the dry season could reasonably be expected to vary from 0.5 to 1.5×10^6 E coli/100 ml depending upon the tidal cycle. This is of the same order of magnitude as the E.coli concentration in lagoon water found by Watertech in 1991, 1.0×10^6/100 ml.

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Cost Estimates

A. *Effluent Discharge Pipeline*

The additional pipeline required is 900 m of 900 mm dia RC pipe to shoreline plus a max of 100 m 900 dia outfall pipe to sea. It may be possible to reduce the outfall to sea by redesigning the pond hydraulics. A 100 m long sea outfall has been costed as a worst case scenario.

Consider 1180 m pipe across open ground, 20 m across road and railway to outfall chamber. Average depth from Watertech design was less than 2.0 m. Assume relaid in higer ground to give greater cover and permit raising of invert if possible. Allow 3.0 m max excavation, 2.5 m average, except at roads. Allow 3.5 at road and backfilling over 200 m pipeline to increase cover.

Unit Costs:

900 dia RC pipe delivered to site	¢25,000/m
Trench excavation and backfill	600/m^3
Pipe laying assuming craneage by excavator	20,000/m
Road reinstalment; EO 20 m	25,000/m
Additional embankment over pipeline for 200 m	7,000/m

Excavation Costs:

For 1.8m wide trench, vertical sides to 1.5m, battered above, with 0.3m overdig, excavations are:

Depth to invert -	2.0 m, excavation	= 4.6 m^3/m
	2.5 m,	= 6.5 m^3/m
	3.6 m,	= 11.7 m^3/m

Cost of Chambers - allow ¢250,000 ea.
Preliminaries to be added at 15%

Cost of pipeline on land				$1,000
Pipe supply	900 m	@	¢ 29,000/m say	70
Trenching	900 m	@	7,800/m say	20
Pipe laying	900 m	@	23,000/m	55
Road crossing	20 m	@	7,000/m	1
Chambers	7 Nos.	@	250,000/no. say	5
Reinstatement	200 m	@	7,000/m	

Sea outfall, 100 m of 900 mm dia pipe across rocky foreshore. Rock to be removed 1.2 max to 0.2 m, average 0.6 m. Trench width 1.6 m min. Pipe material could be polyethylene, GRP, mortar lined DI or steel. RC pipe not recommended due to possible chloride attack on pipe structure. DI and steel fairly heavy and must be protected from corrosion. GRP and MDPE ideal from long term degradation but must have a ballast coat.

The work would be probably carried out in a coffer dam possibly of rock with clay core or tarpaulin sheet water cut off, and two pumps to drain the workings. Blasting of the trench will be necessary and a nominal 200 mm concrete surround will be needed to the outfall pipe.

Unit Costs are based upon estimates prepared by Marine Construction Company Limited:

Temporary works:			¢'000
Armour rock bund, tarpaulin sheet sand bags etc.			42,500
Pumping			1,150
Access road			2,000
Excavate in rock	100 m^3	@ ¢ 2,500/m^3	250
Excavate in sand	100 m^3	@ 1,000/m^3	100
Provide GRP pipe + wastage	108 m	@ 90,600/m^3	9,785
Lay pipe	100 m	@ 12,000/m^3	1,200
Concrete ballast	90 m^3	@ 185,000/m^3	16,650
Add preliminaries at 15%			11,045
TOTAL			84,680

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COASTAL WETLANDS MANAGEMENT PROJECT

Sakumo Lagoon
Effluent Disposal and Hydrological Studies

Terms of Reference
for a Study for a New Outlet for the Sakumo Lagoon

Introduction

1. The Ghana Environmental Resource Management Project includes proposals for the management of five coastal wetlands which are of ecological significance particularly as habitats for migratory sea birds. The Sakumo Lagoon situated to the west of Tema is one of these wetland sites and is of special strategical significance because of its proximity to the urban populations of Tema and Accra.

2. The Sakumo Lagoon was formerly connected to the sea by a wide natural mouth. In 1957, the lagoon outlet was effectively closed by the construction of the coast road and rail line, and was replaced by two 1800 mm diameter culverts. Tidal interchange is inhibited and the discharge of flood water during the rainy season is severely restricted. Additionally, siltation of the lagoon is gradually reducing its capacity and the lagoon bed is now above mean sea level.

