ORGANISATION OF EASTERN CARIBBEAN STATES
ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT

ENVIRONMENTAL AND SOCIO-ECONOMIC STUDIES FOR OPAAL DEMONSTRATION SITES

NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA

SITE REPORT

ECO REPORT No. 10/2007
July 31, 2007

PREPARED BY

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EXECUTIVE SUMMARY

OVERVIEW

Ecoengineering Caribbean Limited was authorised by the Environment and Sustainable Development Unit (ESDU) of the Organization of Eastern Caribbean States (OECS) to undertake Environmental and Socio-Economic studies under the OECS Protected Areas Associated Livelihoods (OPAAL) Project. The OPAAL project global objective is, "to contribute to the conservation of biodiversity of global importance in the Participating Member States by removing barriers to the effective management of protected areas (PAs), and increasing the involvement of civil society and the private sector in the planning, management and sustainable use of these areas."

As part of the establishment of PAs under the OPAAL Project, two types of environmental and socio-economic studies were commissioned. Baseline environmental and socio-economic studies were used to determine the status of the resource base, its use and the nature of communities associated with the site, and, detailed site preparation studies were used to identify adverse environmental or socio-economic impacts associated with the development, identifying safeguards and / or mitigation measures.

This report documents findings of a site visit to the Northeast Marine Management Area (NEMMA) in Antigua during the period February 20 to March 02, 2007.

PHYSICAL CHARACTERISTICS

The NEMMA encompasses an area of over 30 square miles and is located in the Atlantic Ocean, on the windward side of Antigua.

The area is bounded seaward by:

- lat. 17°10' 14"N and long. 061°48' 16"W to
- lat. 17°12' 09.26"N and long. 061°48' 14.87"W to
- lat. 17°06' 34.72"N and long. 061°38' 36.59"W to
- lat. 17°02' 47.07"N and long. 061°38' 36.89"W to
- lat. 17°02' 48.23"N and long. 061°40' 26.74"W

Landwards it is bounded by the edges of the mangrove and wetland systems from Beggars Point in the Parish of St. Peter to Friars Head, in the Parish of St. Phillip, where they exist and the line of permanent vegetation at the coastline where they do not. There are over 30 islands, islets and rocks, (named and unnamed), in the NEMMA.

There several existing protected areas and other proposed areas located within the NEMMA.

The northeastern areas of the island experience a mean annual rainfall between 900 to 1015 mm. The coastline bordering the NEMMA is very indented with numerous islands, creeks and inlets and associated sand bars and wetlands at their inland end. A large portion of the east, north and south coasts are protected by fringing reefs. Areas of sandy bottom in shallow water are found on the west coast and between the fringing reefs and the shore. The numerous islands are largely coralline and range in elevation from as low as 3 m at Nanny Island, to heights of 75 m at Green Island. Channels draining the northeastern areas of the mainland enter the waters of the NEMMA at Fitches Creek (North Sound Stream), Mercers Creek, Ayres Creek (Black Ghaut) and Winthropes Foot Creek. The literature cites discharges from sewage treatment and desalination plants operated by surrounding hotels and from industries as the major contributors for water pollution problems in the NEMMA.

METHODOLOGY

The ESDU and other available sources provided baseline information on the physical, biological and socio-economic environment in the NEMMA. To build a more robust data base for the NEMMA, Ecoengineering expanded on available information from these previous studies by conducting field reconnaissance and having interviews with key stakeholders and Government agencies within and around the study areas where data was less available.

The major marine assets within the NEMMA are the coral reefs, fringing mangroves and sea grass beds which support a wide array of marine life. The Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol and ground-truthing exercises were conducted at selected sites within the NEMMA to determine the current state of these assets (marine and terrestrial).

FINDINGS

Biological

- The reefs have been significantly damaged by hurricanes and storms, anchors, fishing gear, sedimentation, eutrophication, pollution and disease.
- Seagrass beds are common within lagoons on sandy bottoms and were dominated by turtle grass. Seagrass beds have been damaged by algal growth and anchor damage.

- There are over 240 ha of mangroves (four species) and associated wetlands in the NEMMA. Hurricanes are the major cause of damage to seaward mangroves. Land development has also resulted in removal of mangrove.

- Beaches within the NEMMA are important for recreation, as nesting habitats for marine turtles and for beach replenishment. Some of the beaches show erosion caused by oceanic conditions and hurricanes.

- Many of the vegetation alliances found on the islands within the NEMMA and the adjacent coastline of the mainland are considered uncommon or rare and are likely to become in danger of extirpation due to coastal development.

- Several faunal species of conservation interest occur within the NEMMA including the hawksbill turtle (endangered), the Antiguan racer snake (endemic and endangered), the Antiguan ground lizard (endemic), and a number of endangered, vulnerable and threatened sea bird species.

Socio-Economic

Demography

The NEMMA area constitutes exactly 11.8% of the population of Antigua and Barbuda. Overall, the NEMMA region has an average household size of 2.8 persons. Unemployment is at 8.4% in both the NEMMA and the whole of Antigua. There is however, a small difference in unemployment levels between genders in the NEMMA. Almost one-fifth of the employed persons in the NEMMA region are service workers and shop sales workers. Agriculture, forestry and fishery workers represent the occupation with the least participation both in the NEMMA region and at a national level. New Winthorpes, Parham and Piggotts have the largest proportions of businesses in the NEMMA region. The least number of businesses are found in Glanvilles, Seatons and Coolidge.

Fishing

Within the NEMMA, Emerald Cove/Willikies and Mill Reef are primary landing sites. The majority of fishers is male and accounts for approximately 1.1% of employed persons in the NEMMA region. The numbers of fishermen fishing in the NEMMA at present may be smaller due to some fishers becoming employed by Stingray City and Paddles. Part-time fishing has been increasing over the years and this is attributable to high equipment cost, declining catch and availability of better paying jobs in tourism. Fishers normally fish in inshore coastal areas, shallow coral reef areas and on deep fore-reef slopes. Trap fishing has been the most common fishing method used by fishers in the NEMMA region over the last decade. This is followed by gillnetting. Spear fishing, although a prohibited fishing method in the NEMMA remains a fish harvesting method in the region though its practice has been on the decline.

Other Activities

Diving in the NEMMA area is restricted to reefs off Green Island and Great Bird Island. Diving is not a common activity and most users prefer to snorkel.

Tour boating is a significant business activity in the NEMMA. All tour boat operators indicated that Great Bird Island is the final destination on tours. Tour boat operations are the basis of a thriving tourist economy with up to 300 people being accommodated per day during the peak season.

Yacht anchorages are typically in the vicinity of Non Such Bay, Green Island, and Great Bird Island. Yachters typically snorkel and make use of the beaches and amenities at Parham, Jumby Bay, and Harmony.

The Jumby Bay Hotel on Long Island is serviced by two ferries which operate frequently throughout the day between Beachcomber Dock and Parham Harbour.

There are several water sports operations within and outside the NEMMA which rent speedboats, sailcraft, kayaks, surfboards, kites and snorkeling gear for use in the NEMMA.

Vendors operate on beaches in the NEMMA using makeshift tents and table tops to display their exhibits, with competition for the best pitches.

Industrial activities in the NEMMA include operations of two electricity and power plants, a desalination plant, a brewery and a cement receiving facility and a harbour all located on Crabbs Peninsula. There are also industrial estates at Coolidge and Tomlinson, within the watersheds draining into the NEMMA. The international airport is at Coolidge.

There are approximately 80 – 100 farmers growing mainly vegetables, root crops and small amounts of cotton in the watersheds which drain into the NEMMA.

PARK MANAGEMENT PLAN

The objectives of the NEMMA Final Management Plan for the period 2007 – 2010 are: biodiversity protection, research and monitoring, water quality maintenance, scenic preservation, tourism and recreation management, education and awareness, sustainability of traditional uses and livelihoods and promotion of economic and social benefits.

A major component of the management plan was zonation. The plan identified areas for conservation, recreation, fishing, yacht mooring, resort / residential zones, port / harbour zone, local fisheries management areas, and multiple use zones. Three management programmes were proposed to achieve the plan objectives:

- A conservation programme which was further divided into: natural resource protection, natural resource management, and research and monitoring of environmental quality and resource use.
- Education and sustainable use, which is aimed at reducing use conflicts between resource users, promoting compliance with rules and regulations, and promoting the recreational and eco-tourism attractions of the NEMMA.
- Administration and finance: this encompasses training of staff, ensures that the NEMMA Partnership achieves and maintains self-sufficiency, and a system of fees for use of the area.

ANALYSIS OF IMPACTS

A SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis was used as a means of focussing the analysis of potential impacts, specifically in relating pre-existing factors to the approaches in the Management Plan. By identifying Strengths, Weaknesses, Opportunities and Threats associated with the NEMMA, it was easier to identify appropriate measures for protecting the environment and specifically for addressing potential adverse impacts.

The Table below provides a summary of the classification of potential adverse environment impacts with the establishment of the NEMMA, with and without mitigation measures, based on the use of environmental resources by the various stakeholders.

SUMMARY OF CLASSIFICATION OF POTENTIAL ADVERSE IMPACTS

CLASSIFICATION OF POTENTIAL ADVERSE IMPACTS					
ENVIRONMENTAL COMPONENT / STAKEHOLDER	WITH MITIGATION				WITHOUT MITIGATION
	EXTENT	INTENSITY	NATURE	CLASSIFICATION	CLASSIFICATION
Heavy rainfall	Localised	Minor	Reversible	LOW	MODERATE
Drainage	Localised	Very Small	Reversible	LOW	MODERATE
Water quality	Unknown	Unknown	Unknown	UNKNOWN	MODERATE
Coral reefs	On-site	Major	Irreversible	UNKNOWN	HIGH
Mangrove	On-site	Very Small	Reversible	LOW	LOW
Seagrass	On-site	Very small	Reversible	INSIGNIFICANT	LOW
Fisheries	Localised	Minor	Reversible	LOW	MODERATE
Beaches	On-site	Very Small	Reversible	LOW	LOW
Terrestrial vegetation (sensitive species)	Localised	Very Small	Reversible	LOW	EXTREME
Fauna (sensitive species)	Localised	Minor	Reversible	LOW	EXTREME
Fishers	National	Minor	Reversible	BENEFICIAL	LOW
Tour boat operators	Localised	Minor	Reversible	INSIGNIFICANT	LOW
Hotels	Localised	Very Small	Reversible	LOW	LOW

CLASSIFICATION OF POTENTIAL ADVERSE IMPACTS					
ENVIRONMENTAL COMPONENT / STAKEHOLDER	WITH MITIGATION				WITHOUT MITIGATION
	EXTENT	INTENSITY	NATURE	CLASSIFICATION	CLASSIFICATION
Industries (Desalination and power plants)	National	Minor	Reversible	MODERATE	HIGH
Shipping	On-site	Very Small	Reversible	LOW	LOW
Land ownership	Localised	Very Small	Reversible	LOW	LOW
Land use	Localised	Very Small	Reversible	LOW	LOW

RECOMMENDATIONS

Based on the SWOT analysis and the analysis of impacts, a number of recommendations were put forward including:

- Policy and Legal Framework,
- Management Plan,
- Training,
- Monitoring,
- Assessment of Existing Discharges,
- Carrying Capacity Studies, and
- Livelihoods Assessment

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GLOSSARY OF TERMS

TERM	APPLICABLE DEFINITION
Antigua Racer	A critically endangered snake species, endemic to Antigua
Aquaculture	The management and maintenance of aquatic environments
Artificial Reefs	Reefs formed not by natural occurrences but by some sort of unnatural input eg. through man
Baseline	The condition of an ecosystem/ environment before a disaster strikes
Biological environment	Mainly biotic aspects of the environment
Coliforms	Disease causing microorganisms usually associated with fecal matter
Commissioning	The process of preparing the equipment for operation and putting it into operation
Conching	Catching conchs, usually for commercial purposes
Coralline	Made up of mostly coral/ coral-formed
Diminution of impacts	Decrease in effect of an impact
Endemic	Restricted to…
Eutrophication	Oxygen starvation of a river/stream usually due to excessive algal growth because of nutrient rich water
Fauna	Animal life
Flora	Plant life
Intensification of impacts	Increase in effect of an impact
Mangrove	A swamp-associated tree with respiratory roots. It plays a major role in wetland development and fish nurseries. There are different types including red, black, white etc.
Physical environment	Mainly abiotic aspects of the environment
Primary stakeholders	People who directly depend on a resource for their livelihood
Secondary stakeholders	Those who may not directly use the resource but whose actions affect it and who use products from the resource
Social environment	Relationships that occur within the environment

TERM	APPLICABLE DEFINITION
Windward	Part of island facing the wind (eastern side of a southern Caribbean country) where rain is more prevalent than on the leeward side
Xyrophytic	Drought resistant

LIST OF ACRONYMS

ACRONYM	MEANING
AGRRA	The Atlantic and Gulf Rapid Reef Assessment
ARCP	Antiguan Racer Conservation Project
BSAP	Biodiversity Strategy and Action Plan
CBD	Convention on Biological Diversity
CITES	Convention on the International Trade in Endangered Species of Fauna and Flora
DCA	Development Authority
EAG	Environmental Awareness Group
EIAs	Environmental Impact Assessments
EPAs	Environmental Protection Areas
ESDU	Environmental and Sustainable Development Unit
GBI	Great Bird Island
GEF	Global Environmental Facility
GIS	Geographic Information System
MACC	Mainstreaming Adaptation to Climate Change in the Caribbean
MPAs	Marine Protected Areas
NEMS	National Environmental Management Strategy and Action Plan
NEMMA	Northeast Marine Management Area
NGOs	Non-Governmental Organizations

ACRONYM	MEANING
NICE	National Implementation Coordination Entity
OECS	Organization of Eastern Caribbean States
OPAAL	Protected Areas Associated Livelihoods Project
PAs	Protected Areas
SPAW Protocol	Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region
SWOT	Strengths, Weaknesses, Opportunities and Threats
TOR	Terms of Reference

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ECO REPORT No. 10/2007 **July 31, 2007**

ORGANISATION OF EASTERN CARIBBEAN STATES
ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT

ENVIRONMENTAL AND SOCIO-ECONOMIC STUDIES FOR OPAAL DEMONSTRATION PROJECTS

NORTHEAST MARINE MANAGEMENT AREA (NEMMA) SITE REPORT, ANTIGUA

1 INTRODUCTION

1.1 Authorisation and Report Layout

This report, prepared by Ecoengineering Caribbean Limited, is one of three site reports being prepared for the Environment and Sustainable Development Unit (ESDU) of the Organization of Eastern Caribbean States (OECS). Site reports have also been prepared for the Tobago Cays National Park, St. Vincent and the Grenadines and the Cabrits National Park, Dominica. It was conducted in accordance with our revised proposal dated December 15, 2006. This site report documents findings of a site visit to the Northeast Marine Management Area (NEMMA) in Antigua (see Figure 1) during the period February 20 to March 02, 2007.

This report contains nine chapters and 5 appendices. The remainder of this chapter provides a brief background of the proposed project and specifically the NEMMA site visit; indicates the scope of work; introduces the project team and lists acknowledgements. Chapter 2 establishes the regulatory and legal framework for the marine area while Chapter 3 describes the method statement. Chapters 4 and 5 describe respectively the

environmental assets/characteristics within the marine area and the socio-economic context in which the marine area exists including the results of stakeholder consultation. Chapter 6 summarises the draft Management Plan prepared for the NEMMA. Chapter 7 presents the results of a SWOT analysis and Chapter 8 discusses impacts and mitigation measures. Finally Chapter 9 contains recommendations and comments.

In order to keep the text of this report to a manageable length, detailed information is presented in the following Appendices:

Appendix A:	Stakeholder Questionnaires
Appendix B:	Classification of Impacts
Appendix C:	Species Notes for Aquatic Fauna and Flora
Appendix D:	Offshore Island Vegetation
Appendix E:	Monitoring and Evaluation Tool
Appendix F:	Excerpt from User Notes for CIDA's environmental assessment forms

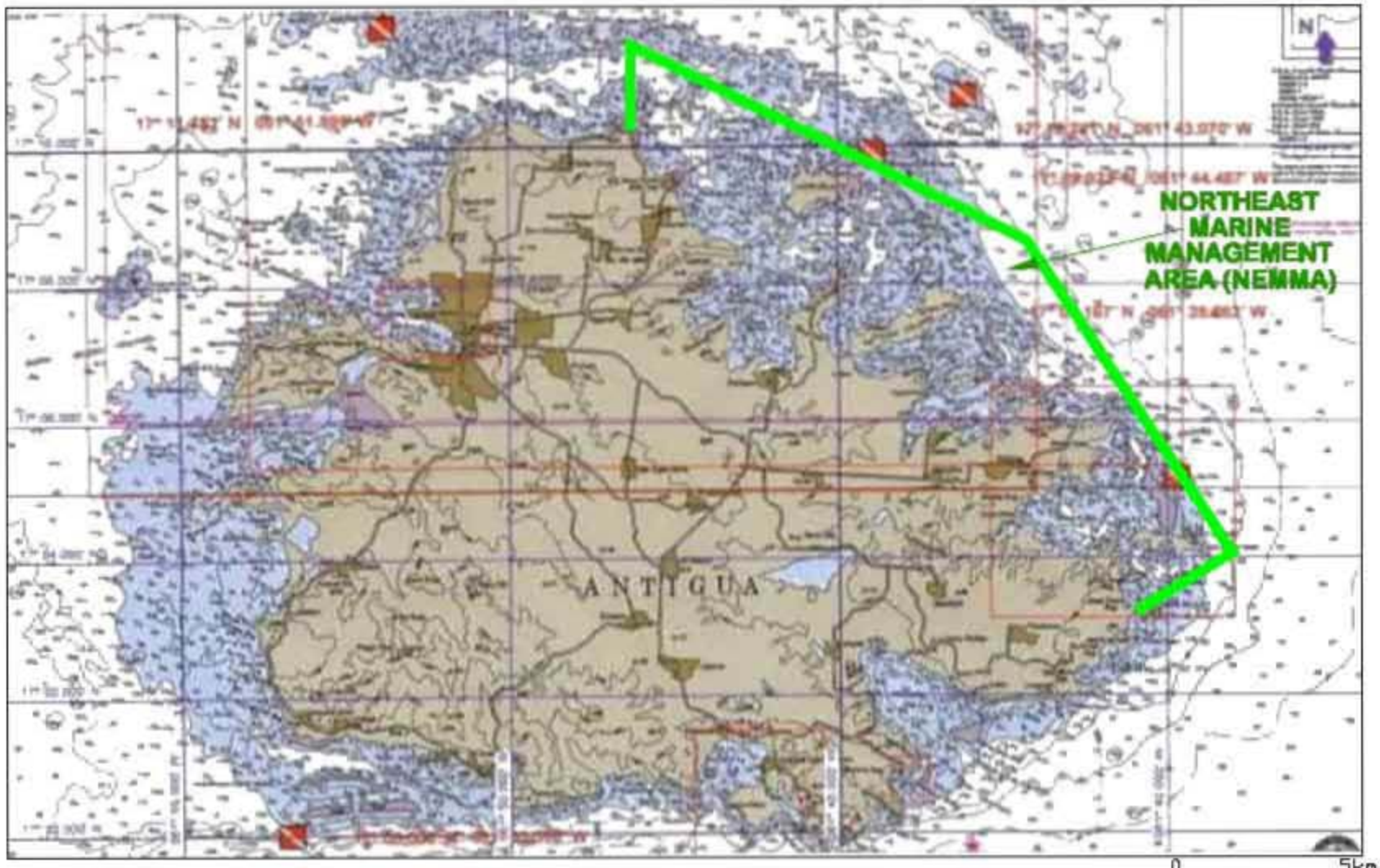
1.2 Background

This project which is termed the OECS Protected Areas Associated Livelihoods Project (OPAAL) has as its global objective "to contribute to the conservation of biodiversity of global importance in the Participating Member States by removing barriers to the effective management of protected areas (PAs), and increasing the involvement of civil society and the private sector in the planning, management and sustainable use of these areas".

Component 2 of the OPAAL Project deals with Protected Areas Management and Associated, Alternative and New Livelihoods. This component seeks to promote biodiversity management and conservation through the establishment of new protected areas and the strengthening existing PAs. This thrust is complemented by support for alternative and/or new livelihoods in areas in proximity to PAs.

As part of the establishment of PAs under the OPAAL Project, two types of environmental and socio-economic studies were commissioned:

- baseline environmental and socio-economic studies to determine the status of the resource base, its use and the nature of communities associated with the site; and



NEMMA SEAWARD BOUNDARY

Ecoengineering Caribbean Ltd.

Eco Report No. 10/2007	CLIENT:	OECS -ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER 1
	PROJECT:	NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
Date: 31/07/07	DWG. NAME:	NEMMA SITE MAP	

- detailed site preparation studies to identify adverse environmental or socio-economic impacts associated with the implementation and management of the PA, and identify safeguards and / or mitigation measures.

This study comprises a combination of two elements of work. Firstly, it sought to update an early environmental assessment undertaken at the time of project design to identify any possible adverse impacts associated with likely Project interventions through a review of project sub-components for potential environmental impact. Both environmental and socio-economic assessments were designed to incorporate relevant mitigation measures which can be taken on board in the finalization and implementation of site management plan and specific project activities including the development of relevant infrastructure and livelihood sub-projects. Secondly, the study was undertaken to describe and assess the health and value of biodiversity within the site, levels of use and threats to inform area management and assist in the establishment of monitoring and evaluation system for the site.

Ideally, this study should have preceded and therefore guided the preparation of the site management plan for the OPAAL demonstration site. This had not been the case due to procurement challenges which affected the timely contracting of services and hence the drafting of a management plan for the site was well advanced at the time of conducting the environmental and socio-economic site assessments. Therefore, it will be important that the information, recommendations and conclusions emanating out of this study be used to further inform and strengthen the management planning process.

This site report is for the Northeast Marine Management Area (NEMMA) in Antigua and documents information gathered on a visit to the NEMMA during the period February 20th to March 02nd , 2007.

1.3 Scope of Work

The scope of work for this assignment is as follows:

- Review of Relevant Documents,
- Understanding the Proposals for the PA,
- Review of Regulatory Framework,
- Field Collection of Data,
- Assessment of Potential Impacts, and
- Recommendation of Mitigation Measures.

1.4 Study Team

The following are the key professional staff who worked on this assignment:

Ecoengineering Caribbean Limited

Dr. George K. Sammy, Study Director/Environmental Engineer,
Ms. Debbie Reyes, Study Manager/Environmental Scientist,
Ms. Linda Sammy, Environmental Scientist,
Mr. Daryl Sankar, Engineer,
Mr. Jahson Alemu I, Ecologist/Certified Diver, and
Ms. Carol James, Sociologist

1.5 Acknowledgements

Ecoengineering Caribbean Limited acknowledges, with thanks, the contributions of the following persons and agencies in completing this assignment:

National Implementation Coordination Entity (NICE)

Mrs. Cheryl Jeffrey-Appleton, Chief Fisheries Officer

Fisheries Department

Mr. Philmore James, Fisheries Officer
Mr. Steve Archibald, Fisheries Officer
Mr. George Looby

Statistical Department

Mr. James (Director)
Mr. Tonge (Statistics Officer III)

Environment Department

Mrs. Diane Black-Lane

Forestry Department

Mr. Adriel Thibou

Pesticides Control Board

Dr. Spencer, Chairman

Agriculture Department

Mr. Thomas, Extension Officer
Mr. Fergus, Extension Officer

Development Control Authority

Mr. Denzil Solomon, Town & Country Planner

The Museum of Antigua and Barbuda

The Antigua and Barbuda Hotels and Tourism Association

Environmental Awareness Group (EAG)

Mr. Junior Prosper
Victor Joseph
Andrea Otto

Coast Guard

Lieutenant James, Operations Officer

Association of Tour Boat Operators

Mr. Patrick Ryan, President

Antigua and Barbuda Marine Association

Mr. John Duffy

Stingray City

Mr. Andrew Moody-Stuart, Owner

Central Board of Health

Mr. Nigel Benjamin

Antigua Public Utilities Authority

Mr. Huburn Edwards

2 REGULATORY FRAMEWORK

This chapter provides a brief synopsis of the laws, regulations and policies which govern the management of the Northeast Marine Management Area (NEMMA). A detailed review of these laws, regulations and policies was conducted for the OECS by Mr. Lloyd Gardner, Environmental Support Services, LLC and these are contained in a separate report (Environmental Support Services, 2007). A summary of that review is presented in the following sections.

2.1 Policy Framework

Antigua and Barbuda does not have a policy and plan for a system of protected areas, and thus, protected areas initiatives are driven by sector and sub-sector sporadic needs rather than by any systematic planning process or overall vision of the role of protected areas in the development of the country.

There are three policy instruments which provide reference to protected areas development and management:

- The Draft Policy for the Development of Forestry, Wildlife and National Parks.
- The Biodiversity Strategy and Action Plan.
- The National Environmental Strategy and Action Plan.

2.1.1 Draft Policy

This draft Policy for the Development of Forestry, Wildlife and National Parks, 1988 was prepared as a policy guidance for the drafting of new forestry and wildlife legislation meant to replace the Forestry Act (1941). The draft policy also focussed on the establishment of forest reserves, protected forests (on private lands) and conservation areas. One weakness of the draft policy was that it intended to provide policy guidance for the development of forestry but was never completed and approved.

2.1.2 Biodiversity Strategy

The Biodiversity Strategy and Action Plan (BSAP) was developed as part of a regional project meant to assist countries with articulating the policies and actions for discharging their obligations under the Convention on Biological Diversity. The Strategy set its overall goal to be that *"the biological diversity of Antigua and Barbuda is sustainably and equitably used, protected and conserved so that it contributes positively to the social and economic development of the country"*.

The two objectives in the Biodiversity Strategy and Action Plan that are most directly relevant to protected areas development and management are:

- Objective 1: A national system, including protected areas, for the management and conservation of biodiversity should be established and developed.
- Objective 2: The capacity of governmental natural resources management institutions, as well as non-governmental organizations, to support the objectives and achieve the overall aim of the BSAP, should be strengthened.

2.1.3 The National Environmental Management Strategy and Action Plan

The National Environmental Management Strategy and Action Plan 2004-2009 (NEMS) is the latest environmental policy guidance and is now being implemented as part of the country's obligations under the St. George's Declaration of Principles for Environmental Sustainability in the OECS. Of the seventeen principles identified in the NEMS, two are directly relevant to protected areas management.

Principle 3 – Improve on Legal and Institutional Frameworks

Strategy:

Develop a comprehensive legal and institutional framework that will effectively implement the Principles contained in the St George's Declaration.

Actions Relevant to Protected Areas:

- Identified ecosystems of national importance should be protected. These should include watersheds, mangrove swamps, beaches, and land needed for food security.
- Identify legislative conflicts and overlaps.
- Need to draft new and/or amend and/or enforce existing laws and regulations to meet multilateral agreements to which the country is a party.
- Conduct an assessment of institutional framework to determine roles and responsibilities of agencies involved in natural resource and environmental management.
- Establish a carefully designed coordinating mechanism to facilitate information sharing, and resource maximization amongst government agencies.

Principle 13 – Protect and Conserve Biological Diversity

Strategy:

Develop appropriate measures for the management of biological resources to ensure their conservation, research and documentation, sustainable use, and restoration of ecosystems.

Actions Relevant to Protected Areas:

- Develop a system of biodiversity protected areas.

2.2 Existing Legal Framework

There are a number of existing laws governing the establishment and management of protected areas. Those relevant to the Northeast Marine Management Area (NEMMA) are listed below and summarized in the following sections.

- Fisheries Act, 2006
- Fisheries Regulations, 2007
- Fisheries (Marine Reserve Area) Notice, 2005
- Marine Areas (Preservation and Enhancement) Act, 1972
- Forestry Act, 1941
- National Parks Act, 1984
- Public Parks Act, 1965
- Physical Planning Act, 2003
- Wild Birds Protection Act,
- Beach Protection Act, 1957
- Dumping at Sea Act, 1975
- Oil Pollution of Maritime Areas Act, 1995
- Litter Act, 1983
- Marine Areas Act, 1982
- Public Health Act, 1857

2.2.1 Fisheries Act, 2006

This Act repeals the Fisheries Act, 1983 and the Importation of Live Fish Act, 1975. It is an Act to provide for the development and management of fisheries and matters incidental thereto.

The Act makes provision for:

- Fisheries Management and Development
- Registration, Construction, Certification and Inspection of Local Fishing Vessels
- Authorization of Fishing and Processing Operations
- Aquaculture
- Marine Reserves and Conservation Measures
- Enforcement

The following sections are of relevance to the NEMMA :

Section 2 adds new definitions, including the addition of marine mammals to the definition of a “fish”.

Section 5 mandates the preparation and periodic review of a plan for the “… responsible management and sustainable development of fisheries in Antigua and Barbuda waters…”

Section 8(1) allows for entry into regional cooperative arrangements for fisheries management.

Inserts a new Part V (Sections 40-51) on aquaculture.

Part VI deals with marine reserves and conservation measures.

Section 53 authorizes the designation of marine reserves for a number of objectives related to fisheries management. Also included is a provision to use the law “to preserve and enhance the natural beauty of such areas” (Section 53(1)(e)).

Section 54 states that persons or vessels conducting fisheries research require a permit.

