Gulf of Honduras
A Programme of the Governments of the Gulf of Honduras Countries, with the assistance of the Inter-American Development Bank

Gulf of Honduras

Preliminary Transboundary Diagnostic Analysis

Final Draft

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1.0 Introduction

1.1 TDA Content and Process

According to GEF guidance, the purpose of conducting a Transboundary Diagnostic Analysis (TDA) is to scale the relative importance of sources and causes, both immediate and root, of transboundary 'waters' problems, and to identify potential preventive and remedial actions. The TDA provides the basis for development of both the National Action Plans (NAPs) and the Strategic Action Programme (SAP) in the area of international waters of the GEF.

This TDA, therefore, summarizes information available from the region, gathered both as part of ongoing national activities within the littoral states, as well as information made available from a variety of internationally supported activities in the region.

The methodology for a TDA consists of the following steps, at a minimum:

- Identification of major perceived problems and issues, including status and gaps
- Classification as national or transboundary in nature
- Causal chain analysis (including root causes)

Because the list of possible interventions and actions arising from the analysis of the Gulf of Honduras problems is so large, a mechanism was needed in order to prioritize the interventions. Borrowing from methodology commonly used in the European Union and other regions, the present preliminary TDA identifies a series of draft Environmental Quality Objectives (EQOs), which represent the regional perspective of major goals for the regional environment. The use of EQOs helps to refine the TDA process by achieving consensus on the desired status of the Gulf of Honduras. Within each EQO (which is a broad policy-oriented statement), several draft specific targets were identified. Each target generally had a timeline associated with it, as well as a specific level of improvement or target status. Thus, the targets illustrate the chain of logic for eventual achievement of the EQO. Specific interventions or actions were identified in the Project Brief to permit realization of each of the targets within the designated time frame.

A prime purpose of the TDA is to determine priority Transboundary problems. EQOs and the entire TDA process may also specify more national problems or issues. Although these national issues are included in the TDA, they are identified as not having strong transboundary implications, and therefore will be of lesser concern to the GEF process.

In summary, this TDA follows the GEF TDA Guidelines for International Waters projects. An additional step was achieved, however, that is, the use of EQOs to facilitate consensus on the desired state of the Gulf of Honduras after the next pentade or decade. The EQOs naturally led to the identification of specific targets to be met within the desired time frame, which then led to the identification of specific interventions and actions that can be considered in the framework of the SAP. GEF interest will focus on those priority transboundary problems and issues.

1.2 Scope of the TDA

This TDA is being developed in support of the project for the environmental management of the Gulf of Honduras, "Environmental Protection and Maritime Transport Pollution Control in the Gulf of

Honduras," which has a primary focus on some of the major environmental problems and issues of the Gulf leading to the degradation of marine and coastal ecosystems by human activities. The present analysis covers the three countries that are located in the Gulf of Honduras: Belize, Guatemala and Honduras. The analysis focuses on prioritizing environmental stressors on the Gulf's coastal and marine ecosystems that are derived from pollution related to the maritime shipping industry in the region and land-based sources of pollution in the watershed.

This study is meant to complement the Threat and Root Cause Analysis developed by the World Bank/GEF/CCAD Project for the Conservation and Sustainable Use of the Mesoamerican Barrier Reef System (MBRS) which identified the tri-national area of the Gulf of Honduras as a critical area. In particular, port and ship-based pollution were recognized as significant threats to the health of the reef ecosystem and are consequently to be addressed by this complementary project. This project also complements the on-going UNDP/GEF Project for the Conservation and Sustainable Use of the Barrier Reef Complex in Belize.

Many institutions and experts from the Gulf of Honduras region participated in the development of this preliminary TDA. After the initial determination of stakeholders and interested parties was made, a public consultation process was developed to inform and incorporate the input from representative members of each of the target groups in the study area. Public consultations were conducted through a combination of regional workshops held in each of the three countries and individual meetings. One international stakeholders meeting was held on November 21, 2002 in San Pedro Sula, Honduras. A second meeting was held on March 20-21, 2003 in Guatemala City, Guatemala and a third stakeholder meeting is to be held on June 12-13, 2003 in Belize City, Belize.

The regional stakeholder advisory committee has had an important role in reviewing and providing comments on the development of this preliminary TDA. The stakeholder committee consists of approximately twenty-five members from representative national line agencies and municipal governments, merchant marines and naval authorities, port authorities, nongovernmental organizations, and industry from Guatemala, Honduras and Belize. Participation has been balanced to maintain a representative group of stakeholders from the three countries. The stakeholder committee has provided background data for this analysis, reviewed drafts of this document and provided information concerning perceptions of problems and challenges facing regulatory agencies, the regulated community and civil society organizations in the region.

While much data were obtained through this process, only partial information on the environmental status was provided by each country, so this TDA is a summary of available information only. Where possible, additional sources of data were sought.

The major sources of information are listed in the bibliography accompanying this TDA. Gaps in information available for this Preliminary TDA can be filled during the full GEF project when the TDA will be updated and completed.

Based on the early project development activities, as well as the regional consensus–building process, this Preliminary TDA identifies a single major perceived problem and issue for the Gulf of Honduras:

Degradation of Coastal and Marine Ecosystems

The following causes of the MPPI have been determined and are examined in detail in the following sections:

- Negative environmental effects arising from existing and future port operations and infrastructure development
- Negative environmental effects arising from marine activities
- Other Land-Based Activities (other than shipping-related) causing degradation of the ecosystems of the Gulf of Honduras

Below, each of these problems and issues is addressed from a status perspective. It answers the questions: What do we know about this problem/issue? What data support the quantification of the extent of the problem/issue? Do the data support these as real problems and issues, or just as perceptions? This analysis took place on a scientific level, including biological, hydrological, physical, social, and other perspectives on the problem. This is in effect the “status” assessment.

The next step was to perform the causal chain analysis; the major perceived problems and issues were analyzed to determine the primary, secondary, and root causes for these problems/issues. Identification of root causes is important because root causes tend to be more systemic and fundamental contributors to environmental degradation. Interventions and actions directed at the root causes tend to be more sustainable and effective than interventions directed at primary or secondary causes. Because the linkages between root causes and solutions of the perceived problems are often not clear to policymakers, however, interventions commonly are mistakenly directed at primary or secondary causes. This Preliminary TDA attempts to clarify the linkages between root causes and the major perceived problem to encourage interventions at this more sustainable level.

This Preliminary TDA faced several challenges in its preparation, including a lack of complete information and data, and a short time frame for its preparation.

2.0 Physical and Biogeochemical Setting

The Gulf of Honduras, bounded by Belize, Guatemala, and Honduras, covers an area of approximately 10,000 square kilometers (Figure 2.0-1). The Project Area for the proposed GEF project extends from Punta Sal, Punta Isopo, in the southeast, northwest towards Sittee Point along the Belize shoreline, inwards along the northern border of the Maya Mountains watershed, southwestward along the various watersheds of Belize (numerous watersheds, lumped here as the Maya Mountain watersheds), Guatemala (Sarstoon, Laguna Izabal, Motagua), and Honduras (Ulua, Lean, Cuyamel, Chamelecon), reaching the coast once again at Punta Isopo (Figure 2.0-2).

Figure 2.0-1. Gulf of Honduras Project Area
(See Appendix D)

Figure 2.0-2. Gulf of Honduras Watershed
(See Appendix D)

The Gulf of Honduras abuts the southwestern Caribbean Sea, having water depths of up to 2000 m. Its western portion is lined by the MesoAmerican Barrier Reef Complex, stretching along the waters of Belize into Guatemala. Inside the barrier reefs are shallow inner reef complexes, with many cays and shoals. Along the Guatemala region, the Gulf of Honduras includes the Bahía de Amatique, and the smaller bays of Graciosa and Santo Tomás de Castilla. Along the Honduras coast, the Gulf of Honduras includes the Bahia de Cortés adjacent to Puerto Cortés.

The Gulf of Honduras is influenced strongly by both open ocean (Caribbean Sea) dynamics, as well as reef-controlled dynamics, river inflow, sediment fluxes, and hurricane passage. Although located in a region having reasonably stable annual climate, a seasonal wet-season, dry season combines with ocean variability to impose scales of variability on the ecosystem. The complex interaction of open ocean waters, coastal multiple time ocean processes, and riverine flows is reflected in geographically-varying ecosystem components that contribute to the region's valuable ecological diversity.

Major coastal and marine ecosystem types along this region include river mouths with their estuaries, coastal lagoons, coastal embayments, inner cayes, mid-lagoon cayes, barrier reefs and the open ocean (Heyman and Kjerfve, 2000). Important coastal and marine resources include mangrove wetlands, seagrass beds, barrier reefs, shrimp, marine turtles (green, hawksbill, leatherback, and loggerhead) and manatees. Marine protected areas dot the coast, and include some dozen or more coastal and marine reserves and parks.

Approximately half a million people live along the coast of the Gulf of Honduras, whereas some 12.4 million people live in the adjacent watersheds. Major coastal population centers include Puerto Barrios and Livingston in Guatemala, San Pedro Sula and Puerto Cortés in Honduras, and Punta Gorda and Belize City in Belize. Shipping, bananas, fisheries (both subsistence and export), and tourism are major industries of the region.

2.1 Watershed

The watersheds of the Gulf of Honduras make up some 53,700 km^2, distributed with about 5,800 km^2 in Belize, 18,300 km^2 in Guatemala, and 29,600 km^2 in Honduras.

2.1.1 Drainage Basins

The Project Area within the Gulf of Honduras region is influenced by eight primary watersheds (Figure 2.0-2), whose total area is about 53,700 km^2 (Table 2.1-1). There are eighteen subsidiary watersheds in Belize (Table 2.1-2), three primary watersheds in Guatemala, and four primary watersheds in Honduras, within the project area. Numerous rivers drain each watershed, but the main rivers are the Sarstoon, Rio Dulce, Motagua, Chamelecon and Ulua.

Table 2.1-1. Major Watersheds of the Gulf of Honduras

Watershed Name	Countries	Watershed Area (km^2)	Major Rivers
Maya Mountains*	Belize	5,800	Sittee River, Swasey Branch, Rio Grande, Moho River
Sarstoon	Guatemala, Belize	2,218	Sarstoon River
Rio Dulce -- Laguna Izabal	Guatemala	3,435	Rio Dulce
Motagua	Guatemala, Honduras	12,670 (2,141 of which are in Honduras)	Motagua River, San Francisco River, Piteros River, Canal de los Ingleses
Chamelecon	Honduras	4,350	Chamelecon River
Cuyamel	Honduras	2,141	Motagua
Ulua	Honduras	21,230	Ulua River
Lean I	Honduras	3,045	Lean River

Table 2.1-2. Subsidiary Watersheds of Belize

Watershed Name	Watershed Area (km^2)	Major Rivers
Freshwater Creek	225	Freshwater, Black Ridge, and Silk Grass creeks
Sittee River	457	Sittee River and Cocoa, Pull Shoes, and Blackwater branches
Cabbage Haul Creek	104	Cabbage Haul Creek
South Stann Creek	261	Sittee, Cockscomb, Mexican and Juan branches of South Stann Creek
Santa Maria Creek	151	Santa Maria and Silver creeks
Mango Creek	250	Mango Creek
Big Creek	59	Big Creek
Sennis River	76	Sennis River
Pine Ridge Creek	40	Pine Ridge Creek
Monkey River	1,290	Monkey River
Freshwater Creek	138	Freshwater and Payne's creeks
Deep River	352	Big Dry Creek, Machaca Creek, Warrie Creek, and Deep River Channel
Golden Stream	206	Golden Stream
Middle River	51	Middle River and Seven Hills Creek
Rio Grande	727	Rio Grande and Columbia Branch
Moho River	822 (1,189 total)**	Moho River
Temash River	364 (475 total)**	Temash River system
Sarstoon River*	194 (2,218 total)**	Sarstoon River

*Shared by Guatemala and Belize
** unbracketed: drainage area in Belize; in parentheses --- total drainage basin area

2.1.2 River Discharge

Few discharge measurements have been made in the Caribbean watersheds of the Gulf of Honduras, and those that do exist are generally of short duration, some installed following Hurricane Mitch in 1998 in order to assist flood disaster planning and prevention. The major rivers are shown in Figure 2.1-1 and characteristics listed in Table 2.1-3.

Figure 2.1-1. Rivers in the Gulf of Honduras Watershed
(See Appendix D)

Table 2.1-3. Major Rivers Entering the Gulf of Honduras

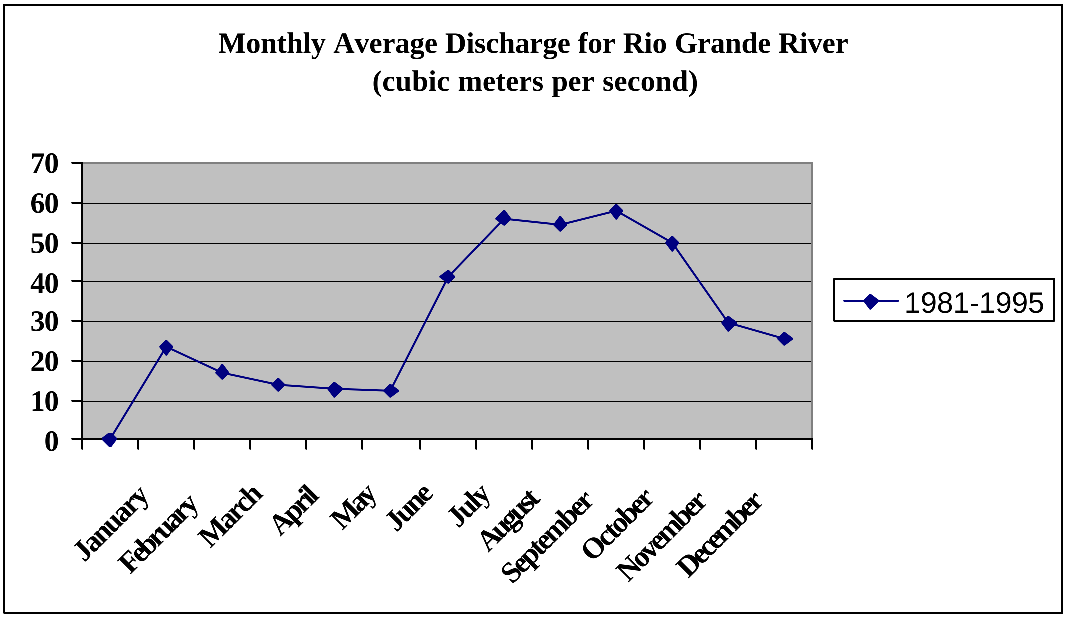
River Name	Country (ies)	Length (km)	Mean Discharge (m^3/sec)
Sittee River	Belize		32
Stann Creek River	Belize		40
Swasey Branch	Belize		27
Monkey River	Belize		63
Rio Grande	Belize		26
Moho River	Belize		37
Sarstoon	Belize (Black Creek)/ Guatemala (San Pedro)	42	160*
Rio Dulce	Guatemala	42	300*
Motagua	Guatemala	487	530*
San Francisco	Guatemala		
Piteros	Guatemala		
Ulua	Honduras	358	690* (1,400**)
Chamelecon	Honduras	256	370 * (400**)

* Heyman and Kjerfve, 1999
** Comision Ejecutiva Valle de Sula, 2002

The largest rivers are in Guatemala and Honduras. Due to the proximity of the Belize Maya Mountains to the coast, the rivers in Belize are more numerous, but smaller in terms of water discharge. The mean water discharges for the rivers in Belize are 10 to 20 times smaller than those in Guatemala and Honduras.

Monthly discharge patterns reflect the seasonal rainfall distribution. Figure 2.1-2 shows the seasonal discharge pattern for the Rio Grande River in Belize. Maximum discharge coincides with the rainy season (June through October). Lower discharges occur in other months.

Figure 2.1-2. Monthly Average Discharge for the Rio Grande River, Honduras



The total mean discharge of rivers to the Gulf of Honduras listed in Table 2.1-3 is about 2,200 m^3/sec. Heyman and Kjerfve estimate a total discharge to the Gulf of 2,400 m^3/sec, equivalent to about 76 km^3 a year. FAO estimates a discharge of 43 km^3 per year from the Guatemalan rivers, 16 km^3 a year from the Project Area of Honduras (of about 75 km^3 a year produced by all of Honduras into the Caribbean), and about 15 km^3 a year from Belize (a total FAO estimate of 74 km^3 per year). All three estimates are relatively similar, giving added confidence to these estimates.

The primary discharge patterns are reflected in the ecology of the region. The small discharges along the Belize coast are associated with an extensive barrier reef (the second largest in the world after Australia's Great Barrier Reef). As the influence of the Guatemalan and Honduran rivers is felt, however, the reefs are not present as continuous barriers. This situation reflects changes in the hydrography, including visibility, nutrient input, water clarity, sediment inputs, etc.

2.1.3 Sediment Discharge from Rivers

Few data exist on sediment discharge to the Gulf of Honduras. Belize has two types of drainage: one in the steeper Maya mountain area to the north of Belize, and a second southern coastal plain having lower slopes. In general, the rocks of the Maya Mountains in Belize are granitic and metasedimentary in nature, and therefore may erode more slowly than sedimentary rocks of the south. The steep slopes of the Belizean drainage to the Caribbean suggest that the sediments will be coarse in grain size, and there will be less than in the much larger rivers of Guatemala and Honduras. This is not to say that the specific sediment transported yield of the rivers (volume of sediment per unit area) in Belize is smaller than in the other two countries. In fact, the specific yield may be greater in Belize than the other countries due to its steeper slopes. Data do not allow determination of the specific yield for all rivers, which represents a trade-off between the slope of the river/watershed, and the geological materials being eroded.

Human activities can also affect the sediment yield from these areas. Deforestation, agriculture, sand mining from rivers and construction of dams and reservoirs, all can affect the sediment yield from rivers. Dams and mining are occurring in all three countries, so sediment yield to the coast is even more uncertain. Since coastal stability depends in large part on sediment availability, at least in the Guatemalan and Honduras regions, more gauging stations may be required for coastal zone management purposes.

Limited data on sediment discharge was collected by WRIScS (2001). They monitored suspended sediment load in the North Stann Creek and Sittee Rivers, and compared those to South Stann Creek. They estimated a total specific yield for suspended sediments of 32 to 53 tons per km^2 per year for 1999, about 85 % of which came during the rainy season. The total suspended sediment load estimates range from 2,000 tons per rainy season (North Stann River) to 14,000 tons per rainy season (Sittee River). These estimates underestimate the total sediment load, since this study did not measure bedload transport.

As part of this study, the erosion potential and potential sediment load were estimated, by assuming an average concentration of suspended sediments in the rivers. These estimates have large error bars.

From a transboundary context, the natural and human-accelerated sediment delivery to the Gulf plays a major role. Regional exchange of sediments from rivers occurs through transboundary currents, and allows dispersal anywhere in this eco-region.

2.1.3.1 Potential Erosion

In order to have a perspective on the erosion problems of the Gulf of Honduras, an analysis was performed considering three important factors for the erosion process which are: land cover, slope and rainfall. Overlays of digitals maps for these factors were used in order to generate a map of potenial erosion for the watershed. The land use map shown in Figure 2.1-3 was used together with digital elevation maps provide by the USAID-PROARCA project. The digital layers were overlaid to generate an index by pixel which aggregation results in the erosion potential map. The erosion index was determined by multiplying for each pixel the slope with a cover factor, which is a function of the land use. The cover factor was the C factor of the Universal Soil Loss Equation (USLE). The minimum values used for each land use were: forest = 0.001, shrubs = 0.030, low vegetation, bare land = 0.500, intensive crops = 0.200 y other crops and pasture = 0.100. Similar values to these ones have been derived in other watersheds of Guatemala and other Central American countries (Abt, 2002).

Figures 2.1-4 and 2.1-5 show the elevation and the slopes maps derived from the elevation map. Figure 2.1-6 presents a map with the annual distribution of rainfall within the Gulf of Honduras watershed. .The results of the superposition of these maps are presented in the map shown by Figure 2.1-7 which depicts the potential erosion for the watershed. In this map the potential erosion in shown from low to high with ranges of grey and green colours for low erosion potential to reds and black for high erosion. These ranges were arbitrarily selected in order to be to show relative differences among the watersheds. However, the digital map is very useful for planning watershed management interventions in areas with land use conflicts like for instance intensive agriculture in high slope areas.

2.1.3.2 Sediment Rates

No information was found on sediment measurements of the tributaries of the Gulf of Honduras. In order to get a “ball-park” estimate of the sediment contribution for rivers the average river discharges were multiplied by an average concentration of sediments. To illustrate this Table 2.1-4 shows the average discharges of the main tributaries to the gulf (Table 2.1-4) and the corresponding load assuming an average concentration of 500 mg/L (Abt 2002). Sediment measurements in other watersheds of

Guatemala oscillate between 50 and 3000 mg/L with an average around 500 mg/L. In other watershed concentrations between 100 y 400 mg/L have been found for dissolved solids INSIVUMEH (2002).

Table 2.1-4. Preliminary Estimation of the sediment Loasd of the main tributaries of the Gulf of Honduras

River Name	Country (ies)	Mean Discharge (m^3/sec)	Sediment Discharge** (ton/día)
Stann Creek River	Belize	40	1728
Monkey River	Belize	63	2722
Rio Grande	Belize	26	1123
Moho River	Belize	37	1598
Sarstoon	Belize, Guatemala	160*	6912
Rio Dulce	Guatemala	300*	12960
Motagua	Guatemala	530*	22896
Ulua	Honduras	690*	29808
Chamelecon	Honduras	370 *	15984
Total			95731

* Heyman and Kjerfve, 1999

**Asumes an average concentartion of 500mg/L

Figure 2.1-3. Land Use Coverage Gulf of Honduras

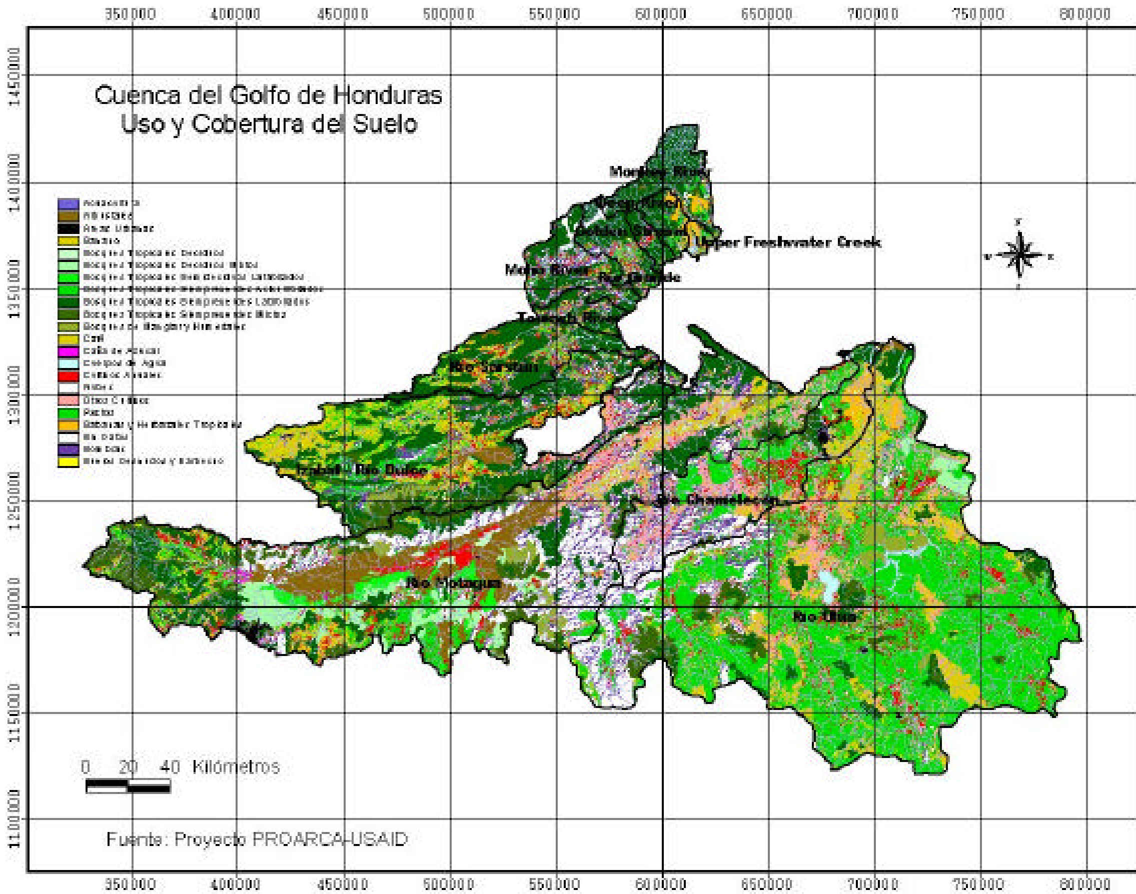


Figure 2.1-4. Digital Elevation Map- Gulf of Honduras

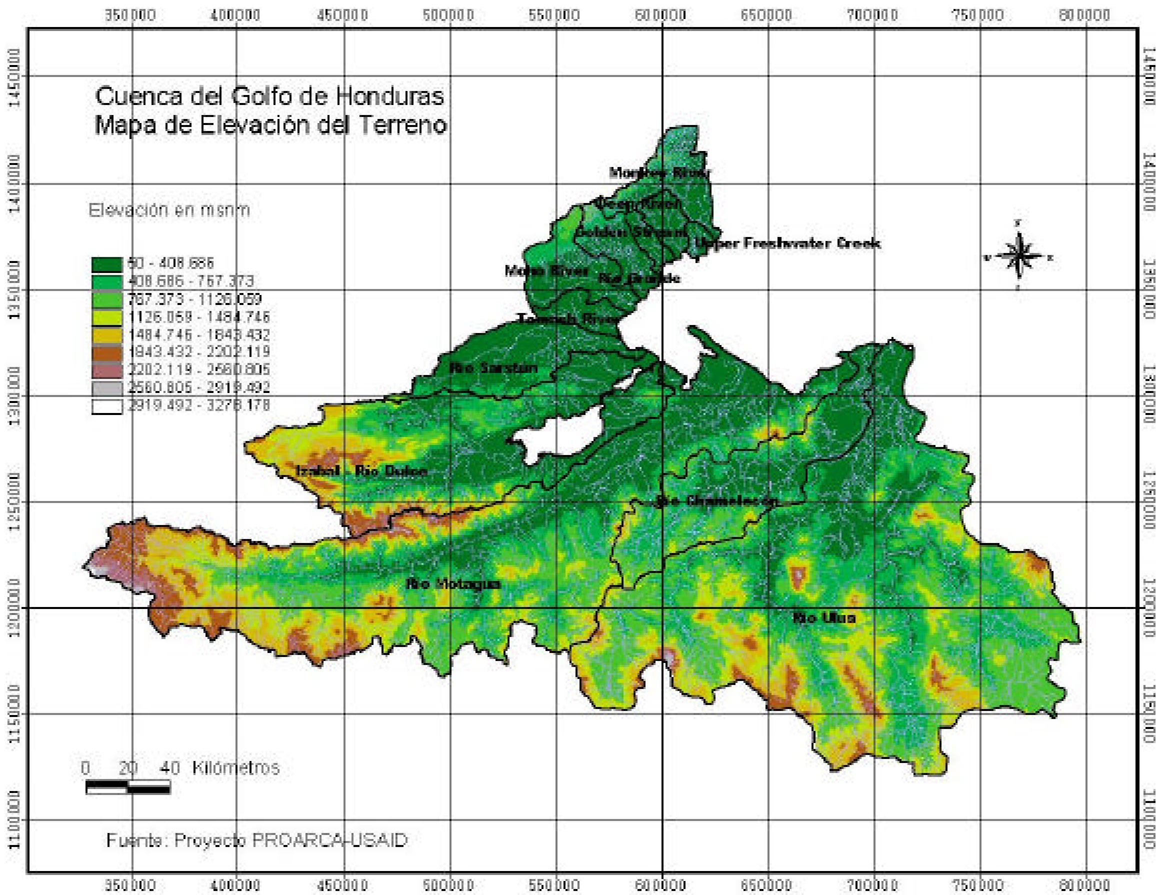


Figure 2.1-5. Slope Map- Gulf of Honduras Watershed

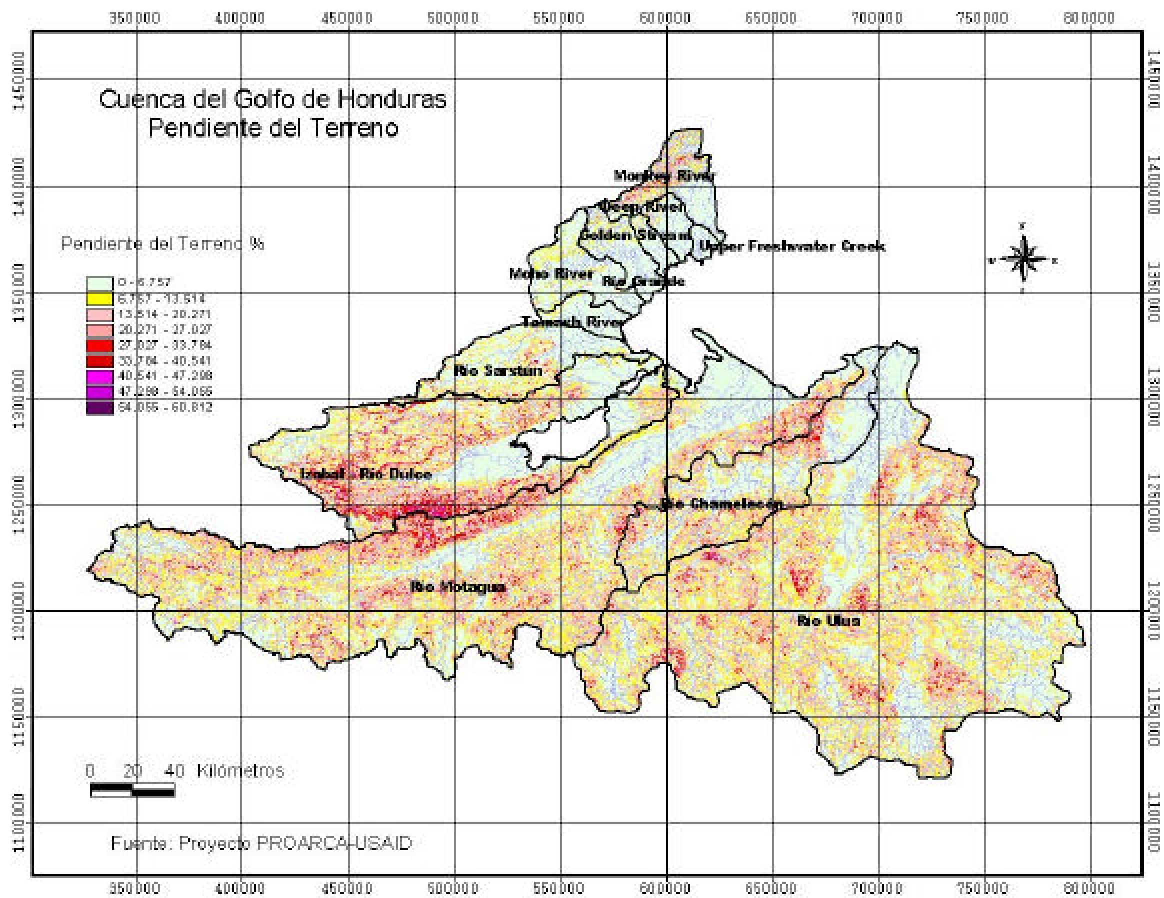


Figure 2.1-6. Average Rainfall- Gulf of Honduras Watershed

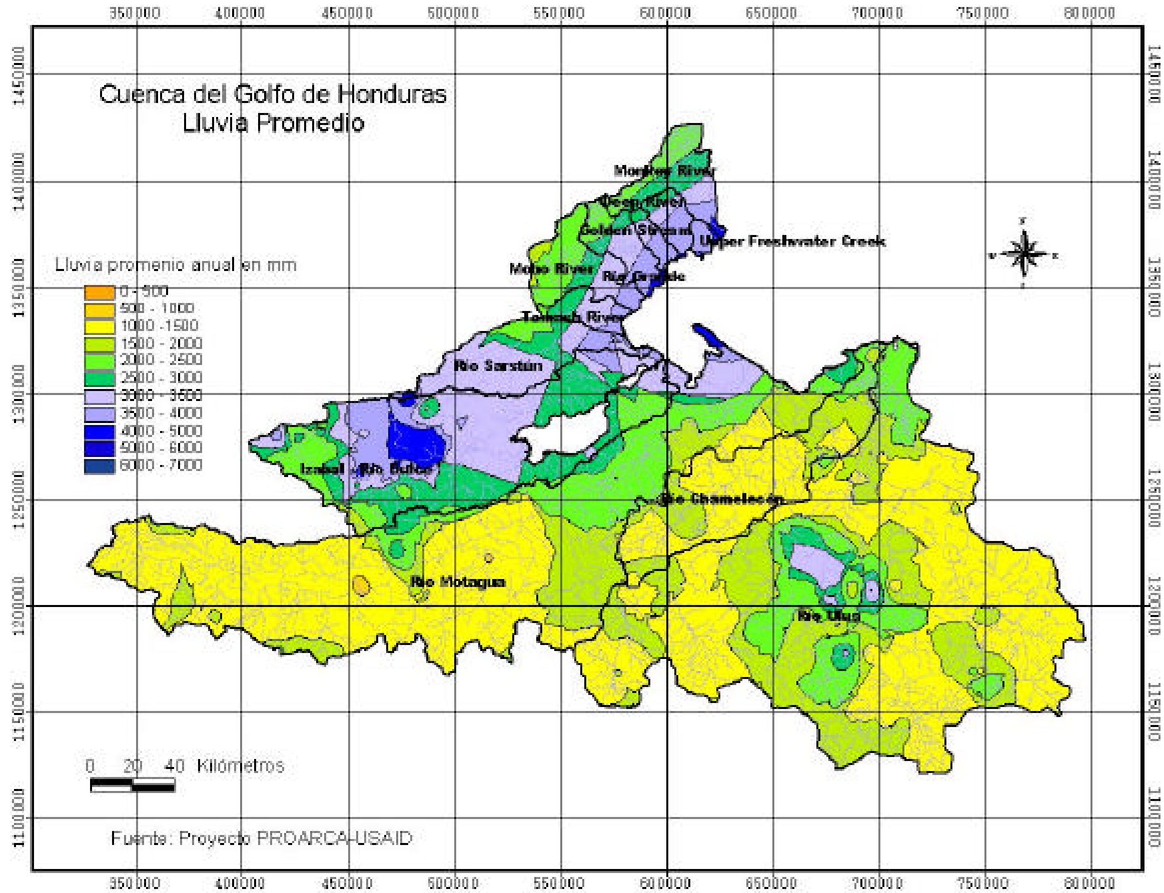
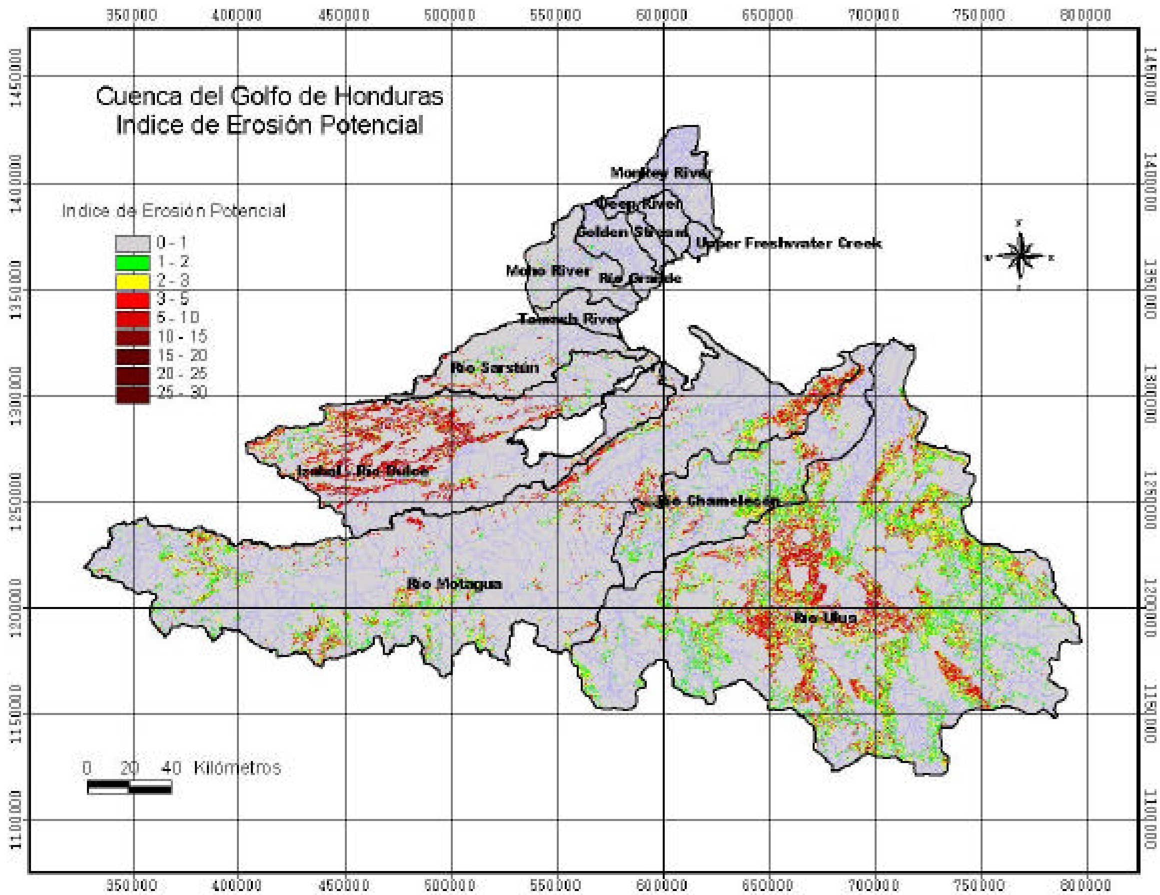


Figure 2.1-7. Erosión Potential Index- Gulf of Honduras Watershed



2.1.4 Shoreline Classification

The shoreline of the region is highly variable, consisting of geologically-controlled structures to recent sedimentary features. Belize's costal zone stretches approximately 375 kilometers, though only a portion of this is in the Project Area. The geomorphology of this region is influenced by five parallel submarine ridges of continental origin that trend NNE to SSW. These five ridges sit on a continental shelf that is approximately 15 to 40 km wide, and which contains the 220 km long Belize Barrier Reef, extending from the Mexican border in the north to Sapodilla Cays in the south. The southern half of the Belize coast, the area within the Project Area, consists of sandy beach ridges and smaller coastal swamps. A shelf lagoon exists along the southern part of the Belize coast, widening towards the south in effect mirroring the width of the shelf. The coastal zone of the south is generally more diverse and richer than that in the north. The Belize coast includes such diverse features as estuaries and lagoons, barrier beaches with beach ridges and saline tidal swamps, cays, mangrove forests, seagrass beds, patch reefs, barrier reefs and cays.

The Guatemalan coastline has a variety of habitats as well. Though lacking a barrier reef, the coast is similarly diverse with vast mangrove areas (La Graciosa, Cocoli River, Santo Tomas, Punta Manabique, Sarstoon-Temash), leading to river mouths and estuaries (Rio Dulce), the large Bahía de Amatique with its vast shallow waters and sea grasses (Bahia Graciosas), the sandy Punta Manabique peninsula (an accretionary feature built from riverine sediments from the east), and long beaches leading to the river mouths of Motagua, San Francisco, and Piteros. These river mouths contain estuaries and various important freshwater and coastal habitats.

The Honduran coastal area is marked by long beaches, vast mangroves, and offshore cays with corals and mangroves. The major city on the coast, Puerto Cortés, has nearby beaches that are a tourist attraction. The river mouths (primarily the Ulua) exhibit a rich vegetative growth, and contain important habitats. The extensive coral reefs of Honduras are farther to the east of the Project Area.

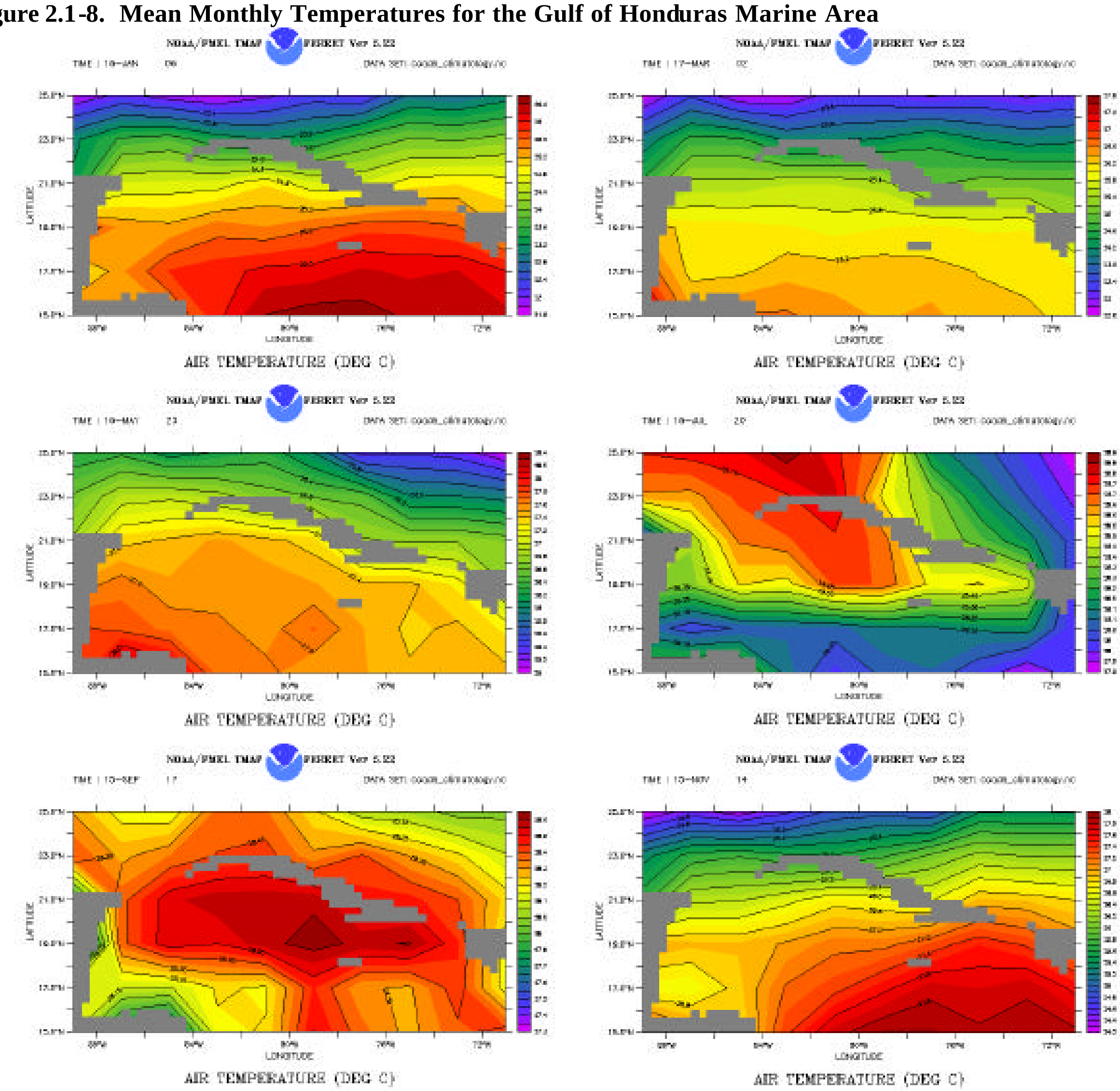
2.1.5 Climate

2.1.5.1 Temperature

Temperatures in the study area tend to have small temporal variability due to the location of the Gulf in the sub-tropical region. Temperatures are generally highest along the coast, with mean annual values of approximately 28 degrees Centigrade. At higher altitudes, the temperature drops, such that the temperature is about 20 degrees at altitudes of 500 to 1000 m. Much of the population lives at these intermediate altitudes. The annual range of temperature is quite small.

Figure 2.1-8 shows a regional view of mean monthly temperatures in the overall Caribbean Sea, as well as in the Gulf of Honduras. Temperature fluctuations over the Gulf of Honduras are on the order of a couple of degrees Centigrade.

Figure 2.1-8. Mean Monthly Temperatures for the Gulf of Honduras Marine Area



2.1.5.2 Precipitation

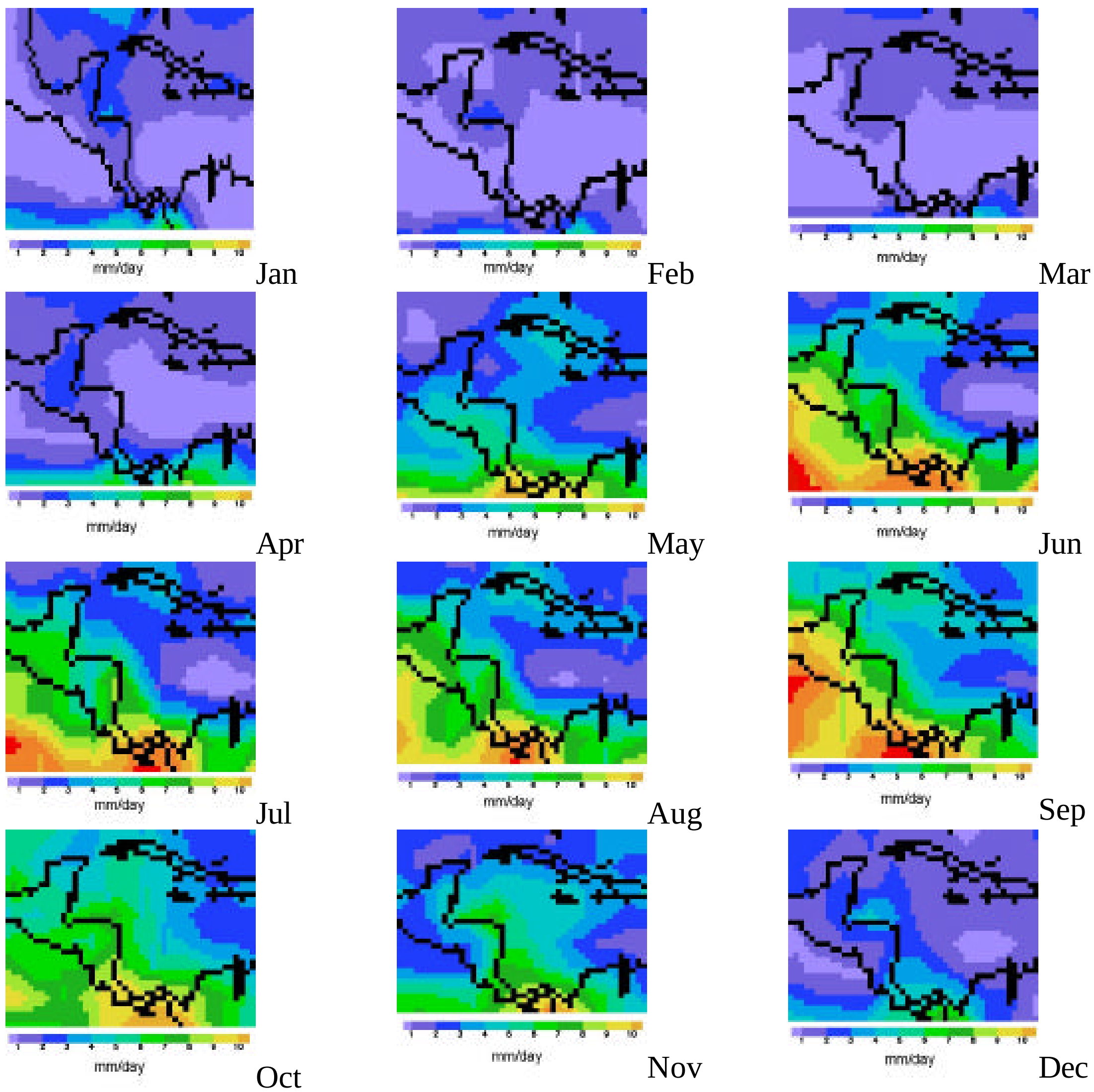
The climate of the Gulf of Honduras falls within the Rainy-Warm type, and presents two distinct climatic periods. A rainy season lasts from June to October with the highest levels of rainfall and humidity, reduction in wind speed, and higher temperatures. The dry season lasts from November to May, and is characterized by a reduction in temperature and rainfall (Porting, 1976). These seasonal variations of meteorological conditions in the area are caused by north-south migrations of the Intertropical Convergence Zone (ITCZ), which is found near the equator in winter and at about 10°N at the end of summer season.

The yearly rainfall averages from 3,000 to 4,000 mm in the coastal regions of the western Cayman Sea (Galleges, 1996; Heyman and Kjerfve, 2000) and up to 10,000 mm per year in the Maya Mountains. At the same time, the offshore areas of the Gulf of Honduras get approximately 40% of the mainland rainfall.

This estimate is based on measurements at Carrie Bow Cay from 1976 through 1980 (Rützler and Ferraris, 1982). Air temperatures in the Gulf vary seasonally from 23°C in winter to 28°C in summer (Heyman and Kjerfve, 2000).