Terms of Reference

3. As part of the Environmental Resource Management Project, funds will be made available to finance a study to determine the most suitable methods of improving the lagoon outlet connection to the sea and of dredging the lagoon. The terms of reference are for consultants to examine the available options, make recommendations as to the most cost effective methods of achieving the desired improvements and prepare an environmental impact assessment of the preferred scheme. Detailed designs and contract documents will be required for the preferred scheme on approval of the study report and EIA.

4. The consultant will:

   - appraise existing reports on and studied of the hydrology of the lagoon and its catchment;

   - survey the lagoon, the existing outfalls and immediate coastline and prepare plans for design purposes;

- assess the requirements for a new lagoon outlet both in terms of tiday mixing and flood prevention;

- determine the need for dredging works to maintain the present minimum lagoon capacity for mean sea level condition;

- determine the most appropriate construction and dredging techniques and phasing of operations to minimize disruption to fishing operations in the lagoon;

- cost any options and determine the most cost beneficial scheme to achieve the desired objectives;

- carry out an environmental impact assessment of the preferred scheme;

- prepare a study report including costs recommendations and an outline design of the preferred scheme including relevant findings and calculations as appendices; and

- on receipt of a review appraisal of the report and the EIA, prepare a detailed design and tender documentation for the two contracts.

5. Qualification

The local consultant will employ a qualified engineer with a minimum of 15 years experience of the design and construction of hydraulic control structures to carry out the report preparation and outline design.

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Sakumo Lagoon
Effluent Disposal and Hydrological Studies

Previous Related Work

A. Tema Infrastructure Rehabilitation Project: Detailed Design Report. Watertech Consulting Engineers - August 1989.

This study considered the options for rehabilitating the Tema sewerage system. Originally all sewage was collected at three pumping stations. Pumping Stations 1 and 2 discharged to the catchment of Pumping Station 3 which in turn pumped to twin sewers discharging to a balancing tank and sea outfall.

Watertech assessed the capacity of the sea outfall and future sewage flows to the three pumping stations and concluded that the outfall, if repaired to its original state, would have only sufficient capacity to pass the flow from the natural catchment of Pumping Station 3 and that the flows to Pumping Stations 1 and 2 should be considered separately. They further concluded that sewage flows from Pumping Stations 1 and 2 should be treated in ponds prior to being discharged.

The report located the treatment works between the coast road to the Tema harbor and the road leading to Poduku, and considered that the effluent should be discharged to sea.

Several basic premise of the Watertech design cannot be verified, nor disproved, but if in error, the implication could be significant:

(a) The per capita sewage flow has been taken as 80% of gross per capita domestic water usage and no allowance has been made for losses in supply.

(b) The peaking factors determined are lower than commonly accepted elsewhere but have been adjusted to suit local experience.

For 2005 the population and peaking factors adopted are:

	Population	Peaking/Factor
PS No.1	145,500	1.47
PS No.2	17,800	2.97
PS No.3	46,300*	1.47

* Industrial flows are estimated to be 5.7 times the domestic flow.

(c) It is assumed that the existing sea outfall may be renovated and that its operating capacity is the gravity flow which it can pass.

(d) The design report stated that with aerated lagoons there would be no sludge production.

B. Environmental Study of Accra Metropolitan Area - Final Report. Environmental Management Associates Limited - December 1984.

The study report covers a large area which includes the Sakumo lagoon and Tema. There is little reference either to the Sakumo lagoon itself or to the urbanization within its catchment but mention is made of the water quality in the lagoon. It appears that limited survey work was carried out and data described are from a survey carried out in 1976. The lagoon water was stated as having the following pollution indicator characteristics:

BOD	12. 5 mg/l
NH_3 - N	0.15 mg/l
NO_3 - N	0.16 mg/l
PO_4 - P	0.08 mg/l

Metal concentrations in the lagoon were low and there was no indication of industrial pollution in the lagoon.

The report highlighted the coastal lagoons, including the Sakumo lagoon as being the most important natural areas to be protected from environmental decline.

C. Urban II Project - Tema Infrastructure Rehabilitation Project Report on Environmental Impact Assessment. Watertech Consulting Engineers - August 1991.

This report was prepared over 18 months after the original design report and the design philosophy has been restated as circumstances had changed since the submission of the original report. In particular the treatment works has been relocated to an area of the Sakumo basin between housing area 3 and the lagoon.

The report covers the design of the sewerage system and proposals for reinstatement works. These proposals are essentially as proposed in the original Detailed Design Report. The emphasis of the report is on the sewage treatment works, its performance and the impact of the discharge on the Sakumo lagoon.