Sections 55 & 56 state that persons wishing to import non-indigenous fish or other live aquatic organisms require a permit.

Section 76 provides the authority to the Minister to make regulations for fisheries development and management, including “… control and deployment of artificial reefs” (Section 76(2)(q)).

Section 41 Repeals the Fisheries Ordinance (Cap. 98).

2.2.2 Fisheries Regulations, 2007

The Fisheries Regulations are made under the Fisheries Act, 2006. These regulations repeal the Fisheries Regulations 1990, Fisheries (Restriction on Methods of Salt Water Fishing) Regulations, 1978, Fisheries (Restriction on Methods of Fresh Water Fishing) Regulations, 1978, and Fisheries (Restriction on Taking of Channel Catfish) Regulations, 1978 and provide for:

- Establishment of a Fisheries Advisory Committee
- Registration, Construction, Certification and Inspection of Local Fishing Vessels
- Foreign Fishing Vessels
- Local Fishing Licences
- Records of Local Commercial Fishers
- Artificial Reefs and Fish Aggregating Devices
- Fisheries Conservation Measures

2.2.3 Fisheries (Marine Reserve Area) Notice, 2005

Notice made by the Minister under Section 22 of the Fisheries Act, 1983, Chap. 173.

Section 2 declares the marine reserve described as the North East Marine Management Area.

The Schedule describes the North East Marine Management Area, and includes 28 offshore islands, including the “un-named Island east of Monocle Point, Guiana Island” and “any other un-named islands and rocky out crops”.

The notice of declaration describes the North East Marine Management Area (NEMMA) as bounded seaward by

- lat. 17° 10' 14"N and long. 061° 48' 16"W to
- lat. 17° 12' 09.26"N and long. 061° 48' 14.87"W to
- lat. 17° 06' 34.72"N and long. 061° 38' 36.59"W to
- lat. 17° 02' 47.07"N and long. 061° 38' 36.89"W to
- lat. 17° 02' 48.23"N and long. 061° 40' 26.74"W to

and landwards by the landward edges of the mangrove and wetland systems from Beggars Point in the Parish of St. Peter to Friars Head, in the Parish of St. Phillip, where they exist and the line of permanent vegetation at the coastline where they do not. This applies to all offshore islands within the boundary and excludes all areas above the line of permanent vegetation.

2.2.4 Marine Areas (Preservation and Enhancement) Act, 1972

The Marine Areas (Preservation and Enhancement) Act (No. 5 of 1972) was amended by Act 18 of 1989. This Act is managed by the Minister responsible for fisheries and provides for the designation of a range of marine protected areas (MPAs). The imposition of user fees for sites is one of the aspects of protected areas management that the Minister can regulate under this Act.

Section 3(1) - The Minister may, by Order, "…designate any portion of the marine areas of Antigua and Barbuda as a restricted area where he considers that special steps are necessary for:

(e) preserving and enhancing the natural beauty of such areas;

(f) the protection of the flora and fauna and wrecks found in such areas;

(g) the promotion of the enjoyment by the public of such areas

(h) the promotion of scientific study and research in respect of such areas".

Section 4 - The Minister may acquire private lands for use as a restricted area as necessary.

Section 5 - The Minister may assign management responsibility for a restricted area under this Act to "…any person, Board, committee or body which he considers competent for the purpose …"

Section 6 - The Minister may make regulations for a range of actions to support the purpose of the Act, including the charging of fees for any services provided (6(1)(h)). Services include management of a site, regulating use and enjoyment, regulating parking and refreshment facilities, etc.

2.2.5 Forestry Act, 1941 (No. 7 of 1941)

This Act was amended by Act 17 of 1952, Act 18 of 1989, and Statutory Instrument No. 39 of 1989.

Section 4 - The Director of Agriculture is the Chief Forest Officer.

Section 5 - Any area that was a forest when the Act enters into force automatically becomes a forest reserve.

Sections 8 and 10 - Permit the Minister to make Orders to declare forest reserves.

2.2.6 National Parks Act, 1984

This Act was amended by Acts 3 of 1986, 17 of 1995, 9 of 2000, and 11 of 2004. It provides for the establishment of National Parks and a National Parks Authority; to make provision for the preservation, protection, management and development of the natural physical and ecological resources and the historical and cultural heritage of Antigua and Barbuda; and for matters connected with these purposes".

Section 2 – The Minister charged with responsibility for this Act is the Minister for Economic Development and Tourism.

Section 2(a) [Amended by The National Parks (Amendment) Act, 2004 (No. 11 of 2004] changes the designation of the Minister responsible for national parks contained in the Principal Act (Cap. 290) to mean the "Minister to whom the responsibility of National Parks has been assigned".

Section 3 – Establishes the National Parks Authority.

Section 4 - Sets out the functions of the National Parks Authority, and charges it with management of natural, physical, and ecological resources, as well as historical and cultural heritage.

The National Parks (Amendment) Act, 2004 (no.11 of 2004 requires the Parks Commissioner to consult with the Town and Country Planner, local authorities and local communities in the preparation, review or amendment of a management plan for a park.

Section 4(a)1 [Amended by Section 3(a) of the National Parks (Amendment) Act, 2004 (No. 11 of 2004] adds the word “natural” to the list of resources to be protected by the Act.

Section 6 - Provides for the Minister to give policy to the National Parks Authority.

Section 10 - Requires the preparation of management and development plans for parks, and each plan is to be prepared within 9 months of the declaration of the park. Section 10(4) obligates the National Parks Authority to hold public consultations on each management plan.

Section 20 - The Minister may, on the request of the National Parks Authority, declare any area of land or water a national park.

Section 23 - The National Parks Authority may request the Crown to acquire private lands (under the Land Acquisition Act) that fall within a national park.

Section 24 - Provides for the declaration of Nelson’s Dockyard National Park (the description is set out in the Second Schedule).

2.2.7 Public Parks Act, 1965

This Act was amended by Statutory Instrument No. 39 of 1989 and authorizes the Minister in charge of lands to designate any area of outstanding natural beauty as a public park.

Section 2(2) - Defines natural beauty to include characteristic natural features, flora, and fauna; as well as architectural, historic, and artistic values.

Section 3 - Establishes the Public Parks Commission to implement the provision of the Act, and includes objectives for preservation and enhancement of natural beauty in areas designated under the Act.

The Minister in charge of lands can designate any area of outstanding natural beauty as a public park.

The Schedule to this Act designates a Public Park at English Harbour (690 acres) and a Public Park at Long Bay (116.887 acres)

2.2.8 Physical Planning Act, 2003

This Act provides for the orderly and progressive development of land and to preserve and improve the amenities thereof; for the grant of permission to develop land and for other powers of control over the use of the land; for the regulation of the construction of buildings and other related matters; to confer additional powers in respect of the acquisition and development of land for planning; and for purposes connected with the matters aforesaid.

Section 2 - Provides definitions for terms that are of somewhat intangible qualities, such as “environment” and “resources”.

Section 10(2)(c) - Development plans must include “a statement of the policies, proposals, and programmes for the future development and use of land in the area including principles for regulating the use and development of lands and measures for the maintenance and improvement of the environment”.

Section 23 - Deals with the requirement for environmental impact assessments (EIAs) for certain types of developments, which are listed in the Third Schedule of the Act.

Section 27(1) - Authorises the Development Control Authority to include conditions in a development permit to achieve a number of purposes, including:

- 27(1)(a)(vii) – “the preservation of trees, vegetation or other natural features of the land where the development is to take place”; and
- 27(1)(a)(viii) – “the preservation of any buildings or sites of importance to the cultural heritage of the country”.

Section 43 - Makes provision for the survey and listing of buildings of architectural, cultural, or historical importance.

Section 44 - The Town and Country Planner may propose a Building Preservation Order for a building or group of buildings of architectural, cultural, or historical importance.

Section 46(1) - Authorises the Minister, after consultation with the Minister of Agriculture, to make Plant Preservation Orders for any plant, group, or species of plant, where for amenity, environmental, landscape, scientific or other similar reason it is determined that such plant, group, or species of plant aught to be preserved.

Section 51 - Allows for regulations to be made under the Act, including 51(5(a)-(b) which deal with regulations for environmental protection areas (EPAs) and other "areas of special control" (amenity areas).

Sections 53 to 56 - Deal with the determination and declaration of environmental protection areas (EPAs). Section 53(3)(c) identifies the factors that are relevant to the declaration of an EPA. Section 56 requires the preparation of a management plan for the EPA, and states the topics for which policies and measures should be included in the management plan.

Section 83 repeals the Town and Country Planning Act (Cap. 432) and the Land Development and Control Act (Cap. 235).

The Second Schedule identifies the matters for which provision may be made in Development Plans, including:

- Part IV(3)-(6) – wildlife sanctuaries, national parks, environmental protection areas, marine parks, protection of historical and cultural objects, protection of forests, etc.

- Part IV(a) – waste disposal and pollution prevention.

The Third Schedule lists the types of developments for which an EIA shall be required.

2.2.9 Wild Birds Protection Act

This Act was amended by SRO No. 26 of 1974 and SRO No. 3 of 1976. Section 3 provides blanket protection for wild birds listed in Schedule A. Section 4 provides for annual close seasons (February 1-July 15) for birds listed in Schedule B.

2.2.10 Beach Protection Act, 1957

Section 4 prohibits the removal of sand and other aggregates from beaches. Section 7 exempts the island of Barbuda from the application of this Act.

2.2.11 Dumping at Sea Act. 1975

This Act was amended by Act 18 of 1989. Section 1 adopts the provisions of the Convention for the Protection of Marine Pollution by Dumping from Ships and Aircrafts as binding in national law. Section 3 prohibits the dumping in Antiguan waters, or dumping in external waters by Antiguan vessels.

2.2.12 Oil Pollution of Maritime Areas Act, 1995.

This Act makes provisions against the discharge or escape of oil into the Maritime areas of Antigua and Barbuda. Section 5 states that the Port Manager may appoint a place for the discharge of ballast water.

2.2.13 Litter Act, 1983

This Act contains broad provisions designed to maintain the amenity values of areas.

2.2.14 Maritime Areas Act, 1982 (No. 18 of 1982)(Cap. 260)

Section 28 gives the Minister the authority to make regulations to give effect to a number of objectives, including:

- 28(1)(b) “for the conservation of the living resources of the sea”, and
- 28(1)(c) pollution prevention.

2.2.15 Public Health Act, 1857

This Act makes broad provisions to protect public health and to investigate and deal with public health nuisances.

2.3 Proposed Legislation

There are two major legislative initiatives that will impact on protected areas development and management:

2.3.1 Draft Forestry and Wildlife Act

An Act to provide for the administration, conservation and proper use of forests, the protection and management of wildlife and the prevention and control of forest fires; and for matters connected with those purposes.

The Bill makes provision for the declaration of forest reserves (Section 6), protected forests (Section 9), conservation areas (Section 13), and wildlife reserves (Section 28).

Section 3 appoints a Chief Forest and Wildlife Officer, and other necessary officers, for the implementation of the Act.

Section 4 sets the functions of the Chief Forest and Wildlife Officer.

Section 5(1) requires the Chief Forest and Wildlife Officer to prepare a national forest plan every 10 years.

Section 6(1) authorizes the Minister to declare any crown land to be a forest reserve, and provides for the leasing and declaration of private lands as forest reserves.

Section 8 states that management plans are to be prepared for forest reserves within two years of their declaration.

Section 9 authorises the Minister to enter into agreements with private landowners to designate such private lands as protected forests.

Section 12 states that protected areas can be declared within forest reserves to prevent development and harvesting activities.

Section 13 provides for the declaration of conservation areas to protect areas from damage and to protect human life from areas that are unstable or hazardous.
Section 15 provides for public consultations on the declaration of conservation areas.

Section 23 makes provision for the establishment of a Forestry Development Fund, and provides some guidance for the management of the fund (Sections 24 & 25), including the annual audit (section 25 (2).

Section 28 states that the Minister may declare wildlife reserves on public or private lands.

Section 53 states that the Minister has the authority to make regulations for a range of purposes of the Act, including recreational uses and resources protection.

2.3.2 Draft Environmental Protection and Management Bill (2005)

The Bill focuses on a wide range of environmental protection functions, and establishes the Department of Environment to develop policy guidance and implement the provisions of the law. The Bill provides for new institutional structures, such as an Environmental Registry and a GIS Unit. There is a significant level of attention paid to protected areas and actions to give effect to the obligations under the multilateral environmental agreements.

2.4 Multilateral Environmental Agreements

Antigua and Barbuda is a Signatory to four (4), and a Party to sixty one (61) international treaties. The environmental conventions of particular importance include:

- Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention).
- Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (SPAW Protocol).
- Vienna Convention and the Montreal Protocol.
- Convention on Biological Diversity (CBD).
- Framework Convention on Climate Change.
- Convention to Combat Desertification.

- Convention on the International Trade in Endangered Species of Fauna and Flora (CITES).

- Convention concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention).

- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention).

Of these, four are of direct relevance to protected areas, these being:

- Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Signed January 18, 1990).

- Convention on Biological Diversity (Signed June 5, 1992; Ratified March 9, 1993).

- Convention concerning the Protection of the World Cultural and Natural Heritage (Acceptance November 11, 1983).

- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Entry into force October 2, 2005).

2.5 Institutional Framework

The institutions with primary responsibility for the daily operations of marine protected areas in Antigua and Barbuda include:

- The Fisheries Division
- The Forestry Unit
- The National Parks Authority

2.5.1 Ministry of Agriculture, Lands, Marine Resources & Agro-Industry

The Ministry of Agriculture, Lands, Marine Resources, and Agro-Industry is involved with natural resources management primarily through its oversight of the Fisheries Division and the Forestry Unit, two of the main natural resources management institutions in the country. Additionally, under the Forestry Act (1941), the Director of Agriculture is also the Chief Forest Officer.

2.5.1.1 The Fisheries Division

The Fisheries Act (2006) (see Section 2.2.1) gives the Fisheries Division responsibility for development and management of fisheries while the Marine Areas (Preservation and Enhancement) Act (1972) (see Section 2.2.4) authorizes the Division to designate restricted marine areas to protect areas of natural beauty, as well as flora, fauna and wrecks found in the areas.

The Division is responsible for four marine reserves, but its marine protected areas programme will be prepared under the OPAAL project. The Division has also prepared a first draft of its Fisheries Development Plan 2006-2010 and is drafting a new regulations to address a range of fisheries management issues, including seafood standards.

The Division also participates in a number of regional and international programmes:

- CARICOM Regional Fisheries Mechanism.
- National Implementation Coordinating Entity (NICE) for the OPAAL project.
- National Focal Point for the Mainstreaming Adaptation to Climate Change in the Caribbean (MACC) Project.
- National Focal Point for Ramsar.

It also collaborates with a number of other institutions such as the National Parks Authority, Reef Check, the Environmental Awareness Group, the South Coast Fishermen's Cooperative and tourism groups which use the marine reserves.

2.5.1.2 The Forestry Unit

The Forestry Unit is responsible for implementing the provisions of the Forestry Act (1941) (see Section 2.2.5), which mandates forestry development and management, establishment of forest reserves, and watershed management. Its current focus is on environmental education and initiatives in forest recreation and provides technical support to a number of public and private sector institutions in the area of trail development at eco-tourism sites (e.g. Wallings) and in protected areas (e.g. arrangement with the Fisheries Division for the development of trails in the North East Marine Management Area). The Unit is also working with the Ministry of Tourism and Civil Aviation to develop the Antigua Rainforest Canopy Tour.

2.5.2 The Ministry of Tourism and Civil Aviation

The Ministry of Tourism and Civil Aviation affects protected areas programming in a number of ways:

- Protected areas support several of the strategic directions of tourism development, and the Ministry is supporting the development of the product in those areas.
- The Ministry is responsible for the National Parks Authority.
- The Ministry is in the process of developing a heritage tourism programme, and several sites have been identified for declaration as protected areas through this programme.

The National Parks Authority was established by the National Parks Act (1984) (see Section 2.2.6), with the mandate to "…preserve, protect, manage and develop the natural physical and ecological resources and the historical and cultural heritage of Antigua and Barbuda". The Authority cooperates with a number of institutions including the Fisheries Division which provides technical support to the Authority, primarily on issues dealing with wetlands; the Ministry of Tourism and Civil Aviation on the development of historic sites; and the Development Control Authority which reviews development plans on private lands within national parks.

2.5.3 Support Agencies

These agencies are supported by a number of other institutions which through their legislative mandates or programme areas, regulate specific activities/operations within protected areas or provide various forms of support to site operations.

These supporting agencies include:

- The Environment Division
- The Development Control Authority

2.5.3.1 Environment Division

The Environment Division was created in 1996 by a Cabinet decision, and given the mandate to coordinate environmental awareness programming, develop and report on national environmental programmes, coordinate implementation of the MEA obligations, and implement projects to protect or rehabilitate the environment. The Division has been conducting environmental awareness programmes, has developed a coordinating mechanism for implementation of MEAs, and has coordinated the preparation of a number of environmental reports (such as the NEMS). In addition, the Division functions as the National Focal Point for the CBD, the Framework Convention on Climate Change, and the Global Environmental Facility (GEF). The Division currently does not have the legal authority to function as a coordinating agency for the environmental management institutions, though it collaborates with them on a number of initiatives, including: the Development Control Authority; the National Parks Authority; the Fisheries Division, the Barbuda Council and the Environmental Awareness Group.

2.5.3.2 The Development Control Authority

The Development Control Authority is responsible for implementing the Physical Planning Act (2003) (see Section 2.2.8), which mandates the Authority to conduct land use planning and regulate the development of land. As such, the Authority supports the protected areas programme by setting aside land for conservation purposes and by controlling the orderly development of land through the development control process.

2.5.3.3 Non-Governmental Agencies

The Environmental Awareness Group (EAG) is a non-profit, non-governmental organization founded in 1989, and managed by a Council of Members. The EAG conducts environmental awareness programmes, participates in inter-agency environmental committees, and coordinates the Antiguan Racer Conservation Project. More recently, the institution collaborated with the Barbuda Council and the Environment Division to provide oversight to the CREP project.

2.6 Summary

The major issues relevant to protected areas management in Antigua and Barbuda identified by the Review which was undertaken by Environmental Support Services. LLC (2007) are the following:

(a) Absence of a National Policy Framework – Antigua and Barbuda does not have in place a comprehensive policy framework for protected areas development and management. As such, protected areas programming is being driven by sector and sub-sector needs rather than by any systematic planning process.

(b) Lack of Institutional Coordination - The absence of any formal institutional coordinating mechanism reduces the level of cooperation, information sharing, and programme planning between the various institutions concerned with protected areas planning. This results in institutional conflicts, inefficient use of scarce resources, and missed opportunities for advancing the protected areas agenda and development process.

(c) Absence of Data Management Systems for Protected Areas – Research, monitoring, and information management systems are generally absent. GIS datasets for physical planning are being developed, though supporting infrastructure and trained personnel are limiting.

(d) Inadequate Institutional Capacity – Institutional capacity for protected areas management is extremely limited.

(e) Threats to Protected Areas – There are several sources of natural and man-made threats to protected areas, with the threat from storms being very high. Disaster/threat reduction planning is not apparent in existing protected areas programmes.

3 METHOD STATEMENT

This chapter is a summary of the methods used on this assignment. It begins with a statement of the context of the study, and then describes each of the tasks which were undertaken, as follows:

- Review of Relevant Documents,
- Understanding the Proposals for the PA,
- Review of Regulatory Framework,
- Field Collection of Data,
- SWOT Analysis, and
- Potential Impacts and Mitigation Measures.

The final section of this chapter introduces two other evaluation tools which were used on this assignment. In describing the various tasks, reference will be made to the original Terms of Reference and Technical Proposal for this assignment; to note any changes and explain the reason for those changes.

3.1 Context

This statement of the context of the study includes four elements:

- Biodiversity in the OECS,
- Challenges in Protected Area Management,
- The OPAAL Project, and
- Environmental and Socio-Economic Studies.

These descriptions are based largely on information provided in the Terms of Reference which formed part of the OECS' Request for Proposals, as well as generalized information (such as is available on the internet). It is in the context stated in this section that the methods for the individual tasks were designed.

3.1.1 Biodiversity in the OECS

The Eastern Caribbean region is endowed with a rich biodiversity, which, partly due to its isolation within the Caribbean Sea, has resulted in relatively high rates of national and regional endemism. One survey of the world's biodiversity hotspots identified the Caribbean as the fifth ranking "hotspot" and one of the highest priorities in any global strategy for biodiversity conservation and sustainable management. A second study based on faunal distributions classified the Eastern Caribbean region as a unique marine ecoregion of the tropical northwestern Atlantic province and as the most threatened given the highest priority ranking for conservation purposes.

Despite the significance of the region's biodiversity endowment, there have been reductions in both its quantity and quality over time. Many of the region's highly productive offshore ecosystems have come under increasing pressure in recent times from a variety of anthropogenic and natural sources. Efforts aimed at protecting the critical ecosystems in the islands of the Eastern Caribbean have not been very successful. The lack of congruence between nation building and the sustainable use of natural resources remains the biggest hurdle to attaining the goals of sustainable development. The nexus between poverty and the loss of natural capital (through over or indiscriminate resource extraction) is still not clearly understood. For now the establishment of protected areas (PAs) remains the primary tool for resource conservation in the Eastern Caribbean but that itself is characterized by a checkered history of implementation.

3.1.2 Challenges in Protected Area Management

The establishment of an effective framework to create and manage PAs is constrained by significant impediments in the OECS. Existing institutional arrangements are weakened by:

- gaps in policy framework, including limited incorporation of environmental and social costs (direct or indirect) in decision-making; and
- inadequate systems to support integrated planning, information sharing and collaboration.

This has led to adverse impacts on PAs (for example, sedimentation from upstream development or unsustainable exploitation of resource).

3.1.3 The OPAAL Project

The Project Development and Global Objective of OPAAL is to contribute to the conservation of biodiversity of global importance in the Participating Member States by removing barriers to the effective management of protected areas (PAs), and increasing the involvement of civil society and the private sector in the planning, management and sustainable use of these areas. The project intends to achieve this objective firstly by strengthening national and regional capacities in the sound management of PAs.

OPAAL is geared towards providing global benefits through the conservation of globally significant biodiversity. Most importantly these global benefits will be closely linked to demonstrable benefits for local populations. Perhaps the most important benefit will be the newly developed constituencies for biodiversity conservation who will act to promote conservation and sustainable development due to the tangible economic benefits and improved economic opportunities.

The project is also geared to providing benefits to those target groups associated with project-supported PAs. Where the nature of that dependency is not compliant with the goals of protection for the area, the project will provide for the identification of alternative sources of livelihoods that will ensure equal or greater socio-economic benefits than previously obtained. The empowerment of target groups/persons will be effected through appropriate capacity building initiatives undertaken by the project.

3.1.4 Environmental and Socio-Economic Studies

Component 2 of the OPAAL Project deals with Protected Areas Management and Associated, Alternative and New Livelihoods. This component seeks to promote biodiversity management and conservation through the establishment of new protected areas and the strengthening existing PAs. This thrust is complemented by support for alternative and/or new livelihoods in areas in proximity to PAs.

As part of the establishment of PAs under the OPAAL Project, two types of environmental and socio-economic studies are required:

- baseline environmental and socio-economic studies to determine the status of the resource base, its use and the nature of communities associated with the site; and

- detailed site preparation studies to identify adverse environmental or socio-economic impacts associated with the development, and identify safeguards and / or mitigation measures.

Site Preparation Studies were carried out as part of the establishment of PAs under the OPAAL Project, these studies did not include baseline data collection in the strictest sense of the term. Instead, these studies were conduced pursuant to World Bank "safeguard" principles. Such studies were carried out for North Sound Islands National Park (Antigua and Barbuda), but that significant additional baseline information must be collected for NE Marine Management Area.

3.2 Review of Relevant Documents

As the first task on this assignment, Ecoengineering collected and reviewed the following documents provided by ESDU or available from other sources:

- Review of the Policy, Legal and Institutional Frameworks for Protected Areas Management in Antigua and Barbuda prepared by Lloyd Gardner in 2007.
- Opportunities for Sustainable Livelihoods on One Protected Area in each of the Six Independent OECS Territories, for the OECS Protected Areas and Sustainable Livelihoods (OPAAL) Project prepared by Peter Espeut in 2006.
- Northeast Marine Management Area (NEMMA) 2007-2010 Management Plan prepared by Ivor Jackson & Associates (2007).
- Protected Areas Training Needs Assessment Study prepared by Kemrak Parsram (2007).

This review allowed the field work to be focussed on areas where data was less-readily available.

3.3 Understanding the Proposals for the PA

Ecoengineering's understanding of the Proposals for the NEMMA was based on a review of the Management Plan prepared by Mr. Ivor Jackman; provided by ESDU. Our initial work was based on a review of the draft Plan (January 2007). A copy of the Final Plan (April 2007) was provided on June 28, 2007, and this report on the Environmental and Socio-Economic Studies was reviewed and amended as required to ensure conformity with the Final Management Plan.

As noted in Section 1.2, the present study paralleled the preparation of the preparation of the Management Plan for the NEMMA. The benefit of this approach is that it allowed a more focussed assessment of the environmental impacts associated with the Management Plan. The demerit was that the output of the environmental and socio-economic study was not available to guide the preparation of the Management Plan.

3.4 Review of Regulatory Framework

Ecoengineering's review of the laws, regulations and standards which govern the operation of the NEMMA focussed on the following:

Policy Framework

- Draft Policy
- Biodiversity Strategy
- National Environmental Management Strategy and Action Plan

Existing Legal Framework

- Fisheries Act, 2006
- Fisheries Regulations, 2007
- Fisheries (Marine Reserve Area) Notice, 2005
- Marine Areas (Preservation and Enhancement) Act, 1972
- Forestry Act, 1941 (No. 7 of 1941)
- National Parks Act, 1984
- Public Parks Act, 1965
- Physical Planning Act, 2003
- Wild Birds Protection Act

- Beach Protection Act, 1957
- Dumping at Sea Act. 1975
- Oil Pollution of Maritime Areas Act, 1995
- Litter Act, 1983
- Maritime Areas Act, 1982 (No. 18 of 1982)(Cap. 260)
- Public Health Act, 1857

Proposed Legislation

- Draft Forestry and Wildlife Act
- Draft Environmental Protection and Management Bill (2005)

3.5 Field Collection of Data

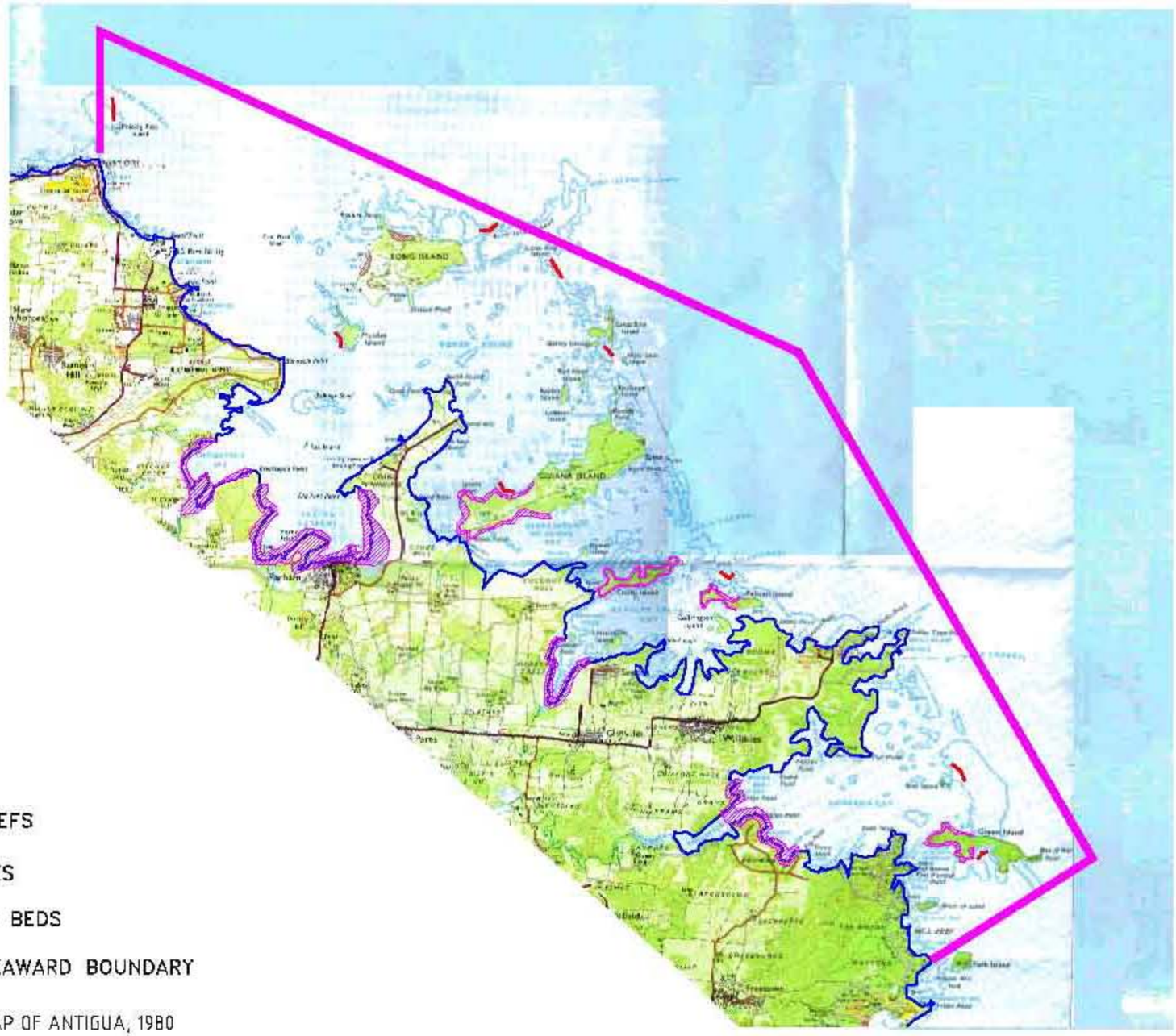
To build a more robust data base for the NEMMA, Ecoengineering expanded on available information from previous studies and published sources (see Section 3.2, above) by field reconnaissance and interviews with key stakeholders.