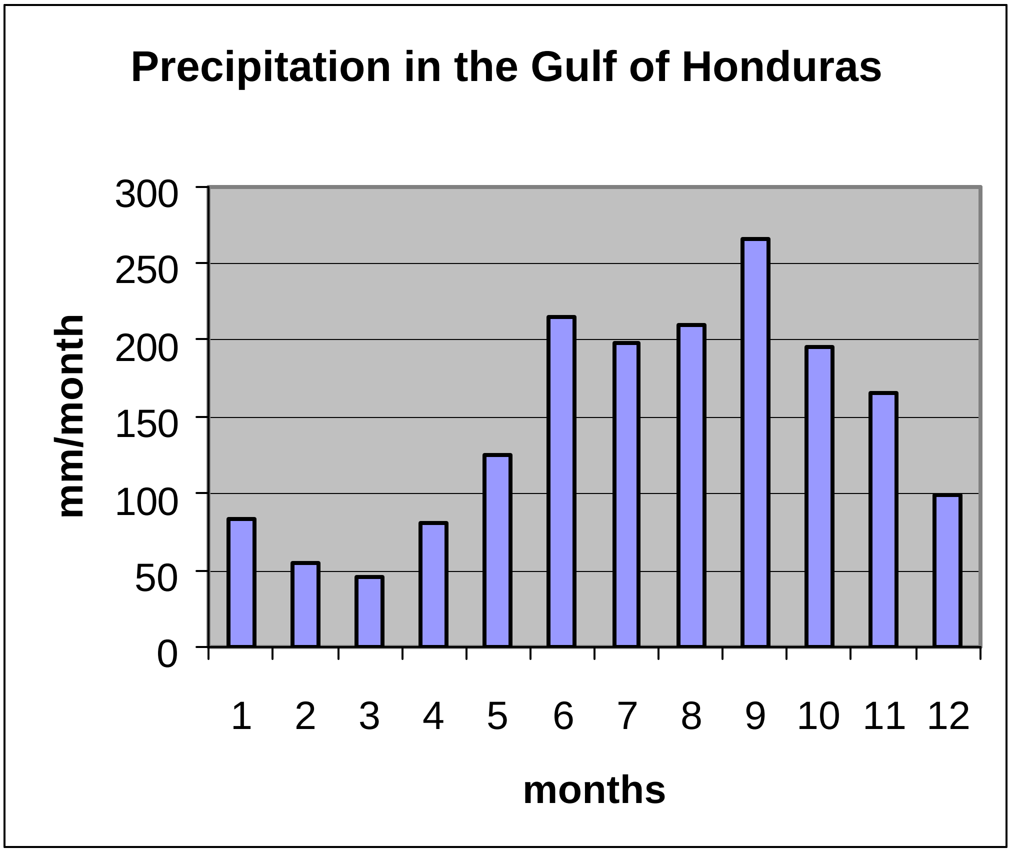
Rainfall is presented in Figures 2.1-9 and 2.1-10. Figure 2.1-9 shows the monthly patterns of precipitation, with the higher values over the mountainous areas and lower values over the Gulf itself. The rainy season patterns are clearly demonstrated. Figure 2.1-10 shows the monthly mean precipitation over the Gulf of Honduras, ranging from a low of 50 mm per month in the dry season, to about 275 mm/month in the rainy season. The rainfall in the interior mountainous areas is much larger.

Figure 2.1-9. Regional Precipitation Patterns in the Gulf of Honduras



Source (http://orbit35i.nesdis.noaa.gov/arad/gpcp/)

Figure 2.1-10. Mean Monthly Precipitation in the Gulf of Honduras

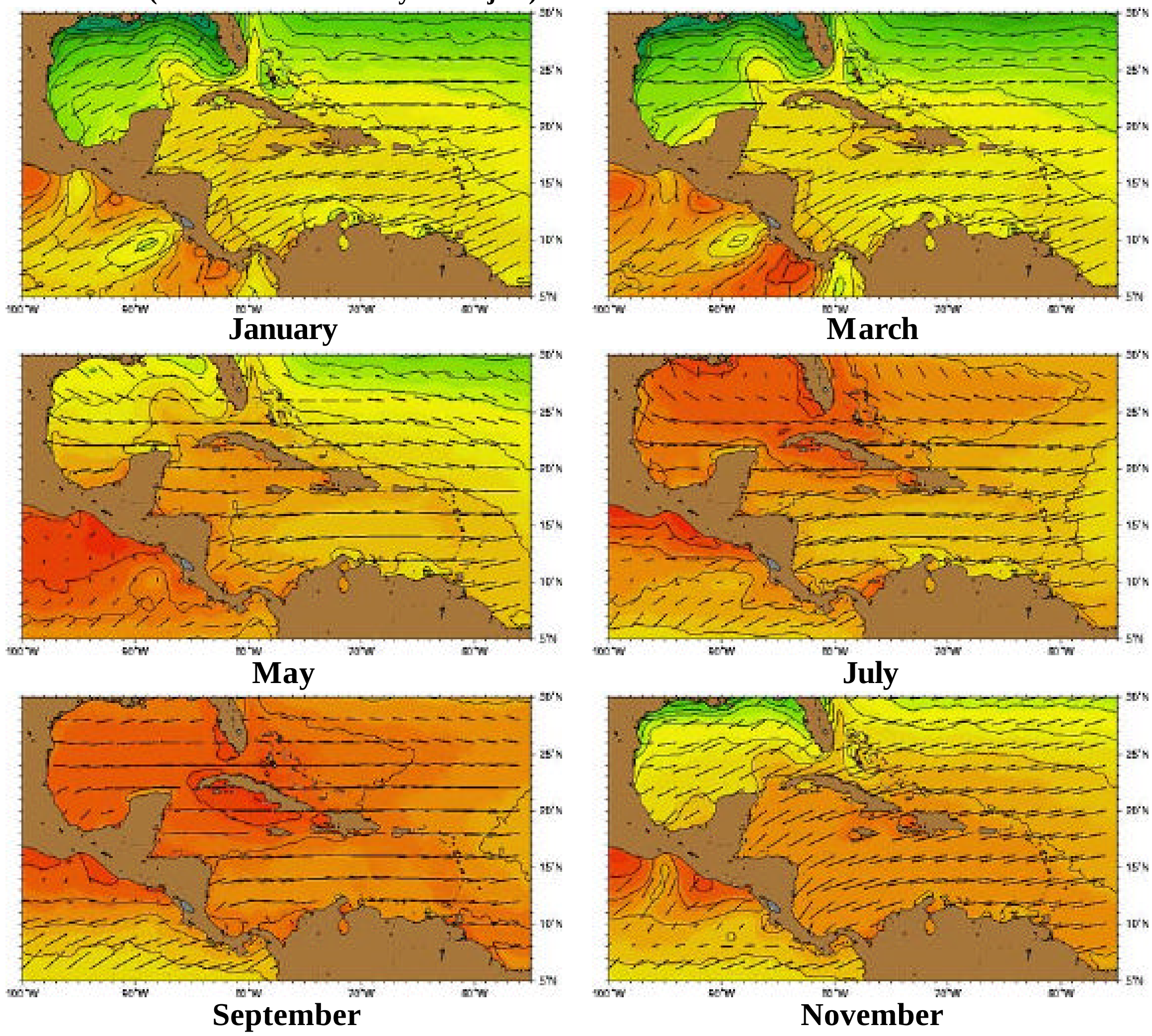


2.1.5.3 Winds

Winds are important to water quality in that they generate currents, thus affecting mixing and advection, and create waves, which resuspend bottom sediments causing higher turbidity. Recent evidence (WRIScS, 2001) indicates that resuspension is as influential as river flooding in generating turbid water in the coastal zone of the Gulf.

In the Gulf of Honduras, the wind pattern is dominated by northeasterly trade winds during the year (Figure 2.1-11) with speeds ranging from 3 to 8 m/s. The winds in the Gulf are stronger during winter months when the ITCZ shifts south. In summer, the southward component of the trade winds is minimal.

Figure 2.1-11. Seasonal Evolution of Sea Surface Temperatures (Pathfinder AVHRR) and Surface Winds (NCEP/NCAR Reanalysis Project) for the Caribbean Sea.



Each month represents an eleven-year average from 1985 through 1995 (from Samuels, 2002).

Typical synoptic meteorological features that cause variations in speed and direction of trade winds and other changes in meteorological conditions are ‘weekly’ easterly waves, some of which develop into tropical storms and hurricanes causing transient circulation, mixing, coastal upwelling and storm surge (Mooers and Maul, 1998). During winter months, occasional cold-air outbreaks from the north (called ‘northers’) associated with the passage of the polar atmospheric front cause strong winds from the north and drops in air temperature.

2.1.5.4 Hurricanes

Tropical storms and hurricanes regularly cross the Gulf of Honduras between August and October. The frequency of tropical storms increases from south to north, being 20 storms per century of the area of the Bahía de Amatique and up to 60 storms per century at the northeastern limit of the Gulf of Honduras (Heyman and Kjerfve, 2000). A recent example of a hurricane that impinged upon the area of the Gulf was category 5 Hurricane Mitch, which hit the region in October 1998 causing devastating effects on coastal areas. For example, precipitation estimates for Mitch for the total storm event in Honduras and Nicaragua have ranged from 1,200 to 1,800 mm for locations receiving the heaviest rainfall (National Climatic Data Center, 1999).

The patterns of hurricanes reaching the Gulf of Honduras are indicated in Figure 2.1-12. Most hurricanes trend east-to-west, however, some recurve and display complex tracks. East-to-west trending hurricanes generate their largest winds in the southwest direction, towards the coasts.

Figure 2.1-12. Map of Hurricane Tracks in the Gulf of Honduras, 1921-1999
(See Appendix D)

2.2 Geology and Geomorphology

The geology of the Gulf of Honduras region is quite complex, being situated in an area of active tectonics (illustrated by strong seismicity and active volcanism). The marine portion of the region reflects the presence of active marine dynamics, including subduction and collision tectonics. The deep Caribbean basin with its chain of islands is a reflection of these complex dynamics. The landward portion reflects both modern processes of volcanism and alluvial processes, but also ancient metasediments.

2.2.1 Geology

The geology of Belize consists primarily of three types of formations. The northern, hilly Maya Mountain region consists of metamorphosed sediments (metasediments) and granitic intrusions, whereas the southern area consists of alluvial material. The metasediments are the oldest rocks in Belize, dating to the Paleozoic era at 300 million years old. These are part of the Santa Rosa Group, comprised of fine-grained phyllites, slates, and mudstones. The coastal plain sediments are young, dating to the tertiary period at about 10 million years. These sediments are thought to be of riverine, not marine, origin.

Primary soil types are Ossory (derived from metasediments), Stopper (derived from granitic rocks), Melinda (derived from alluviual material), Puletan (also from alluvium), and tintal soils (wet, swampy type soils).

The geology of Guatemala is more complex, consisting of four primary physiographic units: coastal plain, Izabal Depression, sedimentary highlands, and Motagua depression. Soils are mixed, and include the Inca, Chocon, Chacalate, Alluvial, and Manabique soil types. UNEP (1995) provides a brief description of these soils. The coastal plain consists primarily of alluvial material from the Quaternary era. The sedimentary highlands are comprised of carbonates of the Mico Mountains, well-known for its karst topography. The Motagua depression is floored by Quaternary era alluvium as well, and includes the Punta de Manabique, a large, sandy barrier.

The geology of Honduras within our study area consists primarily of the following units. The coastal areas consist mainly of Quaternary and Cretaceous rocks, primarily consisting of alluvium and intrusive units. The lithology of the alluvium unit is mainly surficial bounders, cobbles, gravel, sand, and mud while the intrusive unit consists of granite, granodiorite and diorite. The origin of the alluvium is sedimentary while the intrusive rocks are plutonic in origin. The environment of deposition for the alluvium is continental marine.

Intermediate (or farther south) from the coastal plain is a Paleozoic unit called Cacaguapa Shist, a metamorphic rock with an unknown environment of deposition. This unit consists of rocks such as schist, phyllite, gneiss, quartzite, marble and quartz veins.

The mountainous areas to the south are Tertiary and Cretaceous in age and are from the Matagalpa, Patre Miguel, and Yojoa formations. These rocks are pyroclastic, volcanoclastic (tuff), and sedimentary mixed rock types, respectively. The environment of deposition for the Matagalpa and Padre Miguel formations is continental and the Yojoa is marine in origin.

The primary soil types in the Honduras coastal areas are beach sands, alluvial sediments, marshes and bogs and various silty loam soils.

2.2.2 Coastal Processes and Coastal Erosion

The Gulf of Honduras has quite a mixed range of coastal processes occurring within it. Along the Belize sector of the Gulf, the shoreline is characterized by a vast barrier reef of more than 200 km in extent, which protects the shoreline from open Caribbean wave action. Waves are generally locally generated within the lagoon. The numerous small rivers along the Belize coast provide some sediment to the shoreline, but not an excessive amount. In general, the littoral transport is from north to south, though the magnitude of this transport has not been estimated. Numerous types of shorelines exist (see section 2.1.4), some of which are sandy beaches, but many of which are mangroves, swamps, etc. This north-to-south littoral drift is primarily wave-driven, but parallels the general southward residual drift of the coastal currents.

Within Guatemala, the littoral transport is varied. Along with the western side of the Bahía de Amatique, the littoral transport is to the south, and sediments from the rivers there nourish the attractive beaches to the south. Due to the protection afforded by the northern reefs and the bay itself, littoral transport is somewhat slow. In the central and eastern portions of the Bahía de Amatique, open Caribbean waves cannot propagate. This central protected area is characterized instead by locally generated waves, and relative stability of the coast and sea floor. Hurricanes are the dominant destabilizing force in this region, and rivers bring continual sediments to the coastal areas. Along the northeast portion of the Guatemalan coast, from the Honduras border to the tip of the Punta de Manabique, the littoral transport is on average from west to east, though transport at any given time may be in either direction depending on the wind conditions. This section of shoreline is exposed to open Caribbean waves, and likely has the largest waves of the Guatemalan coast. Fortunately, the rivers of Guatemala and Honduras provide a sufficient sediment supply, so coastal accretion dominates over erosion, as evidenced by the growth of Punta de Manabique over historical time periods (despite some localized episodes of erosion).

Along the Honduran coast, the general littoral transport is from west to east also, as the open Caribbean waves approach the shoreline mainly from east to west. The rivers of Honduras tend to nourish the coast, although coastal indentations (at Puerto Cortés, for example) may create local areas of erosion. In general, the beaches of Honduras appear to be relatively stable and sandy.

2.3 Oceanography

This section describes oceanographic conditions in the Gulf of Honduras and adjacent Caribbean Sea. The introduction sub-section gives a brief background on the oceanography of the western Caribbean Sea. The focus of sub-sections 2.3.1 and 2.3. is on the space-time variability of basic properties of seawater, such as temperature, salinity, transparency, and water chemistry, as well as on the circulation patterns that cause variations in seawater characteristics.

The topography of the Caribbean Sea (Figure 2.3-1) shows a succession of five deep basins separated by sills of less than 2000 m depth and set apart from the main Atlantic basins by a chain of islands. Several passages that connect the sea with the Atlantic Ocean have sill depths of 740 -2200 m. The sea has more than one connection with the main ocean basins. The northern basin is connected with the Gulf of Mexico through the Yucatan Strait.

On average, evaporation exceeds precipitation throughout the Caribbean Sea (Etter *et al.*, 1987). The excess of evaporation over precipitation is not balanced by freshwater inputs from rivers on a basin wide scale, which makes this American Mediterranean Sea a concentration basin. The annual mean salinity, averaged over the upper 200 meters, increases from 36.09 at the inflow through the Lesser Antilles to 36.19 in the Yucatan Strait (Etter *et al.*, 1987). These surface salinities are relatively low due to the influence of Amazon and Orinoco River water, however. Therefore, the density increase associated with the concentration process is insufficient to overcome strong density stratification and cause deep vertical convection. As a result, deep-water renewal occurs due to sporadic inflow of oceanic water from outside (Wust, 1964).

The Amazon River and Orinoco River waters are advected to the northwest with the Caribbean Current. On average, 15 -20% of the surface water that enters the Caribbean Sea is derived from the brackish waters of the Orinoco and Amazon River estuaries (Moore *et al.*, 1986). The influence of river runoff is strongly seasonal, with strongest flow occurring between May and November, that is, during the wet season.

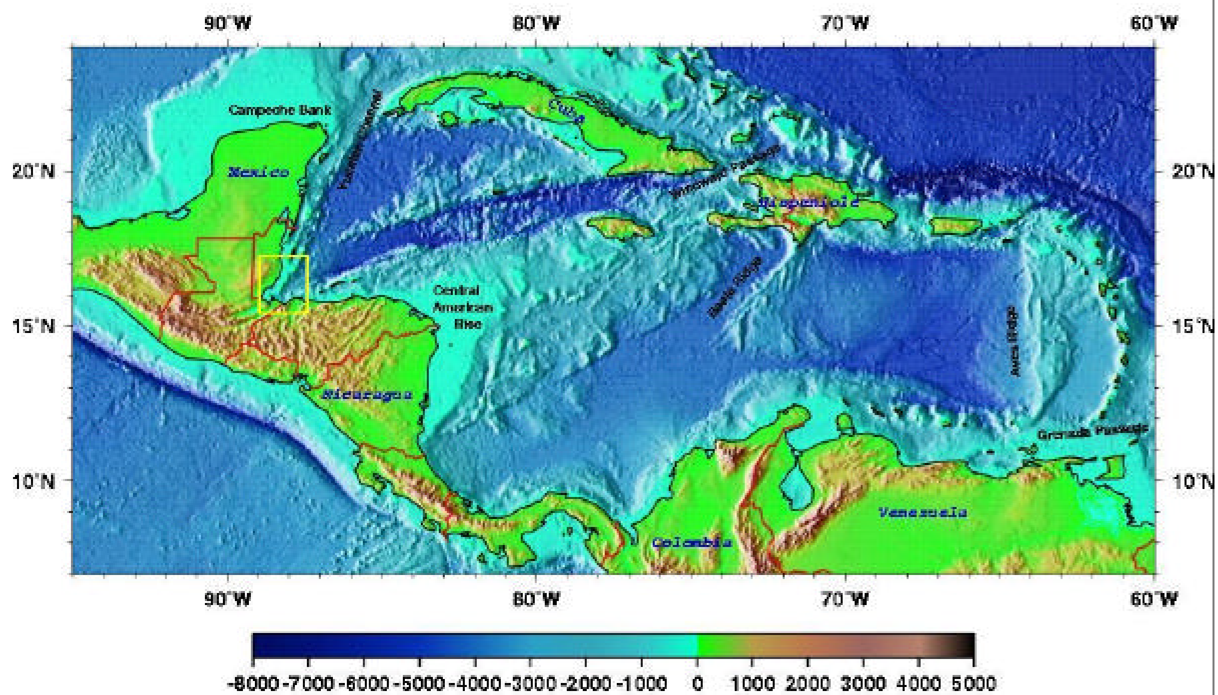
Freshwater inputs from local rivers play a significant role in modifying stratification and formation of buoyancy driven circulation patterns on regional space scales (Murray and Young, 1985). Therefore, the Caribbean Sea is highly stratified in the upper 1200 m of the water column; weakly stratified between 1200 and 2000 m; and nearly homogeneous below 2000 m. This water structure is directly related to the sill depths of the Antilles Islands arc, which impede the flow of deep water into the Caribbean (Gordon, 1967).

Water masses entering the Caribbean originate in both the North Atlantic and the South Atlantic oceans. Several water masses can be distinguished in the Cayman basin (Wust 1964; Gordon 1967; Sukhovey, 1980; Gallegos, 1996). The surface water mass occupies the upper 50 m of the water column. It has salinity around 36.0 in winter and 35.8 in summer. Below the surface water lies the subsurface layer (Subtropical UnderWater (SUW)) occupying a depth from about 50 to 250 m. The core of this water mass is located at about 100-m depth. It forms the salinity maximum, with salinity around 36.5 and temperature in the range of 21 to 23°C. The next 500 m layer of the water column is dominated by Western North Atlantic Central Water (WNACW) with a typical temperature range of 20 – 8°C and salinity range of 36.3 - 35.2. Deeper, at about 700 m, the characteristic salinity minimum of Antarctic Intermediate Water (AAIW), salinity near 34.9 and temperature near 7°C, can be traced through the Caribbean Sea. The deep waters are remarkably uniform, with temperature of about 4°C and salinity of about 35.

The main circulation feature of the Caribbean Sea (Figure 2.3-1) is the Caribbean Current (Wust, 1964; Gordon, 1967; Kinder, 1983; Kinder *et al.*, 1985), the throughflow carrying waters from the Atlantic Ocean into the Gulf of Mexico with a mean transport (Gallegos, 1996) of about 30 Sv (1 Sv = $10^6 m^3/s$). In the western Caribbean, the mean velocity of the Caribbean Current is about 0.5 m/s (Fratantoni, 2001).

Its intensity has a strong seasonal cycle (Gallegos, 1996) with higher current velocities during spring-summer time (about 0.8 m/s) and slower currents during autumn-winter months (about 0.4 m/s).

Figure 2.3-1. The Caribbean Basin: Bathymetry and Circulation



The circulation in the Caribbean experiences much variation in both space and time, some of it in the form of mesoscale eddies and meanders of the Caribbean Current (Mooers and Maul, 1998; Andrade and Barton, 2000). The major mechanisms that may cause generation of the mesoscale eddies in the western Caribbean are interaction of the Caribbean Current with bottom topography (Molinari *et al.*, 1981), wind forcing, and shear instability of the flow. Quasi-permanent cyclonic eddies are formed between the Caribbean Current and the coast in the Colombian and Cayman basins. High-resolution numerical models (Navy Layered Ocean Model, for instance) reveal that an anti-clockwise rotating (cyclonic) eddy is a quasi-permanent circulation feature in the western Cayman Sea (http://www7320.nrlssc.navy.mil/global_nlom/globalnlom/ias.html). It determines flow variability in the deep part of the Gulf of Honduras. Coastal circulation is driven by wind and buoyancy fluxes formed by river runoff and rainfall (Murray and Young, 1985).

The Gulf of Honduras is part of the Cayman basin of the western Caribbean Sea (Figure 2.3-1). This water body has an area of about 10,000 km^2. It includes Bahía de Amatique, the entire Caribbean coast of Guatemala, the eastern part of the coast of Honduras, and the southern part of the Belize Barrier Reef Lagoon. The western part of the gulf, about 60 km off shore, is rather shallow (0 – 30 m). Several coral reefs, which form the southern portion of the MesoAmerican Barrier Reef System (MBRS), are located at the northwest border of the Gulf. Large freshwater inputs from the Motagua, Sarstoon and Dulce Rivers limit reef development in the central part of the Gulf to a few isolated corals and small patch reefs, such as Hunting Cay, for instance. The northeastern part of the Gulf includes a portion of the deep Cayman Trench. The continental slope is rather steep and the water depth drops abruptly from about 30 m at the shelf break to 2000 m depth in the northeast. Therefore, one can expect that both coastal and open ocean processes may play a role in driving circulation dynamics and determine variability of seawater properties in the Gulf of Honduras.

2.3.1 Seawater Properties in the Gulf of Honduras

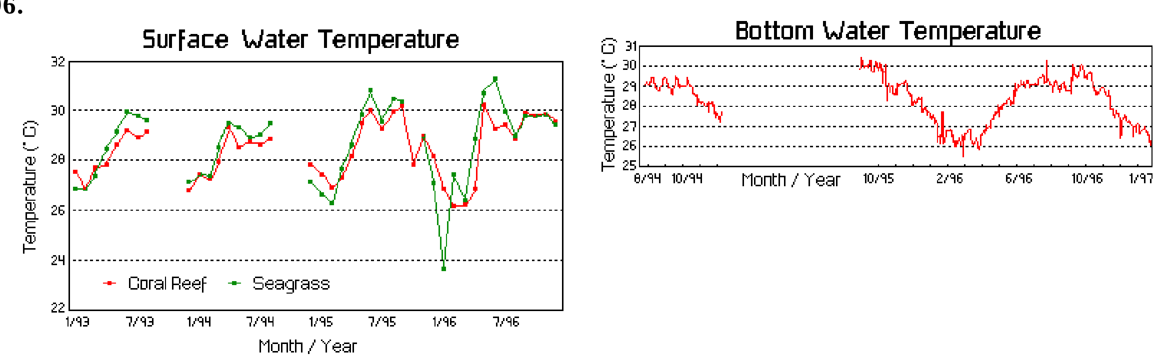
2.3.1.1 Seawater Temperature

Water temperature is an important parameter for a tropical coastal ecosystem because reef corals are sensitive even to subtle changes in water temperature. The temperatures at which they grow best are between 25°C and 29°C. Increase in water temperature eventually causes coral bleaching and decay (Kramer and Kramer, 2000). In spite of that, data on the variability of water temperature in the Gulf are scarce and fragmentary. While seasonal variability is well documented on a basin scale on the basis of satellite data, little is known about regional peculiarities of space-time distribution of seawater properties in the Gulf.

Long-term averages of remotely-sensed sea-surface temperatures (SST) for the Caribbean Sea (Figure 2.3-2) reveal little changes within the seasonal cycle. According to these data SST in the Gulf of Honduras varies within a range from 27°C (January – February) to 29°C (August – September). Brenes et al. (2001) studied time variations of sea-surface temperature at a specific location (Cayos Cochinos) in the area adjacent to the eastern boundary of the Gulf of Honduras using high-resolution data from NOAA - 12 and NOAA - 14 polar orbiting satellites. Sea surface temperature data were also obtained *in situ* to ground truth remote observations.

The data showed a well-defined seasonal cycle (Figure 2.3-2), in which low temperatures observed during the first months of the year were mainly associated with coastal upwelling that occurred in response to seasonal intensification of the trade winds on a local scale. At the same time, the open sea area showed a similar decrease in temperature due to intensification of open sea upwelling within the cyclonic mesoscale eddy (sub-section 2.3.3). Summer temperatures were approximately 1°C higher than could be expected from mean climatological data.

Figure 2.3-2. Surface (left) and Bottom (right) Water Temperature Variations at Cayos Cochinos in 1993 – 1996.



Source: Koltes *et al*., 2002

Seawater properties in the coastal zone of the western part of the Gulf were measured in February 1999 (PROARCA COSTAS, 2003) in the region of the Snake Cays (Port Honduras area). The data showed that sea surface temperature varied during the period of the survey in the range from 29 to 32°C, which is about 2°C higher than could be expected from mean climatological estimates. In 2001, a typical thickness of the upper mixed layer (UML), which has vertically uniform temperature and salinity, was about 15 m in the northwest portion of the Gulf (WRIScS, 2001). The temperature showed a vertical distribution with coolest waters at depth offshore and warmest waters at the surface and inshore. The temperature range was from 28.5 to 31°C. A thermocline developed in the offshore areas at depths of 15 – 20 m. It is possible that the thermocline did not exist in shallower areas due to wave-induced mixing.

2.3.1.2 Seawater Salinity

The open sea surface salinity in the western Caribbean Sea is rather uniform with values around 36.2 (Sukhovey, 1980; Gallegos, 1996). The coastal water salinities may vary over a wide range from 5 to 35 (Figure 2.3-3), with lowest salinities observed close to major rivers. On average, offshore salinities are almost constant throughout the dry season (until June), then drop dramatically in July – August, and gradually increase in September – November (CZMAI, 1999).

Throughout the year, the lowest salinities in the Gulf are found in the Bahía de Amatique, a shallow estuarine basin. It is a body of semi-enclosed coastal waters with a connection to the sea and in which salinity is considerably diluted due to the influence of freshwater discharged from land. In this shallow water body, with an average depth of less than 10m, salinity fluctuates throughout the year from 10 (during wet season) to 30 (during dry season). During the rainy season, there is a clear gradient with salinities from almost zero salinity at the mouths of the Sarstoon, Laguna Izabel, and Motagua rivers to 16 in the outermost part of the bay (Yañez-Arancibia, 1994; Salaverría and Rosales, 1993). There is also vertical stratification of salinity, with average bottom salinity values of 33.7. Higher bottom salinities occur due to the estuarine-type circulation, with a shoreward flow of open seawater near the bottom, creating a ‘salt wedge’, and a seaward flow in the surface layer (Figure 2.3-4). The circulation is formed due to the existence of a density gradient, which forces freshwater to move offshore and overlay more saline (denser) open seawater.

Observations during 2001 in the northwestern portion of the Gulf revealed salinity values from 33.5 to 34.8, with readings increasing with depth and decreasing shoreward (WRIScS, 2001). The range of salinity variations in this area was thus much less than the range of salinity variability in the survey area at Snake Cays (Figure 2.3-3). Other observations (WRIScS, 2001) indicate that salinity even along the inner reef margins can fall to about 32 during periods of intense river flooding.

Figure 2.3-3. Surface Salinity Distribution in the Snake Cays (Western Gulf)

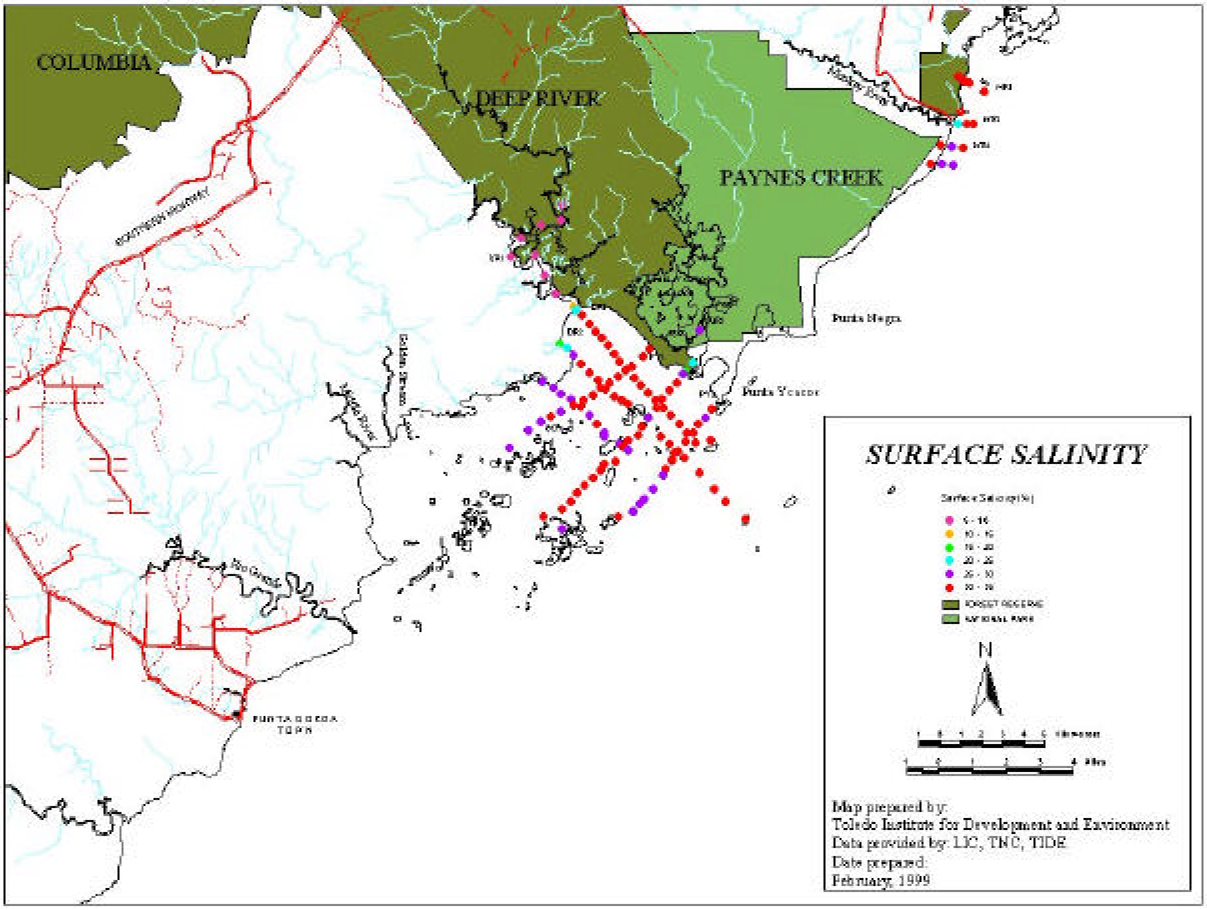
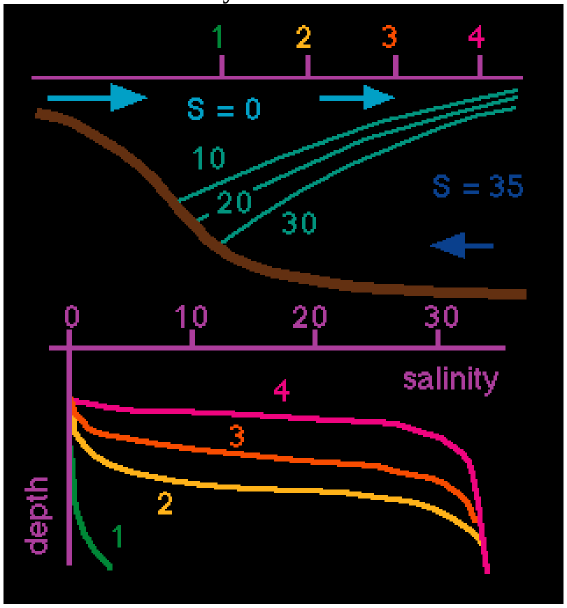


Figure 2.3-4. Schematic Representation of Salinity Distribution and Flows in a Typical Estuarine System



Source: Tomczak, 1996

2.3.1.3 Water Transparency

Water transparency is a critical parameter for a tropical marine system, because coral reefs need low turbidity water to maintain their life cycle. Water clarity is also an indication of the amount of suspended solids and/or primary biological productivity. Typically, the transparency is measured as a depth at which a white disk, the so-called Secchi disk, is no longer visible from the surface.

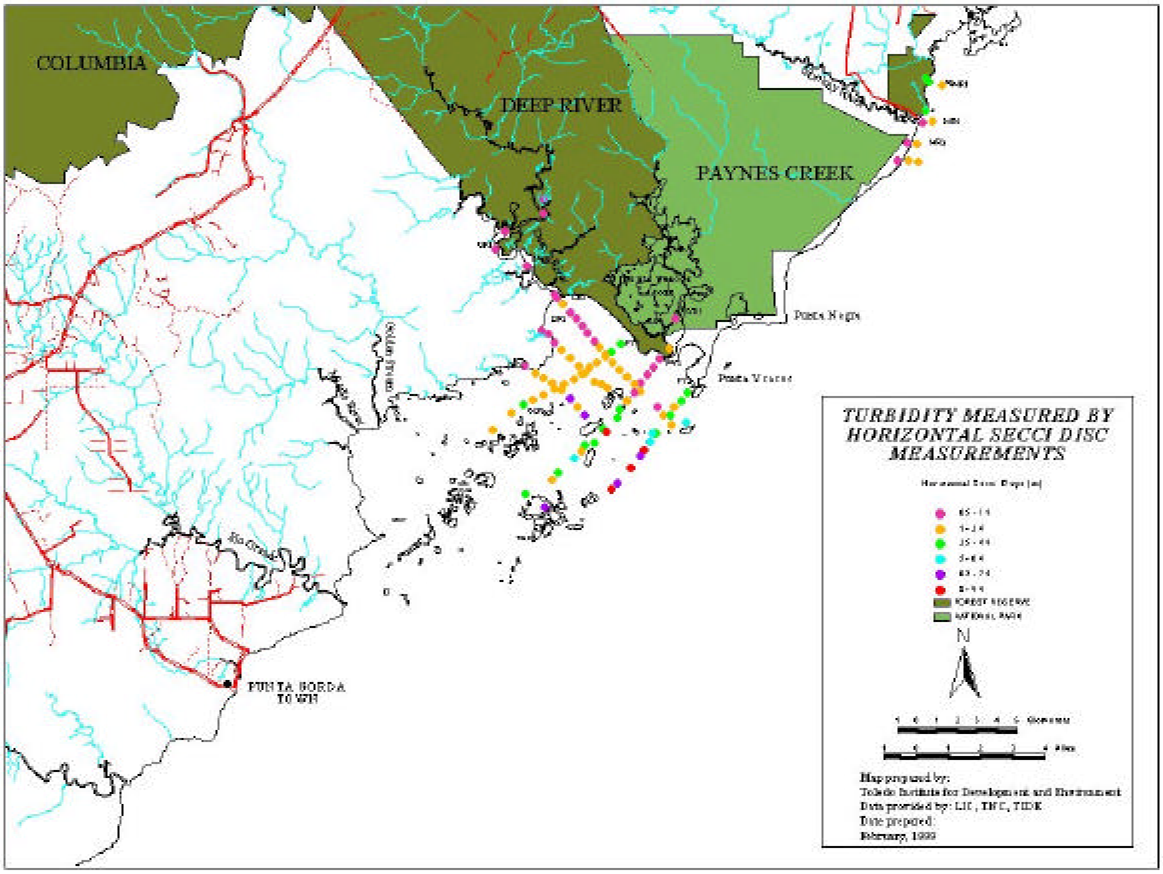
Secchi disk depth measurements were routinely made in the northwest part of the Gulf from March to September 2001 (WRIScS, 2001). These field studies showed that seawater transparency increased eastwards from about 4 meters in the near-shore area to a maximum of 33 m observed in March (dry season) in a relatively deep channel (approximately 30 m depth) on the inner side of the barrier reef. Farther offshore water transparency decreased to about 23 m.

A similar pattern with the clearest water (darker area) can be observed on the inner side of the barrier reef, seen in Figure 2.3-5, that is, in the area not exposed to the impact of wind waves and swell. From this area this transparent seawater is advected toward the southern coast of the Gulf (Figure 2.3-5).

Near the coast and close to river mouths, water transparency may drop to less than 1 m even during dry season (Figure 2.3-6) indicating that rivers are not only a source of terrigenous material but they are a source of nutrients that increase phytoplankton productivity.

Figure 2.3-5. AQUA MODIS (Moderate Resolution Imaging Spectroradiometer) image of the Gulf of Honduras Area (MODIS Band Combination: 1, 4, 3) Showing a Pattern of Low Turbidity Water Formed on the Inner Side of the Barrier Reef

Figure 2.3-6. Seawater Transparency Distribution Close to Deep River Mouth in February 1999



Source: PROARCA COSTAS, 2003

2.3.1.4 Water Chemistry

The major source of information on space-time variability of chemical parameters describing water quality in the Gulf of Honduras is the data collected on a regular basis throughout 1998-99 at several locations in the western part of the Gulf (Port Honduras) in the framework of the Belize Water Quality Monitoring Program (CZMAI, 1999). These data provide a description of temporal variability of major biochemical parameters, such as the dissolved oxygen (DO), pH, nitrate, phosphate, and chlorophyll-a, in the lagoonal, estuarine and open shelf environments.

Dissolved oxygen concentration in seawater is one of the important characteristics of marine ecosystems. There are two major biochemical processes that control the level of DO in seawater. These processes are photosynthesis and respiration. DO concentrations are also a function of water temperature and salinity.

In 1998-99 the values of DO concentration ranged from 5.2 to 9.6 mg/l. The lowest values were found in the areas of wastewater discharge, which also correlated with elevated levels of organic matter. In other areas, such as parts of the Bahía de Amatique without bottom vegetation, DO concentrations can drop to

0.9 mg/l (Yañez-Arancibia *et al.*, 1994) due to high oxygen consumption resulting from organic matter decomposition. High DO concentrations were found in areas close to coral reefs, also known for their low primary productivity (depressed levels of organic matter).

The *pH* is another biochemical parameter that quantifies alkalinity of seawater. Same as dissolved oxygen, pH of seawater depends on the process of respiration. Low pH may be brought about by carbon dioxide, produced through decomposition of organic matter, dissolving in water and forming carbonic acid. In the western part of the Gulf, the pH values ranged from 7.4 in lagoons and estuaries, to about 8.8 in the areas close to coral reefs. Lower values of pH were observed in the semi-enclosed Bahía de Amatique (Yañez-Arancibia *et al.*, 1994), where they ranged from 5.8 (no vegetation) to 7.4 (seagrass bed of *Thalasia testundinum*).

Nitrates and *phosphates* are the biogenic elements crucial for maintaining high levels of primary productivity. The main sources of these elements in coastal water are rivers, where nutrient concentrations can be elevated due to agricultural activity in the area, in particular due to use of fertilizers, and near sewage discharges. In the northeastern part of the Gulf, elevated concentrations of nutrients may be associated with open sea and coastal upwelling during winter months (Yañez-Arancibia, 1994).

Nitrate and phosphate concentration measured at several sites ranged from undetected levels up to 7.0 μM and 1.0 μM, respectively (CZMAI, 1999). Low levels of nutrient concentrations were consistently found in open shelf areas and close to coral reefs. High concentrations appeared sporadically in the coastal zone, which might be a result of nutrient load with river runoff and/or resuspecsion of sediments (CZMAI, 1999).

Section 5.3.6 provides an estimate of the nutrient and BOD conditions for the entire Gulf. Except as cited above, however, little quantitative field data exist to describe nutrient conditions on a time – and space – averaged basis.

Chlorophyll-a concentrations, characterizing the level of primary productivity, ranged from undetected to 0.55 mg/l. The highest concentrations only slightly exceeded an approximate eutrophication threshold (CZMAI, 1999).

2.3.2 Ocean and Coastal Currents

2.3.2.1 Large-Scale Circulation Patterns

The following processes determine shallow and open sea circulation in the Gulf of Honduras. The open sea region is affected by basin-scale circulation features of the Caribbean Sea, the Caribbean Current, and a quasi-permanent cyclonic eddy generated in the southwest corner of the Cayman Trench (Figure 2.3-7). The formation of this cell of cyclonic circulation in the region is a combination of two different and complementary dynamic phenomena. One might be associated with a dynamic response to the interaction of the mean current with the coast of Central America. Another mechanism may be associated with the local wind- and buoyancy-driven cyclonic circulation (Brenes *et al.,* 2001). This cyclonic eddy is most pronounced during winter months, when the ITCZ shifts south and trade winds intensify in the area of the Gulf. The eddy is centered at about 19°N, 86°W (Heyman and Kjerfve, 2000), and the sea surface has a negative 0.2 m height anomaly. The maximum current velocity at the periphery of the eddy is 0.2 to 0.4 m/s.

Figure 2.3-7. Oceanographic Currents in the Gulf of Honduras
(See Appendix D)

The persistent northeasterly trade winds cause downwelling along the coast of Belize and thus the local wind-driven circulation pattern can be described as a southward flowing cyclonic coastal current. Long-term current measurements along the shelf edge in the Gulf north of Gladden Spit (Heyman and Kjerfve, 2000) indicate a persistent reef-parallel flow towards the south with the speed ranging from 0.1 to 0.2 m/s, which was well correlated with local variations in wind speed and direction. This southward slow flow of water persists for most of the year. It may sometimes reverse in summer and flow northward, as observed in the months of September and October 2000 (WRIScS, 2001), when the southward component of trade winds is minimal.

As shown by Brenes *et al.* (2001), the conditions favoring coastal upwelling can occur during winter months in the eastern part of the Gulf. The associated wind-induced density gradients would cause a long-shore westward flow, that is, a counter flow compared to the open sea current. The freshwater inputs are at a minimum during the winter season so this westward current is not opposed by buoyancy-driven circulation.

Buoyancy fluxes introduced by rainfall and river runoff during summer months and the associated horizontal density gradients also favor the existence of a coastal cyclonic (counter-clockwise) current. Murray and Young (1985) studied kinematic structure of such a coastal current associated with freshwater fronts off the coast of Nicaragua. A similar structure of coastal flows should be expected along the coast of the Gulf of Honduras. They showed that freshwater runoff results in a well-defined nearshore current, extending 20 – 40 km out from the coast. Important terms that drive the dynamics of a front are the Coriolis and frictional forces (eddy diffusivity). This coastal current can be characterized by a pronounced maximum in the along-shelf current velocity (up to 0.6 m/s) about 10 km off the coast, a complex cross-shelf velocity structure, and a counter current just seaward of the outer edge. Freshwater-induced density gradients account for about 80% of the flow velocity. These buoyancy-generated currents are important unidirectional conduits for long-shore transport of suspended material of terrigenous origin and pollutants introduced into the coastal waters by river flow.

Figure 2.3-7 shows summary information on the circulation patterns that persist in the Gulf of Honduras. There is a persistent counter clockwise long-shore flow over the shelf with a current speed of about 0.1 – 0.2 m/s, best pronounced off the coast of Belize. During summer months, the buoyancy-driven counter-clockwise coastal flow adds to the wind-driven current. During winter months, the buoyancy-driven circulation is at a minimum and the trade winds may induce coastal upwelling off the coast of Honduras and the associated westward long-shore flow. The open sea boundary is under the influence of a quasi-permanent cyclonic eddy generated in the southeast corner of the Cayman basin due to interaction of the Caribbean Current with the coast of Central America and wind.

2.3.2.2 Tides

The Cayman Sea has a microtidal range. The sea surface elevation induced by the tide is about 0.2 m (Kjerfve, 1981). The ration of the amplitudes of the major diurnal and semidiurnal tidal harmonics, F=(K1+O1)/(M2+S2), is about 1, so the mixed tides are mainly semidiurnal. The M2 tidal wave propagates in the Gulf from north to south. The response of the semidiurnal components is suppressed by about 40% relative to the expected theoretical values derived from astronomical forcing. The tidal constituents for the Carrier Bow Cay were published by Kjerfve *et al.* (1982).

Although the amplitude of the surface tide is small, the currents induced by the tide may be appreciable in constrictions, reaching at times 0.4 m/s in the major reef entrances (Greer and Kjerfve, 1982).

2.3.2.3 Waves

The trade winds, blowing persistently from December to May, give rise to both wind waves and swell. The waves are typically 1 – 3 m high with periods from 3 to 7 seconds (Heyman and Kjerfve, 2000). Waves during passage of hurricanes may have a significant wave height of up to 10 m and a period of 12.7 sec (Kjerfve and Dinnel, 1983). The mean wave direction is towards 255°. The ENE sector accounts for 87% of the frequency of occurrence of wave direction.

2.4 Ecosystems Vulnerable to Water Quality Degradation in the Gulf of Honduras

Mangroves, seagrass beds and coral reefs are among the most productive ecosystems on the planet, in terms of average net primary productivity, and are linked to one another in biologically important ways. The mangroves reduce the amount of sediment transferred to seagrass beds and coral reefs. At the same time, coral reefs reduce wave energy and thereby help to establish conditions favorable for the establishment of mangrove stands. In the coastal and marine areas of the Gulf of Honduras, these ecosystems play a critical role in supporting the rich marine biodiversity.

Amongst the western Caribbean coastal waters, the Gulf of Honduras is marked by richness in coral, seagrass, and mangrove habitats. Though these habitats occur elsewhere in the region, the Gulf of Honduras is notable in the richness of these resources.

2.4.1 Mangroves/Coastal Forests

The mangroves contribute significantly to the productivity of the Gulf of Honduras. The stands act as sediment traps in estuarine waters, thereby protecting coral reefs from sedimentation, and also serve as a physical buffer between the inland areas and marine storms. Additionally, mangroves are an important resource for aquatic species as they provide the main source of nutrients enriching coastal waters and supply feeding and nursery areas for coastal fish species.

Based on *in situ* surveys and the analysis of available information (Yañez-Arancibia *et a*l., 1994) four species of mangroves are observed to be growing in the region: *Rhizophora mangle* (red mangrove), *Avicennia germinans* (black mangrove), *Laguncularia racemosa* (white mangrove) and *Conocarpus erectus* (button mangrove). *Rhizophora mangle* is the dominant species.

Satellite imagery, aerial photographs, and field studies (Yañez-Arancibia *et al.*, 1994) revealed mangrove distribution in the following regions: Rio Sarstoon-Livingston, Livingston-Punta de Palma, Río Dulce-El Golfete River, Puerto Barrios and Punta de Manabique. Mangroves do not appear along the entire length of the coast as the types of soil and topography limit their distribution, as does the small tidal range. The majority of the coast is at an elevation well above mean sea level. The mangroves of the Sarstoon-Temash system and the Port Honduras-Payne's Creek system form the largest mangrove stand on the coasts of Guatemala and Belize. This area serves as critical habitat for the majority of marine species within and beyond the gulf. In Belize there are at least 1,300 km^2 of mangrove forest (Ellison), covering 3.4% of the national territory (Belize Ministry of Natural Resources, 1998). One study identified approximately 708 hectares of mangrove forests in the Atlantic Coastal region of Guatemala. There are 92 km of mangrove growth along the shores of the Bahía de Amatique (Yañez-Arancibia *et al.*, 1998). In Honduras, mangroves can be found in the Jeanette Kawas National Park (House *et al.*, 2002).

Table 2.4-1. Mangrove Coverage and Protection in the Gulf of Honduras Watershed in Guatemala, 1999

Department	Mangrove Coverage (ha)	Mangroves in Protected Areas (ha)
Jutiapa	1,115	1,114
Santa Rosa	4,910	3,543

Source: INAB, 2001

2.4.2 Seagrass Meadows

Seagrass habitats are important for fishery production, as a food source for certain threatened animal species and for coastal stabilization. In Belize, the seagrass provides important habitat for the Conch (*Strombus gigas*), which is the country's second most important commercial fish species.

As was shown by Yañez-Arancibia *et al*. (1994), *Thalassia testudinum* (turtle grass) is the predominant species. Other species such as *Halodule wrigthii* and *Syringodium filiform*, however, may occur. In Salvador Lagoon, there is a large bed of *Vallisneria americana*.