The sewage treatment works proposed is stated as comprising:

- grit channels and measuring flumes;

- 3 Nos. aerated ponds (ultimately) each of 1.25 ha surface area and provided with 8 Nos. floating aerators;
- 4 Nos. facultative/maturation ponds with a total surface area of 8.08 ha; and ancillary facilities.

Space was reserved for the future provision of maturation ponds and two of the facultative ponds were identical to the aerated ponds and could presumably be provided with aerators in the future.

The effect of the project on the environment was stated to be beneficial as the effluent quality after treatment would be much less polluting than the raw sewage currently entering the lagoon. However no mass balance was carried out to demonstrate this.

The effluent quality predicted for the treatment works in 2005 was 10.1 mg/l BOD after maturation ponds following aerated ponds and 11.9 mg/l BOD after maturation ponds following anaerobic ponds. In both cases the total coliform count was predicted to be 6800/ml. The comparison of aerated and anaerobic ponds was made to demonstrate security of treatment in the event that the aerators in the former type of pond failed.

The report suggests two measure to reduce the impact of the treatment works on the ecosystem of the lagoon:

(a) construct additional maturation ponds to cater for one being decommissioned; and
(b) discharge the effluent into the surf zone.

The report considers that anaerobic ponds could be malodorous and tree screens were proposed as a means of reducing the impact of the treatment works on near by residential areas.

Additionally the report recommends that once the treatment works is constructed, sewer renovation works are commenced and the discharge of foul sewage to surface drains ceased. Without such action the beneficial effect of the treatment could be severely reduced.

D. Correspondence between the World Bank and Watertech

The population date and water consumption figures quoted in the detailed Design Report were queried by the World Bank in a letter of 18th April 1991.

The population data were presented by Watertech in a letter of 16th May 1991, in which the total water usage in Tema was justified. It appears however that the water consumption figures quoted are gross figures inclusive of water losses which if reduced would not affect net consumption as implied.

Other queries raised related to the loading on the facultative ponds, odor problems from the ponds, the use of anaerobic ponds in place of aerated lagoons and the bacteriological quality of the effluent.

Watertech consider that anaerobic ponds would give rise to odor problems and that there is an inadequate buffering zone between the works site and housing developments. They also considers that although aerated ponds are significantly more costly than stabilization ponds, they are more appropriate for the Tema situation.

E. Supplementary Design Report

In view of the changes which have occurred since the Detailed Design Report was prepared, Watertech consider that a Supplementary Design Report is required. This would be prepared on approval in principle of the original report. A summary sheet of the latest design figures was presented to the author by Watertech 23 October 1991, and is copied below.

The design has been carried out in order to be able to utilize the first stage ponds as either aerated lagoons or anaerobic ponds. The depth is not stated but it has been increased to 4.5 m from 3 m previously used.

The depth of the facultative ponds is not stated but by inference is approximately 2.0 m deep as previously allowed except that initially one of the future anaerobic ponds/aerated lagoons would be used as a deep facultative pond.

F. Accra Planning and Development Program - Coastal Management Plan for Accra - Draft Report, July, 1991.

With regard to the Sakumo lagoon the Plan envisages a new outlet to the sea to increase the capacity of the lagoon, to reduce flooding in the Sakumo basins and to improve sea water exchange. It is also recommended that the Tema Sewage Treatment Works and outfall should be relocated.

Development guidelines proposed include:

- any sewage treatment should be to at least secondary treatment level prior to discharge to any lagoon;
- there should be no beach discharge unless an Environmental Impact Assessment (EIA) has been approved by EPC;
- there should be no development within 150 m of the Densu delta and Sakumo lagoon;

- Proposals for significant dredging of coastal lagoons should be supported by an EIA.;

- minimum beach slopes are presented for lagoon dredging works; and

- discussions should be held with the lagoon Fetish Priest prior to any waste being discharged to a lagoon.

Scientific papers presented quote the per capita income from fishing to vary form ¢1183 to ¢1675/d and that from crabbing to be ¢494/d.