3.5.1 Biological Field Work

3.5.1.1 Reef Surveys

A rapid ecological assessment was conducted on representative coral reefs in the NEMMA (see Figure 2). The Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol was adapted for this assessment due to time constraints. Nine roving ecological surveys were conducted, covering the widest area possible over the widest range of habitats and stress gradients. Along with the coral reefs, rapid assessments of the seagrass beds were also conducted.

These roving dive surveys involved the diver swimming freely throughout a dive site and recording the presence of all fish species, substrate changes and other invertebrate species that are encountered and that can be positively identified. The search for fishes and/or invertebrates begins as soon as the diver enters the water. The goal is to find as many species as possible. At the conclusion of each survey, each recorded fish species is assigned one of four abundance categories based on about how many were seen throughout the dive [single (1); few (2-10), many (11-100), and abundant (>100)]. The



LEGEND

- CORAL REEFS
- MANGROVES
- SEAGRASS BEDS
- NEMMA SEAWARD BOUNDARY

SOURCE: TOURIST MAP OF ANTIGUA, 1980

0 2km
SCALE

Ecoengineering Caribbean Ltd.

Eco Report No.	10/2007
Date:	31/07/07
CLIENT:	OECS - ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT
PROJECT:	NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA
DWG. NAME:	ECOENGINEERING 2007 NEMMA SURVEY SITES
FIGURE NUMBER:	2

invertebrates are assigned either the abundance codes (Single, Few, Many, Abundant) or Present, depending on the species.

In addition, the Reef Check method was also used to gather data on substrate composition, target and indicator species of fish and invertebrates, coral condition (including bleaching and signs of disease) and obvious signs of human impact (garbage, anchor damage, abandoned fishing line, etc.). This monitoring provided a quantitative view of the extent of human impacts on reefs considered to be in the "best" condition.

The surveys were conducted at the following general locations:

1. Maiden Island Artificial Reef
2. Great Bird Island
3. Bird Island Reef
4. Guiana Island
5. Pelican Island
6. Green Island, and
7. Prickly Pear Horseshoe Reef

Reefs were examined to obtain information on corals species, percentage coral cover, incidence of coral disease and mortality, algal abundance and relative abundance of reef fish. Fish species were also noted and at the conclusion of each survey, all recorded species were assigned one of four abundance categories [single (1); few (2-10); many (11- 100); and abundant (>100)].

Partial mortality in stony corals represents the cumulative effects of hurricane damage, diseases, overgrowth by algae and other encrusting organisms, predation, bleaching, physical abrasion, etc. Most sites were dominated by dead coral rubble and had live coral cover between 5% and 30%.

3.5.1.2 Mangrove Surveys

A rapid ecological assessment of mangrove areas within the NEMMA was carried out in representative areas. Reconnaissance surveys focused on high human activity ("popular") and areas of damage. The following mangroves were surveyed during this assignment:

- Parham Harbour,
- Mercers Creek,
- Guiana Island,
- Pelican Island,
- Crump Island, and
- Fitches Creek.
- Ayres Creek

Field work consisted of travelling the entire project coastline by boat and ground-truthing all the selected mangrove areas to assess mangrove health and species composition. All mangrove surveys were conducted during daylight hours, outside the hours of peak avifauna activity.

3.5.2 Socio-Economic Field Work

3.5.2.1 Interviews with Key Stakeholders

As part of this assignment, the study team met with the following government agencies to discuss the operations of the NEMMA:

- Fisheries Division
- Environment Department
- Forestry Department
- Pesticides and Control Board
- Agriculture Department
- Development Control Authority
- Coast Guard
- Central Board of Health
- Antigua Public Utilities Authority

In addition, a meeting was also held with the Environmental Awareness Group (EAG) and sixty five interviews of other key stakeholders were conducted using a structured questionnaire. The method used to collect information from the various stakeholders was a structured questionnaire (see Appendix A). In general interviews were conducted between 9:00 am to 5:00 pm. However, one particular group, the residents were interviewed after 5:00 pm because in all communities most residents worked away from

home during the day. Finally, information from the secondary stakeholders was obtained through meetings which were arranged prior to the interview or from walk-in interviews.

The actual numbers interviewed in each group were as follows:

- 17 (representing 35 Tour Boat Operators),
- 10 Area Residents,
- 7 Fishermen,
- 6 Tourists,
- 4 Vendors, and
- 3 Hotel / Restaurant Operators.

3.5.2.2 Constraints and Limitations

The following constraints and limitations were experienced with respect to interviews with key stakeholders:

- Fishermen were interviewed at 2 (out of 7) landing sites and in a few cases at the fishers' residents. Given that field work for interviews with several stakeholder groups were within a one week period, it was difficult to capture fishers at landing sites during the hours of 9.00 am to 5.00 pm.

- There was some difficulty in engaging the tourists. The majority of them did not want to go through the interview process as they felt it would disrupt their leisure time. A total of six tourists were interviewed but this includes 2 couples.

- The majority of residents in the NEMMA communities were not at home during working hours. Our investigations indicated that these residents hold jobs that are away from home. One recommended approach was weekend interviews, but this was not possible due to time and cost constraints.

- There was some difficulty in accessing information from the industries. The electricity and power generation plants were under the jurisdiction of the local Public Utilities Association and were approached but there has been no response to the requested information. The desalination plant was under the majority shareholder but requests for information placed through the former majority shareholder, the aforementioned utilities association were unsuccessful. The brewery was under audit at the time of the site visit and further correspondence

has not yielded any results. There was no available contact information for the owner/operator of the cement receiving facility.

Requests were also made to the Development Control Authority for information pertaining to development proposals and to the Central Board of Health for marine water quality and industrial effluent monitoring data. However this information was not received at the time that this report was being prepared.

3.5.3 Application of Results

The results of field data collection were used to prepare a description of baseline conditions on which potential impacts can be evaluated. In addition, the field work also disclosed adverse impacts which are already taking place at the NEMMA.

3.6 SWOT Analysis

The SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis was not part of the original scope of this assignment, but was added by Ecoengineering as a means of focussing the analysis of potential impacts (and specifically in relating pre-existing factors to the approaches in the Management Plan). SWOT Analysis is an extremely useful tool with which data is subjectively assessed and organized into a logical order. By identifying Strengths, Weaknesses, Opportunities and Threats associated with the Northeast Marine Management Area (NEMMA), it will be easier to identify appropriate measures for protecting the environment and specifically for addressing potential adverse impacts. In any SWOT Analysis, it is important to note that the categories are not mutually exclusive. It is quite possible for a single aspect to be associated with a strength and also with a threat.

3.7 Potential Impacts and Mitigation Measures

The assessment of potential impacts consisted of three steps:

-Impact Identification,

-Classification of Impacts, and

-Recommendation of Mitigation Measures.

3.7.1 Impact Identification

Based on the proposals for the PA and the baseline description (see Sections 3.3 and 3.5, respectively), Ecoengineering identified potential adverse impacts to the natural and human environments, of two general kinds:

-new impacts which may arise from the PA Proposal, and

-intensification (or diminution) of existing impacts.

This identification of potential impacts was based, in large measure, on the study team's considerable experience in environmental studies (and in particular Environmental Impact Assessments) in the OECS and in the wider Caricom Region.

3.7.2 Classification of Impacts

The impacts which were identified were also classified on a systematic basis (both assuming that now mitigation measures were applied and also assuming the successful implementation of mitigation measures). The classification method was based on three criteria: extent, intensity, and nature. Based on this, impacts (both with and without mitigation) were classified as low, moderate or high. Where adverse impacts were considered to be insignificant, no classification was applied. Further details on the classification system are provided in Appendix B.

3.7.3 Recommendation of Mitigation Measures

Ecoengineering also identified measures which can be used to effectively reduce environmental impacts of the PA Proposals, both on the Natural Environment and on the Human Environment (that is, on the physical, biological and social environments). Again, we relied largely on our experience on earlier projects of this kind. The mitigation measures were physical measures (fixed anchorages, appropriate trash collection, appropriate sewage treatment) as well as administrative measures (limiting visits during nesting seasons, limiting numbers of visitors at one time).

3.8 Other Evaluation Tools

Two other evaluation tools are discussed in this report:

- A Monitoring and Evaluation (M&E) Checklist, and
- An Evaluation Matrix

The M & E Checklist was adapted for use in Protected Areas in the OECS. This is introduced in Section 6.7, and discussed further in Section 9.10.

The Evaluation Matrix was adapted from a Canadian model. It is introduced in Section 9.13, and used in that same section to summarize environmental, social and livelihood aspects of the actions envisaged in the Management Plan and the Livelihoods Study.

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4 ENVIRONMENTAL CHARACTERISTICS

This chapter describes the key environmental characteristics of the Northeast Marine Management Area (NEMMA), Antigua. It begins with a definition of the area as declared and continues with brief baseline descriptions of the following components:

- Offshore Islands,
- Other Protected Areas,
- Climate,
- Landform,
- Drainage,
- Bathymetry,
- Oceanography,
- Water Quality,
- Archaeological and Historical Sites,
- Coral Reefs,
- Mangroves,
- Fish and other Aquatic Fauna,
- Beaches,
- Floral Alliances, and
- Fauna.

A brief description of the methods used to capture this information is included at the beginning of each section. Baseline descriptions were developed from existing information sources and field reconnaissance conducted during the period February 26 to March 02, 2007.

4.1 Location and Boundaries

The Northeast Marine Management Area (NEMMA) was declared a Marine Reserve under Section 22 of the Fisheries Act Cap. 173 and published in the Official Gazette XXV No. 82 dated December 29, 2005. The NEMMA encompasses an area of over 30 square miles and is located in the Atlantic Ocean. Its boundaries are shown in Figure 1.

The area is bounded seaward by:

- lat. 17?10' 14"N and long. 061?48' 16"W to
- lat. 17?12' 09.26"N and long. 061?48' 14.87"W to
- lat. 17?06' 34.72"N and long. 061?38' 36.59"W to
- lat. 17?02' 47.07"N and long. 061?38' 36.89"W to
- lat. 17?02' 48.23"N and long. 061?40' 26.74"W to

and landwards by the landward edges of the mangrove and wetland systems from Beggars Point in the Parish of St. Peter to Friars Head, in the Parish of St. Phillip, where they exist and the line of permanent vegetation at the coastline where they do not, as the North East Marine Management Area (NEMMA). This applies to all offshore islands within the boundary and excludes all areas above the line of permanent vegetation.

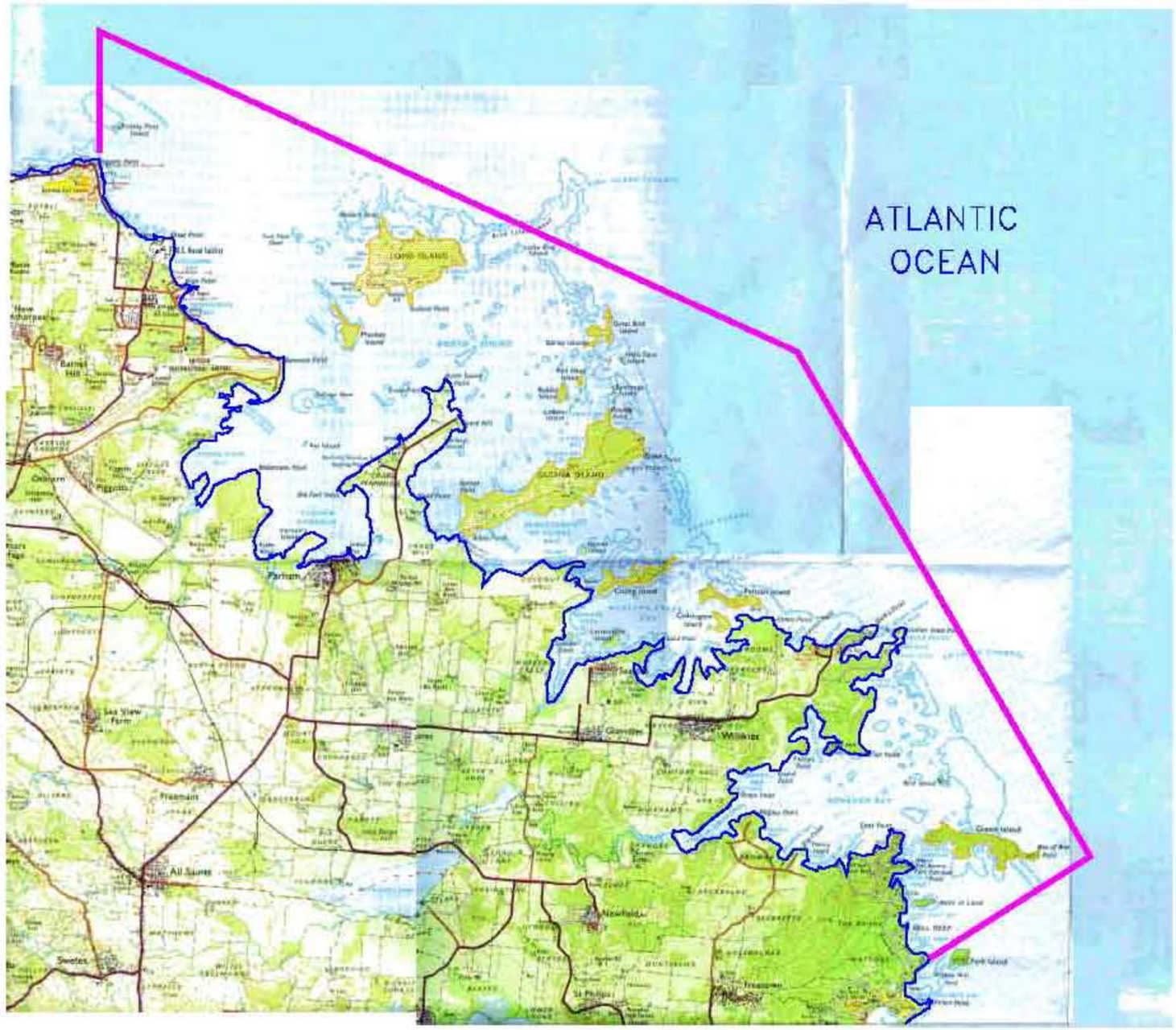
4.2 Offshore Islands

There are over 30 islands, islets and rocks (named and unnamed) in the NEMMA. The major ones are shown in Figure 3. Table 1 lists the major islands giving some ides of their approximate sizes and locations as well as an indication of ownership.

4.3 Other Protected Areas

According to the Draft Management Plan there are several protected areas (existing and proposed) occurring within the NEMMA:

- A Public Park at Long Bay (declared under the Public Parks Act, 1965)
- Crump Island Coral Reef (proposed Marine Park)
- Great Bird Island and associated Islets (proposed Wild Life Sanctuary)
- Guiana Bay Islands (proposed Wild Life Sanctuary)
- Devil's Bridge (proposed Park Reserve)
- Green Island Reefs (proposed Park Reserve)
- Long Island (proposed Wild Life Reserve)
- Area between Green Island and Indian Town Point (proposed Marine Reserve)
- Jabberwock Beach



SOURCE: TOURIST MAP OF ANTIGUA, 1980

Ecoengineering Caribbean Ltd.

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Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
	DWG. NAME: OFFSHORE ISLANDS IN THE NEMMA	

TABLE 1: OFFSHORE ISLANDS IN NEMMA

Source: EAG Database (unpublished)

Name of Island	Approx. Size	Approx. Location	Ownership
Prickly Pear	100 m X 50 m	0.6 km NE of Beggar's Point	Crown
Long	1800 m X 1600 m	1.4km from Crabbs Peninsula	Private
Maiden	800 m X 350 m	1.1 km from Barnacle Point	Crown
Rat	150 m X 50 m	1.8 km from Parham	Crown
Little Bird	50 m X 25 m	0.85 km E of Long Island	Private
Great Bird	950 m X 450 m	2.4 km from Crabbs Peninsula	Private
Galley (2 islets)	150 m X 50 m 50 m X 20 m	100 m S of Great Bird Island	Private
Hells Gate	100 m X 100 m	0.35 SE of Great Bird Island	Private
Exchange	150 m X 50 m	0.29 m N of Monocle Point	
Rabbit	350 m X 120 m	0.75 km NW of Guiana Island	Private
Red Head	240 m X 100 m	0.6 km NW of Guiana Island	Private
Lobster	150 m X 50 m	150 m SE of Rabbit Island	Private
Guiana	2.4 km X 1 km	50 m off mainland	Private
Hawes	150 m X 100 m	0.7 km E of Guiana Island	
Crump	1.5 km X 300 m	At mouth of Mercers Creek	Crown
Little	150 m X 150 m	100 m off Coconut Hall	
Laviscounts	350 m X 200 m	150 m off Seatons' waterfront	Crown
Pelican	1 km X 200 m	100 m off Rooms Estate	Private
Codrington	400 m X 300 m	100 m off Rooms Estate	Crown
Nanny	50 m X 20 m	0.65 km E of Pig Point, Nonsuch Bay	
Bird	120 m X 100 m	0.65 N of Green Island	Private
Green	2 km X 650 m	350 m E of Conk Point	Private
York	300 m X 300 m	400 m off coastline at Watsons	Private

4.4 Physical Characteristics

The physical components of the NEMMA and adjacent areas which are of relevance to the integrity of the NEMMA are briefly described under the following sections:

- Climate,
- Landform,
- Drainage,
- Bathymetry,
- Oceanography, and
- Water Quality.

Information on the physical characteristics of the NEMMA was obtained from the following general sources:

- Country Environmental Profile. Government of Antigua and Barbuda (1991).
- Draft National Physical Development Plan: Volume 2 – Report of the Survey. Development Control Authority (2001).
- Opportunities for Sustainable Livelihoods on One Protected Area in each of the Six Independent OECS Territories, for the OECS Protected Areas and Sustainable Livelihoods (OPAAL) Project. Peter Espeut (2006).
- Unpublished databases of the Environmental Awareness Group (EAG).

4.4.1 Climate

The NEMMA is located on the windward side of Antigua. The north eastern areas of the island experience a mean annual rainfall of between 35 to 40 inches (Government of Antigua and Barbuda, 1991). In the dry season (January to March/April) this rainfall is generally lower.

According to James, Philmore (2003) twenty weather systems (depressions, storms or hurricanes) have affected Antigua between 1996 and 2001 (see Table 2). Such weather systems cause changes in beach profiles and damage to reefs, seagrass and wetlands. The most significant weather systems to have caused notable damage in the NEMMA within recent years are Hurricanes Luis and Marilyn in 1998.

TABLE 2: WEATHER SYSTEMS AFFECTING ANTIGUA FOR THE PERIOD 1995 – 2001

Source: James, Philmore (2003)

YEAR	TROPICAL SYSTEM			
	NAME	TYPE	EFFECTIVE DATE	LOCATION
2001	Chantal	Tropical Depression	August 16	Extra South
	Erin	Tropical Storm	September 5	Extra East
	Iris	Tropical Depression	October 4	Extra South
	Jerry	Tropical Storm	October 8	Extra South
2000	Chris	Tropical Depression	August 19	East
	Debby	Hurricane	August 21	South
	Helene	Tropical Depression	September 16	South
1999	Emily	Tropical Storm	August 26	Extra East
	Floyd	Hurricane	September 11	Extra North
	Jose	Hurricane	October 20	Landfall
	Lenny	Hurricane	November 19	Landfall
1998	Bonnie	Tropical Storm	August 20	North
	Dannielle	Hurricane	August 27	Extra North
	Georges	Hurricane	September 20	Landfall
1997	Erika	Hurricane	September 6	North
	Grace	Tropical Storm	October 15	Extra North
1996	Bertha	Hurricane	July 7	North
	Edouard	Hurricane	August 31	Extra North
	Fran	Tropical Storm	September 8	South
	Isadore	Hurricane	September 28	Extra North
1995	Chantal	Tropical Depression	July 13	North
	Iris	Tropical Storm	August 27	East
	Marilyn	Hurricane	September 14	West
	Sebastian	Tropical Depression	October 23	North
	Luis	Hurricane	November 5	Landfall

4.4.2 Landform

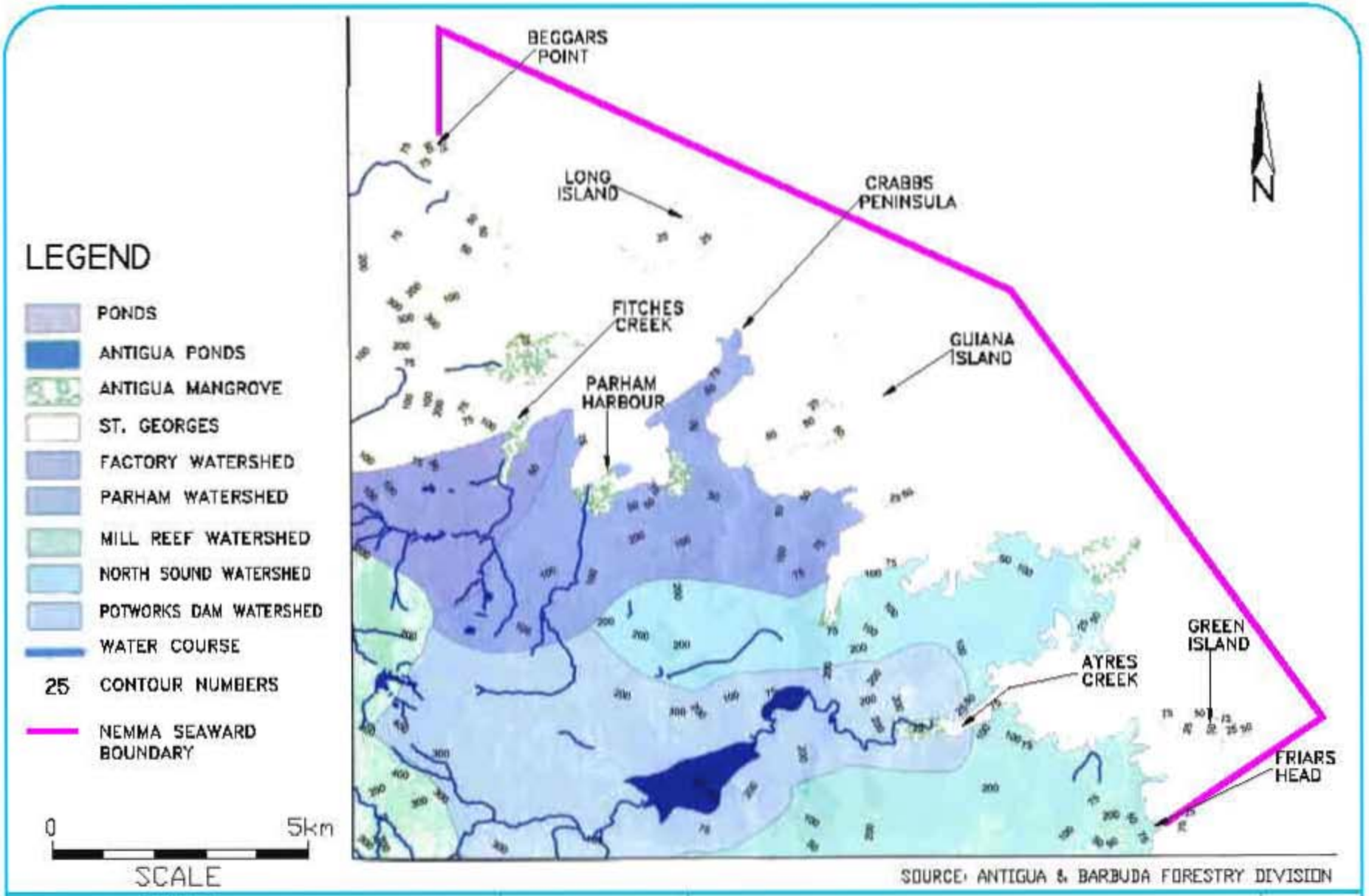
The coastline bordering the NEMMA is very indented. The numerous islands (see Section 4.2) are largely coralline and range in elevation from as low as 3m (Nanny Island) to heights of 75 m (Green Island) (EAG 1997, see Figure 4). Government of Antigua and Barbuda (1991) describes the northern and eastern third of Antigua (including many of the offshore islands in the NEMMA) as limestone.

4.4.3 Drainage

Channels draining the northeastern areas of the mainland enter the waters of the NEMMA at Fitches Creek (North Sound Stream), Mercers Creek, Ayres Creek (Black Ghaut) and Winthropes Foot Creek. Figure 4 shows the major drainage channels and watersheds which discharge into the NEMMA. The Potworks watershed is the second largest watershed comprising some 3160 ha. The Fitches Creek and Parham Watershed occupy 1040 ha and 1472 ha, respectively.

4.4.4 Bathymetry

Antigua and Barbuda are emergent parts of a 3,400 sq. km sub-marine platform, one of the largest in the Eastern Caribbean. The depth of water between the two islands ranges from 27-33 m. The coastline of Antigua is markedly indented with numerous islands, creeks and inlets and associated sand bars and wetlands at their inland end. A large portion of the east, north and south coasts are protected by fringing reefs. Large areas of sandy bottom in shallow water are found on the west coast and between the fringing reefs and the shore (Cooper & Bowen, 2001). Available maps show a number of shoals and channels in the area (see Figures 1 and 3).



SOURCE: ANTIGUA & BARBUDA FORESTRY DIVISION

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	DWG. NAME: WATERSHEDS AND CONTOUR MAP	

4.4.5 Oceanography

Antigua is affected by two ocean currents: the Antilles Current which flows north of Antigua and the stronger Caribbean current which flows to the south. Both flow towards the east or north east transporting warmer waters to the region. These currents dominate offshore but have less effect in nearshore areas (Coastal Systems International (undated)).

4.4.6 Water Quality

Several of the literature sources which were reviewed {Espeut (2006), Cooper and Bowen (2001), IRF (1997), Jackson (2007) and Development Control Authority (2001)} and discussions with the Environment Division acknowledge that water quality in the NEMMA is poor. According to Cooper and Bowen (2001) the CBH has undertaken a programme of monitoring water quality at several of the main beaches around the island. However details of analyses are not published. Requests for water quality data relevant to the NEMMA were made to the Environment Division and the Central Board of Health but no results were forthcoming.

The literature cites discharges from sewage treatment and desalination plants operated by surrounding hotels and from industries as the major contributors. Espeut, 2006 summarises the findings of a 1996 Island Resources Foundation survey of the NEMMA which identified nutrient pollution causing algal growth, sedimentation from soil erosion, and heat and oil pollution from industry. IRF 1997 identifies sedimentation from land erosion, dredging boat channels, building marinas and deposition of cleared material; eutrophication from inland farming; port and industrial pollution and solid waste disposal as potential water pollution problems in the NEMMA.

4.5 Archaeological and Historical Sites

There are numerous archaeological and historical sites within the NEMMA which are also protected. Figure 5 shows the distribution of archaeological sites on some of the offshore islands while Figure 6 shows the locations of shipwrecks within the NEMMA.