The presence and distribution of seagrass beds in any tropical region is related to the degree of water transparency, relatively surf-free environments, shallowness and availability of sandy bottoms. In the study area, these features are present only in some areas, such as Bahía de Amatique, in Graciosa Bay and off the coast of Belize. In these regions, analysis of satellite imagery reveals the presence of evenly distributed seagrass beds. The area covered by this type of vegetation is approximately 3,750.5 ha. At places, the sea grass beds reach a density of 1,433 plants per m^2 and a biomass in dry weight of 12.48 g/m^2 (Yañez-Arancibia *et al.*, 1994).

2.4.3 Coral Reefs

An extensive overview of the modern status of coral reefs in the region can be found in Kramer and Kramer (2000). In Belize, the second longest barrier reef in the world (MBRS) extends for 250 km and covers 22,800 km^2 as an assemblage of lagoon patch reefs, fringing reefs, and offshore atolls. It is unique due to its size, the vast array of reef types, the richness of the corals and its relatively pristine condition and has been declared a World Heritage ecosystem. The outer edges of the reef are marked by deep water corals, sponges, and soft corals, with more delicate finger and palmate corals growing above them. With nearly 60 coral species, it is one of the most diverse coral reefs in the western Atlantic. The reef system is closely linked to coastal wetlands, lagoons, seagrass beds and mangrove islands. This network of habitats is able to support as many as 350 mollusk and 500 fish species.

The southern part of this reef system borders the Gulf of Honduras. The southern reefs are discontinuous and less developed when compared to northern Belize. Large freshwater loads from the Motagua, Sarstoon and Dulce rivers limit reef development to a few isolated corals and small patch reefs in the Gulf of Honduras itself. Several reef islands are located near the eastern boundary of the Gulf. Results of recent coral reef research in this area were published by USGS (2001).

Coral bleaching in response to elevated seawater temperatures was reported for much of the Caribbean during 1983 and 1987, and the first well-documented mass bleaching event in Belize occurred in 1995 where 52% of coral colonies bleached (Kramer and Kramer, 2000). These impacts in 1995 were also observed in Cayos Cochinos, Honduras, where 73% of scleractinian corals and 92% of hydrocorals bleached and higher mortality was reported.

2.5 Biodiversity and Protection Status in the Gulf of Honduras and its Watershed

The Gulf of Honduras region serves as habitat for some of the world's significant biodiversity, both terrestrial and marine. The vast and varied forests that cover much of the watershed in Belize, Guatemala and Honduras are species rich areas that provide cover for thousands of species. The Gulf of Honduras is a highly productive region due to rivers transporting nutrients from the land, the nutrients from the open sea, and the close proximity of the swampy mangrove areas, the seagrass beds and the coral reefs. These factors all contribute to the significant biodiversity found in the region.

In its First Interim National Report to the Convention on Biological Diversity, Belize documented 571 species of birds, 162 species of mammals, 121 species of reptiles, 43 species of freshwater fish, 117 species of total inland fish, 157 mollusks, 43 species of amphibians, 288 species of Lepidoptera, 176 species of Odonata and 2 other terrestrial invertebrae. Two amphibians and one reptile species are endemic.

According to Guatemala's National Biodiversity Strategy, throughout the country there can be found 738 bird species, 251 mammals, 112 amphibians, 214 reptiles and 651 fish species. There are 8,000 flowering plants, 652 ferns and 1,171 endemic species of higher plants (UNEP, 1999).

The National Biodiversity Strategy and Action Plan of Honduras lists 7,524 plant species (including 134 endemic species), 744 birds (5 threatened with extinction), 231 mammals (3 endemic species and 8 threatened with extinction), 200 reptiles (27 endemic), 116 amphibians (38 endemic) and 194 species of fish including those in the exclusive economic zone of the Atlantic.

The Gulf region's marine biodiversity is outlined in more detail below as it is of greater interest to the current study.

2.5.1 Marine Biodiversity

The Gulf of Honduras is rich in marine biodiversity including tropical coastal fisheries, reptiles (snakes, turtles and crocodiles), and marine mammals (manatees). Salaverría and Rosales (1993) reported more than 45 species of fish, mollusks and shellfish in the Bahía de Amatique, while others have identified as many as 194 fish species in the Atlantic Ocean off the coast of Honduras (House *et al.*, 2002). A study of species diversity in the Punta de Manabique protected area found 100 species of fish off the coast of Guatemala, representing 54 families (FUNDARY-ONCA). The reptiles include snakes (*Boa constrictor*), American crocodile (*Crocodylus acutus*) (Platt and Thorbjarnarson, 2000), brown caiman (*Caiman crocodilus*), loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), and leatherback turtle (*Dermochelys coriacea*). The fish species that have commercial importance are mackerel, snook, calale, jackfish, mojarra, palometa, corvina and shark.

The amount of coastal and marine species found on the Atlantic coasts of Belize and Honduras is summarized in the tables below. Detailed information was not available for Guatemala for this study, however.

Table 2.5-1. Summary of Biological Diversity in Caribbean Coastal and Marine Areas in Belize, 1998

Taxa	Coastal		Marine	
	Genera	Species	Genera	Species
Fish	37	173*	229	472
Invertebrates	29	45	296**	456
Reptiles	17	124	5	7
Amphibians	6	7	-	-
Insects	152	240***	-	-
Birds	128	177	34	47
Mammals	37	39	4	5
Plants	188	235	66	315
Sub-Total	**594**	**627**	**338**	**1,302**

* Includes freshwater species
** Some genera and species inferred from carefully analyzed geographic distribution data
*** Including counts from rivers, forest, coastal creeks, beaches, and cayes
Source: Belize National Biodiversity Action Plan, NBC, MNREI, 1998

Table 2.5-2. Invertebrates and Urochordates in the Honduran Coastal Waters of the Caribbean

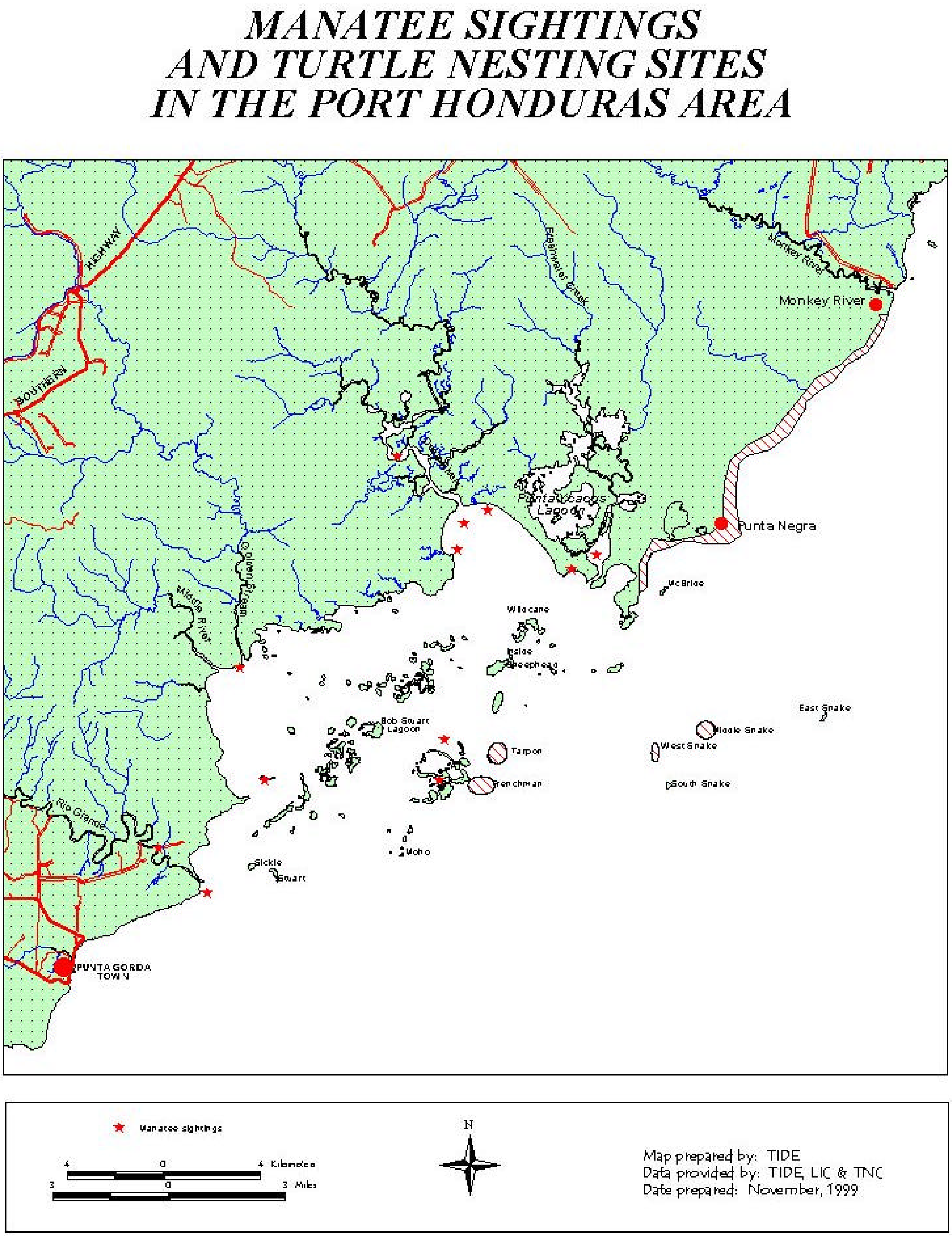
Group	Order	Genera	Species
Sponges*	17	59	23
Celenterata	12	70	103
Ctenophores	n.d.	4	4
Anelids	2	10	11
Mollusks	10	41	332
Arthropods	5	29	33
Equinoderms	4	17	24
Urochordates	n.d.	7	7
TOTAL	**50**	**237**	**537**

Source: Roatan Institute Marine Sciences (RiMS), 1999; Proyecto Utila, 1999; Cerrato, 1986.
*Harbour Branch Oceanographic Institution, 1998.

2.5.2 Endangered Species

A number of threatened and endangered species enjoy the rich habitat of the Gulf of Honduras. The most notable among these are the manatee and sea turtle species. The Gulf provides food and habitat for reproduction and growth of the Caribbean's largest population of *Trichechus manatus*, or West Indies manatee, with 300 to 700 manatees in total. The West Indies manatee is an endangered marine mammal that lives in the lagoons of the Gulf of Honduras. Manatees average 3.3 m in length and weigh between 700 and 1000 kg and move relatively slowly, making them easy targets for boats and poachers. The Gulf of Honduras also provides reproduction and nesting sites for green, leatherback and hawksbill turtles, all of which are endangered. The major manatee habitats and sea turtle nesting areas in the western Gulf of Honduras are shown in Figure 2.5-1.

Figure 2.5-1. Manatee Habitats and Turtle Nesting Areas in the Port Honduras Area



Source: Proacra costas, 2003

The protection and enforcement status of coastal and marine species of greatest commercial and ecological interest off the coast of Belize and Guatemala is outlined in Tables 2.5-3 and 2.5-4. As is shown below, protection measures for the species that have some sort of protected status are either inadequate or not adequately enforced, indicating that the species face continued threats to their survival. Similar information on the status of species on the Atlantic coast of Honduras was not available for this study.

Table 2.5-3. Status of Coastal and Marine Species of Primary Interest in Belize, 1998

Taxa	Threatened with Protective Status	Threatened And Unprotected	Protected but Enforcement Lacking	Protection Measures not Adequate
Hawksbill	+		+	
Green Turtle	+		+	
Loggerhead	+		+	
American Crocodile	+		+	+
Morelets Crocodile	+		+	+
Nassau Grouper		+	+	+
Queen Conch	+		+	+
Common Snook		+		
Bonefish	+		+	
Jewfish		+		
Tarpon		+		
Permit		+		
Manatee	+		+	+
Hicatee	+		+	+
Sharks		+		
Marine Aquarium Fish		+		
Brown Nuddy	+			+
Woodstork	+			+
Bay Breasted Warbler	+			+
Cape May Warbler	+			+
Brown Booby	+			+
Roseate Spoobill	+			+

Source: Belize National Biodiversity Action Plan, NBC, MNREI, 1998

Table 2.5-4. Status of Coastal & Marine Species of Primary Interest in Guatemala

Taxa	Threatened with Protective Status	Threatened and Unprotected	Protected but Enforcement Lacking	Protection Measures not Adequate
Manatee	+		+	
Dolphin	+			+
Sea Turtles	+		+	

Source: FUNDAECO

2.5.3 Protected Areas

In order to preserve the wealth of terrestrial and marine species in the region, Belize, Guatemala and Belize have established a great many protected areas. Belize's system of protected areas was begun more than 75 years ago, whereas Guatemala and Honduras did not establish national parks and reserves until more recently. In the case of Honduras, it was not until 1993.

Since the Belize Forest Department was established in 1927, 50 protected areas have been designated nationally. These include 19 Forest Reserves, 16 National Parks, 4 Nature Reserves, 7 Wildlife Sanctuaries, 4 Natural Monuments and 5 Private Reserves. Two World Heritage Sites and one RAMSAR Site have been designated in the country. More than 43% of the national territory is currently under some level of protection.

Nationally, 3,192,997 ha are included in 120 protected areas in Guatemala, which is equal to 29.3% of the country's territory. These protected areas encompass areas of great ecological value. For example, the Sarstoon River Game Reserve on the Belizean border of Guatemala includes critical habitats such as mangroves and subtropical forests. The reserve provides habitat for a number of endangered species (storks, herons, fishing eagle, toucan, jaguar, manatee, tapir, wild boar, otter and crocodile), as well as commercially important species such as mollusks and fish (Yañez-Arancibia *et al.*, 1998). The Rio Dulce National Park was designated to protect tropical rainforests and manatee habitat. This area is threatened by the destruction of coastal vegetation to build tourist infrastructure, the discharge of untreated wastewater, agriculture and forestry activities.

In Honduras, 102 protected areas cover roughly 27% of the national territory. As of 2002, 75 of these areas were legally established and 61 had legally established territory, equaling 2,121,326 ha, or 18% of the country (Vreugdenhil et al, 2002). In addition to serving as a means to preserving important biodiversity, many of the protected areas are popular tourist destinations. In the year 2000, the Jeannette Kawas National Park in Honduras logged 3,000 visitors (Informe Nacional de Areas Protegidas de Honduras).

Table 2.5-5 lists some of the protected areas that are located in the Gulf of Honduras and its watershed.

Table 2.5-5. Protected Areas in the Gulf of Honduras Region

Belize	Guatemala	Honduras
• Forest reserves: • Swasey Bladen (5,981 ha) • Maya Mountain (51,845 ha) • Columbia River (41,658 ha) • Monkey Caye (591 ha) • Deep River (31,798 ha) • Machaca Creek (1,520 ha) • Río Blanco National Park (40 ha) • Sarstoon Temash National Park (16,956 ha) • Aguacaliente Luha Sanctuary • Paynes Creek National Park (12,819 ha) • Port Honduras Marine Reserve • Gladden Spit Marine Reserve • Sapodilla Cays Marine Reserve (13,517 ha)	• Río Dulce National Park (7,200 ha) • Río Sarstoon Special Protection Area (9,600 ha) • Chocón Machacas Protected Biotope (6,265 ha) • Manantiales Cerro San Gil Protected Reserve (47,433 ha) • Cierra Santa Cruz Special Protection Area (46,600 ha) • Sierra Caral Special Protection Area (25,200 ha) • Punta de Manabique Special Protection Area (139,300) • Santo Tomás de Castilla National Park (1,000 ha)	• Cusuco National Park • Jeannette Kawas National Park • Punta Izopo National Park • Lancetilla Botanical Garden

Source: PROARCA/APM Site Descriptions – Gulf of Honduras

Protected areas in the Gulf of Honduras and its watershed are exhibited on Figure 2.5-2.

Figure 2.5-2. Protected Areas in the Gulf of Honduras
(See Appendix D)

In recent years, interest has been growing in developing marine protected areas. These areas under varying levels of protection have the goal of preserving some of the most productive and species-rich ecosystems, which are often popular tourist destinations. The table below lists the marine protected areas that have been designated by the Government of Belize.

Table 2.5-6. Areas for Existing Marine Protected Areas in Belize

Marine Protected Area	Total Area (ha)	Marine Area (ha)	Marine No-Take Area (ha)
Corozal Bay	73,050	72,350	-
Bacalar Chico Marine Reserve & National Park	11,487	6,303	1,699 (**a**)
Hol Chan	1,638	1,545	273
Caye Caulker Marine Reserve & Forest Reserve	3,951	3,913	-
Half Moon Caye	3,954	3,921	3,921
Blue Hole	414	414	414
Glover's Reef	32,876	32,834	7,226
South Water Cay	47,703	46,833	-
Laughing Bird Caye	4,095	4,077	1,020 (**b**)
Total	**179,168**	**179,190**	**14,556**

(**a** – The zones for this reserve are not yet legally established but have been implemented on an unofficial basis; **b** – Unofficially, a 1-mile radius around the caye is respected as a "no-take" zone)

Source: CZMAI, 1999

Additionally, proposals have been set forth for the establishment of a Belize-Guatemala-Honduras ecological park that would encompass coastal, insular and maritime areas of the three countries. Objectives of the park include preserving biological and genetic diversity, conserving ecosystems, promoting sustainable use by protecting commercially viable species, promoting education and research and promoting recreational and tourism use. Efforts to establish the tri-national ecological park have been hindered by the territorial dispute between Guatemala and Belize, however.

3.0 Socio-Economic and Development Setting

3.1 Population and Demographic Patterns in the Gulf of Honduras Watershed

The Gulf of Honduras drainage basin encompasses large sections of Belize, Guatemala and Honduras, three culturally and resource rich countries. In Belize the Toledo and part of the Stann Creek Districts, the country's two southern-most regions, are located within the watershed. In Guatemala, the watershed includes all or portions of 16 of Guatemala's 22 departments, including the capital Guatemala City and the majority of the population. The watershed in Honduras covers all or parts of 11 of the country's 18 departments.

Overall, the three littoral states have achieved varying levels of political, economic and social development. Belize, which has reached a comparatively high level of development ranked at 58 in the world by the 2002 UNDP Human Development Report, was under British control until only two decades ago. Since independence, Belize has enjoyed political stability, steady development and has become a popular tourist destination. Honduras and Guatemala are ranked much lower on the human development index and have experienced more political upheaval and poverty. Guatemala was ravaged by civil war for nearly four decades that did not end until a 1996 peace accord was signed. Turmoil in Nicaragua and El Salvador has spilled over into Honduras in recent decades, hindering development and causing great movements in population. Natural disasters, such as Hurricane Mitch which blasted the region in 1998, have further impeded development in the Gulf of Honduras littoral countries.

Table 3.1-1 indicates the relative world development rankings of the three Gulf of Honduras countries and important national development statistics.

Table 3.1-1. Human Development Indicators

Country	2002 HDI	World Rank	GDP per Capita	Life Expectancy
Belize	0.784	58	5,606	74.0
Guatemala	0.631	120	3,821	64.8
Honduras	0.638	116	2,453	65.7

Source: Elaboracion propia con base en PNUD, 2002
(from UNDP Informe Sobre Desarrollo Humano Honduras 2002)

Despite the overall disparities in development among the three countries, the populations located within the geographic region of the Gulf of Honduras watershed experience many similar circumstances. The watershed is predominately rural, ethnically diverse with a large percentage of indigenous peoples, and agrarian-focused.

Another characteristic of the rural areas in the watershed is limited access to basic services such as education, healthcare, water and electricity. The Toledo District of Belize has been determined to be the most indigent region in the country, largely due to the lack of basic social services. Roughly 80% of the communities in southern Belize do not have even a rudimentary water system (IADB, 2000). A report prepared for the IADB listed health threats due to inadequate access to potable water and sanitation as one of the greatest threats to regional development on the north coast of Honduras (Niklitschek *et al.*, 2002).

The watershed is also home to many indigenous populations, including Q'ekchi Maya, Mopan, Culies, Garifuna, Creole and Mestizo. In general, particularly in Guatemala where indigenous rights are not as developed, the indigenous populations are less likely to have achieved higher education and more likely to have a lower standard of living than non-indigenous populations.

3.1.1 Current Population and Population Growth Rates

The total population of the administrative districts that are located in total or in part in the Gulf of Honduras watershed is 12.4 million. Approximately 2 million of these live in the large urban centers of Guatemala City, Guatemala and San Pedro Sula, Honduras. Large portions of the watershed population, however, are rural. Population size by administrative district in the Gulf of Honduras watershed is shown in Figure 3.1-1. National population figures and population growth rates are listed in Table 3.1-3.

Figure 3.1-1. Population in the Gulf of Honduras Watershed by Administrative District
(See Appendix D)

Table 3.1-2. National Population and Population Growth Rates in the Gulf of Honduras Countries

Country	Population (2000) millions	Annual Pop. Growth Rate (1975-2000)	Annual Pop. Growth Rate (2000-2015)	Population (2015) millions
Belize	0.2	2.1	1.6	0.3
Guatemala	11.4	2.6	2.4	16.3
Honduras	6.4	3.0	2.0	8.7

Source: UNDP 2002 Human Development Report

Several smaller population centers are located in the Gulf of Honduras coastal zone, which directly affects the coastal and marine ecosystems. Roughly half a million people live along the coast of the Gulf of Honduras. Nonetheless, as is shown in Figure 3.1-2, population density in the coastal zone is very low.

Figure 3.1-2. Population Density in the Coastal Zone of the Gulf of Honduras Watershed
(See Appendix D)

Two sparsely populated administrative districts are included in the Gulf of Honduras watershed in Belize: Toledo and Stann Creek. In 2000, fewer than 50,000 persons were registered in these two districts. Urbanization in these districts is low and is actually decreasing due to agriculture serving as the dominant economic activity in the area. The population density of Southern Belize is currently the lowest in the country, at 21 persons per square mile in the Stann Creek District and 11 persons per square mile in the Toledo District (IADB, 2000) (See Table 3.1-3). While the population remains low, population growth is high in the region. In only the last 20 years, the population in the Toledo and Stann Creek Districts has doubled. Migration is another factor affecting the population in Southern Belize as unskilled workers move into the area from Honduras and Guatemala. Migration into the area is often spurred by economic problems or natural disasters in nearby countries, such as Hurricane Mitch (IADB, 2000).

Table 3.1-3. Population Density in the Southern Region of Belize by District, 1970-1998

District	Area (sq. km)	Density per square kilometer			
		1970	1980	1991	1998
Stann Creek	2,554	5.10	5.55	7.19	9.38
Toledo	4,413	2.04	2.67	4.16	5.13

Source: Belize CSO

According to the 2002 census, roughly 7.8 million people live in the Guatemalan section of the Gulf of Honduras watershed. Included in the watershed is the capital of Guatemala, Guatemala City, with a population of nearly 1.5 million people. Santo Tomás de Castilla, Livingston and Puerto Barrios are the largest population centers on the Atlantic coast of Guatemala.

The 2001 census found the population in the Honduras section of the Gulf of Honduras watershed to be 4,547,491 and that the rate of urbanization was fairly high. In the two major river basins in this area, the population density is also relatively high. While the Ulúa basin covers 19% of the country, it is home to 33% of the population, reaching a density of 49 inhabitants/km^2. Approximately 71% of the population is urban. The Chamelecón basin covers only 4% of the country but has 19% of the population with a density of 137 inhabitants/km^2 (CIAT). The population centers on the coast include Puerto Cortés with a population of 51,000, San Pedro Sula with a population of 350,000, Tela with 25,000 and La Ceiba with 80,000.

3.1.2 Literacy Rates

Access to education varies greatly between the rural and urban areas in the watershed. The poor are much less likely to have educational opportunities than are the non-poor. Additionally, particularly in Guatemala, girls are less likely to receive higher education than are boys (World Bank, 2003).

While overall education rates in Belize are high for the Central American region, the southern area of the country has an unusually low average level of education. In the Toledo District of Belize access to education is very limited and there are only a few primary schools, which is inadequate for the size of the population. For example, there is only one secondary school in Punta Gorda (DHV Consultants, 1994). In 2000, only 6.4% of the population of the district had reached a secondary level of education (Belize Central Statistical Office, 2000).

Guatemala has one of the lowest schooling averages in Latin America, second only to Haiti, and education funding has traditionally been among the lowest in the region at only 1.7% of GDP, compared to 3.6% in Honduras (UNDP, 2002). Table 3.1-4 provides information on national literacy rates in the Gulf of Honduras countries, along with statistics on public expenditure on education.

Table 3.1-5. Literacy rates and education spending in the Gulf of Honduras countries

Country	Adult Literacy Rate (2000)	Public Education Expenditure (% of GDP) 1995-97	Public education expenditure (% of total govt. expenditure) 1995-97
Belize	93.2	5.0	19.5
Guatemala	68.6	1.7	15.8
Honduras	74.6	3.6	16.5

Source: UNDP 2002 Human Development Report

3.1.3 Access to Healthcare

Similar to education, access to healthcare in the Gulf of Honduras watershed differs greatly between rural and urban areas. While many urban areas now have improved health services, those living in more sparsely populated, and largely indigenous, areas have much less access to even basic healthcare. The problems with the lack of healthcare are exacerbated by the lack of potable water supplies and sanitation and the poverty that often results in malnutrition. As a result, infant mortality rates remain high in many of the more rural areas and illnesses such as cholera and diarrhea are common.

Healthcare services in the Toledo and Stann Creek Districts of Belize remain basic despite improvements in other areas of the country (DHV Consultants, 1994). In 2000, there were only six health centers located in the Toledo District and 9 in Stann Creek (Belize Central Statistical Office, 2001). The Toledo District also has some of the highest numbers of infectious diseases in the country. In 1999, more than 1,000 cases of malaria and 12 cases of cholera were counted (Belize Central Statistical Office, 2000).

In Guatemala, approximately 54% of the country's population has access to healthcare, but the majority of doctors are located in the vicinity of Guatemala City. Those living in rural areas have much less access to healthcare than the national average. The country's infant mortality rate is high and about 60% of young people suffer from malnutrition (UNEP, 1999). According to a recent World Bank report, Guatemala ranks last in Latin America and the Caribbean for life expectancy, infant mortality and maternal mortality (2003).

Those living in urban areas in Honduras have greater access to healthcare than do those in rural areas. For example, Puerto Cortés has a regional hospital as well as private clinics. The infant mortality rate for the city is 29 per 1,000 live births, lower than the national average of 32 (Banco Interamericano de Desarrollo, 1997).

Those living in the coastal zone of Guatemala and Honduras have increased health problems compared to the average in the countries. Coastal residents have higher rates of mortality and morbidity caused by infectious diseases, parasites, nutritional deficiencies, and a lack of access to basic services such as potable drinking water, sewage and adequate healthcare services (OAS, 1998).

Table 3.1-5 provides basic national healthcare statistics for the Gulf of Honduras countries.

Table 3.1-5. Healthcare Statistics in the Gulf of Honduras Countries

Country	Infant Mortality Rates (2000)	Physicians (per 100,000 people) 1990-99	Health expenditure per capita (PPP US$) 1998
Belize	34	55	82
Guatemala	44	93	78
Honduras	32	83	74

Source: UNDP 2002 Human Development Report

3.2 Regional Economic Characteristics

3.2.1 Structure of Economic Output in the Watershed

The economies in the region are largely agriculturally based, with bananas, coffee and sugar being the lead export products. Guatemala is also the world's leading exporter of cardamom. Recently, however, light manufacturing of clothing and textiles has increased in Guatemala and Honduras. Other manufacturing done in the watershed is food processing, chemicals and paper. Tourism in the watershed is also one of the fastest growing sectors.

Poverty in the watershed is high, particularly in the rural regions. While 33% of Belize's population is below the poverty level, 43% of those in rural areas are poor (Belize Ministry of Natural Resources, Environment, and Industry, 2002) and a disproportionate amount of these are located in the Toledo District.

A very high percentage of all Guatemalans live below the poverty level even though the country has the largest economy in Central America. Guatemala has the third highest degree of inequality among low- to middle-income countries in the world and the indigenous population is much more vulnerable to poverty than the non-indigenous. 44% of the children in Guatemala under the age of five are stunted due to malnutrition. More than 81% of the poor and as high as 93% of the extreme poor in Guatemala live in rural areas (World Bank, 2003).

Honduras is ranked as one of the lowest-income countries in the Western Hemisphere. Even though the poverty rate in Honduras decreased by 10% during the 1990s, in 1999 nearly 75% of the country's rural population was still considered poor (World Bank Honduras Poverty Diagnostic, 2001). While the economies of Guatemala and Honduras had been improving in recent years, Hurricane Mitch in 1998 had a devastating effect on economic output in the region

3.2.2 Future Trends in Economic Output in the Watershed for the Next 10 Years

Economic development is projected to continue to increase in the region in the future. Because the countries are so heavily dependent on natural resources, however, their ability to protect the environment will affect their prospects for development of the agriculture, fishing and tourist industries.

One of the most distinguishing trends in the region's economy is the strengthening role of tourism, led by Belize. While most tourists have traditionally visited areas outside the boundary of this project study area, such as the northern areas of Belize in the vicinity of the coral reefs and the bay islands of Honduras, tourism is now spreading into other areas. As southern Belize is made more accessible via roads, additional hotels are being built to attract visitors. Areas on the Atlantic Coast of Guatemala are becoming tourist destinations, and cities such as Puerto Cortés in Honduras are building hotels. A 1998 sustainable development plan for the coastal zone of Guatemala and Honduras focused on tourism development as its centerpiece, highlighting its future potential (OAS).

Another trend that seems to be emerging in the region, particularly in Guatemala and Honduras, is increasing industry. In the near future Guatemala's production of crude oil, used mainly for asphalt and other derivatives, is expected to continue to increase. Additionally, the clothing and textile industries emerging in the area appear to be growing. The sustainable development plan for the Atlantic Coast of Guatemala and Honduras encourages the development of food processing industries in the region (OAS, 1998).

At the same time, the overall role of agriculture in the countries' economies will likely continue to diminish. The coffee market has contracted due to a structural terms-of-trade decline, and while other non-traditional products have been grown in its place, they have not offset the income and employment lost as a result of the coffee crisis (World Bank, 2003). Over the last three decades, the importance of agriculture to Honduras's national economy has been diminished significantly, while the role of industry has steadily increased (Cotty et al., 2002). Between 1990 and 2001, agriculture, forestry, livestock and fisheries fell from 25.9% of the GDP to 22.6% (UNDP, 2002). Nonetheless, the agricultural sector will continue to be the largest employer in the region for the foreseeable future due to its labor intensive nature and the high percentage of the population engaged in subsistence farming.

Forecasters predict an increasing need for maritime transport in the future as globalization continues. Larger numbers of tourists will bring in additional cruise ships. The increased oil production in Guatemala will necessitate more maritime transport. A proposal has been developed to build a large power plant in the vicinity of Puerto Cortés that would be fueled by liquid natural gas (AES Honduras, 2001). The LNG would be brought in by tanker through the Puerto Cortés navigation channel and offloaded at the Texaco installation. This has the potential to increase shipping of hazardous materials into the Gulf of Honduras. And as the economies in the region continue to grow there will be even greater exchange of goods between the region and its trade partners. The signing of the trade agreement between Central America and the United States will likely result in increased shipping in the region, although no conclusive studies of the impacts of the trade agreement have yet been completed.

3.3 Industries Impacting and Impacted by the Gulf of Honduras

The economic activities taking place in the Gulf of Honduras and its watershed both depend upon and affect the Gulf of Honduras region environment. Agriculture, aquaculture, fisheries and tourism require clean water and other natural resources. At the same time, these industries have the potential to negatively affect the region's environment through dispersal of harmful chemicals, the use of destructive fishing methods and sedimentation of waterways. In Sections 3.3.1-3.3.6 below the major industries in the region are discussed in terms of their current status and role in the regional economy. In section 5.3, each of these industries is discussed in greater detail in terms of its effects on the marine and coastal environment in the Gulf of Honduras.

3.3.1 Agriculture

Despite its declining economic influence, agriculture remains the dominant economic activity in the Gulf of Honduras watershed. It also continues to be the largest sector of employment for the region's population. For example, more than 30% of southern Belize's labor force, or 5,000 people, is engaged in the activity. At the same time, the average wage provided by agriculture is significantly lower than that of other industries such as tourism (IADB, 2000).

Agriculture takes place at both the subsistence and the commercial levels in the watershed. The small-scale farming methods used in the region are very labor intensive and primarily non-mechanized, but are productive. Other crops that are cultivated for export, such as bananas, are grown on larger plantations. Bananas are an important export product for all three Gulf of Honduras countries. Additionally, coffee is a major product of Guatemala and Honduras. Other crops grown in the region include cardamom, sugar, citrus fruits, rice, cacao, beans and corn. Subsistence farming focuses on basic crops such as corn, beans and maicillo. Rubber plantations are also present in the region and the farming of African palm is expanding. Export is currently primarily limited to coffee, cacao and banana, however.

3.3.2 Commercial and Artisanal Fisheries

The Gulf of Honduras sustains a number of commercially-exploited species including, populations of shrimp, lobster, conch and scale fish (swordfish, jurel, sea bass, barracuda, tuna, *pejerrey* and anchovy) and there is an active fishing population in each of the Gulf countries. Additionally, flyfishing has become a popular tourist activity in the region. Species caught include shad, *pompano* and sea bass. One study indicates that in the entire Gulf of Honduras region landings reach approximately 14,300,000 pounds of fish annually, valued at approximately US$ 11,400,000 (Heyman *et al.*, 2002).

The waters off of southern Belize are potentially the richest in the country, including the best shrimping grounds, which are found in the far south near the mouths of the Moho, Temash and Sarstoon Rivers. Belize has both an artisanal shrimp fishery and industrial trawl fishery. The artisanal shrimp fishery uses only small skiffs and canoes and consists of about 200 fishermen (Gladden Spit Marine Reserve), whereas the industrial fishery consists of large fleets. In 2001, 10 trawlers were operating in the southern waters of Belize and produced more than 150,000 lbs. of shrimp for both local consumption and export (Belize Fisheries Department, 2001). In addition to catching fish in the region, fishermen dive for conch and lobster. Even though the lobster catch has been in decline in recent years, it remains one of Belize's most valuable seafood exports. The value of the Belizean fishery in the Gulf of Honduras is estimated to be about US$ 1 million, or 8% of the total Gulf catch (Heyman *et al.*, 2002).

On the Atlantic Coast of Guatemala, fishing is primarily carried out by unskilled fishermen in Graciosa Bay, near Punta Manabique, in the mouth of the Sarstoon River, near Livingston and in the Río Dulce-Golfete region (UNEP, 1995). Guatemala has 1,415 active fishermen (Gladden Spit Marine Reserve). Commercially valuable species include mackerel, snook, calale, jackfish, mojarra, palometa, corvina and shark. Shrimp, lobster and tarpon are also exploited in the region. Little information is available, however, on the current state of fisheries, including the volume of fish catch and in terms of their biology. This lack of knowledge potentially could lead to problems of overexploitation.

Honduras has 647 active fishermen (Gladden Spit Marine Reserve). According to the FAO, nationwide Honduras is one of the largest fisheries producers in terms of value in Latin America and the Caribbean with 8.3% of the region's fisheries value (1996). Similar to Guatemala, however, studies are lacking on the current status of fisheries.

3.3.3 Aquaculture

Aquaculture is a major economic activity in the coastal region of southern Belize. In Honduras aquaculture is limited to the Gulf of Fonseca on the Pacific coast. The predominant fishing and aquaculture products in the region are *Panulirus sp.* Lobster and prawn. The primary shrimp species grown in Belize is *Penaeus vannamei*, or white farm shrimp. Several shrimp farms are located in the Gulf of Honduras watershed, including one in the vicinity of the port of Big Creek (CZMAI, State of the Coast Report 1999). The shrimp farms are sited in coastal areas in order to use the seawater to grow the shrimp, and so far the fisheries have used the existing mangroves to filter the seawater instead of destroying them (DHV Consultants, 1994). The major shrimp farms in southern Belize are listed in Table 3.3-1.

Table 3.3-1. Status of Active Shrimp Farms in the Southern Region of Belize, 1999

Company	Location	Size of Property (acres)	Area under Production (acres)	Number of Ponds	Production (lbs.)
Nova Toledo	Nr Indian Hill Lagoon, Toledo District	9,450	411	27	554,440
Nova Laguna Madre	Nr Placencia Lagoon, Stann Creek District	2,297	48	12	1,037,661
Belize Aquaculture, Ltd.	Blair Atoll, Placencia Lagoon, Stann Creek District	11,000	91	36	432,565
Toledo Fish Farm	Nr Monkey River Village, Toledo District	n/a	172	32	n/a

Source: Shrimp farm companies and Belize Fisheries Department

3.3.4 Tourism

As the second largest foreign exchange earner, tourism is an important industry for the Gulf of Honduras countries. It is also a major focus of regional development activities in the watershed. While traditional tourism continues to be popular, ecotourism has been increasing in the region in recent years.

Although tourism is the second highest foreign exchange earner in Belize, it historically has been limited to the regions north of the Gulf of Honduras watershed (DHV Consultants, 1994). In 2001, only 2.2% of Belize's total tourists were destined for the Toledo District and only 8.9% for Stann Creek (Belize Tourism Board, 2001). Tourism infrastructure in the southern region of Belize has increased dramatically in recent years, however. Between 1988 and 2001, the number of hotels in Stann Creek grew from 14 to 41, and from 10 to 36 in the Toledo District (Belize Tourism Board, 2001). Occupancy rates for Stann Creek (not including Placencia where occupancy rates are higher) averaged only 21% in the late 1990s, however, while those for Toledo averaged 10%. Whereas the region accounted for the 23% of the nation's hotels and 14% of rooms and beds, it accounted for only 6% of tourism income derived from accommodation (IADB, 2000).

Tourists in Belize are attracted primarily to the coral reefs, cayes, and islands located in the northern section of the country. The tourism product in the southern part of the country consists mainly of eco-cultural type activities, including two main archaeological sites and several protected areas, as well as some beach and marine adventure activities.

Tourism is the second largest foreign exchange earner for Guatemala after coffee. The Atlantic Coast, however, has only limited tourism infrastructure and services. Some hotels with basic services can be found in Puerto Barrios, Santo Tomás de Castilla, Livingston and Golfete. Ecotourism is growing as an economic activity in the region, though. Punta de Manabique now has the infrastructure required for tourism and ecotourism is being promoted as an economic alternative for area communities. Hiking, camping, kayaking and bird watching packages are being sold for the area and interpretative trails have been built.

To further promote the industry in the country, the Guatemalan Institute of Tourism (INGUAT) designed a plan of action known as the National Plan for Developing Sustainable Tourism. Recognizing that the tourism potential of the Atlantic Coast needed to be exploited in a manner that did not harm the area's sensitive ecosystems, the INGUAT worked with the Caribbean Environment Programme (CEP) of the United Nations Environment Programme to prepare the "Integral Plan for Management of the Marine Zone of the Atlantic Coast of Guatemala."

Nationally, tourism is the second largest foreign exchange earner for Honduras (Vreugdenhil *et al.*, 2002). While tourism traditionally has not been a major industry in the northern region of Honduras, it is currently growing, particularly on the bay islands. In 2001, the World Bank approved a US $5 million, interest-free credit to promote sustainable tourism along Honduras's North Coast and offshore Bay Islands, including the communities of Omoa, Tela and La Ceiba. Omoa and Cortés have 10 hotels with 80 rooms and 121 beds (Inventario de establecimientos turísticos, 2001). The city of San Pedro Sula also has adequate infrastructure to support tourism in the region. Puerto Cortés has 15 hotels with 277 rooms and 438 beds. Approximately 16,000 tourists arrive in Puerto Cortés via cruise ship annually (Dirección General de Población y Política Migratoria). There is significant uncertainty regarding tourism visitation levels in non-island destinations in northern Honduras, however. In 1999 it was estimated that the Bay Islands had 41,000 visitors and 36,000 tourists visited the remainder of the North Coast (Pratt, 2002).

Strategic planning of tourism in Honduras has been guided by the two following important policy documents: El Plan del Desarrollo Turístico Sostenible de Honduras 1998-2002 and Turismo en Honduras: El Reto de la Competitividad.

3.3.5 Marine Transport

Marine transport plays a critical role in the region's economy. The major port facilities on the Gulf of Honduras are Puerto Cortés in Honduras, Puerto Barrios and Puerto Santo Tomás de Castilla in Bahía de Amatique in Guatemala, and Big Creek and Belize City Port in Belize. Although the Belize City Port is located to the north of the TDA study boundary, its port and maritime activities are considered in this study because a spill or grounding in the vicinity of the Belize City Port could negatively affect the Gulf of Honduras environment due to the prevailing oceanographic currents.

These ports include infrastructure for loading, unloading, storage and transport of hydrocarbons, bulk liquids and dangerous chemicals as well as containerized cargo and bulk goods. Puerto Cortés is Central America's only deep water port and one of the best equipped in the region. Annually it accommodates more than 1700 vessels with a diverse cargo handling both liquid, including refined oil products, and bulk. Puerto Santo Tomás de Castilla receives more than 1200 ships annually, including 160 oil tankers. Tankers also use Puerto Barrios to transport large volumes of hydrocarbon and chemical products. Although Big Creek is currently limited to banana export, future plans could include additional products. Belize City Port handles a wide variety of cargo of both liquid and bulk, but the majority of the cargo is now containerized. In 2001, the five major ports in the Gulf of Honduras region accommodated nearly 4,000 ships and handled more than 12 million metric tons of cargo. Details on the ships and volumes of goods accommodated by the five ports between 1996 and 2002 is listed in Tables 3.3-2 and 3.3-3 below.

Table 3.3-2. Cargo Imported/Exported Through Ports Annually (Metric Tons)

	1996	1997	1998	1999	2000	2001	2002
Belize City Port	449,378*	487,099*	504,450*	578,407*	610,505*	704,837*	n/a
Big Creek	65,868*	57,774*	57,683*	64,157*	134,621*	90,232*	n/a
Santo Tomás de Castilla	3,185,949†	3,775,375†	4,437,009†	4,255,514†	4,349,697†	4,245,118†	4,800,027†
Puerto Barrios	1,152,000**	1,299,000**	1,537,000**	1,705,000**	n/a	1,679,700	1,353,113
Puerto Cortés	3,992,700‡	4,677,800‡	5,091,100‡	4,977,360‡	5,398,290‡	5,661,940‡	n/a

* Port of Belize Prospectus 2002
** SIECA 2001
† EMPORNAC 2002
‡ Puerto Cortés

Table 3.3-3. Port Ship Calls in the Gulf of Honduras

	1996	1997	1998	1999	2000	2001
Belize City Port	231	221*	210*	252*	223*	196*
Big Creek	54*	56*	58*	58*	105*	77*
Santo Tomás de Castilla			1244**			1,263†
Puerto Barrios	462**	376**	468**	583**		535
Puerto Cortés	1,325‡	1,558‡	1,694‡	1,951‡	1,790‡	1,786‡

* Port of Belize Prospectus 2002. Figures for 2001 are only through September.
** ECAT, SIECA 2001
† EMPORNAC 2002
‡ Puerto Cortés

Shipping has served as a major means of transport of goods into and out of the Gulf of Honduras and the volume of goods shipped is expected to continue to increase. As population growth and increasing globalization cause the expansion of trade in the region, the importance of shipping will only continue to grow. From 1990-1999, the volume of goods handled at Puerto Santo Tomás de Castilla, Puerto Barrios and Puerto Cortés annually increased an average of 11.09% (1991-1998), 16.50% and 8.52%, respectively (SIECA, 2001). In 2001, Puerto Cortés almost reached the limits of its capacity. Santo Tomás de Castilla and Puerto Barrios are projected to reach the limits of their capacity in 2003-2004 (SIECA, 2001).

The shipping of hazardous cargo in the region is also expected to increase. Accelerated growth in the traffic and handling of hydrocarbons is projected in the next decade as a result of increasing crude oil production in Guatemala, expanding hydrocarbon exploration, and an increased energy demand in the region. This is being accompanied by several projects for the expansion or construction of new port facilities at all five ports. Transport of hazardous cargo is discussed in more detail in Section 5.1 and details on the types of and amounts of hazardous cargo transported through the ports is included in Appendix C.

3.3.6 Industry

Manufacturing in the region remains underdeveloped, particularly in Belize. In the southern region of Belize, the only major industries are two citrus processing plants and one rice processing factory (DHV Consultants, 1994).

Although industry remains a comparatively small percentage of Guatemala's national economy, the majority of manufacturing takes place in the Gulf of Honduras watershed. Guatemala City serves as the industrial center of the country. Efforts are underway to increase the oil and food processing industries in the watershed.

Two of Honduras's main industrial areas are located in the Gulf of Honduras watershed: San Pedro Sula and Puerto Cortés. Forty-six percent of Honduras's industry is located in Cortés province, on the Gulf of Honduras. Nationally, cement, cotton and sugar are produced for export. Textiles, detergents, light metals, chemicals and food products are also manufactured there, but mainly for domestic consumption.

4.0 Overview of Applicable Institutional and Regulatory Frameworks

4.1 International Conventions

Port operation generally falls into the categories of cargo handling, passenger terminals, fishing, recreation, and tourism activities. The execution of these activities requires a variety of maintenance activities such as dredge and fill operations, construction, and disposal of solid and hazardous wastes. These ongoing maintenance activities can cause environmental damage if not carried out in accordance with internationally recognized best practices. Standardization of port operation and navigational safety have been enforced through international conventions and national laws.

For international conventions to be effective, it is necessary for them to be accepted and implemented by a majority of the shipping community and port systems. When conventions are not put into practice by their signatories, the result is a confusing set of requirements and expectations for the shipping industry as well as an unlevel playing field for those who choose to invest in the training and equipment necessary to comply with the standards.

Once a government makes the formal commitment to become signatory of a convention, it assumes the obligation to enforce the measures required by the convention. In most cases, this implies the enactment of a national law, establishment of standards, and sometimes institutional reorganization. These changes require the government to work closely with and provide adequate notice to the shipping industry, port authority, and other stakeholders so they may make the investments necessary to comply with new requirements. Relevant international conventions for the GEF Project include:

- **United Nations Convention on the Law of the Sea (UNCLOS, 1982)** - Broad-based convention addressing diverse aspects of protection and preservation of the oceans including investigation and control of contamination from land-based operations and ships.

- **International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) -** Convention addressing contamination from ships including waste, oil, air emissions and other hazardous substances.

- **London Convention on the Prevention of Maritime Pollution by Dumping of Waste and other Matters (LDC, 1972)** - Prohibits the dumping of certain hazardous materials, requires a prior special or general permit for other wastes.

- **COLREG -** Updates and replaces the Collision Regulations of 1960 that were adopted at the same time as the 1960 SOLAS Convention. **Rule 10** provides guidance to determining safe speed, the risk of collision and the conduct of vessels operating in traffic zones.

- **Safety of Life At Sea (SOLAS, 1960) -** Specifies minimum standards for the construction, equipment and operation of ships. Flag States are responsible for ensuring that ships under their flag comply with its requirements.

- **CLC 69 -** Civil Liability Convention financially covers those who suffer oil pollution damage resulting from maritime accidents involving oil-carrying ships. Places the liability for damage on the owner of the ship from which the oil escaped or was discharged.

- **FUND 71 -** Establishes a Fund for providing compensation for oil pollution incidents beyond that provided for by the CLC Convention.

- **Cartagena Treaty 1983 -** Provides for the protection and management of the environment and coastal areas of the Caribbean Region, its protocol (1986) provides for cooperation to respond to oil spills.

- **International Maritime Dangerous Goods Code (IMDC, 1990) -** The IMDG Code is intended to prevent marine pollution through safe shipping of hazardous materials. The IMDC is based on the United Nations "Recommendations on the Transport of Dangerous Goods", but also includes additional requirements applicable to the transport of hazardous materials by sea.

- **Load Lines 66 -** Establishes limitations on the draught to which a ship may be loaded. Limits are given in the form of freeboards, which constitute external weathertight and watertight integrity.

-

Table 4.1-1. Figure Relevant International Conventions Related to Maritime Administration

	IMO Convention 48	IMO amendments 91	IMO amendments 93	SOLAS Convention 74	SOLAS Protocol 78	SOLAS Protocol 88	Stockholm Agreement 96	LOAD LINES Convention 66	LOAD LINES Protocol 88	TONNAGE Convention 69	COLREG Convention 72	CSC Convention 72	SFV Protocol 93	STCW Convention 78	SAR Convention 79	INMARSAT Convention 76	MARPOL 73/78 (Annex I/II)	MARPOL 73/78 (Annex III)	MARPOL 73/78 (Annex IV)	MARPOL 73/78 (Annex V)	MARPOL Protocol 97 (Annex VI)	London Convention 72	London Convention Protocol 96	INTERVENTION Convention 69	CLC Convention 69	CLC Protocol 76	CLC Protocol 92	FUND Convention 71	FUND Protocol 76	FUND Protocol 92	OPRC Convention 90	HNS Convention 96	OPRC/HNS 2000	Bunkers Convention 01	Anti Fouling 01
Belize	x		x	x	x			x		x	x			x			x	x	x	x					x	x	x			x					
Guatemala	x	x	x	x		x		x			x			x			x	x	x	x		x			x										
Honduras	x	x	x	x	x			x		x	x	x		x			x			x		x			x										

Source: The strategic role of Hydrography in the proposed GEF project Environmental Protection and Maritime Transport Pollution Control in the Gulf of Honduras prepared by Meso-American Caribbean Hydrographic Commission

In addition to being signatories to international conventions, Honduras, Guatemala, and Belize have also promulgated national legislation. While a general framework exists to support program activities to address marine contamination and navigational security, implementation has been inconsistent as laws and international conventions remain without supporting regulations and adequate institutional support at the national level. In the case of Guatemala, the situation is more confusing, because the country does not have a viable Port Authority. This may be changing in the near future as the World Bank is extending technical assistance to the government of Guatemala for the purpose of creating a National Port Authority.

