GEO Bahamas 2005

PNUMA

State of The Environment

The Bahamas State of the Environment Report

GEO Bahamas 2005

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Acknowledgements

This publication was developed with the help of the persons, representing government agencies and non-government organizations of The Bahamas. Their participation throughout the GEO process, and especially their willingness to share their expertise and provide some of the recommendations sited in Chapter 4, facilitated the production of this report. We are very grateful to:

Carol Albury, Dwight Allen, Margo Blackwell, John Bowleg, Brenda Bullard, Richard Cant, Sheila Cox, Michael Culmer, Jeffrey Deleveaux, Roger Demeritte, Kelsey Dorsett, Sam Duncombe, Tanya Ferguson, Crystal Francis, Khalile Francis, Lynn Gape, John Gibb, Prisca Gibbs, Alexandra Hall, John Hammerton, Linda Hammerton, Danielle Hanek, Jolyon Hugh, Maurice Isaacs, Margo Jarrett, Anita Knowles, David Knowles, Gary Knowles, Gilford Lloyd, Gordon Major, Juliet Mallet-Philips, Melonie McKenzie, Casuarina McKinney, Bertha McPhee, Earlston McPhee, Maurice Minnis, Claudine Minus, Eris Moncur, Boston Morley, Sharrah Moss, Stacey Moultrie, Henry Moxey, Fred Murray, Rochelle Newbold, Tiffany Newman, Eleanor Philips, Tamicka Rahming, Kenneth Richardson, Arthur Rolle, Jeffrey Simmons, Carl Smith, Carlton Smith, Stan Smith, Monique Sweeting, Beverly Taylor, Beverly Thacker, Lindsay Thompson, Dorica Walker, Launa Williams, Shena Williams, Brent Williamson, Cypreanna Winters and Koji Wright.

We also wish to acknowledge Eleanor Philips, Karra Reddy, Eric Rose, Derek Smith and The Bahamas Environment, Science and Technology Commission for contributing the photos included in this report.

Special thanks are extended to the lead authors and their technical support from The College of The Bahamas, whose names are listed below, as well as the Library's staff at the College.

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We also wish to express our sincerest thanks to our editing team and project coordinators:
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Sincere appreciation is also expressed to the technical experts of the United Nations Environment Programme, Kakuko Nagatani Yoshida and Morten Wasstol, for their support and guidance throughout this process.

Foreword

As Minister with responsibility for the Environment, it is an honour for me to launch The Bahamas' first State of the Environment Report. The Bahamas, like most Small Island Developing States (SIDS), depends greatly on the environment. Having a population of approximately 305,000 and millions of tourists visiting our shores annually, the Government realizes that protecting and managing the country's natural resources and safeguarding against social and environmental ills is critical and in our best interest.

This report brings focus to the current state and pressures on the natural resources of The Bahamas. Consultation with various stakeholders actively working in the environmental arena throughout The Bahamas determined the issues to be discussed in this report. The information and recommendations contained herein are useful to the nations' continued environmental assessment and policy review; and will undoubtedly provide a basis for the expansion of themes in future publications.

To this end, I must commend the Bahamas Environment, Science and Technology (BEST) Commission for their vision, researchers and consultants of the College of The Bahamas, along with various government and non-government agencies for their invaluable input in this process. Accordingly, I look forward to further collaborations and commitments to data gathering and analysis for future state of the environment reports.

Marcus C. Bethel, M.D.
Minister of Health

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Introduction

The Global Environment Outlook (GEO) Bahamas 2005 report represents the first of its kind for The Bahamas, which assesses the intrinsic and external aspects that characterize the socioeconomic and environmental nature of the country. As such, it seeks to provide an outlook that is important for local use and fulfillment of The Bahamas' international mandate. The production of this report has been made possible through the collaborative efforts of the Bahamas Environment, Science & Technology (BEST) Commission, researchers and consultants at The College of The Bahamas, along with various Government and Non-Government agencies

GEO Bahamas 2005 features four chapters that provide a clear overview of the current state of the environment in The Bahamas. The assessment provides data and other information that could benefit environmental, social and economic management, planning and decision making.

In the first chapter, various aspects of The Bahamas are captured in discussions on its geography, demography, lifestyles, infrastructure and economic sectors. One element echoed is that of the extraordinary beauty of the coastal features of The Bahamas, the most extensive archipelago in the Western hemisphere, coupled with the climate it enjoys, which provides the primary natural resources that fuel its major industry, tourism. This aspect, along with others are evaluated for the roles they play in shaping the environment in which Bahamians live and also for providing an accurate context for how the country should be perceived internationally.

The state of the environment in The Bahamas is elaborated upon in the second chapter, with a concentration on five specific thematic areas for this first exercise. Particular attention is given to the predominant feature of the Bahamian environment, the marine and coastal ecosystem. Discussions on the beaches, coral reefs and fishing industry help to express the significance of these resources. In addition, an account of land resources, waste management, fresh water resources, and the vulnerability to natural and technological hazards are similarly discussed.

The third chapter offers a policy response review of, existing and proposed environmental policies and legislation in The Bahamas. Particular emphasis is given to the provisions of the current legislation and strategies to manage and protect environmental issues, which may arise as a result of population growth, increased visitors and development pressures on the country's natural resources.

Finally, the fourth chapter provides specific recommendations from experts engaged in this process within The Bahamas, on each thematic area covered, to guide decision-makers as well as the general public in mitigating existing environmental threats. These recommendations are also offered to prevent or further minimize degradation of the Bahamian environment. Further, the information is provided to stimulate participation in the conservation and protection of the environment. No particular priority or suggestion of an appropriate managing authority is given.

The GEO Bahamas 2005 report hopes to bring about a greater local and international awareness of the state of the Bahamian environment. Additionally, the recommendations that are made in this report are offered with a view of bettering the quality and expectations of life desired by Bahamians and visitors to this archipelagic destination. It is hoped that with increased data collection and analysis, future GEO reports would allow for inclusion of discussions on scenarios, which essentially would determine the future projections of events that might arise, given present trends and conditions, whilst examining driving forces and the consequences of decisions made or not.

GEO

Socio-Economic Overview

Chapter 1

1.1 Introduction

Politically independent since 1973, The Commonwealth of The Bahamas has undergone considerable social, economic and infrastructural development in a relatively short period within the context of a rapidly changing world. This chapter constructs a demographic profile and socio-economic overview of The Bahamas, including population, health, employment and education statistics, as well as indices of human, economic, scientific and technical development. Highlighted are unique characteristics of The Bahamas (its archipelagic composition, its high ratio of sea to land mass, the primacy of tourism in the economy, and the demographics of its people and some of their culture) all of which provide an unavoidable context for the review, discussion and comparison of environmental pressures, status and outlook from local, regional and global perspectives.

1.2 Geography

Total territorial area of lands and waters of The Bahamas (latitude 20°.50'N and 27°.30'N and longitude 72°.35'W and 80°.30'W) is estimated at 259 000 km^2 (100 000 mi^2). Deep-water channels intersect the shallow banks of some of the islands providing active shipping lanes that for centuries have made The Bahamas an accessible destination for explorers and travellers. As such, The Bahamas is not an isolated area and therefore does not enjoy, or suffer from, much of the isolation common to some other island states. Its close proximity to North America and the Northern Caribbean, contributes considerably to its socio-economic development.

The Bahamas constitutes one of the most extensive archipelagos in the world comprising a chain of seven hundred islands and cays. This archipelagic feature (many islands separated by wide expanses of water) presents additional challenges in the public administration of the country, which would not be experienced by single, island states or landlocked small states.

The total land area of all of The Bahamas is 15 000 km^2 (5 792 mi^2). Andros Island, at 5 956 km^2 (2 300 mi^2), is the largest landmass in the archipelago while New Providence, the most densely populated island, is 207 km^2 (80 mi^2) (Department of Statistics, 2002). The islands are flat; consequently landslides are rare, limited in magnitude and aerial extent, and economically insignificant (University of the West Indies, 1999).

The Bahama Islands are low-lying; the highest point in the entire archipelago, at 62.8 m (206 ft), is found in Cat Island (Dupuch, 2005). In addition, the geographical makeup and location of The Bahama Islands makes them vulnerable to seasonal storms and hurricanes. Extensive damage to landscape, particularly shoreline erosion in addition to flooding and structural damage, is usually experienced, resulting in great economic and property losses.

Figure 1.1 Map depicting the major Islands

Source: Bahamas Environment, Science & Technology (BEST) Commission, 2005

In addition to its equitable climate, the most valuable and well known natural resources of The Bahamas are aspects of its environment, including its numerous white and pink sandy beaches; coral reefs; and clear, shallow and sheltered waters. These environmental treasures, along with a stable political economy, contribute to the popularity of The Bahamas as a favourite destination for world travelers including tourists, business travelers, researchers and other explorers.

The Bahamas is not well endowed with mineral resources. Its soils, in general, are sandy, stony and alkaline. There are no appreciable amounts of metallic ores or fossil fuels; however salt and aragonite have been exploited on a large scale (Sealey, 1994). Bahamian soils are poor in nutrients and require heavy fertilization. Nonetheless, there are areas in the Family Islands, such as Abaco, Cat Island, Eleuthera and Long Island, where some farming is done. Mechanized agriculture is restricted by the shallowness of the soil and the frequent outcrops of bare rock (Sealey, 1994).

1.3 Geology

There are several theories on the origin of The Bahamas; however, it is generally believed that The Bahamas was born a little less than 200 million years ago (Sealey, 1994). The Bahama Islands are the exposed portion of a platform that was built in shallow waters. Past geological investigations revealed that virtually all the rocks forming The Bahamas are various types of limestone (sedimentary rock mainly consisting of calcium carbonate that was deposited by the remains of marine animals and petrified corals).

Bahamian limestone, which is relatively young, is often porous. The pore spaces allow rain water to penetrate underground. As the rainwater moves downward through the rock, it erodes the rock, creating wider pores. Some of the enlarged pores are joined by channels, which look like holes (sinkholes) at the surface.

Over time, large sinkholes appear whenever smaller sinkholes join up; however, in general the holes only get very wide if the water table is very deep below the surface (Sealey, 1994). The largest of these sinkholes in The Bahamas are blue holes, which are holes flooded with water.[1]

All the main islands of The Bahamas have blue holes. Some blue holes demonstrate whirlpool conditions, as seen at the surface. This is due to the fact that these holes are connected to the sea and therefore influenced by the tides. Blue holes are found in other parts of the world, but tidal blue holes are unique to The Bahamas. Moreover, blue holes are most abundant in The Bahamas than anywhere else in the world. The abundance and uniqueness of the underwater world of Bahamian blue holes has enhanced the popularity of diving making it a distinctive experience in The Bahamas.

Some blue holes support life. Leaves and other vegetative matter that collect in blue holes provide food, which supports small fish and other creatures. Offshore blue holes do not provide much food, but they are used as shelters by various marine species.

1.4 Demography

1.4.1 Population: Characteristics, Distribution and Density

Population characteristics based on the 2000 Census indicate that in The Bahamas: life expectancy at birth is 69 years; the crude birth rate, and death rate per thousand is 18 and 5.3 respectively; infant mortality (live birth) per thousand is 16; under five mortality rate per thousand is 22.9 (International Monetary Fund Report, 2003). In addition, the 2000 Census data indicates that more than 50 per cent of the populace is below the age of - 25 years.

The total population of The Bahamas enumerated in the most recent Census year 2000 is 303 611. More than two-thirds of the population of The Bahamas lives in Nassau, the capital city, which is located on the island of New Providence (Table 1.1). The second largest city is Freeport, located on Grand Bahama Island with a population of 46 994. The populations of the other islands vary and are significantly smaller. Before Independence all islands in the archipelago other than New Providence were termed "Out Islands". After Independence the Out Islands were called "the Family Islands". However, recently, in tourism promotion campaigns they are again being called the Out Islands Table 1.1, shows the distribution, increase and decrease of the populations of the most significantly inhabited islands and island groups during the period 1963 to 2000.

Using Census 2000 data, population density is calculated at 22 per km^2 for all of The Bahamas including all Cays. The five most densely populated Islands of The Bahamas are New Providence 1 018 per km^2 (2 635 per mi^2); Harbour Island and Spanish Wells 94 per

[1] *Not all blue holes are formed from sinkholes; some are formed by the collapse of underground cavern roofs.*

Table 1.1 Population distribution for significantly inhabited Islands of The Bahamas

ISLAND	1963	1970	1980	1990	2000
Northwestern Region					
Abaco	6 490	6 501	7 271	10 061	13 170
Andros	7 461	8 845	8 307	8 155	7 686
Berry Islands	266	443	509	634	709
Biminis	1 658	1 503	1 411	1 638	1 717
Eleuthera, Harbour Island & Spanish Wells	9 093	9 468	10 631	10 524	11 165
Grand Bahama Island	8 230	25 859	33 102	41 035	46 994
New Providence	80 907	101 503	135 437	171 542	210 832
Sub-region total	**114 105**	**154 122**	**196 668**	**243 589**	**292 273**
Central Region					
Cat Island	3 131	2 657	2 215	1 678	1 647
Exumas	3 440	3 767	3 670	3 539	3 571
Long Island	4 176	3 861	3 404	3 107	2 992
Rum Cay & San Salvador	945	856	825	518	1 050
Sub-region total	**11 692**	**11 141**	**10 114**	**8 842**	**9 260**
Southeastern Region					
Acklins	1 217	936	618	405	428
Crooked Island (Long Cay included)	788	715	553	423	350
Inagua	1 846	1 009	924	985	969
Mayaguana	707	581	464	308	259
Ragged Island	371	208	164	89	72
Sub-region total	**4 929**	**3 449**	**2 723**	**2 210**	**2 078**
TOTAL POPULATION	**130 220**	**168 812**	**209 505**	**255 049**	**303 611**

Source: Data adapted from, Department of Statistics, 2002

km^2 (244 per mi^2) The Bimini Islands 74 per km^2 (191 per mi^2); Grand Bahama 4 per km^2 (89 per mi^2); The Berry Islands 23 per km^2 (59 per mi^2).

Total population increases during intercensal periods 1980 to 1990 and 1990 to 2000 (Table 1.1) were 21.6 per cent and 19 per cent, respectively (Department of Statistics, 2002). Rural to urban drift is readily apparent. The populations of Islands in the Central and Southeast Bahamas are decreasing while those in the Northwest Bahamas particularly New Providence and Grand Bahama are increasing. Persons are drawn to the larger cities, especially Nassau, because of the availability of basic services such as schools, health care, etc. On the other hand, people are drawn away from the capital to whatever island or cay experiences increased investment; Grand Bahama, for example, more than doubled its population between the period 1963 and 1970.

1.4.2 Ethnicity

The Bahamas is an independent nation of several hundred islands, among which only sixteen are significantly inhabited (Table 1.1). Although Bahamians are not tribally divided there are distinct cultural differences among the islands of The Bahamas. For example, it is often possible to distinguish the island of origin based on a person's surname, use of accents and speech patterns. English is the common written and spoken language, however there is also a distinct local patois used by many Bahamians. The notion of family is not restricted to a nuclear configuration. Kinship is strong and the extended family is the norm rather than the exception (Vanderpool, 1998; Minnis, Rolle, & Vanderpool, 2002).

The present population of The Bahamas is largely derivative in nature, comprising inhabitants who have

descended from people of other lands. The original inhabitants were called Arawak, Lucayan, and Taino Indians. These indigenous peoples are said to have not survived because of the diseases, trade and aggression of early European explorers and settlers.

More than 85% of the nation's present inhabitants are black, having descended from slaves as well as free persons of African origin, many of whom came to the Bahama Islands in the seventeenth and eighteenth centuries.

The Eleutheran Adventurers, a group of English immigrants accompanied by their slaves, established one of the first permanent settlements in the Bahamas in the 17th century. Other groups followed including early American settlers loyal to the English Crown migrated to the Bahama Islands at the time of American Revolution. In 1717 The Bahamas became a British Colony. However the colonization of the Bahama Islands by the British was an eventful process. The Spanish attacked Nassau several times and captured the Colony during the 18th century.

Over the centuries, persons from various countries including China, Greece, the United Kingdom, the United States of America (USA), Canada, Haiti, Jamaica, the Turks and Caicos Islands and other Caribbean nations have made The Bahamas their home. For example, during the 20th century Barbadians, Jamaicans, Trinidadians and persons of other West Indian descent were recruited to work in the Bahama Islands as teachers, nurses and policemen. After political independence was gained in 1973, numerous British and other European expatriates left The Bahamas; however, many remained as legal residents either on a full-time or seasonal basis. Today, the expatriate population continues to grow, with some groups forming the majority in various communities.

The migration of people into the country has continued to this day and has often resulted in an illegal populace base. As an archipelagic nation, the islands of The Bahamas are very exposed and easily accessible by illegal immigrants from every region of the world. This accessibility, coupled with The Bahamas' proximity to the USA makes the country very vulnerable to the persistence of illegal immigrants. Among these illegal immigrants, Haitians have been the predominant group. Other groups that have recurrently migrated illegally into The Bahamas on a smaller scale include Americans, Chinese, Cubans, Dominicans, Jamaicans, Peruvians and Turks (Table 1.2).

The large numbers of illegal immigrants and the amount of money spent annually on the repatriation of those apprehended has often resulted in a reoccurring economic and social impasse. For example, for the period January – March 2005, US$216 385 has already been expended on the repatriation of 1 179 illegal foreign nationals. For this same period, the number of persons arrested on land and interdicted at sea totals 1 015 and 1 480, respectively (Bahamas Immigration Department, 2005).

Table 1.2 Repatriation statistics of some of the predominant illegal immigrant groups (2001-2004)

Countries	2001	2002	2003	2004
American	15	16	12	18
Chinese	78	67	18	8
Cuban	59	68	240	106
Dominican	43	74	128	15
Haitian	6 298	5 462	3 512	2 500
Jamaican	954	551	606	334
Peruvian	6	14	11	7
Turkish	9	2	7	1
TOTAL	**7 462**	**6 254**	**4 534**	**2 989**

Source: Bahamas Immigration Department, 2005.

1.5 Societal outlook: Governance, Religion, Culture and Education

1.5.1 Governance

In 1729, the oldest sitting Parliament in the Americas was established in the Bahama Islands. However, democracy was not attained until restrictions on participation of slaves and freed blacks imposed by colonial powers were lifted in the 19th century and women were allowed to vote in the 20th century. The Bahamas is also known for its 'quiet revolutions'. Indeed, majority rule was won in 1968; political independence gained in 1973 and, more than once, strongly entrenched political powers were overturned without the aid of a coup d'etat or other violent upheavals.