4.6 Biological Environment

The description of the biological environment of the NEMMA will focus on the key environmental assets and will be presented under the following sub-sections:

- Marine Environment, and
- Terrestrial Environment

4.6.1 Marine Environment

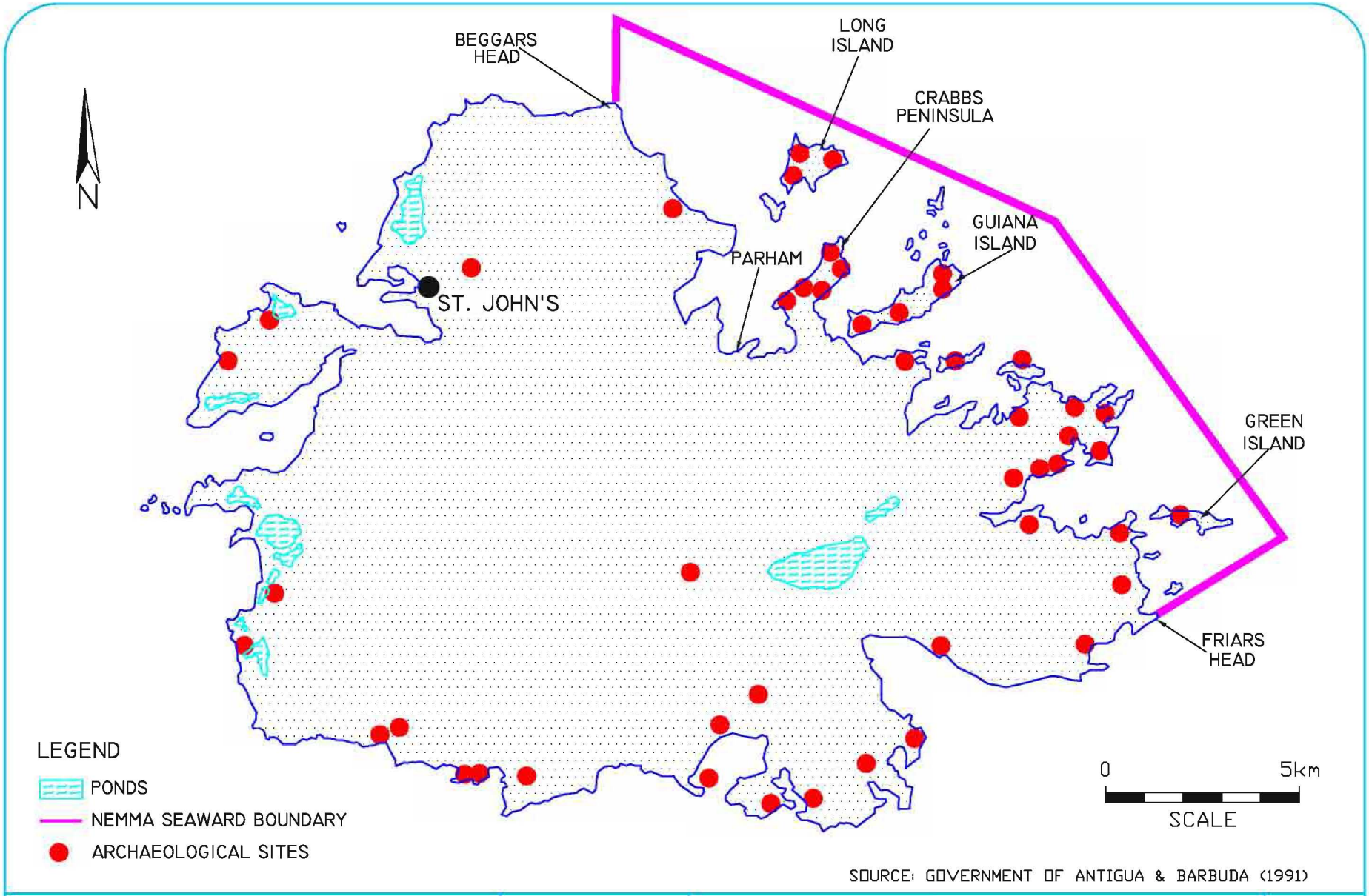
The major marine assets within the NEMMA are the coral reefs, fringing mangroves and sea grass beds which support a wide array of marine life. General information concerning the NEMMA was obtained from the Fisheries Division and several historical documents. Field reconnaissance surveys and ground truthing exercises were also conducted at selected sites within the NEMMA to determine the current state of these assets. Figure 2 shows the extent of the NEMMA and the areas surveyed. Reconnaissance surveys focused on areas of high marine diversity, artificial reefs, areas of high human activity ("popular") and areas of damage or scaring.

4.6.1.1 Method

In February 2007 roving ecological surveys were conducted at the following general locations (see Figure 2):

- Maiden Island Artificial Reef
- Great Bird Island
- Bird Island Reef
- Guiana Island
- Pelican Island
- Green Island, and
- Prickly Pear Horseshoe Reef

Along with the coral reefs, rapid assessments of the seagrass beds within the NEMMA were also conducted.



SOURCE: GOVERNMENT OF ANTIGUA & BARBUDA (1991)

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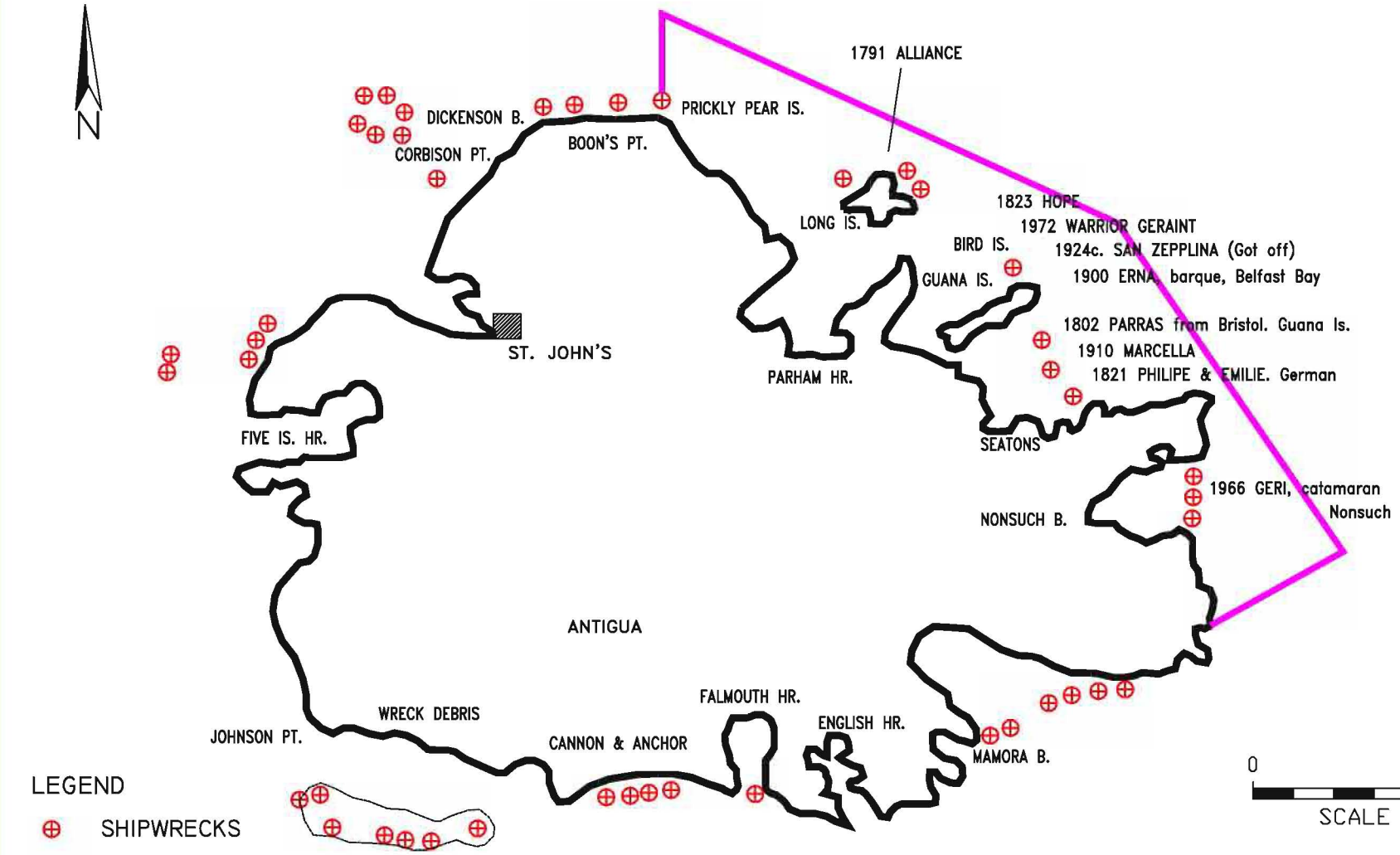
		DWG. NAME: ARCHAEOLOGICAL SITES IN THE NEMMA	



SOURCE: NICHOLSON, DESMOND V. (2002)

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	Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
		DWG. NAME: SHIPWRECK SITES IN THE NEMMA	

The literature which was reviewed included:

- Natural Resources of North Sound and Current Uses. Bird Island Reserve Management Plan. Island Resources Foundation, 1997.
- Results of a Coral Reef Survey of the North Sound of Antigua. Marilyn E. Brandt, Wade T. Cooper, Aletta T. Yniguez and John McManus. The National Center for Coral Reef Research (NCORE), 2005.

4.6.1.2 Coral Reefs

Coral reefs are a vital habitat for many marine organisms as well as providing habitat for life stages of many pelagic fish. It is also an important fisheries resource for some fishermen.

Antigua possesses an extensive area of coral reefs which provide a wide variety habitat and support a high biodiversity (see Figure 7). However within the last 10-15 years the reefs have experienced devastating effects of hurricanes (Cooper et al 2001). This has altered the structure of the reefs, where currently much of it is built atop coral rubble. The reefs within the NEMMA consist of a series of coral patches, reef crests and one horseshoe reef. Reef crests and the horseshoe reefs are found in deeper waters, whereas in shallower and more inshore areas coral patches dominate. Historical baseline studies of the reefs within the North Sound area concluded:

- Most hard corals in shallow waters are dead (IRF 1997, Goreau et al 1996),
- Deeper reefs tended to be healthier (IRF 1997, Bunce 1995)
- There has been a significant deterioration of the hard and sort corals with replacement of marcoalgae and seagrass (IRF 1997), and
- Some reefs are showing considerable signs of stress (CIDA 1988).

These conclusions of general deterioration of the reefs reflect a phenomenon affecting most Caribbean reefs. Eutrophication and pollution from sewage discharge are also frequently cited as concerns, despite some improvement in the standards of maintenance by hotels of their sewage treatment plants (Cooper et al 2001). Stressors on the reef include physical storm damage (associated with the passage of hurricanes and tropical storms), anchors, sedimentation and fishing gear, as well as from white-band disease, other diseases, and localized nutrient pollution from yachts (Wells, 1988; Smith et al, 1997). Hurricane Hugo in 1989 and Hurricanes Luis and Marilyn in 1995 caused extensive damage to reefs on the south and southeast coasts of Antigua, particularly to *Acropora sp*. on shallow reefs. (Smith et al. 1998).

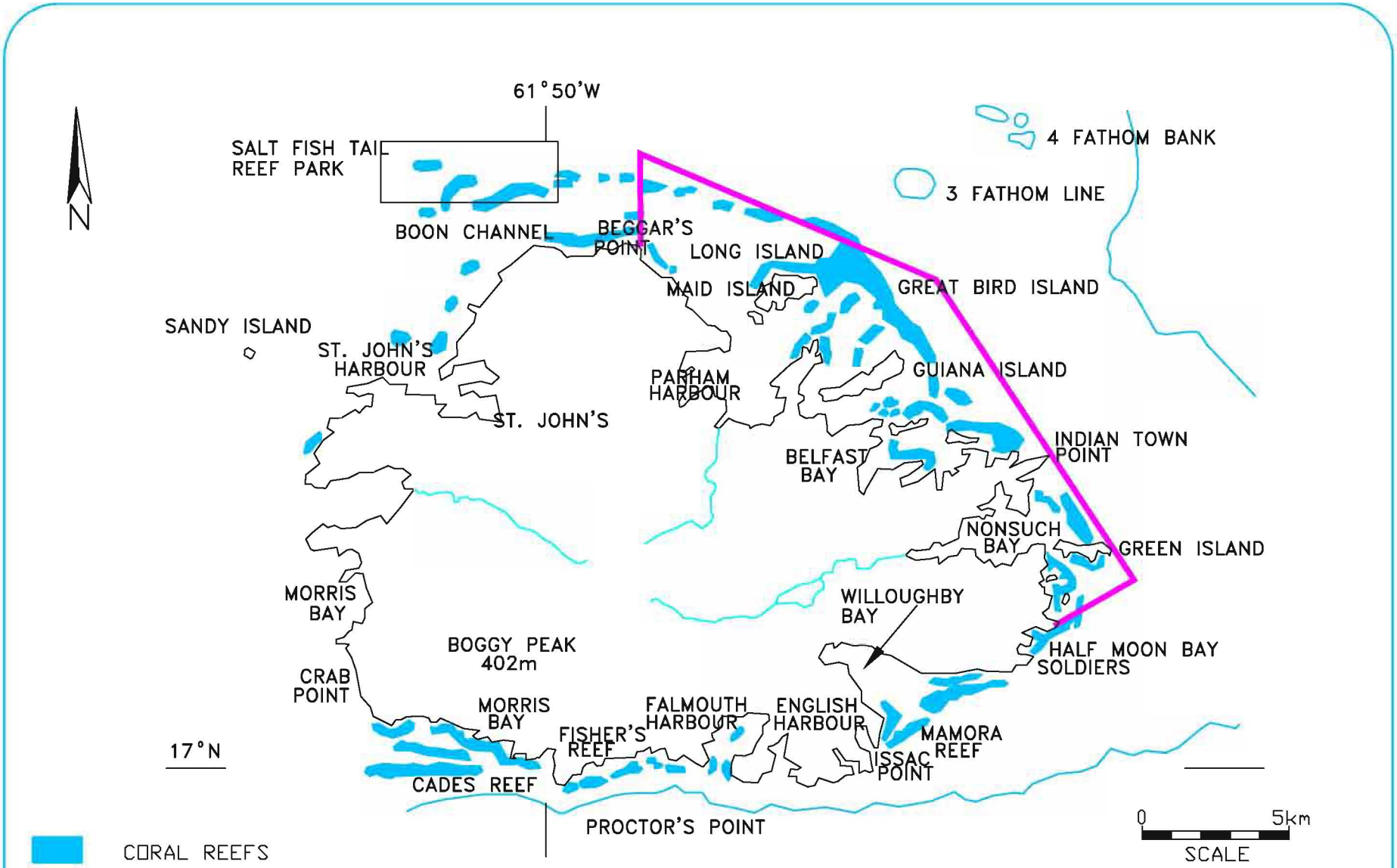
4.6.1.2.1 Maiden Island

Maiden Island is a small island just south west of Long Island. Surrounding the island are several shallow fringing reefs, however Maiden Island's windward reef has been devastated by Hurricane Luis (1995). An artificial reefball breakwater reef system was established along this coast to protect the remaining coastline from further erosion (Reef ball foundation, 2005). Several species of corals species have been propagated and transplanted, including threatened Staghorn (*Acropora cervicornis*) and Elkhorn corals (*A. palmata*) (RBF 2005). The roving diver surveys confirmed that the artificial reef provided suitable habitats for sea grasses (*Thalassia*) sea urchins (*Echinometra lucunter* and *Diadema*), juvenile and adult spiny lobsters (*Panulirus argus*), reef squid (*Sepioteuthis sepioidea*), several species of juvenile and adult fish grouper (Serranidae), snapper (Lutjanidae), grunt (Haemulidae), parrotfish (Scaridae), surgeonfish (Acanthuridae), turtles and dolphins. See Appendix C for a complete list of species noted.

The artificial reef has been in existence for the last 5 years and press releases by the Reefball Association have boasted of a community of over 70 species of corals (RBF 2003). The Ecoengineering 2007 survey of the reef showed a contrasting view on the status of the reef. The coral community consisted primarily of soft corals {Sea fans (*Gorgonia sp.*), Sea whips, and encrusting corals). Hard corals colonies were few, small and far between which included brain corals (*Diploria sp and Colpophyllia sp*), Finger Corals (*Porites sp*), Elk horns (*Acropora palmata*), Fire corals (*Millepora*) and boulder coral complexes (*Montastrea spp.*). The reef balls had small colonies of soft corals growing on them, as well as encrusting red algae and *Halimeda*. Sea grass beds were moderately covered with the green algae (*Halimeda*). Diseases noted onsite included white plague disease on *Porites* and *Acropora*.

4.6.1.2.2 Prickly Pear (Horseshoe Reef)

Goreau et al, 1996 described this reef as a coral community growing over a substrate composed primarily of coarse *Acropora palmata* rubble covered by encrusting red coralline algae (primarily *Porolithon* on upper surfaces and *Mesophyllum* in interior crevices). The survey goes on to indicate the dominant corals were *Porites, Diploria* and *Montastrea*, however most of the corals were small and the community was relatively young. The reef has been adversely impacted by hurricane damage and ship groundings, which have devastated several of the remaining large live *Acropora* colonies (Goreau 1996, and per. conv.). The study also indicated evidence of small-scale coral bleaching in individuals of most of the species observed (*Porites astreoides, Millepora alcicornis, Montastrea annularis*, and *Agaricia agaricites*).



SOURCE: GOVERNMENT OF ANTIGUA AND BARBUDA, 1991

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		DWG. NAME: CORAL REEFS AROUND ANTIGUA	

The roving reef assessment of Prickly Pear Horseshoe Reef was consistent with the report by Goreau (1996), with respect to the dominance hard corals and the presence of disease. The impact of Hurricanes Luis was still evident on the reef. There were expanses of dead staghorn coral (*Acropora palmata*) skeleton with encrusting red algae. Existing coral colonies included gorgonians, sea squirts, *Acropora* corals (*A. cervicornis*, *Millepora sp.* and *Porites sp)* (see Photographs 1 and 2). In deeper areas, greater then 10 m deep, colonises of *Montastrea sp., Porites* and *A. cervicornis* were dominant. Along the windward side of the reef, colonies *A. palmata* were the only living corals present.

The coral rubble has provided a large number of habitats, and as such the reef exhibited a wide diversity of fish. Several families of key herbivores were noted: Damselfish (Pomacentridae), Parrotfish (Scaridae) and Butterflyfish (Chaetondontidae), however other key stone grazers such as the long spined sea urchins (*Diadema*) were not observed. Green alga cover was approximately 5-10% of the ground cover.

Nearby coral shoals exhibited very little hard coral recolonisation. They were primarily utilised by encrusting soft corals, encrusting algae and sponges. The dominant hard coral was *Porites*.

4.6.1.2.3 Green Island

The reefs to the north and south of Green Island were surveyed during this survey (see Figure 2). Both areas teemed with reef life however coral colonies consisted of living corals mixed in with dead corals.

Most of the northern reefs were relatively shallow and as deep as 10 m. The survey showed that much of the reef rests atop mounds of red algae encrusted *Acropora palmata* (Elkhorn coral) and *Porites furcata* (finger coral) rubble. There was little coral cover in areas shallower than 7 m, but the dominant bottom cover was shared between live corals and coral rubble, with approximately 20% of the area being sand. Dominant corals included pioneer species such as *Montastrea sp.* complex, *Millepora sp*., *Diploria sp*., *Favia sp*., *Agaricia sp*. and several soft corals (Gorgonians), encrusting tube and vase sponges and tunicates. No live colonies of *A. palmata* were observed. The reef framework was largely covered with alga, with discrete patches overgrown with *Dictyota sp.* and *Halimeda sp.* The reef also showed diseases such as yellow spot, white band and bleaching. Relative to the southern reefs, fish fauna diversity was also low, and dominated primarily by parrotfish (Scaridae). Other fishes noted are described in Appendix C with the dominant species.

The southern reefs were much smaller than the northern reef, with greater abundance of fish and healthier looking corals. This reef was very shallow, ranging from 1-5 m with several small patchy colonies. Areas between the reef patches were a combination of sand and sea grass. Some of the existing colonies developed on dead *A. palmata* skeleton, while others developed on *Montastrea* skeletons. These areas are frequented by tourists and "reef walking" was the most obvious impact on these reefs. Shallower areas showed the most coral damage, and in some areas there were no living coral colonies. Soft corals were confined to the corals in the deeper areas. The dominant stony corals were *Montastrea sp., Siderastrea sp.* and *Diploria* sp. However, many of these showed signs of diseases such as yellow blotch, white band and bleaching. Several key herbivores were noted, in particular the spiny sea urchin, *Diadema*. However, like the northern reef, there was an overgrowth of alga.

4.6.1.2.4 Great Bird Island

The reefs around Great Bird Island consist of a mixture of shallow coral patches, fringing reefs and mounds of coral rubble. The reefs also show a high degree of mortality with a mixture of alive and dead coral, with new colonies establishing themselves atop dead *Acropora* branches. The dominant stony corals included *Montastrea* and *Siderastrea (see* Photograph 3*)*. Inshore areas were mainly coral patches of *Montastrea sp, Siderastrea sp*. and *Diploria sp*. Other less dominant corals included *Favia, Millepora*, *Gorgonia*, and *Porites*.

In areas in excess of 15 m, the existing reef was built atop mounds of dead *Acropora, Porites* and *Montastrea* colonies. Some areas have not been recolonised by hard corals and are dominated by soft corals, algae and encrusting sponges. The majority of the reef coral rubble has been recolonised by fast spreading pioneer species, such as *Montastrea* and Porites. Some thickets of *Acropora sp*. were noted however, these were few and fare between. The partial mortality on large heads of *Siderastrea, Diploria, Montastrea*, *Colpophyllia sp.* and *Agaricia* were common on the reef (see Photograph 4). Many coral showed signs of white plague and other diseases, resulting in bare splotches void of polyps. These bare patches were a common sight on the reef.

The fish fauna consisted primarily of juveniles of parrotfish (Scaridae), damselfish (Pomacentridae), grunts (Haemulidae), and surgeonfish (Acanthuridae). Appendix C contains a list of all the species of fish encountered on the reef.

PHOTOGRAPH 1: *Acropora* CORAL RUBBLE

PHOTOGRAPH 2: REPRESENTATIVE REEF STRUCTURE OF PRICKLY PEAR HORSESHOE REEF

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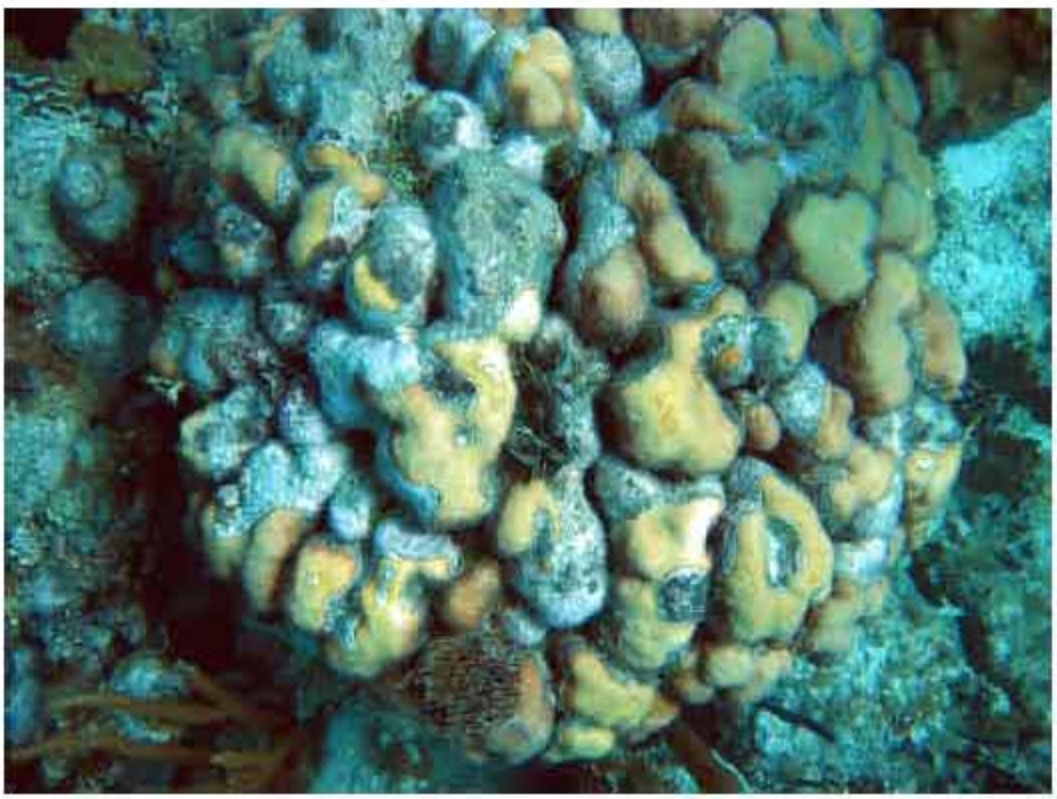
		DWG. NAME: PHOTOGRAPHS 1 & 2

PHOTOGRAPH 3: DOMINANT HARD CORALS *Montastrea*, *Siderastrea* AND *Agaricia* IN FOREGROUND



PHOTOGRAPH 4: PARTIAL MORTALITY OF CORALS

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4.6.1.2.5 Bird Island Reef

Bird Island Reef is located to the east of Long Island, extending south to Great Bird Island. This reef exhibits reef features similar to those found along the reefs on the south of Great Bird Island. The outer reef consists of red algae covered *Acropora* and *Montastrea* coral rubble. Major hard corals colonising the reef were *Millepora, A. cervicornis, Porites, Agaricia and Favia (*see Photographs 5 and 6). Along the leeward side of the reef *Siderastrea* and *Diploria* were also dominant. The reef crest areas were dominated by several small coral complexes of *Montastrea sp, Siderastrea* and *Diploria*. Bottom cover was primarily sand, which was dominated by gorgonians and other soft corals and sponges (see Photograph 7).

Diseases noted on the reef included yellow blotch and white band on *Porites sp*, and *Diploria sp*, and black band on *Diploria sp*. However, coral bleaching has affected over 35% of the living colonies. Like the other reefs surveyed within the NEMMA, there was also a heavy presence of the marcoalgae *Halimeda,* which in some instances completely covered areas of coral rubble and were encroaching on small living coral heads (see Photograph 8). The partial mortality of corals at this reef is representative of the status of most of the reefs in the NEMMA.

Fish fauna were mainly parrotfishes (Scaridae), surgeonfishes (Acanthuridae), snappers Lutjanidae) and damselfishes (Pomacentridae), which showed a dominance of juveniles.

4.6.1.2.6 Guiana Island

The reefs along and off the north eastern coast of Guiana Island were surveyed and were found to be one of the healthier reefs of the surveyed sites. The existing reef was built atop an extensive *Acropora* and *Porites* coral rubble mound. Along the southern boundary, the reef was patchier with a greater presence of Alcyonarians and *Diploria, and* some seagrass (*Thalassia*) between the colonies.

The dominant corals were *Montastrea sp*. and *Siderastrea* accounting for approximately 30% of the total live coral observer. Other coral included *Acropora, Diploria, Porites, Favia, Millepora* and Alcyonarians, which together accounted for 40% of the bottom cover. The remaining bottom cover was shared between *Acropora* rubble and bar sand. Many of the smaller coral heads showed signs of disease such as yellow blotch and black band. Large coral heads of *Montastrea* were partially dead, with significant area of bare skeleton.

There was also a greater abundance of fish fauna as compared to other sites. However, juveniles were still more dominant than adults. Dominant fishes were parrotfish (Scaridae), snappers (Lutjanidae), surgeonfishes (Acanthuridae) and damselfishes (Pomacentridae).

4.6.1.2.7 Pelican Island

Like the other reef in the NEMMA, the reefs around Pelican Island were also devastated by the passage of hurricanes. Approximately 60% of the surveyed area (see Photograph 9) was coral rubble. The majority of the coral rubble was Elkhorn coral (*Acropora palmata*). Approximately 10% of the coral rubble was shared between *Porites* and *Montastrea*. Living hard corals were very few and small consisting of brain corals (*Diploria*), finger corals (*Porites*), staghorn corals (*A. cervicornis*) and elkhorn corals (*A. palmata*).

Soft corals were dominant, accounting for 70% of the live colonies. The three hard corals *Porites, Diploria* and *Acropora* comprised the rest of corals. Some colonies of *A. palmata* (see Photograph 10) were also noted amidst the coral rubble. Along the sand boundaries of the reef, there was a greater presence of brain corals and sea grass (*Thalassia*).

Diseases included aspergillosis (affecting sea fans) (see Photograph 11), yellow spot and black band (affect brain corals) and bleaching affecting (brain corals and elkhorn corals) (see Photograph 12). Several areas of dead coral and live colonies were partially smothered by *Dictyota.* This system seemed to be a highly stressed resulting in the low biodiversity present.

Few fish fauna species were noted, and were mainly juvenile parrotfish (Scaridae), surgeonfish (Acanthuridae), wrasse (Grammatidae), chromis (Pomacentridae) and barracuda (Sphyraenidae).

PHOTOGRAPH 5: THRIVING FIRECORAL *(Millepora)*

PHOTOGRAPH 6: TYPICAL COLONY ON OUTER REEF OF BIRD ISLAND REEF

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PHOTOGRAPH 7: SOFT CORAL DOMINANCE ON SANDY BOTTOM OF REEF

PHOTOGRAPH 8: ALGAL OVERGROWTH ON REEF

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PHOTOGRAPH 9: *Acropora* CORAL RUBBLE

PHOTOGRAPH 10: *Acropora palmata*

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PHOTOGRAPH 11: ASPERGILLOSIS ON COMMON SEA FAN

PHOTOGRAPH 12: BLEACHING ON BRAIN CORAL

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4.6.1.3 Seagrass beds

Seagrass beds were common to the shallow lagoons formed within the NEMMA, such as at Mercers Creek, Ayres Creek and off the coast of Guiana Island. These beds occur on sandy bottoms, around fringing reefs and between coral patches. The dominant seagrass species was turtle grass (*Thalassia*) and however other species noted were manatee grass (*Syringodium sp*.) and shoal grass (*Halodule wrightii*). The seagrass beds provide important feeding grounds, shelter and breeding areas for several species of juvenile fish, turtles, spiny lobster and other marine organisms.

The largest and healthiest seagrass beds were observed around Long Island, a known sea turtle nesting site. Other seagrass beds showed signs of algal overgrowth by *Dictyota* and anchor scarring (see Photograph 13). The seagrasses showed no major signs of disease, nor did the small colonies of soft corals (sea fans and sea whips), coral encrusting sponges, epiphytes and small mounds of *Montastrea*, found within them. Other fauna utilising the sea grass were conchs (Prosobranchia), starfish (Asteroidae), stingrays, black sea urchins (Echinoidae), and juvenile wrasse (Grammatidae), surgeonfish (Acanthuridae) and puffers (Diodontidae).