The operation of the national port system varies among the three countries and even within countries there are issues with fragmentation of responsibilities among the national regulatory agencies and local government. A detailed study carried out by ECAT in 2001 (ECAT, 2001) determined that the majority of Central American countries have not given maritime issues the necessary emphasis. Greater priority has been dedicated to terrestrial transport and telecommunications because they are more visible activities with greater impact on the daily lives of the public. Global problems that have been identified throughout Central America maritime administration include:

- Lack of stakeholder participation in the development of international norms
- Need for better trained personnel
- Few academic or educational institutions that offer specialized professional development
- Inadequate financial resources for personnel and equipment
- • Need to strengthen the legislative framework and national policies governing maritime issues

4.2 Maritime Administration

Both Honduras and Belize have national port authorities responsible for compliance with marine pollution control, port operations, and concessions. Guatemala does not have a viable national port authority and responsibilities are shared among several institutions. Additionally, each country has other ministries responsible for coastal planning, compliance with international conventions, environmental monitoring, sanitation, and environmental impact assessment. These agencies with the national maritime authorities form a comprehensive network of regulatory programs. The institutional and regulatory framework for the three countries are characterized by certain institutional successes, but are generally impeded by fragmentation of responsibilities and deficiencies in program coverage.

This section provides an overview of the primary institutions involved in the planning and operational aspects of marine pollution control, port administration, and navigational safety.

4.2.1 Belize

Belize is a constitutional monarchy with a parliamentary form of government based on the British model. The British monarch is the titular head of state and is represented in Belize by a governor general. The governor general has a largely ceremonial role and is expected to be politically neutral.

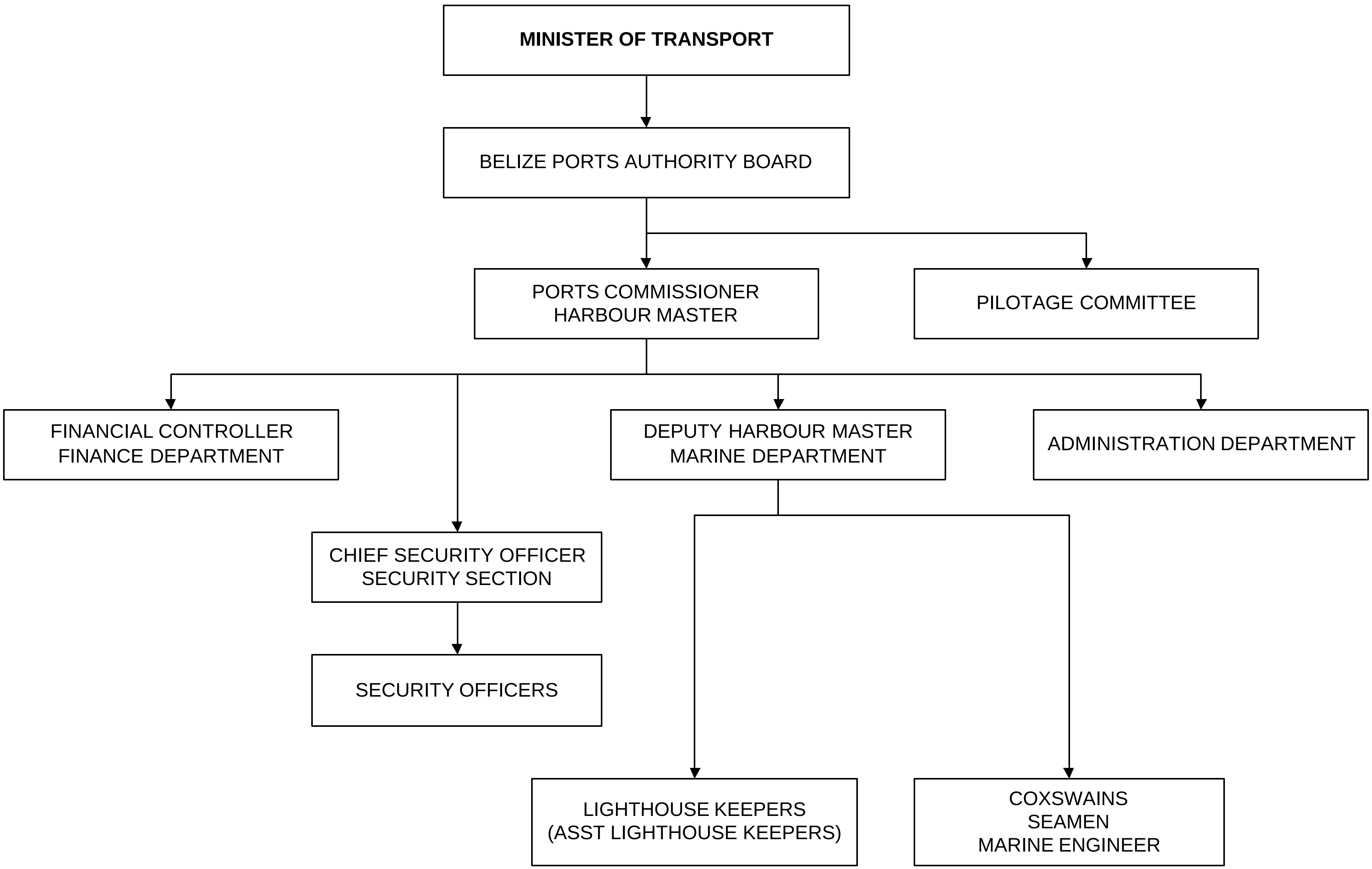
The national government is responsible for national policy and planning; development of technical norms, standards and procedures; and inter-sectoral coordination. The district government is responsible for local level implementation, inter-sectoral collaboration at the district and community level, and community participation. Management and coordination of all ministries and departments are controlled from ministry headquarters, although some maintain offices in the smaller cities. The highly centralized government has had limited effectiveness targeting and addressing regional and local needs.

The Belize Ports Authority is administered by a Board consisting of a Chairman and eight members that are appointed for renewable terms of two years. The Authority is responsible for all aspects of port operation, shipping, and navigation control. The maritime administration for Belize is shown in Figure 4.2-1.

Big Creek Port forms part of the proposed GEF project. It is operated by the Banana Growers Association and Banana Enterprises Limited. Pesticide monitoring has been conducted by inspectors from the National Environmental Authority. Environmental problems that have been identified at Big Creek include lack of wastewater treatment and improper application and disposal of pesticides by the banana growers industry.

Belize possesses a Draft National Oil Spill Plan, but there is no infrastructure or resources for its implementation. In the event of an oil spill, the ports would be primarily dependent on the petroleum industry for response capability.

Figure 4.2-1. Maritime Administration for Belize (next page)


MINISTER OF TRANSPORT
BELIZE PORTS AUTHORITY BOARD
PORTS COMMISSIONER
HARBOUR MASTER
PILOTAGE COMMITTEE
FINANCIAL CONTROLLER
FINANCE DEPARTMENT
DEPUTY HARBOUR MASTER
MARINE DEPARTMENT
ADMINISTRATION DEPARTMENT
CHIEF SECURITY OFFICER
SECURITY SECTION
SECURITY OFFICERS
LIGHTHOUSE KEEPERS
(ASST LIGHTHOUSE KEEPERS)
COXSWAINS
SEAMEN
MARINE ENGINEER

4.2.2 Guatemala

The maritime administration in Guatemala is stipulated by the National Law (Decreto Ley No. 19-83, March 1983) that designates the Ministry of Communications Transportation and Public Works (Ministerio de Communicaciones Transporte y Obras Públicas) as the lead ministry for maritime transportation. However, the Ministry has not assumed a leadership role and the country has effectively operated without a national maritime authority. It is interesting to note that Guatemala is the Central American country that has ratified the greatest number of international maritime conventions, although the conventions remain without implementing regulations and maritime authority with resources and personnel to execute its legal mandates.

The Municipal Code (Decreto 58-88 de Congreso de la Repblica) stipulates that the municipalities must create an environmental commission. Each port in Guatemala is essentially considered a branch office ("cabecera") and Article 56 of the Code requires the establishment of an environmental commission at the port.

The National Port Commission (Comisión Portuaria Nacional) was created in 1972 by national law (Acuerdo Gubernativo del 10 de marzo de 1972). The Commission is charged with protecting Guatemala's national interests related to port activities and representing the nation in international fora. In the absence of a national maritime authority, the CPN has supported program activities from the IMO and other international institutions.

The National Port Company (Empresa Nacional Portuaria) is a quasi-governmental institution that functions semi-autonomously. National legislation outlines the organization of the company and the membership of its steering committee including:

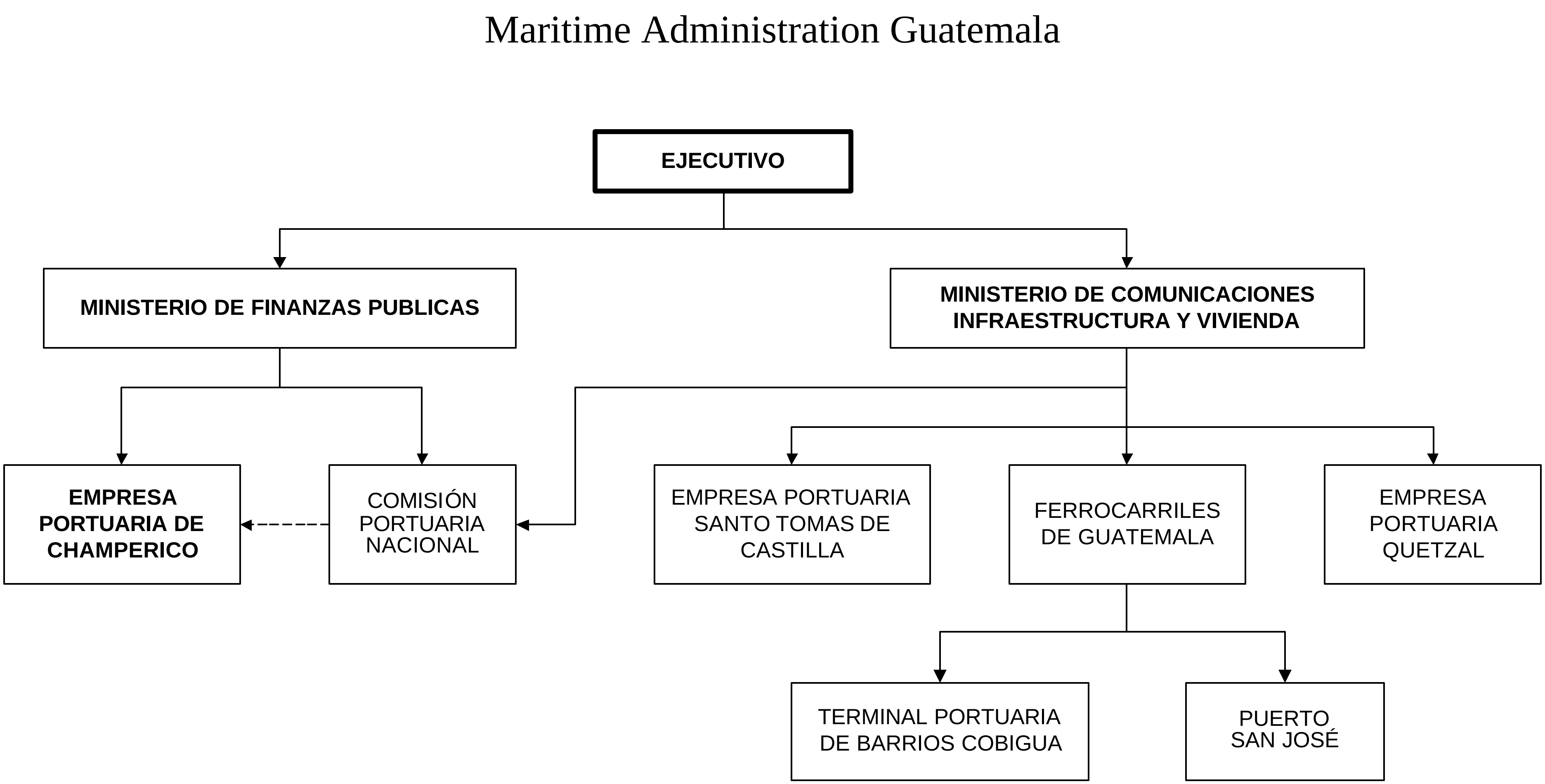
- A President that is a representative of the President of the Republic
- Representatives from the Ministry of Communications, Infrastructure and Housing
- Ministry of Public Finances
- Ministry of National Defense
- A Representative from the labor union of the company

The two ports participating in the GEF Project are Puerto Santo Thomas de Castilla and Puerto Barrios. Puerto Santo Tomás is operated by the Empresa Nacional Portuaria. Some operational areas of the port are concessioned. Puerto Barrios is operated through a concession to the Compañia Bananera Independiente de Guatemala S.A. (COBIGUA). The administration at Puerto Barrios reports a positive working relationship with both the CPN and COCATRAM. Environmental problems that have been identified at Puerto Barrios include lack of wastewater treatment and improper application and disposal of pesticides by the banana growers. At Santo Tomás there have been problems with improper handling of hazardous waste.

The national law of the Naval Police (Acuerdo Gubernativo 326-85) designates the National Defense Ministry as the responsible institution for policing the national waters and port installations. The regulation for the policing of ports (Acuerdo Gubernativo del 21 de Abril de 1939) delegates to the Commander and Port Captain the authority to provide indications concerning ballast water discharge and disposal of ship wastes. A special unit was created by the Ministerio de la Defensa Nacional called the Dirección de Asuntos Maritimos to act as the focus within the government for pollution prevention and national oil spill contingency planning.

The Ministry of Communication, Infrastructure and Housing was created in 1971. The Ministry is charged with the construction and maintenance of the nation's transportation systems by air, land and water. The Ministry is also responsible for the nation's compliance with international treaties.

Figure 4.2-2. Maritime Organization in Guatemala



4.2.3 Honduras

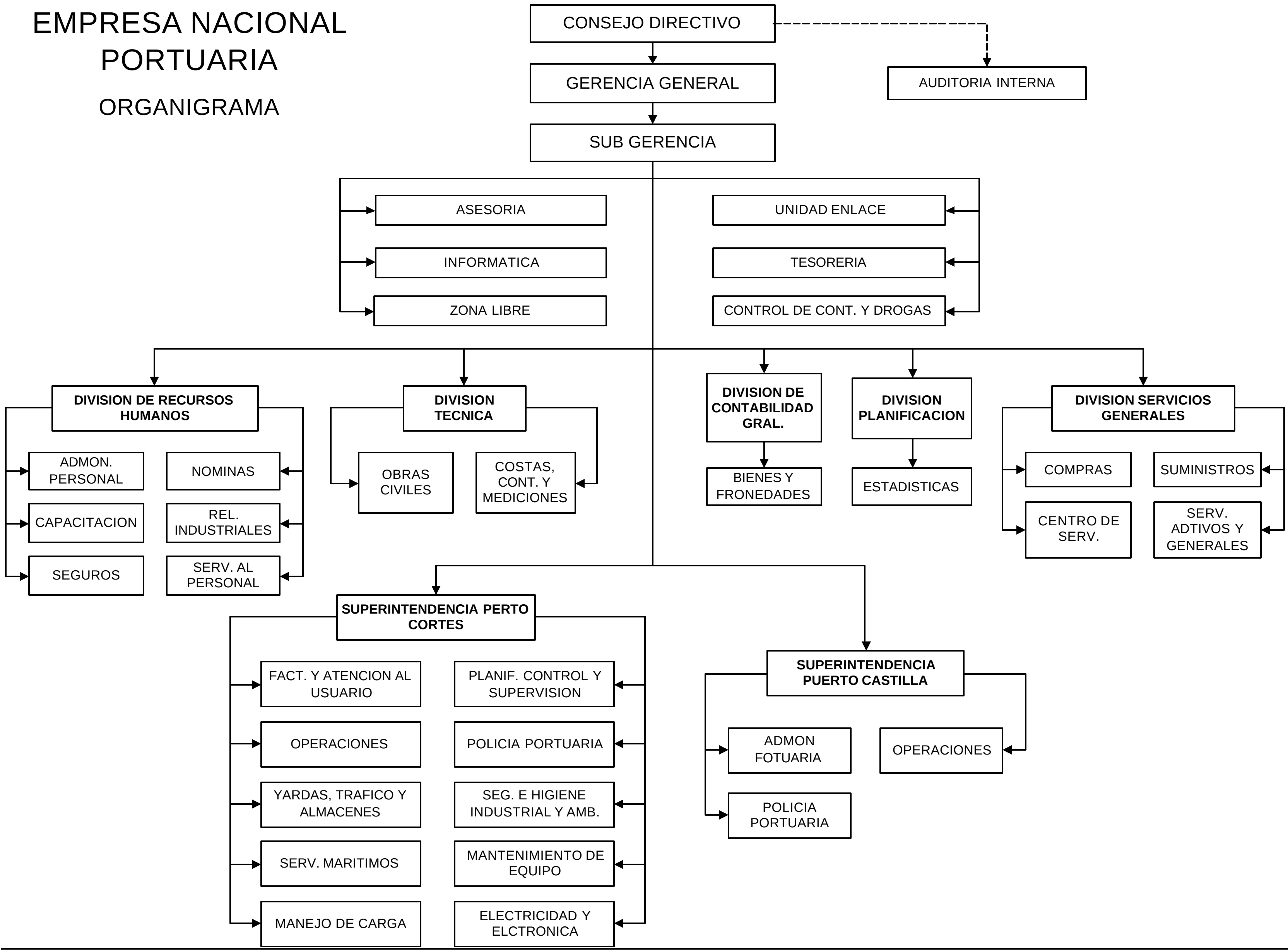
Several ministries share jurisdiction for programs covering marine pollution control, protected areas, coastal planning, and navigational safety. The Merchant Marines (Direción Nacional del Mercante Marina, DGMM) are responsible for a range of regulatory responsibilities that together form one of the Honduran government's primary institutions for the overall control of maritime pollution. The Merchant Marines was reorganized and strengthened into its existing structure when the Honduran Congress passed the National Merchant Marines Law (Ley Organica de la Marina Mercante Nacional, Decreto No. 167-94) in 1995. The Law provides the regulatory framework outlining activities to be executed by the Merchant Marines including the prevention of pollution generated from ships, platforms or other installations within the legal zone corresponding to Honduras, oversight of salvaging operations, inspections, and certifications of compliance with national and international requirements related to security and pollution as established by MARPOL.

The port system in Honduras is administered by the National Port Authority (Empresa Nacional Portuaria, ENP). The Port Authority was created in 1965 by the Legislative Decree No. 40. It was created as a semi-autonomous, decentralized organization with its own authorizing law and regulations. The Port Authority is able to concession certain port operation functions.

In 1990, the Honduran government initiated a modernization program aimed at improving the efficiency of government operation. The vehicle for the legal and institutional reform was the National Modernization Law (Proyecto de Ley para la Modernización del Estado) of January 1992, which created a Presidential commission for the modernization of the country. As part of the modernization initiative, the government of Honduras was to evaluate and strengthen the Port Authority. The Port Authority was to undergo an analysis to determine means of increasing private sector participation in port operations, define the institutional role of the Authority, and restructure the institution. Assessments of the initiative have found no substantive progress in the objectives. The result is that the Port Authority continues to operate under a framework of often vague and conflicting legal requirements. The organization of the National Port Authority is provided in Figure 2.

Honduras has six commercial ports. The principal national port in Honduras is Puerto Cortes and is the only port in Honduras participating in the IDB-GEF Project. At Puerto Cortes, the operations related to cargo loading, and transportation, fumigation and maintenance of the port sites and other related container services are concessioned.

Figure 4.2-3. Organization of the National Port Authority in Honduras (next page)


EMPRESA NACIONAL PORTUARIA
ORGANIGRAMA
CONSEJO DIRECTIVO
AUDITORIA INTERNA
GERENCIA GENERAL
SUB GERENCIA
ASESORIA
INFORMATICA
ZONA LIBRE
UNIDAD ENLACE
TESORERIA
CONTROL DE CONT. Y DROGAS
DIVISION DE RECURSOS HUMANOS
ADMON. PERSONAL
CAPACITACION
SEGUROS
NOMINAS
REL. INDUSTRIALES
SERV. AL PERSONAL
DIVISION TECNICA
OBRAS CIVILES
COSTAS, CONT. Y MEDICIONES
DIVISION DE CONTABILIDAD GRAL.
BIENES Y FRONEDADES
DIVISION PLANIFICACION
ESTADISTICAS
DIVISION SERVICIOS GENERALES
COMPRAS
SUMINISTROS
CENTRO DE SERV.
SERV. ADTIVOS Y GENERALES
SUPERINTENDENCIA PERTO CORTES
FACT. Y ATENCION AL USUARIO
OPERACIONES
YARDAS, TRAFICO Y ALMACENES
SERV. MARITIMOS
MANEJO DE CARGA
PLANIF. CONTROL Y SUPERVISION
POLICIA PORTUARIA
SEG. E HIGIENE INDUSTRIAL Y AMB.
MANTENIMIENTO DE EQUIPO
ELECTRICIDAD Y ELCTRONICA
SUPERINTENDENCIA PUERTO CASTILLA
ADMON FOTUARIA
POLICIA PORTUARIA
OPERACIONES

4.3 Other Project-Related Program Areas

Belize

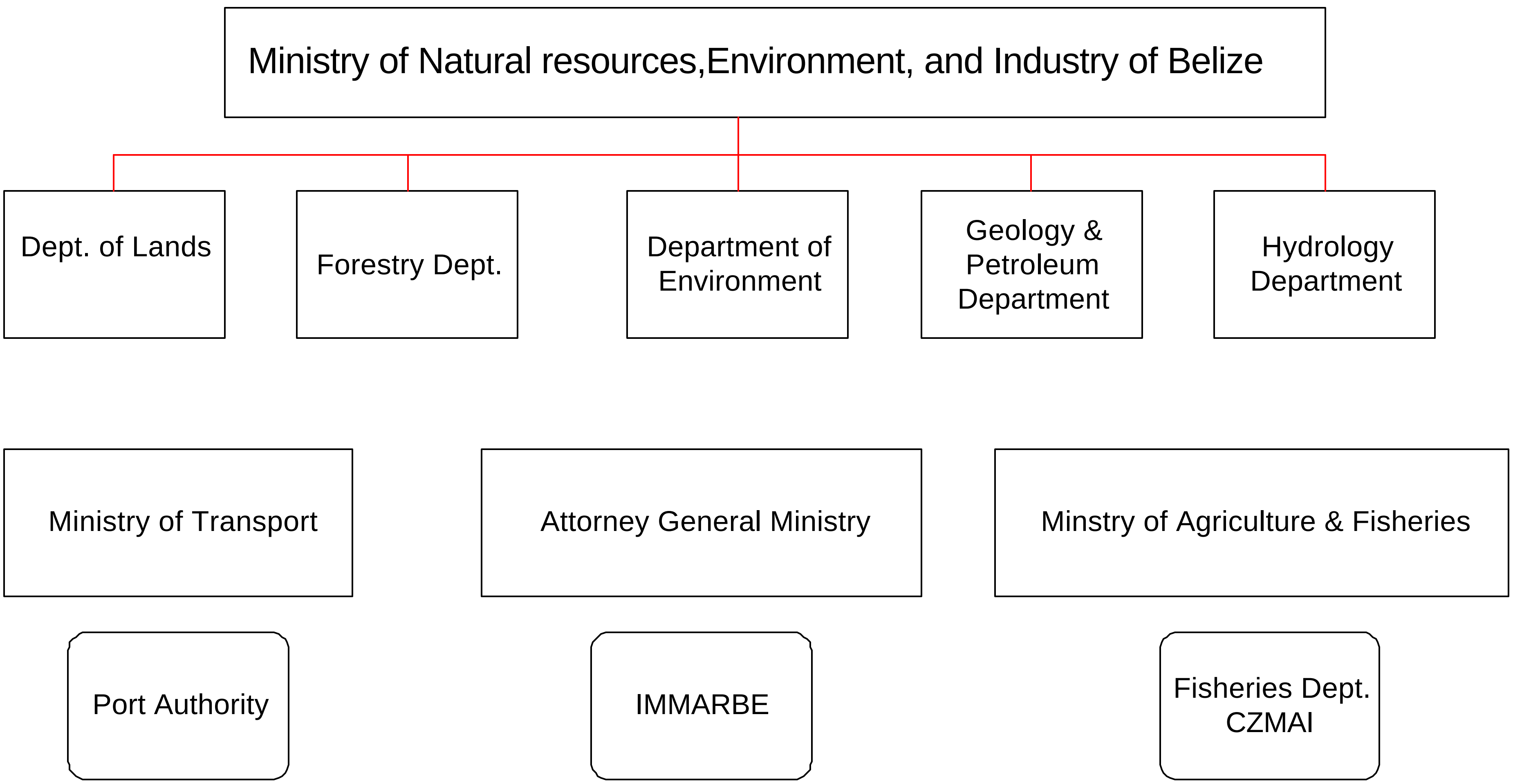
The Coastal Zone Management Authority (CZM) was established by the Coastal Zone Management Act and is located organizationally under the Ministry of Agriculture, Fisheries and Cooperatives. The Authority is an autonomous public statutory body responsible for implementing the use and development of the coastal zone in Belize. The Authority addresses issues of overlap in legislation and institutional strengthening. It consists of a Board of Directors appointed by the Minister and a Chief Executive Officer appointed by the Board. The CZM Institute carries out the technical functions of coastal management in coordination with various government agencies.

The Department of the Environment is organized under the Ministry of Natural Resources and Environment. The Department is responsible for all aspects of environmental protection and review of Environmental Impact Assessments. Discharges from terrestrial sources including sewage, dumping and hazardous waste are subject to effluent limit and require a discharge permit and monitoring.

Pollution control from ships is regulated through the Maritime Areas Act (January 19, 1992). The content of the law has been difficult to enforce due to vague guidelines. Enforcement has been primarily through review of ships' records. The Belize Defense Force is responsible for ship-based pollution, although the Environmental Department and Public Health may also participate. The Environmental Department is responsible for terrestrial sources along with the Public Health Department. The Coastal Zone Management Authority conducts inter-institutional coordination.

Since the establishment of legislation to protect Belize's cultural and natural resources came into effect, more than 50 declared protected areas in both terrestrial and coastal/marine environment have been established. The legal framework for protected areas includes a network of laws. The Forestry and Fisheries Departments are responsible for the compliance with protected areas legislation and regulation. The Ministry of Natural Resources and the Ministry of Agriculture and Fisheries are responsible for compliance with management plans.

Figure 4.3-1. Belize Government Structure for Environmental Protection



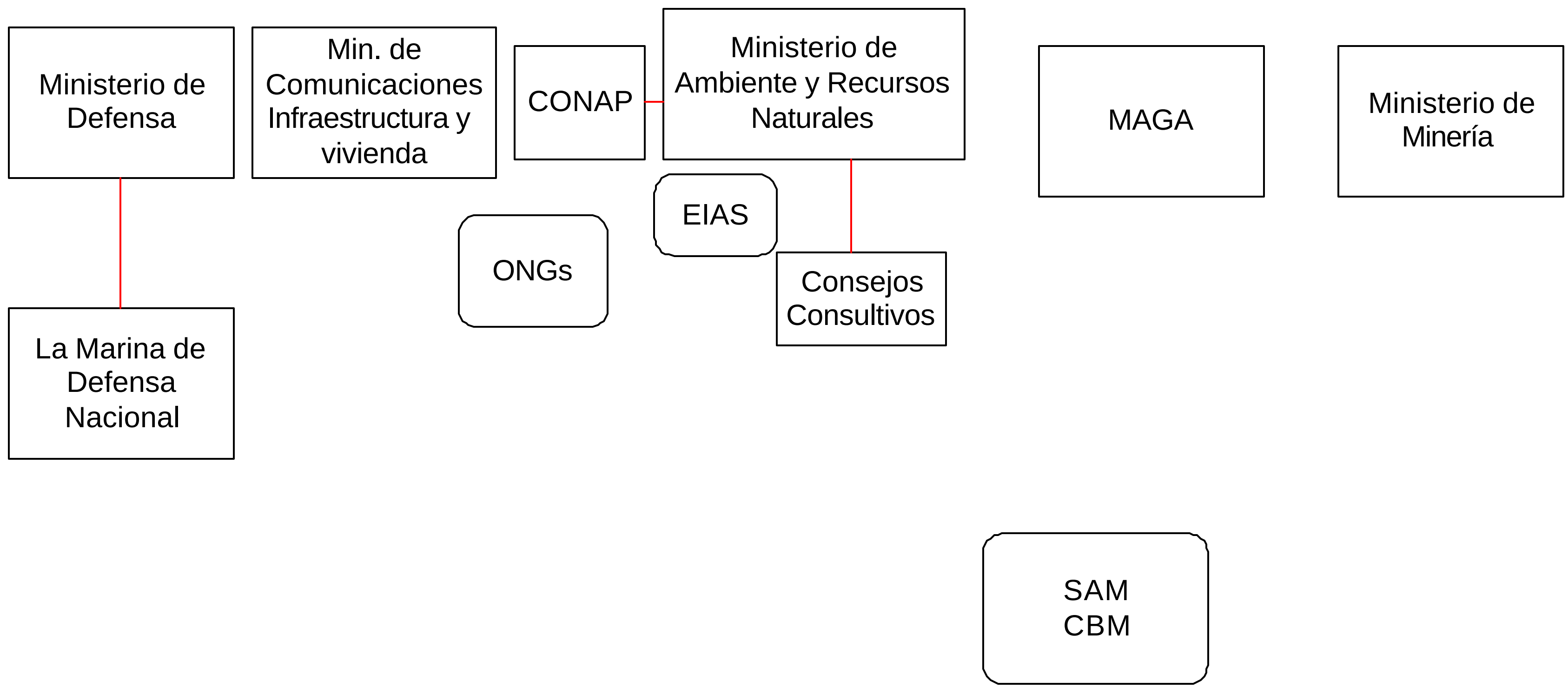
Guatemala

The Environmental Ministry was established in 1986 by the national law (Decreto 68-86, Ley de Proteccion y Mejoramiento del Medio Ambiente) as the National Environmental Commission (Comisión Nacional de Medio Ambiente, CONAMA). The agency was reorganized and renamed to the Ministerio de Ambiente y Recursos Naturales in_2000. The Ministry is charged with the preservation of the environment including the application of environmental norms and environmental impact assessment.

The Ministry of Health and Social Services (Ministerio de Salud Pública y Servicios Sociales) is charged with both protecting public health and certain aspects of environmental health. It has jurisdictional responsibilities to develop and promulgate environmental clean up standards and enforce their application. The regulations for maritime sanitation apply international sanitary standards and hygiene related controls to ships, ports and their surroundings.

Protected areas are administered through two agencies with the National Council of Protected Areas (Consejo Nacional de Areas Protejidos, CONAP) with lead jurisdiction. CONAP shares some responsibilities with the Office for the Control of National Reserves.

Figure 4.3-2. Guatemala Government Structure for Environmental Protection



Honduras

The national environmental law provides the Secretariat for Natural Resources and the Environment (Secretaria de Recursos Naturales y Ambiente, SERNA) with diverse responsibilities as part of its legal mandate to implement measures to protect natural resources; and prevent, control, and clean up of pollution. The law has regulations that authorize government agencies to elaborate standards for emission of contaminants into the environment and where national standards are absent to use international standards adopted by the Honduran government. The agency is responsible for complying with international conventions and treaties. SERNA is responsible for the issuing environmental licenses after the review and approval of an Environmental Impact Assessment.

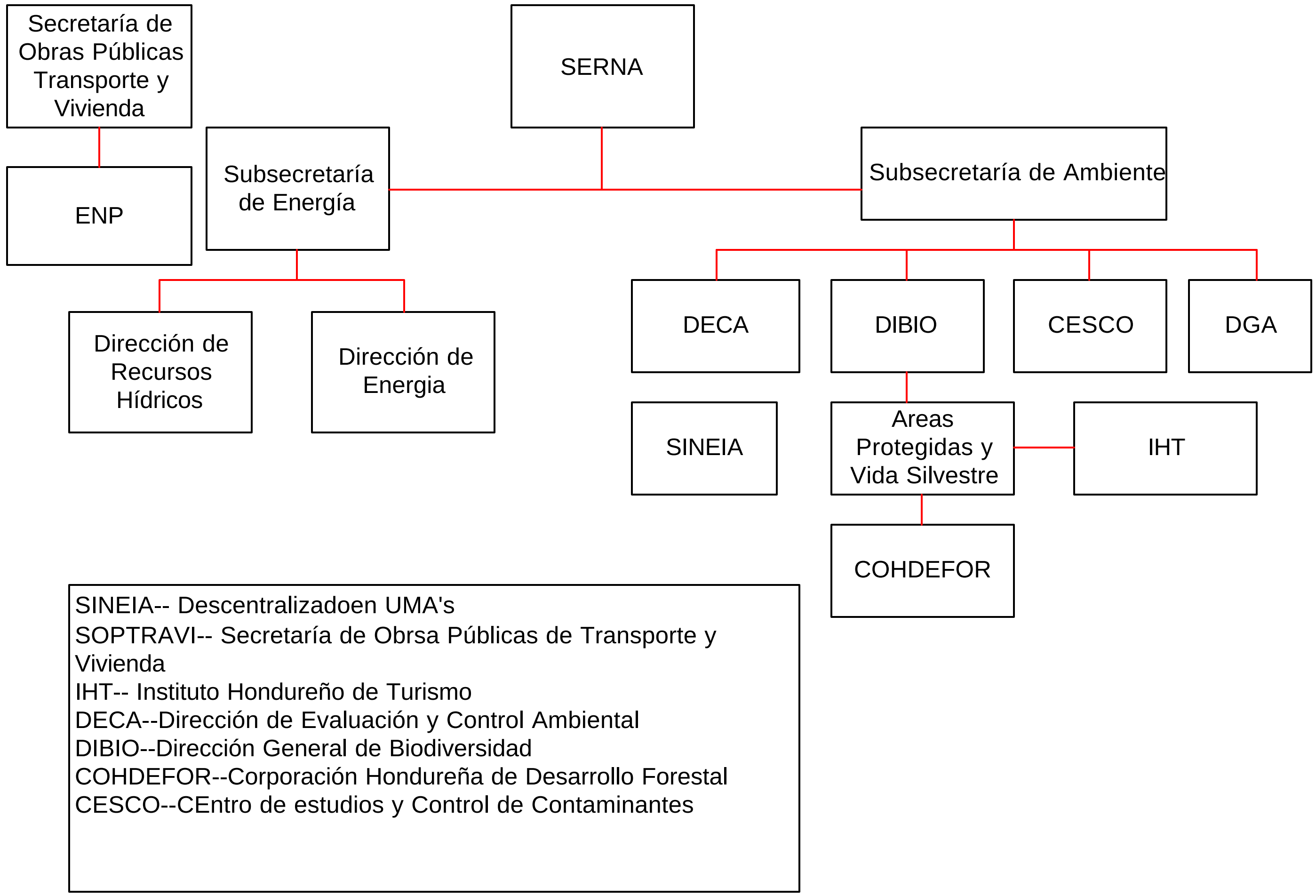
In the Protected Areas Program, SERNA shares responsibility with the Forestry Agency (Corporación Hondureña de Desarrollo Forestal, COHDEFOR) for the administration of protected areas. The shared responsibility is divided between planning and implementation responsibilities. SERNA is responsible for the development of government policies and norms and COHDEFOR for program implementation. SERNA is responsible for the inter-institutional coordination that includes the role of municipalities (Art. 29, Ley General del Ambiente) in the management of protected areas. International coordination has been conducted through CCAD allowing high-level coordination on matters concerning the environment and sustainable development.

The Transportation and Housing Secretariat (Secretaria de Estado de Obras Publicas, Transporte y Vivienda, SOPTRAVI) is responsible for all aspects for public works, transportation and housing issues. The ministry has a high level of coordination with DECA (Dirección General de Evaluación y Control Ambiental) through the National System of Environmental Impact Assessment. Government focus has been primarily on roadways. SOPTRAVI has some involvement with protected areas and coordinates activities with the National Forestry Agency (COHDEFOR).

The Health Ministry (Ministerio de Salud) is brought into the project scope through its jurisdiction over sanitation issues that include port facilities. The agency is also responsible for water quality issues related to public health.

The Labor Ministry (Ministerio de Trabajo y Asistencia Social) is responsible for ensuring compliance standards designed to provide safe work conditions including work condition at sea.

Figure 4.3-3. Honduras Government Structure for Environmental Protection



5.0 Major Perceived Problems and Issues

The identification of the major perceived[1] problems and issues (MPPI) and their causes is a first step in the TDA process and it constitutes the justification for the subsequent in-depth analyses. The significance of the perceived issues and problems should be substantiated on scientific, environmental, economic, social, and cultural grounds. The MPPIs and their causes should represent the perceptions of the scientific and expert community on the priority environmental issues of the region. The experts may come from the scientific community, the NGO community, government, and other stakeholder groups.

This section of the TDA analyzes the primary MPPI identified in the region and its causes to examine the technical basis supporting or refuting each cause as a priority issue in the Gulf of Honduras. The intent is to provide a technical rationale for prioritizing the causes in order to help guide the direction of future interventions to improve the Gulf of Honduras environment. It will be of no use to identify major intervention efforts for an MPPI and its cause if the technical basis supporting its priority is missing. In such a case, either the cause can be dismissed as a non-priority issue, or just as importantly, gaps in knowledge can be identified, and filling the gaps can become the next step towards addressing that particular MPPI and its cause.

This section, therefore, relies on the literature generated by the scientific community, by governments, and by non-governmental and inter-governmental organizations to determine the technical basis for each cause of the MPPI. The major sources of information are listed within each individual section as well as in the References accompanying this TDA. Given the limited size of this TDA, not all information available in the region can be included in this section.

The following MPPI has been identified as the priority in the Gulf of Honduras region:

Degradation of Coastal and Marine Ecosystems

The following primary causes of the MPPI have been identified and are examined in detail in the following sections:

- Negative environmental effects arising from existing and future port operations and infrastructure development
- Negative environmental effects arising from marine activities
- Other Land-Based Activities (other than shipping-related) causing degradation of the ecosystems of the Gulf of Honduras

Statement of the problem/issue

As is discussed in more detail in section 2.5, the Gulf of Honduras and surrounding waters include a variety of ecologically important ecosystems. The coastal ecosystems of the region are generally both rich in natural resources and highly productive. Important habitats include mangrove forests, coral reefs and seagrass beds. The world's second largest barrier reef system extends into the Gulf, containing a variety of corals and serving as habitat for marine species. Much of the coast is lined with mangrove forests that provide a vital role in coastal ecosystem processes. Seagrass beds cover large sections of the Gulf. These sensitive ecosystems serve as habitat for and contribute to the wealth of marine fishes and mammals that inhabit or travel through the Gulf, some of which are endangered, such as the manatee. There is great interconnectivity between the ecosystems. The integrity of each ecosystem is dependent on

[1] "Perceived" is used to include issues which may not have been identified or proved to be major problems as yet due to data gaps or lack of analysis or which are expected to lead to major problems in the future under prevailing conditions.

the health and influence of adjacent ecosystems. For example, there is nutrient, sediment, and organic matter interchange between the coral reefs and mangrove ecosystems.

A wide variety of terrestrial ecosystems also exist in the watershed of the Gulf of Honduras.

Figure 5.1-1. Ecosystems of the Gulf of Honduras and its Watershed
(See Appendix D)

Coral reefs and mangroves are the most biologically diverse ecosystems and greatly at risk. Coral reefs grow in clear water and reefs growth is extremely sensitive to pollution, whether due to chemical contaminants or suspended sediments. The rapid expansion of coastal populations and consequentially increased loads of domestic sewage, agricultural runoff and industrial effluent to the marine environment, as well as the increased maritime operations and traffic, represents a significant threat to the coral reef habitat.

Coral reefs in the Gulf have shown signs of degradation in recent years. As is discussed in section 2.5, bleaching has occurred. Bleaching may be due more to global human impacts (climate change) rather than local effects. However, it is still of concern due to the vast size of the coral barrier. Additionally, recreational boats as well as commercial ships have hit coral and broken corals. The extent of the degradation of the reefs due to boating accidents, water pollution and global warming has not been fully assessed, however.

Significant areas of mangrove forests have been cut down in the Gulf, either for the wood or to make way for agriculture or coastal development. Specific data on the amount of area cleared are not available, however. It is also not known whether the remaining stands have suffered degradation from land-based and marine-based sources of pollution.

The status of seagrass beds in the Gulf of Honduras has not been adequately assessed. It is unclear whether these ecosystems have suffered degradation due to pollution from land and marine-based sources.

The primary contributors to the degradation of the coastal and marine ecosystems are:

- Port operations and infrastructure development.
- Marine activities such as marine discharges, collisions, groundings, etc.
- Non-shipping related land-based activities.

Each of these causes is examined in detail below, their concrete contributions identified, and the magnitude of their impacts is supported by data where available.

<u>Transboundary elements</u>

- Loss of income from regional and global trade of marine products
- Marine living resources are often migratory
- Coastal zone habitats are the backbone for the productivity of marine and coastal habitats
- The coastal habitats provide feeding and nursery grounds to migratory species
- The coastal habitats are accumulating transboundary pollution
- Degradation of coastal habitats contribute to the overall decline of regional and global biodiversity
- Regional-wide destructive activities degrading coral reefs, mangroves and seagrass habitats

- The sustainability of marine and coastal biodiversity depends on the integrity of the interlinked ecosystems that supports all trophic levels in the food chain.
- Damage to transboundary ecosystems

Environmental impacts

- Loss of biodiversity
- Loss of natural productivity
- Reduction of fish stocks
- Effects on number and distribution of global population of certain migratory species
- Changes in coastal ecosystems
- Depletion of mangroves
- Degradation of coral reefs
- Reduction in value of marine resources
- Degradation of coastal landscape
- Changes of the hydrological regimes
- Changes in food web
- Increased vulnerability of commercially important species
- Long term changes in genetic diversity
- Stock reduction
- Habitat degradation due to destructive fishing techniques

Socioeconomic impacts

The degradation of coastal and marine ecosystems by maritime and land-based activities leads to the degradation of the interdependent habitats and reduced fish catches. For example, a reduction in seagrass or mangrove cover can reduce fish spawning, leading to reduced catches, which has both social and economic implications, particularly for artisanal fisheries. Additionally, degraded habitats reduce the tourism potential. Some of the most important impacts include:

- Reduction in income from fisheries
- Reduction in income from tourism industry
- Changes in employment
- Loss of aesthetic value
- Loss of cultural heritage
- Conflicts between user groups
- Loss of recreational opportunities

Causal chain analysis

See Appendix B.

5.1 Negative Environmental Effects Arising from Existing and Future Port Operations and Infrastructure Development:

Marine transport has important environmental consequences. The Gulf of Honduras ports are located adjacent to important sensitive coastal and marine ecosystems that are threatened by the shipping activities. Daily port operations as well as the risk of ship collisions or large oil spills pose a significant risk to coastal ecosystems, particularly in the semi-enclosed Bahía de Amatique. Currently, there are no environmental management systems implemented in the ports included in this study to mitigate the risks from the shipping operations. Environmental threats posed by the ports in the region include:

- Environmental effects from port expansion and maintenance activities, such as dredging.
- Accidental spills during the loading, offloading and storage of cargo, particularly during the handling of hazardous materials.
- The absence of contingency plans in case of an accident.
- Inadequate capacity to meet the standards established by the MARPOL Convention related to the operational discharge of solid wastes and oily ballast, and lack treatment of ballast water.

Each of the five ports included in the current study is discussed below in terms of management, infrastructure and capacity to address environmental problems. The volume and type of goods received at the ports is also discussed, but more detailed information is included in Appendix C.

Belize City Port

Belize City Port was privatized in January 2003 and it is now owned and operated by the Port of Belize LTD. The Belize Port Authority is the regulatory body overseeing the port. Figure 5.1-1 shows the main infrastructure of the port.

Figure 5.1-1. Belize City Port
(See Appendix D)

In 2000, 46% of the total cargo imported by sea to Belize entered through the Belize City Port (Port of Belize Limited, 2002). The major products exported from Belize by sea include citrus concentrate, bananas, sugar, molasses, dolomite, seafood, papaya, beans and lumber. The main cargo imports into the Belize City Port are fuel, dry bulk, steel and finished goods. Fuel imports are handled by the Esso Corporation through their terminal adjacent to the Belize City Port. Dry bulk imports include wheat, animal feed and fertilizer. Finished goods shipped through the port are containerized. Break bulk cargo consisting of low value bagged foodstuffs or steel is occasionally shipped through the port. See Appendix C for more detailed information on port cargo.

The number of ships using the Belize City Port is rapidly expanding. Belize recently has seen an explosive increase in the cruise ship industry. In 2001, there were 51 cruise ship calls. In 2003 it is forecast that 339 ships will visit Belizean ports and this number is expected to increase to 401 cruise ships in 2004. These figures do not include the “pocket cruise” ships or mega yachts that are under 300’ in length. On average there are 350 cargo vessels per year, 80 of which are tankers. Fuel barges that maintain service to outlying Cayes average 60-80 voyages per year carrying a total of approximately 41,000 barrels of gasoline and 42,000 barrels of diesel fuel, classified as a class 3 pollutant.

Port of Belize LTD now has responsibility for environmental management of Belize City Port under the regulation of the Department of the Environment, in conjunction with the Department of Fisheries and the

Belize Port Authority (BPA). The ability of Port of Belize LTD to effectively deal with environmental issues has not yet been determined.

Belize has a National Emergency Preparedness Plan for Oil Spills (NEPPOS) which was prepared by the University of South Alabama, Center for Emergency Response Training in 1996 and funded by the United States Agency for International Development (USAID). The Department of the Environment is responsible for implementation of the plan, but in the case of the use of dispersants it has joint responsibility with the Department of Fisheries. The plan provides for the supply of oil spill response equipment from the Clean Caribbean Co-operative (Oil Response Center) in Fort Lauderdale, Florida. Esso Belize's Loyola Terminal also has an Oil Spill Response Contingency Plan. Although some equipment is held at the Loyola Terminal, this plan calls for the use of the services of the Clean Caribbean Co-operative.

The port was constructed from pre-stressed concrete T-piers, beams and open pile platform pierheads supporting heavy-duty decks, made of steel gratings. The piers are connected to shore by single-lane trestle bridges. The Belize City Port is located 800 m offshore and has 67 m of berths, 5.18 m of natural draught, 4.6 m draught for the roll-on, roll-off (Ro-Ro) berthing of approximately 25 m length and is serviced by one mobile Manitowoc crane with a capacity of 140 tons, 1 Hyster Forklift with a capacity of 50 tons, 1 Super Stacker with a capacity of 49.5 tons, 5 Hyster Forklifts with a capacity of 5 tons each and 4 Dock tractors with 12 trailers. The port also has a transit shed measuring 6,583 m^2, a main container yard totalling 30,968 m^2 and various sheds, ships and spare parts storage areas.

Big Creek

Big Creek, officially called Toledo Port, is a small private port administered by Banana Enterprises and regulated by the Belize Port Authority (BPA) in Belize City. It is located between 16º25'50'' latitude north and 88º21'50'' longitude west. Figure 4.1-2 shows the main infrastructure of the port and its navigational channel.

Figure 5.1-2. Port of Big Creek
(See Appendix D)

Bananas and citrus are exported on a weekly basis. Additionally, the company Savannah Resources uses this port to export pine roots to the United States through special ships three times per year. The only imports received at the port are equipment and products for the banana industry and port, which are brought in by a ship every three weeks. The current port owners have plans to try to increase the amount of imported products coming through the port if the mandate from the port authority is changed to allow it, however.

In Big Creek, all environmental and industrial safety activities are evenly distributed among the port operations' personnel as no separate entity exists to coordinate and address environmental issues. In general, the capacity for handling environmental problems is low and in the past the port has had to hire external experts to perform assessments. Environmental issues are regulated by the Department of the Environment, according to the Marine Environmental Protection Act 1992, and the Belize Port Authority, according to the Belize Ports Authority Regulations.

Big Creek has a marginal dock with a length of 300 m, depths of up to 6.7 m and an area of about 12 ha. This port has a movable crane with a capacity of 65 tons, a tugboat, freight elevators, and courtyards for containers and general cargo. Additionally, two warehouses are located at the port behind the quay. There are two tanks for the storage of chicken feed that belong to the Mennonite Church and another tank for the storage of water. The port is equipped with a fire pump, which functions using seawater, and extinguishers (most of them of 12 kilos).

Puerto Santo Tomás de Castilla

This port offers the services of an international port with an Industrial and Commercial Free Zone (ZOLIC) located next to it. It is a multipurpose port, administered by the Empresa Portuaria Nacional Santo Tomás de Castilla (EMPORNAC). It is located between latitude 15º 57' 8'' North and 88º 37' 24'' longitude West and serves as Guatemala's main port on the Atlantic coast. The port is currently operated by the central government (the ultimate port authority). Figure 5.1-3 shows the main infrastructure of the port and its navigational channel.