The Bahamas is a parliamentary democracy with a bicameral (two chambered) legislature comprising a House of Assembly and a Senate. Presently 40 constituencies are each represented by an elected member of parliament who sits in the House of Assembly. The Bahamas is still a part of the British Commonwealth of Nations; therefore the titular head of state is the Queen of England. The head of government is the Prime Minister. Three men have served as Prime Minister of The Bahamas: the late Rt Hon Sir Lynden O Pindling from 1973 to 1992, Rt Hon Hubert A Ingraham from 1992 to 2002 and Rt Hon Perry G Christie from 2002 to the present.

Following the Westminister system of governance, the Prime Minister forms his Cabinet by appointing the Ministers of the government and the Attorney General usually from among the elected parliamentarians. The line of authority within The Bahamas government ministries includes Ministers, Parliamentary Secretaries (also referred to as Junior Ministers), Permanent Secretaries, Undersecretaries, Deputy Permanent Secretaries, and Executive Officers; all of whom operate from the capital.

The laws of The Bahamas are enacted in the legislative chamber (The House of Assembly) of parliament, ratified by the Senate, signed by the Governor General and enforced and upheld by The Bahamas criminal justice system. The Bahamas criminal justice system includes the Judiciary, the Royal Bahamas Police Force and the Royal Bahamas Defense Force.

The judiciary comprises the Supreme Court, the Chief Justice, and other Justices of that court; the magistrate's courts headed by the Chief Magistrate and other Magistrates. The Attorney General, a member of the Cabinet heads the Attorney General's Office which is the government arm of the criminal justice system. According to Bar Administration Office, as of March 2005 their records show that 717 attorneys-at- law have been called to The Bahamas Bar.

To facilitate governance in the Family Islands, the Local Government Act was established in 1996. The Minister who carries the portfolio for local government makes decisions on the establishment of districts, changes in their boundaries, and their location throughout The Bahamas. Each district has a District Council, a body which has responsibility for various functions including traffic schemes, town planning, public transportation, the maintenance and upkeep of public and government-owned buildings and their environs, boat registration, energy supply, water supply, telephones, etc.

1.5.2 Religion

Christianity is the predominant religion among Bahamian people and is practiced by several denominations featuring varying styles of preaching, and worship (Dupuch, 1995). There is no strict separation of Church and State. Prayer is allowed, even encouraged, during affairs of state, school assemblies, and other public gatherings.

It has been reported that at least 95 per cent of Bahamians if asked their religion will respond that they are Christian (Saunders, 2003). The three largest Christian denominations are Baptists (37 per cent), Anglicans (18 per cent), and Roman Catholics (14 per cent). Other Christian denominations in The Bahamas include Pentecostals, Methodists, Church of God, Lutherans, Greek Orthodox, Presbyterians and Adventists. Other religions practiced in The Bahamas include: Bahai, Buddhism, Hinduism, Islam, Jehovah's Witnesses, Judaism and Rastafarianism.

1.5.3 Culture

The Bahamas, like other nations, has distinct cultural characteristics as demonstrated by its art, craft, music, dance and food. As in other countries of the Americas and the Caribbean, the cultures of both African and European civilizations influence Bahamian culture. On the other hand unlike some Caribbean countries, East Indian influences are negligible.

One extraordinary cultural phenomenon in The Bahamas is Junkanoo (Figure 1.2). Particularly during Annual Boxing Day and New Year's Day Parades, Junkanoo embodies all expressions of a vibrant and dynamic Bahamian heritage. Preparation for Junkanoo is a year-round event that requires not only artistic design and planning but strong leadership, effective management and collaborative efforts. Hundreds of Bahamians participate in the making and performance of Junkanoo. Spectators are treated to a kaleidoscope of art, dance and music. Handmade cowbells and goat skin drums, whistles, trumpets and tubas are all incorporated in renditions of Bahamian songs as well as those from other countries. Although the predominant dance of the Junkanoo is "rushin", other natural and choreographed movements are used. Costuming for the parades is comprised of small and large beautifully crafted pieces of art made predominantly from cardboard and fringed coloured crepe paper. The intricate cutting, placement and pasting of these fringes onto clothing and cardboard is so carefully crafted that

a fringed Junkanoo piece of art often has the appearance of a painting.

Heritage Festivals (see Figure 1.3) and Regattas are also cultural celebrations that take place annually in The Bahamas. Heritage Festivals are usually held in various Family Islands and feature the main attribute of that island, such as the Pineapple Festival in Eleuthera, CrabFest in Andros, and the Rake n' Scrape Festival in Cat Island. Regattas are sailing competitions that are conducted in different boating communities on the islands in a friendly and competitive atmosphere. These events, usually a weekend long, showcase national music, dance and embody the preparation and taste of local delicacies, bringing together residents, visitors and descendants now living in New Providence or other Bahama Islands.

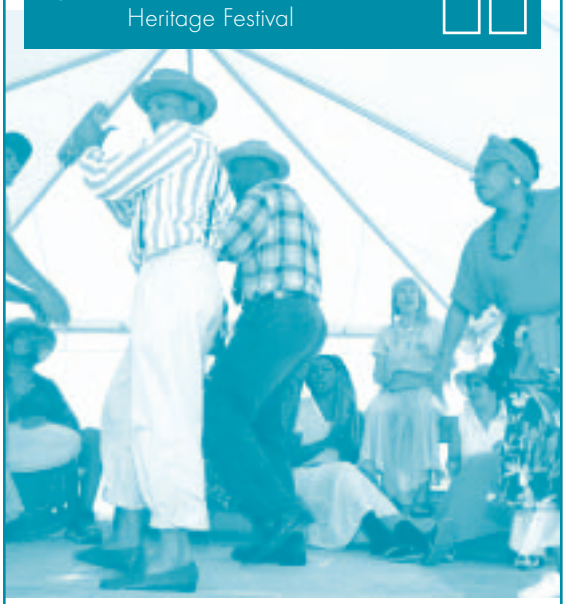
One main highlight of cultural events in The Bahamas is the wide array of Bahamian dishes often available. Vendors are usually organized at these functions to sell particular delicacies that are either unique to The Bahamas or are prepared in a uniquely Bahamian way. One popular dish often served includes the dish called peas and rice, which for example is prepared differently than the Jamaican dish known as rice and peas. Crab and dough, and Guava duff, are just a few other examples of uniquely Bahamian preparations which use locally grown foodstuffs. The most popular seafood dishes in The Bahamas are fish and conch. Fish is served baked, boiled, stewed, steamed and fried. Conch is served raw (usually in salads) or cooked by boiling, steaming, stewing and frying.

Fig.1.2 The pageantry of Junkanoo Parade: 30th Anniversary of Independence (July 5, 2003)

Source: Derek Smith, Bahamas Information Services

Bahamian hotels and resorts have only recently begun to feature aspects of the native culture, including music, food and art. These cultural exhibitions often allow tourists to get involved and experience some of what is Bahamian. In addition, local seaside venues called "Fish Frys" have emerged. At these places of recreation, both residents and tourists gather to enjoy Bahamian culture.

Fig.1.3 The Bahamas Heritage Festival



Source: Derek Smith, Bahamas Information Services

1.5.4 Traditions and Education

The Bahamas has a strong tradition of oral history. Story-telling, news brought by the many world travelers plying its waters and touching its shores, were all readily communicated and shared amongst the people. Bahamian folklore features stories and tales of African origin, such as the popular Ber' Bookie and Ber' Rabbie stories. In many cases, particularly on the Family Islands, the wisdom of elders in the community is respected whether or not the individuals possessing it are formally educated.

Much is documented regarding the deep regard for knowledge and education held by the people of the English-speaking Caribbean, including The Bahamas, and their determination to educate their children even in the face of indifferent colonial rule and antagonistic plantation owners and managers who were determined not to let education 'interfere' with their sources of cheap labour (Waggoner & Waggoner, 1986; Bacchus, 1994). Black Bahamians in particular strived

to ensure the formal education of their children because they perceived education to be the only opportunity for advancement in a colonial and neo colonial society.

School attendance is mandatory until the age of 16. There are 191 schools in The Bahamas: 147 maintained by Government and 44 private (Dupuch, 2005). Free education is available in government schools throughout The Bahamas. In addition, the Government provides subsidies to private schools.

Prior to Independence, persons left home and sought postsecondary education abroad. The predominant destinations for studies at universities and colleges off-shore were the United Kingdom, USA, Canada and the West Indies. After Independence however, the development of higher education in The Bahamas was both rapid and eventful as several local institutions and programmes became available which offer degree level instruction locally, ranging from associate to master degree levels. The oldest among Bahamian higher education institutions are The College of The Bahamas, The Bahamas Technical and Vocational Institute, Success Training College, and The Bahamas Baptist College.

As an independent nation, The Bahamas has consistently allocated a large portion of its budget to education. In the budgetary allocations for 2001/2, 2002/3 and 2003/4, the Government allocated US$145 655 824, US$183 710 652 and US$188 636 375, respectively (Dupuch, 2004).

The College of The Bahamas (COB) is the nation's premier higher education institution. COB presently offers associate and bachelor degrees. The College also provides master degree programmes in conjunction with selected, accredited off-shore universities; continuing education credit and non-credit offerings; research; and other services to the community. COB is scheduled to achieve University status in 2007.

Several offshore universities and institutions offer higher education programmes locally, including the University of The West Indies, The University of Miami, Sojourner Douglas College, and Nova Southeastern University. Some postgraduate programmes from offshore colleges and universities are offered in conjunction with local colleges.

Working adults account for a significant percentage of persons enrolled in higher education programmes in The Bahamas. The participation of Bahamians in higher education is increasing both at home and abroad. Female enrollment in and graduation from Bahamian higher education institutions, with the exception of some engineering and technology programmes, outnumbers that of males. In 2003 it was projected that at the College of The Bahamas, should the graduation trends continue, the ratio of females to males graduating could increase to a high of 7.2:1 and 8:1 by the year 2005/6 and 2010/11 respectively (Chipman-Johnson & Vanderpool, 2003). Further research studies are needed to discover reasons for low enrollment and graduation rates for males.

1.6 Infrastructure

The socio-economic activity and growth of a widespread archipelago, such as The Bahamas, depends on its system of public works. In looking at various aspects of the infrastructure throughout the archipelago, specifically potable water supply, sewerage, health care, energy, communications and transportation, some are advanced and others are still developing.

Potable water is provided to most of New Providence and approximately 70 per cent of the Family Island population (Water and Sewerage Corporation, 2001). The potable water supply of New Providence consists of water from Government and private wells and local reverse osmosis plants. Many Family Islands, particularly those in the Southeastern Bahamas, have inadequate water resources and are prone to seasonal drought. Reverse osmosis systems are gradually being introduced into the Family Islands, despite the poor economic returns associated with serving small, scattered communities.

There are 37 centralized sewerage systems on New Providence that service various pockets of the island, including the downtown area, the airport area and several subdivisions. In total, only 20 per cent of households in New Providence are served by sewage collection systems; the remaining households use septic tank systems. With the exception of Grand Bahama and Abaco, centralized sewerage systems in the Family Islands are mainly limited to some private developments and resorts. The onus is on private developers to install centralized sewerage systems, depending on the size and location of the development project.

Health care services, in the form of government and private hospitals and clinics, are available throughout The Bahamas. The Government operates one hospital on each of New Providence and Grand Bahama, and health care clinics throughout The Bahamas. Bahamians that can demonstrate a legitimate need, pay nominal fees to receive services at the government-owned institutions. In the 2003/04 budget,

health-related services accounted for approximately 13 per cent of Government expenditures (Dupuch, 2004).

The Bahamas does not have petroleum reserves; therefore, fuel oil and gasoline is imported from various suppliers to meet the energy and fuel demands. The two major agencies responsible for meeting the energy needs of The Bahamas are Grand Bahama Power Company (GBPC) and The Bahamas Electricity Corporation (BEC). GBPC provides electricity to all of Grand Bahama, while BEC services New Providence and the other major Family Islands. To ensure all Bahamians have access to electricity, New Providence consumers subsidize power costs for the Family Islands (other than Grand Bahama). Commercial energy users pay BEC between approximately US$0.14 per kVA (kilovolt amperes) and US$0.19 per kVA (Dupuch, 2004). It is widely believed that these prices are too high, despite the need to import fuel and the scattered and small size of BEC operations.

The Bahamas continues to maintain adequate communication systems that link the Bahama Islands and the entire country to the rest of the world. The Bahamas Telecommunications Company (BTC), a government-owned operation, is the sole telecommunications provider. Some of the services provided by BTC include wireless, cellular, maritime, telegraph and Internet access (BTC, 2003). There are several Internet service providers offering high-speed linkages in New Providence and some of the Family Islands. In addition, cable services are available in most of the islands and one national radio station broadcasts throughout the country. A wide variety of postal and courier services are available to receive and deliver mail and packages world-wide. Mailboats, which are subsidized by the Government as mail carriers, take on freight and priority mailbags.

Marine and air travel are common modes of transportation in The Bahamas. Apart from cargo, mailboats also take passengers, offering an inexpensive and rewarding way of seeing the islands. Fast ferry services between New Providence and Abaco, Andros, Eleuthera, Exuma, Habour Island and Spanish Wells are also available (Dupuch, 2004). In addition, a national airline and private air services operate from several international and domestic airports throughout The Bahamas. These air services are provided on a daily basis, both inter-island and abroad. There are 19 sufferance wharves in The Bahamas and 32 major ports of entry, more than half of which can accommodate boats, landplanes and seaplanes (Dupuch, 2004).

1.7 Economy

Fifteenth and sixteenth century activity in The Bahamas was characterized by expeditions, wars, slave-trading and piracy by legitimate and illegitimate representatives of British and other European and later North American interests. Although the coat of arms of the Bahama Islands bore the motto "Expulsis Piratis Resitutia Commercia", which means "When the pirates were expelled, trade was restored", the wrecking of hapless ships deliberately lured on to rocks and reefs, the smuggling and bootlegging of various commodities, all continued long after the pirates were supposedly expelled in the early 18th century. The geography of The Bahamas, with its miles of coastline and hundreds of small islands, cays, harbours and coves, makes it possible for smugglers to hide and/or off-load their booty.

In the 18th and early 19th centuries, American blockades, and later prohibition, encouraged trafficking in goods desired by a large American market. Since the mid 19th century the trafficking of drugs passing through The Bahamas en route to the USA continues in spite of local and collaborative efforts to curtail this nefarious activity. People, particularly illegal migrants, are also smuggled directly into The Bahamas or pass through on their way to the USA.

Today, the largest sectors of the Bahamian economy are tourism, and banking and financial services. Tourism employs approximately 50 000 persons; over 4 500 persons are engaged in the banking sector (Dupuch, 2004). Although an Industries Encouragement Act was passed in 1970, manufacturing, agriculture and fishing industries account for less than five per cent of the total number of persons employed in 2003. Subsequently, expenditure on imported goods into The Bahamas is very high. In 2003 the total value of imports in 2003 was approximately US$1.6 million, while the total value of exports for the same year was US$617 million (CIA World Fact Book, 2004).

The Bahamas has the third highest per-capita gross domestic product (GDP) in the Western Hemisphere. Many Bahamians have expressed concern that the appearance of a wealthy Bahamas is very misleading due to the uneven distribution of income and the high costs incurred in the administration of an archipelagic nation. Moreover The Bahamas is not eligible for certain types of international funding that is sorely needed for development in rural communities and depressed urban areas because of its "high" GDP ranking.

The Bahamian dollar has been on par with the US dollar for the past several years; however the purchasing power parity (PPP) should be considered. (The PPP theory states that the exchange rate between one currency and another is in equilibrium when their domestic purchasing powers at that rate of exchange are equivalent.) Analyzing the GDP using the PPP method changes The Bahamas' position relative to other countries. For example, the 2001 nominal GDP for The Bahamas is 54 per cent higher than that of Barbados; but by employing the PPP method, the GDP of The Bahamas (US$16 270) is only 5 per cent higher than that of Barbados (US$15 560). This indicates that the purchasing power of the Bahamian dollar is relatively not as strong as it appears on the surface and the per capita income is not as large over other countries (Saunders, 2003).

In fact in The Bahamas it is possible to find evidence of the social and economic development of first, third and developing worlds. Distribution of wealth ranges from poor or subsistence, to several levels of the middle class, to the extremely wealthy. The Bahamas is a nation in which rural simplicity as well as the sophistication of high technology can be found.

1.7.1 Tourism

The Tourism Encouragement Act was passed in 1851; however, it was the Development Board Act of 1914, which was confirmed in 1919, that clearly laid the vision and future of tourism's leading role in the advancement of the Colony of The Bahamas (Saunders, 2004). The main focus of the Development Board was tourism. This focus escalated in the mid – 1900s when the Bahama Islands increasingly became a year-round destination for tourists. The Development Board was abolished and replaced by the Ministry of Tourism in 1973, with the advent of Independence.

In the 21st century, tourism continues to lead in the advancement of the Bahamian economy. The Ministry of Tourism has extended its marketing strategies beyond the promotion of the Islands as a year round destination for vacationers. Such strategies now include a focus on vertical markets attractive to travellers with special interests. These niche markets include ecotourism, cultural heritage, the film industry, private aviation and boating, religion, and sports. The development of niche markets not only increases revenue but supports the Ministry's campaign to showcase Bahamian Islands within the archipelago as individual destinations.

Estimated Numbers of Employed Persons in the Hotel Industry (1999-2001)

Location	1999	2000	2001
New Providence	15 992	17 562	18 194
Family Islands incl. Grand Bahama	3 578	3 168	5 092
TOTAL	**19 570**	**20 730**	**21 286**

There are varying estimates concerning tourism's contribution to the Bahamian economy. Generally it is estimated that tourism produces 50 to 60 per cent of the total GDP and directly or indirectly employs from 50 to 60 per cent of the total workforce. Expenditure for all visitors to The Bahamas increased from US$1.58 thousand million in 1993 to US$1.76 thousand million in 2003 (Ministry of Tourism, n.d.). Data compiled by

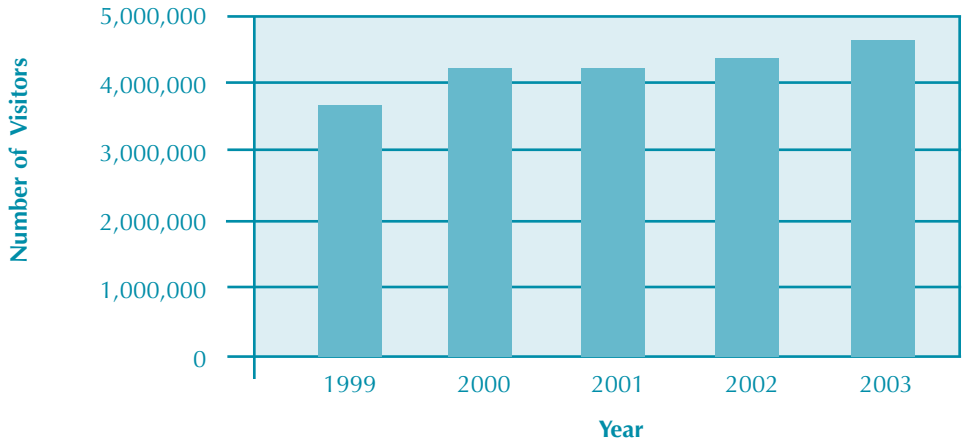
The Ministry of Tourism Research Department indicate that the number of visitors to The Bahamas continues to rise(Research Department, Ministry of Tourism, n.d.). This is based on head counts by the Immigration Department of all foreign visitors and transit arrivals to The Bahamas, excluding ship crews, diplomatic personnel and returning residents (Figure 1.4). The data does not take into account multiple entries made by the same visitors at different ports in the Islands of The Bahamas.