4.6.1.4 Mangroves

Antigua' wetlands and the associated mangrove woodlands, are vital components in the maintenance of a healthy beach and reef system. Mangrove wetlands filter the water of heavy sediments from existing watersheds and release cleaner and nutrient rich water to the seagrass beds and corals. The four mangrove species were noted in the NEMMA: the red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*) and button mangrove (*Conocarpus erectus*).

A rapid ecological assessment of mangrove areas within the NEMMA was carried out in representative areas (see Figure 2). Reconnaissance surveys focused on high human activity ("popular") and areas of damage. The following mangroves were surveyed during this assignment:

- Parham Harbour,
- Mercers Creek,
- Guiana Island,

- Pelican Island,
- Crump Island, and
- Fitches Creek.
- Ayres Creek

Field work consisted of travelling the entire project coastline by boat and ground-truthing all the selected mangrove areas to assess mangrove health and species composition. All mangrove surveys were conducted during daylight hours, outside the hours of peak avifauna activity.

In addition information was obtained from the following documents:

- Mangrove Report, Prepared by Bruce Horwith and Kevel Lindsay submitted to Ivor Jackson and Associates. May 6, 1997

- Monitoring Programs for Mangroves. in Caribbean Park and Protected Area News. P R Bacon, 1990. CANARI.

- The status of mangrove conservation in the CARICOM Islands of the Eastern Caribbean. Report to the Commission of the European Communities as part of the Tropical Forestry Action Plan for the Caribbean Region. 196 pp. P R Bacon, 1991.

- Mangroves in the Lesser Antilles, Jamaica, and Trinidad and Tobago. pages 155-210 in, LD Lacerda (ed), Conservation and Sustainable Utilization of Mangrove Forests in Latin America and Africa Regions. Part I-Latin America. International Society for Mangrove Ecosystems. 272 pp. P R Bacon, 1993.

- Status of coral reefs in the Lesser Antilles, Western Atlantic. In: C. Wilkinson (ed.), Status of Coral Reefs of the World: 1998. Australian Institute of Marine Science, Townsville. A. Smith, C. Rogers, and C. Bouchon C, 1998.

- Draft Inventory of Antigua Wetlands. Environmental Awareness Group (unpublished).

- Antigua and Barbuda First National Report to the Convention on Biological Diversity. March 2001.

PHOTOGRAPH 13: *Dictyota* OVERGROWTH IN SEAGRASS *(Thalassia)* BED

4.6.1.4.1 General

There are over 240 ha of mangroves and associated wetlands occurring in the NEMMA. These are important as fish nursery, for nesting birds, feeding site for birds, ecotourism and "crabbing". Much of the coastline has red mangrove (*Rhizophora mangle*) at the water's edge ranging from isolated trees to bands approximately 10 – 20 m wide. Typically behind the coastal band of red mangrove the black (*Avicenia nitida*), white (*Languncularia racemosa*) and button mangroves (*Conocarpus erectus*) are dominant. Within the last two decades the mangroves of Antigua have been severely affected by hurricane damage, as well as coastal development. Few formal studies have been conducted on the mangroves, however non-governmental agencies (NGOs), such as the Environmental Awareness Group (EAG), continue to conduct regular monitoring of the health and status of the existing fringing mangroves. 1995 hurricanes appear to have caused damage to some of the red mangrove trees present on the seaward side in some areas. It is reported that land development at Emerald Cove resulted in the removal of fringing mangrove (Baldwin, 2000).

Figures 4 and 8 show the locations of the major wetlands found in the NEMMA. The draft Management Plan lists the following wetland areas according to Bacon (1991).

- Elys Bay (7.5 ha)
- Winthorpes Foot Creek (40ha)
- Nibbs Wharf (19.9 ha)
- Parham Harbour to Fitches Creek (60 ha)
- Crabbs Peninsula (25.5 ha)
- Gaynors
- Mercers Creek (32 ha)
- Keeve's Landing (10 ha)
- Spencers
- Lords Cove (2 ha)
- Fanny Cove (1.5 ha)
- Ledeatt Cove (4.75 ha)
- Ayres Creek
- Guiana Island (32.3 ha)
- Crump Island (4.4 ha)
- Laviscount Island (2.5 ha)
- Pelican Island (1.25 ha)

4.6.1.4.2 Parham Harbour and Fitches Creek

The mangroves of Parham and Fitches Creek cover a total area of approximately 92 ha. The vast majority of the coastline is fringing red mangrove, approximately 2-4m high and in some areas as high as 6 m. The high densities of juvenile red mangroves seaward, also suggest that the mangroves are proliferating and spreading (see Photograph 14). A history of hurricane damage has resulted in the death of some of the taller mangroves. Landward there is a dominance of black mangroves, followed by button wood. Overall the mangrove system looks healthy.

The was very little fauna diversity at Parham Harbour at the time of the survey, however it was indicated by Fisheries Department, that these mangroves support a wide variety of birds, fishes and crustaceans.

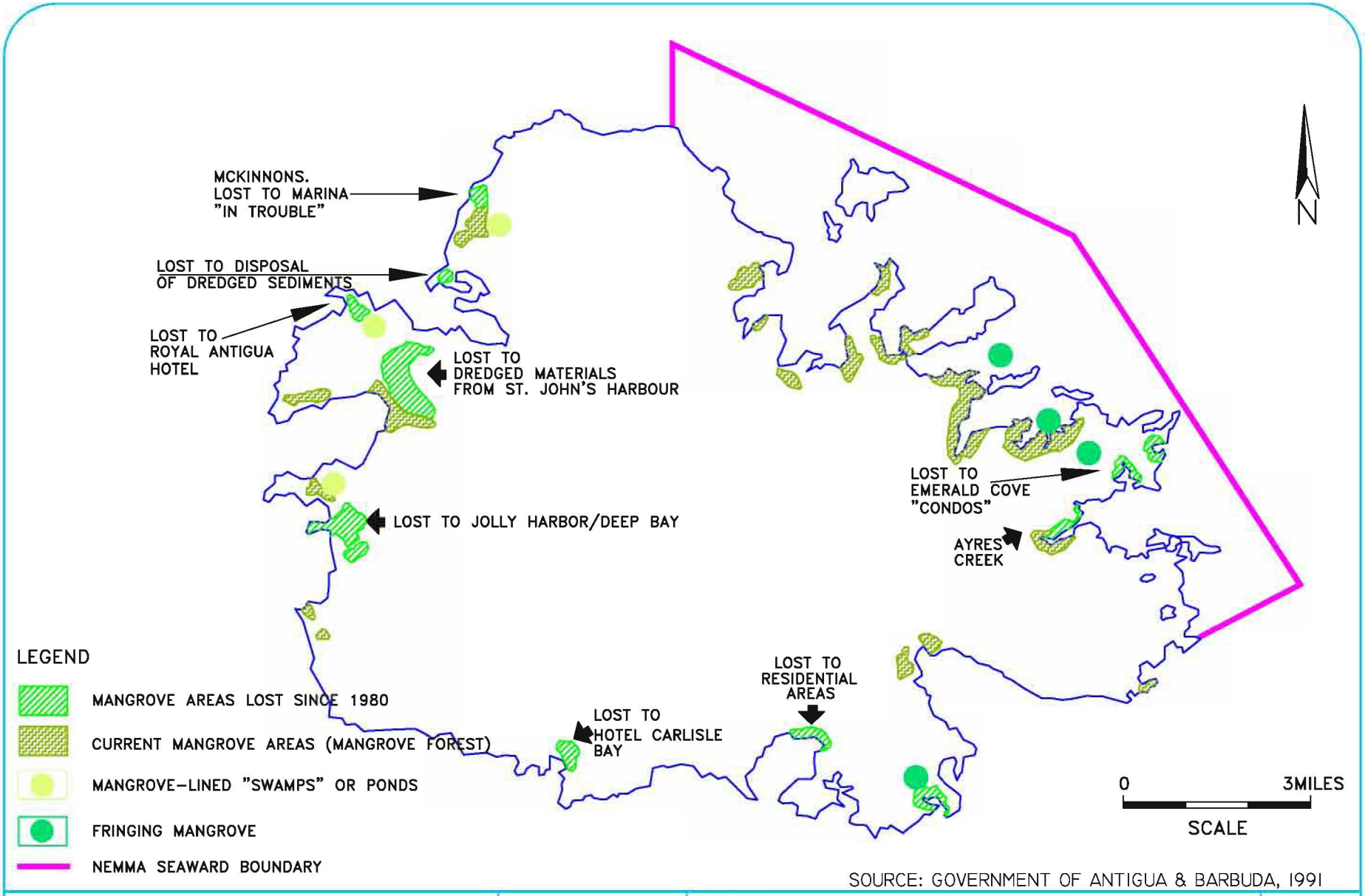
4.6.1.4.3 Crabbs Peninsula

This wetland occurs on the eastern side of Crabb's Peninsula. It occupies approximately 25.5 ha. It comprises a broad fringe starting at Hand Point and extending to the Guiana Island narrows. There is extensive colonization of red mangrove into the bay with black and white mangrove occurring landward (EAG, 1999). Associated habitats include a small mangrove creek west of Guiana Island "narrows".

However along the eastern part of the Parham harbour, along the Crabb's peninsula, industrialisation in this area has resulted in a negative impact on the mangroves in some areas (see Photograph 15). The desalination plant on Crabb's peninsula discharges its effluent into a mangrove area in the bay. This has resulted in some localised mangrove die back. Surrounding areas of fringing mangroves seemed unaffected; however this could be as a result of tidal flushing of industrial effluents.

4.6.1.4.4 Mercers Creek

The mangrove system within Mercer's Creek is quite extensive, spanning along the entire coast line (approximately 32 ha) and several river mouths. The largest mangroves were noted in this area, ranging from 4-6 m in height. Red mangroves were the dominant species; however less salt tolerant species such as black mangrove, white mangrove and



SOURCE: GOVERNMENT OF ANTIGUA & BARBUDA, 1991

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		DWG. NAME: WETLANDS OF ANTIGUA	

PHOTOGRAPH 14: RED MANGROVE *(Rhizophora mangle)* PROLIFERATION

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PHOTOGRAPH 15: MANGROVE DIE-BACK AT CRABBS PENINSULA

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		DWG. NAME: PHOTOGRAPH 15

button wood were also common in the interior of the creek (EAG, 1999). This was confirmed during the 2007 survey. Overall there were no signs of major degradation or die back and the mangrove system seemed undisturbed. In the localised area close to the nearby town of Seatons, some areas of fringing mangrove have been cleared for housing and building jetties (EAG, 1999).

4.6.1.4.5 Guiana Island, Pelican Island and Crump Island

The mangroves fringing Guiana Island, Pelican Island and Crump Island were all very similar. The islands are surrounded by semi-continuous borders of well-developed red mangroves (EAG undated). The border varies from isolated plants to dense bands of red mangrove. Some areas red mangrove still show hurricane damage, but are still vibrant. The dominant interior forests of the islands varied between dry littoral to xerophytic forests (EAG undated), however in the interface between the interior forest and the fringing red mangroves, some isolated patches of button wood and to a lesser extent black mangrove were noted.

4.6.1.4.6 Ayers Creek

This is an estuarine wetland system which is fed with fresh water from the Potswork dam along Black Ghaut into Ayers Creek. It is dominated by red mangrove (*Rhizophora mangle*). With black and white mangrove intermixed. This system was disturbed by the 1988 construction of a dam along Black Ghaut which restricts the flow of water (EAG undated).

4.6.1.4.7 Elys Bay/Jabberwock Saltpond

This wetland covers approximately 7.5 ha. It comprises a fringe of mainly red mangrove around a salt pond that is isolated behind a wide sand barrier. The outlet for the pond is located on the eastern end where the overflow empties into Jabberwock Bay. The pond receives runoff from the surrounding watershed, which is generally wooded in acacia scrub, with some development on the northwestern and western edges. The pond becomes flooded during the main rainy season. Periodic salt water flooding may occur during storm surges and or exceptionally high tides. The tops of most of the mangrove trees were destroyed and or damaged during the passage of Hurricanes Luis and Marilyn.

4.6.1.4.8 Winthropes Foot Creek

This wetland comprises some 40 ha of red (predominantly) and white mangrove (EAG, 1999).

4.6.1.4.9 Nibb's Wharf

This wetland fringes the Rendevouz or Guiana Bay and stretches from the Guiana Island "narrows" to the Crump Island. It comprises some 19.9 ha of mainly red mangrove. White and button mangrove occur landward. Nearby Hawes Island is also fringed by mangrove. This wetland is estimated to be about 0.5 ha. Associated habitat includes a large salina /black mangrove basin east of Nibb's Wharf (EAG, 1999).

4.6.1.4.10 Green Island

A small area of mangrove is located just behind a beach comprising white and button mangrove. It suffered damage during Hurricanes Luis and Marilyn (1995), Georges (1998), Jose and Lenny (1999), which consisted of fallen trees and broken branches. This island is managed by the owners, Mill Reef Club.

4.6.1.4.11 Other Minor Wetlands

There are smaller areas of predominantly red mangrove at Indian Town Creek and Fannys Cove.

4.6.1.5 Fish and Other Aquatic Fauna

Species of fish observed on the reef were noted. These are listed in Appendix C.

Existing sources of information used included:

- Antigua and Barbuda Fisheries Development Plan 2006 – 2010. Fisheries Division 2005.

- Draft National Physical Development Plan. Development Control Authority 2001.

Other aquatic fauna described in the literature for the NEMMA include bivalves ("cockle") which are harvested from seagrass beds and wetland areas, Tiger lucine (*Codakia orbicularis*), Pennsylvania lucine (*Lucina pensylvanica*), the spiny lobster (*Panulirus argus*), crabs (Fiddler crabs, Great Land Crab, *Cardisoma*, the marbled marsh crab, the mud crab, the spotted mangrove crab and the Common blue crab *Callinectes),* snails (the Coffee bean snail, *Melampus coffeus*, and *Littorina* snails), copepods, ostracod, nematodes hyroids, shrimp, tree oysters, mussels, and barnacles.

4.6.2 Terrestrial Environment

The NEMMA declaration excludes all areas of the offshore islands above the line of permanent vegetation (see Section 4.1). The relevant terrestrial component would therefore be the beaches. However for completeness the flora and fauna on the offshore islands is also briefly discussed. Vegetation consists of alliances of dry forest, mangrove, shrubland and broad leave evergreen. The beaches provide nesting habitats for marine turtles and recreation.

The terrestrial environment was described from the following information sources:

- Antigua and Barbuda Fisheries Development Plan 2006 – 2010. First Draft. Fisheries Division (2005).
- Analysis of Beach Changes in Antigua and Barbuda 1996-2001. Volume 1 – Assessment Report. Philmore James (2003).
- Tourism Development, Wetland Degradation and Beach Erosion in Antigua, West Indies. Jeff Baldwin (2000).
- A Vegetation Classification System of Antigua-Barbuda-Redonda: Implications for Conservation. Island Resources Foundation. Eastern Caribbean Biodiversity Programme Biodiversity Publication #2. K. Lindsay and B. Horwith (1997).

4.6.2.1 Beaches

There are several popular beaches within the NEMMA which are utilized by tourists and locals specifically on and around Prickly Pear, Guiana Island, Long Island, Maiden Island, Great Bird Island, and Green Island.

Baldwin (2000) claims that almost all of the small pocket beaches on the Atlantic coast are already occupied by small-scale resorts and describes the construction of a new beach at Emerald Cove by a hotel developer. This was done by bulldozing flat terraces into the low coastal limestone, removing fringing mangrove. Using a suction dredge sand was removed from the offshore reef to the terraces.

Sandy beaches depend on coral reefs and algal beds for a constant supply of base material. They also provide recreation and nesting sites for marine turtles. As such the Fisheries Division has been monitoring some 25 beaches around Antigua and Barbuda noting changes in profile area and width. These include beaches within the NEMMA at Jabberwock Bay, Dutchman Bay and Long Bay (James, Philmore, 2003). The report noted changes in profile area over the period 1996 to 2001 of -1.15 m^2 at Jabberwock, -0.57 m^2 at Dutchman Bay and -0.48 m^2 at Long Bay. Changes in profile width were -0.11 m/yr at Jabberwock, -0.30 m/yr at Dutchman Bay and -0.25 m/yr at Long Bay. It does not appear that the beaches on the Atlantic side of the island have been subject to significant sand mining. Any erosion noted may therefore be attributable to oceanic conditions.

Following the passage of Hurricane Georges in 1998 an analysis was done of beach erosion hazard in Antigua and Barbuda. The beaches at Jabberwock and Dutchman Bay fell into the medium hazard category (+1.47 to -0.43 m/yr) while the beach at Long Bay fell into the high hazard category (-2.35 to 4.25 m/yr) (James, Philmore, 2003).

4.6.2.2 Vegetation

In accordance with our Terms of Reference for this assignment, very little emphasis was placed on the terrestrial vegetation within the NEMMA (see Section 4.6.2). However, for completeness, the dominant flora present in the NEMMA was described from information documented in a Vegetation Classification of Antigua-Barbuda-Redonda (Kevel Lindsay and Brian Horwith 1997).

According to the vegetation classification system the following alliances are found on the islands within the NEMMA and the adjacent coastline of the mainland. Many of the alliances are considered uncommon or rare and are vulnerable (likely to become in danger of extirpation) due to coastal development. A summary of the plant species recorded on the islands is found in Appendix D (IRF 1997) and the forest types are shown in Figure 9.

- *Pisonia subcordata – Canella winterana* lowland tropical or subtropical mixed evergreen-deciduous closed tree canopy Alliance. This is described as offshore island dry forest with *Pisona subcordata* and *Canella winterana* as the most conspicuous canopy species reaching heights of approximately 10 m. *Pithecellobium unguis-cati* and *Agave karrato* are abundant in the undergrowth but vegetation is not distinctively separated into stories. This alliance is found on Great Bird Island, Green Island, ridge of Crump Island, patches on Guiana Island, Hawes Island, Maiden Island, Pelican Island, Laviscount Island, Little Island and Long Island. It is considered uncommon and vulnerable.

- *Rhizophora mangle* tidally flooded tropical or subtropical broad-leaved evergreen sclerophyllous closed tree canopy Alliance occurring at Fitches Creek and Ayer's Creek. It is considered common and vulnerable.

- *Rhizophora-Avicennia-Laguncularia* Semipermanently flooded tropical or subtropical broad-leaved evergreen open tree canopy Alliance. It is found at Jabberwock and is considered uncommon and vulnerable.

- *Rhizophora-Avicennia-Laguncularia* tidally flooded tropical or subtropical broad-leaved evergreen open tree canopy Alliance found in inland areas at Ayer's Creek, Fitches Creek and Jabberwock and is considered uncommon and vulnerable.

- *Rhizophora-Avicennia-Laguncularia* semipermanently flooded tropical or subtropical broad-leaved evergreen shrubland Alliance in which the mangroves occur more as shrubs. This alliance is found at Jabberwock and is considered uncommon and vulnerable.

Rhizophora-Avicennia-Laguncularia-Conocarpus tidally flooded tropical or subtropical broad-leaved evergreen shrubland Alliance. The mangroves in this alliance occur more as shrubs and may contain all or any of *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa*, *Conocarpus erectus*. This alliance is found further inland at Indian Creek, Bethesda, Ayer's Creek, Seaton's Harbour, Guiana Bay, Parham Harbour, Fitches Creek and Jabberwock and is considered uncommon and vulnerable.

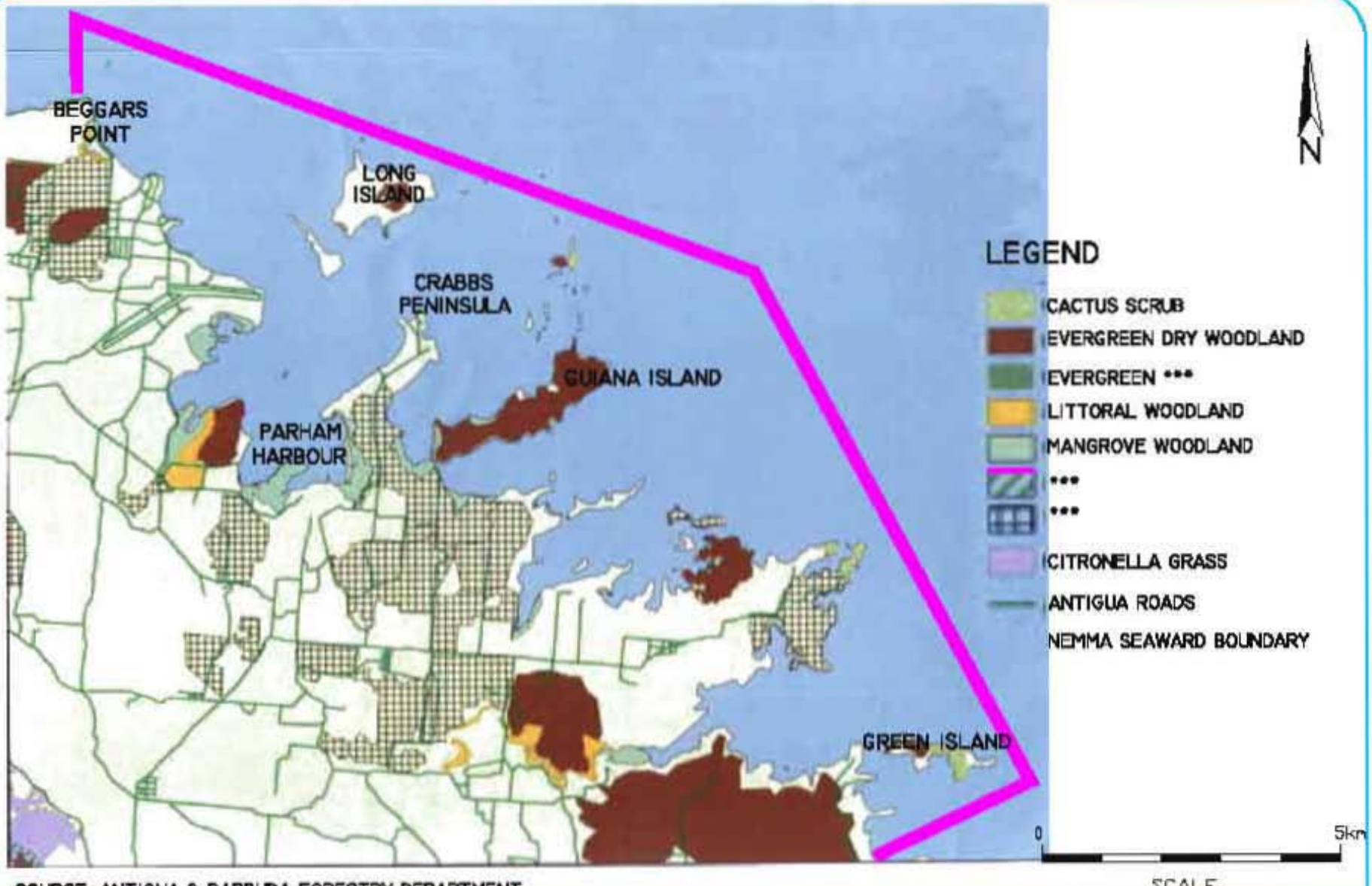
- *Pilosocereus royeni-Agave karatto* facultatively deciduous extremely xeromorphic tropical or subtropical shrubland alliance. This cactus and thorn vegetation occurs in areas of low water availability which restricts the height of the woody species. Occurs near the coast at Devil's Bridge, Willikies and other small areas on the eastern coast and offshore on Rabbit Island, Red Head Island, Galley Islands, Guiana Island, Crump Island, Pelican Island, Codrington Island, Laviscount Island, Green Island, York Island, Smith Island, Bird Island and Little Bird Island. This vegetation alliance is considered common and stable.

- *Melocactus intortus-Jacquinia arborea* tropical or sub-tropical succulent-facultatively-deciduous dwarf shrubland alliance consisting of scattered cacti and short shrubs and trees found at Willpughby Bay, Mill Reef, Great Bird Island, Rabbit Island, Red Head Island, Guiana Island, Lobster Island, Exchange Island, Crump Island, Pelican Island, Codrington Island (and the unnamed island to the west), Green Island, York Island, Smith Island, Bird Island, and Little Bird Island. This alliance is considered to be uncommon but stable.

- Medium-tall tropical or subtropical grassland with broad-leaved evergreen trees. This alliance consists of grassland, with some forbs, with scattered shrubs and trees providing a cover of generally 10-25%. This alliance consists of trees and shrubs including *Coccoloba uvifera, Borrichea arborescens* and *Sesuvium portulacastrum*; herbaceous species include *Spartina patens, Sporobolus virginicus, Cyperus panifolius, Fimbristylis cymosa.* It is found on Great Bird Island, Hell's Gate Island and Guiana Island. This alliance is considered to be rare and vulnerable.

- *Rhizophora-Avicennia-Laguncularia-Conocarpus* tidally flooded mudflats. This alliance is characterized by sparse mangrove vegetation and either bare ground or shallow water over bare ground. It is found on Rabbit Island and is considered to be uncommon and vulnerable.

- Sparsely vegetated cliffs alliance in which *Ficus citrifolia, Peperomia myrtifolia, Pilea microphylla, Boerhavia coccinea, Portulaca oleracea, P. halimoides, Talinum fruticosum, Trianthema portulacastrum, Croton lobatus, Jathropa gossypifolia, Pilosocereus royeni, Melocactus intortus, Opuntia triacantha, Plumbago scandens, Metastelma parviflorum* [formerly,*Cynanchum parviflorum*], *Wedelia calycina* occur. This type of vegetation is found on many of the offshore islands. This alliance is considered uncommon but stable.



SOURCE: ANTIGUA & BARBUDA FORESTRY DEPARTMENT

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Eco Report No. 10/2007	CLIENT:	OECS -ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER 9
Date: 31/07/07	PROJECT:	NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
	DWG. NAME:	FOREST TYPES IN THE NEMMA	

- *Ipomoea pes-caprae-Canavalia rosea* dunes with sparse herbaceous vegetation. This alliance is common along beaches, from just above high water mark inland as far as sand extends. It consists of low-lying grasses, vines and herbs, with some stunted woody species and is found on Great Bird Island, Guiana Island, Long Island, Maiden Island, Green Island, Prickly Pear Island and Sandy Island. This alliance is considered to be common but vulnerable.

4.6.2.3 Fauna

Figure 10 illustrates the occurrence of some of the fauna found in the NEMMA. This was described from documented sources:

- Surveys of the Lizard *Ameiva griswoldi* on Antiguan Offshore Islands III: Summer 2001. Antiguan Racer Conservation Project Report Number 8. Smith, Brian E; Davis, Oniika; Bartscher, Nicole S (2002).
- Sea Turtle Recovery Action Plan for Antigua and Barbuda. CEP Technical Report No.16. WIDECAST (1992).
- 2004 Annual Report: Jumby Bay Hawksbill Project. WIDECAST (2004).
- Seabird Research and Public Awareness on the Offshore Islands of Antigua, West Indies. Environmental Awareness Group (2004).
- 2003 Antiguan Racer Census and Re-introduction. Antiguan Racer Conservation Project, St. John's Antigua and Barbuda. Daltry J. C; Morton, M; Smith B. E; Sylvester, I (2003).

4.6.2.3.1 Turtles

The hawksbill (*Eretmochelys imbricate*) nests on Long Island. The Jumby Bay Hawkbill Project is an initiative of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST 2004). The project is privately funded by the homeowners of the island (Jumby Bay Hotel and 30 residential estates) and has been on-going since the late 1980's.

In 1992 WIDECAST estimated that a total of 130 females nest per year (for all marine turtles). In 2004 which marked the 18th consecutive year that hawksbill nesting research has been conducted on Jumby Bay, Long Island. Fifty-one adult female hawksbills were

observed (the highest on record for the project). A total of 186 nests were deposited on Long Island during the 2004 patrol season. The number of clutches per female ranged from 1 to 6 with an average of 3.7 clutches per turtle. Activity levels were highest in August and September. The estimated average of number of eggs per clutch was 145 (WIDECAST, 2004).