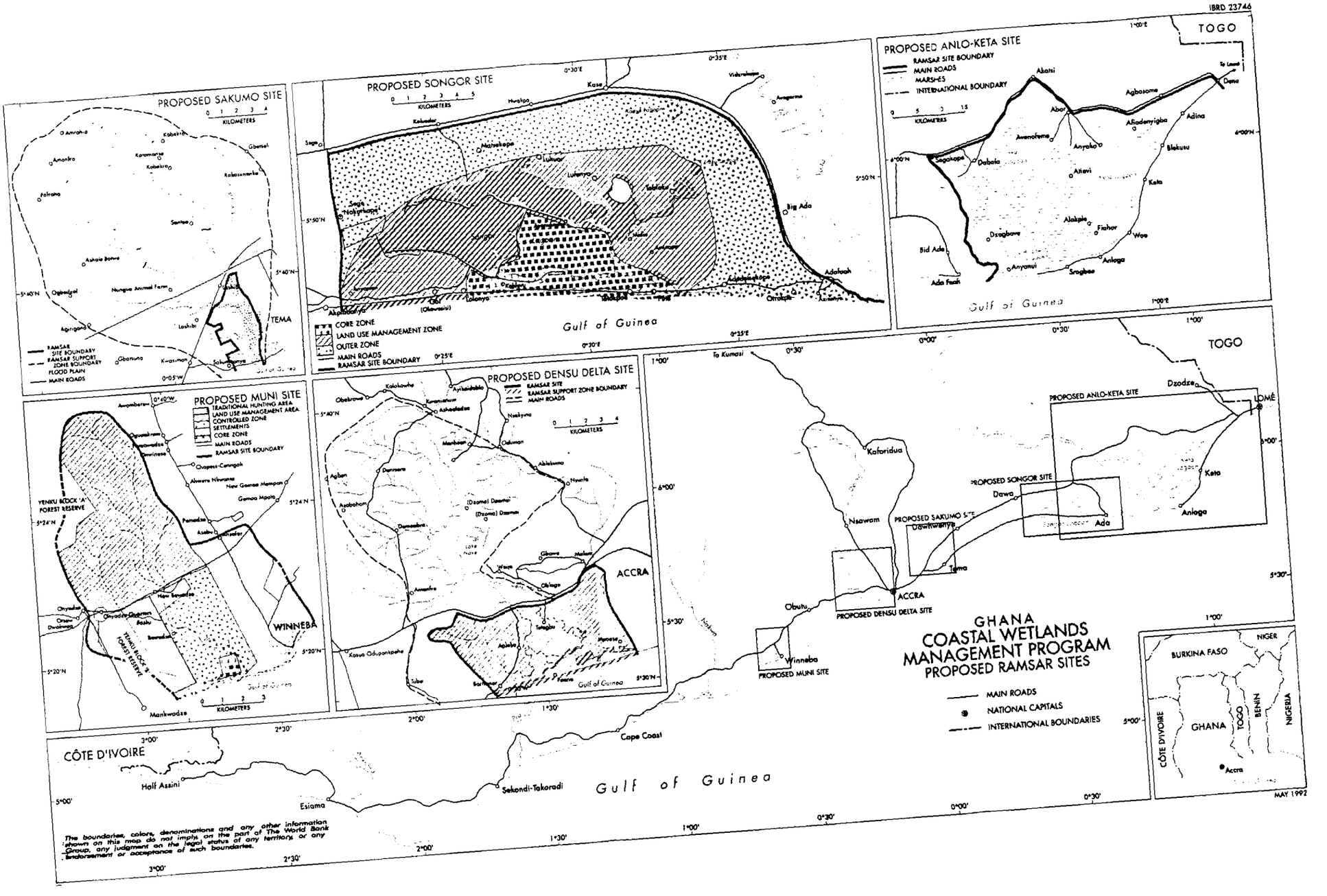
The catchment area is stated as 350 sq km of which 20% is urbanized. Annual rainfall is quoted at 770 mm/yr with an annual run off of 70 Mm^3 and an annual sediment load of 6000 T. The sediment damage potential is said to be serious.

G. Discussions with Dr. Yaa Ntiamoa-Baidu (University of Ghana, Legon) and Charles A. Biney (IAB).

Both Dr. Ntiamoa-Baidu and Mr. Biney confirm that there is very limited biota in the bottom deposits of the Sakumo Lagoon and that the bottom deposits have, for some time, been black with a typical sulphide odor. Both authorities also confirm that there are occasional very severe algal blooms in the lagoon, but as yet there have been no large fish kills as a result.

Dr. Ntiamoa-Baidu considers that the cesspool and septic tanker sludges unofficially dumped adjacent the drain feeding into the lagoon from Ashaiman have been washed into the lagoon during periods of heavy rainfall.

IBRD 23746



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