1.7.2 Banking and Finance

The Bahamas, which is considered to be one of the most developed international financial centres, has been providing banking and trust services to the international financial community since the 1930's. Linked to every major market in the world, The Bahamas has over 400 banks and trust companies and handles more than US$300 thousand million of Eurocurrency business.

Specifically, the financial sector includes commercial banking, private banking, other local financial institutions, trust companies, insurance companies and captive insurance. Various sources estimate this sector's contribution to the Bahamian economy at 12 to 15 per cent of the GDP, and the sector employs approximately 4 500 persons (Dupuch, 2004).

Figure 1.4 The number of visitors to The Bahamas (1999-2003)



Source: Data adapted from: Ministry of Tourism, n.d.

1.8 Conclusion

The Bahamas is both blessed and challenged as an archipelagic nation. The islands are the exposed portion of a carbonate platform and lie in shallow waters. They primarily consist of relatively young limestone formations. The geology is characterized with cavernous zones, sink holes and blue holes. The Bahamas has the highest number of blue holes in the world. Some are under tidal influence, which is a very unique feature. The soils are generally alkaline and non-conducive to a self-sustaining agricultural sector. However the proximity to the USA, the equitable climate and the natural resources, namely the clear, blue waters, white and sandy beaches and diverse marine ecosystems, fuel the cornerstone of the Bahamian economy – tourism.

Growth in tourism dictates the overall economic success of the country and the country's demography has evolved to reflect this. The northern islands, which are situated closer to major markets and less arid than the southern islands, are the most populous islands in the chain. Over the years, economic growth has occurred primarily among these islands and created a disproportionate population distribution. Consequently, there are marked differences between the Northern and Southern Bahamas in some infrastructure and levels of service.

The economic state and stable political environment and the people and their inherent appreciation of knowledge, has facilitated the evolution of a standard of living attractive to many nationals of first and developing worlds. This is reflected in the diverse origins of Bahamian ethnicity and the challenges posed by the continuous influx of illegal immigrants to The Bahamas.

It is clear that the socio-economic environment of The Bahamas is dependent on tourism. In turn, tourism is dependent on the state of the environment. Consequently, maintaining a balance between the environment and economic development is essential for Bahamians, both present and future generations.

GEO

State of the Environment

Chapter 2

2.1 Introduction

This chapter provides a review of the diverse terrestrial and marine habitats found within the Bahamian archipelago. Other marine, freshwater and land resources, as well as natural and anthropogenic hazards that threaten the Bahamian environment are also discussed.

2.2 Coastal and Marine Environments

Usually the definition of the coastal zone is limited to where the shoreline or coastline starts (that is, the interface between water and land) and extends landward to where the tidal or sea-spray reaches, or where there are signs of major changes in the terrain. This makes The Bahamas a coastal country, with the entire population living within the coastal zone.

The Bahamas is an archipelago of 700 low-lying islands and cays, stretching over approximately 259 000 km2 (100 000 mi2) of ocean with the Great Bahama Bank to the west and the Atlantic Ocean to the east. The archipelago is blessed with many sandy beaches, clear warm waters and colorful coral reefs. The tourism industry relies heavily on the natural resources of the coastal zone. Ironically development in this sector, as well as urban and infrastructure expansion, has resulted in many physically damaging changes to the coast.

2.2.1 Wetlands/Mangroves

Wetlands comprise 40 per cent of the land area in The Bahamas and are habitats for many plants, and both migratory and native birds. They also serve as the most important fish nurseries and provide a number of economic and ecological services. There are both inland and coastal wetlands. Inland wetlands receive water from precipitation, ground water and/or surface water. Coastal wetlands receive water from precipitation, surface runoff, tidal flows and ground water.

The mangroves that inhabit the wetlands in The Bahamas are mainly fringe and coastal shrubs. They mainly grow in lagoons, sheltered bays, tidal mudflats and marshes. Four species of mangroves are found in The Bahamas: red (Rhizophora mangle), black (Avicennia germinans), white (Laguncularia racemosa), and buttonwood mangrove (Conocarpus erectus). Mangroves have very diverse roles. Bahamian people have always benefited from mangroves. They may serve as land builders, by trapping sediments and by removing heavy metals and excess nutrients from runoffs; they also stabilize the shoreline and serve as nurseries and feeding sites for many reef fish; they protect the land from waves, storm winds and floods; and they provide a habitat for bromeliads, orchids and many species of birds that may nest or feed in these mangroves, such as The Bahama swallow (Tachycinetacyaneoviridis), Bahama woodstar (Calliphlox eveltnae), white-cheeked pintail (Anas Bahamensi), Bahama yellowthroat (Geothylpis spp.), green heron and the mangrove cuckoo (Coccyzus mino).

Many species of sea turtles are found in mangrove habitats throughout The Bahama Islands for at least part of their life histories. These sea turtles include the green turtle (Chelonia mydas), the hawksbill (Eretmochelys imbricata), the loggerhead (Caretta caretta), and the leatherback turtle (Dermochelys coriacea). Economically important fish species are also found in mangroves. They are the Nassau grouper (Epinephelus striatus), snapper (Lutjanus spp.), parrotfish (Scarus spp. and Sparisoma spp.), grunt (Haemulon spp.), mojarra (Gerres spp. and Eucinostomus spp.), tarpon (Megalops atlanticus), barracuda (Sphyraena barracuda), and bonefish (Albula vulpes). The latter is important economically as a sport fishery (Buchan, 2000; Frazier, 1999; Raffaele et al., 1998).

Most national parks and protected areas within the Bahama Islands contain mangroves. One such park, the Inagua National Park, was added to the Ramsar List of Wetlands of International Importance in 1997. This park is 32 600 ha (80 556 acres) in size and contains marshes, swamps, open waters and pools. It is the main breeding ground for flamingos (Phoenicopterus rubber) and the home of the endangered Bahama parrot (Amazona leucocephala bahamensi). In this park, the dominant mangrove species include the buttonwood and black mangrove.

Human activities in The Bahamas, as in many places in the Caribbean, have impacted the mangrove ecosystem. Urbanization of mangrove wetlands has caused a decline in the number of such wetlands. Mangroves continue to be cleared for coastal developments in the form of marinas, hotels, residential projects, and for health reasons in order to control mosquito populations. Other anthropogenic impacts on the ecosystem include the filling of mangrove wetlands to serve as refuse sites for solid waste from construction areas and also for household waste, for the construction of airports as in Freeport, Grand Bahama, and for residential developments and roadways. In addition, scientific evidence suggests that global warming may be a natural pressure on mangroves, as they will be affected by a rise in sea level.

2.2.2 Beaches

The Bahamas is endowed with priceless white sandy beaches. These beaches attract thousands of visitors year after year, and as such, the major thrust of the Bahamian tourism industry is based on this dynamic environment.

Beaches provide a buffer between the offshore zone and the adjoining coastal land. The unconsolidated sediment found on the beaches in The Bahamas originates from coral reefs, and calcareous organisms and animal shells. They also provide habitat for a multitude of burrowing species, such as crabs, clams, and other invertebrates. Sea turtles use many beaches in The Bahamas to dig their nests and deposit their eggs.

Beaches undergo natural alterations in their profile throughout the year. These changes result from natural processes such as storms, hurricanes, surges, changes in tides and sea level rise. As a result, a beach may experience seasonal changes, changes from day to day and also over long periods of time. Man has also influenced the changes the beaches experience by constructing groynes, by channeling through the beaches and the dunes to make entrances to marinas, by sand mining, and by removing and clearing beach vegetation.

Varying degrees of erosion can be observed on many of the beaches in The Bahamas. The major causes are construction on the sand dunes, removal of sand dunes for development and building in the active beach zone, inappropriately siting structures on the coastline in the active beach zone, and ill-planned coastal development.

The greatest threat to beaches for the future is the increased threat of hurricanes and storm surges and the potential effects of sea level rise.

2.2.3 Seagrass Beds

Throughout The Bahamas, seagrass beds serve as a foraging and nursery habitat for many sea turtle species and a variety of fish species, many of which are of commercial importance. Several species of seagrass are found throughout The Bahamas. These include turtle grass (Thalassia testudinum), shoal grass (Halodule wrightii) and manatee grass (Syringodium filiforme), which are often found at low-energy sites in association with mangroves (Buchan, 2000; Gerace, Ostrander, and Smith, 1998).

Seagrass beds are affected by both natural and anthropogenic threats. Natural threats include storms, wind-driven waves and rise in sea level. Anthropogenic threats include sedimentation (caused by activities that increase turbidity), surface run-off carrying excessive amounts of nutrients from fertilizers, raw sewage disposal throughout the Family Islands, accidental or incidental grounding of marine vessels, inappropriate use of fishing gear (such as drag nets) and coastal development (such as construction of docks and piers).

Approximately 0.4 ha (1 acre) of seagrass can produce over 9 tonnes (8.9 long tons) of leaves per year. This vast biomass provides food, habitat, and nursery areas for a myriad of adult and juvenile vertebrates and invertebrates. Furthermore, 0.4 ha of seagrass may support as many as 40 000 fish, and 50 million small invertebrates (Hill, 2002). Seagrass beds are important indicator species of the overall health of coastal ecosystems as they support such high biodiversity and they are sensitive to changes in water quality (Hill, 2002); however, they are the least documented in terms of the total extent of seagrass beds and their geographical distribution. Seagrass beds must be seen as an important aspect of the fisheries habitat and baseline data must be collected and accessible.

2.2.4. Coral Reefs

The most ecologically important and diverse ecosystem in The Bahamas is the coral reef and its plant and animal communities. Coral reefs provide habitats for a variety of commercial fisheries such as lobsters, groupers (Epinephelus spp.), grunts (Haemulon spp.), snappers (Lutjanus spp.), jacks (Seriola spp.), triggerfish, (Canthidermis spp.), and parrotfish (Scarus spp. and Sparisoma spp.) and act as buffers against erosion of the shoreline, by reducing the impact of tidal flows and storm surges. In addition, they are the main source of carbonate sand and beaches.

The islands are low-lying and they are comprised mostly of very porous limestone. Given this geology, there is minimal surface runoff that contains sediments; therefore the corals can grow close to the shore. Coral reefs occur mostly fringing the bank margins, with some small patch reefs on the banks in areas with high tidal circulation, and a few bank-barrier reefs. The most important reef regions, with their approximate areas from north to south, can be seen in Table 2.1. The reefs are more abundant on the windward north and the eastern sides of the islands and cays than on the leeward sides.

Table 2.1 Important reef regions of The Bahamas

Reef Regions	Approximate Areas km
Little Bahama Bank	323
Biminis	90
Berry Islands & Andros	182
New Providence	30
Eleuthera & Cat Island San Salvador, Rum Cay	200
& Conception Island	132
Exuma Cays & Ragged Island	386
Samana Cays	50
Plana Cays	31
Mayaguana	72
Inagua	164
Hogsty Reef	23
Cay Sal Bank	153
Crooked & Acklins Islands	151

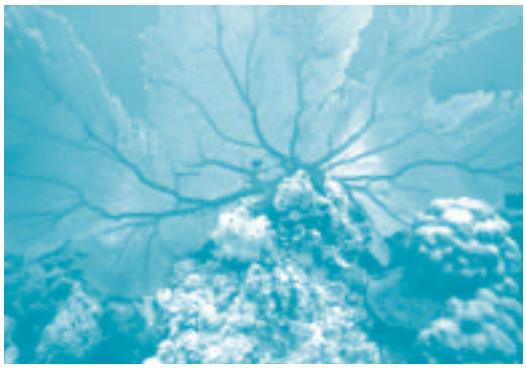
Source: Data adapted from Linton, et.al, 2002

Coral reefs have declined in waters of the more developed and populated islands, but are generally in good condition, especially on isolated offshore banks. Relatively isolated reefs of the less developed islands, including the Abacos, Andros, Bimini, Eleuthera, Cat Island, Long Island, and the Exumas, are still considered to be very healthy with high percentage cover by hard corals as well as high densities of fish.

Andros Island is the largest island but one of the least populated of The Bahamas, with the third longest barrier reef system in the world (229 km). Surveys by the Atlantic and Gulf Rapid Reef Assessment (AGRRA) Programme and the University of Miami identified a total of 18 species of major reef building corals throughout all sites, with elkhorn coral (Acropora palmata) the most abundant in shallow areas (less than 3 m mean water depth) and boulder star coral (Montastrea annularis) the most abundant in deeper waters (up to 10 m mean water depth). Coral colony frequency and coral cover was generally high at both depth zones surveyed, and coral mortality was low to moderate. Sites in North and Central Andros seem to be the healthiest based on lower coral mortality, lower abundance of macroalgae and higher abundance and diversity of fish. The reefs are considered to be in good condition overall, probably because of low levels of human impacts. Some areas to the south however, show obvious anthropogenic impacts, with high algal cover, a likely result of inadequate liquid waste treatment and other land-based sources. Increased fishing pressures account for low fish abundance and diversity. Coral disease, particularly white band disease of the main Acropora species has been widespread. Coral reef decline is more pronounced where they are in close proximity to development, on the islands of New Providence and San Salvador. San Salvador, monitored by the Caribbean Coastal Marine Productivity (CARICOMP) Programme since 1994, shows a change in coral cover at 10 m depths from 9.6 per cent in 1994 to 4 per cent in 2001.

The Bahamas is located in a hurricane belt and coral reefs are vulnerable and may be destroyed or altered by severe hurricane conditions. After Hurricane Frances and Jeanne, the corals in the Exuma Cays showed signs of erosion by sand scouring and in some sites small corals were detached and the large sea corals (gorgonian corals) were possibly overturned by wave surges (Brumbaugh, 2004). Sand scouring was also responsible for the removal of masses of algae. Sedimentation was also observed on the reefs and decomposing organic material such as seagrass and algae had accumulated on the sea floor.

Table 2.1 Coral reef of The Bahamas



Source: Kate Holmes, American Museum of Natural History's Center for Biodiversity and Conservation

2.2.5 Fisheries

In The Bahamas there are three categories of fisheries. There is recreational/subsistence fishing which involves the capture of small quantities of reef fish, crawfish, lobster and conch for recreation and/or subsistence. This is practiced by both visitors and Bahamians. There is also a sportsfishing industry

which targets the large pelagics such as blue marlin, white marlin, wahoo and dolphin fish. This industry usually involves catch and release. The third and most economically significant component of the fishing industry is commercial fishing.

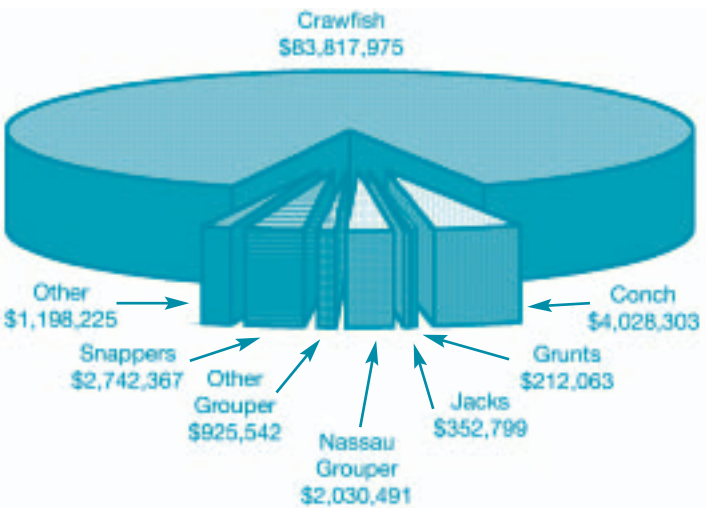
Commercial fishing in The Bahamas occurs primarily on the shallow banks of The Bahama Islands. This includes both the Little and Great Bahama Banks. Commercial catches include crawfish or spiny lobster (Panulirus argus), queen conch (Strombus gigas) and scale fish such as reef fish species like the Nassau grouper (Epinephalus atriatus), other species of grouper (Epinephelus spp.), grunts (Haemulon spp.), snappers (Lutjanus spp.), jacks (Seriola spp.), triggerfish (Canthidermis spp.), and parrotfish (Scarus spp. and Sparisoma spp.) and hogfish (Lachnolaimus spp.)

According to the Department of Fisheries, the total fisheries landings in The Bahamas for 2004 was 5 748 tonnes (5 657 long tons), valued at US$95.3 million. Crawfish accounted for 88 per cent of the total fisheries product (Figure 2.2). The crawfish fisheries in The Bahamas are a significant resource, and have been rated fourth in the world (Department of Fisheries, 2005).

There are a number of problems facing the fishing industry in The Bahamas. In general, knowledge of the status of reef fish stocks is very poor. Nonetheless, there is evidence to suggest that some of the fisheries in The Bahamas are overexploited, specifically conch and grouper populations.

There are specific problems associated with each category of fishing. Non-adherance to bag limits and the use of unselective gear and improper techniques (such as fish traps and bleaching) plagues recreational fishing. Sportsfishing boats often exceed their limits and their catches go unrecorded. Moreover illegal catches by poachers from neighbouring countries,such as the Dominican Republic, Cuba, the United States of America (USA) and elsewhere, target the commercial fisheries (for example the conch, grouper and crawfish). This poses a serious threat to The Bahamas fisheries because often these poachers fish outside designated closed seasons and within marine reserves. There have also been reports of illegal crawfish sales to visitors, who take their purchases home in boats or planes. In addition, illegal acts of long line fishing within The Bahamas Economic Exclusion Zone have been reported.

Table 2.2 Fisheries Landings for 2004 (in US$) of The Bahamas



Source: Data adapted from: Department of Fisheries, 2005

2.2.6 Marine Protected Areas

IUCN – The World Conservation Union, an international union of states, government agencies, non-government organizations, scientists and other experts that promotes conservation of nature, defines marine protected areas (MPAs) as, "Any area of intertidal or sub-tidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" (IUCN, 2004). In The Bahamas the MPAs are generally referred to as marine reserves or marine parks because they are established for the maintenance and restitution of biodiversity and the protection of marine habitats and the life they support.

To date, there are 4 established marine parks (Figure 2.3). These reserves benefit fisheries through two major avenues: spillover and larval export. Spillover is the movement of adult fish across the reserve boundary into adjacent fisheries areas. It benefits fishermen on a spatially limited scale, but the benefits quickly accrue.