Figure 5.1-3. Puerto Santo Tomás de Castilla
(See Appendix D)

Products imported via the port include refined oil products, paper products, chemicals, metal products, oil and grease. Exported products include bananas, coffee, fruit, vegetables, meat, seafood and crude oil. The port has patios of containers with a storage capacity of 5000 TEU. Conventional ships, container carriers, multipurpose, Ro-Ro, solid bulks, liquid bulks, frigates, launches and cruise ships operate in the port; during the year 2001, 1262 ships docked in this port, mobilizing a cargo more than 4,500,000 tons (including imports and exports). In 1999, the volume of the goods handled by the port represented 44% of all goods imported and exported through Guatemalan ports, and 73% of the volume handled on the Caribbean coast. Between 1995 and 1999, the volume of goods handled by the port increased an average of 12.1% annually (SIECA, 2001). Between 1995 and 1998, the greatest increase in types of cargo moving through the port was petroleum (23.6%), followed by Roll-on Roll-off (18.3%), containerized (11.2%) and general cargo (9.8%) (SIECA, 2001). In 1998 the ships stayed at the port an average of 27.04 hours. In 1997, the rate of occupation at the port was 49.33% (SIECA, 2001). According to a SIECA study, the port has the capacity to handle 6,314,243 tons annually, which is 42% more than it handled in 1998 (SIECA, 2001). See Appendix C for more detailed information on the cargo imported and exported through the port.

Santo Tomás de Castilla has an Industrial Safety Department, which is also in charge of the port's environmental issues. The current capacity to address environmental issues is low, but plans exist to enhance the environmental unit.

The port has a shore-attached dock with an estimated length of 915 m (distributed as six docks of 152 m each). The height above sea level of docks 1, 2 and 3 are 2.5 m ± 0.25 m, and for docks 4, 5 and 6 are 2.7 ± 0.25 m, with a maximum depth of 9.5 m. A portico crane cannot be installed for the handling of containers due to the docks' bearing capacity (only of 2.9 tons/m^2). The port also has a turning basin that is 906 m long and 150 m wide and is positioned from East to West. The turning basin is 667.64 m^2 with a depth of 11 m. It has 4 storage buildings for all types of cargoes, one for reels and banana and another for vehicles. It also has courtyards with a total area of 197,017 m^2 for the storage of filled and empty import and export containers and a courtyard with 208 electrical plugs for refrigeration containers.

The following equipment is located at Puerto Santo Tomás de Castilla:

- tugboats of: 450 HP, 1600 HP, 1500 HP and 2720 HP
- 2 sailing-master launches of 150 HP and 32.8 HP
- 1 belay launch of 400 HP

- 2 multi-purpose cranes of 104 metric tons
- 2 movable cranes of 30 metric tons
- 2 movable cranes of 10 and 20 metric tons
- Hoists: 39 of 4 metric tons, 5 of 5 metric tons, 15 of 5 metric tons, 2 of 9 metric tons and 1 of 18 metric tons
- 2 front loaders, one of 40 metric tons and another of 7 metric tons
- 14 container carriers: 7 of 35 metric tons and 7 of 40 metric tons
- 45 deck terminals with capacity of 25 metric tons
- 49 gondola-cars: 46 of 20 metric tons, 2 of 10 metric tons and one of 20 metric tons

Puerto Barrios

Puerto Barrios, Guatemala's first private seaport, is privately owned and has been administered by the Independent Banana Company of Guatemala, S.A. (COBIGUA, member of Chiquita Brands) since 1989. It is located between latitude 15º 44' 3'' North and longitude 88º 36' 21'' West. Figure 5.1-4 shows the main infrastructure of the port and its navigational channel.

Figure 5.1-4. Puerto Barrios
(See Appendix D)

The port takes in refined oil products (Texaco), fertilizers (bulk), paper products, resin and bulk iron. Bananas, melons, fertilizers, vegetables and cloth are the principal products exported through the port. Puerto Barrios has a storage capacity of 1200 TEU. In 1999, the volume of the goods handled by the port, 1,705,000 tons, represented 16% of all goods imported and exported through Guatemalan ports. In 1999, containerized cargo represented 78% of the volume moved through the port, with bananas being the main product exported. Combustibles and petroleum derivatives for TEXACO represented 12% of the volume (SIECA, 2001). In 1999, 583 ships visited the port, which is an average of 1.6 ships per day or 1 ship every 15 hours (SIECA, 2001). Ships stayed an average of 21.16 hours at the port. According to a SIECA study, Puerto Barrios has the capacity to handle 2,453,142 tons annually, which is 44% more than it handled in 1999 (2001).

Puerto Barrios has an Industrial Safety Department, which is also in charge of the port's environmental issues. The port has a reasonable capacity to address environmental issues and appears to be willing to further improve in this area. Although there is no national or regional administration currently overseeing the port, it maintains good contact with and gets support from COCATRAM.

At Puerto Barrios and Puerto Santo Tomás de Castilla a contingency brigade has been formed, involving representatives from the civil and military authorities, industries with activities related to the port sector, environmental non-governmental organizations and port-related industries. This brigade has been working together to prepare to face an emergency situation that could happen inside the ports' facilities, such as a spill during the loading and offloading of cargo.

Puerto Barrios has a detached dock with a capacity for four berths (two for the southern side and two for the northern side), a draught of 9.5 m, 125 m^2 of maneuvering dolphins at both sides of the main dock, areas for the filling and emptying of containers, container-weighing services, general cargo and bulk services, and a navigational aids system including buoys and lighthouses.

It also has a 24-hour electronic surveillance system activated by means of a control and monitoring alarm center, an enclosed television circuit along the entire terminal, as well as access and anti-narcotic controls.

The following equipment is located at Puerto Barrios:

- 7 Sideloaders with a capacity of 35 metric tons
- 2 Sideloaders with a capacity of 6 metric tons
- Freight elevators: 9 of 4 metric tons, 8 of 3 metric tons and 2 of 10 metric tons
- 2 mill-hoppers with a capacity of 5 metric tons and 2 mill-hoppers with a capacity of 19 metric tons for the unloading of solid bulks
- 5 deck terminals
- 24 transference deck terminals
- 3 tugboats of: 5950 HP, 957 HP and 850 HP

Puerto Cortés

Constructed within a natural bay, Puerto Cortés is Honduras´ major port with one of the best port infrastructures in Central America. This port is administered by the National Port Enterprise (ENP), but private companies operate parts of the port. It is located at 15º51' latitude North and 87º57.7' longitude West. It has a turning area 900 m in diameter. Figure 5.1-5 shows the main infrastructure of the port and its navigational channel. Additionally, the major infrastructure and areas of environmental concern identified during an EIA of the port are indicated (DDH, 2002)

Figure 5.1-5. Puerto Cortés
(See Appendix D)

Products imported through the port include refined oil products, foodstuff, fertilizers, wheat, coal, steel and iron. Export products include bananas, fruit, coffee, wood and minerals. In 1999, Puerto Cortés handled 89%, or 4,978,083 tons, of the goods transported in and out of Honduras via maritime routes. The port handled 1,728 ships that year. Between 1992 -1999, the volume of goods handled increased on average 8.52% annually (SIECA, 2001). In 1999, 33% of the ships handled were containerized, 9% were RO-RO, 19% were refrigerator, 18% had general cargo, and 6% had petroleum (SIECA, 2001). According to a SIECA study, the port's capacity is 5,837,664 tons and the rate of occupation of the port in 1999 was 59.7%. UNCTAD recommends that an acceptable occupation for a port of this size is 70% (2001).

The Jefe de Departamento de Seguridad e Higiene Industrial y Gestion Ambiental is responsible for environmental issues, security and industrial hygiene in the port. The local Environmental Management Unit is responsible for requesting an EIA for every activity or project developed within the port's facilities. The port has good relations with COCATRAM and is under a strong central administration.

The most important aspect to mention related to the environmental matters is the initiative of the port authority in signing an agreement as part of the international framework for the cooperation between the Empresa Nacional Portuaria, the Canadian Agency for International Development (ACDI) and DDH. The main objective of this project was to develop an environmental management project in Honduras´s ports, using Puerto Cortés as a model. Puerto Cortés is the only port in the region to have undertaken such a project.

The project consists of 4 phases. The first phase included an environmental diagnosis of the ports' operating conditions. The second phase consisted of an assessment of the environmental status of the bay and of the port facilities in Puerto Cortés. Recommendations for action were also given. The third phase of this project consists of the design of the Municipality's Environmental Management System (SIGMA), as well as the identification and inventory of all the equipment and materials required to handle an emergency. Included in this phase is the development of an emergency brigade from all of the sector's enterprises. Only the first two phases of the project have been carried out to date, however. At this time funding is being sought to purchase the equipment required for carrying out the third phase of the project.

The port currently has 5 mooring docks: two of them are breakwater docks (one is being used for the discharge of crude oil-derived products and the other one for the handling of liquid bulks such as molasses, feed, oil and chemicals), and the remaining 3 are marginal docks.

Two of the docks have portico cranes with a capacity of 45 tons each to provide service to the container carriers and Ro-Ro boats. The port is acquiring a Post-Panama crane which is expected to increase the volume of cargo handled at the port. The containers´ terminal has an area of 47,936 m^2, with 114 electrical plugs for the refrigerated containers. It also has a holding freezer with an area of 4,189 m^2, with 6,700-ton capacity cranes. This cold storage room is being concessioned to a private company.

Table 5.1-1. Port Equipment

Type	Quantity (units)
Tugboats	3
Sailing-master launches	2
Courtyard weighing machines of 60 tons	3
Storage weighing machines of 5,000 kg	2
Portico cranes of 45 tons	2
Movable cranes	7
Chassis	12
Dredges	24
Deck terminals	44
High-road deck terminals	4
Freight elevators of 3,000 pounds	9
Freight elevators of 6,000 pounds	9
Freight elevators of 8,000 pounds	23
Freight elevators of 8 tons	1
Freight elevators of 15,000 pounds	11

Port operations and activities identified with having the greatest environmental impacts on the Gulf of Honduras are discussed below. The information contained in the following sections was provided by port personnel at regional stakeholders meetings, during one-on-one interviews and through surveys. Information was also obtained from port publications. Information in some sections is incomplete, however, and will need to be obtained during the completion of the Final TDA.

5.1.1. Port Expansion and Maintenance Activities

<u>*Dredging*</u>

Navigational channels and ports must be dredged regularly due to siltation in order to keep them accessible to large ships. Additionally, there are plans for expansion dredging at the ports to deepen and widen channels and ports to allow even larger ships than currently can be accommodated to enter. Siltation occurs as a result of natural processes, but also results from anthropogenic activities in the watershed such as logging, agriculture and development of lands. Major storm events such as Hurricane Mitch have also exacerbated siltation in the Gulf of Honduras. Ship traffic itself can affect the need for dredging as passage of many ships in narrow channels can cause channel banks to collapse, reducing water depths and enhancing dredging requirements.

There are a number of environmental concerns related to dredging activities. First, the act of dredging can cause the removal of aquatic vegetation on the seafloor including seagrasses and corals. Second, the suspension of sediments during the dredging process can harm aquatic species and damage nearby sensitive seagrass beds, mangrove forests and coral reefs. Sediments in the vicinity of the ports, particularly in Honduras, have been found to be contaminated with heavy metals and other persistent toxic pollutants (Rambøll, 2000). Thus, dredging operations that are either inadequately planned or incorrectly carried out could cause the release of contaminants and sediments into the water column.

Another concern is the disposal of contaminated dredged sediments. In the past, dredged sediments most often have been used as fill material for expanding port infrastructure. It is unclear whether the appropriate tests were conducted to determine whether it was safe to re-use the contaminated sediments. In other cases, dredged material has been deposited in deep ocean areas, which also could pose a threat to marine habitats.

Prior to privatization of Belize City Port, the government of Belize began a project to dredge the important areas of Belize City Harbor including the areas immediately surrounding the port. According to the plan, more than 2 million cubic yards of consolidated seafloor material were to be extracted and used to reclaim a large area of swampland and mangrove forest adjacent to and south of the port. Some of the acreage was to be used for further development of port facilities. The cost of the dredging project was estimated to be US$ 18.4 million of which US$ 7.9 million was to be spent to construct an access channel at the pierhead of Belize City Port and 4,600 m of access channel. The access channel specifications are summarized below:

• Turning Basin:		Length	600 m
		Width	200 m
		Dredging Depth	-10.0 m
• Access Channel	Length	Approx. 4600 m (up to -10 m contour)	
		Width	120 m
		Dredging Depth	-10.0 m

Port of Belize LTD is responsible for all future maintenance dredging of the access channel. Dredging takes place when it is required and the Belize Port Authority is not currently aware of any planned dredging activities. Any development project in Belize is required by law to be supported by an Environmental Impact Assessment.

The access channel to Big Creek was dredged when the port operations began in 1989-1990 to a depth of 6.7 m, with a base width of 63 m on straight sections and 80 m on bends. The channel was designed for vessels of length 110 m and draft 5.5 m. During the initial dredging, some mangroves were cleared to make way for the dredger to operate. Salt spray from the spoil disposal operations also damaged mangroves, causing some trees to lose their leaves, but the mangroves have since recovered.

Although maintenance dredging does not appear to be necessary as there seems to have been little deterioration of the depth of the channel, at least up until April 1998 (Posford Duvivier, 1998), the port owners have plans to expand the navigational channel to allow larger ships to enter the port. Some options that have been considered would include the loss of mangroves surrounding the port and channel, as well as the removal of coral heads. All channel expansion options would also result in the disturbance to sensitive species, including the manatee, and the re-suspension of sediment causing the smothering of adjacent mangrove habitats. It is thought that damage from suspended sediments would not be extensive, however, due to the weak flows of the creek (Posford Duvivier, 1998). Expansion of the navigational channel would also result in an expansion of the port itself.

Puerto Barrios and Puerto Santo Tomás de Castilla share one navigational channel, which Puerto Santo Tomás dredges every 20 years. The port of Santo Tomás practices general maintenance dredging every 10 years. Puerto Barrios practices maintenance dredging in its navigational channel every 3 years (due to the direction of the currents, which may enhance sedimentation in its navigational channel). The dredged material is transferred to deeper zones of Bahía la Graciosa and dredging operations are monitored by the port. In 2000, 360,000 m^3 were dredged from the access channel to increase its depth to 9.5 m. Dredging in the Santo Tomás de Castilla Bay has been found to affect the marine environment in the region. The coastal currents carry the sediments and suspended solids along the littoral towards the Bahía la Graciosa, reducing water transparency and thereby diminishing productivity or causing the total loss of vegetation (Yañez-Arancibia *et al.*, 1998). Ships using Puerto Barrios pay a fee to Puerto Santo Tomás de Castilla, which is used by EMPORNAC to carry out such duties as dredging and maintaining navigational aids.

The Empresa Nacional Portuaria of Honduras recently undertook the dredging of its access channel. To accommodate the docking needs of larger vessels, approximately 3 km of channel were dredged, resulting in 300,000 m^3 of sediments. This created a channel depth of 14 m from a current depth of 12 m. According to the Chief of the ENP's Technical Division, the port decided to transfer the dredged material to an area approximately 1600 m to the northwest (inside a small channel with a depth from 25 to 35 m). Research studies carried out in this zone indicate that the area along the port facilities' access channel is surrounded by coral, but they are covered by a layer of sediments produced by the urban and up-river discharges and are not in good condition.

Regular maintenance dredging of docks is also conducted at Puerto Cortés to maintain an acceptable depth to accommodate the ships' draughts. Dredging was recently done and it is carried out approximately every two years. TEXACO also has regularly carried out maintenance dredging in its dock (dock nº 1). The last dredging exercise was executed during the year 2000 due to the siltation produced by Hurricane Mitch.

Development of new infrastructure

Given the increase in the number and size of ships carrying cargo into Central America, each of the ports has plans to expand to increase its capacity. Depending on the type of infrastructure, port expansion efforts could have both direct and indirect environmental effects. The construction itself could directly affect the local environment through clearing of land to make way for the infrastructure and improperly carried out construction activities could affect water quality in the port's vicinity. Indirect environmental impacts could result from the increased ship traffic, such as an increased risk of collisions and spills.

At Belize City Port discussions have been held regarding the development of a cruise ship terminal at Port Loyola (Kings Head Pier) that would be operated by Port of Belize LTD.

The owners of Big Creek have discussed expansion plans. The expansion would include deepening the port basins and stretching (re-cutting) the access channel through the mangroves. .

According to the Municipality of Puerto Barrios, a Mexican company is interested in the construction of a port equipped with state-of-the-art technology for the reception of oil-tanker ships (centralizing the export and import of crude oil and other refined products).

Three additional plans for expansion have been considered for future development of Puerto Barrios: further capital dredging, extension of the pier and expansion of warehouse area to accommodate more containers. There are no immediate plans for further infrastructure development at this time, however. The port maintains that EIAs are conducted for all projects. The Ministry of Environment and Natural Resources, however, states that no EIAs have been presented to or approved by them.

Projects planned at Puerto Santo Tomás de Castilla include a bathymetric survey for the basins and channel, post-Mitch dredging to increase the channel depth and an extension north of the port. Damage caused by an earthquake also needs to be repaired.

At Puerto Cortés, the Enterprise AES has the approval of the national authorities to initiate the construction of an electrical energy generation terminal (that will be located in barrio el Faro in Puerto Cortés) based on liquefied gas. This project will use dock nº 1, which is currently used by TEXACO, for import of the raw material. This dock is equipped with state-of-the-art technology. Additionally, areas of the quay are being changed from general and liquid cargo to dry bulk. Post-Mitch dredging is planned. A large extension project for the port is also planned. EIAs are done for all activities and approved by the Secretaria Nacional del Ambiente (SENA).

5.1.2 Loading/Offloading and Storage of Cargo

During the loading and offloading of cargo from a ship, many opportunities for accidents arise. The greatest risks occur with the handling of hazardous cargo, such as chemicals and petroleum products. Miscommunications can happen or port workers can make careless errors that result in faulty pump connections or variations in the rate of pumping causing spills to occur.

Puerto Santo Tomás de Castilla does not meet the minimum safety environmental standards within the port-related industry. At the port the handling of hazardous cargo such as oil and chemical products is not controlled; safety regulations are not mandated. Additionally, the quality and alignment of piping used for transporting dangerous liquid cargo pose a high risk for accidents.

At Puerto Barrios, storage services have been concessioned by COBIGUA to two private stowage companies in charge of cargo handling and storage. Approximately 90% of the cargo arrives to the port stored in containers; the remaining 10% is composed of general cargo (mostly vehicles). Most of the hazardous cargo that enters Guatemala through this port is containerized. Dangerous bulk goods (usually stored in sacks or cans) are accepted only by direct transship. Hazardous cargo must be directly discharged from the ship to the consignee. Texaco receives the only dangerous liquid cargo at the terminal and there has not yet been a spill related to the discharge of Texaco's cargo. The port keeps a copy of the International Maritime Dangerous Goods Code (IMDG) in order to handle the dangerous goods as established by this code.

All ports have knowledge of IMO's IMDG and almost all of them have a one volume copy. Nonetheless, at almost all of the ports, the handling and storage of these dangerous goods is done in an empirical way. Generally, the employee with the highest seniority determines, based on his personal experience, the appropriate storage and segregation method.

5.1.3 Waste Generation and Handling

The handling of ship-generated and port-generated wastes, including ballast water, is one of the most important port operational issues in terms of environmental protection faced in the Gulf of Honduras. As is discussed above in Section 4, each of the three countries has ratified the MARPOL Convention. None of these countries has yet put in place the regulations necessary to implement the Convention, however. Nor do they have an adequate monitoring and enforcement system established in order to ensure compliance.

Treatment and final disposal of the solid wastes generated on ship:

None of the ports in the Gulf of Honduras has adequate installations for the reception of solid wastes. Belize City Port, Big Creek, Puerto Barrios and Puerto Santo Tomás de Castilla do not receive waste from ships. In Puerto Cortés, Honduras, this service is given by the Municiapality.

Vessels are directed to not release any solid or liquid wastes in Belizean waters. The Environmental Compliance Plan for Cruise Ships promulgated by the Government of Belize states that cruise ships must submit the proper ships' documents certifying compliance with MARPOL's Solid Waste Management and Separation Plan. This, however, does not mention whether it applies to other vessels operating in Belizean waters.

National legislation forbids the reception of waste generated on ships in Guatemala. Additionally, Puerto Barrios does not have a waste treatment plant that meets international regulations. Neither Puerto Barrios nor Puerto Santo Tomás de Castilla accepts wastes and they do not carry out any inspections or control of ship-generated wastes. As a result, there is a risk that ships jettison their wastes at sea.

At Puerto Cortés, wastes are not currently handled according to MARPOL. The municipality handles waste discharge from ships, but there are no controls regulating the services. Through a written application, any individual, or through a ship-owner agent, can request waste discharge services. This petition must be signed by the chief of the environmental unit, by the municipality's public service unit and by the Industrial Safety Department from Empresa Nacional Portuaria. Once the petition is signed, it has to be presented to the municipal treasury with a fee, as established by the municipality's tax plan. The wastes are then disposed of without any regulation in the municipality's uncontrolled landfill site. The only requirement established by the local authorities is that the wastes should be domestic (characterizing "domestic" type wastes as those generated from the time the ship begins on-board operations until it reaches its final destination).

In Honduras, the Regional Office for Agriculture and Livestock Sanitation (belonging to the Agriculture and Livestock International Sanitation's Organization) OIRSA, has a mandate from the President to provide an unloading service for the wastes generated on-board. In order to facilitate the service, OIRSA constructed an incinerator inside the port facilities in 1996, but the municipal authorities and OIRSA have not yet reached agreement as to which authority has the right to provide this service. The incinerator does not yet have an environmental license for operating. The municipality is concerned that significant income would be lost if OIRSA remains in charge of providing the service (approximately $100/ship that demands the discharge service). When the presidential mandate granted OIRSA the rights to provide the service, Honduras had not yet ratified the MARPOL Convention.

Treatment and final disposal of the solid wastes generated by on land activities within the port facilities:

In Belize's ports, a crew is assigned to clean-up activities, which is supervised by the port authorities. Big Creek and Belize City Port do not yet have incinerators and therefore do not adhere to MARPOL standards. At Big Creek, waste oil from tug oil changes is re-used to lubricate the chains on the port's cranes so there is no need to dispose of oil. A new latrine system with septic tanks was planned for the port and the contents would be taken to a designated dumpsite. A boat collects garbage from the port and monthly takes away debris (e.g., broken pallets) from the channel and nearby mangroves.

In Guatemala and in Honduras, this service is provided by the private sector through concession or an auction process with contracts that last for one year. The wastes are deposited in each municipality's landfill site. At present, the uncontrolled open air landfill sites are most commonly used for this purpose. The construction of a controlled landfill site outside Puerto Cortés is currently underway. A private enterprise provides clean-up services inside the facilities of Puerto Barrios (they clean the dock each time a boat completes its operations).

Treatment and final disposal of the recovered products from an accidental spill:

There are concerns that some ports in the region do not have the capacity to ensure that recovered products from accidental oil or chemical spills are adequately disposed of. Reports have been made that some recovered products were illegally disposed of in municipal landfill sites, posing an environmental risk.

Port operators at Big Creek are careful to avoid spills of oils or fuels, in large part out of concern for the intake for the nearby shrimp farm that is located near the port. If oil is discovered in the creek, staff investigates to find the source and prevent further leakage if necessary. Big Creek has no equipment to clean-up oil spills and all vessel operators entering the port are warned of the need to avoid discharges of fuel or oil.

Largely due to the types of products handled in its ports, Guatemala is the country with the most registered accidental hydrocarbon spills. At the same time, Guatemala has a better coordinated evacuation brigade in case of an accidental spill than any other country in the region. Although several authorities participate in the recovery of spills, the company DVG is in charge of the treatment and final disposal of the recovered product.

In Honduras, each company is responsible for developing its own preventive measures and cleanup plans for addressing spills. If they lack capacity, it is the company's responsibility to request an assessment if they face an accidental spill. The company then disposes of the recovered product according to its own methods.

5.1.4 Ballast Water

The discharge of ballast water is a serious threat in the Gulf of Honduras, as it is worldwide. The introduction of invasive marine species into new environments through ballast water and other shipping vectors has been identified by the GEF as one of the four most serious threats to the world's oceans (Global Ballast Water Management Programme, 2000). Invasive species threaten the survival of many native freshwater, coastal and marine species and have proved to be economically devastating. To cite one example, the introduction of the European Zebra Mussel into 40% of internal waterways in the United States has required more than US$ 1 billion on control measures since 1989.

Only three of the five main ports in the region accept sludge for treatment. None of the ports, however, has non-oily ballast water discharge services. Although no statistics are available, the lack of ballast water treatment facilities most likely results in ships regularly discharging untreated water into ports and adjacent marine areas. This lack of ballast water treatment has been listed by stakeholders in the region as the most serious environmental threat posed by port operations in the Gulf of Honduras.

There are no treatment facilities for oily-water or non oily-water in Belizean waters. The Belize City Port receives little or no information regarding the dumping of oily-ballast or non-oily ballast in Belizean waters due to the lack of resources to perform effective monitoring and compliance.

Ships docking at Puerto Santo Tomás de Castilla and Puerto Barrios in Guatemala have the option to use the services of the company DVG to safely dispose of their oily ballast. According to DVG personnel, the company takes sludge from approximately 80% of the ships docking at Puerto Santo Tomás de Castilla. DVG has a treatment plant for the recovery and/or recycling of the oil product for its later commercialization. Ships must pay a fee for this service, however. It is believed that some ships instead choose to illegally dump their oily ballast several miles from the port where there is no enforcement.

At Puerto Cortés, the company Facilitadores Navieros, S.A handles the discharge of oily ballast. Although Facilitadores Navieros of Honduras has an environmental license for its operation, the company still lacks adequate treatment facilities and it is currently unknown where and how they dispose of the final product.

5.1.5. Port-Related Industry

Several of the ports have associated industries that also pose a threat to the sensitive ecosystems in the vicinity. ZOLIC, located at Puerto Santo Tomás de Castilla is Guatemala's first free zone and has 39 registered companies dedicated to the manufacture of products such as liquor, cosmetics, foodstuffs, chemicals and fertilizers. The enterprises that are located within the ZOLIC on the port facilities are listed (including their storage capacity and stored products) in Appendix C. At Puerto Cortés, several areas of the port are operated by private companies, such as oil and chemical companies. There is a danger that spills or accidental discharges of hazardous substances could occur from these port-related industries. Additionally, wastes are generated from these enterprises that must be handled.

Supporting data

Adequate monitoring data are not available that would allow the accurate analysis of the effects of port operations on the surrounding environment. The most extensive testing conducted in the Gulf of Honduras harbors was undertaken as a part of the environmental management cooperation program between Puerto Cortés, ACDI and DDH. During their environmental analysis of the port, they found elevated levels of heavy metals (As, Cr, Bu, Pb and Zn) accumulated in sediments within the port (DDH, 2002). This suggests that port operations have impacted the environment. Data provided by the National Port Authority in 1992 for Santo Tomás de Castilla Bay showed high levels of contaminating nutrients and fecal matter (from 750>25,000 NMP/DL) far exceeding the maximum permissible limit prescribed by the Guatemalan Government for drinking water (3 NMP/DL) (Yañez-Arancibia *et al.*, 1998).

Also necessary for the assessment of the environmental effects of port operations would be an accurate record of spills and discharges into the port harbors. These records, unfortunately, are also not available. The decision of whether or not to register an accident is up to the discretion of the port authority in each country and is usually made based upon the magnitude of the mishap. It is known that accidental contaminant discharges caused by shipping activities have taken place at all ports in the Gulf, but there is no comprehensive registry listing each of these accidents and the quantity and type of contaminant released into the port.

Data on spills at Belize City Port were not available for this report. Big Creek does not record accidental oil spills.

Guatemala registered 12 accidental spills between 1975 and 2002, most of which occurred in the port facilities of Santo Tomás de Castilla:

- August, 1997: Spill of lubricating oil
- August, 1997: Spill of industrial primer, 2 tons
- December, 1997: Spill of sludge, 200 gallons
- May, 1999: Spill of sunflower oil
- July 1999: Spill of combustibles

Puerto Barrios reported a spill of fuel oil and sludge that occurred as a result of a collision of a Chiquita brands vessel with a pier in 1993. On February 27, 2003, a ship in the port spilled approximately 100 gallons of bunker as a result of the incorrect handling of valves in the machinery room. The port coordinated with DVG to put out barriers and was able to confine the area of the spill in 25 minutes. The bunker was picked up manually using absorbent material. The local spill brigade was informed of the spill, but the port was able to handle the emergency.

Between 1994 and 2002, Puerto Cortés registered no oil spill accidents in its bay. Some accidents have occurred, however, at the companies installed adjacent to the port's facilities. For example, in August 1999, 150 gallons of bunker oil were spilled on the mainland by HONDUPETROL due to a perforated pipeline. This incident was controlled by HONDUPETROL's personnel and as a result of this accident, the company created an Environmental and Industrial Safety department. So far, HONDUPETROL has invested in personnel training as well as in the acquisition of equipment and materials that are necessary during an oil spill. At the end of 2002, approximately 49 gallons of bunker oil were spilled within a 15 m^3 area during the discharge of a tanker consigned to HONDUPETROL. The area where the spill took place was immediately confined by using containment barriers specially designed for the cleanup of spills. Within 8 hours the spill was completely mitigated and no damages resulted. Texaco has caused other environmental damages when receiving crude oil to be refined.

Sectors and stakeholders

Some of the main stakeholders include:

- Port authorities
- Port owners
- Shipping companies
- Municipalities
- Port-related industries

5.2 Negative Environmental Effects Arising from Marine Activities

5.2.1 Degradation Resulting from Oil and Chemical Discharge

5.2.1.1. Collision

The threat of oil and chemical spills resulting from navigational risks is quite serious in the Gulf of Honduras. Due to the limited accessibility of Puerto Barrios and Puerto Santo Tomás de Castilla in Guatemala within the inner section of the Bahía de Amatique, the risk of collisions and groundings is significant. This risk is increased by the shallow depths and narrow width of the navigational channels (on the average only 90 m wide and 11 m deep, while many ships reach depths of up to 10.5 m). The sometimes extreme weather patterns in the region including frequent hurricanes also threaten maritime safety. The age, type and maintenance of the ships entering the Gulf of Honduras ports factor into the risk of accidents, as does the training of the ship crewmembers. The need for impr oved navigational safety is widely recognized, including better communication systems and infrastructure, as well as the capability to update bathymetric maps.

Spills occurring in the Gulf, particularly in the Bahía de Amatique, have the potential to devastate nearby sensitive habitats. One oceanographic current analysis carried out in the Bahía de Amatique concluded that within 48 hours a major oil spill could spread along the shores of the Bay and reach other areas of the Gulf, including the Honduran National Park of Jeanette Kawas. The strong rotary currents of the Bay combined with its semi-closed and shallow nature make it highly vulnerable to spills. The study also indicated that the Mesoamerican Barrier Reef could be threatened by a spill in the Bahía de Amatique if the predominant winds were blowing in the opposite direction of the currents (EPOMEX, 1993).

The risks of collisions or groundings occurring in the Gulf of Honduras are enhanced by the following factors:

Inadequate navigational aids

Adequate and properly maintained navigational aids are critical elements of navigational safety, particularly in areas such as the Bahía de Amatique where the navigational channels are extremely shallow and narrow. There are concerns that the navigational aids in the Gulf of Honduras are inadequate or improperly maintained and could enhance vessels' risk of collision.

Belize City Port's navigational aids consist of 24 buoys and beacons. There are also lighthouses outside the delineated port boundaries. The buoys and beacons are of old technology and are maintained by the Belize Port Authority on a limited budget. Increased funding would allow these older systems to be phased out to be replaced with newer more maintenance-free units.

Big Creek's navigational aid system consists of buoys; twenty buoys mark the access channel (Posford Duvivier, 1998).

The access channel that leads to the port facilities of Puerto Barrios and Santo Tomás de Castilla in Guatemala is located in Bahía de Amatique. This channel, connected by sea buoys, has a depth of 11 m, a length of 12 km and a width of 90 m. It has a navigational aids system type "B" approved by the International Association of Lighthouse Authorities (IALA). The channel's entrance has a sight land buoy, 8 buoys installed along the channel and an inland lighthouse. The sight land buoy indicates the entrance to the access channel; it is located at latitude 15º 47.8’ N and longitude 88º 36.2’ W.

The system at Puerto Cortés operates through a major lighthouse with an elevation of 72 ft. The lighthouse is in the form of a red and white metallic tower and can be seen from up to 20 nautical miles. Four articulated buoys indicate the entrance as well as the exit channels existing in the port, in accordance with IALA specifications. The port also has a “RONMARC” satellite station and D.G.P.S. satellite stations, both of which are currently under repair. Volpe National Transportation Systems Center trains port personnel to maintain this equipment. A study conducted on the effects of Hurricane Mitch on ports in Honduras and Nicaragua made the following recommendations for repairing and improving navigational aids at Puerto Cortés: repair the lighthouse at Punta Caballos, repair the alignment markings and install a buoy one nautical mile north of the entrance to the channel (USGS, 2000).

Bad weather

As is discussed above in Section 2.1.5, the Gulf of Honduras regularly experiences severe weather patterns such as hurricanes and tropical storms. If ships do not have adequate warning to allow them to escape the storm path, they risk being run aground on the coral reefs or shallow sea-bottom in the Gulf.

Inadequate training and hydrographic capabilities

Seaman training is currently limited in the Gulf of Honduras. Inadequate training of seamen increases the likelihood of collisions and groundings in the region. Additionally, seamen with insufficient training are less prepared to handle cleanup of oil and chemical spills should they occur.

The Maritime Defense Force of Belize has a basic skills programme for seamen training, but there is no specialized training program. The Belize Port Authority is currently holding Port Security Training, but this appears to be the first time that formal training has taken place in many years. Training for oil spill response and hazmat is required for all relevant port personnel in Belize, however.

The Atlantic Naval Base from Guatemala trains seamen in a basic skills programme. The port safety and industrial security departments of Puerto Barrios train their personnel in first aid issues, use of fire extinguishers, industrial security and emergency plans.

In Honduras seaman training is under the direction of the Merchant Marines. Seamen are taught four basic courses: firefighting measures, survival techniques, first aid measures and social responsibility (all recommended by IMO). The more highly experienced seamen also receive two additional courses related to bridges and machinery. Puerto Cortés is completing an Environmental, Industrial Hygiene and Security programme. A manual is also being prepared to cover each department’s needs.

None of these countries currently trains officers and ship masters. Puerto Cortés, in coordination with the Merchant Marine’s General Direction, recently founded the Seamen’s Education Center. Plans are being developed to expand the education center and make it the first specifically dedicated to seamen training in Central America

As part of this TDA preparation, the Mesoamerican and Caribbean Sea Hydrographic Commission (MACHE) performed a gap analysis of hydrographic capabilities for the three countries. They focused on institutional capacity, data gaps, marine survey capacity, electronic chart development (ENC), and GIS/other product development. Table 5.2-1 sumamrizes these gaps, whereas Table 5.2-2 provides more detail about the findings. This detailed review demonstrates the significant gaps in the region regarding institutions, human and survey capacity, and data availability.

Table 5.2-1. Hydrographic Component Gap Analysis – Summary Findings

		Belize	Guatemala	Honduras
Institutional capacity	mandates and policies	V		
	resources	V	V	V
	organizations	V		
	coordination & collaboration	V	V	V
Data gaps	major ports	~	V	~
	coastal areas	V	V	V
Survey technical capacity	vessels	V		V
	equipment	V	V	V
	skills	V	V	V
ENC development	skills	V	V	V
	equipment	V	V	V
Marine GIS/ Other product development	skills	V	V	V
	equipment	V	V	V

~ partial gaps
V major gaps

Table 5.2-2. Hydrographic Component Gap Analysis -- Belize

Existing Capabilities

Institutional capacity (mandates, organizations, coordination, access, resources, ability to perform and deliver, etc.)	Geog. focus	**Data** availability, quality, accessibility, etc.	**Data acquisition**		Product development		**Related initiatives**
			Technical equipment	Personnel proficiency	Technical equipment	Personnel proficiency	
No affiliation with IHO or MACHC party to SOLAS, UNCLOS and MARPOL 73/78 Port Authority and Ministry of Natural Resources Environment and Industry (MNREI) survey, Port Authority maintains data; institutions conduct survey work independently do not share resources. No Current effort to integrate through National hydrographic commission MNREI and Port rely on International Survey Division (HYCOOP) at the U.S Naval Oceanographic Office for equipment, software and technical assistance. Contract surveys provide data to port authority	National level	Refer to Table 2.1 Do not have national or strategic charting plan	No vessel No Hydrographic equipment	One worker at the MNREI	None	Inadequate	None
	Belize City	Refer to Table 2.1 Data available digital format some data gaps exist	No vessel No Hydrographic equipment	One worker at the MNREI	**None**	Inadequate	
	Big Creek	Refer to Table 2.1 Limited products available No digital data	No vessel No Hydrographic equipment	One worker at the MNREI	None	Inadequate	

Needs

Institutional capacity	Geog. focus	**Data**	**Data acquisition**		**Product dev.**	
			Technical	Personnel	Technical	Personnel
Devlopment of National hydrographic commission to coordinate efforts amoung Ministries and Internationally funded projects in Belize. Development of national policy and mandates to allocate resources	National level		Hydrographic equipment suite needed	Personnel and training	Workstations needed	Training needed
	Belize Ctiy	Requires a hydrographic survey to meet internatinal standards	Hydrographic equipment suite needed	Personnel and training	Workstations needed	Training needed
	Big Creek	Requires a hydrographic survey to meet international standards	Hydrographic equipment suite needed	Personnel and training	Workstations needed	Training needed

Table 5.2-3. Hydrographic Component Gap Analysis -- Guatemala

Existing Capabilities

Institutional capacity (mandates, organizations, coordination, access, resources, ability to perform and deliver, etc.)	Geog. focus	**Data** availability, quality, accessibility, etc.	**Data acquisition**		Product development		**Related initiatives**
			Technical equipment	Personnel proficiency	Technical equipment	Personnel proficiency	
IHO member state and party to SOLAS, UNCLOS and MARPOL 73/78 Navy and Port Authority survey, Port Authority maintains data; institutions conduct survey work independently do not share resources. Current effort to integrate through National hydrographic commission Navy relies on International Survey Division (HYCOOP) at the U.S Naval Oceanographic Office; Port Authority has Budget Working with COCATRAM to look for economic support within the European community	National level	Refer to Table 2.1 Do not have strategic charting plan	Navy vessels No Hydrographic equipment	Four officers Six sailors; Four workers at Port	None	Inadequate	None
	Puerto Barrios	Refer to Table 2.1 Limited products available No digital data	Navy vessels No Hydrographic equipment	Four officers Six sailors; Four workers at Port	None	Inadequate	
	Puerto Santo Tomas	Refer to Table 2.1 Limited products available No digital data	Navy vessels No Hydrographic equipment	Four officers Six sailors; Four workers at Port	None	Inadequate	

Needs

Institutional capacity	Geog. focus	**Data**	**Data acquisition**		**Product dev.**	
			Technical	Personnel	Technical	Personnel
Continue work with National Hydrographic Commission to further working relationships in hydrography both natinally with links to the region	National level		Hydrographic equipment suite needed		Workstations needed	Training needed
	Puerto Barrios	Requires a hydrographic survey to meet international standards	Hydrographic equipment suite needed		Workstations needed	Training needed
	Puerto Santo Tomas	Requires a hydrographic survey to meet international standards	Hydrographic equipment suite needed		Workstations needed	Training needed

Table 5.2-4. Hydrographic Component Gap Analysis -- Honduras

Existing Capabilities

Institutional capacity (mandates, organizations, coordination, access, resources, ability to perform and deliver, etc.)	Geog. focus	**Data** availability, quality, accessibility, etc.	**Data acquisition**: Technical equipment	**Data acquisition**: Personnel proficiency	Product development: Technical equipment	Product development: Personnel proficiency	**Related initiatives**
Associate IHO member state and party to SOLAS, UNCLOS and MARPOL 73/78 Port Authority collects, processes, disseminates hydrographic data Port Authority relies has a budget but counts on International Survey Division (HYCOOP) at the U.S Naval Oceanographic Office for equipment, software and technical assistance and the U.S National Imaging and Mapping Agency (NIMA) for chart production	National level	Refer to Table 2.1 have a national charting plan no strategic charting plan	No vessel No Hydrographic equipment	Six workers from the Port	None	Inadequate	Planned surveys
	Puerto Cortes	Refer to Table 2.1 Data is available and in Digital format Data does not meet IHO standards for Harbors	No vessel No Hydrographic equipment The National Port Authority relies on HYCOOP for equipment and contracted vessel time	Six workers from the Port	None	Inadequate	

Needs

Institutional capacity	Geog. focus	**Data**	**Data acquisition**: Technical	**Data acquisition**: Personnel	**Product dev.**: Technical	**Product dev.**: Personnel
Organizational policy and mandates need to be developed at the national level to support capacity building, and resurce needs for hydrographic surveys; national and regional coordination	National level		Hydrographic equipment suite needed	Six workers	Workstations needed	Training needed
	Puerto Cortes	Requires a hydrographic survey to meet international standards	Hydrographic equipment suite needed Including hardware and software	Six workers	Workstations needed	Training needed

Table 5.2-5. Hydrographic Surveys and Data Availability in the Region

	State	Port/Area	Source Data availability	Digital coverage	Survey information/ Surveying needs
Ports, harbors and approaches	Belize	Belize City Harbor	In-country	100%	Surveyed by Belize 1998, 2002 IHO Order1 single beam and side scan sonar; data gaps exist in Harbor area and strategic charting plan needed for future port infrastructure development and navigational safety.
		Big Creek	Unknown	Unknown	
	Guatemala	Puerto Barrios	In-country	0%	Inadequate coverage: most recent data from 1979. All areas need to be re-surveyed
		Puerto Santo Thomas de Castilla	In-country	0%	
		Bahia Manabique and approaches	In-country	0%	
	Honduras	Puerto Cortez	In-country	100%	Surveyed by Honduras (ENP) May 1998 IHO order2, single beam and side scan sonar; does not meet international standards. Additionally dredging activity and Hurricane Mitch have affected the harbor area since last survey
		Puerto Cortez Approaches	In-country	100%	Surveyed by Honduras (ENP) in June 1999 IHO order2 single beam, does not meet international standards.
		Tela	In-country	0%	Needs to be re-surveyed
		La Ceiba	In-country	100%	Being surveyed (ENP) IHO order unknown
		Puerto Castia / Trujillo	In-country	100%	Surveyed (ENP) IHO order unknown
		Bay Islands	In-country	100% in limited areas	Coxen Hole, French Harbor Roatan surveyed by ENP 2002 IHO 2 single beam and side scan sonar.
Coastal Surveys	Honduras	Coast-wide survey (red band on fig 1.1)	In-country	0%	An 1984-85 survey carried out by the US. Only some of the data could be used for conversion into digital format.

Terrorism

Although small, the risk of a collision occurring in the Gulf of Honduras as a result of terrorist activities does exist. There is a chance that a terrorist attack could be made on a ship in the Gulf, similar to the attack that was made against the USS Cole in a Yemeni port in October 2000. Such risks have not been evaluated fully at this time.

Traffic Intensity

The number and size of ships entering the ports of the Gulf of Honduras are increasing as trade expands in the region. As the amount of ships moving through the Gulf of Honduras increases, so does the risk for collisions and groundings. The number of ships using the Gulf of Honduras ports has dramatically increased over the last decade and is expected continue to grow in the foreseeable future. For example, the number of cruise ships using Belize City Port is expected to increase from 51 to 401 between 2001 and 2004.

A factor increasing the risks of collision from the rise in traffic intensity is the lack of notification provided by some ships. Not all ships entering ports in the Gulf of Honduras ports provide adequate warning before their arrival. As a result, it is becoming more difficult to regulate the ships and the risk for accidents increases. Because the ship channels are narrow, positive control and tracking of vessels using the navigation channels are advisable. A Vessel Tracking System (VTS) would be advantageous for these ports.

Inadequate vessel standards

Port inspectors are in charge of vessel supervision at each port. None of these inspectors, however, assesses whether each ship arriving to the ports meets all safety standards established by the national authorities and by the international organizations (such as the International Maritime Organization, or IMO). The problems posed by the ships entering the ports of the Gulf of Honduras are similar to those arising worldwide.

Presence of hazardous cargo

With the exception of Big Creek, hazardous cargo is regularly shipped in and out through the ports in the Gulf of Honduras. Such products include oil and petroleum products and chemicals. The presence of such cargo on board the ships navigating through the narrow channels, possibly during storm conditions, increases the possible harm that could come from a collision in the Gulf waters. Appendix C contains information on the amount and types of cargo handled by each of the ports.

According to the Belize Port Authority, fuel oil shipped into and within the region is the only dangerous cargo. No hazardous cargo is shipped out of the Belize City Port. The Belize Port Authority recently implemented a new form for the transportation of “Dangerous Goods”, however, as the old form was not up to international standards. These have been supplied to all the Shipping Agents.

Puerto Barrios does not have specific statistics for dangerous cargo since (except for Texaco’s hydrocarbons and liquid bulk) all hazardous cargo is transported inside containers, which are not emptied in the port and are statistically considered to be containerized cargo.

No statistical data related to hazardous cargo is available for Puerto Cortés as the shipping companies have only recently begun to inform the port about this cargo.

5.2.1.2 Vessel Discharge

As is discussed above in Section 5.1.3, three of the Gulf of Honduras ports accept sludge from ships, but none of the ports treats non-oily ballast water. As a result, ships are forced to release their untreated ballast water either before or after entering the port. Discharge of oily ballast can significantly affect the environment through the release of such contaminants as heavy metals and petroleum. There is also a risk that exotic species can be introduced into the sensitive Gulf of Honduras ecosystems, as has occurred with the *Mnemiopsis leidyi*, or comb jelly, in the Black Sea and the European Zebra Mussel in the USA.

In extreme cases it could also be necessary for ships to discharge fuel or part of their cargo load before entering the port. This could be necessary if, for instance, a hurricane or tropical storm was going to hit the area.

5.2.1.3 Dispersant Usage

A common component of oil spill response plans is the use of dispersants to respond to marine oil spills. Dispersants are solvents or agents for reducing surface tension (surfactants like soap and detergent), causing oil to enter the water column as fine droplets where it then disperses and a portion eventually degrades with natural processes (water column and sediment transport; microbial degradation). Dispersants are used to control movement of surface slicks into sensitive environments such as coral reefs, mangroves, wetlands, etc.

Use of dispersants has been evaluated by a series of studies, including one exhaustive study by the Marine Board of the National Research Council (NRC, 1989). This study reviewed the evidence for effectiveness of dispersants, identified their positive and negative impacts, and provided recommendations for their use. In their summary, they review situations where use of dispersants have proven effective, and others where their use has proven to be less effective. Effective use mandates early treatment following the spill (at a time when the oil spill is least viscous and most contained). Direct application of dispersants on marine life (e.g., birds, manatees, etc.) is to be avoided, because they destroy water-repellency and insulating capacity of fur and feathers, and some components may affect the structural integrity of sensitive membranes and surfaces. Sublethal effects of dispersed oil may also occur to marine life, according to laboratory studies. In general, marine organisms at the surface will be less affected by dispersed oil than organisms in the water column. In shallow water, benthic organisms may be more affected by dispersed oil. For most habitats such as mangroves, however, long-term effects are less and the habitat recovers faster if the oil is dispersed before it reaches the area.

The NRC study suggested that sensitive inshore habitats such as salt marshes, coral reefs, sea grasses, and mangroves are best protected by preventing oil from reaching them, and dispersion is one mechanism for protection. NRC recommended further study, however, to establish those conditions under which dispersants may harm certain ecotones rather than helping them.

NOAA has produced studies on oil spills in Coral Reefs and in Mangroves, focusing on planning and response considerations. They discuss use of dispersed oil as one component of the planning and response. For coral reefs, NOAA reiterated the NRC findings:

- "Whenever an oil spill occurs in the general vicinity of a coral reef, dispersant use should be considered to prevent floating oil from reaching the reef.
- Dispersant-use decisions to treat oil already over a reef should take into account the type of oil and the location of the reef.
- Coral reefs with emergent portions are high-priority habitats for protection during oil spills.
- The use of dispersants over shallow submergent reefs is generally not recommended, but the potential impacts to the reef should be weighted against impacts that might occur from allowing the oil to come ashore.
- Dispersant use should be considered to treat oil over reefs in water depths greater than 10 m if the alternative is to allow the oil to impact other sensitive habitats on shore.
- Dispersal is not recommended to treat oil in reef habitats having low-water exchange rates (e.g., lagoons and atolls) if mechanical cleanup methods are possible."
-

In NOAA's guidance document on Oil Spills in Mangroves, Planning and Response Considerations (2002), they consider that "If applied appropriately offshore, chemical dispersants can be an effective tool for protecting mangrove forests and the habitat they provide. Tradeoffs among other resources at risk, such as potential effects of high concentrations of oil in the water column on pelagic organisms and coral reefs, should be considered before dispersant use. When applied appropriately in sufficiently deep water, impacts to corals are expected to be minimal."