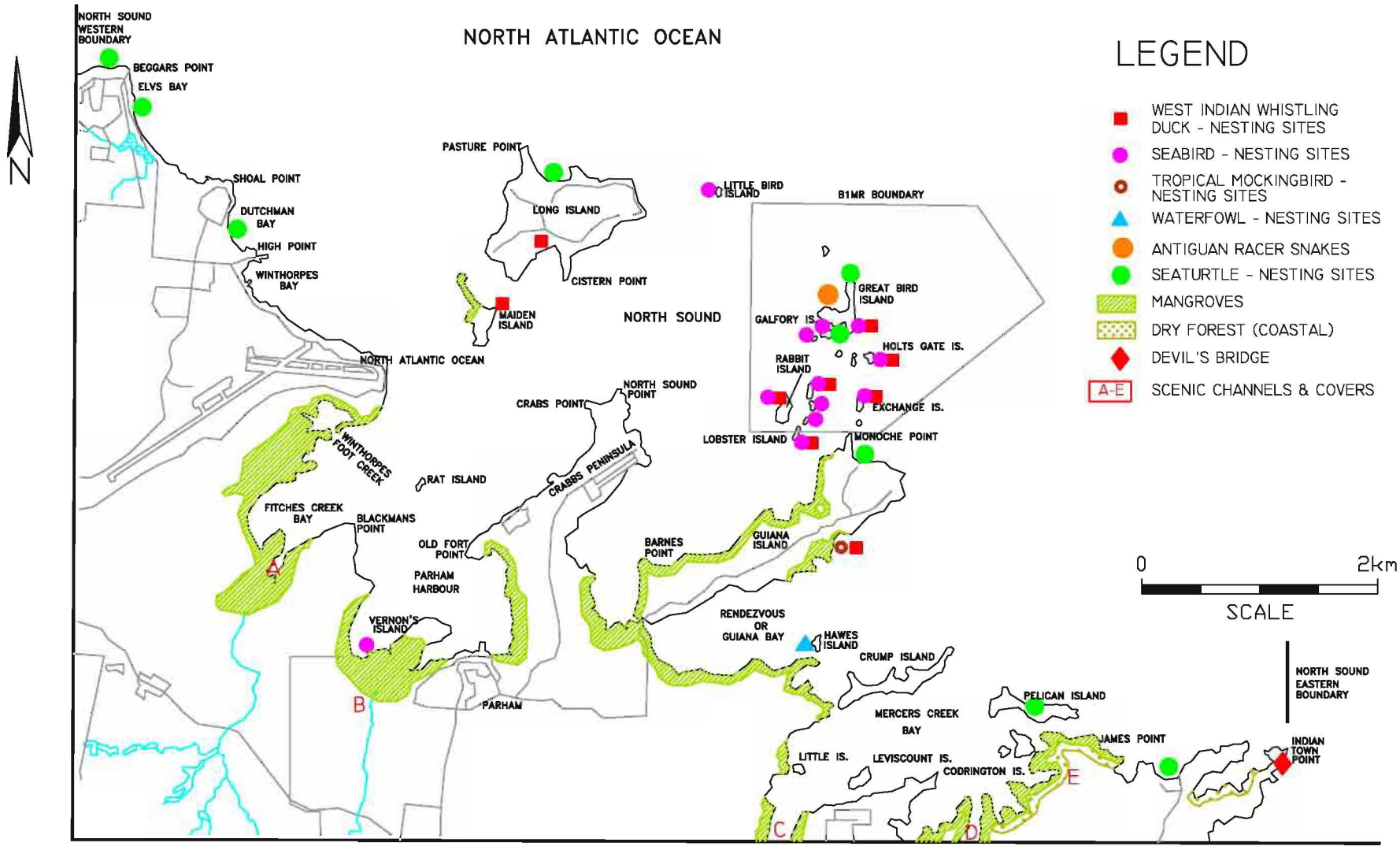
The National Physical Development Plan states that turtle nesting sites can be found in other areas within the NEMMA at Jabberwock, Rendezvous Bay, Devils Bridge Beach, Green Island and Goat Island.

4.6.2.3.2 Lizards

Ameiva griswoldi (the Antiguan ground lizard) is a species of lizard which is endemic to Antigua and most of the offshore islands. It is present on over half the islands and has been reported on Great Bird Island, Lobster Island, Red Head Island and Green Island. Other species of lizards (all of which are endemic to Antigua) which are found on the islands within the NEMMA include Watts' anole (*Anolis wattsi*), Antiguan spotted anole (*Anolis leachi*), and the Antiguan dwarf gecko (*Sphaerodactylus elegantulus*). *Gymnopthalmus underwoodi* (an invasive species) has been observed on Great Bird Island.

4.6.2.3.3 Snakes

Until recently the Antiguan racer (*Alsophis antiguae)* only survived on Great Bird Island.. The Antiguan Racer Conservation Project was started in 1995 by six organizations: Antiguan Forestry Unit, EAG, Black Hills State University, Island Resource Foundation, Durrell Wildlife Conservation Trust, and Fauna & Flora International. The project undertook to eradicate the black rats which were preying on the snakes and also to re-introduce the snake on Rabbit Island. In 2004 the population estimate was 135 to 145 adult and sub-adult racers. *Typhlops monastus* (worm snake) is found on Green Island.



SOURCE: ISLAND RESOURCES FOUNDATION, DECEMBER 1990

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		DWG. NAME: WILDLIFE OCCURENCES IN THE NEMMA

FIGURE NUMBER 10

4.6.2.3.4 Birds

The offshore islands in the NEMMA which are relatively isolated provide refuge and nesting sites for several endangered, vulnerable and threatened species of seabirds (both migratory and resident). These include the brown pelican (*Pelecanus occidentalis*), magnificent frigatebird (*Fregata magnificiens*), red-billed tropicbird (*Phaethon aetherus*), least tern (*Sterna antillarum*), laughing gull (*Larus atricilla*), brown noddy (*Anous stolidus*), brown booby (*Sula leucogaster*) (EAG, 2004). The major threat to these birds is the black rat which is presently the subject of an on-going eradication programme.

Other species of birds which have been observed within the NEMMA include:

- The Red-billed Tropic Birds (*Phaethon aethereus mesonauta*) which were noticed returning to breed on Great Bird Island in 2003.
- West Indian whistling ducks (*Dendrocygna arborea*) which were observed in the wetlands at Ayers Creek which is also an important site for shorebirds, herons, and other waterfowl.
- Peregrine falcons (*Falco peregrinus tundris*; *F.p. anatum*).
- Great Egret (*Egretta alba*), Great Blue Heron (*Ardea herodias occidentalis*), Little Blue Heron (*Egretta caerulea*), Yellow Crowned Night Heron (*Nyctanassa violaceus bancrofti*), Spotted Sandpiper (*Tringa macularia*), Kingbird (*Tyrannus dominicensis vorax*), Bananaquit (*Coereba flaveola bartholemica*), Mangrove Cuckoo (*Coccyzus minor*), Yellow Warbler (Dendroica petechia bartholemica), White Crowned Pigeon (*Columba leucocephala*), Zenaida Dove (Zenaida aurita), and the Ground Dove (*Columbina passerina nigrirostris*) which were documented by the EAG as found in the Parham to Fitches Creek wetlands.

4.7 Summary

Within the boundaries of the NEMMA are located over 30 islands, islets and rocks as well as a number of existing (including archaeological and historical sites) and proposed protected areas. The northern and eastern third of Antigua which includes the islands are coralline.

The NEMMA is located on the windward side of the island which has been affected over the years by extreme weather conditions which have caused changes to beach profiles and damage to reefs, seagrass and wetlands.

Watersheds (occupying in excess of 5000 ha) in the northeastern areas of the mainland drain into the NEMMA. These waters also receive discharges from other surrounding land uses such as sewage treatment plants, desalination plants, ports and industries and activities such as dredging, land clearing and solid waste disposal. Water pollutants include nutrients, sediment, heat and oil.

The depth of water between Antigua and Barbuda ranges between 27-33 m. Significant marine features include coral reefs (patches, reef crests and horse shoe as well as an artificial reef on Maiden Island), large areas of sand between the reefs and the shore, shoals and channels. Offshore areas in particular are affected by the Antilles and Caribbean currents which flow towards the east or north east transporting warmer water to the region.

The major marine assets within the NEMMA are coral reefs, fringing mangroves and sea grass beds which support a wide array of marine life. The reefs have been significantly damaged by hurricanes and storms, anchors, fishing gear, sedimentation, eutrophication, pollution and disease. Seagrass beds are common within lagoons on sandy bottoms and were dominated by turtle grass. Seagrass beds have been damaged by algal growth and anchor damage. Therea re over 240 ha of mangroves (four species) and associated wetlands in the NEMMA. Hurricanes are the major cause of damage to seaward mangroves. Land development has also resulted in removal of mangrove.

Beaches within the NEMMA are important for recreation, as nesting habitats for marine turtles and for beach replenishment. Some of the beaches are monitored and show erosion caused by oceanic conditions and hurricanes. At least one developer has constructed a new beach. Many of the vegetation alliances found on the islands within the NEMMA and the adjacent coastline of the mainland are considered uncommon or rare and are likely to become in danger of extirpation due to coastal development.

Several faunal species of conservation interest occur within the NEMMA including the hawksbill turtle (endangered), the Antiguan racer snake (endemic and endangered), the Antiguan ground lizard (endemic), a number of endangered, vulnerable and threatened sea bird species. On-going conservation efforts by local NGOs and island residents (with assistance from international agencies in some cases) include the eradication of the black rat which is a major pest and a threat to island fauna and the monitoring of the hawskbill turtle.

5 SOCIO-ECONOMIC CHARACTERISTICS

This discussion of socio-economic characteristics is derived from two main sources, meetings with government agencies and other organisations in Antigua; and a number of reports including:

- Opportunities for Sustainable Livelihoods in One Protected Area in Each of the Six Independent OECS Territories, for the OPAAL Project, Espeut, 2006;
- A Survey of Fishermen – North Sound, Antigua, Anthonyson and McCauley, 2002; and
- Northeast Coast Management Area and the Bird Island Marine and Wildlife Sanctuary – Usage Patterns and the Resource Management Perceptions of Users, Island Resource Foundation, Antigua and US Virgin Islands, 1996;

2001 Population Data obtained from the Central Statistical Office of Antigua and Barbuda was also a significant source of information for this section. However, there were two main constraints in accessing this information:

- The census data was obtained one week prior to our report submission deadline date; and

- Efforts to acquire data on previous census periods were futile constraining our demographic analysis to focussing on the status within the current census period. A comparative analysis of changes over time could not be done.

Additionally, socio-economic data on the various stakeholders associated with the NEMMA were obtained through a series of questionnaires, interviews and meetings.

5.1 Demographic Data

The data provided in this section are discussed under the following headings:

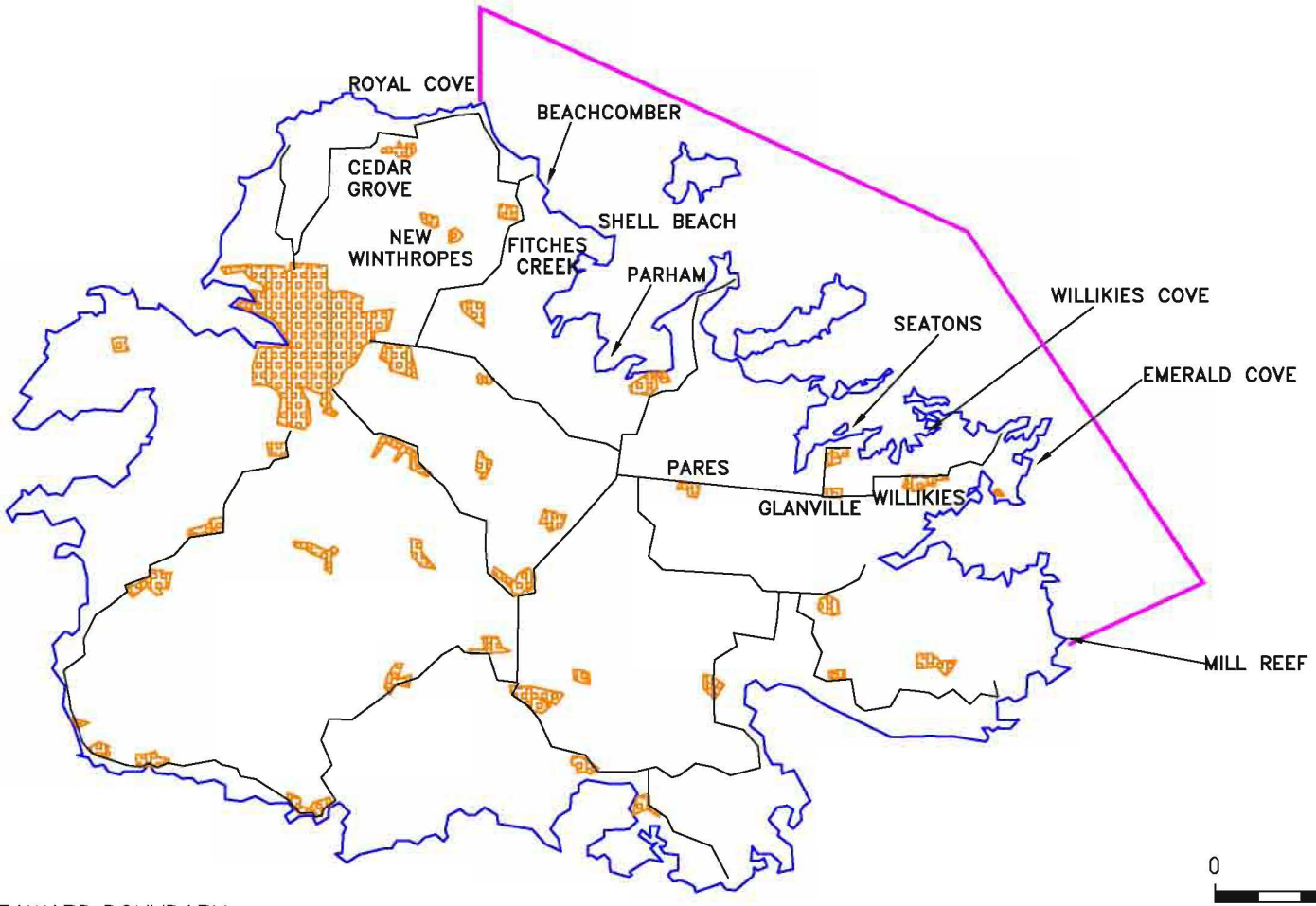
- Population,
- Number of Households,
- Employment / Unemployment, and
- Standard of Living.

This information is provided as a context for the results of stakeholder consultations.

5.1.1 Population

Espeut (2006) identified the following 22 census districts on the coast and just inland of the NEMMA (see Figure 11):

- Hodges Bay / Benaire
- Fitches Creek
- Coolidge
- Airport
- Parham/Lovers Lane
- Parham (North, West, South)
- Vernons
- Willikies (north, West, Central, South 2, East)
- Freetown (North, West, South)
- Glanvilles (Central, Outer)
- Seatons (Central, Coastal)
- Long Lane/Collins
- Brownes Bay / Mont Pellier / Gaynors
- Mill Reef / Half Moon Bay
- Long Bay
- Royals
- Cedar Grove
- New Winthorpes
- Piggots
- Crabbs
- Pares
- Jumby Bay (Long Island)



SOURCE: FISHERIES DIVISION 2000

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		DWG. NAME: SETTLEMENTS CLOSE TO THE NEMMA	

The Statistical Department provided demographic data for 11 major divisions (referred to as communities in the report) shown in Table 3. Table 3 lists these major divisions and shows that the NEMMA area constitutes over 10% (exactly 11.8%) of the population of Antigua and Barbuda. Parham (which includes Crabbs) which is situated in the northern NEMMA region, and its neighbour Piggotts are the most populated divisions comprising 16.4% and 16.2% of the NEMMA population respectively. In essence, these two divisions make up approximately one-third of the NEMMA population.

TABLE 3: NEMMA POPULATION AND PERCENTAGE OF NATIONAL POPULATION

Source: Antigua and Barbuda Statistical Department (2001)

COMMUNITIES	2001 POPULATION	% OF NEMMA	% OF NATIONAL
ANTIGUA & BARBUDA	63863		100.0
Parham (includes Crabbs)	1234	16.4	1.9
Pares	513	6.8	0.8
Willikies	977	13.0	1.5
Glanvilles	346	4.6	0.5
Seatons	379	5.0	0.6
Cedar Grove	752	10.0	1.2
Coolidge	262	3.5	0.4
New Winthorpes	730	9.7	1.1
Barnes Hill	661	8.8	1.0
Piggotts	1221	16.2	1.9
Newfields/ St. Phillips	454	6.0	0.7
Total NEMMA Communities	7529	100.0	11.8

The smaller, less populated communities range from 262 to 454 persons or 3.5% to 6% of the NEMMA population. The tiny village of Coolidge is the least populated community in the NEMMA region.

5.1.2 Number of Households

Household numbers for the individual NEMMA communities are provided in Table 3. The data shows that the most populated communities in the NEMMA have the largest number of households. Parham has 410 households while Piggotts has 462 households.

Simple calculations involving the population size and number of households were used to determine the average household size per community (see Table 4). Overall, the NEMMA region has an average household size of 2.8 persons. This figure is indicative of average household sizes for most individual communities in the NEMMA. Average household sizes at the extremities are those for New Winthorpes with an average of 2 persons, and for Newfields/ St. Phillips with an average of 4.2 persons.

TABLE 4: NUMBER OF HOUSEHOLDS AND AVERAGE SIZE PER COMMUNITY

Source: Antigua and Barbuda Statistical Department (2001)

COMMUNITIES	HOUSEHOLDS	AVERAGE SIZE
Parham (includes Crabbs)	410	3.0
Pares	172	3.0
Willikies	326	3.0
Glanvilles	102	3.4
Seatons	139	2.7
Cedar Grove	274	2.7
Coolidge	108	2.4
New Winthorpes	368	2.0
Barnes Hill	236	2.8
Piggotts	462	2.6
Newfields/ St. Phillips	109	4.2
Total NEMMA Communities	2706	2.8

5.1.3 Employment/Unemployment

According to Espeut (2006), there is no recent assessment of the poverty and unemployment status of Antigua and Barbuda. Table 5 is based on Espeut's analysis of unemployment in the NEMMA and on data from the Central Statistical Office in Antigua. Employment in the NEMMA seems to be parallel to that at a national level with unemployment ranking at 8.4% both in the NEMMA and in Antigua and Barbuda.

TABLE 5: UNEMPLOYMENT BY GENDER

Source: Espeut (2006)

REGION	% UNEMPLOYED 2001		
	MALE	FEMALE	TOTAL
NEMMA	8.0	8.7	8.4
Antigua & Barbuda	8.1	8.8	8.4

There is a small difference in unemployment levels between genders in the NEMMA area (see Table 6). Unemployment is slightly higher among women than men. However, this gender disparity in unemployment is similar at a national level.

According to Census data, persons employed in the NEMMA, and Antigua and Barbuda in general fall within one of the 9 occupation categories listed in Table 6. Agriculture, forestry and fishery workers represent the occupation with the least participation both in the NEMMA region and at a national level. This group denotes 1.1% of the employed population in the NEMMA. Also, 7.6% of the agriculture, forestry and fishery workers in the nation reside in the NEMMA.

Almost one-fifth (19.9%) of the employed persons in the NEMMA region are service workers and shop sales workers. This occupation has the largest participation, not only in the NEMMA but in the nation. Other groups that rank in close proportions are clerks (18.3%), elementary occupations (18.2%) and craft and related workers (17.2%).

TABLE 6: EMPLOYED PERSONS IN THE NEMMA (2001)

Source: Antigua and Barbuda Statistical Department (2001)

OCCUPATION	FREQUENCY IN NEMMA	% OF NEMMA TOTAL	NATIONAL FREQUENCY	% OF NATIONAL TOTAL	RATIO OF NEMMA TO NATIONAL
Legislators, Sr. Officials & Managers	132	3.7	1350	0.5	9.8
Professionals	189	5.3	1791	0.6	10.6
Technicians & Assoc. Professionals	370	10.4	3201	1.3	11.6
Clerks	651	18.3	4323	2.2	15.1
Service Workers & Shop Sales Workers	707	19.9	6281	2.4	11.3
Agric., Forestry & Fishery Workers	38	1.1	497	0.1	7.6
Craft & Related Workers	611	17.2	4746	2.1	12.9
Plant & Machine Ops. & Assemblers	211	5.9	1493	0.7	14.1
Elementary Occupations	646	18.2	5566	2.2	11.6
TOTAL NEMMA/ National	3555	100.0	29248	12.2	12.2

5.1.4 Standard of Living

The possession of selected household appliances was used by Espeut (2006) as a standard of living indicator. It was observed that a slightly higher percentage of NEMMA residents had thirteen of the fourteen household appliances than Antiguans as a whole (see Table 7). There was slightly higher percentage of televisions in the NEMMA area (93.6% than in the entire island (92.4%). The report suggested that the residents adjacent to the NEMMA are better off than the average Antiguan implying that the natural resources in the NEMMA might not be under much threat from poor persons seeking to survive (Espeut, 2006).

TABLE 7: POSSESSION OF SELECTED HOUSEHOLD APPLIANCES

Source: Espeut (2006)

APPLIANCE	AROUND NEMMA	ALL ANTIGUA
Stove	96.0 %	96.7 %
Refrigerator	92.6 %	91.3 %
Freezer	20.5 %	17.2 %
Microwave	38.4 %	28.6 %
Washing Machine	64.5 %	57.8 %
Water Pump	24.5 %	17.6 %
Water Heater	21.9 %	14.6 %
Radio	91.9 %	89.6 %
Television	93.6 %	92.4 %
Cable TV	38.0 %	35.7 %
VCR	61.5 %	57.4 %
Land Phone	76.4 %	69.8 %
Cell Phone	47.8 %	46.5 %
Home Computer	31.4 %	24.3 %

5.2 Commercial and Industrial Activity

Commercial and industrial activity specifically associated with the NEMMA region includes:

- General Businesses,
- Fishing,
- Diving and Snorkeling,
- Tour/Charter Boating,
- Yachts,
- Ferries,
- Water Sports
- Vending,
- Interactive Recreation,
- Hotels, and
- Industries.

This information was obtained in the main from the three source documents listed at the beginning of this chapter, with substantive data being extracted from the most recent report by Espeut (2006) and a vessel frame report prepared by Horsford (2004). Data obtained from interviews with fishermen, boat operators and vendors was also included.

5.2.1 General Businesses

Central statistical information indicated that there are 171 businesses in the NEMMA region. The types of businesses were not defined by the Statistical Department. Table 8 shows the number of businesses in each NEMMA community.

New Winthorpes (18.1%), Parham (17.5%) and Piggotts (17%) hold the largest proportions of businesses in the NEMMA region. The least number of businesses are found in Glanvilles, Seatons and Coolidge. These communities possess 4.1% of the businesses in the NEMMA region respectively.

TABLE 8: NUMBER OF BUSINESSES PER COMMUNITY

Source: Antigua and Barbuda Statistical Department (2001)

COMMUNITIES	BUSINESSES	% OF TOTAL
Parham (includes Crabbs)	30	17.5
Pares	5	2.9
Willikies	20	11.7
Glanvilles	7	4.1
Seatons	7	4.1
Cedar Grove	14	8.2
Coolidge	7	4.1
New Winthorpes	31	18.1
Barnes Hill	12	7.0
Piggotts	29	17.0
Newfields/ St. Phillips	9	5.3
TOTAL	171	100.0

5.2.2 Fishing

The following aspects of fishing in the NEMMA are discussed in this section:

- Fish Landing Sites,
- Number of Fishermen,
- Fishing Vessels, and
- Fishing Methods

From discussions with the Fisheries Division the view was expressed that the NEMMA is not as important to livelihood in terms of fish catch but its importance lies in reefs and wetlands serving as nurseries and feeding grounds. The Division also noted that almost all of the fishermen are part time and have other means of livelihood. They also cautioned that the fish landed within the NEMMA does not necessarily mean that the fish were caught in the waters of the NEMMA and also pointed out that while boats belonging to conchers may be found in the NEMMA, conching is not done in this area. The boats are brought there for convenience but conching is done in the south of the island.

5.2.2.1 Fish Landing Sites

There are some 25 fish landing sites around Antigua and Barbuda (Horsford, 2004). Within the NEMMA, Emerald Cove/Willikies and Mill Reef are primary landing sites. Secondary landing sites include Beachcomber, Shell Beach, Fitches Creek, Parham and Seatons (see Figure 12). No definitions to distinguish between primary and secondary land sites was available for inclusion in this report.

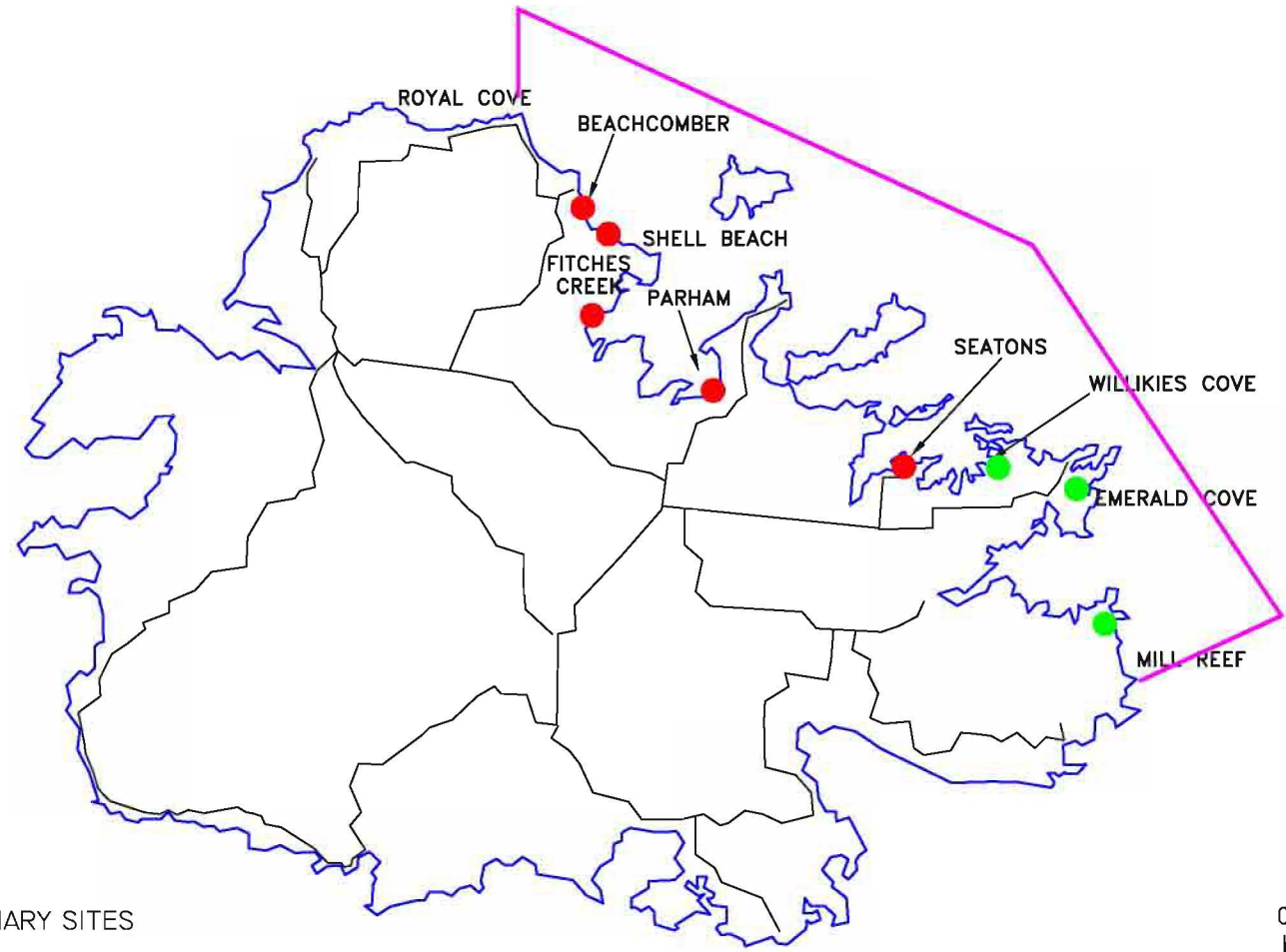
5.2.2.2 Number of Fishermen

As noted in Section 5.1.3, fishing along with other agricultural activities accounted for approximately 1.1% of employed persons in the NEMMA region (Statistical Department, 2001). Table 9 below gives a breakdown of the number of fishermen operating from each landing site in the NEMMA within two time periods that are about a decade apart. Based on interviews and information from the Fisheries department the majority of these fishers are male. An accurate account of the number of fishermen living in the NEMMA is difficult to acquire, since documented numbers are conflicting. Island Resource Foundation (1996) in their study of the Northeast Coast Management Area (now part of NEMMA) showed disparities in figures for individual landing sites compared to that given by Espeut (2006). Espeut (2006) reports Fisheries Division statistics and this data was the main source of information for this section especially since it is most up-to-date.

TABLE 9: NUMBER OF FISHERS IN THE NEMMA

Source: Espeut, 2006

LANDING SITES	1992	2001	% CHANGE 1992-2001
Beachcomber	19	17	-10.5
Fitches Creek	5	3	-40.0
Shell Beach	9	23	155.6
Parham	25	27	8.0
Seatons	21	20	-4.8
Willikies	22	32	45.5
Mill Reef	19	10	-47.4
TOTAL	120	132	10.0



SOURCE: FISHERIES DIVISION 2000

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	Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
		DWG. NAME: FISH LANDING SITES IN THE NEMMA	

There has been an overall increase in the total number of registered fishers in the NEMMA over the period 1992 to 2001 by 10%. Although there was an absolute reduction in the number of fishermen at Beachcomber, Fitches Creek, Shell Beach, Seatons and Mill Reef; the huge increases at Shell Beach (155.6% increase), Willikies (45.5% increase) and Parham (8% increase) contributed to the overall rise in the number of fishers in the NEMMA.