In 2000, five locations were identified as areas to establish MPAs, with the goal of eventually reserving 20 per cent of the marine environment of the country. These areas include: North Bimini, Berry Islands (Frozen Cay to Whale Cay), South Eleuthera, Exuma Cays (south of the Land and Sea Park in the Lee Stocking Island area), and the Northern Abaco Cays.

In larval export, target species, protected within a reserve serve as breeding stocks, are dispersed outside of the reserve and mature in other fisheries areas. The benefits will be distributed on a larger scale than spillover, but they will take longer to appear, as the larvae must develop to a harvestable size.

In 1958, the first MPA, the Exuma Land and Sea Park, was established. The marine area within this park became a no-take marine reserve in 1986 and now serves as an example of an effective MPA. Evidence has shown that invertebrates and fish are larger and more abundant, increasing the population available for the local fishing industry.

There are non-consumptive benefits to this reserve as well. It provides an excellent place for education about marine ecosystems and conservation for both Bahamians and visitors. In addition, it also serves as an ecotourism and recreational dive site.

Figure 2.3 Map of the Marine Parks in The Bahamas

Source: Eleanor Philips, The Nature Conservancy

2.3 Land Resources, Waste Management and Fresh Water Resources

Based on inland vegetation, the islands of The Bahamas are classified into three groups: pine islands (Andros, Abaco, Grand Bahama and New Providence), the coppice islands (Cat Island, Eleuthera, Exuma, Long Island, Rum Cay and San Salvador) and the more drought-resistant woodland islands (Acklins, Crooked Island, Inagua, Mayaguana and Ragged Island). Each island group has its own particular mix of flora and fauna that are well adapted to the terrestrial ecosystem of their islands. The geographical distinction in biodiversity is largely in response to the amount of precipitation received in each region. On an annual basis, the pine islands receive the most precipitation, while the woodland islands receive the least amount. This climatic variable, along with other factors, has shaped land use in The Bahamas and consequently the management of solid waste, sewage and freshwater resources.

2.3.1 Land Resources

Originally, all land in The Bahamas was Crown Land (that is land held in trust by Her Majesty, Queen Elizabeth II on behalf of the Bahamian people), and remained as such until freehold grants to individuals were made. Those Crown Lands that were not subject to freehold grants and were acquired by various government agencies, prior to the Constitution of 1973, are Government lands. Today, approximately 70 per cent or 1.1 million ha (2.6 million acres) of the land area comprising The Bahamas represents Crown land, and 15 per cent of this land is leased for different uses, such as agricultural development and conservation (Department of Lands and Surveys, 1998).

Ninety percent of the agricultural land in The Bahamas is government-owned. Three of the pine islands contain approximately 76 per cent of this land:

Abaco contains 20 000 ha (49 421 acres), Andros 40 000 km^2 (98 842 acres) and Grand Bahama 12 000 ha (29 653 acres). Of the 95 000 ha (234 750 acres) of arable land in the country, only 7 650 ha (18 904 acres) is under cultivation, with two very distinct types of agricultural practices taking place: mechanized methods and shifting cultivation. Large-scale, mechanized farming occurs in the northern islands, as these islands are geographically closer to major economic markets, receive more rainfall and have larger underground freshwater reserves. The drier central and southern islands practice a form of shifting cultivation that utilizes little commercial input and is mainly geared for subsistence farming (Pinder, 1996).

Pine and coppice forests account for 15 per cent of the total area of The Bahamas (BEST, 1995). Pine forests occupy much of the landmasses of Andros, Abaco and Grand Bahama, and smaller areas of New Providence. Timber license holders exploited the pine forests on these northern islands extensively until the mid-1970s. This left behind small areas of old growth pine forest and large areas of immature trees. Today, the pine forests comprise approximately 618 500 ha (1 528 347 acres). In addition to the dominant Caribbean pine (Pinus caribea var. bahamensis), other plant species that inhabit these forests include the following: sabal palmetto (Cocothrinax argenta), poisonwood (Metopium toxiferum), purple-flowered orchid (Bletia purpurea), southern bracken fern (Pteridium aquilinum), bushy beard grass (Andropogon glomeratus), five finger or chicken foot (Tabebuia bahamense), snow berry (Chiococca alba), scale leafed love vine (Cassytha filiformis), auricled green brier (Smilax auriculata), wolly corchorus (Corchorus hirsutus) and pigeon plum (Cocoloba diversifolia).

The pine forest is also a habitat for many avian species. Among them are over thirty different species of warbler, of which two are endemic: the Bahamian yellowthroat (Geothlypis rostrata) and the pine warbler (Dendroica pinus). The remaining warblers, which include the endangered Kirtland's warbler (Dendroica kirtlandii), are winter migrants. In addition, the pine forest is also the habitat of a rare atalia hairstreak butterfly (Eumarus atala) and, on Abaco, the endangered Bahama parrot (Amazona leucocephala bahamensis) (BNT, 1995).

The coppice forests are mainly confined to the central and southern islands and characterized by many valuable hardwood trees. Many of these trees were cut down by early colonizers in the 17th and 18th centuries and exported to the mainland of the United States of America for construction and furniture making. Few, if any, sizable hardwood trees are left, as much of the coppice were also cut down and burned for establishing settlements and plantations. Other activities such as shifting cultivation, woodcarving and charcoal making have led to further reduction of the coppice area and threatened many endemic plant species.

There are two different types of coppice in The Bahamas: blackland coppice and whiteland coppice. The blackland coppice occurs inland and it is the habitat for trees such as mahogany (Swietenia mahagoni), cedar (Cedrela odorata), mastic (Mastichodendron foetidissimum) and horseflesh (Lysiloma sabicu). Under the shade of these tall trees grow a variety of shrubs that include many species of stoppers (Eugenia spp.), wild coffee (Psychotria spp.), satin leaf or saffron (Chrysophyllum oliviforme), Bahamas strongbark (Bourreria ovata), pigeon plum (Cocoloba diversifolia) and poisonwood (Metopium toxiferum). Many epiphytes, such as several species of orchids and bromeliads, grow on the trees under the shade and humidity in the blackland coppice. The blackland coppice is also the habitat for the Bahamian boa constrictor (Epicrates spp.), lizards and birds, such as smooth-billed anis (Crotophaga ani), white-crowned pigeon (Columba leucocephala) and Key West quail dove (Geotrygon chrysia) (BNT, 1995).

The whiteland coppice occurs in areas in close proximity to the sea and under stress caused by factors such as drought, storms and grazing animals. The plant-life that occurs in whiteland coppice includes rugged brasiletto (Caesalpinia vesicaria), haulback (Mimosa bahamensis) and several Acacia spp. and tall shade trees such as mahagony (Swietenia mahagoni), balsam or autograph tree (Clusia rosea), sea grape (Coccoloba uvifera) and manchineel (Hippomane mancinella). The whiteland coppice is the habitat for the land crabs namely the giant whiteland crab (Cardisoma gunahumi) and the black crab (Gecarcinus lateralis), which are eaten by Bahamians.

Clearing areas of endemic species, in both pine and coppice forests, has facilitated the uncontrolled proliferation of invasive plant species, such as the Australian pine (Casuarina spp.). To curtail this trend various endemic plant species, such as the Caribbean pine (Pinus caribea var. bahamensis) and the Lignum vitae (Guiacum sanctum) are protected under the Conservation and Preservation of the Physical Landscape of The Bahamas Act (1997).

Another effort to protect and maintain the biodiversity of the Bahama Islands is the national park system.

Twenty-five national parks, accounting for another 283 300 ha (700 000 acres) of Crown land, are maintained to preserve nature and its ecological function. For example, the Inagua National Park is home to the largest breeding colony of West Indian flamingoes (approximately 50 000); Little Inagua is the nesting location for critically endangered sea turtle species; and the Abaco National Park is the major habitat of the endangered Bahama parrot (BNT, 2005).

2.3.2 Waste Management

2.3.2.1 Solid Waste

In 1998, Bahamians and visitors together generated more than 239 448 tonnes (236 000 long tons) of municipal solid waste annually. New Providence Island contributed about 77 per cent or 184 375 tonnes (181 500 long tons) and Grand Bahama 17 per cent or 40 706 tonnes (40 063 long tons) of this total, leaving only about 6 per cent or 14 331 tonnes (14 105 long tons) annually generated on the other islands. The waste generated in The Bahamas has, for the most part, been disposed of in dumps with little protection from scavengers, vermin or cover material. Indiscriminate dumping along roadsides and on abandoned land is not uncommon, even in the islands with sanitary landfills. (Inter-American Development Bank (IDB), 1998). This situation is due largely to the dispersed nature of the population of The Bahamas on various islands, the volume of waste generated and the number of facilities available to adequately handle its accumulation.

Figure 2.4 Burning of refuse at a dump site

Source: The Bahamas Environment, Science and Technology Commission

The long distances between settlements in the Family Islands have resulted in most settlements having their own primary or formal dumpsites (IDB, 1998). The usual method of disposal is to dump, burn, and push the burned material aside to make space for more waste. There are no proper guidelines or operational plans to assist Local Government in implementing appropriate solid waste disposal. Collection and disposal facilities in the Family Islands are contracted to private firms by the Local Government authorities. Many sites are poorly located in areas such as near airports, residential communities, wetlands, well fields or sites with high groundwater tables. Siting in these areas can pose serious health and aesthetic implications, as well as environmental contamination.

Recently, the Government of The Bahamas has undertaken a comprehensive plan of action to address the shortcomings of the solid waste system in the country. It involves a major expansion of the capacity of the sanitary landfill in New Providence through the establishment of a new solid waste disposal facility on 40.5 ha (100 acres) of land adjacent to the former landfill at Harrold Road. Sixteen sanitary landfills are also proposed for the following Family Islands: Abaco, Andros, Bimini, Cat Island, Eleuthera, Great Exuma, Grand Bahama, Inagua, Long Island and San Salvador. Some, such as those on Bimini and Long Island, have already been constructed.

The new and improved facilities should address many of the concerns that plagued the existing sites. These include scavenging, spontaneous fires, proper fencing to control access to facilities, pests, collection of leachate, illicit dumping, proper sorting and disposal of waste at facilities and improved procedures for the transport of waste to the facilities.

2.3.2.2 Hazardous Waste

Because of the lack of proper facilities for the disposal of potentially hazardous waste, the practice of indiscriminate acceptance of hazardous waste at landfills persists throughout The Bahamas. Materials include used motor oil, automobile batteries, dry cleaning solvents, automobile tires, pesticides, paints, medical waste, asbestos and solvents, all of which are potentially damaging to the environment.

A hazardous waste storage facility is planned for New Providence. It will allow hazardous materials that were previously mixed with municipal waste to be properly identified, treated, detoxified or stabilized, and appropriately handled and packaged for offshore disposal, in accordance with the Basel Convention on

the Transboundary Movement of Hazardous Waste. The facility will be constructed adjacent to the Harrold Road landfill site and capable of storing some 331 tonnes (326 long tons) of materials (IDB, 1998). This storage capacity is sufficient to allow wastes of the more abundant waste classifications to accumulate for about two years prior to shipping a container load of any one classification.

2.3.2.3 Medical Waste

A treatment facility was recently built by a company called Bahamas Waste Ltd. to properly dispose of the approximately 9 500 kg (21 000 lbs.) of medical waste that is generated in New Providence each month. It is estimated that as much as 6 810 kg (15 000 lbs.) of this monthly accumulation is currently not being treated and properly disposed. Most of the medical waste ends up in general landfills (Cromwell, 2004). In some of the Family Islands, health officials have indicated that for disposal, medical waste is burnt in pits or underground caverns.

2.3.2.4 Sewage/Wastewater

One-fifth of the households in the capital city of Nassau are served by sewer collection systems. On the Family Islands, collection is limited to a few small subdivisions and some private developments and hotels. There are some places where liquid wastes are directly discharged to the sea. However, the most common practice is the septic tank system, though many tanks do not always conform to the Building Code. This system usually includes a drain field or a deep injection well that discharges the liquid effluent below the water lens and into the salt water (Bowleg, 2004a).

Periodically tanker trucks collect sewage from the septic tanks of private homes. On New Providence, sludge from septic tanks is collected and taken to the Harrold Road septic and sludge facility for disposal.

The major hotels operate sewage treatment plants that are designed to utilize a secondary treatment process. Typically, the sewage sludge from these plants is drained of excess liquid and then disposed in sanitary landfills. No viable option yet exists to address those hotels on Family Islands that do not have sanitary landfills.

Some resorts recycle the treated wastewater for irrigation purposes; however, in general the wastewater, like brine and stormwater, is discharged into disposal wells for final disposal. These wells exit into cavernous zones, which favour mixing of the effluent with freshwater to dilute and disperse the effluent. The wells used to dispose large volumes of effluent are normally cased down to about 183 m (600 ft). It is assumed that any threat to the environment is nullified, as geophysical and fluid dynamic studies of the receiving zones have not been done (Cant, 1992).

In the older built up areas of Nassau, the current method of wastewater disposal is via conventional sewage collection systems to a deep well injection facility at Malcolm's Park. The normal practice in more recently developed areas is centralized sewage collection, secondary treatment, and subsequent deep well disposal to a depth of about 200 m. Large portions of developed sections of the island are not equipped with sewers; septic tanks are most commonly used.

2.3.3 Freshwater Resources

In The Bahamas the only source of freshwater is rainfall that percolates through the ground and becomes trapped in the Ghyben-Hertzberg lenses (Figure 2.5); therefore, rainfall records are pivotal in estimating the required annual recharge of lenses from which freshwater is extracted.

Rainfall is received mostly between April and November, with a slight variation between the northern and southern islands; the Northern Bahamas receives more rain annually compared to the Southern Bahamas (Table 2.3). The northern islands show a wet period from May/June to October, with June and October being the wettest months. Whereas, in the southern islands, the wet period extends from April/May to October with a pronounced dry period in July and August and October being the wettest month (Little et. al., 1977).

The amount of rainfall received is affected by factors such as closeness to the mainland of the United States of America (USA), size of the island and the frequency of tropical storms. During the winter, the northern islands receive more rain from cold fronts arriving from the USA than the southern islands, due to the warming of cold fronts as they move southward. The colder the front, the more rainfall received.

In the summer, the larger islands radiate more heat and therefore receive more convectional rain from the trade winds than the smaller islands. The Atlantic hurricane season extends between June 1 and November

Table 2.2 Comparison of the quantified freshwater resources

Island	Max. Amount available Daily from All Sources (million Imp gal)	Water available Daily per Person (Imp gal) 2000 Census	Calculated Water Demand** (million Imp gal)	Total Population 2000 Census
Abaco	79.1	6 004	0.66	13 174
Acklins	4.36	10 307	0.02	423
Andros	209.92	27 567	0.38	7 615
Bimini & the Berry Islands	0.17	74	0.12	2 308
Cat Island	6.8	4 393	0.08	1 548
Crooked Island	1.74	5 103	0.02	341
Eleuthera, Harbour Island & Spanish Wells	8.13	721	0.56	11 269
Exuma & Cays	2.9	811	0.18	3 575
Grand Bahama	93.17	1 984	2.35	46 954
Great Inagua	0.86	822	0.05	1 046
Long Island	2.88	978	0.15	2 945
Mayaguana	0.65	2 481	0.01	262
New Providence	**9.63**	**45**	**10.62**	**212 432**
Ragged Island	0.01	145	0.0*	69
San Salvador & Rum Cay	0.1	97	0.05	1 028

Source: Bowleg, 2004b
* Actual calculated water demand = 0.000013 kL (0.00286 Imp gal)
** Calculated based on standard water usage of 0.19 kL (50 Imp gal) per person per day

30 (Little et. al, 1977). Approximately one quarter of the rain received by The Bahamas is from tropical storms and hurricanes (Sealey, 1994). However, the occurrence of hurricanes is unpredictable and they may be more damaging than beneficial due to wind, storm surge and flooding.

In addition to the amount of rainfall, the thickness of the lenses also varies depending on the size of the islands. Larger islands such as Andros, Abaco and Grand Bahama have freshwater lenses with thickness up to 30 m (100 ft) compared to lenses only 3 to 6 m (10 to 20 ft) thick on smaller islands. The known freshwater resources are stored in the centre of thirteen major islands and estimated at 7.7_109 m3 (Cant & Weech, 1986), with more than 90 per cent of them reported to occur within 1.5 m of the surface (Bowleg, 2004b). The freshwater in these lenses remains intact as long as the amount of water extracted does not exceed the amount of recharge through rainfall. Over-extraction leads to the shrinkage of the freshwater lens and a rise in saline water (Sealey, 1994).

The extraction of water from the freshwater lenses is mainly done through trenches and bore wells (Figures 2.6 and 2.7). The best extraction technique depends on a number of factors such as depth of the water table, type of rock, thickness of lens, quantity of water extracted, recharge, monitoring and pollution (Little et al, 1977). In general, extraction of large quantities of water from trenches is cheaper and easier to monitor than boreholes.

The extraction of groundwater started in 1927 with the establishment of the Blue Hill Waterworks that consisted of a well field of 24.3 ha (60 acres) and a pumping station. Since then, a number of well fields have been developed by the Water and Sewerage Corporation (WSC) in New Providence to meet the increased demand for freshwater. Figure 2.8 shows the

Table 2.3 Area and annual rainfall by Island

Island	Area km² (mi²)	Rainfall mm (in)	Island	Area km² (mi²)	Rainfall mm (in)
Abaco	1 681 (649)	1 550 (61)	Grand Bahama	1 373 (530)	1 499 (59)
Acklins	389 (150)	813 (32)	Great Inagua	1 544 (596)	711 (28)
Andros	5 957(2 300)	1 168 (46)	Long Island	448 (173)	889 (35)
Cat Island	389 (150)	965 (38)	Mayaguana	285 (110)	864 (34)
Crooked Island	238 (92)	881 (35)	New Providence	215 (83)	1 346 (53)
Eleuthera	518 (200)	1 143 (45)	Rum Cay	78 (30)	965 (38)
Exuma	290 (112)	1 016 (40)	San Salvador	163 (63)	1 143 (45)

Source: BEST, 1995

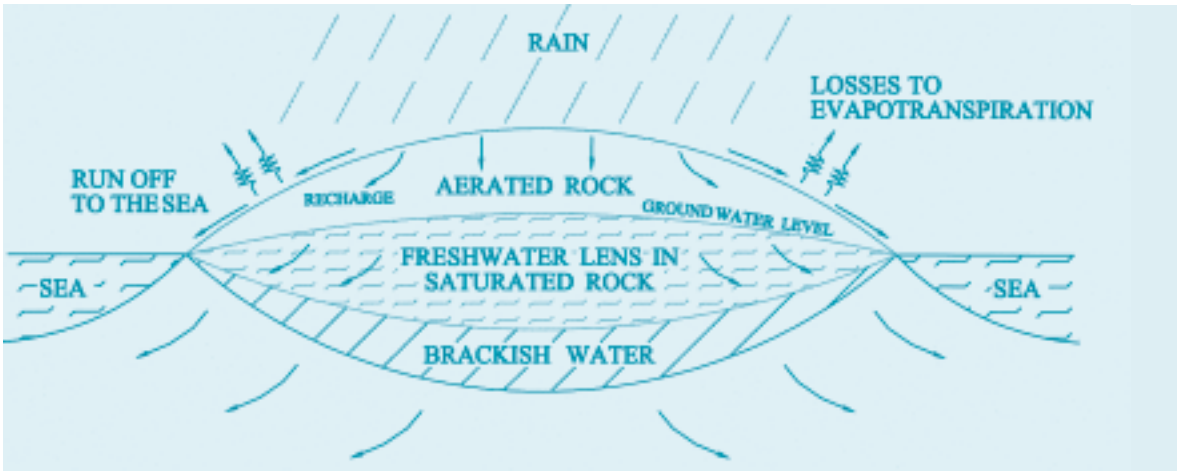
amount of water supplied from various sources on New Providence for the year 2000.