In summary, recent experience and studies have shown that use of dispersants in areas such as the Gulf of Honduras depends on many factors, including the sea conditions, the type of oil, the water depth, the proximity to resource areas, the mix of organisms to be impacted and the time scale for response. An effective oil spill planning and response plan should be based on detailed studies of the ecology, biology, physical oceanography and geology of the Gulf of Honduras, including detailed modeling of the expected dispersal patterns of dispersants. Templates should be prepared so response will consider these factors appropriately immediately upon occurrence of a spill, and rapid and therefore effective dispersant use can occur for those spills, conditions and habitats for which it is appropriate.

In the Gulf of Honduras, dispersants are available to the Guatemalen Navy for spill response. However, dispersants have not been used to date in the region. The Navy has received some training in the use of dispersants, should the need arise; however, there is no existing, effective decision tree governing use of dispersants regionally, so dispersant impacts should be considered carefully before use.

5.2.2 Degradation Resulting from Other Marine Activities

5.2.2.1 Fishing

Overfishing and use of destructive fishing techniques are other marine activities that harm marine and coastal ecosystems. Fishing in the region is conducted both artisanally and commercially, but it is not governed by regional agreements and no national quotas have been established. Artisanal fish catch and effort are not routinely reported to the government. Fish catch methods are not strongly enforced. For Guatemala, the last study by the Food and Agricultural Organization of the United Nations appears to be in 1986, nearly two decades ago. No UN/FAO reports were found for Honduras or Belize. Surveys of artisanal fishermen were conducted by NGOs in the Gulf of Honduras in 1998 and 1999 to document the status of the region's fisheries resources from their perspective. The fishermen noted a steady decline in the fish stocks while at the same time the number of fishermen was increasing. They cited the main causes of the decline to be overfishing, smuggling, the use of destructive gear and limited enforcement of existing regulations (Heyman *et al.*, 2000).

5.2.2.2 Anchoring

Small boats used for artisanal fisheries as well as for tourism and other uses commonly anchor to perform their tasks. Such anchoring can damage coral reefs, disturb the vegetative community on the bottom and destroy the benthos. In areas where such activities are frequent, such as popular diving spots, such anchorage can disrupt the marine resources and cause damage. If left unaddressed, such anchorage misuse can irretrievably reduce biodiversity and resource values. Unfortunately, no information or data are available on this topic for the Gulf of Honduras.

5.2.2.3 Marine Collections

The Gulf of Honduras has many spectacular fish and marine organisms. Some of these are the objects of marine collections for export purposes (primarily). If laws, regulations and enforcement are lacking, such collections can result in economic and biodiversity loss to the region. Unfortunately, little information is available on the extent of marine collection activities in the Gulf of Honduras, nor the legal and regulatory basis for such activities.

5.2.3 Sensitive Area Mapping

For this project, an ecosystem map was developed for the Gulf of Honduras and its watershed in order to assess potential impacts from port, marine and other land-based sources of contamination (Figure 5.1-1). The terrestrial ecosystems were taken from the Central America Ecosystems Map developed by CCAD with support from the World Bank and the Netherlands (Vreugdenhil *et al.*, 2002). This mapping system followed a modified version of the UNESCO system of classification. Because this terrestrial mapping system reached a level of complexity that was not necessary for the purposes of this project, the map included in this Preliminary TDA is a simplified version of the terrestrial ecosystems defined in the Central America Ecosystems Map.

The Central America Ecosystems Map did not, however, define such important marine and coastal ecosystems as seagrass beds and coral reefs. For this project, the delineation of seagrass beds in the Gulf of Honduras was taken from Yañez-Arancibia *et al.* (1994) and mapping done by WWF. The coral reef delineations were taken from British Admiralty nautical charts of the region.

In order to examine potential threats posed by port, marine and land-based sources of pollution to coastal and marine habitats, a sensitive vulnerable ecosystem map was developed for the marine and coastal areas of the Gulf of Honduras (Figure 5.2-1). This map shows mangrove forests, seagrass beds, coral reefs and protected areas in the Gulf as these were the habitats determined to be the most vulnerable to land and sea-based contamination. To more specifically determine potential threats from port and marine shipping operations, maps were developed for each of the major ports in the study area. The maps show sensitive vulnerable ecosystems in the vicinity of the ports. Additionally, the maps show navigational channels and currents in order to determine potential threats from marine spills.

Figure 5.2-1. Sensitive Areas in the Gulf of Honduras Particularly Vulnerable to Contamination from Oil and Chemical Spills
(See Appendix D)

Big Creek[2]

The port of Big Creek is located in a sensitive area that is habitat for endangered species. As indicated on Figure 5.2-2 the port and navigational channel are surrounded by mangroves. The Belize Coastal Zone Management Project has recorded sitings of the endangered West Indian Manatee at the mouth of Big Creek and in the adjacent Placencia Lagoon. Port staff stated in interviews that manatees are present in the Big Creek channel at least as far upstream as the port (Posford Duvivier, 1998). Endangered turtle nesting sites have also been recorded in the adjacent Placencia Lagoon.

[2] The sensitive vulnerable areas adjacent to the Belize City Port have not been mapped as a part of the current study because this area is located north of the boundary of the Gulf of Honduas.

Figure 5.2-2. Sensitive Vulnerable Areas Adjacent to the Port of Big Creek
(See Appendix D)

In the port area are important fisheries resources. The near-shore coastal area to the south of Big Creek was recorded in 1993 as a conch fishery. A reef fishery area is located approximately 10 km south of the port. An extensive shrimp resource area runs parallel to the southern portion of Belize's coast and a shrimp farm is located south of Big Creek. The water intake for the farm is located only a couple of kilometers upstream of the port.

A large spill in the navigational channel could have a devastating effect on the nearby ecosystems and fisheries resources. Due to the prevailing winds, the current runs north to south and spills within the navigational channel would be pushed southwards rather than north towards the Placencia Lagoon. Located to the south are seagrass beds, mangroves and significant fisheries resources. Additionally, a spill within Big Creek could affect the upstream shrimp farm and the fringing mangroves.

Puerto Barrios and Puerto Santo Tomás de Castilla

Puerto Barrios and Puerto Santo Tomás de Castilla are located on the semi-enclosed Bay of Amatíque. As has already been discussed above, a spill in this area could have an environmentally devastating effect. One oceanographic current analysis carried out in the Bahía de Amatique concluded that within 48 hours a major oil spill could spread along the shores of the Bay and reach other areas of the Gulf, including the Honduran National Park of Jeanette Kawas. The study also indicated that the Mesoamerican Barrier Reef could be threatened by a spill in the Bahía de Amatique if the predominant winds were blowing in the opposite direction of the currents (EPOMEX, 1993).

Even a smaller more localized spill would affect important ecosystems. The Bahía de Amatique is the "most important estuarine ecosystem in Guatemala because of its size, conservation state, ecological and socioeconomical value as well as its great great ecotouristic potential" (Yañez-Arancibia *et al.*, 1998). Surrounding the ports are areas of mangroves and in the bay there is sparse seagrass (See Figure 5.2-3). On land, a protected area is sited in the vicinity of the ports and there is significant potential for the development of ecotourism in the area. The Bahía la Graciosa and Piteros River area has the most highly developed mangrove forests in the region, as well as seagrass beds. The coastline from Punta de Manabique to the mouth of the San Francisco River has beaches with fine even sand and good water quality. The Punta de Manabique protected area serves as habitat for the endangered manatee and provides habitat for fish and crustaceans.

Figure 5.2-3. Sensitive Vulnerable Areas Adjacent to Puerto Santo Tomás de Castilla and Puerto Barrios
(See Appendix D)

Puerto Cortés

Few sensitive vulnerable ecosystems are located immediately adjacent to Puerto Cortés (See Figure 5.2-4); turtle nesting beaches may be the most sensitive use of these adjacent coastal resources. Nonetheless, a spill has the potential to flow to other areas, including to the Jeanette Kawas National Park, one of the largest protected areas in Honduras that is located east of the port. This national park includes lagoons, estuaries, coral reefs and some of the best preserved mangrove forests on the Atlantic Coast. It is also habitat for the following endangered and threatened species: six sea turtle species, five fish species, five reptile species, tropical birds and twelve mammals. In the park, 374 species of marine species have been recorded including 51 corals. The Río Motaqua Biological Reserve and Cayos Zapotillos National Monument are also located in the vicinity of the port.

Figure 5.2-4. Sensitive Vulnerable Areas Adjacent to Puerto Cortés
(See Appendix D)

Supporting data
Only one serious navigational accident has occurred in the Gulf of Honduras ports. On April 1, 1975, the Shell barge Caribbean II was wrecked in the Bay of Amitíque. 40,000 gallons of asphalt and 58,390 gallons of fuel oil were spilled. The accident caused considerable damage to the bay.

At Belize City Port one serious collision occurred between a large cargo vessel and the Kings Head Pier. Additionally, recently there has been a minor collision between a medium-sized cargo vessel and a navigational aid.

Fortunately, no other serious accidents have been recorded in the Gulf. The potential exists for one, however, especially given the amount of hazardous cargo that is transported in and out of the Gulf of Honduras.

Sectors and stakeholders
Some of the main stakeholders include:
- Port authorities
- Shipping companies
- Merchant Marine
- Navy
- Port-related industry
- IMO
- COCATRAM
- Port owners

5.3 Other Land-Based Activities (other than shipping-related) Causing degradation of the ecosystems of the Gulf of Honduras

The sensitive habitats of the Gulf of Honduras are being negatively affected by a variety of land-based activities other than port and shipping-related operations (See Figure 5.3-1 for a delineation of land uses in the Gulf of Honduras). Solid waste and urban, agricultural and industrial run-off, all contribute to the degradation of the coastal and marine ecosystems of the region.

Figure 5.3-1 Land Use in the Gulf of Honduras
(See Appendix D)

Below the six industries, other than maritime transport-related, identified as having the greatest impact on the Gulf of Honduras environment are discussed. These sections provide only a summary of information available on the different sectors and their environmental impacts, however. In many areas data were lacking.

Assessing the effects of these land-based sources of contamination on the Gulf of Honduras is difficult as little water or sediment quality monitoring has been done in the region. In the case of Belize, it has only been in recent years that environmental monitoring has become a national priority. Prior to that, the country's low population density, richness of natural resources and limited industrial development kept interest in environmental management low (Lee *et al*,. 1996). In Guatemala and Honduras attention until recently has been focused on achieving political stability and developing the economy. As in other developing countries, environmental protection historically has taken a backseat to competing interests and little emphasis has been placed on environmental monitoring. Thus, a complete and accurate assessment of the effects of contamination resulting from land-based sources in the Gulf of Honduras region is not possible at this time.

5.3.1 Agriculture

Agriculture has been identified as the greatest land-based source of pollution in the Gulf of Honduras watershed. Subsistence and large-scale agriculture are significant economic activities in the region, and the industry is the largest employer in the watershed. Agriculture affects the marine and coastal environment in several ways. First, increased runoff resulting from clearing of land to make way for cultivation adds to the sedimentation of the waterways, reducing productivity in coastal waters and smothering corals. As the region's population continues to grow, more land will be needed to sustain it and deforestation will continue to occur. Second, the chemicals used in agriculture are harmful to the aquatic environment. In coffee and banana production, intensive methods are used that include fertilizers and other chemicals that runoff and flow into waterbodies, causing nutrification of the coastal waters. Nutrients promote the growth of phytoplankton, which inhibits seagrass and coral photosynthesis and promotes algal overgrowth of reefs. Pesticides and herbicides have potentially harmful effects on marine organisms. Third, solid waste resulting from intensive agricultural practices is carried into coastal waters from the upper watersheds and harms the sensitive ecosystem.

In Belize, the main crops planted are bananas, citrus, corn, rice, cassavas, mangoes and cocoa. Large tracts of land have been cleared to make way for cultivation.nnAlthough agricultural production in the region is moving towards permanent subsistence farming, the slash and burn methods used by the Maya Indians still persists in the Toledo District. Roughly 22% of the national rice crop is produced in the southern region of Belize, 60% from milpa production (IADB, 2000). Citrus and bananas are grown on plantations; however, these Milpa farmers continue to make up 80% of the farming community (DHV Consultants, 1994). Citrus is grown on 7,000 ha and is transported to processing plants where it is processed for export (DHV Consultants, 1994).

Agriculture in the Toledo and Stann Creek Districts of Belize poses a particular threat as many areas in the region are highly prone to erosion. Areas of concern include the steeper slopes of the Maya Mountain foothills which are farmed by Milpa farmers and the marginal Puletan soils on the coastal plains which are farmed by citrus farmers (DHV Consultants, 1994).

Another problem associated with agriculture in southern Belize is the use of agro-chemicals. Although specific numbers were not available, researchers found that small farmers in the southern region of Belize use amounts of pesticides, insecticides and herbicides that are too high and that the situation is more dangerous than is generally believed (DHV Consultants, 1994). Overall, it was estimated that in 1994 the total amount of fertilizers used was 270 kg/acre (UNEP, 1999).

On large banana plantations, fertilizers, fungicides and nematicides are regularly used. It has been estimated that a total of 284 lbs. N, 72 lbs. P_20_2 and 636 lbs. K_2O are required to produce 30 tons/ha (12 tons/acre) of bananas (Oschatz in Holder *et al.*, 1999). To combat the Black Sigatoka Fungus banana farmers have been conducting aerial spraying of several types of fungicides, including the hazardous Tilt, Sico, Benlate, Vandozeb, Dithane, Manzate, Calixin and Bravo (Ariola *et al.*, 1999). Water samples from three rivers in southern Belize watersheds where bananas are grown at low flows did not show any elevated levels of minerals, with the exception of ammonium levels that were slightly above the normal range, however (Holder *et al.*, 1999). Additionally, studies analyzing fungicides and nematicides in waterways and accumulating in the environment did not detect the chemicals, however (Holder *et al.*, 1999)

The citrus industry in southern Belize also uses pesticides, including Malathion and Temic (Ariola *et al.*, 1999). Malathion is typically used to control the proliferation of the Mediterranean and Mexican fruit fly. The broad-spectrum pesticide Temic is used to control nematodes, aphids and other insects on citrus farms. Other hazardous agrochemicals in use in the region are the herbicides Paraquat, Glyphosae, Roundup and 2-4D. These chemicals are easily leached into the waterways and are introduced by the rinsing of spray pumps in streams adjacent to farms.

Table 5.3-1. Estimate of Nitrate and Phosphate Loads into Surface Waters by Banana and Citrus Production in the District of Stann Creek, Belize1994

Agricultural Production	Area ha	Phosphates Loads (tons/year)	Phosphates Loads (%)	Nitrate Loads (tons/year)	Nitrate Loads (%)
Banana	1,960	64	65	520	48
Citrus	6,975	35	35	488	52
Total	**8,935**	**99**	**100**	**1,008**	**100**

Source: World Bank, Belize Environmental Report (1996)

Livestock production in southern Belize is another contributor to environmental degradation in the watershed, although the herds are relatively small in part due to competition over grazing lands with citrus plantations. In 1994, the region produced only 4% of the national cattle population. The region is also home to approximately 25% of the national swine population (IADB, 2000).

Another problem identified with agricultural production in southern Belize is waste plastic from banana cultivation. The waste is sometimes washed downstream and it accumulates in coastal areas.

Agriculture is the activity that has had the most significant impact on the loss of woodlands, mangroves and marshes in the Gulf of Honduras region of Guatemala, even though the soils are not well suited to crop production. Slash and burn methods are commonly used in the region without any consideration for conservation. Herding is a complementary activity.

Coffee and bananas are probably the most significant crops grown in the watershed. In 1999-2000, roughly 230,000 ha were used for coffee cultivation (MAGA, 2001). Other crops grown in the wateshed include rice, black beans, corn, red beans, sorghum and sugarcane. Information was not available on the amount of pesticides used in the Guatemalan portion of the watershed.

Agriculture, the largest sector of the national economy, plays an important role in the Honduran portion of the Gulf of Honduras watershed. Major crops planted include banana and coffee. Large areas are also used for the cultivation of sugarcane and African palm. Other crops include corn, rice, beans, onions, potatoes, plantains and oranges. As in other areas of Central America, Honduras relies on an excessive use of biocides, in part due to lack of awareness in the farming communities. A total of 1,726,350 kg of insecticides and nematocides and 1,186,630 kg of herbicides were imported into Honduras in one year (UNEP 1999). There is no reliable data on how serious an environmental threat this agro-chemical use poses to the Gulf of Honduras, however.

Table 5.3-2 summarizes some of the regional characteristics for agricultural wastes and inputs to the environment.

Table 5.3-2. Agricultural Wastes and Inputs to the Environment

	BELIZE	GUATEMALA	HONDURAS
Total HA in Agriculture	2400 HA Banana 7000 HA Citrus	668,600	340,000
Annual % increase in agricultural land			
Annual fertilizer use	600 kg/HA		
Annual agro-chemical use (tons)			3,000

5.3.2 Logging

Forestry, as well as deforestation occurring to make way for expanding agricultural production, has caused the degradation of coastal waters. Much of the deforestation has occurred in the upper watersheds where the potential for erosion is high. Mangroves along the coast have also been cut, however, thereby directly destroying important habitats. The removal of tree cover causes soil erosion and the ensuing sedimentation of rivers and sea beds. Nutrients are released causing the degradation of waters and damage to corals and sea grass. Seagrass beds are also affected by the changes in water transparency indirectly caused by logging.

Belizean forests have been logged since the 1700s. It was recently determined that only 14% of the forests of Belize were suitable for timber production and in the past few years the forest industry contributed roughly 3% to the GDP annually (Ministry of Natural Resources, Environment, and Industry, 2002). Primary species sought by woodcutters include Mahogany (*Swietenia macrophylla*), Pinewood (*Pinus caribaea*), Rosewood and Logwood (*Haematoxylon campechianum*) (DHV Consultants, 1994).

Seventy-five percent of southern Belize is covered in broadleaf forest, pine forest, broken ridge, and other natural vegetation habitats and the region has eight forest reserves. In recent years, bgging in Stann

Creek has declined, including in mahogany and other hardwoods, indicating that these resources are diminishing. The logging industry in the Toledo District is still strong, dominated by harvests from government lands. There is a perception that this area remains a good source of hardwoods, but estimates of remaining timber sources may be overstated (IADB, 2000). Seventeen licenses have been issued for logging in the region and the logging industry employs 218 persons full-time. In 1998, lumber production was reported at 494,171 cu ft of log timber, and 2,012 cu ft of pine holes, but actual production is estimated to be roughly 50% higher than what is reported (IADB, 2000).

Deforestation is currently occurring at a rate of approximately 5,000 ha/year in southern Belize (Meerman, 1999). It has been determined that between 1989 and 1994, 78,076 ha were deforested, and that 9% or 6,682 ha of this total cleared was inside protected areas (Belize Ministry of Natural Resources, 1998). Nonetheless, approximately 65% of the country remains under closed forest cover and most mangrove forests are still relatively pristine. While no logging is permitted in National Parks, logging concessions are awarded in Forest Reserves.

Logging is a major industry in Guatemala and a significant contributor to deforestation. Nationally, forests have been declining at a rate of approximately 90,000 ha annually, as trees are cut for construction materials and firewood (UNEP, 1999). Satellite imagery from 1998-99 showed that 45.4%, or 49,300 km^2 of the country was forested, .4% of which was mangroves (UNDP, 2002). Mangroves are being cut rapidly, however. Between 1992 and 1998, the mangrove coverage in Guatemala decreased by 29% (CONAP *et al.,* 2001).

Forestry is common on the Atlantic Coast and is not subjected to any form of sustainable management. Significant destruction of the tropical forest in the Sarstoon River's upper watershed has been observed where the forests have been substituted for cattle pasture. The felling and burning of trees has been linked to sedimentation of the Sarstoon River.

Forestry is an important activity in Honduras. According to some sources, Honduras has the potential to become the largest producer of timber and non-timber forest products in Central America, particularly in the northern and eastern regions of the country (Salazar, 1997). Pine, mahogany, ebony, walnut and rosewood are the most valuable woods and logging of these trees has resulted in deforestation.

Originally, 87.7% of the country's 112,492 km^2 was covered in forest (Salazar, 1997), but between 1965 and 2001, the amount of forested land in Honduras decreased by 23%. The State Forestry Commission reported in 2001 that nationally, 1,652,200 hectares were deforested, 3,607,400 hectares were used for agriculture and livestock, 559,100 hectares were covered in mixed forests, 2,512,700 hectares were covered in pine forests, and 2,917,800 were broad-leaved forests.

Table 5.3-3 summarizes the logging activities in the Gulf of Honduras region.

Table 5.3-3. Logging Activity

	BELIZE	**GUATEMALA**	**HONDURAS**
Total area of forests (HA)		3,600,000 (nationally)	5,989,600 (nationally)
Annual logging intensity (HA)	5,000 (southern Belize)	82,000	
Area of Mangroves (HA)	40,000	16,765	54,300 (4,500 in the project area)

Annual loss of mangroves (HA)			3,000 (nationally)

5.3.3 Municipal Sewage Discharge

One of the most significant sources of contamination in the region is untreated wastewater. Virtually all of the cities in the three countries bordering the Gulf of Honduras lack any or an adequate sewerage system, causing the discharge of untreated wastewaters either directly into the sea or indirectly via rivers. Since the population living in the watershed is quite large, the amount of raw sewage entering the Gulf is substantial. The effects of this discharge include the reduction of water and ecosystem quality and changes in transparency and light penetration that could affect photosynthesis processes and the productivity of phytoplankton and seagrass.

Access to sanitation facilities is extremely low in the Stann Creek and Toledo Districts of Belize. This has led to contamination of groundwater and the occurrence of human health problems such as gastroenteritis and hepatitis. No areas of the Stann Creek and Toledo Districts have access to sewerage systems (Belize Central Statistical Office, 2000).

Table 5.3-4. Sanitation Coverage by District in Southern Belize, 1994

District	Percent Urban	Percent Rural
Stann Creek	18	19
Toledo	33	24

Source: WASA and RWSSP Report, 1994

One of the most significant threats to the Gulf from Guatemala is the lack of a sewage disposal system, drainage and sewage treatment plants in the coastal area towns of Puerto Barrios, Puerto de Santo Tomás de Castilla and Livingston, as well as in the small villages and towns in the area.

Sewage is also a problem on the Honduras coast, as is solid waste. In urban areas, it is noted that 61% of the population is covered by a sewer system, while only 7.8% is covered in the rural areas (UNEP, 1999). The Chamelecón River is contaminated by untreated liquid and solid wastes run-off produced by the major cities of San Pedro Sula and Puerto Cortés, causing health problems and damage to the coastal ecosystems. It was estimated in 1989 that 64% of the total solid waste generated in Honduras (923 tons/day) was handled by individuals, which was commonly dumped in nearby vacant lots (UNEP, 1999).

5.3.4 Aquaculture

Aquaculture is another source of degradation of the sensitive habitats and species of the region. Aquaculture has the potential to harm coastal and marine ecosystems in several ways. Pond effluent consisting mainly of nutrients threatens the health of coral reefs and seagrass beds. There is also a possibility that the farmed shrimp will pose a threat to native shrimp. Shrimp farming is also a concern as there is a potential that sensitive mangrove habitats will be destroyed in order to make way for the farms and chemicals are used in the production of shrimp. So far, the farms in southern Belize have used the existing mangroves as a filtering system, and have left them intact. But if the farms expand, there is a potential they will be destroyed (CZMAI).

Aquaculture, primarily of shrimp, is an expanding economic activity in the Belize portion of the watershed. Approximately 40 % of Belize's total production facilities of this industry are located in the southern region of the country. These 8 farms include approximately 30,000 acres of land-holdings, roughly 9,500 acres of which are potentially suitable for production use. Prior to 1999, roughly 1,069 acres had been placed into shrimp production, and another 1,000 acres were planned for construction and production of shrimp during 1999 (IADB, 2000).

Fertilizer (consisting mainly of urea, sodium nitrate, ammonium nitrate triple superphosphate and diammonium phosphate) is applied to ponds to increase nutrient concentrations at a rate of approximately 348 lbs/acre/wk (Belize Central Statistical Office, 2000). White lime is also used to control algal production in ponds and to control disease. Most of the shrimp farms dump the waste from the ponds into the nearby mangroves, hoping that the excess nutrients will be absorbed by the ecosystem. Little monitoring or research on carrying capacities has been done, however, and this practice has the potential to be devastating to the mangroves (Gladden Spit Marine Reserve).

Table 5.3-5. Parameters Monitored by the Shrimp Mariculture Industry in Southern Belize, 1998

Farm	Seawater Source	Intake Volume (mil gals/ day)	Effluent Treated / Monitored	Inputs		
				Feed (‘000 lbs/yr)	Fertilizer (lbs/acre/week)	White Lime (‘000 lbs/yr)
Nova Toledo	Sea	16.3	Yes/Yes	1,600	60	246
Nova Laguna Madre	Lagoon	0.1	Yes/Yes	600	60	28
Belize Aquaculture Ltd.	Sea	0.2	Yes/Yes	455	N/A	1
Toledo Fish Farm	Sea	12.0	No/No	317	3	152

Source: Belize Central Statistical Office

Aquaculture is not carried out on the Atlantic coast of Guatemala and Honduras.

5.3.5 Tourism

Increased tourism and its associated coastal development also affect habitats in the Gulf of Honduras region. Mangroves and coastal littoral forests have been destroyed to make way for hotels and other tourism infrastructure. This clearing of vegetation and dredging increases sedimentation of the coastal waters. Untreated sewage and wastewater from these new developments cause nutrification and decreases vegetation. Garbage disposal from tourist boats and coastal development is often inadequate resulting in solid waste entering waterways and further decreasing water quality.

The increase in population and the tourism in Belize (due to the beauty of its coral reefs) has promoted the conversion of the natural coasts into ports, tourist beaches and new settlements, whereby the felling of mangroves and destruction of other natural areas has reduced the breeding places for marine species as well as the nursery for plant aquatic species.

As development in the coastal zone continues, spurred on by increasing tourism, marine dredging is an activity that is occurring in the coastal zone of Belize. Since the Belize coast and cayes are low-lying, development in these areas frequently requires that nearby areas be dredged in order to provide fill material. This activity both directly destroys the seabed and causes the suspension of sediments which reduces light penetration, smothers seagrass and corals and releases contamination (CZAI, State of the Coast Report 1999).

Although tourism is the second largest foreign exchange earner in Guatemala, the industry is not well developed along the Atlantic Coast. Coastal tourism in the region remains largely domestic and tourism infrastructure and services are not ample. Nonetheless, the tourism industry is negatively affecting the Bahía de Amatique as wastewater generated by hotels and boats anchoring in Golfete is discharged into the marine area without treatment (Yañez-Arancibia *et al.*, 1998).

Information was not available on the effects of tourism on the Honduran area of the Gulf of Honduras.

5.3.6 Industrial Discharge

Industrial development in the watershed is another factor causing degradation of the vulnerable ecosystems of the Gulf of Honduras. A number of large manufacturing centers, such as San Pedro Sula in Honduras and Guatemala City, are located in the watershed with agro-processing, textile and chemical industries. Laws regulating industrial effluent are new and enforcement is lax. Additionally, the infrastructure does not exist to adequately handle industrial waste and wastewater. As a result, the Gulf has been contaminated with chemicals, heavy metals and petroleum products.

Belize has no heavy industry and has thereby largely remained free of industrial contamination. The citrus industry in the southern region of the country has contaminated the Stann Creek to a certain extent, however. Citrus processing typically results in large volumes of effluents being released into nearby streams, but the largest citrus processing plant has recently installed a treatment system of anaerobic settlement lagoons (Ministry of Natural Resources, Environment, and Industry, 2002).

Oil exploration is being considered for Lake Izabal in Guatemala and could seriously degrade water quality and habitats if preventive measures are not taken. Oil exploration could also negatively affect the surrounding Río Dulce and the marine/coastal zone due to chronic release or accidental spills, or also by the interruption of natural run-off as a result of the development of canal and access routes. Additionally, activities such as oil drilling cause an influx of population and associated infrastructure that could further degrade the environment as demand for services such as drinking water, solid waste disposal and sewage increases.

Forty-six percent of Honduras's industry is located in Cortés province on the Gulf of Honduras. Very few industries treat their liquid, solid or atmospheric waste. Data are not available on the extent of contamination from industries in the region, however.

Table 5.3-6 lists the major industries in the Gulf of Honduras region.

Table 5.3-6. Major Industries (Excluding Those Associated with Ports)

INDUSTRY	BELIZE	GUATEMALA	HONDURAS
Oil exploration (onshore)		3.4 million barrels per year	
Oil exploration (marine)			
Hydrocarbon refinement			
Chemical processing			v
Tanning industry			
Lumber Industry			v
Mining industry		Ni, Pb, Fe, Zn, Au, Aq	Pb, Zn
Sugar processing	v		v
Clothing and textiles		v	v

Supporting data

As part of this TDA preparation, estimates were made of the potential inputs of nutrients and Carbonaceous Biochemical Oxygen Demand (CBOD) into the Gulf of Honduras.

Land Based Contamination

In this section an estimate of the potential land based contamination from point sources (industries, municipal wastewater, solid waste) and nonpoint sources such as agricultural and urban runoff is presented. Table 5.3-7 presents a summary of the results by source of this analysis. The analysed sources were industrial contamination, domestic wastewater, agriculture including animal waste. Figures 5.3-2, 5.3-3, y 5.3-4 show the total potential loads for BOD, and nutrients.

The estimates were calculated base a methodology using loading factors which is described below: The information from provinces, municipal units, or other administrative unit were aggregated by watershed using GIS.

The contaminant loads are "potential" loads discharged to the environment which can reach water bodies and have been estimated using loading factor from the literature. Estimation of the actual loads reaching the streams, river and the gulf can only be obtained after implementing monitoring programs with mathematical models to determine the loads at different points within the watershed or at their outlets at the gulf. Sources used to estimate these loads were:

- Population by watershed
- Digital maps of watersheds, provinces, districts, and agricultural regions.
- Land Use Land cover provided by USAID-PROARCA

- Inventory of Animals (cattle, swine, fowl).
- Inventory of Industries for Guatemala ("Directorio Nacional de Empresas y sus Locales-Instituto Nacional de Estadísticas del Banco de Guatemala") and for Honduras a list provided by the Secretariat of Comerse and Industry with special export considerations.
-

Potential loads were estimated as follows:

Municipal Wastewaters – BOD loads were estimated assuming a daily consumption of 180 liters/day/person for population with water supply assuming concentrations of 300 mg/L of BOD, 30mg/l of Total nitrogen, and 6 mg/l of phosphorus.

Solid waste – An average of 1kg of daily waste was assumed per person of which 50% could potentially reach the water bodies y areas with no proper disposal

Urban runoff – With the land use information on urban areas the followin g loading factors were used to estimate nutirient loads exported from urban areas: DBO=90kg/ha/year, TN=11.4kg/ha/year, and TP=3.4kg/ha/year.

Industrial loads – BOD loads were estimated using a meted developed by the World Bank. This method, is based on emisión sources based on the economic activity of the industry (Industrial Pollution Projection System, IPPS). The methos was developed based on US data for each industry activity (employment, production) and their emissions for each contaminant in order to obtain intensity factors for contamination for each industrial activity unit.

This method has been applied to many countries and has been adequate to determine priorities in terms of industrial contamination. In this application, the method is used to estimate BOD loads. The methods could also be applied to estimate contaminants loads for other 10 categories to air, water and soil. Table 5.3-7 presents de estimated loads for BOD

Animal Waste – Inventories of animals (cattle, swine, chickens, etc.) were assigned by watershed using the following potential pollution loads per animal. beef: 0.7kg/BOD/day, milk: 0.77kg/BOD/day, swine: 0.12 kg/BOD/day, y fowl 0.006kg/BOD/day. Nutrient content in the waste of animals were assigned to animal wastes in relation to a standard weight of 454Kg. The factors used were: 0.15kg/TN/day, milk: 0.20kg/TN/day, swine: 0.24 kg/TN/day, and fowl 0.5kg/TN/day, and for total phosphorus: 0.942kg/TP/day, milk: 0.043kg/TP/day, swine: 0.082kg/TP/day, and fowl 0.136kg/TP/day.

Assumed average weights for animals were cattle: 281kg, swine 94kg, fowl 0.9 kg. It is assumed that only 25% of the produced nutrients reach a water body due to volatilization and other factors.

Agriculture - Loads from agriculture activities were estimated for nitrogen and phosphorus using the land use information and applying the following loading factor for potential contaminant loads: Nitrogen 30Kg-TN/ha/year and for phosphorus 2.5Kg-TP/ha/year.

Other (Non agriculture)- Other non-agricultural land uses discharge nutrients to the environment. The loading factor assumed for these uses are: Nitrogen-3Kg-TN/ha/year and phosphorus 0.4Kg-TP/ha/year.

Table 5.3-7. BOD, Nitrogen and Phosphorus Potential Loads to the Gulf of Honduras

Watershed	BOD (kg/day)	Nitrogen(Kg/day)	Phosphorus (kg/day)
Chamelecón			
Wastewater	30,640	3,064	613
Industrial discharges	5,904	ND	ND
Solid waste	14,469	851	284
Urban Runoff	1,894	240	72
Agriculture	0	11,387	949
Animal Waste	30,483	4,276	1,236
Other (Pasture, Forest)	0	2,269	302
Total-Chamelecon	83,391	22,087	3,455
Ulua			
Wastewater	194,088	19,409	3,882
Industrial discharges	7,914	ND	ND
Solid waste	91,653	5,391	1,797
Urban Runoff	1,045	132	39
Agriculture	NA	45,329	3,777
Animal Waste	273,705	8,517	2,432
Other (Pasture, Forest)	NA	13,588	1,812
Total-Ulua	568,405	92,367	13,740
Sarstun			
Wastewater	16,110	1,611	322
Industrial discharges	776	ND	ND
Solid waste	7,608	448	149
Urban Runoff	0	0	0
Agriculture	NA	3,679	307
Animal Waste	1,234	184	57
Other (Pasture, Forest)	NA	1,406	188
Total-Sarstun	25,727	7,329	1,022
Motagua			
Wastewater	344,895	34,490	6,898
Industrial discharges	59,878	ND	ND
Solid waste	162,867	9,580	3,193
Urban Runoff	3,005	381	114
Agriculture	NA	28,804	2,400
Animal Waste	46,401	10,183	2,255
Other (Pasture, Forest)	NA	11,517	1,536
Total-Chamelecon	617,046	94,955	16,396

Watershed	BOD (kg/day)	Nitrogen(Kg/day)	Phosphorus (kg/day)
Izabal-Rio Dulce			
Wastewater	51,280	5,128	1,026
Industrial discharges	1,409	ND	ND
Solid waste	24,216	1,424	475
Urban Runoff	261	33	10
Agriculture	NA	18,789	1,566
Animal Waste	5,005	624	185
Other (Pasture, Forest)	NA	4,688	625
Total-Izabal-Rio Dulce	82,171	30,687	3,886
Belice Watersheds			
Wastewater	23,412	2,341	468
Industrial discharges	150	ND	ND
Solid waste	11,056	650	217
Urban Runoff	131	17	5
Agriculture	NA	2,438	203
Animal Waste	677	120	37
Other (Pasture, Forest)	NA	3,658	488
Total-Belize Watershed	35,425	9,225	1,418

Figure 5.3-2. Potential BOD Loads - Gulf of Honduras Watershed

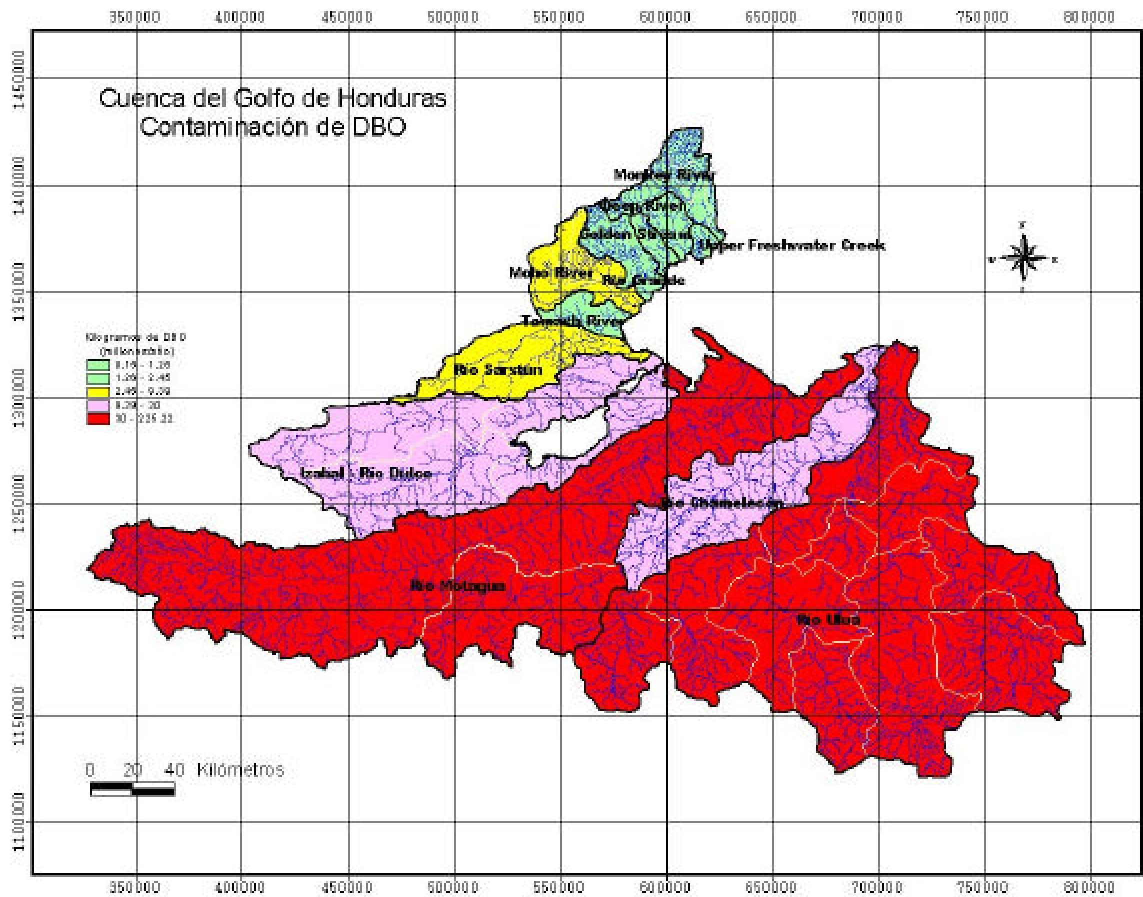


Figure 5.3-3. Potential Nitrogen Loads - Gulf of Honduras Watershed

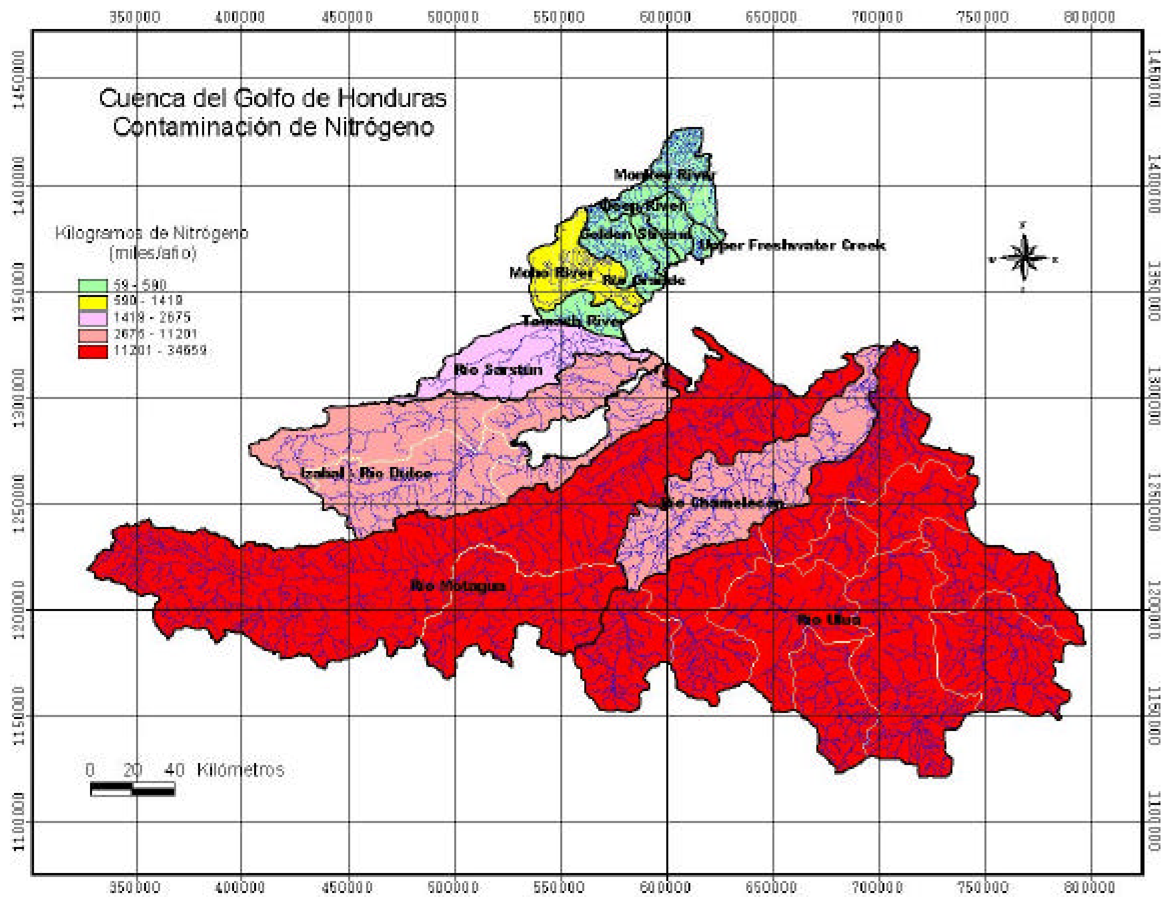
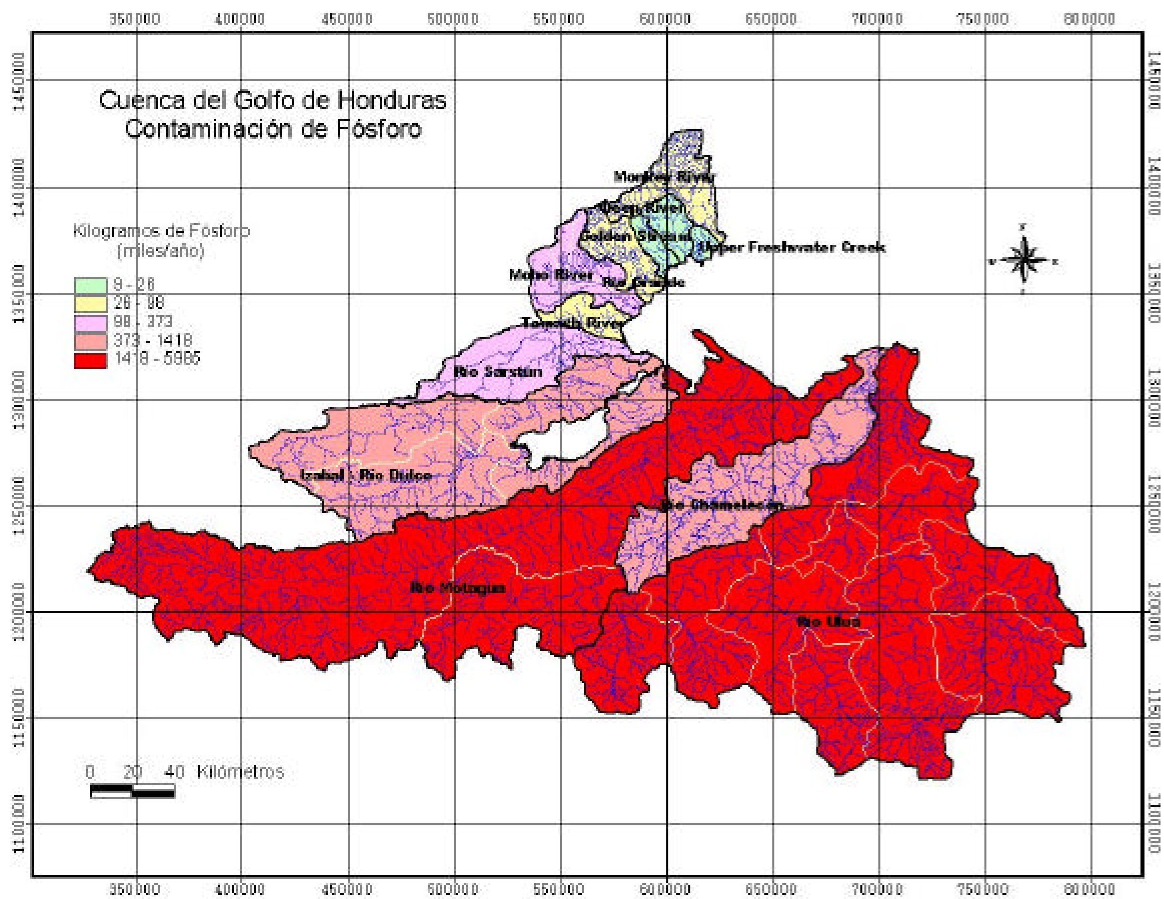


Figure 5.3-4. Potential Phosphorus Loads - Gulf of Honduras Watershed



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5.4 Preliminary Assessment of the Relative Importance and Local and Transboundary Impact of Land-Based vs. Ship-Based Sources of Pollution

This section addresses the relative importance of land-based versus ship-based sources of pollution from both local and transboundary perspectives. The transboundary perspective is important since it is the basis for intervention by the Global Environment Facility (GEF). The local perspective is important since it represents one basis for action on a national level, leading oftentimes to measurable improvements to environmental conditions and resources. Economically, the local condition may attract the major attention by the country, though transboundary issues may be more critical environmentally.

There are no generally accepted methods for assessing the relative importance of land-based versus ship-based sources, and most such assessments have been made more or less heuristically. That is the approach that this assessment takes. Several difficulties compound the assessment process:

- Lack of quantitative data on land-based sources: The land-based sources of pollution have been reviewed in Section 5.3. In this section, various sectors were reviewed, including agriculture, logging, municipal sewage discharge, aquaculture, tourism and industrial discharge. Quantitative and comparable data for each of these sectors for each of the three countries is not available. In some countries, for some sectors, data exist, but generally not for all sectors, nor for all countries. This makes quantification much more difficult. An attempt was made in this TDA to estimate land-based inputs of nutrients and Biochemical Oxygen Demand; however, ground-truthing has not been done to verify these estimates.
- Lack of quantitative data on ship-based sources: The legal and regulatory systems in the region do not provide for routine monitoring and reporting of environmental activities associated with shipping and port activities. Spills and marine accidents are sometimes reported, but generally not methodically. Accident and spill records are not available, so the quantity and composition of spilled materials are unknown, as are their ultimate fates. Routine sediment and water column monitoring might shed some light on the environmental degradation caused by port and shipping activities, but these data are not routinely acquired. Whatever data may exist it was not available for this study.
- Status and trends of marine resources: There is no coordinated, routine, monitoring of the coastal and marine resources of the Gulf of Honduras. Fish stocks are poorly understood. Status and trends of mangroves are not routinely monitored. Status and trends of seagrass beds are not routinely monitored. Coral reef studies are not consistent across all three countries, and routine monitoring depends on external resources or cooperative studies. Lacking these monitoring data, it is difficult to ascribe trends to marine resources, and to quantify the impacts of ship-based and/or land-based activities on those resources.
- Lack of economic valuation for the marine resources: The countries within the Gulf of Honduras apparently have not completed economic valuations of their marine resources. Although commonly accepted, international valuations are possible, each country may ascribe natural resource values that are unique to that country, depending on the country's reliance and dependence on those resources. From a transboundary perspective, it may be appropriate to use global valuations; however, national valuations provide more clarity on the national situation.

These difficulties make a quantitative comparative assessment of the effects of ship-based and land-based activities on the transboundary resources hard. This TDA will perform such a comparative evaluation using the following methodology, however.

First, some terms are defined:

- Land-based activities other than ship-based or port-based: This category includes land-based impacts upon the marine environment, specifically those resulting from sewage, persistent organic pollutants, radioactive substances, heavy metals, oils (hydrocarbons), nutrients, sediment mobilization, litter, and physical alteration and destruction of habitat.
- Ship-based activities: These include those activities related to marine transport and shipping, including port and harbor activities, dredging, spills, physical alteration of the coastal area (expansion), accidents, use of dispersants to combat oil spills, etc.
- Risk factor: A derived value based on the likelihood of the event occurring multiplied by the damage arising from such an event.

The approach followed for this heuristic relative assessment is based on the following steps:

- Identification of the level of land-based and ship-based activities (see Sections 5.1-5.3 above), using quantitative indicators and/or measures where possible (e.g., number of hectares lost due to agriculture, volume of agrochemicals used in the coastal zone, number of ships operating).
- Characterization of the trends in these land-based and ship-based activities, generally using qualitative measures such as rate of population growth, rate of economic growth, rate of shipping increase. Also, this characterization can be based in part on national policies (encouragement of agriculture, expansion of shipping, economic focus on oil exploration and exploitation, etc.).
- Classification of activity as resulting in either local or transboundary impact.
- Assessment of the types of environmental resources affected by such activities, such as the global value of resources, its rare or endangered status, its economic value to the region, global biodiversity value, proximity to protected areas, etc.
- A qualitative assessment of the risk factor for impacts of such activities: e.g., what is the risk of ship collision, or the risk of major spillage at a chemical factory; together with its potential scale, multiplied by the potential damage caused by such an event.