There was no evidence in the literature to suggest reasons for the aforementioned increases in fishermen. However, according to Espeut (2006), "[e]xcept at Shell Beach and Willikies (the only landing sites to show increases both in registered fishers and boats), the fisheries sector in northeast Antigua is in slow but appreciable decline." From discussions with the Fisheries Division the view was expressed that the NEMMA is not as important to livelihood in terms of fish catch but its importance lies in reefs and wetlands serving as nurseries and feeding grounds. The Division also noted that almost all of the fishermen are part time and have other means of livelihood. Fishermen when interviewed (see Section 5.7.2.1.3) indicated that many of them had other skills and did not depend on fishing as a full-time activity

It should also be noted that the numbers of fishermen fishing in the NEMMA at present may be smaller since the development of Stingray City and Paddles. These two operations have employed fishermen thus reducing their numbers. In fact it is evident based on interviews with fishermen over the last decade that part-time fishing has been increasing over the years and that this was attributable to equipment cost, declining catch and availability of better paying jobs in tourism (see Section 5.7.2.1.3).

5.2.2.3 Fishing Vessels

Tables 10 and 11 summarize the distribution and activity of fishing vessels in the NEMMA for the period January – March 2001. Most of the artisanal fishers in the NEMMA use simple coastal fishing crafts. These are usually open or partially decked wooden or fibreglass boats with outboard engines (see Table 10). They normally fish in inshore coastal areas, shallow coral reef areas and on deep fore-reef slopes. Interviews with fishermen confirmed their activities in these areas (see Section 5.7.2.1.3)

TABLE 10: DISTRIBUTION AND ACTIVITY OF FISHING VESELS IN THE NEMMA (2001)

Source: Horsford (2004)

FISH LANDING SITE	VESSEL TYPE					TOTAL		NUMBER OF VESSELS ACTIVE	
	OPEN	OPEN/ CABIN	LAUNCH	SLOOP	OTHER	1992	2001	COM	REC
Beachcomber	5	2	2	0	0	12	7	7	0
Shell Beach	8	1	5	0	1	5	9	9	0
Fitches Creek	2	2	0	0	0	3	1	1	0
Parham	12	0	1	0	0	20	11	10	1
Seatons	6	2	0	0	0	11	8	7	1
Willikies/ Emerald Cove	14	1	3	0	0	10	13	13	0
Mill Reef	4	0	1	0	0	11	4	4	0

Note: * COM = commercial, REC = recreational

Table 11 gives the number of registered fishing vessels at the NEMMA landing sites for the years 1992 and 2001. According to Espeut (2006), these vessels fish both inside and outside the NEMMA.

TABLE 11: NUMBER OF FISHING VESSELS IN THE NEMMA

Source: Espeut, 2006

LANDING SITES	1992	2001	% CHANGE 1992-2001
Beachcomber	12	7	-41.7
Fitches Creek	3	1	-66.7
Shell Beach	5	9	80.0
Parham	20	11	-45.0
Seatons	11	8	-27.3
Willikies	10	13	30.0
Mill Reef	11	3	-72.7
TOTAL	72	53	-26.4

In Section 5.2.2.2 we saw that the number of fishermen in the NEMMA increased by 10% over the period 1992 to 2001. However, as demonstrated in Table 10, there has been an overall decline in the number of fishing vessels over the same period. The total number of registered fishing boats in the NEMMA decreased by 26.4% over the period 1992 to 2001 (Espeut, 2006). The only absolute increases in fishing vessels were experienced at Shell Beach and Willikies landing sites. This may be due to the considerable increases in fishers at these two landing sites.

5.2.2.4 Fishing Methods

The small-scale fisheries of the NEMMA are pursued by a variety of fishing methods and vessel types. The methods consist mainly of fish traps, hand lines, trolling lines, gill nets, long lines, scuba diving and free diving. Table 12 outlines these various types of fishing methods and the frequency of their use at the individual landing sites in the NEMMA.

Fishing methods used are generally simple, small scale and of low efficiency. Trap fishing is the most common fishing method used by fishers in the NEMMA region and is used at all landing sites. This fishing method is done with traditional wire traps made of hexagonal mesh wire stretched over a wooden frame. Some are set in shallow water for subsistence catches while most are set deeper (>18-27 m) and catch a wide variety of reef fish including red snappers, groupers and parrotfish. Traps are typically checked every 5-7 days.

Gill nets are the second most common fishing method used at most NEMMA landing sites with Fitches Creek and Mill Reef as the only exceptions. Gill nets are made from monofilament nylon and are not easily detected visually by fish. They can be set/fixed at any depth or left to drift at the surface. Gill nets are commonly arranged circularly, or semi-circularly open to the beach while schools of fish are driven towards the mesh where they are trapped, usually by their gills. These nets are used to catch pelagic fishes.

Hand lining methods include trolling lines. Trolling lines mainly catch tunas, kingfish, dolphin and barracuda. Table 12 indicates that hand lining is used by fishers at 3 landing sites in the NEMMA while troll lining is used by fishers at 4 landing sites. Seatons is the only landing site where both hand lining and troll lining is used. In fact, Seatons is the landing site where the greatest variety of fishing methods is used (4 out of 6).

TABLE 12: TYPES OF FISHING METHODS USED IN NEMMA

Source: Espeut, 2006

LANDING SITES	FISHING METHOD					
	Trap	Hand Line	Gill Net	Troll Line	SCUBA	Free Dive
Beachcomber	4	-	1	2	-	-
Fitches Creek	1	-	-	-	-	-
Shell Beach	6	-	1	1	-	1
Parham	3	-	7	1	-	-
Seatons	3	2	2	1	-	-
Willikies	4	6	3	-	-	-
Mill Reef	2	1	-	-	1	-
TOTAL	23	9	14	5	1	1

Spear fishing, although a prohibited fishing method in the NEMMA, remains a fish harvesting method in the region. Information provided by fishermen during interviews over the last decade suggest that this activity has experienced a significant decline over the period (see Section 5.7.2.1.3). Spear guns are used (while snorkelling) for some demersal fish species and turtles. Wire snares attached to end of hand held wooden sticks (1m in length) are used while diving for capturing lobster. Scuba diving targets similar fish species as spear fishing, however, the benefit of scuba diving is the ability to stay below for longer periods of times and thus catch more elusive species.

5.2.3 Diving and Snorkeling

Diving in the NEMMA area is restricted to reefs off Green Island and Great Bird Island. Most fishermen also dive for recreational purposes and to explore fishing grounds in the NEMMA area. There is no regulation stipulating that a local master diver must accompany divers or that divers must use local dive shops. It was noted that diving is not a common activity and that most users prefer to snorkel. No definitive number of divers using the NEMMA area was available.

According to Jackson (2007) snorkeling is popular at Long Bay and also occurs in coves around Non Such Bay, Green Island, Great Bird Island, Hell's Gate, Maiden Island and Prickly Pear.

5.2.4 Tour Boatings

Tour boating is a significant business activity in the NEMMA. In a 1996 survey (IRF 1996) sixteen operators were identified and Jackson (2006) estimates approximately 18 boating excursion companies presently operating within the NEMMA. Tour and charter boat operations are highly popular activities in Antigua given the number of tourists annually.

Based on interviews conducted with tour operators (see Section 5.7.2.5) it was noted that most medium and small tour boat operators were based in the NEMMA area, with operations based in the villages of Seatons and Willikies. Larger operators include chartered yachts and catamarans and were based in St. Johns. All tour boat operators indicated that Great Bird Island is the final destination on tours. All tour boats are required by law to be licensed and have cruising permits, which must be renewed annually.

Most vessels used for tour boats are motorized and made of fiberglass, with some of the larger vessels being outfitted with "zodiac-ribbed" type material, similar to the Coast Guard Vessels. Tour boat operations are the basis of a thriving tourist economy with up to 300 people being accommodated per day during the peak season of November to April. Table 13 categorizes tour boats by size and frequency of operations. It was noted that there is a new large catamaran with a capacity of 125 people operating 5 days weekly, with extended full day tours (see Section 5.7.2.5).

TABLE 13: TOUR BOAT OPERATIONS IN THE NEMMA

Source: President of the Tour Boat Operators Association (personal communication)

CLASS OF BOAT	CAPACITY	FREQUENCY OF OPERATIONS / WEEKLY
Small	10-20	2
Medium	30-40	3
Large	50-75	5

5.2.5 Yachts

A number of anchorages in the vicinity of Non Such Bay, Green Island, and Great Bird Island attract private yachts to the area. Yachters typically make use of the snorkeling, beaches, and the amenities at Parham, Jumby Bay, and Harmony Hall (Jackson, 2007).

5.2.6 Ferries

The Jumby Bay Hotel on Long Island is serviced by two ferries which operate frequently throughout the day between Beachcomber Dock and Parham Harbour and the hotel.

5.2.7 Watersports

There are several water sports operations within and outside of the NEMMA which rent speedboats, sailcraft, kayaks, surfboards, kites and snorkeling gear for use in the NEMMA (Espeut, 2006 and Jackson, 2007). Some of these companies include H_2O, Sunsail/Clud Colona, Kite Antigua and Paddles.

5.2.8 Vending

Vendors operate on beaches in the NEMMA selling T-shirts, wrap skirts, other hand-made clothing, handicraft jewelry and other ornaments, and souvenirs to tourists. Most vendors use make shift tents with strings tied along the sides of the tents and table tops to display their exhibits, there is some competition for the best pitches. The Antiguan government has recently commenced a program for beach vendors where proper stalls and sheds will be built for vendors. Consultations and discussions with the vendors therefore seem to be on-going.

5.2.9 Stingray City

Permission has been given to the owner of Stingray City to temporarily fence off an area of the seabed off Seatons in which is enclosed a number of southern stingrays. Visitors are taken to this area where they can enter the water and interact with the rays. The operator has expressed the desire to expand this concept to dolphins.

5.2.10 Hotels

The Antigua and Barbuda Hotels and Tourism Association provided information for the major hotels located within the NEMMA (see Table 14). Espeut (2006) also lists Brown's Bay and Lord Nelson's within the area., making it a total of 9 hotels in the north east.

TABLE 14: MAJOR HOTELS WITHIN THE NEMMA

Source: The Antigua and Barbuda Hotels and Tourism Association

HOTEL	NUMBER OF ROOMS	LOCATIO
Antigua Beachcomber	28	Coolidge
Jumby Bay Hotel	40 +11 villas	Long Island
Occidental Grand Pineapple Beach Resort	150	Long Bay
Long Bay Hotel	40 + 5 cottages	
Dian Bay Resort and Spa	49	
Emerald Cove	129 apartments	Non Such Bay
Harmony Hall	6 rooms in 2 villas	Harmony Hall

5.2.11 Industrial Activity

Industrial activities in the NEMMA include operations of two electricity and power plants, a desalination plant, a brewery and a cement receiving facility and a harbour all located on Crabbs Peninsula. Shipment of products and input materials for the industrial activity required dredging of a shipping channel and a 16 ft to 20 ft deep turning basin (Jackson, 2007) within the NEMMA. There are also industrial estates at Coolidge and Tomlinson, within the watersheds draining into the NEMMA. The international airport is also at Coolidge.

5.3 Coastal Infrastructure

There are harbour facilities at Parham and at Crabbs. There is a marina and boat yard at Shell Beach and private jetties at Jumby Bay, Maiden Island, Harmony Hall and Barnacle Point.

5.4 Agriculture

Agriculture is carried out in the watersheds which drain into the NEMMA. The Agriculture Extension Officers for the north eastern areas of Antigua indicated that crops are grown at Parham, Betty's Hope, Willikies, and Freetown, Bethesda, Newfield and St. Phillip in the Potswork area. There are an estimated 80 – 100 farmers growing mainly vegetables, root crops and small amounts of cotton.

Farmers are encouraged to use good agricultural practices (GAPs) to control soil erosion and pests. Some of the common agrochemicals which are used in these areas include biocides, fungicides, fertilizers and herbicides (see Table 15).

5.5 Land Ownership and Land Use

The ownership, use (existing and proposed) and proposed development of lands adjacent to the NEMMA are discussed in the following sections:

5.5.1 Land Ownership

Lands adjacent to the NEMMA are either privately owned or are crown lands. The majority of the offshore islands are privately owned (see Table 1). The ownership status of Guiana Island is presently in contention.

TABLE 15: AGROCHEMICALS USED IN WATERSHEDS DRAINING INTO THE NEMMA

Source: List of Pesticides Imported into Antigua and Barbuda during 2005 (Pesticides Control Board)

TRADE NAME	COMMON NAME
BIOCIDES	
AZA Direct	Azadirachtin
Cure	Abamectin
New BT; Xentari	Bacillus thuringiensis
Newmectin	Abamectin
FUNGICIDES	
Banrot	Etridiazole + thiophanate methyl
Dithane	
Mankocide*	Copper Hydroxide Mancozeb
Phyton*	Copper II Sulphate Tannic Acid Picric Acid
Ridomil*	Mefenoxam
FERTILIZERS	
12-24-12*	
12-12-17 + 2 mg*	
13-13-21*	
20-20-20*	
Calmax	
HERBICIDES	
Fusilade*	Fluazifop
Gramoxone*	Paraquat
Reglone*	Diquat
Roundup Ultra, Roundup Pro Sprayer*	Glyphosate
Touchdown*	Glyphosate Trimesium
Goal	Oxyfluorfen
INSECTICIDES	
Karate*	Lambdacyhalothrin
Lannate*	Methomyl
Malathion*	Malathion
Padan*	Cartap Hydrochlotride
Cypro D.P	Cypermethrin – Profenfos
Danitol	
Diazinon	Diazinon
Fastac	Alpha Cypermethrin
Mpede	Potassium Salt/Fatty Acid
Pirate	Chlorfenapyr Propane 1,2-diol
Pro Control Plus	Pyrethrin
Pronto	Imidacloprid
Sevin Powder	Carbaryl

Note: * most commonly used chemical

5.5.2 Land Use

Proposed land use according to the National Physical Development Plan is shown in Figure 13. Although these designations are still proposed they are presently used by the Development Control Authority to give approval in principle to project. Lands adjacent to the NEMMA can be used for industrial, tourism and residential development.

The proposed tourism resort zones include:

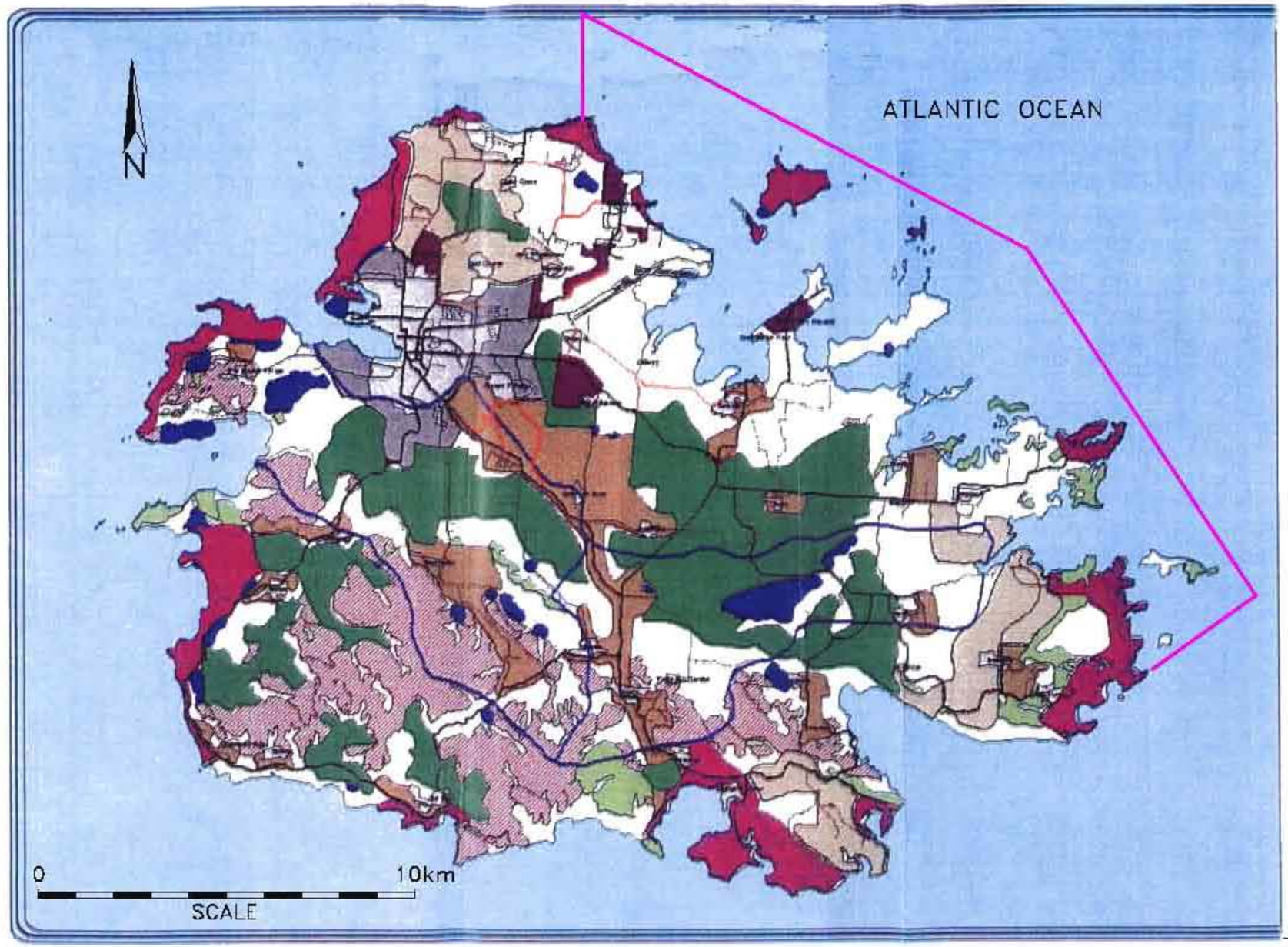
- Mill Reef (including Little Deep Bay and Great Deep Bay).
- Indian Town Point to Dums Point.
- Beggars Point.
- Jabberwock.
- Long Island.
- Maiden Island.
- Great Bird Island.

Industrial Activity is proposed for Coolidge and Tomlinson which are within watersheds draining into the NEMMA and at Crabbs Peninsula. Low density residential areas may be developed at Seatons and Parham, while high density residential development may be developed at Willikies and the area to the east and north of Freetown. There is a major agricultural zone in the Potworks and Parham watersheds.

5.5.3 Land Development Proposals

The Development Control Authority has a register of applications for proposed developments which is kept mainly for accounting purposes. A request was made for a listing of applications for proposed activities for the last 3 years. No information was received at the time that this report was being prepared.

The Development Control Authority (2001) lists the following development proposals which had been received by the Ministry for areas within and in close proximity to the NEMMA:



LEGEND

- INDUSTRIAL
- CLASS 9 SETTELMENT
- AGRICULTURE
- LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- ST. JOHN'S
- TOURISM
- EROSION
- PONDS
- SLOPE
- LAND
- MAIN ROAD
- SECONDARY ROAD
- TRACK
- NEED RESURFACE
- WATERSHED
- NEMMA SEAWARD BOUNDARY

MAP 2A

PREPARED BY:
DEVELOPMENT CONTROL AUTHORITY
GOVERNMENT OF ANTIGUA AND BARBUDA

Ecoengineering Caribbean Ltd.

Eco Report No. 10/2007	CLIENT: OECS - ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER: 13
Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
	DWG. NAME: PROPOSED LANDUSE IN ANTIGUA	

- 150 villas at Willikies
- 260 room 5-star hotel at Emerald Cove
- 150 rooms at Pineapple

A proposal for a 2250 room resort complex on Guiana Island appears to be dormant. There are also proposals for development at Parham Harbour (personal communication with Environment Division, February 2007) to accommodate the expected increase in activity at this harbour related to export of aggregates and cement. An EIA is presently being conducted for this activity.

5.6 Research and Education

There are on-going research and educational programmes within the NEMMA. These are being conducted by local NGOs (the Environmental Awareness Group, in particular) and communities and international agencies and institutions. Research initiatives have focussed on coral reefs, the Antiguan Racer snake and the hawksbill turtle. These projects have also served as training grounds for researchers and have offered educational opportunities for local individuals and communities.

5.7 Results of Stakeholder Consultations

Discussions with key informants and a review of the existing literature on the NEMMA, revealed that there are several stakeholders whose livelihoods are directly or indirectly associated with the NEMMA. These stakeholders were separated into primary and secondary stakeholders based on guidelines outlined in the Socio-Economic Manual for Coral Reef Management. Based on these guidelines the following are the definitions used for identification of primary and secondary stakeholders:

Primary stakeholders – people who directly depend on the reef for a living and who make direct use of the reef and its resources (e.g. fishermen, dive operators).

Secondary stakeholders – people who do not use the reef and its resources directly, but make use of products or services from the reef (e.g. fish traders) or whose actions may affect the reef (e.g. upstream farmers);

5.7.1 Method

A structured questionnaire was used to collect information from the various stakeholders (see Section 3.5.2 and Appendix A). Information from the secondary stakeholders was also obtained through meetings which were arranged prior to the interview or from walk-in interviews. A total of sixty five interviews were conducted (see Table 16).

TABLE 16: NUMBERS OF INTERVIEWS THAT WERE CONDUCTED

GROUP	NUMBER INTERVIEWED
Fishermen	7
Vendors	4
Tourists	6
Hotels and Restaurants	3
Tour boat operators**	35
Residents	10
TOTAL	**65**

** Note 1: Meeting was held with Tour Boat Association which represents 17 members. Operations where tour operators were employed had consensus from all members before partaking interviews.

- It was difficult to capture fishers at landing sites during the hours of 9.00 am to 5.00 pm within the time frame of the assignment so fishermen were interviewed at only 2 (out of 7) landing sites and in a few cases at the fishers' residents.

- The majority of tourists who were approached declined to be interviewed as they felt that their leisure time would be disrupted.

- The majority of residents in the NEMMA communities were not at home during working hours when the interviews were conducted as many of them hold jobs that are away from home.

- The electricity, power generation and desalination plants did not response to the request for information. The brewery was under audit at the time of the site visit and further correspondence has not yielded any results. There was no available contact information for the owner/operator of the cement receiving facility.

5.7.2 Primary Stakeholders

Using the definition of primary stakeholders outlined above, the following were the primary stakeholders identified for the NEMMA:

- Fishermen,
- Divers,
- Tourists,
- Vendors,
- Tour Boat Operators, and
- Charter Boat Operators.

5.7.2.1 Fishermen

The information provided in this section is based on:

- Interviews with fishermen for this assignment.
- A 2000-2001 Survey of Fishermen, North Sound, Antigua conducted by Donald Anthonyson and Carole McCauley (Anthonyson, D & McCauley C, 2002).
- A 1996 report on Usage Patterns and the Resource Management Perceptions of Users of the Northeast Coast Management Area and the Bird Island Marine Reserve and Wildlife Sanctuary prepared by Island Resources Foundation (IRF, 1996).

5.7.2.1.1 Respondent Information

The 2000-2001 survey included 15 fishermen from Seatons (3), Cedar Grove (2), Crabbs Marina (1), Royal Bay (5), Willikies (2) and Parham (1) (Anthonyson et al, 2002).

Only seven fishermen were interviewed in 2007: three from Parham; two from Seatons, one from Winthropes and the other from Cooks Hill. All were male. The majority of respondents (72%) were in the 46 to 55 age category. One fisherman was in the 36 to 45 age category, while the other was younger (26 to 35 years) (see Table 17). A decade ago the ages of fishers were evenly divided among young, middle-aged and older generations (IRF, 1996).

TABLE 17: AGE CATEGORIES OF FISHERMEN

AGE CATEGORY	FREQUENCY	PERCENTAGE
18 – 25	0	0
26 – 35	1	14
36 – 45	1	14
46 – 55	5	72
56 – 65	0	0
> 66	0	0
No response	0	0

Equal proportions of respondents in the 2007 survey (43%) reached primary as well as well as secondary education levels respectively (see Table 18). There was no response from one fisherman. Eighty-six percent of respondents indicated that they had experience in other occupations (carpenters, masons, welders, landscapers and chefs).

TABLE 18: FISHERMEN'S LEVEL OF EDUCATION

LEVEL OF EDUCATION	FREQUENCY	PERCENTAGE
Primary	3	43
Secondary	3	43
Technical / Vocational	0	0
Tertiary	0	0
No response	1	14

5.7.2.1.2 Household Information

All of the respondents in the 2007 survey indicated that they were the main income earner in their households (see Table 19). The dependents were male and female from all age categories giving a total of 28 dependents among the fishermen (see Table 20). There were 10 students (6 at primary and 4 at secondary). The adults engaged in occupations in the service industry such as receptionist, waitress, airline attendant and events coordinator. There was one teacher.

TABLE 19: FREQUENCY OF MAIN INCOME EARNERS

ARE YOU THE MAIN INCOME EARNER?	FREQUENCY	PERCENTAGE
Yes	7	100
No	0	0
No response	0	0

TABLE 20: AGE CATEGORIES OF FISHERMENS' HOUSEHOLDS

AGE CATEGORY	FEMALE	MALE	TOTAL
0 – 5	2		2
6 – 11	2	4	6
12 – 17	1	3	4
18 – 29	6	1	7
30 -45	3	2	5
46 – 60	2	2	4
> 60	0	0	0
Total	16	12	28

5.7.2.1.3 Use of the NEMMA

In the 1996 survey of fishermen (IRF, 1996) there were some fishermen who started fishing in the area some 60 years ago.

Fishermen in the 2000-2001 survey had been fishing for between 6 years to all their life (over 30 years). Two indicated that they were semi-retired.

When asked how long they had been fishing, all of the respondents in the 2007 survey indicated that they were fishing for 16 years and over. Fifty-seven percent had been fishing for more than 20 years and the remainder had been fishing for 16 to 20 years (see Table 21).

TABLE 21: DURATION IN OCCUPATION

DURATION IN OCCUPATION	FREQUENCY	PERCENTAGE
< 1	0	0
1 – 5	0	0
6 – 10	0	0
11 – 15	0	0
16 – 20	3	43
> 20	4	57
No response	0	0

All of the current fishermen interviewed owned their own boat. Among them there are 13 vessels. Seventy percent of these boats were made of fibreglass. Fifteen percent of them were made of wood and the other 15% of both wood and fibreglass. All of these vessels were motorised. All of the respondents claimed that their boats were licensed.

Over the last decade fishing as a part-time activity has been increasing. In the 1996 survey (IRF, 1996) fishermen stated that there was a decline in the number of fishermen and a shift to part-time and weekend fishing, with such fishermen often holding full-time jobs during the week. This decline was attributed to increase in equipment expenses, declines in catch and availability of better paying jobs in tourism (see Section 5.7.2.1.3). In the 2000-2001 survey about half the fishermen interviewed fished part-time (1 – 3 days per week) and did other jobs while the other half fished 4 – 5 days for the week (Anthonyson et al, 2002). Six out of the seven fishermen interviewed in 2007 had the same frequency of fishing. They all fished many times a week. One respondent however fished once a week. Four respondents fished seasonally, one particularly specifying the lobster season from August to October. The other 3 fishermen fished all year round.

All the fishermen interviewed in the three studies consider the NEMMA their main fishing grounds. In the 2007 survey four identified the area from Hodges Bay to Green Island, where they consider the North Sound Marine area. The areas commonly used by fishermen interviewed in the 2000-2001 survey were the mangroves and near-shore reefs in the coastal areas of the North Sound (Mercers Creek, the Narrows, Guiana Island, Byam's Wharf, Parham Harbour and Fitches Creek), the area north of Royal Bay, and the area around Green Island extending south to Indian Creek. A few also fished in Barbuda about once per week.

Ten years ago trap fishing was most commonly used and spear fishing was much more popular (IRF, 1996). In 2000-2001 to present spear fishing appears to be less popular, with trapping being the preferred method, followed by line and gill nets (see Section 5.2.2.4).

In 1996, fishermen noted a decline in catch to 1/5 to 1/10 the amount they would have caught twenty years previous (approximately 200 lb/day). The catch size stated by fishermen in 2007 ranged from 80 to 500 pounds. Fifty-seven percent of these fishermen indicated that catch size has remained the same, twenty-nine percent indicated that it decreased and the remainder said that it had increased since they started fishing.

In 1996, fishermen stated that while previously targeted species were snapper and grouper they were forced to be less discriminating catching and keeping whatever they could. In 2000-2001 fishermen indicated that parrotfish, snapper and doctorfish were the main species caught with some grouper, barracuda, grunt and angelfish. Two fishermen also caught lobster. In 2007, the types of fish caught were red snapper, grunt, parrot fish, ducktail, goat fish, silver fish and cavalli. Reef surveys in 2007 identified a greater presence of juveniles and small adults suggesting deletion of fish stock (see Section 4.6.1.5).

5.7.2.1.4 Perceived Changes

Over the last decade fishermen have consistently noted the effect of hurricanes on the NEMMA fishery. Other attributable causes (though less important) included overfishing, spear fishing, dredging for navigation purposes and oil spills and bilge water from boats.

Half the fishermen in the 2000-2001 survey indicated that they had not noted any major changes to their catch (type and amount) except as a result of hurricanes, weather and tides. The remainder felt that changes in fish catch were attributed to the death of the reefs, seasonal factors such as tides and the destructive fishing techniques of other fishermen. The fishermen who were interviewed in 2007 indicated that the activity that negatively impacted the reef the most is natural disasters, specifically hurricanes. The most common changes to the reef were reef breakage and decrease in water clarity. One fisherman indicated that there was a decrease in fish and fish nurseries.