In addition to withdrawal of water from well fields on New Providence that are owned by the WSC, water is also purchased from privately-owned well fields by The New Providence Development Company.

The WSC also imports water from well fields in northern Andros via tankers to meet the shortage of supplies in Nassau. This operation began in 1976, and now approximately 55 per cent of the potable water supply in New Providence is met by water that is transported across 60 km (37 mi) of sea from well fields in Andros. The potable water demand on some islands, such as Harbour Island and Spanish Wells, is met by transporting water through pipelines from North Eleuthera (Sealey, 1994). Potable water is also made available by desalination, a process in which the salts in ocean water or brackish water are removed. Removal of salts is done by two ways: distillation, in which water is boiled, the water vapour condensed and pure water collected; and reverse osmosis, in which saltwater is forced through special membranes to separate salts from water and pure water is collected on the other side.

In 1997, a seawater reverse osmosis plant was commissioned on New Providence. This facility is owned and operated by the Water Field Company Ltd., which sells 7 571 kL (1.7 million Imp gal) of pure water per day to the WSC. This water is mixed with water from the New Providence well fields to produce potable water for distribution.

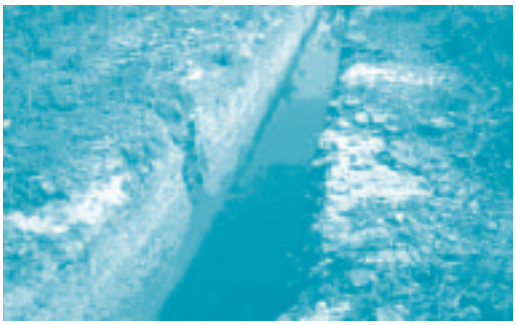
Figure 2.5 Diagram of a Ghyben-Hertzberg Lens



Source: The Bahamas Environment, Science and Technology Commission

Currently, there are a number of small reverse osmosis plants throughout The Bahamas. Many houses, hotels, restaurants and marinas use reverse osmosis, and most of the bottled water in The Bahamas is produced by reverse osmosis. In the settlements of various inhabited islands such as Moore's Island in the Abacos, the Berry Islands, Bimini, Black Point and Farmers Cay in the Exumas and Grand Cay, where there is a lack of adequate water supply from aquifers, the WSC provides water for the residents by reverse osmosis. Reverse osmosis plants are also planned for Long Island, Ragged Island, Rum Cay and San Salvador in the near future.

Figure 2.6 Open trench



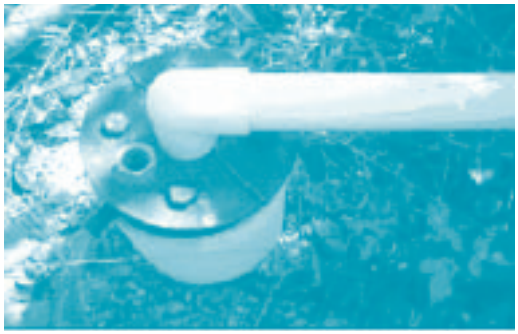
Source: The Bahamas Environment, Science and Technology Commission

2.4 Vulnerability to Natural and Technological Hazards

2.4.1 Introduction

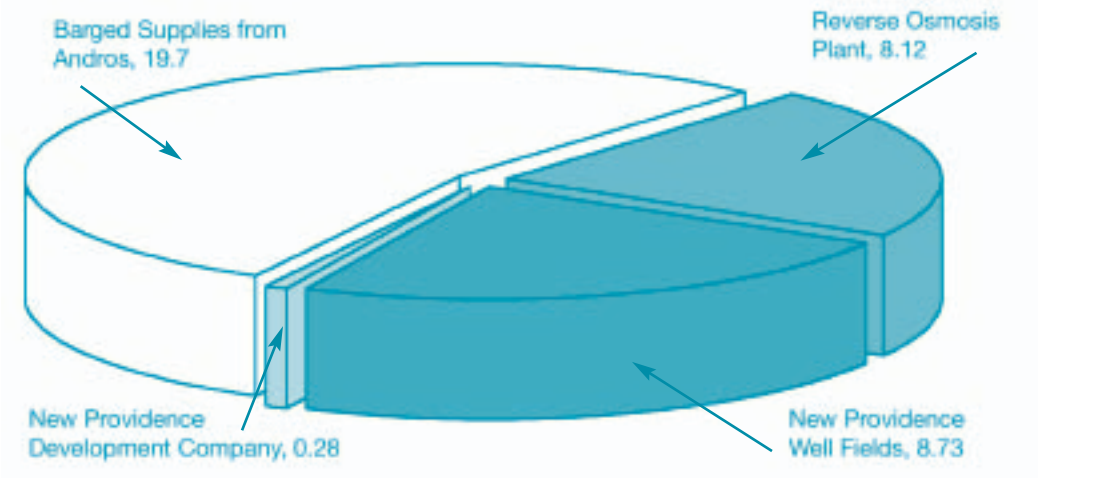
As a low-lying archipelago, The Bahamas is extremely vulnerable to natural disasters, in particular hurricanes. With an economy based on tourism, any hazard can impact the well-being of most of the country's people either through direct impacts, physical or economic, or through economic linkages. A recent working paper from the Organization for Economic Cooperation and Development has indicated that countries such as The Bahamas are extremely vulnerable to natural hazards and that the effects can be long-lasting and may defer or preclude future development possibilities (Dayton-Johnson, 2004). This section will examine various natural and technological hazards as they presently impact, or may impact in the future, The Bahamas.

Figure 2.7 Bore well



Source: The Bahamas Environment, Science and Technology Commission

Figure 2.8 Sources of fresh water (in millions of litres per day) for New Providence during 2000



Source: The Bahamas Environment, Science and Technology Commission

2.4.2 Climate Change

2.4.2.1 Greenhouse Gases and Other Air Pollutants

In March 1996, the National Climate Change Committee of The Bahamas set out to prepare the First National Greenhouse Gas Inventory for the country. Greenhouse gas emissions were calculated for 1990 and 1994 (Table 2.4). Carbon dioxide was the major constituent of these emissions. The main sources of such emissions were electricity generation and transportation. Electricity in The Bahamas is produced through combustion of liquid fossil fuels (gas/diesel oil).

Other greenhouse gases cited in the first inventory for The Bahamas are methane, nitrous oxide, carbon monoxide, and non-methane volatile organic carbon compounds. Compared to carbon dioxide, none of these are emitted in substantial amounts in the country.

Data from the World Resources Institute (WRI) indicate The Bahamas had 1 792 Gg of carbon dioxide emissions in 1998 (WRI, 2003). Of this, 1 788 Gg was derived from liquid fuels, while 4 Gg were from solid fuels. Between 1900 and 1999, 143 000 Gg of carbon dioxide had been emitted in The Bahamas. Other identified air pollutants include sulphur dioxide (2 000 tonnes), nitrogen oxide (2 000 tonnes), carbon monoxide (51 000 tonnes), and non-methane volatile organic compounds [2] (7 000 tonnes) [3]. In addition, the average concentration of small particle matter (PM10)[4] in outdoor urban air was 11 to 15 _g/m3, similar to that of neighbouring North America cities (World Health Organization, 2000); and with two-thirds of the population residing on New Providence, the bulk of the emissions originate from that island.

Air quality is also impacted from sources outside The Bahamas due to the influence of the trade winds. These winds transport dust from North Africa and the Sahara Desert. Persistent toxic substances, such as dichlorodiphenyltrichloroethane (commonly called DDT), may be transported to The Bahamas via these trade winds and enter the environment by precipitation. Bacteria and fungal spores may also be present. The dust from the Sahara has been cited as a factor in the decline in Caribbean coral reefs (Garrison et al., 2003; Shinn et al., 2000; Simpson, 2000; Smith et al., 1996). Coral reefs are resources of considerable importance to the Bahamian tourism industry. Additionally, migratory birds often carry persistent toxic substances that enter the local environment. Data on such transport is limited or unavailable.

Table 2.4 Carbon Dioxide (CO_2) emisions from fossil fuel sources in The Bahamas for 1990 and 1994 in Gigagrams of CO_2

Fuel Type	1990	1994	Per Cent Total
Gasoline	470.7	476.5	25%
Jet Kerosene	55.0	43.6	3%
Gas/diesel oil	802.4	593.5	37%
Residual fuel oil	424.8	696.9	30%
Liquid Petroleum Gas	39.7	40.8	2%
Other oils	101.5	14.9	3%
Total	**1 894.1**	**1 866.2**	**100%**

(1 Gg = 1,000,000,000g) Source: BEST, 200l (b)

2.4.2.2 Global Warming

Increasing concentrations of greenhouse gases are predicted to cause rises in global temperatures. Accompanying these rising temperatures are likely increases in the frequency and intensity of tropical storms and hurricanes, both of which have considerable impacts on The Bahamas. Increased flooding and periodic droughts are also expected to result from global warming. Under changing climate conditions, the Northern Bahamas is expected to receive increases in rainfall, while in the Southern Bahamas it is anticipated that more frequent dry periods or droughts will be experienced (Martin & Weech, 2001). Both flooding and drought will impact tourism. Too much rain will discourage return visitors, while too little may lead to water rationing that could impact those staying in hotels and resorts or the loss of perceived aesthetic appeal of the landscape.

As noted in the First Communication on Climate Change, The Bahamas is very vulnerable to climate change. An archipelago of low-lying islands and cays, The Bahamas is susceptible to storm surges and flooding from both tropical storms and hurricanes. Given that the primary industry of the islands is tourism, which relies heavily on the beautiful waters and beaches, this is very important. The costs of cleanup after increasing numbers of storms would be prohibi-

[2] *These include benzene, toluene, methylene chloride, and methyl chloroform from housekeeping and maintenance products and building and furnishing materials such as solvents, paints, and glues.*

[3] *All data from 1995.*

[4] *Particles of this size can enter the lungs causing ill health.*

tive and impact all levels of the economy through various linkages; furthermore, natural disasters can inhibit growth by destroying capital and diverting resources toward relief and reconstruction (Dayton-Johnson, 2004). This diversion of resources redirects much needed resources from economic development. An increase in the frequency and strength of storms will affect the overall adaptive capacity of the country and weaken it economically.

In addition to the increase in storms, the islands are susceptible to sea-level rise. Many of the islands and cays of The Bahamas would suffer significant damage through very minor sea level rises. Loss of beaches could be devastating to the country's economy. Most of the settlements and infrastructure are located on or near the coast. A rise in sea level will bring these areas into the reach of storm waves and sea surges, increasing the potential for damage. Beach erosion will increase, as will flooding and salinization of soils and groundwater.

Coral reef damage through increased temperatures of the waters of The Bahamas must also be considered, as these reefs are a major part of the tourism package being sold to attract visitors to the country. Increasing temperatures will lead to bleaching of the reefs and pose a threat to the survival of these ecosystems and the life that is dependent on them.

Many mangroves will be impacted by sea level rise as well, though the actual impact is still unknown and some believe that they will be able to adapt (Intergovernmental Panel on Climate Change, 2001). There are extensive areas of mangroves in The Bahamas; many act as buffers to salt water incursions during storm surges, and the loss of, or damage to, such habitats would seriously impact other ecosystems in the country.

2.4.3 Hurricanes

The Bahamas is located in the subtropical region of the North Atlantic Ocean. This means that the country is frequently visited by hurricanes and tropical storms between June and November of each year. For example, recent damage from Hurricanes Andrew, Floyd and Michelle proved costly for the country. In 2004, Hurricane Frances, a category four hurricane (on the Saffir-Simpson scale), stalled over Grand Bahama and caused severe flooding and infrastructural damage. Most of the islands were impacted as its route followed the archipelago. Damages (at the time of writing) were estimated to cost in the area of US$200 million. Shortly after Hurricane Frances (approximately two weeks), another major storm, Hurricane Jeanne, also visited the northern islands and caused further damage on Grand Bahama and the Abacos.

Table 2.5 shows the number of tropical storms experienced by The Bahamas between 1871 and 2000 for selected islands. Clearly, the Northern Bahamas is visited by more of these storms than the central and Southern Bahamas. Additionally, it should be noted that the 1890s and 1930s experienced more tropical storms than in recent years.

Table 2.6 shows a similar set of statistics for hurricanes. In this case, the Northern Bahamas and San Salvador have experienced the greatest number of hurricanes. Inagua has experienced the least number. As with tropical storms, the 1890s and 1930s experienced more hurricanes than more recent years.

Hurricanes cause considerable damage to utilities, roads, docks, bridges, etc. Hurricane Andrew in 1992 led to millions of dollars of damages in The Biminis and Berry Islands. Eleuthera similarly experienced infrastructural and building damage (Department of Meteorology, n.d.).

Hurricane Floyd in 1999 was felt by the more easterly of the islands. Extensive damage was experienced on San Salvador, Cat Island, Exuma and Long Island. Insurance claims from Floyd totaled approximately US$400 million (Jackson, 2003). Also, revenue from 13 000 cruise passengers in the week following the hurricane was lost due to cancelled visits (Jackson, 2003). Most recently, The Bahamas General Insurance Association estimated that insurance claims from Hurricane Frances totaled approximately US$228 million (Matthews, 2004).

Hurricanes impact the tourism industry by decreasing visitors during and in the post-hurricane period. The majority of the tourists visit the northern islands where hurricanes are more prevalent. Revenues for these islands are decreased due to damages to hotels and closures. For example, in the aftermath of Hurricane Frances several hotels throughout The Bahamas (particularly in Grand Bahama) had to be closed for a period of time in order to make repairs and perform cleanup.

Damage from hurricanes and tropical storms can be either direct or indirect as indicated in a recent study prepared for the Caribbean Disaster Emergency Response Agency. Direct damages include those to physical or capital stocks (buildings, piers, roads, etc.) and to environmental goods and services such as

Table 2.5 Tropical storms for selected Islands (1871 - 2000)

Decade	Northern Bahamas			Central Bahamas			Southern Bahamas
	Abaco	Bimini	Grand Bahama	Exuma	New Providence	San Salvador	Inagua
1871-1880	3	2	3	2	3	2	1
1881-1890	2	3	3	2	1	4	3
1891-1900	6	5	6	2	4	2	2
1901-1910	3	3	3	3	2	3	2
1911-1920	5	1	2	-	-	4	-
1921-1930	4	2	3	-	3	1	2
1931-1940	6	5	4	7	6	7	2
1941-1950	2	2	3	3	2	1	2
1951-1960	4	2	4	2	1	3	2
1961-1970	-	-	-	1	-	-	-
1971-1980	1	1	2	1	1	-	1
1981-1990	2	2	2	2	1	1	1
1991-2000	1	3	4	-	-	-	-
Totals	**40**	**33**	**41**	**25**	**25**	**29**	**21**

Source: Data adapted from www.stormcarib.com and www.noaa.gov

Table 2.6 Hurricanes for selected Islands (1871 - 2000)

Decade	Northern Bahamas			Central Bahamas			Southern Bahamas
	Abaco	Bimini	Grand Bahama	Exuma	New Providence	San Salvador	Inagua
1871-1880	3	2	3	2	3	2	1
1881-1890	2	3	3	2	1	4	3
1891-1900	6	5	6	2	4	2	2
1901-1910	3	3	3	3	2	3	2
1911-1920	5	1	2	-	-	4	-
1921-1930	4	2	3	-	3	1	2
1931-1940	6	5	4	7	6	7	2
1941-1950	2	2	3	3	2	1	2
1951-1960	4	2	4	2	1	3	2
1961-1970	-	-	-	1	-	-	-
1971-1980	1	1	2	1	1	-	1
1981-1990	2	2	2	2	1	1	1
1991-2000	1	3	4	-	-	-	-
Totals	**40**	**33**	**41**	**25**	**25**	**29**	**21**

Source: Data adapted from www.stormcarib.com and www.noaa.gov

aquifers, reefs, sea grass beds, etc. In the study, it was estimated that the replacement value for hotel rooms totaled US$1 300 million (Jackson, 2003). In addition, a case study conducted by the Water and Sewerage Corporation after Hurricane Frances revealed that chloride levels in the freshwater well fields of North Andros increased dramatically. The target potable salinity level is 600 mg/L; however, the storm surge associated with Hurricane Frances raised the salinity level range to 1 300 – 15 000 mg/L (Bowleg, 2004c). This affected daily imports into New Providence, and subsequently potable water was rationed throughout the island for approximately three weeks.

Indirect damages include the loss of guest revenue and the subsequent job losses, including those in hotels and other services that are centred on the tourism industry. Additionally, there are secondary impacts including a reduction in the gross domestic product and a change in the country's balance of payments.

Salinization of soils and loss of vegetation also occur as a result of hurricanes. This directly impacts agriculture by destroying crops and delaying planting seasons, resulting in loss of revenue for farmers. In addition, tourism is indirectly affected by damage to and the loss of vegetation and delayed growth due to salt damage and strong winds that impact the beauty of the islands.

2.4.4 Floods

Storm surges as a result of tropical storms and hurricanes are the principal causes of flooding in The Bahamas (Bowleg, n.d.). The islands are low-lying (80 per cent are less than 1.5 m above mean sea level) making them extremely vulnerable to surges associated with these types of storms. Storm surges produce the greatest amount of flooding leading to damage to property and infrastructure and to loss of life through drowning (BEST, 2001). Flooding also leads to contamination of wells and aquifers, directly impacting freshwater supplies on the island.

Infilling and destruction of mangrove habitats also affect flooding on the islands. Increasing population pressures on both inland and coastal mangroves will affect future flooding conditions. Mangroves help preserve coastlines, providing natural wind and water breaks and protecting the shoreline from severe erosion during hurricanes and tropical storms.