These considerations are used to formulate an overall environmental ranking, in the following manner. Each factor for each type of activity is given a relative ranking level, based on the following table (Table 5.4-1):

Table 5.4-1. Ranking Scheme for Relative Assessment of Impacts

Factor type	Rank	Explanation
Level of Activity	1	Few activities
	2	Moderate level of activity
	3	High level of activity
Trend of Activity	1	Decreasing
	2	Stable
	3	Increasing
Transboundary/local	1	Local impacts
	3	Strong transboundary impacts
Types of threatened resources	1	Few
	2	Moderate, including some rare, endangered; protected areas
	3	Many, including rare and endangered; high biodiversity value (e.g., endemic), near protected areas
Risk Factor	1	Low risk factor

	2	Moderate risk factor
	3	High risk factor

The following table (Table 5.4-2) summarizes the results of this relative ranking of environmental impacts. The heuristic analysis shows that of the land-based activities, agriculture and deforestation possibly play a major role in environmental degradation (where a rank of 11 is arbitrarily picked as a cut-off between high and low ranking; the mean ranking is 11.2 points). By contrast, six of eleven port-based or ship-based activities rank at 11 or higher. Of the "other marine-based activities," fisheries ranks as possibly important, because of its potential transboundary impacts. Data are missing on this activity, however, and it may rank lower.

An alternative to the above heuristic ranking could be a ranking based on quantitative data. For instance, once the data tables in section 4 are filled out, the Global International Waters Assessment (GIWA) ranking for Rapid Assessment of Point Sources (RAP) and non-point sources could be used to estimate actual contaminant loads (for persistent organics and metals, primarily), and this ranking could be compared against shipping. However, the shipping-related activities are emphasized by their increasing trend, proximity to high-value resource areas, including corals, mangroves, seagrasses, marine mammals and protected areas.

Given available data and information, the following activities are ranked as priorities requiring intervention to improve the quality of coastal and marine ecosystems:

- Agriculture
- Deforestation
- Port Maintenance
- Ballast Water
- Ship Collision
- Vessel Standards
- Vessel Discharges
- Hazardous cargo transport and handling

Table 5.4-2. Relative Ranking of Environmental Importance of Various Land-Based and Ship-Based Activities

Activity type	Level of activity	Trend of Activity	Transboundary or Local	Types of Environmental Resources Threatened	Risk Factor	Overall Environmental Ranking
Land-Based						
Agricultural	High	Increasing	Regional (no evidence of regional eutrophication, build-up of persistent organic pollutants)	Benthos, water column, including fisheries, human health	High	12
Deforestation	High	Increasing	Local (increased sedimentation, no evidence of regional impacts)	Benthos and water column, mangroves and reefs	High	12
Municipal Sewage Discharge, Solid Waste	High	Increasing	Local (no evidence of eutrophication)	Benthos and water column, mangroves, reefs, beaches and waterbodies	Moder ate	11
Aquaculture	Low	Slowly increasing	Local (scale is still small; no evidence of carbon overloading or nutrient over-enrichment)	Biodiversity, alteration of ecosystems	Low/ Moder ate	7
Tourism	Moderate	Slowly increasing	Local (no transboundary adverse impacts identified)	Beaches and reefs	Low/ Moder ate	9
Industrial Discharge	Low (Moderate in Honduras)	Increasing	Local except for some industries (oil exploitation in Laguna Izabal, for instance)	Waterbodies, coastal zone	High	9
Port-based						
Port Expansion	Low/ Moderate	Increasing gradually	Local (no evidence of regional impacts)	Mangroves, intertidal areas, beaches	Low	8
Port Maintenance	Moderate/ High	Increasing	Transboundary (dredging effects; dredge disposal – depending on types of operations)	Seagrasses, corals, benthic habitat, fisheries, water column	Moder ate/ High	13
Loading/ offloading cargo	High	Increasing	Local (no evidence of regional impacts)	Water column, benthic resources	Moder ate	10
Waste generation/ Handling	Low	Increasing	Local (no evidence of regional impacts)	Water column, benthic resources	Moder ate	9
Ballast water	Moderate	Increasing	Transboundary (movement of introduced species across borders)	Any resource: flora and fauna, marine and coastal, fisheries	High	14

Activity type	Level of activity	Trend of Activity	Transboundary or Local	Types of Environmental Resources Threatened	Risk Factor	Overall Environmental Ranking
Port-related industry	Moderate	Increasing	Local (no evidence of regional pollution effects)	Mangroves, benthos, water column	Moder ate/ High	10.5
Marine-based						
Ship collision	Low	Unknown	Transboundary (may occur in international waters, may transport across boundaries)	All resources: benthic, water column, corals, seagrasses, mangroves	High	12
Inadequate vessel standards	High	Increasing	Transboundary	All resources	Moder ate	14
Vessel Discharge	High	Increasing	Transboundary (contaminant transport processes)	All resources	High	15
Dispersant usage	Low	Unknown	Transboundary (transport processes, effects on resources)	All resources	Low	9
Hazardous cargo	High	Increasing	Transboundary	All resources	Moder ate/ High	14.5
Other Marine Activities						
Fishing	Moderate	Increasing	Transboundary (stocks may be affected by one country's actions)	Fisheries	Low	10
Anchoring	Low	Moderately stable	Local	Benthos	Low	6
Marine collections	Low	Moderately stable	Too little data available	Benthos, fisheries	Low	6

6.0 STAKEHOLDER ANALYSIS

The following stakeholder analysis is primarily based on a series of regional stakeholder meetings, one-on-one interviews and a survey. Regional stakeholder meetings were held in San Pedro Sula, Honduras, Guatemala City, Guatemala and Belize City, Belize. One-on-one meetings were carried out at site visits and the regional meetings. A standard survey form was created for the stakeholder interviews in order to provide a framework that combined both structured and open-ended questions. The survey was designed to collect detailed information about the institutional and legislative frameworks, strengthening needs, and working relationships among the sectors. Stakeholder consultations were not intended to provide a comprehensive analysis of all Project beneficiaries and decision-makers. The meetings were an initial outreach effort to both inform and incorporate observations from representative stakeholder groups.

6.1 Links with other International and Regionally Significant Projects and Institutions

The following section provides an overview of international organizations and programs that have regional significance to the GEF Project by contributing to capacity building, and institutional and regulatory strengthening in the areas of environmental and natural resource management, port operation, and navigational safety.

International Maritime Organization

The International Maritime Organization (IMO) Convention entered into force in 1958. The OMI Convention was created "to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships".(IMO website). The adoption of maritime legislation has been one of the IMO's top priorities. Approximately 40 conventions and protocols have been adopted by the IMO and most of them have been amended to ensure that they are kept current.

The IMO's most important effort in terms of addressing marine pollution has been the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78). It covers oil pollution from accidents and routine operations. MARPOL also includes other types of pollutants such as chemicals, cargo, sewage, solid waste, and air emissions. In other conventions, the IMO addresses the system for providing compensation to those who have incurred financial damages as a result of pollution.

The IMO has promoted the establishment of regional port control systems providing for inspection of ships in foreign ports to ensure that they meet IMO standards. Organizing regional inspections has helped conserve limited resources in developing countries.

The IMO maintains a technical cooperation program that is designed to assist governments that require capacity building and resources. The IMO has emphasized issues of container safety, bulk cargoes, and liquefied gas tankers. The quality of maritime personnel has been addressed through establishment of crew standards and the adoption of a convention on training standards, certification, and watchkeeping. Amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, strengthened standards and gave the IMO authority to check government actions.

Inter-American Port Commission

In 1996, the General Assembly of the Organization of American States (OAS) upgraded the classification of the port forum from "Port Conference" to "Port Committee". The new OAS classification provided the Inter-American Port Commission (IPC) with additional technical, financial, and decision-making autonomy. The proposal was approved by the Inter-American Council for Integral Development (CIDI) and authorized by the OAS General Assembly in 1998.

The IPC maintains Technical Advisory Groups (TAG) that provide technical advice to the Commission on different aspects of port sector development. Member countries may appoint a representative to each TAG. TAG members are selected from port operations; academic, scientific, commercial, financial, industrial institutions and other organizations involved in maritime-related activities. The IPC maintains a navigational safety and environment committee that provides for exchange of information, identification of training needs, preparation of studies and technical documents, and organization of national and international conferences.

In general, the IPC operates at a high diplomatic level rather than addressing operational issues at the national and subnational levels. The IPC collaborates with the Inter-American Development Bank, World Bank, Economic Commission on Latin American and the Caribbean, the International Labor Organization, Central American Commission of Maritime Transport, the United Nations Conference for Trade and Development, and the IMO, among others.

Central America Integration System

The Central American Integration System (Sistema de la Integración Centroamericana, SICA) is an international organization created by the Tegucigalpa Protocol of the Organization of Central American States. Its member countries include Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and Belize. The goal of SICA is the creation of an integrated Central America. Its program areas include democracy, regional security, economic well-being, auto-determination, environment, and sustainable development. SICA has two important regional commissions, COCATRAM and CCAD, which together have contributed significantly to planning initiatives in the areas of maritime pollution control and navigational security.

Central American Maritime Transport Commission

The Central American Maritime Commission (Comisión Centroamericana de Transporte Marítimo, COCATRAM) was created in 1980 by the Ministers Transportation Council. COCATRAM is a regional organization that forms part of the Central American Integration System. COCATRAM works with both the public and private sectors of its member countries providing technical assistance and capacity building in areas related to international transport including security, environment, facilitation, and legislation. COCATRAM works directly with regional organizations including the ministries of transportation, maritime administrations, port administrators and both users and providers of international transportation. Both Guatemala and Honduras are members of COCATRAM. Belize is not a member, but maintains informal relations.

COCATRAM implements its work in the region through different specialized fora that coordinate directly with their institutions' including:

- TRAINMAR
- REPICA
- ROCRAM-CA
- Country-level liaison committees
- Network of Regional Port statisticians

COCATRAM maintains a small permanent staff consisting of four department managers. Projects are staffed through the use of contractors. COCATRAM's budget is supported equally by each of its member countries (Guatemala, Honduras, Nicaragua, Costa Rica and Panamá). COCATRAM also receives international funding to execute regional projects.

COCATRAM is the focal point for the IMO in Central America. Examples of activities that COCATRAM coordinates and implements for the IMO include the adoption and ratification of international conventions and capacity building programs. COCATRAM also collaborates with the United Nations and has been designated as the Secretariat for the Northeast Regional Seas Program (NRSP) since 2001. NRSP activities have included updating of contingency plans at ports in the region and the preparation of a regional capacity building plan.

COCATRAM has established itself as an important institution in Central America with ties to international institutions such as IMO, IPC, CCAD, multi-lateral funding agencies, and other institutions working on maritime pollution and safety issues. A representative from COCATRAM participates in the Regional Stakeholder Advisory Committee.

Central American Commission for the Environment and Development
The Central American Commission for the Environment and Development (Comisión Centroamericana de Ambiente y Desarrollo, CCAD) was created in 1989 with the goal of creating awareness of environmental awareness, strengthening institutions involved in natural resources and environmental protection, and assisting with the harmonization of related legislation to incorporate sustainable development issues into national development plans. CCAD also seeks to promote participatory decision-making and decentralization of governmental activities. Honduras, Belize, and Guatemala are members of CCAD.

Since its creation in 1989, CCAD has focused on the institutionalization of environmental and sustainable development programs. CCAD advanced the creation of a Central American Interparliamentary Commission for the Environment and Development (Commission Interparlamentaria Centroamericana de Ambiente y Desarrollo, CICAD). CCAD also promoted and obtained the creation of a regional initiative to integrate political, economic, social and environmental issues to promote sustainable development. The Alliance for Sustainable Development (La Alianza para el Desarrollo Sostenible, ALIDES) advocates a regional approach to sustainable development and synergy of regional efforts as opposed to individual national efforts. ALIDES promotes responsibilities and rights outlined in Agenda 21. The Central American Regional Environmental Plan (Plan Ambiental de la Región Centroamericana, PARCA) continues to be the medium and long-term strategy to address environmental issues in the region. CCAD has expanded its outreach effort with the addition of its Environmental Dialogue (Diálogo Ambiental) initiative in which civil society uses its web site as part of its public consultation process.

Trinational Alliance for the Conservation of the Gulf of Honduras
In 1997, eight nongovernmental organizations from Belize, Honduras and Guatemala joined forces to form the Trinational Alliance for the Conservation of the Gulf of Honduras (Alliance). Its executive representation alternates every two years among the project countries. The legal and political trinational framework of the project is defined by the following:

- The Central American Alliance for Sustainable Development
- The Tulum Declaration
- The Initiative for the Mesoamerican Coral Reef System.
- The Initiative and Project for the Mesoamerican Biologic Corridor

Protected areas are managed by each country's agencies and coordinated with project efforts. The project goal is to establish and consolidate public participation processes for information, planning, consultation and co-management of the natural resources of the Gulf of Honduras in order to ensure its long-term conservation and sustainable use. The project strives to foster trinational exchanges and resolution of conflicts related to the management of the coastal development of the Gulf of Honduras.

The Alliance has undertaken a range of activities that are planned to increase the knowledge of sustainable development issues in the Gulf of Honduras, strengthen the institutions and regulatory framework for the region, and foster collaborative activities and agreements among the three countries. The Alliance also reviews the compliance of each member country with respect to implementing the provisions of its laws and regulations governing protected areas. Representatives from several member organizations of TRIGOH participate on the Regional Stakeholders Advisory Committee.

PROARCA/COSTAS

PROARCA is a five-year, USAID-funded program with the goal to promote an effective regional environment stewardship. PROARCA's principal partner is the Central American Integration System (SICA) and its Environment Division, the Central American Commission for Environment and Development (CCAD) is the lead regional counterpart organization in implementation of PROARCA.

PROARCA has several program components that contribute to the advancement of protected areas in the Gulf of Honduras. Project objectives include:

- Consolidation of the Central American Protected Areas System (CAPAS) by increasing the number of protected and special management areas under improved management
- Increase of local stewardship of the environment by helping local communities manage coastal and forest resources
- Harmonization and strengthening of Central American environmental policy frameworks by supporting the drafting and introduction of environmental laws and regulations to national legislatures/executive branches.

PROARCA has a representative participating on the Regional Stakeholder Advisory Committee.

Mesoamerican Barrier Reef System Project

CCAD approached the World Bank in 1997 to request support for the conservation and sustainable use of the MBRS. An Action Plan was prepared with financial support from GEF and technical support from the World Bank, the government of Mexico and other international organizations. The MBRS Action Plan provides the basis for a comprehensive program of regional and national-level activities directed at protecting the Mesoamerican Barrier Reef System and providing for its social and environmental sustainability. The Action Plan includes the following program areas: integrated land use planning, research and monitoring, education and information dissemination, establishment of marine protected areas, development of sustainable tourism, maintenance of water quality and pollution prevention, capacity building, institutional strengthening, participatory management, financial sustainability, harmonization and strengthening of legal frameworks, and regional coordination. A representative from the MBRS participates on the Regional Stakeholders Advisory Committee.

6.2 Stakeholder Consultations

Transboundary projects are inherently complex due to multiple layers of political issues and the relative newness of multi-stakeholder projects to addressing both national and regional technical and management issues. However, the benefits can also be greater than individual country programs, because of the opportunity to leverage resources, collaborative problem-solving, and regional harmonization of institutions and legislation.

Reoccurring themes and challenges were identified in the consultations with stakeholders. In general, the observations were generally along sector lines with fewer differences among countries. Many technical and management professionals were not familiar with the project and the one-on-one stakeholder meetings provided an opportunity to inform them about project advances. All interviewees were positive about the need for a project addressing both marine pollution and navigational safety issues. Global observations expressed during the regional workshops and individual meetings include:

- Need for stakeholder participation and Project 'ownership'.
- Develop financial sustainability during the Project's initial phase.
- Review existing regional programs and create linkages where indicated to avoid gaps or duplication of efforts.
- Streamline project organization to reduce resource and personnel strain for the Project and stakeholder participants.
- Information-sharing and management are challenges at the national level with an additional layer of complexity at the transboundary level by adding political considerations and coordination.

6.2.1 Public Sector – National and Local Government

Initial Findings

Belize, Guatemala, and Honduras have ratified and are signatories to MARPOL and the principal conventions covering marine pollution and navigational security in the Gulf of Honduras. However, meetings with professionals working in these program areas and review of the literature, reinforce observations that conventions without implementing regulations have limited the effectiveness of inspections and enforcement actions. Limited inter-agency and intra-agency coordination and unclear lines of authority often result in gaps and duplication of efforts in regulatory responsibilities. Several national agencies responsible for maritime pollution control indicating they were not implementing program activities due to competing agency priorities. The Regional Action Plan "La Agenda de Seguridad Ambiental Maritimo Portuario de Centroamerica" prepared through a collaboration of COCATRAM, CCAD and PROARCA was cited as a useful document that has advanced maritime environmental issues in the region.

All agencies reported financial considerations as a critical factor impeding full implementation of their programs, particularly inadequate staffing and equipment shortages. Equipment needs range from computers and vehicles to specialized equipment needed for spill containment, clean up, and environmental monitoring.

Guatemala and Honduras have national laws that provide the municipalities with the authority to conduct environmental programs within their jurisdictions including inspections and enforcement actions. In the areas of maritime pollution control, the municipal environmental departments have focused on waste disposal from ships and the handling and disposal of hazardous wastes. Reports from Guatemalan and Honduran municipalities indicate that their contact with their respective Port Authority, Merchant Marines, or Navy has been limited and not pursued to the fullest extent. This has been attributed to limited staff resources and competing agency priorities.

Honduras has legal and institutional frameworks that provide for environmental management by the municipalities. The Constitution, Municipalities Law, Law of Administrative Procedures, and the

National Environmental Law all contain provisions delegating certain authorities to the municipalities for the operation of programs, enforcement, and collection of sanctions within their jurisdictions. The National Environmental Law provides the municipalities with the responsibility, in coordination with the Secretariat of Natural Resources and the Environment, for assuming the delegation of authority within its respective jurisdiction.

The Honduran National Environmental Law provides the municipality with the functions of water resource protection, prevention and control of disasters and emergencies, regulation of contaminant discharges in compliance with national norms, and participation in the National System of Environmental Impact Assessment (Sistema Nacional de Evaluación de Impacto Ambiental, SINEIA). An example of a Memorandum of Agreement between the Honduran Secretary of Environment and Natural Resources and the Municipality of Puerto Cortes is provided in Appendix C. It is an example of existing legal and institutional mechanisms that the Project can facilitate to strengthen the contributions of municipalities to the Project and in their jurisdictions.

In Guatemala, the Presidential Commission for the Reform of the State of Guatemala, Decentralization and Public Participation (COPRE) was formulated by Decree 12-2002 and the creation of a new Municipal Code. The decentralization of government jurisdictions provides the municipalities with the administration of drinking water, sewer systems; collection, treatment and disposal of solid waste; construction permits; and administration of natural resources in the municipality. The municipal government is also responsible for preparing and implementing land use plans and control of construction through issuance of permits.

In contrast to Guatemala and Honduras, most decision-making processes in Belize occur at the national-level. Sector programs at the local level primarily involve development of annual projections, baseline data collection and public consultation. The emphasis on centralized management has limited the government's ability to target local needs. In recent years, there have been several regional planning initiatives that have promoted vertical integration of government services and strengthened public participation.

In Belize, revenue from all sectors collected at the local level, goes into the General Revenue. This is an important consideration when evaluating funding mechanisms for the project, because it complicates or possibly limits applications of local revenue generation for GEF Project activities.

In all three countries, there is limited access to institutions capable of providing environmental laboratory analysis and monitoring services. Academic institutions offering degrees or professional certification courses in fields related to maritime pollution control and navigational safety are also rare in the region. The Project should consider strengthening universities and other institutions to provide more opportunities for contracting environmental laboratory analysis, training, and professional development courses in the GEF Project areas.

Issues highlighted in Public Sector Stakeholder Meetings:

- Need to promulgate regulations for MARPOL and other key international conventions
- Inadequate coordination and communication among national agencies and between national and local government agencies.
- Fragmentation of agency responsibilities include unclear or ignored agency mandates and overlapping jurisdictions
- Need for training assessments and follow up

- Government generally has inadequate resources, equipment, and staffing to execute functions
- Difficulty with staff retention

Discussion

Interviews with government representatives found that inadequate resources are probably the most significant impediment to execution of regulatory responsibilities. The situation is more severe for local government. Because of limited financial and human resources, the Project should consider focusing on the strengthening of a few priority actions rather than a large-scale planning effort. The successful implementation of specific actions can be subsequently phased into larger planning actions in conjunction with a financial plan developed by the Project.

There are three principal challenges that institutional strengthening projects typically encounter to achieving long-term project benefits - 1) Staff retention, 2) Creation of permanent information repositories, and 3) Financial sustainability of programs. The Project should consider addressing these issues by linking funding and training to specific institutional commitments. These problems are pervasive in Latin America and often result from the political instability of public sector employment at all levels and the organizational culture of government agencies. However, GEF Project performance will be greatly enhanced by attempting to address these issues through project planning and funding agreements.

In recent years, local governments in Latin America have been delegated more responsibilities through decentralization of national government programs and the acknowledgement of the role of local government. Guatemala and Honduras both have a legal framework that provides for the delegation of responsibilities from national government to the corresponding local government authorities. Unfortunately, the decentralization of responsibilities has not necessarily been accompanied with financial and technical support to the municipalities. The result has been that the additional responsibilities have been largely theoretical as under-funded and under-staffed local government agencies attempt to execute their traditional responsibilities while assuming the additional delegated authorities. Strengthening local government will provide greater efficiency through closer work relationships with local stakeholders, increased public participation, and ultimately more accountability by the regulated community.

The Project provides a regional opportunity to promote inter-sectoral collaboration. In particular, the project should encourage public-private sector collaboration to facilitate better working relationship between the regulators and the regulated community. Civil society has also demonstrated the ability to advance of public sector programs. Public sector-civil society collaboration is increasing in Belize and Caribbean countries.

The nature of a transboundary project requires that participating countries recognize that benefits from regional collaboration require a new perspective in terms of national policy. The Gulf of Honduras region has historically had territorial conflicts and the GEF Project should support international efforts to create buffer zones to relieve potential areas of political disaccord. Creation of transboundary protected areas can be useful and may have applications for the Gulf of Honduras, particularly between Guatemala and Belize.

Proposed project actions for the public sector include:

- Preparation of a detailed legal and regulatory analysis.

- Harmonization of national-level policies and legislation to support the implementation of international conventions addressing maritime pollution control and navigational safety.
- Development of templates to strengthen national legislation and promulgate regulations to comply with international conventions covering marine pollution control and navigational safety.
- Institutional strengthening of government agencies to address fragmentation of responsibilities and clarify agency jurisdictions. Strengthening of local government should include definition of delegated activities and coordination with national agency counterparts. Where required, the Project should assist with the drafting of MOUs to assist with delegation of activities and identification of revenue generating sources for local government contributions.
- Development of train-the-trainer courses for national and local government officials.
- Development of a funding strategy that can generate fees for local government services.
- Development of a public-private sector demonstration project
- Preparation of a staff retention strategy for project-trained personnel.
- Improve access to professional development certifications and academic training in project-related fields by creating project linkages with local universities and institutes to strengthen existing programs and, where necessary, create new ones.

6.2.2 Civil Society

Initial Findings

Environmental organizations in the region have been active in establishing marine protected areas and proactive in advancing an agenda to promote harmonization of legislation and building institutional capacity for maritime pollution control and navigation safety. As an example, TRIGOH is addressing transboundary issues related to maritime pollution control and navigational safety. This is a logical component of coastal management that remains vulnerable to contamination from normal operational activities from ships and ports as well the catastrophic consequence of an oil spill. Specific issues highlighted by environmental organizations include:

- Few opportunities to participate in the decision-making process
- Need for project sustainability through stable project financing
- Need for capacity building and project-specific training for NGOs

Of the three countries, environmental organizations in Guatemala have been the most successful in advancing a regional agenda for protecting the Gulf through harmonization of legislation, creation of protected areas, and promoting a regional agenda for marine pollution control and navigational safety. There are regional examples where NGOS have contributed to preparation of spill contingency plans and participation in awareness building concerning the need to strengthen regional capacity for the management of maritime pollution and navigational safety. NGOs have successfully collaborated with regional organizations such as CCAD. TRIGOH is contributing to the implementation of PROARCA/COSTAS. Discussions with both NGOs and COCATRAM indicated that presently there is limited interaction. This is probably due to COCATRAM's focus on user groups comprised primarily of industry, port operators, and government.

Belize has an active environmental nongovernmental organization, TIDE that forms part of TRIGOH's trinational alliance of environmental NGOs in the Gulf of Honduras. TIDE works in the areas of environmental education, protected area management, and environmental monitoring. TIDE is a well-developed organization with 25 employees.

In addition to TRIGOH, Belize participates in BEMAMCCOR, another transboundary working group for protected areas and wildlife. Together, the two NGOs contribute to several protected areas including Sarstoon Temash National Park, Corozal Bay Wildlife Sanctuary, Aguas Turbias National Park, and Rio Bravo Conservation and Management Area. These transboundary areas form part of the regional projects of Mesoamerican Biological Corridors Project (MBCP) and the Mesoamerican Barrier Reef System Project (MBRS).

Discussion

The Gulf of Honduras benefits from an active and well-respected network of environmental organizations. NGOs from TRIGOH demonstrate a network that links the three countries. Environmental NGOs have shown the capability to link transboundary environmental programs that might otherwise have been hampered by government protocol and bureaucracy. The Project will benefit from their participation as technical experts in the project, but possibly more importantly is the public education and outreach support.

Proposed Project Actions:

- Incorporation of civil society participation in all decision-making components of the Project.
- Include civil society as one of the target groups for technical training.
- Review legal and institutional recommendations of the Project for adequate public consultation provisions.
- Evaluate feasibility of pilot projects testing new or under-utilized collaborations between civil society and the private and public sectors.

6.2.3 Private Sector

Initial Findings

In recent years, the development and use of large tankers and container vessels has necessitated the transformation of port facilities and related infrastructure. During the 1980s, substantial reforms were made in the area of port organization and administration. These reforms were initiated by state port institutions that turned to private sector involvement in port management. Guatemala, Honduras and Belize have concessioned much of the day-to-day operation. The national government's role has focused more on compliance of global issues and municipalities have focused on the regulation of select local issues. Meetings with the private sector focused on shipping and port operations.

Texaco in Honduras indicated that they operate in accordance with U.S. laws, company policies, and compliance with the requirements of the IMO. They comply with inspections by the Merchant Marines and SERNA. They indicated that there are also local government requirements that are generally unenforced. Primary concerns expressed by Texaco included a general lack of enforcement of hazardous materials handling, disposal, and transportation requirements; the need for uniform ship standards; and inadequate off-loading of petroleum and chemicals by some ships. The Texaco's experience is representative of large international companies that rely primarily on self-monitoring for compliance and are often the only organizations with in-country capability to respond to oil spill accidents.

Information provided by Banana Enterprises Limited of Belize indicated that solid waste and ballast water discharge continue to be environmental problems. Training and awareness building is available to port operators and suggestions were made that the shipping industry needs to be included in future trainings. Specific issues highlighted include:

- Need to have uniform enforcement of shipping regulations.
- Need to strengthen local capacity to conduct inspections and enforce regulations.
- Need to strengthen government capacity to conduct oil spill contingency planning and respond to emergencies.
- Capacity and awareness building should be expanded to include the shipping industry as well as port operators

Discussion

The Project will need to strengthen outreach to the private sector, particularly shipping companies. Private sector acceptance is crucial to the successful implementation of new and existing regulations, and permit requirements. Generally, the public sector is under-staffed with limited resources that hinder the ability to fully implement a comprehensive enforcement program. The Project should consider actions to direct funding to inspectors. As part of the institutional strengthening component, it may be feasible to consider privatization of ship and port inspections. An alternative approach is to shift the compliance burden to the private sector by requiring documentation of compliance with permits and environmental monitoring data, and supplementing the information with interim government inspections. Examples of self-monitoring include ballast water logs, wastewater discharge permits, and solid waste manifests.

Proposed Project Actions

- Expand private sector participation in technical training and include opportunities for collaboration as a technical leader.
- Include the private sector in regulation development and institutional strengthening activities including creation of a project legislative workgroup with industry participation.
- As part of the Project financial strategy, evaluate options to create a fund or provide low-interest loans to the private sector for purchase of equipment, monitoring services, or implementation of industry best practices to comply with national and international requirements
- Develop demonstration projects that provide for public-private and private-civil society collaboration.

7.0 Environmental Quality Objectives

Two overarching Environmental Quality Objectives have been identified as a possible basis for long-term action to improve the Gulf of Honduras environment. These EQOs were discussed at regional meetings during preparation of the project (e.g., Guatemala, March 2003), but they are only draft at this stage. As part of the full TDA/SAP process, the EQOs will be updated and strengthened. They are presented here only to indicate the major environmental drivers for the region.

Stabilized Marine and Coastal Water Quality

TARGETS

1. Reduce pollution from port and other land-based activities in the Gulf of Honduras by 25% by 2008
2. Reduce pollution from marine activities by 50% by 2008
3. Reduce risk of marine accidents, including coral destruction, by half by 2013

Prevention of Degradation of Sensitive Coastal and Marine Habitats

TARGETS

1. Rate of decline in the quality of selected coral reef sites halved by 2013
2. Rate of decline in the quality of selected mangrove sites halved by 2013
3. Stabilize seagrass inventory by 2020

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Appendix A

List of Abbreviations

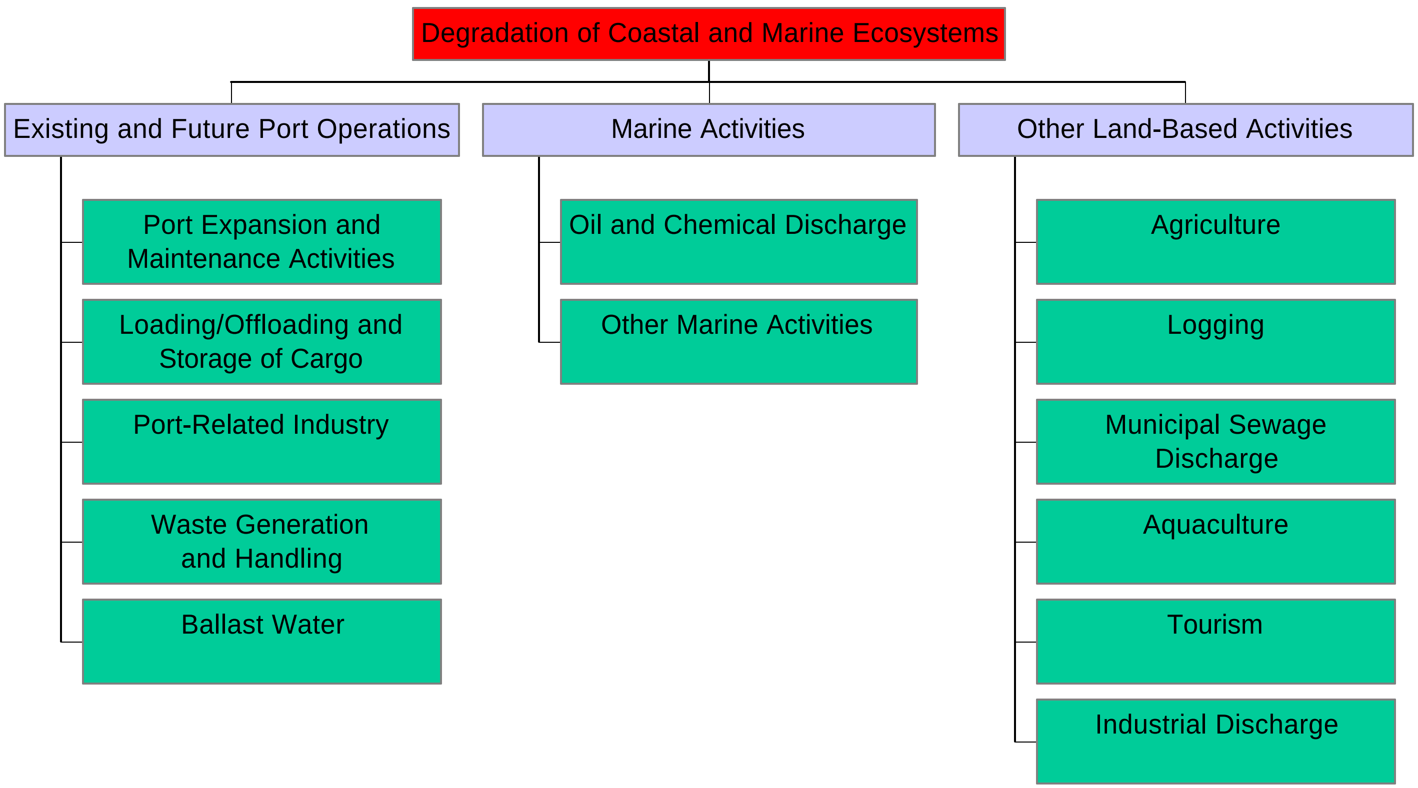
AAIW	Antarctic Intermediate Water
ACDI	Canadian Agency for International Development
ALIDES	Alliance for Sustainable Development (La Alianza para el Desarrollo Sostenible)
CAPAS	Consolidation of the Central American Protected Areas System
CESSCO	Centro de Estudios y Contaminantes
CEP	Caribbean Environment Programme
CCAD	Central American Commission for Environment and Development (Comision Centroamericana de Ambiente y Desarrollo)
CIDI	Ingter-American Council for Integral Development
COBIGUA	Compañía Bananera Independiente de Guatemala S.A.
COCATRAM	Comision Centroamericana de Transporte Marítimo
COLREG	Collision Regulations
CONAMA	Comision Nacional del Medio Ambiente
CONAP	National Council of Protected Areas
COPRE	Commission for the Reform of the State of Guatemala Decentralization and Public Participation
CSO	Central Statistical Office
CZMAI	Coastal Zone Management Authority and Institute
DGMM	Merchant Marines (Direción Nacional del Mercante Marina)
DMSP	U.S. Defense Meteorological Satellite Program
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EMPORNAC	Empresa Portuaria Nacional
ENP	Empresa Nacional Portuaria
EPOMEX	Programa de Ecología, Pesquerías y Oceanografía del Golfo de México
EQO	Environmental Quality Objective
FAO	Food and Agriculture Organization of the United Nations
FUNDARY	Fundación para la Conservación del Medio Ambiente y de los Recursos Naturales
GEF	Global Environment Facility
GDP	Gross Domestic Product
GIWA	Global International Waters Assessment
GPCP	Global Precipitation Climatology Project
HDR	Human Development Report
IADB	Inter-American Development Bank
IALA	International Association of Lighthouse Authorities
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
INGUAT	Guatemalan Institute of Tourism
IPC	Inter-American Port Commission
ISP	Inter-American Strategy for Public Participation in Sustainable Development Decision-making
ITCZ	Intertropical Convergence Zone
LNG	Liquid Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MBRS	MesoAmerican Barrier Reef System
MODIS	Moderate Resolution Imaging Spectrorodiometer
MICIVI	Ministry of Communications, Infrastructure and Housing
MPPI	Major Perceived Problem and Issue
MOU	Memorandum of Understanding

NAP	National Action Plan
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRSP	Northeast Regional Seas Program
OAS	Organization of American States
OIRSA	Regional Office for Agriculture and Livestock Sanitation
PDF	Project Development Facility
PROARCA	Programa Ambiental Regional Para Centroamerica
RAMSAR	International Convention on Wetlands
RAP	Rapid Assessment of Point Sources and Non-Point Sources
SAP	Strategic Action Programme
SENA	Secretaria Nacional del Ambiente
SERNA	Secretaria de Recursos Naturales y Ambiente
SICA	Central American Integration System (Sistema de la Integración Centroamericana)
SIECA	Secretaría de Integración Económica Centroamericana
SIGMA	Environmental Management Systems
SINEIA	National System of Environmental Impact Assessment (Sistema Nacional de Evaluación de Impacto Ambiental)
SOLAS	Safety of Life at Sea
SOPTRAVI	Ministry of Public Works, Transportation and Housing (Secretaria de Estado de Obras Publicas, Transporte y Vivienda)
SSM/I	Special Sensor Microwave Imager
SST	Sea-Surface Temperatures
SUW	Subtropical UnderWater
TAG	Technical Advisory Groups
TDA	Transboundary Diagnostic Analysis
TIDE	Toledo Institute for Development and the Environment
TRIGOH	Trinational Alliance for the Conservation of the Gulf of Honduras
UML	Upper Mixed Layer
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USGS	U.S. Geological Survey
VTS	Vessel Tracking System
WCMC	World Conservation Monitoring Centre
WCRP	World Climate Research Program
WNACW	Western North Atlantic Central Water
WRIScS	Watershed Reef Interconnectivity Scientific Study
WWF	World Wildlife Fund
ZOLIC	Industrial and Commercial Free Zone

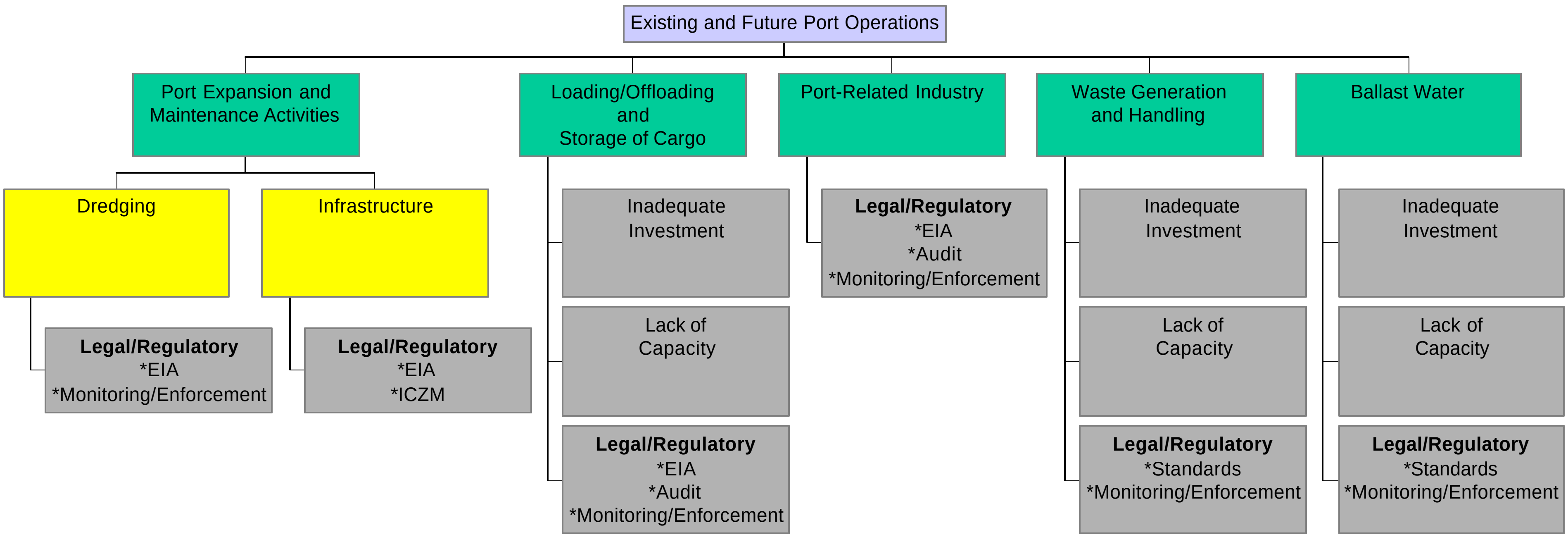
Appendix B

Causal Chain Analysis

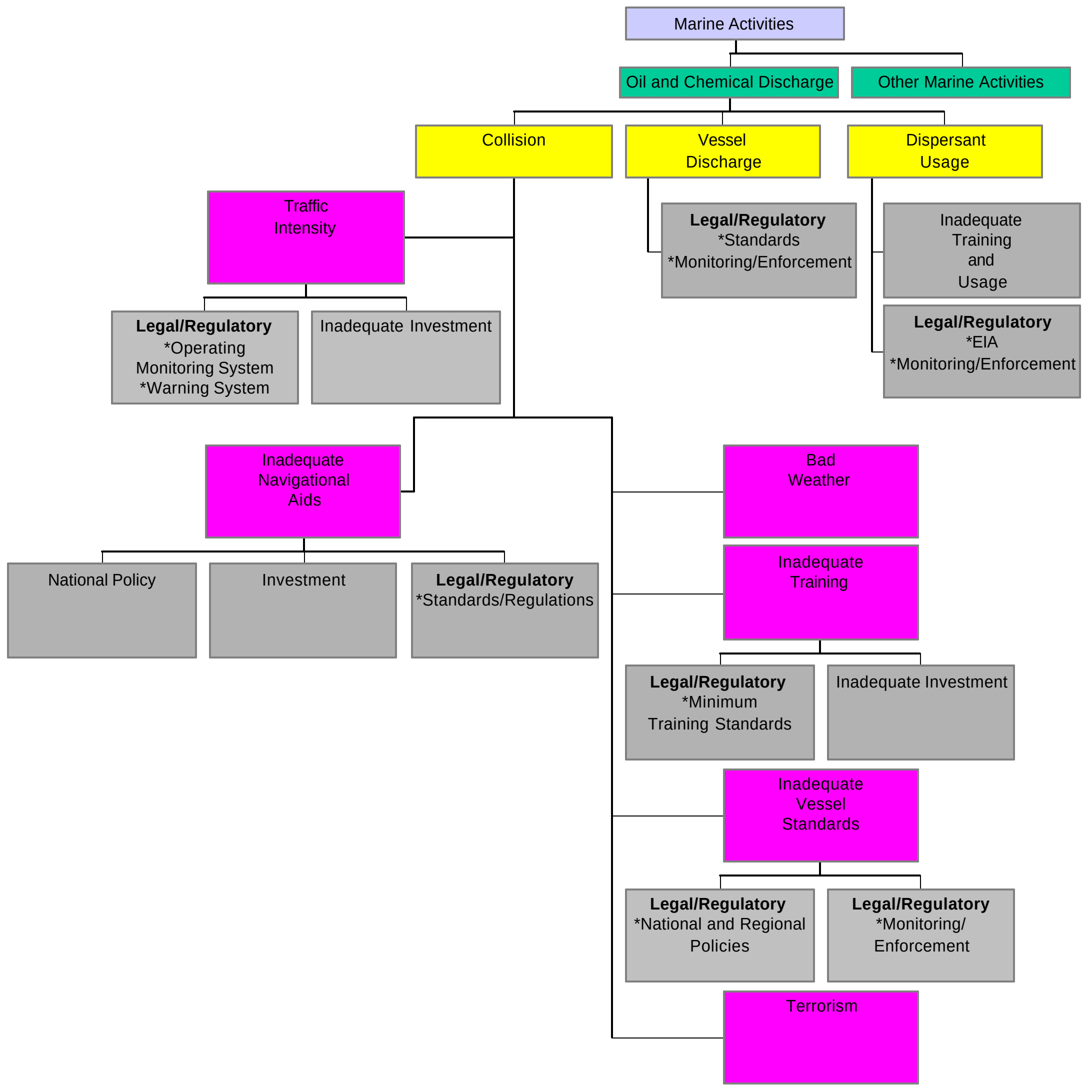
Degradation of Coastal and Marine Ecosystems



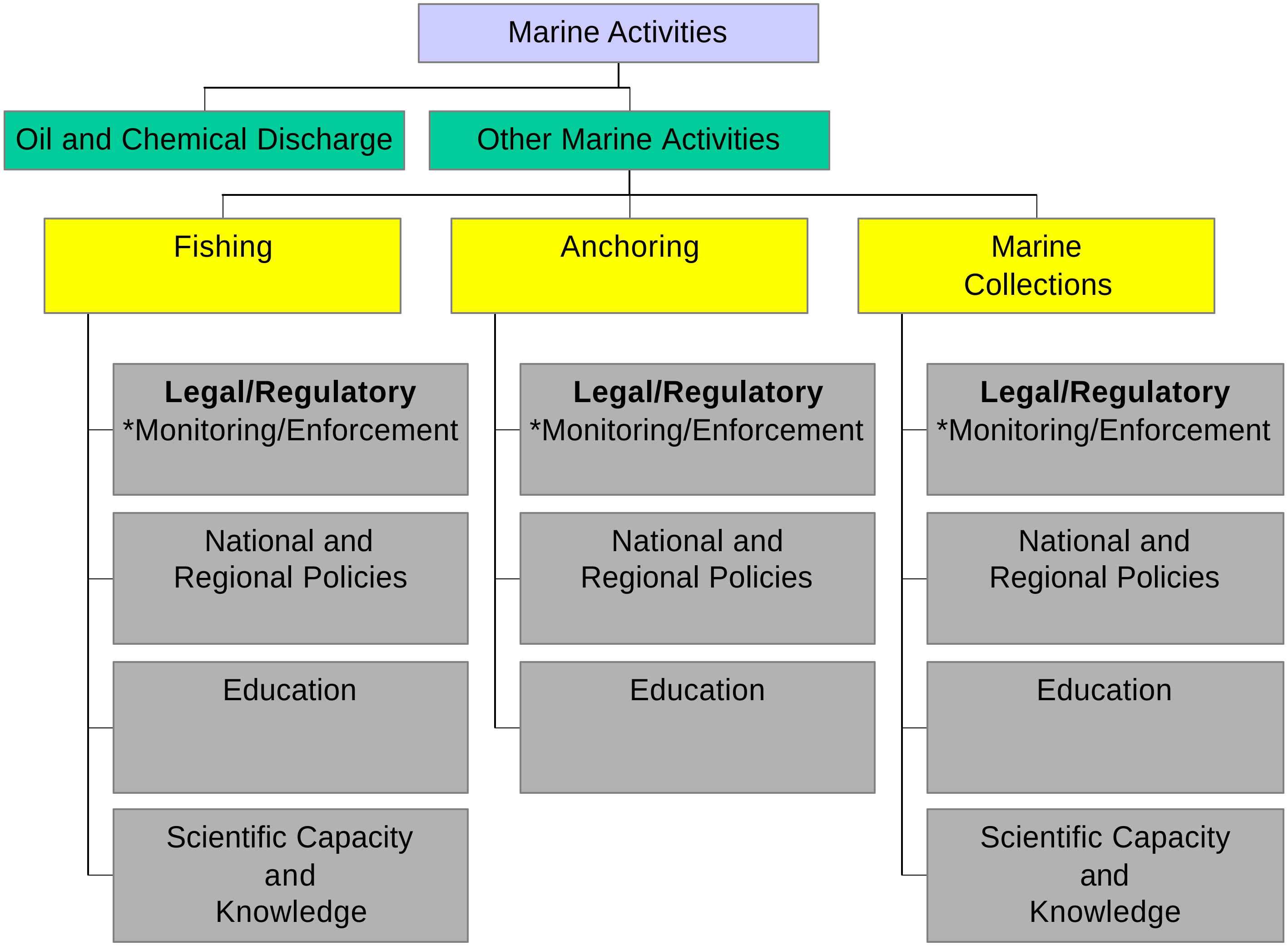
Existing and Future Port Operations



Marine Activities – Oil and Chemical Discharge



Marine Activities – Other Marine Activities



Appendix C

Supplementary Data

C. 1. Belizean Ports Export/Import Summary (metric tons), 1996-2001

Belize City													
		1996		**1997**		**1998**		**1999**		**2000**		**2001**	
Cargo	**Sub-type**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
Hazardous		93,117	0	104,620	0	132,103	0	178,549	0	159,943	0	187,364	0
	Petroleum	92,758	0	104,430	0	131,910	0	178,170	0	159,773	0	187,352	0
	Non-Petroleum	359	0	191	0	193	0	378	0	170	0	12	0
Non-Hazardous		183,666	172,595	198,491	183,988	209,558	162,789	233,997	165,861	294,292	156,270	339,433	178,040
	Banana	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Banana	183,666	172,595	198,491	183,988	209,558	162,789	233,997	165,861	294,292	156,270	339,433	178,040
Total		276,783	172,595	303,111	183,988	341,661	162,789	412,546	165,861	454,235	156,270	526,797	178,040
Big Creek													
Hazardous		0	0	0	0	0	0	0	0	0	0	0	0
	Petroleum	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Petroleum	0	0	0	0	0	0	0	0	0	0	0	0
Non-Hazardous		1,180	64,688	0	57,744	1,179	56,404	2,723	61,434	49,184	85,437	33,739	56,493
	Banana	0	57,925	0	53,622	0	51,648	0	57,631	0	66,686	0	45,140
	Non-Banana	1,180	6,763	0	4,122	1,179	4,756	2,723	3,803	49,184	18,751	33,739	11,354
Total		1,180	64,688	0	57,744	1,179	56,404	2,723	61,434	49,184	85,437	33,739	56,493
Commerce Bight													
Hazardous		0	0	0	0	0	0	0	0	0	0	0	0
	Petroleum	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Petroleum	0	0	0	0	0	0	0	0	0	0	0	0
Non-Hazardous		0	18,106	0	28,663	0	29,137	0	32,987	0	26,226	462	16,791
	Banana	0	0	0	0	0	0	0	0	0	0	0	0
	Non-Banana	0	18,106	0	28,663	0	29,137	0	32,987	0	26,226	462	16,791
Total		0	18,106	0	28,663	0	29,137	0	32,987	0	26,226	462	16,791
All Ports		**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**% growth 1996-2001**					
Hazardous		93,117	104,620	132,103	178,549	159,943	187,364	15.0%					
	Petroleum	92,758	104,430	131,910	178,170	159,773	187,352	15.1%					
	Non-Petroleum	359	191	193	378	170	12	-49.5%					
Non-Hazardous		440,235	468,886	459,068	497,000	611,409	624,958	7.3%					
	Banana	57,925	53,622	51,648	57,631	66,686	45,140	-4.9%					
	Non-Banana	382,310	415,264	407,420	439,370	544,723	579,819	8.7%					
Total		533,352	573,506	591,171	675,549	771,352	812,322	8.8%					

Source: Port of Belize Limited (2002) Offer for Sale Relating to Government of Belize Shareholdings in Port of Belize Limited.