Floodwaters in The Bahamas are also associated with seasonal rainfall. Rainfall is heaviest in the period from June through October each year. These rains are frequently heavy and when accompanied by high tides the situation is worsened. According to Bowleg (n.d.), most flooding occurs south of the Nassau Ridge on New Providence, where land is flat with some depressions that collect water. The runoff from the ridge during heavy rains leads to flooding.

Salt water from storm surges contaminates the soil and groundwater, killing vegetation and making groundwater undrinkable. Removal of coastal wetlands for development increases the chances of such contamination, as they are natural protective barriers of inland resources.

The Department of Meteorology has indicated that as little as 37.5 mm (1.5 in) of rainfall over 6 hours can lead to flooding in parts of New Providence (Bowleg, n.d.). In the future, flooding of all the islands may be impacted by factors such as changes in climate, increased numbers of tropical storms and hurricanes and rising sea levels. The exact level of such impacts has not been estimated, but the costs to the economy in damages to homes and infrastructure, and through both direct and indirect linkages to the tourism industry, could be considerable.

2.4.5 Spills

The Bahamas is dependent on the import of petroleum products for electricity generation and transportation purposes. Freeport and South Riding Point in Grand Bahama, Clifton Pier in New Providence and the distribution facilities in the inhabited Family Islands are sites of domestic oil-related activities within The Bahamas. Additionally, 3 million tonnes of fuel are stored on Grand Bahama every year for transshipment to areas outside of The Bahamas (BEST, 2001b).

There is a high density of marine traffic passing from the North Atlantic and the east coast of the USA to and from the Gulf of Mexico. Oil tankers in the waters of The Bahamas mean that there is always the potential for oil spillage. The larger tankers cannot travel over the shallow banks of The Bahamas and fuel must be transferred to smaller vessels in order to deliver the necessary fuel to many of the Family Islands. Transshipment of fuel from large tankers to smaller ones leads to further vulnerability to oil spills. Every transfer has the potential for some spillage.

In the main ports of Nassau and Freeport, cruise liner and container ship activities also pose a daily risk of accidental spills. Relatively small spills of bunker

oil from these vessels could cause considerable clean up problems, as well as contamination of environmental, fisheries and amenity resources (Bahamas Government, 1999).

In 2003, seven spills of petroleum-based products to marine waters, representing over 3800 L of contaminants, were reported (DEHS, 2003). The effects of these spills have not been assessed; however releases of these contaminants into the marine environment have the potential to cause the loss of marine life and damage to the coral reefs of the islands. This would have significant impacts on tourism and fisheries.

Spills of gasoline are contaminating the groundwater in parts of New Providence. Since 1997, the Department of Environmental Health Services has received several complaints of the presence of petroleum products either in private wells or inside telecommunication manholes located in close proximity to service stations (Ryan, 2005). Unfortunately, the extent of the contamination is not known and a remediation plan has not been developed.

2.4.6 Fires

According to data provided by the Royal Bahamas Police Force Fire Services, there was a 45 per cent increase in the number of factual incidents (that is calls responded to, excluding false alarms) reported between 2003 and 2004. In 2004, fires were responsible for an estimated US$9.98 million in damages in the Northern Bahamas (Royal Bahamas Police Force, 2005). There were 1 994 factual incidents reported in New Providence, with garbage and bush fires accounting for over 60 per cent of the calls. The data also shows a decrease in the number of reported fires occurring on New Providence between 2000 and 2004, followed by a marked increase in 2004. However, there is no apparent explanation for the recent change in trend. In the other northern islands, 2004 also had a noticeable increase (71 per cent) in factual incidents reported when compared with 2003. In 2004 there were 894 factual incidents reported and over 80 per cent were bush, garbage or structural fires. Damage estimates for these islands were US$2.1 million. Overall, most of the reported incidents for the northern islands can be attributed to anthropogenic causes (Table 2.7).

Table 2.7 Fire incident reports for the Northern Bahamas

Type of Incident	New Providence		Other Northern Islands	
	2003	2004	2003	2004
Bush	301	534	234	519
Electrical	35	52	27	35
Refuse	566	742	58	104
Structural	217	252	77	104
Vehicle	221	238	70	73
Other	124	176	58	59
Total	**1 464**	**1 994**	**524**	**894**

Source: Data adapted from the Royal Bahamas Police Force Fire Services, 2005.

GEO

Policy Response

Chapter 3

3.1 Introduction

The combination of the population growth and the increasing numbers of visitors places development pressures on the country's natural resources. Such pressures have made it necessary to develop legislation, policies, strategies and management systems in order to preserve the country's resources.

Generally, management of environmental issues in The Bahamas has been the responsibility of public agencies such as the Departments of Environmental Health Services (DEHS), Agriculture and Fisheries and the Bahamas Environment, Science and Technology (BEST) Commission. In addition, there is an increasing growth in the number of non-government organizations (NGOs) becoming advocates of the environment.

The various issues affecting the environment, including weak and outdated legislation, has made government responsiveness more reactive than proactive. Legislation, in many cases, fragments the management of environmental issues among several public agencies, resulting in a lack of coordination for programme and policy planning and a limited level of responsiveness.

To address the issue of an integrated approach to environmental management The BEST Commission was established in 1994. In general the mandate of the BEST Commission includes the coordination of the national effort to:

- protect, conserve and responsibly manage the environmental resources of The Bahamas;
- develop a National Sustainable Development Strategy and related Action Plans;
- identify suitable scientific and technological advances that can contribute to the development of The Bahamas;
- propose legislation to enforce the provisions of the National Conservation Plan environmental policies; and,
- identify and make application for technical assistance and financial grants to meet the Commission's responsibilities. [5]

Fulfillment of the above mandate is often hampered by the lack of human resources coupled with the volume of work, as well as the absence of statutory authority.

[5] *BEST Commission website: http://www.best.bs/about_us.htm*

To rectify the inadequacies of fragmented management and ineffective programme planning and coordination, Government is proposing the introduction of a bill to establish a Department of Environmental Planning and Protection. The Department will be charged with managing issues related to the environment such as land use planning, environmental protection standards, disposal of waste, environmental accidents and emergencies, environmental education, research and enforcement (BEST, 2001a). In this draft bill, "The Minister is charged with the responsibility of ensuring the integrated protection of the environment of The Bahamas and ensuring the sustainable management of natural resources" (BEST, 2001a)

This chapter will review and provide analysis of current policies and legislation affecting the environment and their effectiveness. It will examine policies and legislation relating to: coastal environment, marine environment, land, tourism, water, waste management, natural and technological hazards, non-profit organizations and international conventions.

3.2 Coastal Environment

The administration and monitoring of the country's coastal environment is an inter-agency activity involving the following government agencies: Port Department, Department of Environmental Health Services (DEHS), Lands and Surveys Department and the Ministry of Works and Utilities. This combined administration results in duplication, fragmentation and inconsistency of efforts. While this inter-agency administration allows agencies to contribute to issues affecting their individual portfolios, it slows responsiveness for example permission to dredge to construct a dock requires input from several government agencies. An application to dredge between the high and low water mark is submitted to the Department Lands & Surveys. A permit is issued for the activity by the Department, after consultation with the Port Department, the Department of Fisheries and the BEST Commission (particularly if an environmental impact assessment (EIA) was reviewed by the Commission for the project).

A major piece of legislation overseeing coastal preservation and maintenance is the Coast Protection Act (1968). This Act gives the Minister responsible for ports and harbours the power to carry out works for the protection of the coast, and mandates publication of the specifics pertaining to maintenance work being conducted. The Act also allows the Minister to recover charges relating to coastal maintenance from owners of land abutting onto the coast.

However, the Coastal Protection Act does not impose any punitive fees for the degradation of coastal zones. Moreover the Act has never been amended, despite many new environmental issues and concerns.

Other legislation protecting the coastal environment are found in the Roads Act (1968), Ports Authorities Act (1966), Abutments Act (1864), Abutments (Out Islands) Act (1883), Fisheries Resources (Jurisdiction and Conservation) Act (1977), Agriculture and Fisheries Act (1963), Environmental Health Services Act (1987), The Bahamas National Trust Act (1959) and the Land Surveyors Act (1975).

Government efforts to protect coastal environments include partnerships with international conventions such as the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), Convention on Biological Diversity, United Nations Convention to Combat Desertification (UNCCD), and the United Nations Framework Convention on Climate Change.

At the regional level, The Bahamas participated in the Caribbean Planning for Adaptation to Climate Change (CPACC) project. CPACC was designed to improve the data available on the likely impact of climate change, including data necessary for the protection of local coastlines. Another activity of the project was reef monitoring, in which The Bahamas was involved. The Department of Fisheries conducted the local reef monitoring (BEST, 2001b). The CPACC project has evolved into the Mainstreaming Adaptation to Climate Change Project (MACC). This project is funded by the Global Environment Facility (GEF) and other donor agencies and is managed by the Caribbean Community (CARICOM) Secretariat through a Project Implementation Unit. It has four components: downscaling of models to give better definition for small islands and vulnerability and risk assessment methods; development of adaptation strategies for food security and inclusion of climate change in EIAs; development of national and regional strategies and action plans; and public education and outreach programmes.

3.3 Marine Environment

Protection and conservation of marine life in The Bahamas is a partnership between public agencies and non-government organizations (NGOs). The management of the marine environment and issues affecting it, however, is the responsibility of the Department of Fisheries. Initial legislation to manage the local marine environment was enacted in 1963, the Agriculture and Fisheries Act (1963). This Act grants the Minister of Agriculture and Fisheries jurisdiction on marine matters, specifically the power to enter into contracts issues relating to the marine. Conservation, management and regulations are addressed in the Fisheries Resources (Jurisdiction and Conservation) Act (1977). This Act designates exclusive fishery zones, prohibits foreign fishing except with a license issued by the Minister of Agriculture and Fisheries, and stipulates regulations for commercial Bahamian fishing vessels. This Act grants designated officers of the Department of Fisheries, as well as law enforcement officers, powers to inspect, seize and arrest.

Emerging marine environment issues necessitate that legislation remain current. The amended Fisheries Resources (Jurisdiction and Conservation) Regulations were enacted in 1986 and emphasized conservation of marine species. These regulations prohibit the possession of poisons and firearms for use in the exclusive fishery zones and the use of spearfishing apparatus and nets. These regulations also introduce a closed season for crawfish, outline the minimum size of crawfish and mandate permits for crawfish trapping.

The Fisheries Resources (Jurisdiction and Conservation) Regulations also introduced closed seasons for turtles and stone crabs while setting measurements for sponges and prohibiting the possession of underdeveloped conch. Rules relating to the export of both conch and crab were outlined. These regulations mandated that permits are necessary to engage in aquaculture and sportsfishing.

In preparation for its obligations under the Law of the Sea Convention, a new Fisheries Act has been drafted. This draft Act defines government's policy regarding the utilization and management of the fisheries resources within the fisheries zones. This Act is coupled with new fisheries regulations to better conserve and manage the fisheries resources and the fishing industry. The draft Act and regulations will "ensure that the fishing industry is managed and developed on a sustainable basis for the maximum benefit of the Bahamian people." [6]

The regulations stipulated that factories and premises must be both inspected and approved and conditions which must exist before a license to operate a fisheries plant is granted. Further legislation on the processing and preserving of fishery resources is outlined in the draft Bahamas Fish Inspection Regulations

[6] *Briefing Document – Department of Fisheries 2003 Page 19*

which have been prepared and reviewed by the Government. These Regulations will govern the processing of seafood and is considered an urgent matter by the Department of Fisheries. [7]

While the Fisheries Resources (Jurisdiction and Conservation) Regulations and The Fisheries Resources (Jurisdiction and Conservation) Act (1977) grant powers of enforcement to the Department of Fisheries officer, enforcement remains a challenge. Obstacles to enforcement include the small number of officers currently employed, the archipelagic nature of the country and the other responsibilities and demands imposed on assisting public agencies such as the Royal Bahamas Defence Force and the Royal Bahamas Police Force.

With the ever increasing demand for certain species, a number of projects have been undertaken by the Department of Fisheries to optimize sustainable yields while not endangering future harvesting of crawfish, stone crab and conch fisheries. Recent initiatives by the Department of Fisheries for the protection of marine life from exploitation and extinction include the development of a management plan for queen conch (Strombus gigas). In 2003, Government enacted legislation to prohibit the fishing of the Nassau grouper (Epinephalus atriatus) during its spawning season. This combined with the allocation of 20 per cent of shallow water habitats, as "no take zones" in 1999 to protect spawning aggregation sites and critical habitats were governmental efforts to preserve the country's marine environment.

The draft Marine Mammal Act and Regulations are initiatives intended to provide jurisdiction, protection and conservation of marine mammals. Regulations under this act will provide for the proper care and maintenance of captive dolphins in The Bahamas and the conditions under which captive dolphin facilities can operate.

While partnerships exist between government and NGOs for the protection of marine resources, government alone has the right to explore the continental shelf. The Continental Shelf Act (1970) allows for the exploration of natural resources while, simultaneously, protecting the continental shelf by prohibiting ships from travelling in specified areas. The Act allows for parties to be penalized for the discharge of oils to the sea, as does the Merchant Shipping Act (1976). The latter act, though enacted in 1976, did not come into effect until 1989, to comply with the International Convention for the Prevention of Pollution of the Sea by Oil.

The penalty imposed for pollution of the sea by the Continental Shelf Act (1970) is a fine of less than US$3 000. The Continental Shelf Act (1970) is administered by the Department of Fisheries, while the enforcement and monitoring is controlled by the Department of Environmental Health Services (DEHS).

The Water Skiing and Motor Boat Control Act (1970) regulates the use of marine waters for recreational purposes. This Act places restrictions on water skiing and driving motorboats, outlines safety restrictions and grants power to peace officers. Enforcement of this Act is granted to the Minister responsible for maritime affairs, but enforcement powers are granted to peace officers and persons authorized (by the Minister) in writing to enforce the provisions of the Act. No single public or private agency is charged specifically with enforcement. Successful prosecution for offences related to watercraft operations requires the cooperation between relevant government agencies such as the Port Authority, the Royal Bahamas Police Force, the Royal Bahamas Defence Force and, occasionally, the Ministry of Tourism. While the monitoring of recreational water vehicles and their potential to cause water pollution is unlegislated, the Merchant Shipping Act (1976) addresses water pollution by large vessels. The monitoring of harbours and marinas for pollution is the responsibility of DEHS.

In 2004, the Minister of Transport and Aviation indicated "that the New Providence Port Authority Board has been plagued with many challenges since it took office a year ago, including the control and regulation of watercraft operating in and around New Providence" (Thompson, 2004). In an attempt to control and regulate watercraft, a limit was placed on the number of licenses granted for operation of watercrafts especially jet skis.

3.4 Land

With a total of 15 000 km2 (5 792 mi2) of land in the country, the management and monitoring of land use, particularly Crown Lands, for agriculture and development is the responsibility of Government. This responsibility is divided among separate government agencies depending on the purpose for which the land is being used.

Current parliamentary Acts affecting land management divides this responsibility among Government agencies such as: Departments of Agriculture,

[7] *Fisheries Briefing Document 2002*

Environmental Health Services, Lands and Surveys, the Water and Sewerage Corporation, and the Ministry of Works and Utilities. The only non-governmental agency mandated by an Act of parliament to manage land is the Bahamas National Trust.

The Department of Agriculture, of the Ministry of Agriculture Fisheries and Local Government, is responsible for the production, harvesting and marketing of food, and the protection of animals and birds. One of its major responsibilities is the management of land for agriculture. Among its other responsibilities are: horticulture, quality control of food and beverage, protection of plants, veterinary services and animal diseases, public markets, slaughterhouses and agricultural land.

The Department of Environmental Health Services (DEHS), a department within the Ministry of Health and Environment, has as its mandate "the conservation and maintenance and promotion of the environment". [8] DEHS is comprised of five sections: Environmental Sanitation Land Consumer Protection (Health Inspectorate), Environmental Risk Assessment and Monitoring (Public Analyst Laboratory), Solid Waste Management, Grounds Beautification (Roads and Parks) and a general administration section.

The Director of DEHS has the overall function of coordinating the activities in each section, as the nature of work differs. For example, the Environmental Sanitation Land Consumer Protection section has responsibility for the vector control and functions both as an enforcement agency to control the prevalence of vectors and works with other public agencies to eliminate incidences of indiscriminate dumping, land clearing, demolition of dilapidated structures and the management of derelict vehicles. The Environmental Risk Assessment and Monitoring section provides the analytical laboratory services, monitoring among other things, sewerage facilities, costal water quality, and chemical and petroleum base pollution.

Under the ministerial portfolio of the Office of the Prime Minister (OPM), the Department of Lands and Surveys (DLS) is responsible for all Crown Land (DLS, 1998). This responsibility includes the disposing and leasing of Crown Lands, including the seabed, while protecting Crown and Government interest and encouraging a balance use and preservation (BEST, 2002). Some of the other functions of the Department include estate management, land surveying, photogrammetry, and reproduction photography. Using the Acquisition of Land Act (1957) as its legal framework, it also advises on the evaluation of land and the recording of land documents. In addition to the land management component, the department advises on permits to dredge the seabed. The Department is divided into four units: Forestry, Valuation, Land Management and Surveying and Mapping.

The Water and Sewage Corporation, working along with DEHS, contributes to the preparation of land use plans and physical planning activities. This includes the designation and protection of areas as well fields and the provision of water and sewerage systems for residences, private resorts and subdivisions.

The Ministry of Works and Utilities has the responsibility of monitoring and enforcing many aspects of urban development on New Providence through its various departments. The Building Control Unit approves and issues building permits for the construction of new buildings after reviewing building plans. The Department of Physical Planning advises the Town Planning Committee on major developments like subdivisions and road construction. It also has responsibility for issuing permits to excavate/mine land and for permits to harvest protected trees. Enacted legislation such as the Private Roads and Sub-divisions Act (1961), the Town Planning Act (1961) and the Building Regulation Act (1971), facilitates the ministry's mandate.

Established as a non-profit, non-governmental organization in 1959 by the Bahamas National Trust Act, BNT has a parliamentary mandate to build and manage the country's national park system (BEST, 2002). There are currently 25 national parks totalling approximately 283 300 hectares (700 000 acres) under the management of the Trust.

Other legislation relating to land management includes: the Water and Sewerage Corporation Act (1976), Environmental Health Services Act (1987), Land Surveyors Act (1975), Plants Protection Act (1916), Wild Birds Protection Act (1952), Wild Animals (Protection) Act (1968) and the Conservation and Protection of the Physical Landscape of The Bahamas Act (1997). The jurisdiction of some of these acts, however, is limited only to New Providence. The Grand Bahama Port Authority controls issues affecting land and development in the Freeport Area of Grand Bahama. Local Government, in each respective Family Island, controls those issues affecting land in Grand Bahama outside of the Freeport Area and land in the other Family Islands. Enacted legislation, such as the Freeport Bye-laws Act (1965) and the Private Roads and Sub-divisions (Out Islands) Act (1965),

[8] *Document compiled by DEHS* January 2005

assist the Grand Bahama Port Authority and Local Governments in land management.

The triple responsibility of management, monitoring and enforcement remains a challenge to Government because of the many agencies involved. The Division of responsibilities has resulted in blurred jurisdictional lines and overlapping of both duties and efforts. Moreover, in many cases legislation and penalties are outdated.

To eliminate current land management inadequacies, government recently advanced a resolution in Parliament, which would allow it to borrow US$3.5 million from the Inter-American Development Bank (IDB). This loan will facilitate land administration reform.

This reform project will consist of several components including technological upgrades to the Department of Lands and Surveys, and the establishment of a Project Coordinating Unit in the OPM. As another part of the project, Government will establish National Land Issues and Policy Guidelines, which will begin the development of a comprehensive land policy. [9]

3.4.1 Agricultural Land

The Government instituted an Agricultural Land Policy in 1992 to aid in the diversification of the economy, to reduce food imports and to achieve greater self-sufficiency. A component of the policy includes leasing government-owned land and Crown Land, for agriculture. Under this policy, the Government had initially earmarked 146 km2 (56 mi2) of land to be used for agricultural purposes. This policy allows Crown Land to be leased for periods of twenty-one years. Additionally, the policy also allows for agricultural loans (through the Bahamas Development Bank), duty exemptions, provision of training, and other incentives (Ministry of Agriculture and Fisheries, 1992).

3.4.2 Land for Housing

The Town Planning Committee approves use of land for building. This committee is governed by the Town Planning Act (1961), which grants the Minister of Works and Utilities authority to prescribe areas for building, to restrict and forbid construction in some areas, and makes it illegal to erect buildings or make changes to buildings without the approval of the committee. The Act appoints an architectural committee, which advises the government on architectural design, building in historic areas of Nassau, and mandates prosecution for procedural violations. The Act, however, lacks a comprehensive land use policy. A new draft Town Planning Act proposes to:

- Prepare and adopt a land use policy for New Providence;
- Facilitate public participation in planning and land use matters;
- Formalize the types of projects requiring Environmental Impact Studies;
- Extend the boundary of the Historic Nassau District and,
- Designate Historic Districts in the Family Island (BEST, 2001b).

The Private Roads and Subdivisions Act authorizes approval of the Minister of Works and Utilities to develop new roads and subdivisions and governs the development of subdivisions. Private companies and individuals develop subdivisions using privately acquired land, and occasionally publicly-acquired Crown Land. Land used to develop government-owned subdivisions is generally Crown Land (Gordon Major, personal communication, December 2004). Using maps and plans obtained from the Department of Lands and Surveys, the Department of Housing of the Ministry of Housing and National Insurance is able to identify available lands. A plan of the proposed subdivision is developed, and submitted to the Department of Physical Planning, Department of Environmental Health Services (DEHS) and other relevant regulatory agencies for approval. The Buildings Regulation Act (1971) authorizes the granting of building permits, and stipulates the building code.

3.4.3 Protection and Conservation Land

Protection and conservation of the country from over-development and overexploitation of its natural resources are generally the responsibility of the government. Government initiatives to protect the beauty and fauna of the country are driven by the consideration of several draft policies, including one on wetlands that is intended to promote conservation

[9] *Rupert Missick. The Tribune, Thursday March 3rd 2005. Page 3*

of areas such as the Inagua National Park. The establishment of a national park system, with its recent expansion to 25 seeks to preserve the natural terrestrial and marine resources of The Bahamas, through management by the Bahamas National Trust. These Crown Lands are leased on a 99-year basis.

A draft Forestry Act is being considered which would provide "a legal framework for the long-term management of forests in The Bahamas through the establishment of a government forestry agency and a permanent forest estate subject to scientific management and the licensing of timber–cutting activities" (BEST, 2001b). This Act is in response to the increasing loss of local pine forests despite Government's attempts to regulate and limit the cutting down of native trees.

Government protection of wild birds is addressed in the Wild Birds Protection Act (1952). This Act allows for the use of Crown Land or privately owned lands to establish reserves for wild birds, the appointment of game wardens, the granting of hunting licenses and the imposition of penalties for violators of the Act. The Government imposed hunting season controls the catching and hunting of bird species. The protection of some endangered species and wild animals residing in the forests is limited by government bans. The imposition of open and closed seasons allows the species to maintain its populations. Effectiveness is questionable, however, as there is insufficient wardens and forest officers to monitor the enforcement of this Act.

In addition to local efforts, The Bahamas is a contracting party to a number of international agreements affecting land management including, the United Nations Convention to Combat Desertification (UNCCD), and the Convention on Biological Diversity (CBD)

3.4.4 Land for Touristic Resorts

The Department of Lands and Surveys in the Office of the Prime Minister is responsible for all Crown Land, seabeds and subsoils in the submarine land areas adjacent to the Bahamian coasts. Crown Land for tourism development is available for lease as part of the government's National Investment Policy.

Persons proposing to use Crown Land or privately owned land for tourism development must submit an environmental impact assessment (EIA) indicating current conditions of site and possible implications of the development on the environment and measures to mitigate them. Authorization to proceed with the proposed development requires numerous forms of consent, including approval of the EIA and the issuance of various permits (such as dredging and building permits).

3.4.5 Industrial Land

Currently, Government has 10.5 ha (26 acres) of land designated for industrial development. This area is called the Soldier Road Industrial Park. Permission to lease land available in this park is granted by the Bahamas Agricultural and Industrial Corporation (BAIC), a quasi government entity. Tenants of land include various light manufacturing companies which produce products such as paper, shoes and t-shirts.

BAIC obtained a Crown Land grant of 40.5 ha (100 acres) in southern New Providence to develop a second industrial park. This development is known as the Agro Industrial Park (Joyce Treco , personal communication, December 2004). Land will be available in allotments of 0.4-0.8 ha (1-2 acres), and leases granted for periods of ten or more years. Types of business activities to be conducted in the industrial park include a plant nursery, food processing, and roof tiling companies, as well as agricultural businesses.

3.5 Tourism

No single legislation directly addressing both tourism and its related development, and the treatment and protection of the environment by tourist activities exists. Tourism issues that have indirect environmental effects are addressed in legislation like the Immigration Act, which outlines the conditions in which non-Bahamians may visit or reside in The Bahamas, and the Hotels Encouragement Act.

Using the Hotels Encouragement Act as its legal framework, the Ministry of Financial Services and Investments seeks to further develop the tourism industry. According to the Office of the Prime Minister (n.d.), in order to cultivate an investment friendly climate, a National Investment Policy was developed to guarantee:

the complementarity of Bahamian and overseas investments, fosters appropriate linkages with all sectors of the economy, in particular, the tourism and financial services sectors; encourages the exploitation of our natural resources in an environmentally sound and sustainable manner; provides for the maximum level of

employment, guarantees an acceptable level of economic security and generally fosters the economic growth and development of The Bahamas

The Office of The Prime Minister administers the National Investment Policy, which encourages use of the country's natural resources for tourism development. These resources must be protected from overuse and exploitation. Therefore to assist in this protection, environmental impact assessments (EIAs) are mandatory for large-scale development proposals using the human and natural resources of The Bahamas. The Bahamas Environment, Science and Technology (BEST) Commission reviews these EIAs, which are prepared using pre-approved expertise of reputable companies. The current guidelines for developing EIAs were designed through collaboration with relevant public agencies and consultants (Office of the Prime Minister, n.d.).

Within the Ministry of Tourism two units were created to incorporate environmental management and awareness into the industry: the Eco-tourism and the Sustainable Tourism units. The Eco-tourism Unit was established after the Earth Summit (Rio de Janeiro Brazil, 1992) to promote eco-friendly initiatives in The Bahamas and to cater to a niche market (S. Cox, personal communication, April, 2005). The latter unit was established to implement some of the recommendations emanating from "A Sustainable Tourism Policy, Guidelines and Implementation Strategy for the Out Islands of The Bahamas", which was produced in 1994 through the assistance of the Organization of American States (E. McPhee, personal communication, April, 2005).

3.6 Freshwater

The Water and Sewerage Corporation (WSC) was mandated by the Water and Sewerage Corporation Act (1976) to:

- provide water supplies for domestic and other uses, and provide adequate drainage and disposal of sewage and other effluents;
- extend the systems in the country;
- ensure and control the optimum development and use of the water resources; and,
- serve as advisor to the Minister responsible for water and sewerage, draft regulations, register users etc.

The protection and management of fresh water is essential as availability is "scarce", according to United Nations criteria (US Army Corps of Engineers, 2004). Existing freshwater resources are from shallow aquifers, which are often inadequately protected. Over the years, issues affecting fresh water supply such as well field squatting, septic tank construction, and private well construction have surfaced. The inadequacy of legislation makes it difficult to deal efficiently with these problems. There are no application requirements for well digging. Along with this, the country's fresh water supply is jeopardized by pollution resulting from poorly constructed septic tanks and soakaways. The Water Resources Assessment of The Bahamas states, "issues affecting the country and the ground water resources could be controlled by proper land use legislation" and recommends a comprehensive "land use policy that is complimentary to legislation of specific sectors" (US Army Corps of Engineers, 2004).

This assessment also recommends public awareness and recycling programmes. It recommends the education of residents regarding the importance of ground water protection and the proper construction of soakaways and septic tanks as initiatives geared to protect and manage water resources. Legislation to ensure safe use of pesticides should be enacted to prevent the contamination of ground water. No studies have been completed to determine the effect of pesticide use on ground water.

According to the US Army Corps of Engineers (2004), regulatory strategies for protecting and preserving the ground water, as outlined in a 2003 study conducted by Water and Sewerage Consultants, include the following:

- ground water should be treated as a strategic national resource and afforded protection from over-abstraction and pollution;
- enactment of proposed regulatory instruments to, among other things, control well field squatting, septic tank and soakaway construction, private well permitting, sewerage treatment, land zoning for sewerage installation and operation;
- threats to ground water in each island should be addressed using the appropriate regulatory instruments and level of regulation to effect change in abstractors and polluters, while affording the appropriate degree of ground water protection; and,

- establishment of a new environmental regulatory body to regulate certain activities involving ground water abstraction. This new body should fall within the Ministry of Health and Environment.

These regulatory strategies presently exist under the Bahamas Building Code and the Environmental Health Services Act (1987).

The current legal and institutional framework for water management is incorporated in legislative acts regulating the Ministry of Health and Environment, and the Ministry of Works and Utilities. This shared responsibility grants The Department of Environmental Health Services, through the Environmental Health Services Act (1987) and the Health Services Act (1914), input in the testing of water resources. The Ministry of Works and Utilities, through the Building Regulations Act (1971) is charged with the preparation of land use plans and physical planning that affects water. The Ministry of Trade and Industry is responsible for monitoring consumer affairs relating to the provision of water along with the Public Utilities Commission (PUC), which was created in 1993 by the Public Utilities Commission Act (1993).

It is challenging to create and implement a national development plan for water resources with so many agencies sharing in the management process. It has been proposed under the Draft Bill for the creation of the Department of Environmental Planning and Protection that a plan for the sustainable management of groundwater will be developed, applied and updated by the Department with the assistance of the WSC and the Ministry of Public Works and Utilities. Activities to be undertaken under this plan would include an inventory of groundwater resources and their properties, and the establishment of conservation, water quality and development objectives (BEST, 2001a).

3.7 Waste Management

The responsibility for solid waste management, including its collection and disposal, falls under the jurisdiction of the Department of Environmental Health Services (DEHS). The Environmental Health Services Act (1987) provides the regulatory framework for waste management in the country. On the Family Islands, the Local Government Act (1996) allows local governments to be responsible for solid waste collection and disposal.

As the country continues to import most of its consumer goods, and as development increases, the need to manage waste is critical. In 1998, the Government implemented the Solid Waste Management Programme. This programme was facilitated by a loan from the Inter-American Development Bank (IDB). It involves the design of an efficient, financially sustainable and environmentally conscious waste management system for The Bahamas.

An activity of this programme involves the creation of landfill sites on New Providence and major Family Islands. Essential to this programme is the maintenance and sustainability of this solid waste system; therefore a "tipping fee" has been imposed on users of solid waste landfill sites. This "tipping fee" requires that users pay a tonnage rate for waste being disposed, with different rates assigned for the various types of wastes.

Additionally, government is examining the implementation of an environmental levy for imported goods (H. Moxey, personal communication, November, 2004). This levy takes into account costs associated with environmental programmes and the cost of operating the current waste disposal system. The Environmental Health Services Act (1987) is expected to be amended to incorporate both the "tipping fees" and the environmental levy.

Another activity of the waste management programme is a public awareness and education initiative on waste disposal. These public efforts have been combined with international efforts as the country has become party to the following international agreements in order to facilitate proper waste disposal: The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, the Montreal Protocol on Substances that Deplete the Ozone Layer and the Stockholm Convention on Persistent Organic Pollutants (POPS).

Solid waste management in the Family Islands is managed by the local government districts. This is legislated by the Local Government Act (1996), which listed as a function of district governments "to provide for the collection and removal of all refuse from any public place, the maintenance of cleanliness, the establishment, upkeep and maintenance of all public conveniences, dustbins, and other receptacles for the temporary deposit and collection of waste." While most Family Islands have their own dumpsites, there are no guidelines to assist in the implementation of solid waste disposal. As part of a comprehensive plan to address solid waste management in the country, landfill sites are proposed for some Family Islands. The separation of functions related to waste manage-

ment among different entities like DEHS, Local Government and the Water and Sewerage Corporation sometimes creates an overlapping of functions and makes the monitoring and enforcement difficult.

The Water and Sewerage Corporation (WSC) along with the Ministry of Works and the Department of Environmental Health Services (DEHS), manage sewerage waste or liquid waste from residences. While the WSC manages the centralized sewerage systems, DEHS conducts the monitoring of septic tanks for residents that are not part of a centralized sewerage system. This is outlined in the Environmental Health Services Act (1987) and the Health Services Act (1914). To determine water and sewerage requirements, the Ministry of Works forwards copies of applications to develop subdivisions to WSC.

One policy implemented by the Corporation is the "25-Lot Rule". This policy stipulates that where the number of lots in a subdivision exceeds 25 lots, a sewerage system is required. The rationale for using 25 is based on The Bahamas Building Code, Section 3615.2, which requires sewage collection for daily flows in excess of 22 712 L (5 000 Imp gal), and the assumptions of 4 persons per household (using census figures) and 227 L (50 Imp gal) of sewage per person. This policy, however, has been circumvented by the development of subdivisions in 24-lot packages (WSC, n.d.). Additionally this does not take into account the effects of multi-family lots and commercial/industrial properties. The criteria used to determine sewerage requirements for a subdivision are:

- Depth to the Water Table
- Number of Lots
- Size of Lots
- Proximity to Adjacent Sewered Areas
- Industrial/Commercial Discharge
- Affluence
- Ecological/Environmental Impact
- Public Water Supply Availability

Each criterion is scored individually, and then multiplied by a weighing factor and a final weighted scored is determined. Based upon the weighted scores, the sewerage requirement can be interpreted as needing a septic tank with a soak-a-way, a central sewerage collection system with disposal well, or a central sewerage collection system with secondary treatment and disposal well (WSC, n.d.).

3.8 Vulnerability to Natural and Technological Hazards

The management of vulnerability to natural and technological hazards is the responsibility of the National Emergency Management Agency (NEMA), a public agency evolving from the National Committee for Hurricanes Management. Recognizing the need for preparedness and response to hazards other than hurricanes, in June 2004, the National Committee for Hurricane Management transitioned into a hazards preparedness agency (C. Smith, personal communication, November, 2004).

NEMA functions as a coordinating body for hazards preparedness in the Cabinet Office. Although no hazards preparedness legislation currently exists, NEMA is mandated to develop proactive measures to prevent or reduce the impacts of hazards on the country, its natural resources and the economy. This is done through collaboration with national, regional and international agencies such as Ministry of Transport and Aviation, the Royal Bahamas Defence Force, the BEST Commission - National Climate Change Committee (NCCC), the Caribbean Disaster Emergency Response Agency (CDERA) and the United Nations Framework Convention on Climate Change (UNFCCC). Another function of NEMA is to develop and plan coordination efforts during and after major emergencies or disasters. The agency is to remain active through all aspects of the disaster cycle: prevention, mitigation preparation, response and recovery.

As there is no legislation for natural disasters, The Emergency Powers Act (1974) is normally used to facilitate response to disasters (C. Smith, personal communication, November, 2004). Generally, response to disaster occurrences is more reactive in nature, but proactive and planned responses are viewed as a necessity in order to eliminate or reduce the impacts of potential disasters. To this end, Government has drafted a Bill for a Natural Disaster Preparedness and Response Act, which "should provide relevant statutory authority for disaster management which is lacking and considered critical by relevant stakeholders" (Jackson, 2003).

In response to recent hurricanes, Frances and Jeanne, NEMA implemented programmes to provide direct assistance to residents affected by these hurricanes. Assistance such as duty-free concessions on building supplies and clothing, rental assistance and government loan guarantees were given to residents.

Despite presently not having disaster-related legislation, relevant agencies have undertaken

initiatives, which attempt to manage hazards. The BEST Commission, for example, has implemented a number of initiatives that addresses the vulnerability and mitigation aspects of disasters like climate change through the creation of a National Climate Change Committee. The Committee has produced the First National Communication on Climate Change and is working towards the production of the Second National Communication. The First National Communication on Climate Change noted that, "there is a need to develop strategies to implement policies and measures to reduce The Bahamas' vulnerability to the impacts of climate change" (BEST, 2001). The Second National Communication would seek to address issues related to public education and outreach, national inventory of greenhouse gases, and a vulnerability and risk assessment associated with climate change. The production of these Communication reports is in fulfillment of the country's obligation as a Party to the United Nations Framework Convention on Climate Change.

The NCCC has also developed a National Climate Change Policy, which recognizes that global climate change is an environmental phenomenon with serious implications for the country, especially as a Small Island Developing State. The document also recognizes that climate change has the potential to negatively impact vital sectors and natural resources of the country. Consequently, the Policy provides goals, directives and recommendations of strategies and actions to reduce the consequences of climate change.

A National Oil Spill Contingency Plan has been developed to address the accidental spillage of oil. The Plan sets a detection, reporting and coordination mechanism to ensure a timely and effective response to pollution which may threaten the natural resources of The Bahamas. The lead agency involved in executing the plan is the Ministry with the responsibility for the Port Department. To assist in the execution of the plan, an Oil Spill Contingency Advisory Committee, made up of representatives from government, industry and environmental representatives exists. In the Family Islands, the Local Government Administrator with the Chief Councilor establishes a committee and contingency arrangements, and reports to the lead agency (Bahamas Government, 1999).