Offering Memorandum. January. Note that the data for 2001 apparently are only for the first nine months of the year (see page 3 of report).

C. 2 Belize City Port Cargo Import/Export Statistics (short tons), 1996 - 2002

			1996		1997		1998		199		2000		2001		2002	
			Short/tons		Short/tons		Short/tons		Short/tons		Short/tons		Short/tons		Short/tons	
Description		Hazardous	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
N.C.S. Containers		No	7,182	1,830	17,521	9,673	18,736	9,907	34,599	15,811	66,380	20,405	58,426	15,570	n/a	n/a
Container Lo Co		No	144,655	12,523	146,687	17,223	149,264	13,311	167,171	13,353	190,962	14,161	252,313	32,347	232,202	29,003
Break Bulk		No	8,421	3,199	11,024	1,163	17,828	647	5,419	770	5,773	1	6,893	60	870	3
Break Bulk/Poles		No	0	0	0	0	0	0	0	0	0	0	1,147	0	0	0
Fuel		Yes	102,246	0	115,112	0	142,433	0	191,816	0	174,504	0	206,359	0	163,920	0
Fertilizer		No	14,794	0	18,823	0	15,296	0	20,543	0	8,399	0	9,646	0	9,522	0
Wheat		No	24,472	0	21,892	0	23,904	0	14,949	0	24,682	0	23,953	0	23,122	0
Insecticides		Yes	326	0	129	0	186	0	273	0	176	0	0	0	0	0
Butane		Yes	0	0	0	0	2,970	0	4,580	0	1,613	0	158	0	0	0
Cement		No	0	0	0	0	235	0	10,817	0	17,515	0	7,598	0	5,111	0
Sugar		No	0	105,368	0	121,594	0	110,606	0	110,255	0	100,252	0	112,278	0	108,932
Explosives		Yes	70	0	81	0	27	0	144	0	11	0	13	0	0	0
Molasses		No	0	64,738	0	52,163	0	43,647	0	40,895	0	37,436	0	34,977	0	32,593
Steel		No	2,928	0	2,848	0	5,731	0	4,435	0	10,685	0	14,179	0	13,175	0
Dolomite P.G.		No	2	2,592	0	993	0	1,323	0	1,743	0	0	0	1,020	n/a	n/a
Total			305,096	190,250	334,117	202,809	376,610	179,441	454,746	182,827	500,700	172,255	580,685	196,252		

Source: Port of Belize Limited (2002) Offer for Sale Relating to Government of Belize Shareholdings in Port of Belize Limited.
Offering Memorandum. January. Note that the data for 2001 apparently are only for the first nine months of the year (see page 3 of report).
The 2001 numbers were supplemented with those from the electronic file from the port.
The additional 2001 data do not have N.C.S. Containers and Dolomite P.G., so the data in this summary just reflects the first nine months of the year for these two categories.

C. 3 Big Creek Port Cargo Import/Export Statistics (short tons), 1996 – 2002

		1996		1997		1998		199		2000		2001		1996-2001
		Short/tons		Short/tons		Short/tons		Short/tons		Short/tons		Short/tons		
Description	Hazardous	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Total
Container B.C.	No	0	0	0	0	0	0	0	0	38,027	760	25,664	448	64,899
Break Bulk B.C.	No	0	0	0	0	0	0	0	0	4,294	1,671	3,693	67	9,725
Bananas B.C.	No	0	63,850	0	59,107	0	56,931	0	63,526	0	73,508	0	49,757	366,679
Concentrate B.C.	No	0	0	0	0	0	0	0	0	0	15,315	0	10,007	25,322
Fertilizer B.C.	No	0	0	0	0	0	0	0	0	4,674	0	3,632	0	8,306
Pine Stumps B.C.	No	0	7,455	0	4,544	0	5,243	0	4,192	0	2,923	0	1,993	26,350
Feed B.C.	No	1,301	0	0	0	1,300	0	3,001	0	7,220	0	4,201	0	17,023
Total		1,301	71,305	0	63,651	1,300	62,174	3,001	67,718	54,215	94,177	37,190	62,272	518,304

Source: Port of Belize Limited (2002) Offer for Sale Relating to Government of Belize Shareholdings in Port of Belize Limited. Offering Memorandum. January. Note that the data for 2001 apparently are only for the first nine months of the year

C. 4. Belize City Port Ship Calls, 1996 – September 2001

	1996	1997	1998	199	2000	2001	Total
N.C.S. Containers	15	25	24	31	52	52	199
Container Lo Co	127	118	92	104	85	61	587
Break Bulk	9	11	18	12	7	9	66
Break Bulk/Poles	0	0	0	0	0	1	1
Fuel	15	12	17	29	25	25	123
Fertilizer	19	18	13	15	4	3	72
Wheat	8	7	8	5	8	6	42
Insecticides	14	3	1	0	3	0	21
Butane	0	0	8	13	4	1	26
Cement	0	0	1	13	14	14	42
Sugar	10	12	15	13	10	10	70
Explosives	2	3	4	7	1	1	18
Molasses	8	9	5	5	5	5	37
Steel	2	2	3	3	5	6	21
Dolomite P.G.	2	1	1	2	0	2	8
Total	231	221	210	252	223	196	1,333

Source: Port of Belize Limited (2002) Offer for Sale Relating to Government of Belize Shareholdings in Port of Belize Limited.

C. 5. Big Creek Port Ship Calls, 1996 – September 2001

	1996	1997	1998	199	2000	2001	Total
Container B.C.	0	0	0	0	28	19	47
Break Bulk B.C.	0	0	0	0	10	7	17
Bananas B.C.	49	52	52	52	52	39	296
Concentrate B.C.	0	0	0	0	1	3	4
Fertilizer B.C.	0	0	0	0	7	5	12
Pine Stumps B.C.	4	4	5	4	3	2	22
Feed B.C.	1	0	1	2	4	2	10
Total	54	56	58	58	105	77	408

Source: Port of Belize Limited (2002) Offer for Sale Relating to Government of Belize Shareholdings in Port of Belize Limited.

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C 6. Santo Tomás de Castilla and Puerto Barrios Export/Import Summary (Metric Tons), 1993-2002

Santo Tomás de Castilla		Imports										
Cargo	**Sub-type**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	
Hazardous		572,645	661,528	662,599	666,161	713,210	817,470	837,033	773,062	951,719	870,687	
	Petroleum	446,934	504,288	554,868	527,970	551,528	644,085	640,386	559,676	636,519	619,898	
	Non-Petroleum	125,711	157,241	137,731	138,192	161,682	173,384	196,647	213,386	315,200	250,790	
Non-Hazardous		828,216	859,192	848,546	792,876	938,199	1,311,572	1,250,647	1,304,256	1,149,010	1,415,081	
	Banana	1,255	107	0	396	0	118	0	147	0	0	
	Non-Banana	826,961	859,085	848,546	792,480	938,199	1,311,454	1,250,647	1,304,109	1,149,010	1,415,081	
Total		1,400,861	1,520,720	1,541,145	1,459,037	1,651,409	2,129,042	2,087,680	2,077,318	2,100,729	2,285,768	
		Exports										
Cargo	**Sub-type**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	
Hazardous		352,914	297,597	458,313	748,708	1,309	3,338	2,740	3,265	1,091,060	1,336,847	
	Petroleum	346,753	287,602	448,234	730,637	972	562	986	55	1,066,601	1,302,459	
	Non-Petroleum	6,161	9,995	10,079	18,071	336	2,776	1,754	3,211	24,459	34,389	
Non-Hazardous		776,320	820,868	836,490	978,205	2,122,658	2,304,629	2,165,095	2,269,113	1053,329	1,177,412	
	Banana	230,494	275,038	284,051	326,272	15,697	18,949	23,413	14,574	213,915	238,756	
	Non-Banana	545,826	545,829	552,439	651,932	2,106,961	2,285,680	2,141,681	2,254,539	839,414	938,655	
Total		1,129,234	1,118,465	1,294,803	1,726,912	2,123,966	2,307,967	2,167,834	2,272,379	2,144,389	2,514,259	
		Imports and Exports										

Santo Tomás de Castilla		**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**% growth 1993-2002**
Hazardous		925,560	959,125	1,150,912	1,414,869	714,519	820,808	839,773	776,327	2,042,779	2,207,535	9.1%
	Petroleum	793,687	791,890	1,003,103	1,258,607	552,500	644,647	641,372	559,730	1,703,120	1,922,357	9.2%
	Non-Petroleum	131,873	167,235	147,810	156,262	162,019	76,160	198,401	216,597	339,659	285,178	8.0%
Non-Hazardous		1,604,536	1,680,059	1,685,036	1,771,080	3,060,857	3,616,201	3,415,742	3,573,369	2,303,339	2,592,493	4.9%
	Banana	231,749	275,145	284,051	326,669	15,697	19,068	23,413	14,721	213,915	238,756	0.3%
	Non-Banana	1,372,787	1,404,914	1,400,985	1,444,412	3,045,160	3,597,134	3,392,328	3,558,648	1,988,424	2,353,736	5.5%
		2002										
Puerto Barrios		**Imports**	**Exports**	**Imp/Exp**								
Hazardous		171,646	0	171,646								
	Petroleum	171,646	0	171,646								
	Non-Petroleum	0	0	0								
Non-Hazardous		232,997	948,470	1,181,467								
	Banana	0	614,891	614,891								
	Non-Banana	232,997	333,578	566,575								
Total		404,643	948,470	1,353,113								

C. 7. Puerto Santo Tomás de Castilla Import Statistics (Metric Tons), 1993 - 2002

Type	Hazardous	1993	1994	1995	1996	1997	1,998	1999	2000	2001	2002
ABONOS	No	5,711	5,510	9,902	7,923	11,265	94,318	118,988	88,240	16,817	15,504
ACEITES,GRASA VEGETAL Y ANIMAL	No	50,136	46,672	60,542	50,133	49,701	60,825	63,818	75,258	73,354	75,104
AJONJOLI	No	3,544	1,143		693			1,619	3,676	33	0
ALGODON INCLUYE BORRA	No	17,807	22,186	26,959	23,273	41,104	64,372	14,143	27,785	19,120	18,153
ARCILLA *	No	2,911	3,183	1,144	4,161	1,252	1,636	2,436	4,505	3,437	4,346
ARENA QUIMICA	No	183	119	92	40	42	20	81	146	110	331
ARROZ	No	15,780	11,352	10,962	14,997	4,260	4,327	9,451	6,170	5,245	6,380
ASBESTOS	No	250	1,342	818	4	380		858	221	163	0
ASFALTO	No	8,799	3,744	4,597	4,470	1,049	281	9,327	4,406	13,035	4,283
AUTOBUSES	No		1,321	1,510	1,565	1,727	1,277	913	859	915	914
AVENA	No	186	49			104	1,306	996		236	159
AZUCAR Y DERIVADOS	No	145	77	36	30	160	21	192	72	60	40
BANANOS	No	1,255	107		396		118		147	0	0
BARRO, LOZA, PORCELANA Y VIDRIO	No	19,003	17,558	13,835	12,404	14,150	13,763	19,147	19,919	24,101	22,341
BEBIDAS ALCOHOLICAS O ARTIF.	No	5,767	5,465	5,268	4,951	5,223	5,397	8,262	6,775	8,872	7,511
BUNKER	Yes								25,197	28,750	53,022
BICICLETAS	No						11	45	102	178	183
CACAO	No		15	21	14		24	28	21	10	16
CAFE EN GRANO	No	20		3			20	183	20	535	73
CAMARONES, LANGOSTAS	No	29	228	232	71	67	90	71	102	1,042	62
CAMIONES	No		2,733	4,131	1,887	2,920	5,489	2,674	2,833	5,479	2,596
CAÑA DE IZOTE	No	16								140	0
CAOLIN	No	100	76		113	487	394	121		20	102
CARBON	No	1,164	1,711	328	477	1,337	73,609	53,894	145,023	32,243	144,138
CARDAMOMO	No					11					30
CARNES	No	3,451	796	1,152	588	1,081	1,723	3,710	1,604	1,568	1,294
CEMENTO, CAL, YESO	No	2,869	6,484	4,720	2,503	1,341	1,744	909	1,144	1,712	2,334
CERAMICA	No	6,062	13,355	15,935	11,098	23,249	39,006	23,714	36,076	45,137	56,640
CHASISES PARA CONT. Y FURG.	No		1,741	709	387	1,322	305	383	477	685	868

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CINCHONA (QUINA)	No				21						
CONCRETO Y OTROS	No	2,488	2,454	1,161	1,856	1,349	8,677	5,676	246	140	258
DESPERDICIO DE PAPEL	No				362	2,853	4,956	9,942	9,529	11,112	18,397
DIESEL Y OTROS ACEITES COMBUST.	Yes	196,623	220,551	220,230	192,658	169,810	249,074	196,925	178,674	185,352	162,527
ELECTRONICOS PARA MAQUILA	No					41	30			1,043	1,486
ESPECIES	No	1,333	217	362	627	536	351	501	863	448	1,324
FIBRAS SINTETICAS, TEXTILES	No	3,242	6,366	5,268	8,626	5,078	6,376	6,384	6,427	3,653	3,294
FIBRAS Y RESINAS SINTETICAS	No	6,065									
FRIJOL EN GRANOS	No	8,030	974	1,702	390	1,623	4,533	4,035	3,626	4,242	6,445
FRUTAS	No	2,008	565	2,306	920	172	83	423	93	312	317
GAS BUTANO	Yes	1,351		829	2,121		17,459	9,359			232
GAS NATURAL	Yes										
GAS PROPANO	Yes	17,821	30,625	54,588	80,171	54,662	46,798	57,846	45,220	64,661	96,037
GASOLINA	Yes	159,271	184,985	230,316	211,973	248,292	256,322	286,653	227,585	307,232	269,985
GOMA DE MASCAR	No	536	1,027	837	477	767	730	612	1,379	507	465
GRANOS BASICOS	No		247	340			0	0	3	0	0
HARINA	No	5,039	2,759	2,483	915	1,587	2,496	3,651	3,699	484	2,432
HENEQUEN	No	300					0	0	0	161	46
HORTALIZAS	No	89	109	40	153	394	93	725	277	92	595
HULE NATURAL SIN PROCESO	No	163	258	372	137	19	21	17	81	847	283
KEROSSENE	Yes	26,071	28,839	12,272	6,626	5,721	5,486	3,927	4,600	3,488	2,455
JUEGOS MECANICOS	No									699	67
LANCHAS Y MOTOS ACUATICAS	No				2	52	18	63	44	63	64
LECHE	No	16,723	18,314	17,055	15,779	17,180	15,510	8,264	6,798	9,948	29,184
LIMON SECO	No				0		0	16	0	0	0
MADERA ASERRADA	No	733	1,103	285	260	640	2,660	5,921	6,889	15,757	11,449
MAIZ	No	22,149	26,965	14,633	10,969	7,935	3,885	16,861	13,379	13,859	10,622
MALTA	No	2,470	7,749	9,371	8,030	5,384	7,028	264	17	92	44
MAQUINARIA Y EQUIPO	No	25,568	24,105	19,634	15,686	27,287	30,964	20,564	15,096	18,851	19,670
MARMOL	No					254	96	84	233	482	589
MATERIAL DE TRANSPORTE	No	643	744	172	219	233	206	500	313	252	624
MELON	No	22		13			60	19	0	0	0

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
MENAJE DE CASA EFEC.PERSONALES	No	2,320	2,306	2,166	2,825	3,243	2,449	2,393	1,621	2,490	3,229
MIEL DE ABEJA	No		86	7			0	0	0	0	84
MINERALES METALICOS	No	688	19				84	141	1,186	63	0
MOTOCICLETAS	No					17	180	108	153	337	669
MUEBLES DE MADERA	No	350	391	562	409	1,270	1,749	3,176	2,657	3,625	4,950
NEUMATICOS	No				1,792	11,254	12,666	10,369	11,614	12,336	13,827
NIQUEL	No	1				4					46
NUEZ	No	2	2	12		20					42
OTRAS INDUSTRIAS	No	56,648	62,696	53,861	36,887	43,918	62,740	40,214	37,229	31,707	21,645
OTRAS SEMILLAS	No	705	436	217	1,327	291	1,799	835	1,243	786	476
OTROS ALIMENTOS	No	20,615	21,935	20,063	27,414	36,888	42,626	55,863	61,751	81,352	100,519
OTROS ANIMALES VIVOS	No		46								
OTROS DESTILADOS DEL PETROLEO	Yes	45,744	39,252	36,583	34,404	73,027	68,946	85,677	78,398	46,259	35,641
OTROS MINERALES	No	19	137	136	130	23	201	415	5,666	251	232
OTROS PRODUCTOS AGRICOLAS	No	226	146	269			9	34	26	0	10
OTROS PRODUCTOS METALICOS	No	38,642	36,015	34,578	38,152	50,965	45,291	41,048	41,779	43,613	49,723
OTROS PRODUCTOS PARA MAQUILA	No	66				24	51	35	33	19	3,496
OTROS PRODUCTOS QUIMICOS	Yes	117,394	146,045	120,307	119,276	144,978	155,620	178,243	198,722	298,487	237,276
PALETAS VACIAS	No				2,838	3,133	2,516		25	0	0
PAPEL, PROD. DE PAPEL, IMPRESOS	No	167,720	167,660	154,207	132,556	141,136	165,114	188,420	179,540	175,396	188,738
PESCADOS, OTRAS, ALMEJAS	No	186		115	47	48		14	110	114	72
PETROLEO CRUDO	Yes	52	36	50	17	16				777	0
PIEDRAS POMEZ	No	18				0	0		19	27	45
PIEZAS DE CORREO	No	108	132	81	95	187	80	54	66	36	70
PLAGUICIDAS	Si	7,838	7,220	10,061	10,340	10,832	12,154	10,975	11,504	13,680	11,507
PLATANOS	No						0	0	0	21	0
PLAYWOOD	No				0	406	1,114	673	650	463	1,822
POLLO CONGELADO	No	9,148	9,152	8,014	2,118	4,118	4,689	4,559	4,090	6,031	10,152
PROD. DE ASBESTOS Y FIBROCEMENTO	No		1	1,750	400	215	961	738	1,851	4,030	5,671
PROD. DE MADERA EXCEPTO MUEBLE	No	5,830	8,296	6,162	6,293	2,204	3,290	1,190	5,496	2,355	4,411
PROD. ELECTRICOS Y ELECTRONICOS	No	17,257	23,319	26,045	26,395	28,246	46,331	31,846	33,130	35,065	42,083
PROD. FARMACEUTICOS, MEDICAMENTO	No	1,847	15,002	2,282	2,089	3,198	2,995	1,521	2,641	4,123	4,207

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PROD. METALICOS ESTRUCTURALES	No	6,265	3,720	5,256	4,474	4,195	5,247	4,366	11,725	3,442	1,283
PROD. Y EQUIPO DE OFICINA	No				411	1,394	1,680	2,292	1,814	2,035	1,490
PROD. Y MATERIAL REFRACTORIO	No				66	3,143	2,568	893	1,483	2,766	1,143
PRODUCTOS DE CAUCHO	No	11,825	11,566	13,542	13,129	6,744	6,623	5,786	5,037	4,298	3,722
PRODUCTOS DE MARMOL	No					134	187	87	89	5	0
PRODUCTOS DE PESCA - SIN PROCESO	No						0	0	0	0	6
PRODUCTOS DE SILVICULTURA	No	32	281	174	261	381	309	379	1,432	2,975	2,099
PRODUCTOS DE TABACO	No	9	154	28	106	33	459	457	109	558	697
PRODUCTOS METALICOS BASICOS	No	39,893	41,906	66,803	53,729	63,160	136,495	84,162	26,057	14,092	17,871
PRODUCTOS PLASTICOS	No	8,260	15,847	14,048	12,418	13,990	14,924	20,583	20,198	26,884	32,940
PULPA DE MADERA	No	8,730	3,684	6,352	4,141	9,434	6,718	6,184	6,198	5,326	6,165
RASTRA VACIA	No								7	23	0
REPUESTOS P/MAT. DE TRANSPORTE	No	61	187	259	155	207	207	179	154	161	609
REPUESTOS PARA MAQUINARIA	No	7,306	6,341	9,404	9,828	16,516	16,734	10,995	8,331	9,349	11,523
REPUESTOS PARA VEHICULOS	No	5,152	5,942	4,825	7,580	7,399	7,025	3,686	4,731	3,665	10,123
RESINA SINTETICA	No	90,157	96,360	73,295	82,292	92,948	78,994	91,306	70,855	83,970	102,533
SEBO INDUSTRIAL	No	4,782	2,793	11,577	7,040	14,131	32,892	47,287	28,455	16,939	27,033
SEMILLA DE ALGODON	No	21	316	278		256	3		114	72	0
SOYA	No	2,365	2,222	4,529	4,979	6,996	3,145	4,374	839	548	4,488
ST. QUIMICOS INDUSTRIALES BASICAS	Yes	479	3,976	7,364	8,575	5,872	5,610	7,429	3,160	3,034	2,007
TABACO EN BRUTO	No	4	65	89	370	196	412	87	283	122	147
TANQUES VACIOS	No	33	462	465	535	263	1,040	425	352	145	402
TE DE LIMON Y OTROS	No	3	1			4		42	25	137	22
TEXTILES PARA MAQUILA	No	16,780	31,053	41,359	49,708	74,659	88,875	106,717	145,020	146,540	132,966
TEXTILES,PRENDAS VESTIR,CUERO	No	40,069	32,918	35,463	43,357	42,160	37,534	45,714	53,893	64,920	111,744
TRIGO	No	6,444	5,355	687		4,735	3,456	562	11,541	659	183
VEHICULOS AUTOMOTORES	No	12,593	9,283	10,574	8,906	8,357	10,081	9,357	17,103	17,367	18,003
YUTE EN RAMA	No	2,243	39	85	18	342	181	597	1,260	479	610
T O T A L E S		1,400,861	1,520,720	1,541,145	1,459,037	1,651,409	2,129,042	2,087,680	2,077,318	2,100,729	2,285,768
FUENTE DE INFORMACION: SECCION DE ESTADISTICA											

Source: Informe Estadistico, Empresa Portuaria Nacional Santo Tomás de Castilla

C. 8. Puerto Santo Tomás de Castilla Export Statistics (Metric Tons), 1993 - 2002

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
ABONOS	No					227	27	35	95	17	117
ACEITES,GRASA VEGETAL Y ANIMAL	No	573	764	438	626	564	2,308	1,338	1,827	2,286	415
AJONJOLI	No	31,932	25,818	27,643	24,223	22,871	20,301	15,502	15,659	13,254	18,138
ALGODON INCLUYE BORRA	No	564	637	170	69	306	166	96	310	243	140
ARCILLA *	No		2	298				70	35	2,253	181
ARCILLA, CONCRETO Y OTROS	No						0	16	0	0	0
ARENA	No		45							1,584	0
ARROZ	No						18				0
ASBESTOS	Yes								10		0
AUTOBUSES	No		1	9	83			15			10
AVENA	No					2,877	1,181	3,576	5,406		100
AZUCAR Y DERIVADOS	No	102	1,567	1,006	20	355,959	324,777	153,707	239,636	5,497	5,835
BANANOS	No	230,494	275,038	284,051	326,272	15,697	18,949	23,413	14,574	213,915	238,756
BARRO, LOZA, PORCELANA Y VIDRIO	No	10,475	11,797	5,685	15,589	1,016	831	2,014	3,870	17,316	24,291
BEBIDAS ALCOHOLICAS O ARTIF.	No	801	575	568	1,257	57			5	6,012	12,660
BICICLETAS	No				12		41		20		0
CACAO	No	144	103	302		327,606	241,309	317,195	362,173		0
CAFE EN GRANO	No	237,944	204,191	223,905	275,252	5,469	6,411	6,256	4,300	264,504	233,370
CAMARONES, LANGOSTAS	No	8,338	7,610	6,273	10,266	27	101	76	83	7,020	8,811
CAMIONES	No		18	18	9	1,249	1,543	396	89		95
CAÑA DE IZOTE	No	1,578	312	780	1,348					138	422
CAOLIN	No				9			8	30		0
CARBON	No					15,407	12,756	12,083	12,987	0	0
CARDAMOMO	No	12,431	14,211	13,999	15,616	175	36	10	41	13,701	19,830
CARNES	No	8,843	5,936	3,494	314	31	249	130	15	133	97
CEMENTO, CAL, YESO	No	367	556	567	41	374	18	56	90		23
CERAMICA	No		10	193	378			455		553	663
CHASISES PARA CONT. Y FURG.	No		49	3	17	2,195	373	315	402	96	74
CINCHONA QUINA	No	494	517	517	459		1			335	442
CONCRETO Y OTROS	No	259	88	39	56	6,428	5,688	4,918	9,708	55	35
DESPERDICIO DE PAPEL	No				627					10,253	12,853
DIESEL Y OTROS ACEITES COMBUST.	Yes	0						0	0	0	0

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
ESPECIES	No	305	563	850	1,165	1,101	918	79	99	958	2,056
FIBRAS SINTETICAS, TEXTILES	No	71	294	268	403	347	101			2,139	190
FIBRAS Y RESINAS SINTETICAS	No					186	135	159	288	0	0
FRIJOL EN GRANOS	No	84	136	816	106	7,258	12,409	10,162	11,885	468	19
FRUTAS	No	3,450	4,988	5,994	8,713	378	105	120	104	8,988	9,219
GOMA DE MASCAR	No	1,033	1,310	1,221	356		97	23		196	240
GRANOS BASICOS	No	84				66	11		31	23	0
HARINA	No	20			11	67,043	56,675	61,845	42,143	60	288
HORTALIZAS	No	64,085	71,116	65,053	63,923	6,737	2,615	1,954	2,710	38,427	52,566
HULE NATURAL SIN PROCESO	No	4,644	4,637	7,288	9,270				45	0	3,466
JUEGOS MECANICOS	No						144	21	154	104	120
LECHE	No	133	194	44	18				19	305	101
LANCHAS Y MOTOS ACUATICAS	No					393	442	1,362	1,291	0	0
LIMON SECO	No	369	374	707	370	7,059	5,019	4,915	7,140	10,087	911
MADERA ASERRADA	No	4,205	6,005	8,938	8,315	227	549	22	506	7,524	4,189
MAIZ	No	2				49	49			733	573
MALTA	No			18		1,633	1,784	1,215	1,669	0	13
MAQUINARIA Y EQUIPO	No	2,714	3,086	990	553	5,878	5,186	3,759	3,466	1,072	902
MARMOL	No	1,159	938	2,727	5,713	2	21	50	54	2,143	2,818
MATERIAL DE TRANSPORTE	No	175	31	173	21	60,538	48,416	66,957	85,702	23	55
MELON	No	55,845	61,718	53,821	51,681	1,198	967	1,641	1,591	71,217	113,011
MENAJE DE CASA EFEC. PERSONALES	No	738	869	887	914	2,895	3,801	2,527	2,005	1,720	1,357
MIEL DE ABEJAS	No	3,268	3,501	3,242	3,488	127	19	477		3,112	2,362
MINERALES METALICOS	No			293	138	3	4	0	3	282	0
MOTOCICLETAS	No				1	2,441	1,638	1,743	1,498	10	2
MUEBLES DE MADERA	No	730	1,367	1,922	2,413	1,085	862	817	731	1,614	1,579
NEUMATICOS	No				33	621	453	471	582	170	117
NUEZ	No	481	386	359	477	1,622	952	4,159	3,534	601	508
OTRAS INDUSTRIAS	No	797	839	508	831	155	262	770	171	1,474	1,384
OTRAS SEMILLAS	No	476	193	58	13	9,965	14,095	12,919	17,459	810	204
OTROS ALIMENTOS	No	6,231	7,223	7,916	8,443	226	1,772	10,090	10,019	20,467	36,178
OTROS DESTILADOS DEL PETROLEO	Yes	178	32,635	653	265	795	272	843	55	35,692	4,148
OTROS MINERALES	No		37	149		10	40	115	0	218	0
OTROS PRODUCTOS AGRICOLAS	No	16	16			3,386	5,775	6,219	15,244	0	0

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
OTROS PRODUCTOS METALICOS	No	2,662	2,006	2,258	2,241		2	0	0	7,429	10,765
OTROS PRODUCTOS PARA MAQUILA	No					12,709	14,240	13,799	20,189	629	88
OTROS PRODUCTOS QUIMICOS	Yes	3,963	6,555	5,836	12,029	139	553	27	150	16,034	27,216
PALETAS VACIA S	No				15	3,224	3,506	3,715	4,120	0	0
PAPEL, PROD. DE PAPEL, IMPRESOS	No	4,966	6,773	5,779	6,878		709	43	184	7,620	4,997
PESCADOS, OSTRAS, ALMEJAS	No			43		987,734	1,271,760	1,155,482	1,057,760	55	140
PETROLEO CRUDO	Yes	346,575	254,967	447,581	730,372	177	291	143		1,030,909	1,298,311
PIEDRA POMEZ	No	21		42	121	5,413	6,762	7,092	6,281	0	0
PLAGUICIDAS	Yes	2,198	3,440	4,224	5,959	170	2,177	1,668	2,953	8,101	6,371
PLATANOS	No	11	4	37	98	240	238	144	190	4,693	10,554
PLAYWOOD	No				93		20	40	20	0	24
POLLO CONGELADO	No		37			624	1,267	662	938	411	172
PROD. DE ASBESTOS Y FIBROCEMENTO	No	23		229	718	2,111	3,527	4,400	5,493	3,173	1,912
PROD.ASBESTO Y FIBROCEMENTO	No					1,220	2,286	2,325	2,766	1,659	0
PROD. DE MADERA EXCEPTO MUEBLE	No	3,237	3,217	2,510	2,468	3,124	3,099	2,054	1,882	0	5,135
PROD. ELECTRICOS Y ELECTRONICOS	No	250	396	337	659	189	59	654	99	2,777	5,782
PROD. FARMACEUTICOS, MEDICAMENTO	No	243	365	805	1,640			52	73	1,284	1,144
PROD. METALICOS ESTRUCTURALES	No	20				52	5	23	19	47	1,865
PROD. Y MATERIAL REFRACTORIO	No					2,583	2,967	2,186	1,532	325	0
PROD. Y EQUIPO DE OFICINA	No				22	501	18	104	720	56	10
PRODUCTOS DE CAUCHO	No	1,881	3,504	4,157	3,425			4	16	1,949	1,391
PRODUCTOS DE MARMOL	No	1				15,889	16,488	18,691	20,150	2,298	0
PRODUCT OS DE PESCA- SIN PROCESO	No					273	5,582	6,190	2,747	3,278	0
PRODUCTOS DE SILVICULTURA	No	12,436	10,510	12,160	15,028	3,195	4,396	3,673	3,607	19,893	19,142
PRODUCTOS DE TABACO	No	183	402		14	4,807	5,560	4,939	6,133	4,176	9,661
PRODUCTOS METALICOS BASICOS	No		26	478	3,524		313	657		1,814	3,626
PRODUCTOS PLASTICOS	No	3,391	4,255	3,661	4,777	6				6,585	9,413
PULPA DE MADERA	No					2	59	19	23	0	0
RASTRA VACIA	No					271	664	685	998	0	0
REPUESTO P/MAT. DE TRANSPORTE	No	26	0	56	6	67	266	265	183	95	26
REPUESTOS PARA MAQUINARIA	No	159	234	292	236	234	541	325	690	2,322	453
REPUESTOS PARA VEHICULOS	No					2,608	4,269	6,073	3,024	141	411
RESINA SINTETICA	No	168	269	435	366	44		23	15	713	1,970
SANDIA	No				930					4,128	4,867

Type	Hazardous	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
SEMILLA DE ALGODON	No					142	575	187	564	23	3
SOYA	No			22		7,997	2,507	1,903	5,039	279	0
ST. QUIMICOS INDUSTRIALES BASICOS	Yes			19	83	27	46	60	97	324	802
TABACO EN BRUTO	No	13,880	7,864	3,247	6,702	232	131	100	46	1,915	1,704
TANQUES VACIOS	No	12	138	36	159	52	48		140	1,267	1,330
TE DE LIMON Y OTROS	No	261	172	109	121	125,708	150,055	190,781	240,783	277	25
TEXTILES PARA MAQUILA	No	947	493	845	1,200	161	301	186	182		37
TEXTILES,PRENDAS VESTIR,CUERO	No	34,841	60,299	64,072	86,684	62				237,544	268,659
TRIGO	No						0	0	0	0	4
VEHICULOS AUTOMOTORES	No	247	234	665	168					344	227
YUTE EN RAMA	No			16						19	19
T O T A L E S		1,129,234	1,118,465	1,294,803	1,726,912	2,123,948	2,307,959	2,166,492	2,271,365	2,144,384	2,514,193
FUENTE DE INFORMACION: SECCION DE ESTADISTICA											

Source: Informe Estadistico, Empresa Portuaria Nacional Santo Tomás de Castilla

C. 9. Puerto Barrios Import/Export Statistics (metric tons), 2002

Imports		
Type	**Hazardous**	**2,002**
Granel Liquido		
Unknown	Yes	171,646
Granel Solido		
Fertilizante a granel	No	45,806
Fertilizante en sacos	No	4,674
Mercado General		
Hierro	No	150,907
Vehiculos	No	1,334
Madera	No	14,005
Azúcar	No	7,847
Otros	No	8,423
Total Imports		**404,643**
Exports		
Type	**Hazardous**	**2,002**
Contenedor		
Banano	No	602,567
Otro	No	256,137
Mercado General		
Banano Granel	No	12,325
Banano Palet.	No	0
Melon	No	65,963
Fertilizantes Sacos	No	7,823
Otros	No	3,656
Total Exports		948,469.83

Source: Puerto Barrios

C. 10. Puerto Cortés Import/Export Statistics Summary (metric tons), 1992 - 2001

						Imports						
Cargo	**Sub-type**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	
Hazardous		645,526	717,058	809,735	1,064,189	960,982	989,809	1,161,342	1,134,186	1,069,565	1,140,447	
	Petroleum	596,147	667,143	736,580	1,011,517	840,480	920,301	1,077,016	1,055,502	995,912	1,065,834	
	Non-Petroleum	49,379	49,915	73,155	52,672	120,502	69,508	84,326	78,684	73,653	74,613	
Non-Hazardous		625,182	910,977	971,964	956,372	1,013,190	1,307,168	1,407,947	1,573,894	1,587,735	2,059,346	
	Banana	0	1	2	3	4	5	6	7	8	9	
	Non-Banana	625,182	910,976	971,962	956,369	1,013,186	1,307,163	1,407,941	1,573,887	1,587,727	2,059,337	
Total		1,270,708	1,628,035	1,781,699	2,020,561	1,974,172	2,296,977	2,569,289	2,708,080	2,657,300	3,199,793	
						Exports						
Cargo	**Sub-type**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	
Hazardous		0	0	482	2,320	0	0	758	0	0	0	
	Petroleum	0	0	482	2,320	0	0	758	0	0	0	
	Non-Petroleum	0	0	0	0	0	0	0	0	0	0	
Non-Hazardous		1,279,193	1,316,242	1,207,380	1,382,450	1,505,190	1,684,893	1,751,410	1,485,025	1,933,288	1,963,348	
	Banana	541,640	538,586	309,837	429,936	508,611	446,515	382,760	109,707	289,484	355,864	
	Non-Banana	737,553	777,656	897,543	952,514	996,579	1,238,378	1,368,650	1,375,318	1,643,804	1,607,484	
Total		1,279,193	1,316,242	1,207,862	1,384,770	1,505,190	1,684,893	1,752,168	1,485,025	1,933,288	1,963,348	
						Import and Exports						
Cargo	**Sub-type**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	% growth
Hazardous		645,526	717,058	810,217	1,066,509	960,982	989,809	1,162,100	1,134,186	1,069,565	1,140,447	5.9%
	Petroleum	596,147	667,143	737,062	1,013,837	840,480	920,301	1,077,774	1,055,502	995,912	1,065,834	6.0%
	Non-Petroleum	49,379	49,915	73,155	52,672	120,502	69,508	84,326	78,684	73,653	74,613	4.2%
Non-Hazardous		1,904,375	2,227,219	2,179,344	2,338,822	2,518,380	2,992,061	3,159,357	3,058,919	3,521,023	4,022,694	7.8%
	Banana	541,640	538,587	309,839	429,939	508,615	446,520	382,766	109,714	289,492	355,873	-4.1%
	Non-Banana	1,362,735	1,688,632	1,869,505	1,908,883	2,009,765	2,545,541	2,776,591	2,949,205	3,231,531	3,666,821	10.4%
Total		2,549,901	2,944,277	2,989,561	3,405,331	3,479,362	3,981,870	4,321,457	4,193,105	4,590,588	5,163,141	7.3%

Source: Empresa Nacional Portuaria

C. 11. Puerto Cortés Import/Export Statistics (metric tons), 1992 - 2001

IMPORTACION	Hazardous	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TRIGO	No	106,542	228,168	233,374	136,908	120,013	165,394	152,722	214,473	168,280	199,379
OTROS PRODUCTOS ALIMETICOS	No	103,028	101,950	151,128	211,324	182,962	286,276	272,592	267,329	414,634	544,049
BEBIDAS Y TABACO	No	1,862	2,349	2,044	1,670	2,554	4,165	1,909	4,092	2,374	7,462
PRODUCT OS QUIMICOS	Yes	49,379	49,915	73,155	52,672	120,502	69,508	84,326	78,684	73,653	74,613
CARBON MINERAL	No									111,968	123,172
GRASA DE ORIGEN ANIM/VEG.	No	9,238	5,416	3,804	19,279	14,031	10,724	22,017	29,626	21,039	14,459
FERTILIZANTES	No	88,833	173,418	177,989	152,323	212,690	238,361	239,158	243,097	212,128	196,417
DERIVADOS DE PETROLEO	Yes	596,147	667,143	736,580	1,011,517	840,480	920,301	1,077,016	1,055,502	995,912	1,065,834
HIERRO Y ACERO	No	53,248	74,668	61,677	50,277	44,303	48,365	85,106	75,172	62,066	88,720
MAQUINARIA Y EQUIPO/TRANS.	No	21,776	29,323	25,529	23,954	22,171	36,988	53,186	45,765	46,223	40,211
PAPEL Y CARTON EN BOBINAS	No	17,042	19,657	18,357	28,356	32,444	34,822	41,692	53,487	40,735	45,574
OTROS	No	223,613	276,027	298,060	332,278	382,018	482,068	539,559	640,846	508,280	799,894
TRANSITO											
NACIONAL		204,181	263,095	308,346	363,834	396,968	489,435	536,421	549,912	576,192	280,487
EXTRANJERO		55,231	79,172	130,825	116,179	116,388	206,360	233,215	234,073	231,464	218,322
TOTAL IMPORTACION		1,530,120	1,970,301	2,220,868	2,500,571	2,487,524	2,992,767	3,338,919	3,492,058	3,464,948	3,698,593
EXPORTACION											
CARNE	No	17,147	16,729	16,206	6,646	5,096	4,735	702	616	430	489
PLANTANOS	No	13,370	8,516	2,526	2,108	667	1,055	1,194	3,777	392	751
BANANOS	No	529,378	527,293	303,532	415,244	491,528	428,291	366,574	101,841	284,805	350,916
PURE DE BANANOS	No	12,262	11,293	6,305	14,692	17,083	18,224	16,186	7,866	4,679	4,948
CAFÉ	No	106,822	91,223	91,991	102,749	116,254	98,509	134,302	112,796	156,947	131,085
AZUCAR	No	12,820	11,504	11,461	13,292	19,363	24,275	18,121	10,399	6,669	88,208
TABACO	No	4,009	5,563	3,402	2,735	3,830	4,721	4,810	4,557	5,342	4,964
MADERA	No	81,472	103,771	87,961	74,579	74,073	90,660	77,115	103,645	88,966	95,172
CEMENTO	No	29,167							574	5,831	12,495
MAIZ	No										
MINERALES	No	72,325	52,460	52,802	66,488	64,954	106,636	91,902	82,801	92,817	57,337
COMBUST. Y DERIV/PETROL.	Yes			482	2,320			758			
MELAZA	No	23,546	17,209	21,201	11,901	10,350	31,098	26,182	37,339	65,559	46,035
ACEITE DE PALMA AFRICANA	No	2,038		6,048	2,585	1,000	3,064	15,716	11,173	11,571	
PINAS	No	7,863	2,937	3,687	6,422	6,552	7,185	15,896	26,406	14,275	7,958
COCOS	No	492	7		133	225	210	367	396	99	3

IMPORTACION	Hazardous	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TORONJAS	No	1,121	1,610	55	749	1,576	2,161	109	7,619	1,391	10,470
MELONES	No	57,691	68,958	75,272	77,265	69,079	105,536	98,088	101,632	99,443	109,080
OTRA FRUTAS	No	4,816	7,260	6,722	11,786	13,674	6,701	9,783	10,957	13,031	8,441
OTROS	No	278,167	322,612	390,298	435,455	480,008	580,469	683,724	708,135	810,617	805,944
MERCADEIRA DE OTROS PAISES	No	24,687	67,297	127,911	137,621	129,878	171,363	190,639	152,496	270,424	229,052
TOTAL EXPORTACION		1,279,193	1,316,242	1,207,862	1,384,770	1,505,190	1,684,893	1,752,168	1,485,025	1,933,288	1,963,348
TOTAL EXPORTACION+IMPORTACION		2,809,313	3,286,543	3,428,730	3,885,341	3,992,714	4,677,660	5,091,087	4,977,083	5,398,236	5,661,941

Source: Empresa Nacional Portuaria

C. 12. Puerto Cortés Ship Calls, 1992 - 2001

TIPO DE FUNCION	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CARGUERO CONVENCIONAL	119	106	135	128	113	110	199	228	166	197
CONVENCIONAL REFRIGERADO	148	114	69	58	82	97	71	84	54	88
MADERERO	19	26	19	13	12	49	27	66	34	35
GRANELERO SOLIDO	43	63	60	70	65	85	73	84	90	98
GRANELERO LIQUIDO	84	97	100	121	114	131	143	199	140	118
PORTACONTENDEOR	499	565	603	721	615	660	731	789	838	750
PORTAFURGONES	275	315	252	292	306	366	398	454	447	440
LASTRE	28	25	12	7	9	17	22	34	12	46
PASAJE	9	31	41	42	9	43	30	13	9	14
Total	1,224	1,342	1,291	1,452	1,325	1,558	1,694	1,951	1,790	1,786

Source: Empresa Nacional Portuaria

C. 13. Port-Related Enterprises located in the ZOLIC at Puerto Santo Tomás de Castillo

PERENCO

This company exports Guatemala's crude oil (at the end of the year 2002, PERENCO purchased **Basic Resources**, which is responsible for crude oil exploration). The port's terminal has 5 tanks (4 with a capacity of 55,000 barrels, and 1 with 35,000 barrel capacity) and an underground network/conduction area of 12" x 8". There are approximately 350 km. from the crude's intake to the storage exporting tanks located in the port. This oil pipeline crosses the Río Dulce via underground and has an average loading movement of 5,300 barrels/hour.

REFINERIA GUATEMALTECA

This company imports oil and other refined products, such as diesel, gasoline and kerosene. The facilities of Refinería Guatemalteca include:

- 2 tanks of 100,000 gallons each for the reception of diesel
- 1 tank of 100,000 gallons for the reception of super gasoline
- 2 tanks of 26,000 gallons each for the reception of regular gasoline
- 2 tanks of 10,000 gallons each for the reception of kerosene
- 2 tanks of 20,000 gallons each for the reception of any type of product in case of an emergency situation
- 1 tank of 30,000 gallons for the reception of any type of product in case of an emergency situation
- An oil pipeline of 14" with an average unloading movement of 4,000 barrels/hour

SHELL GUATEMALA S, A. - ASPHALTS AND LUBRICANTS

- 2 asphalt tanks each with a capacity of 14,852 barrels
- 1 asphalt tank with a capacity of 7,714 barrels
- 1 asphalt tank with a capacity of 714 barrels
- 1 lubricant tank with a capacity of 7,750 barrels
- 1 lubricant tank with a capacity of 3,172 barrels
- 1 lubricant tank with a capacity of 1,392 barrels
- An oil pipeline of 8" for asphalt with a loading movement of 1,200 barrels/hour
- An oil pipeline of 6" for lubricants with a loading movement of 800 barrels/hour

GAS DEL PACIFICO, S. A. PROPANE GAS

- 14 tanks each with a capacity of 66,045 gallons
- 27 tanks each with a capacity of 30,000 gallons

- An oil pipeline of 6” with an average discharge of 85 tons/hour
-

INCOSIDA/AGISA: Handles animal feeds

- 1 tank with a capacity of 131,739 gallons
- 1 tank with a capacity of 152,961 gallons
- An oil pipeline of 4” with an average discharge of 60 tons/hour

MOJA LA LUZ : Handles vegetable oils and feeds

- 1 tank with a capacity of 82,000 gallons
- 2 tanks with a capacity of 43,000 gallons each
- 1 tank with a capacity of 65,000 gallons
- 1 tank with a capacity of 104,000 gallons
- 1 tank with a capacity of 209,000 gallons
- 2 tanks with a capacity of 158,000 gallons each
- 2 oil pipelines of 4” (one of them is not operational) with an average discharge of 65 tons/hour

OLMECA VALDES GRASAS: Handles vegetable oils and feeds

- 3 tanks with a capacity of 64,000 gallons each
- 3 tanks with a capacity of 137,000 gallons each
- 1 tank with a capacity of 25,000 gallons
- 1 tank with a capacity of 143,000 gallons
- 1 tank with a capacity of 295,000 gallons
- 1 tank with a capacity of 211,000 gallons
- 2 conducting lines of 4” with an average discharge of 65 tons/hour per line

ENTERPRISES INSTALLED IN THE FREE ZONE

As mentioned above, 39 enterprises are currently operating in ZOLIC. The following companies are the most significant, considering their size and potential environmental risks due to the types of product:

CENTRO QUÍMICO – Distributes twelve different types of products

- 6 tanks with a capacity of 16,000 gallons each
- 12 tanks with a capacity of 34,000 gallons each
- 5 tanks with a capacity of 26,000 gallons each
- 2 tanks with a capacity of 40,500 gallons each
- 1 tank with a capacity of 31,500 gallons
- 2 tanks with a capacity of 78,108 gallons each
- 1 tank with a capacity of 138,700 gallons
- 1 tank with a capacity of 126,500 gallons
- 1 tank with a capacity of 125,000 gallons
- 1 tank with a capacity of 260,000 gallons
- An oil pipeline of 6” with a loading movement of 95 tons/hour
- 3 oil pipelines of 4” with a loading movement of 60 tons/hour

ELECTRO QUÍMICAS DE GUATEMALA – Caustic soda

- 1 tank with a capacity of 232,500 gallons
- 1 tank with a capacity of 235,000 gallons
- An oil pipeline of 6” with a loading movement of 95 tons/hour
- An oil pipeline of 4” not in use

PROQUISA – Oils and feeds

- 5 tanks with a capacity of 80,500 gallons each
- 2 tanks with a capacity of 90,000 gallons each
- 1 tank with a capacity of 66,000 gallons
- 1 tank with a capacity of 59,000 gallons
- 1 tank with a capacity of 81,000 gallons
- 1 tank with a capacity of 130,000 gallons
- 1 tank with a capacity of 94,000 gallons

- 2 tanks with a capacity of 298,000 gallons each
- An oil pipeline of 6”, with an average discharge of 110 tons/hour

ISTANSA - Chemicals

- 1 tank with a capacity of 52,300 gallons
- 2 tanks with a capacity of 52,800 gallons each
- 1 tank with a capacity of 53,000 gallons
- 1 tank with a capacity of 160,000 gallons
- 1 tank with a capacity of 135,500 gallons
- An oil pipeline of 4” with an average discharge of 50 tons/hour
-

ESSO STANDARD OIL – Orchex and lubricants

- 1 tank with a capacity of 427,000 gallons
- 1 tank with a capacity of 628,000 gallons
- 2 tanks with a capacity of 152,000 gallons each
- 2 oil pipelines of 8” with an average discharge of 100 tons/hour

TANQUESA –Vegetable oils

- 7 tanks with a capacity of 3,000 gallons each
- 3 tanks with a capacity of 153,000 gallons each
- An oil pipeline of 4” with an average discharge of 60 tons/hour

TRANSMERIDIAN –Chemicals

- 1 tank with a capacity of 90,000 gallons
- 4 tanks with a capacity of 48,000 gallons each
- 3 tanks with a capacity of 47,000 gallons each
- 3 tanks with a capacity of 20,000 gallons each
- 1 tank with a capacity of 103,000 gallons
- 1 tank with a capacity of 102,000 gallons

- 2 oil pipelines of 4” with an average discharge of 60 tons/hour

SHELL GUATEMALA, S.A. –Chemicals

- 3 tanks with a capacity of 136,000 gallons each
- An oil pipeline of 6” with an average discharge of 100 tons/hour