Moreover, The Bahamas is a signatory to a number of international instruments that regulate oil spills and pollution in general in the marine environment. One such instrument is the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78). The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. Pollution by oil, chemicals, and harmful substances in packaged form, sewage and garbage are covered by this Convention.

With respect to fire safety, the Royal Bahamas Police Force Fire Services established a programme aimed at reducing fire incidents through education and prevention. Through this programme, Fire Services conducted over 100 lectures and inspected several business, hotels and schools. In the Family Islands, similar outreach initiatives are also undertaken (Corporal Moss, personal communication, April 2005).

Notwithstanding these new initiatives, hazard management is still in its infancy in The Bahamas. However, the Bill for an Act to establish a Department of Environmental Planning and Protection stipulates that the "Minister shall develop a programme for efficient, coordinated and effective action to prevent and minimize adverse environmental impact from environmental accidents and emergencies in The Bahamas" (BEST, 2001a).

3.9 Non-Government Organizations

Local advocacy groups generally initiate discussion on issues affecting the environment. Public awareness, education and discussion often sensitize government to the need to draft relevant policy and legislation. This creates a loosely structured partnership between government and non-government organizations (NGOs) in the protection and conservation of the country's environment. While a number of NGOs have become advocates for environmental protection and conservation, The Bahamas National Trust (BNT), established by The Bahamas National Trust Act (1959), is the only NGO established by a parliamentary act. BNT "grew out of efforts to rescue the West Indian Flamingo from extinction and create the world's first land and sea park" (Bahamas National Trust, n.d.).

The mandate of the Trust is to:

- promote the preservation of land and submarine areas deemed to have natural or historic interest;
- acquire, whether by purchase or gift, lands and submarine areas for preservation;
- advise government in matters relating to preservation and enforcement, and

- and raise funds for preservation and historical purposes.

Among its efforts, BNT facilitated the development and became trustee of national marine parks. In these parks, fishing and poaching are prohibited. While the BNT is a trustee of marine parks, the monitoring and enforcement of fishing and poaching regulations is a shared responsibility between BNT, The Royal Bahamas Defence Force and The Department of Fisheries.

Other environmental NGOs operating in the country include: Andros Conservancy and Trust (ANCAT), Bahamas Reef Environment Educational Foundation (BREEF), Friends of the Environment, The Nature Conservancy (TNC) and ReEarth (Table 3.1). Generally programmes conducted by these organizations centre around advocacy, public awareness and education.

Currently, there exists no policy or regulations affecting NGOs and their administration. However, BNT is mandated to conduct annual financial audits, maintain an office and an organizational secretary. While the Ministry of Health and Environment maintains a registry of NGOs, this registry does not include NGOs with an environmental agenda. A bill has been drafted that intends to "provide for the establishment and registration of Non-Governmental Organizations; to regulate the operations of Non-Governmental Organizations; to create transparency and accountability; to specify minimum standards which must be observed by all Non-Governmental Organizations; and to provide for matters connected therewith or incidental thereto" (BEST, 2004).

Table 3.1 Environmental non-govermental organizations and their interests

Organization	Area of Interest	World Wide Web Contact
Andros Conservancy and Trust (ANCAT)	Preservation and management of national parks on the island of Andros	www.ancat.org
Bahamas Reef Environment Educational Foundation (BREEF)	Promotion of marine conservation in The Bahamas through education, research, and management. BREEF educates teachers, students, and the public about the marine environment.	www.breef.org
Friends of the Environment	Preservation of Abaco's natural environment through Community Education	www.friendsoftheenvironment.org
The Nature Conservancy (Bahamas Programme)	Assisting local organizations in the development of Park Management Plans and providing technical and financial support on the islands of Exuma and Andros	http://nature.org/wherewework/caribbean/bahamas/work/
ReEarth	Environmental watch group, promoting public awareness Source: Listed Websites	www.reearth.org

Source: listed websites

3.10 International Conventions

The Bahamas, is a signatory to a number of international environmental conventions (Table 3.1), with the foremost being the Convention on Biological Diversity (CBD). This Convention promotes long-term conservation and sustainability of biological diversity. Some of the other Conventions which The Bahamas is actively involved in, from a national perspective, are:

- The Ramsar Convention - provides the frame work for national action and international co-operation in the conservation and sustainable use of wetland biodiversity and resources. Under the support of the Ramsar Convention, The Bahamas has developed a draft policy on wetlands that seeks to balance conservation and development efforts and promote greater public awareness. The Bahamas has also designated the Inagua National Park a Ramsar site, which limits the type of development in and around the park.

- The United Nations Framework Convention on Climate Change (UNFCCC) - sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. Article 4 of the Convention, states that Parties shall "adopt national policies and are to take corresponding measures on the mitigation of climate change…" and to "develop, periodically update, publish national inventories of anthro pogenic emission sources…". In response, The Bahamas has adopted a National Climate Change Policy and is also developing its Second National Communication.

- United Nations Convention to Combat Desertification (UNCCD) - addresses the issue of land degradation as a result of overcultivation, over grazing, deforestation, and poor irrigation practices, reduced biological and economic productivity of drylands as a result of long droughts and dry periods. A draft National Action Programme to address land degradation is currently underway, in fulfillment of one of The Bahamas' obligations to the Convention.

- The Convention of International Trade in Endangered Species (CITES) - establishes controls on the international trade and movement of animal and plant species that have been, or may be, threatened due to excessive commercial exploitation. In December 2004, the Wildlife Conservation and Trade Act (2004) was passed by Parliament to implement CITES in The Bahamas. This Act allows the Department of Agriculture (the managing authority) to assume responsibility for implementing CITES in The Bahamas. Included among the imple mentation duties are: the coordination of implementation and enforcement legislation relating to the conservation of species, the establishment of a scientific authority to advise on the import and monitor the export of species and the appointment of a national advisory committee to advise the Minister responsible for agriculture on matters relating to the Act and the implementation of CITES.

GEO

Recommendations

Chapter 4

4.1 Introduction

This chapter lists recommendations for mitigations of existing environmental threats, based on the issues raised in the preceding chapters, to prevent or minimize further degradation of the Bahamian environment. No attempt is made to prioritize these, or to suggest the responsible ministry, department or agency, or the allocation of portfolios: these are political matters.

4.2 Coastal and Marine Environments

Given the archipelagic nature of The Bahamas, the marine and coastal environments are of immense importance to the well-being of Bahamians and the national economic growth; therefore, recommendations affecting wetlands, coastal zone management and fisheries are provided.

4.2.1 Wetlands

- Enactment and enforcement of legislation to prohibit the infilling of wetlands for any purpose, including prohibition of the any action that prevents access of wetlands to the ocean;
- Development and implementation of a compliance programme for fulfilling the obligations under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention);
- Collection of spatial data on wetlands and the development of a digital inventory; and,
- Establishment of a programme that studies wetland functions and monitors changes and losses in wetland ecosystems resulting from global warming and other exogenous factors.

4.2.2 Coastal Zone

- Establishment of an agency to manage the entire coastal zone of The Bahamas, including research and monitoring;
- Consolidation of all coastal zone management legislation into one public document or onto a web site that is both publicly accessible and easily navigated;
- Enforcement of regulations against sand mining from beaches and inland areas;
- Enforcement of regulations to prohibit the uprooting and destruction of beach vegetation;
- Development of programmes to emphasize the importance of beach vegetation and promote planting of native vegetation;
- Establishment of programmes to ensure that the guidelines for setbacks and the construction of all engineered structures are observed;
- Enactment of legislation to ensure public access to all beaches and prohibit development in active beach zones (that is, the high water mark outward to the sea);
- Enactment of legislation to prohibit construction on, and artificial lighting of, all beaches known to be turtle nesting areas, and prohibit the harvesting of turtle eggs;
- Enactment and enforcement of legislation to require pump-out stations at all marinas and docking facilities; and,
- Establishment of a formal process whereby each developer pays for monitoring, by government agencies, of development during construction and commissioning.

4.2.3 Fisheries

- Enforcement of regulations concerning fishing gear and techniques;
- Review and enforcement of permitted catch limits and fees for sport fishing permits;
- Establishment and enforcement of closed seasons for all types of fisheries, including the prohibition of fishing around spawning aggregations;
- Evaluation of marine protected areas and enactment of regular patrols of no-take zones;
- Procurement of funding to undertake research on fisheries, including the mapping of sea grass beds, coral reefs, and fish populations, including monitoring over time;

- Enhancement of programmes designed to deter and prosecute poaching offences by commercial vessels and pleasure craft; and,

- Establishment of a regular programme to identify and monitor fisheries, including types, populations, habitats, state and trends, for each island.

4.3 Land Resources

The land resources of The Bahamas include forest lands, agricultural lands (including large-scale and small-scale commercial and subsistence farming) and built-up lands (including residential and industrial lands, and tourist facilities). Development of these resources must be counterbalanced by sound management practices. Recommendations to establish such a framework are provided.

4.3.1 Landscape

- Enforcement of regulations under the Conservation and Protection of the Physical Landscape of The Bahamas Act (1997) concerning mining of hills and to conserve the protected plant species named in the Schedule.

4.3.2 Forestry

- Enactment of forestry legislation and development of management plans for all forested Crown Land and require management plans from privately owned forested lands exceeding a specified area; and,

- Enactment of legislation to prohibit squatting on Crown Lands.

4.3.3 Biodiversity

- Declaration of certain plant species and designation of areas of special scientific interest as protected under the Agriculture and Fisheries Act (1963);

- Enactment of legislation to prohibit the importation of living modified organisms, except under certain specified conditions;

- Enactment of legislation to declare certain islands to be kept free of unwanted organisms, both invasive species of plants and animals, and of living modified organisms;

- Establishment of programmes to educate Bahamians on endemic flora and fauna; and,

- Enactment of legislation to regulate the import, use and application of pesticides .

4.4 Waste Management

Management of both solid waste and sewerage is a challenge for The Bahamas, given its limited land mass, geological characteristics and, in the case of solid waste, heavy reliance on imported goods. Inadequate solid waste management practices affect public health, as well as island aesthetics and overall public enjoyment of the country. In addition, it is questionable whether employment of septic tank systems in densely populated centres, such as areas on New Providence, is sustainable. To compliment existing programmes, recommendations to address waste management are provided.

4.4.1 Solid Waste Management

- Establishment of environmental education and awareness programmes focused on solid waste issues;

- Establishment and proper management of a secure hazardous waste disposal; and,

- Establishment of satellite waste collection sites in the Family Islands to be served by dumpsters that are emptied regularly.

4.4.2 Sewerage/Wastewater Management

- Establishment of a national policy to address sewerage/wastewater management and disposal;

- Installation of new sewerage systems and sewage treatment facilities on the Family Islands, and the extension of existing sewerage systems, as appropriate, that are designed to ensure full and proper usage of “grey water”;

- Elimination of pit latrines throughout The Bahamas as soon as possible; and

- Regulation of the location and design of septic tank systems, so as to prevent contamination in the event of flooding and ensure proper operation.

4. 5 Freshwater Resources

Potable water is a limited commodity under pressure in many islands. Consequently, reverse osmosis technology is utilized to augment existing freshwater supplies. However this technology requires imported energy and large volumes of seawater to produce very little potable water and vast volumes of wastewater (brine). As a result, freshwater conservation and management programmes are needed. Additional recommendations include the following suggestions.

- Enactment of a revised Water and Sewerage Corporation Act (1976) to give the Corporation greater authority to control all freshwater resources of The Bahamas;
- Establishment or national recognition of freshwater resources as a national resource;
- Development of a national water plan, to include both fresh and saline sources;
- Enactment of legislation to encourage householders to install gutters, down pipes and storage tanks or cisterns to collect water to be used for non-potable uses, by means of, *inter alia*, duty concessions;
- Prohibition of the use of private wells, except for non-potable uses, and the requirement of permits to drill new wells;
- Refurbishment of the underground water distribution system in New Providence, and the encouragement of households to remedy leaks within the house;
- Development and implementation of programmes to monitor the quality of water in aquifers and other water bodies for contami nants such as fertilizers, pesticides, bacteria (from septic tanks), industrial effluents, and hydrocarbons;
- Establishment and enforcement of legislation to regulate groundwater abstraction and pollution control;
- Construction of runoff drainage system designed to collect runoff resulting from heavy rainfall and, wherever possible, to recharge aquifers using the collect water; and,
- Establishment of a programme for automated collection and analysis of rainfall data.

4.6 Vulnerability to Natural and Technological Hazards

The Bahamas, being low-lying and limited in land mass, is extremely vulnerable to disasters caused by both natural and technological hazards. Furthermore, the health of the tourism industry, which determines the economic viability of The Bahamas, is heavily dependent on the health of the environment,. Recommendations intended to reduce hazard vulnerability are provided. (Other previously cited recommendations made to protect wetland systems and the coastal environment may also reduce vulnerability.)

4.6.1 Air Pollution

- Enactment and enforcement of stricter emission control standards and mandatory clean air controls for all forms of transportation; and,
- Enactment and enforcement of regulations for vehicle emissions that include annual testing and prohibit the importation of second-hand vehicles older than a certain date or lacking proper certification from the jurisdiction of export.

4.6.2 Global Warming

- Development of a national energy policy;
- Promotion of energy-efficient technologies through the use of incentives;
- Implementation of early warning systems to measure altered weather patterns; and,
- Implementation of specific sectoral recommendations as outlined in the Climate Change Policy developed by the National Climate Change Committee.

4.6.3 Flooding

- Development of a land use policy based on maps that show the susceptibility to flooding and storm surge; and,
- Prohibition of the construction of any structure (including roads, residents, commercial premises and public buildings) within the coastal zone and adjudged susceptible to storm surge, and in inland areas known to be liable to flooding.

4.6.4 Fires

- Enforcement of regulations prohibiting the burning of domestic trash of any sort in urban areas and in areas where fires pose a hazard to pine forests; and,
- Encouragement of composting vegetable and garden waste for use as fertilizer and mulch.

4.7 Policy

In order to increase the efficiency of environmental management in The Bahamas, strengthen the existing legislative framework and facilitate data storage and access, there are some fundamental recommendations to consider, such as the:

- Enactment of legislation to establish a Department of Environment Planning and Protection, with the consequent reallocation of responsibilities and portfolios;
- Enactment of legislation and regulations to formalize the environmental impact assessment process;
- Examination of existing environmental legislation and policies to identify gaps and overlaps, and to enact measures to rationalize these: this process should be periodic;
- Establishment of a mechanism to periodically review legislation to evaluate effectiveness and any need for amendment;
- Assessment of the role of Local Government in regulating environmental issues;
- Establishment of a mechanism to ensure easy access by District Councils to Government experts in various disciplines;
- Establishment of formal mechanisms to address the storage, dissemination, and public access to environmental information and legislation;
- Development of a public disclosure system to identify violators of environmental legislation;
- Application of geographic information systems in land use planning and zoning and early-warning awareness programmes;
- Establishment of community-based conservation societies to develop appreciation of local ecosystems, habitats and to protect those assets;
- Implementation of comprehensive socio-economic studies that focus on the economic implications and social and infrastructure pressures caused by development projects proposed for The Bahamas; and,
- Establishment of programmes that foster development and capacity-building in the areas of science, technology and research.

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Annex – List of International Instruments

Legal, International Environmental-Related Instruments to which The Bahamas is a signatory	Date of Conclusion	Date entered into force in The Bahamas
Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks	4 December, 1995	16 January, 1997 (accession)
Amendments to the International Convention for the Prevention of Pollution of the Sea, Concerning the Protection of the Great Barrier Reef	12 October, 1971	16 February, 1969
Amendment to the International Convention for the Prevention of Pollution of the Sea by Oil 1954	15 October, 1971	28 March, 1977
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	22 March, 1989	12 August , 1992 (accession)
Cartagena Protocol on Biosafety	29 January, 2000	15 January, 2004 (ratification)
Convention on Biological Diversity	5 June, 1992	2 September, 1993 (ratification)
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITIES)	3 March, 1973	18 September, 1979 (accession)
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)	2 February, 1971	7 June, 1997
International Convention on Civil Liability for Oil Pollution Damage	29 November, 1969	20 October, 1976 (accession)
International Convention on Oil Pollution Preparedness, Response and Cooperation	30 November, 1990	4 January, 2002 (accession)
International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)	2 November, 1973	2 October, 1983 (accession)
Protocol to the International Convention on Civil Liability for Oil Pollution Damage	19 November, 1976	9 April, 1981 (accession)
Montreal Protocol on Substances that Deplete the Ozone Layer, as amended	16 September, 1987	4 May, 1993 (accession)
United Nations Convention to Combat Desertification (UNCCD)	15 October, 1994	10 November, 2000 (accession)
United Nations Convention on the Law of the Sea (UNLOS)	10 December, 1982	29 July 1983 (ratification)
United Nations Framework Convention on Climate Change Concluded at New York	9 May, 1992	29 March, 1994 (ratification)
United Nations Framework Convention on Climate Change Kyoto Protocol	16 March, 1998	9 April, 1999 (accession)
Vienna Convention for the Protection of the Ozone Layer	22 March, 1985	1 April, 1993 (accession)

Source: Bahamas Ministry of Foreign Affairs, 2004

List of Acronyms

AGRRA
Atlantic and Gulf Rapid Reef Assessment

ANCAT
Andros Nature Conservancy and Trust

BAIC
Bahamas Agricultural and Industrial Corporation

BEC
Bahamas Electricity Corporation

BEST
Bahamas Environment, Science and Technology Commission

BNT
Bahamas National Trust

BREEF
Bahamas Reef Environment Educational Foundation

BTC
Bahamas Telecommunication Company

CARICOMP
Caribbean Coastal Marine Productivity

CARICOM
Caribbean Community

CBD
Convention on Biological Diversity

CDERA
Caribbean Disaster Emergency Response Agency

COB
College of The Bahamas

CITES
Convention of International Trade in Endangered Species

CPACC
Caribbean Planning for Adaptation for Climate Change

DDT
Dichloridephenyl-dichcloroethane

DEHS
Department of Environmental Health Services

EIA
Environmental Impact Assessment

GBPC
Grand Bahama Power Company

GDP
Gross Domestic Product

GEF
Global Environment Facility

GEO
Global Environment Outlook

IUCN
International Union for Conservation of Nature and Natural Resources

IDB
Inter-American Development Bank

MACC
Mainstreaming Adaptation to Climate Change

MPAs
Marine Protected Areas

NCCC
National Climate Change Committee

NEMA
National Emergency Management Agency

NGOs
Non-Governmental Orgnizations

OPM
Office of the Prime Minister

PPP
Purchasing Power Parity

TNC
The Nature Conservancy

UNCCD
United Nations Convention to Combat Desertification

UNFCCC
United Nations Framework Convention on Climate Change

USA
United States of America

WHO
World Health Organization

WQU
Water Quality Unit

WRI
World Resources Institute

WSC
Water & Sewerage Corporation

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GEO

PNUMA