Roving diver surveys of the coral reefs in the NEMMA conducted in 2007 as well as other surveys done prior to this (see Section 4.6.1.2) identified areas of reef damage attributable to hurricanes in areas such as Prickly Pear and Pelican Island.

5.7.2.1.5 Management

Since 1996 fishermen have been open to the suggestion of management of the NEMMA but they were concerned about any fishing restrictions that impact on those who depended on the activity for an income or who felt that it was a right. When asked to recommend measures to protect the quality of the reef, fishermen in 2007 suggested that spear fishers be given a seasonal period to fish and proper mooring should be provided for yachts. Others felt that it was impossible to protect the reef from natural disasters. One respondent said that there is need to provide proper waste disposal facilities for tourists using the area.

In the 2000-2001 survey fishermen made recommendations for improving the area in general including docking and jetty facilities (particularly at Royal Bay), mooring buoys and, repair facilities for fishing boats. They also felt that fishing laws, regulation of potentially harmful fishing methods and litter laws should be enforced and dredging should be prohibited. The fishermen also suggested zoning laws to regulate the use of the NEMMA, and raising public awareness.

All the fishermen interviewed in 2007 felt that making the reef a marine protected area would have a positive impact on the reef if properly managed. They also felt that there should be zoned management however there should not be total restriction of fishing since this would have a negative impact on their livelihood. However, all the fishermen felt that the reef should become a managed protected area.

5.7.2.1.6 Summary of Concerns

As noted in Section 5.7.2.1.4, fishermen are primarily concerned with the following:

- Damage of the reefs by hurricanes;
- Pollution of the water by oil spills and bilge water from boats;
- Reduction in fish populations; and
- Destructive fishing techniques by other fishermen.

These concerns are further discussed in Sections 7.3.4.3 and 8.3.1. In addition, the impact of the project on the livelihoods of this important stakeholder group as well as potential alternative livelihoods that may be suitable for the fishermen are discussed in Section 9.12.1.

5.7.2.2 Divers

As noted in Section 5.2.3, diving is restricted to Green Island and Great Bird Island. Many of the fishermen were also recreational divers but to avoid double counting they were only interviewed once. Therefore, no divers were interviewed.

5.7.2.3 Tourists

5.7.2.3.1 Respondent Information

Four out of the six (67%) of the respondents were male, ranging in ages from forty-six to over sixty-six (see Table 22). Their countries of origin were: United States and England. Fifty percent had visited this area for the first time, while the other 50% visited on one previous occasion. The main purpose of their visit was pleasure while the number of persons travelling together ranged from two to seven.

When asked how they first became aware of the area, eighty-three percent of respondents learned through a travel agent. The remaining respondent was informed by family and friends. Only the two couples indicated their professions. These included: a writer, an attorney, as well as a few retired individuals.

5.7.2.3.2 Use of Reef

The activities that tourists engage in while at beaches in the NEMMA included: diving, snorkelling, swimming, sailing, hiking, jet skiing and sun bathing. They accessed the reef by snorkelling, or tour boat.

TABLE 22: TOURISTS' AGE GROUPS AND FREQUENCIES

AGE CATEGORY	MALE	FEMALE
18 – 25	0	0
26 – 35	0	0
36 – 45	0	0
46 – 55	2	1
56 – 65	1	1
> 66	1	0
No response	0	0

5.7.2.3.3 Perceived Changes

When asked if the reef quality had changed, all those who visited the area before (50% of the respondents) indicated that it had not changed. What respondents enjoyed most about the reef were the corals and fishes including the easy access of the reef from the beach.

5.7.2.3.4 Management

When asked if they thought that developing the NEMMA into a Marine Protected Area would help improve the quality of the coral reefs and protect them, all of the respondents agreed that it would with strong agreement from 83%.

Tourists were also asked how they may be affected if the area becomes a Marine Protected Area. They agreed that it would have no impact or even enhance their experience, if implemented in an effective, reasonable manner. One respondent suggested a rotational system in using reef areas for snorkelling and diving. Also, environmental education and guidance was seen as a necessity.

5.7.2.4 Vendors

5.7.2.4.1 Respondent Information

All of the respondents were female. It is unsure whether nationally vendors are predominantly female, but our observations at two main vending sites in the NEMMA (Long Bay and Mercers Creek Bay) suggest that all the vendors (about 8 in total) on these two sites were women. Fifty percent lived inland in All Saints, twenty-five percent were from Willikies and the remaining twenty-five percent were from a village called Potters. The highest level of education attained by seventy-five percent of the vendors was primary, while the remaining twenty-five percent attended secondary school. Fifty percent indicated that they had no other skills, while the other fifty percent listed their other skills as: waitress, and housewife.

5.7.2.4.2 Household Information

The majority of vendors (75%) were the main income earners in their household. The numbers in their households they supported ranged from 2 to 4. Both the male and female dependents ranged from 12 to 17 years and 18 to 29 years of age, with the majority being males (see Table 23).

In three households, there were other employed adults, which included a mechanic and a vendor. A total of three students were included in the vendors' households. They all attended secondary schools.

TABLE 23: AGES OF OCCUPANTS OF VENDORS' HOUSEHOLDS

AGE CATEGORY	FEMALE	MALE
0 – 5	0	0
6 – 11	0	0
12 - 17	1	4
18 – 29	1	2
30 -45	0	0
46 – 60	0	0
> 60	0	0

5.7.2.4.3 Use of Reef

Seventy-five percent of the vendors have been vending for 20 to 30 years, while the remaining twenty-five percent have been vending for 10 to 20 years. T-shirts, souvenirs, craft items and jewellery were the most popular items sold by all vendors. One vendor sold wrap skirts also.

Seventy-five percent of the vendors indicated that business had decreased since they started vending, while twenty-five percent indicated that it had remained the same. None of the vendors interviewed used the reef.

When asked if there were any constraints in using the protected area, there was no response from the vendors interviewed.

5.7.2.4.4 Perceived Changes

Seventy-five percent of the vendors said that in their opinion reef quality had changed over time, indicating changes such as reef breakage and decrease in water quality. Although they do not use the reef, vendors would get information on the reef from other users such as tourists, tour boat operators and fishers. One vendor did not feel that the quality of the reef had changed.

5.7.2.4.5 Management

When asked to recommend measures to protect the quality of the reef, the vendors had no response or did not know since, in their opinion, the reefs were impacted mainly by hurricanes. Seventy-five percent were neutral on the issue of making the reef into a Marine Protected Area, while the remainder agreed with the proposition.

5.7.2.5 Tour Boat Operators

5.7.2.5.1 Respondent Information

All of the respondents were male, ranging in ages from 26 to 45 years (see Table 24). Forty nine percent operated out of the St. Johns area whilst thirty seven percent were based in the village of Seatons in the NEMMA. The remaining percentile (14%) was from Willikies. Fifty two percent indicated that they were former fishermen and had only secondary education.

TABLE 24: TOUR BOAT AGE GROUPS AND FREQUENCIES

AGE CATEGORY	MALE	FEMALE
18 – 25	5	0
26 – 35	20	0
36 – 45	10	0
46 – 55	0	0
56 – 65	0	0
> 66	0	0
No response	0	0

Most medium and small tour boat operators were based in the NEMMA area, with operations based in the villages of Seatons and Willikies. Larger operators include chartered yachts and catamarans and were based in St. Johns. All tour boat operators indicated that Great Bird Island is the final destination on tours. All tour boats are required by law to be licensed and have cruising permits, which must be renewed annually.

Most vessels used for tour boats are motorized and made of fiberglass, with some of the larger vessels being outfitted with “zodiac-ribbed” type material, similar to the Coast Guard Vessels. Tour boat operations are the basis of a thriving tourist economy with up to 300 people being accommodated per day during the peak season of November to April. Table 25 categorizes tour boats by size and frequency of operations. It was noted that there is a new large catamaran with a capacity of 125 people operating 5 days weekly, with extended full day tours.

TABLE 25: TOUR BOAT OPERATIONS IN THE NEMMA

Source: President of the Tour Boat Operators Association (personal communication)

CLASS OF BOAT	CAPACITY	FREQUENCY OF OPERATIONS / WEEKLY
Small	10-20	2
Medium	30-40	3
Large	50-75	5

5.7.2.5.2 Current Use of Protected Area

All of the respondents indicated that the NEMMA is utilized mainly as part of guided 2.5 to 3 hour tours, with the final destination being the beaches on Great Bird Island. Most of these tours include snorkelling, kayaking and some type of water sports. One operator has a fenced area off Seatons where visitors are allowed to interact and feed live stingrays. The reefs form part of the main attraction to visitors and are used mainly for snorkelling.

Most operators indicated that there were no constraints in using the protected area. All of the operators indicated a decrease in reef quality and fish population attributed to hurricane surge damage and excessive spear fishing respectively. All respondents also indicated an abuse of Great Bird Island and degradation of natural flora and fauna.

5.7.2.5.3 Management

All of the respondents indicated that proper supervision and policing of the protected area was required as well as facilities on Great Bird Island to prevent garbage build-up. Ten of the respondents indicated that reef markers would help establish areas so boats and yachts would not run aground, resulting in further damage of the coral.

All the tour boat operators interviewed felt that making the reef a Marine Protected Area would have a positive impact on the reef if properly managed. They felt that there should be zoned management and restrictions of fishing since this would have a negative impact on their livelihood i.e. decreasing fish numbers and damaging coral.

5.7.2.5.4 Summary

As noted in Section 5.7.2.5.2, tour boat operators are primarily concerned with the following:

- Decrease in the reef quality;
- Decrease in fish populations;
- Excessive spear fishing; and
- Lack of supervision and policy of the NEMMA

In addition, the tour boat operators clearly stated that the excessive fishing if allowed to continue would have a negative impact on their livelihood. These concerns are discussed in Section 8.3, 7.3.4.1 and 7.3.4.2. Alternative livelihood opportunities that may be applicable to the fishermen are described in Section 9.12.1.

5.7.2.6 Residents

5.7.2.6.1 Household Information

Sixty percent of the respondents interviewed were female (see Table 26). Fifty percent of them were between the ages 36 to 55, while 20% were 18 to 25 years old and another 20% over 66 years old. One resident did not respond when asked her age. The highest level of education attained by 70% was secondary, and 20% reached primary level. One respondent attained tertiary education.

Seventy percent of respondents lived at their current address for ten years and over. Forty percent indicated that they occupied their current residence for more than thirty years, 30% within 10 and 30 years and 20% within 5 to 10 years. The remaining respondents lived at their present home for less than 5 years. Household sizes ranged from one to ten, with males comprising fifty-five percent. Household members ranged from ages 0 to 60, the majority (22.5%) being in the category 18 to 29. Employed adults included: business owners, bartenders, tour operators, mason, carpenter, cleaner, electrician, clinic aid, pharmacist, librarian, bus driver, and administrative assistant.

TABLE 26: AGES OF OCCUPANTS OF RESIDENTS' HOUSEHOLDS

AGE CATEGORY	FEMALE	MALE
0 – 5	2	3
6 – 11	1	3
12 - 17	2	4
18 – 29	4	5
30 -45	4	1
46 – 60	4	4
> 60	1	2

5.7.2.6.2 Use of Reef

Fifty percent of respondents never visited the reef in the NEMMA. Forty percent visited yearly and a further ten percent visited weekly. Most respondents stated that they did not have a particular time to visit the reef, while one respondent indicated that August was his preferred visiting time and another said Easter. Forty percent of the residents utilized private boats to access the reef, 10% used other means and the remainder had no response since the question was not relevant.

While 50% of respondents did not personally visit the reef, they had family members who worked at jobs where they visited the reefs frequently and they formed their opinions from discussions with them.
The activities that residents engaged in at the NEMMA include: diving, snorkelling, swimming/ sea bathing, fishing, collecting corals for souvenirs, and wind surfing.

5.7.2.6.3 Perceived Changes

When asked if the reef quality had changed, half of the residents indicated that it had, due to pollution, the removal of mangroves, coastline erosion and the reduction in water clarity. Twenty percent of the respondents did not know whether the quality of the reef had changed, while one respondent said that there was no change in the reef quality.

5.7.2.6.4 Management

When asked what activities should be controlled or prohibited in the NEMMA, residents responded that pollution and extensive hotel development should be controlled. They were also asked what impact turning the reef into a Marine Protected Area would have. Some responded that the reef would be preserved and reef breakage decreased, fish will multiply and marine life would be protected.

5.7.2.6.5 Summary

As noted in Section 5.7.2.6.3, residents were primarily concerned with the following:

- Pollution;
- The removal of mangroves;
- Coastline erosion;
- The reduction in water clarity; and
- Extensive hotel development.

These concerns are discussed in detail in Sections 7.3.4 and 7.5.4.1.

5.7.2.7 Management of Reefs

This section documents the attitudes of respondents to statements pertaining to reef management and value. Respondents were asked to rate these statements on a scale of 1 to five with 1 representing strong disagreement and 5 representing strong agreement.

The responses for all the stakeholders are summarized below.

- The user groups and stakeholders interviewed exhibited pro-environmental attitudes to varying degrees. The fishermen, tour operators and residents appeared most knowledgeable on the importance of reefs and other coastal resources like sea grass beds. On the other hand the vendors appeared quite passive in their opinions on the NEMMA resource. There was unanimous agreement that future generations should be allowed to enjoy the coral reefs.

- 'Reefs are important for protecting land from storm waves'. Most respondents (96%) agreed with this statement (see Table 27). Two vendors did not agree with this statement, while one was neutral.

TABLE 27: REEFS IMPORTANCE

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	0	0
Disagree	2	3
Neutral	1	1
Agree	19	30
Strongly agree	42	66
No response	0	0

- 'Coral reefs are only important if you fish or dive'. Ninety-two percent (92%) of respondents disagreed with this statement (see Table 28). Of the eleven percent who agreed, two were fishermen and one was a resident.

TABLE 28: CORAL REEFS IMPORTANT IF YOU FISH OR DIVE

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	22	41
Disagree	27	51
Neutral	1	1
Agree	3	6
Strongly agree	0	0
No response	1	1

- 'In the long run, fishing would be better if we cleared the coral'. Ninety-four percent (94%) disagreed with this statement (see Table 29). One resident was neutral, one fisherman agreed, and there was no response from one resident.

- 'Fishing should be restricted in certain areas just to allow the fish and coral to grow'. Ninety-two percent (92%) of respondents agreed with this statement (see Table 30). Those respondents who disagreed with this statement were residents and fishermen.

TABLE 29: INCREASED FISHING IF CORALS ARE CLEARED

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	38	59
Disagree	23	35
Neutral	1	2
Agree	1	2
Strongly agree	0	0
No response	1	2

TABLE 30: RESTRICTION OF FISHING

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	1	2
Disagree	2	3
Neutral	2	3
Agree	40	63
Strongly agree	19	29
No response	0	0

- 'Future generations should be able to enjoy the coral reefs'. All of the respondents agreed with this statement (see Table 31).

TABLE 31: REEFS FOR FUTURE GENERATION

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	0	0
Disagree	0	0
Neutral	0	0
Agree	11	18
Strongly agree	51	82
No response	0	0

- 'We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow'. The majority (83%) of the respondents agreed with this statement (see Table 32). One resident and one vendor took a neutral position.

TABLE 32: RESTRICT DEVELOPMENT ALONG COASTAL AREAS

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	0	0
Disagree	9	14
Neutral	2	3
Agree	39	61
Strongly agree	14	22
No response	0	0

- 'Seagrass beds have no value to people'. Eighty-seven percent (87%) of respondents disagreed with this statement (see Table 33). However, a resident and a fisherman agreed with this statement.

TABLE 33: SEAGRASS BEDS OF VALUE TO PEOPLE

RESPONSE	FREQUENCY	PERCENTAGE
Strongly disagree	50	78
Disagree	6	9
Neutral	5	8
Agree	2	3
Strongly agree	0	0
No response	1	2

- Ninety-six percent of the respondents thought that the NEMMA should be a Marine Protected Area. One resident did not agree.

5.7.3 Secondary Stakeholders

Again, based on the definition of secondary stakeholders given above, the following were the secondary stakeholders identified:

- Hotels, and
- Restaurants.

5.7.3.1 Hotels and Restaurants

Three out of nine hotels in the NEMMA region were interviewed for this assignment. These hotels also had restaurants on the premises. The main objectives of these interviews were:

- The level of interaction that hotel guests have with the NEMMA;
- Whether the hotels buy fish from fishermen that fish within the NEMMA;

Two of the hotels interviewed indicated that their guests use the NEMMA area for recreational activity. Hotel capacity ranged from 6 rooms to 28 rooms. One hotel which is situated on the beach front at Long Bay said that their guests use the beach area for snorkelling and swimming. They may also participate in some other recreational activities like boat tours or water skiing, but these are arranged by the guests themselves. At Harmony Hall the hotel has a small boat which takes guests to Green Island for swimming.

One hotel indicated that due to its small capacity, fish is purchased from local fishers. However, the respondent was unclear as to whether the fish came fom the NEMMA marine area. Other hotels do not purchase their fish from local fishers or NEMMA fishermen. The only explanation they gave for the source of their fish was that it came from overseas markets.

5.7.3.2 Management

All of the respondents at the various hotels and restaurants were unanimous in their agreement that the development of the NEMMA as a marine protected area would benefit the reefs. Additionally, they all agreed that the NEMMA should continue to be developed as a marine protected area.

5.8 Summary of Key Findings

The following are the key characteristics of the socio-economic environment in the NEMMA:

- Employment in the NEMMA seems to be parallel to that at a national level with unemployment ranking at 8.4% both in the NEMMA and in Antigua and Barbuda.
- Fishing along with other agricultural activities accounted for approximately 1.1% of employed persons in the NEMMA region (Statistical Office, 2001).
- Although the number of registered fishers in the NEMMA increased by 10%; the number of registered fishing vessels reduced by 26.4% during the same period (1992 – 2001). No information to shed light on this phenomenon was available.
- There has been an overall increase in the total number of registered fishers in the NEMMA over the period 1992 to 2001 by 10%.
- There was no evidence in the literature to suggest reasons for these increases in fishermen, which suggests the need for further investigation. However, it was mentioned that “the fisheries sector in northeast Antigua is in slow but appreciable decline” (Espeut, 2006).
- Fishers interviewed indicated that they were the main income earner of their household. However, the majority of them were experienced in other occupations and had adults in their households who worked. Part-time fishing has been increasing over the last decade.
- Overall, there was a general agreement by the primary stakeholders that the development of a Marine Protected Area would be beneficial to the reef. In response to the question of whether or not the reef should become a Protected Area, ninety-eight percent of the respondents said that it should.

- All of the respondents at the various hotels and restaurants (secondary stakeholders) were unanimous in their agreement that the development of the NEMMA as a marine protected area would benefit the reefs. Additionally, they all agreed that the NEMMA should continue to be developed as a marine protected area.

- Respondents indicated that natural disasters, mainly hurricanes, were one of the major causes of reef damage. They also felt that pollution and extensive hotel development should be controlled in the NEMMA.

- When asked what impact turning the reef into a Marine Protected Area would have, some responded that the damage to the reef would decrease, fish will multiply and marine life would be protected.

- Based on the response to the statements about the importance of coral reefs and sea grass beds, it was evident that most of the respondents were knowledgeable about coral reefs.

- Evidence from two main vending beaches suggests that vendors seem to be predominantly female and were the head their households is also significant. However, there was no information on whether this was a national phenomenon.

- The large number of tour operators is also significant from a livelihoods perspective, since they seem to be the dominant group gaining economically from the area.

6 PARK MANAGEMENT PLAN

This chapter summarizes relevant information from the Final Management Plan for the Northeast Marine Management Area (NEMMA) 2007 – 2010 (April, 2007), prepared by Mr. Ivor Jackson. These aspects of the plan will be used in the SWOT Analysis in Chapter 7, from which recommendations will be made for the environmental management of the NEMMA.

6.1 Guiding Principles

The Management Plan was guided by the following principles:

- Stakeholder involvement is considered essential in building support for management objectives and rules designed to achieve them.
- Management must deploy creative mechanisms for interagency and public/private sector cooperation.
- Flexibility must be applied in implementing management rules and procedures allowing for adjustments in the formative years of the NEMMA's management.

6.2 Management Vision

The management vision for the NEMMA evolved during several stakeholder consultations. As stated in the Management Plan it seeks to achieve:

> ***"A self-financing, multiple use (yachting, fishing ,tourism, conservation, recreation) protected area that maintains and enhances the natural beauty and unique biodiversity of the area, both terrestrial and marine, supported by an efficient legislative framework and ongoing awareness program"***

6.3 Objectives

The reasons for establishing marine reserves are outlined in Section 22(1) of the Fisheries Act, 2006. During the formulation of the Management Plan a list of objectives was clarified and agreed in a consultative meeting with stakeholders of the NEMMA to include:

- Biodiversity protection
- Research and monitoring
- Water quality maintenance
- Scenic preservation
- Tourism and recreation management
- Education and awareness
- Sustainability of traditional uses and livelihoods
- Promotion of economic and social benefits

6.4 Management Programs, Sub-Programs and Activities

The Management Plan proposes the implementation of three management programs for achieving its goals and objectives:

- Conservation
- Education and Sustainable Use
- Administration and Finance

Each of these programs is broken into sub-programs for which specific activities are detailed which seek to achieve the more general management objective and the vision of the NEMMA. A time frame over 2007 – 2010 is proposed for the respective activities within each sub-program.

6.4.1 Conservation

There are three sub-programs which focus on conservation:

- Natural Resource Protection
- Natural Resources Management
- Research and Monitoring of Environmental Quality and Resource Use.

6.4.1.1 Natural Resource Protection

The objectives of this sub-program are to:

i Maintain biological diversity
ii Conserve economically valuable resources
iii Promote recovery of rare, threatened, endangered or overexploited species of the NEMMA

6.4.1.2 Natural Resource Management

The objectives of this sub-program are to:

- Provide required staff and infrastructure to manage resources and resource users.
- Promote stakeholder participation in management.

6.4.1.3 Research and Monitoring

The objectives of this sub-program are to:

i Build an adequate data base for management and protection.
ii Provide the Management Partnership with information to make sound management decisions.
iii Disseminate and use local knowledge in resources management.

6.4.2 Education and Sustainable Use

The following two sub-programs will focus on education and sustainable use:

- Environmental Education, Public Awareness and Communications.
- Livelihood Development and Sustainability.

6.4.2.1 Environmental Education

The objectives of this sub-program are to:

i Build community support for NEMMA zoning and regulations.
ii Reduce use conflicts between resource users.
iii Establish the credibility of the Management Partnership among communities, resource users and other stakeholder interests.
iv Promote compliance with regulations and rules by commercial and recreational users.
v Promote the recreational and eco-tourism attractions of the NEMMA.

6.4.2.2 Livelihood Development

The objectives of this sub-program are to:

i Support and develop compatible uses within the NEMMA.
ii Provide education and technical support to micro-enterprises operated by community groups.

6.4.3 Administration and Finance

The following three sub-programs will focus on administration and finance:

- Management and Operations.
- Finance.
- Training.

6.4.3.1 Management and Operations

The objective of this sub-program is to provide an efficient organization and the technical and administrative capacity to achieve the objectives and vision of the NEMMA.

6.4.3.2 Finance

The objectives of this sub-program are to:

i Provide capable and transparent financial management of the affairs of the Management Partnership in a transparent and timely manner.

ii Ensure that the NEMMA Partnership achieves and maintains self-sufficiency.

6.4.3.3 Training

The objectives of this sub-program are to:

i To build the capacity of NEMMA staff to carry out administrative technical and line functions.

ii To provide opportunities where possible for the training of staff and volunteers from partner of stakeholder organizations.

6.5 Management Framework

The Minister of Agriculture and Fisheries will have ultimate responsibility for the management of the NEMMA in accordance with the Fisheries Act, 2007. The Management Plan further proposes a not-for-profit company called the NEMMA Management Partnership which will function in principle as a statutory body. Its members will be drawn from eligible stakeholders (relevant government agencies, bona fide private enterprise associations, non-profit environmental and developmental organizations, active voluntary community groups, etc). Members will elect a Board of Directors which will function to provide policy direction and oversight for the NEMMA's management. Procedures governing the conduct of the Board and its members will be set out in Articles of Association.

A NEMMA Office headed by a Manager will provide executive functions and have responsibility for revenue collection, education and awareness, infrastructure development (reef markers, boat moorings, etc), underwater trails, garbage collection, interpretation, visitor data, etc). Other staffing will include an administrative and

accounting officer, a research and monitoring officer, a product development and interpretation officer, an education and awareness officer, a public relations marketing and sales officer, a maintenance supervisor and six wardens. Management services such as business planning, auditing and instalment and maintenance of fixed moorings will be outsourced as needed.

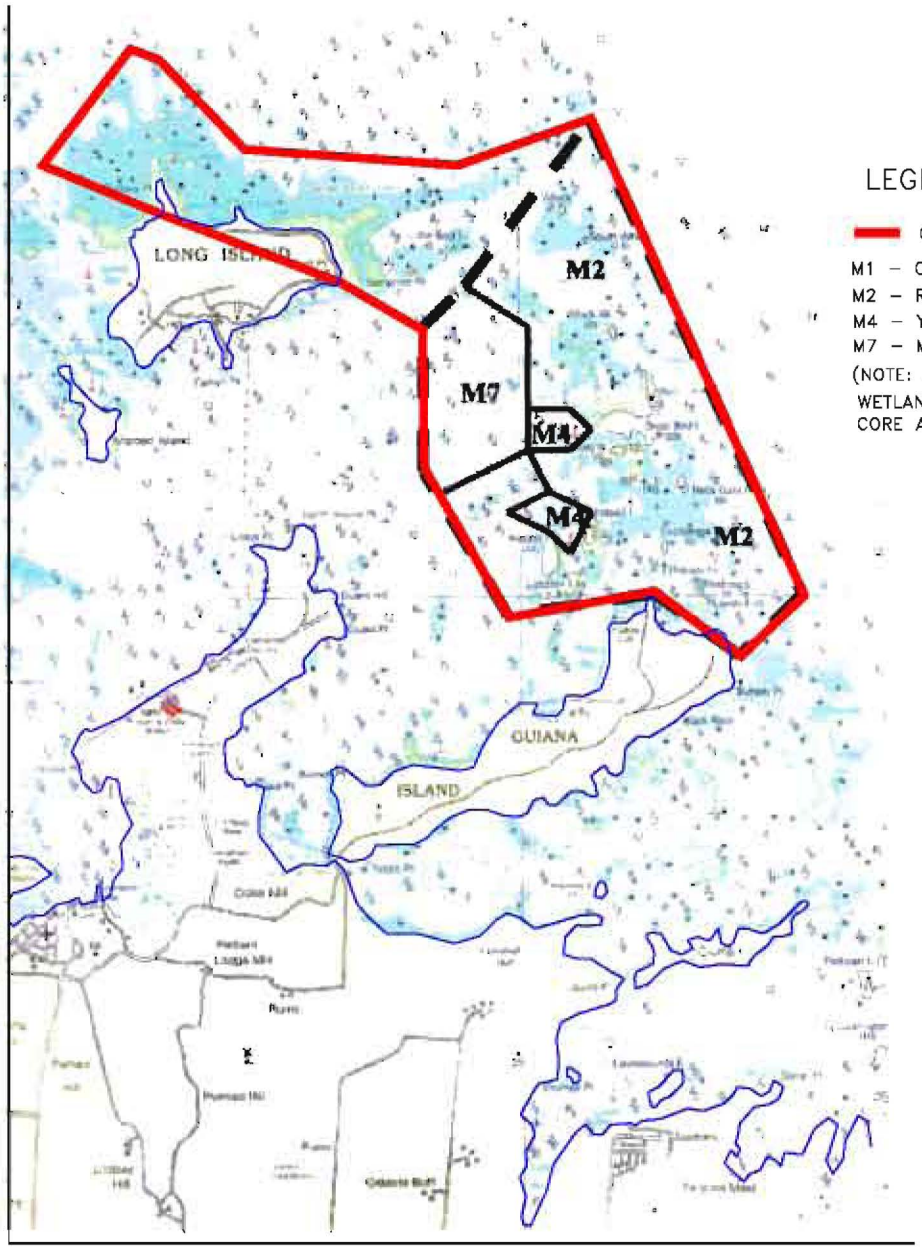
A system of fees is suggested for the various uses of the NEMMA such as kayaking, snorkelling, interactive experiences (stingray and dolphin) tour operators and passengers, yachts (mooring and passenger), vendors, sport fishing, commercial filming, camping, jetties, marina berths, surfing and tent rentals. These are to be agreed and adopted as regulations. The fee structure proposed is further discussed in Section 9.8.

6.6 Zoning Plan and Process

The Management Plan acknowledges that the NEMMA is already a multiple-use area which includes activities such as Research and Education, Fishing (pot, net, line), Recreation (including water sports such as kayaking, snorkelling, scuba diving, water skiing, jet skiing, hiking, etc), Resort and Residential, Yachting, Industry and Commerce, and Marine Transportation and Shipping. Zoning of the NEMMA to provide for the existing multiple uses is proposed for its management. The Management Plan focuses on two core areas of the NEMMA (Great Bird Island and Green Island) and these are shown in Figures 14 and 15.

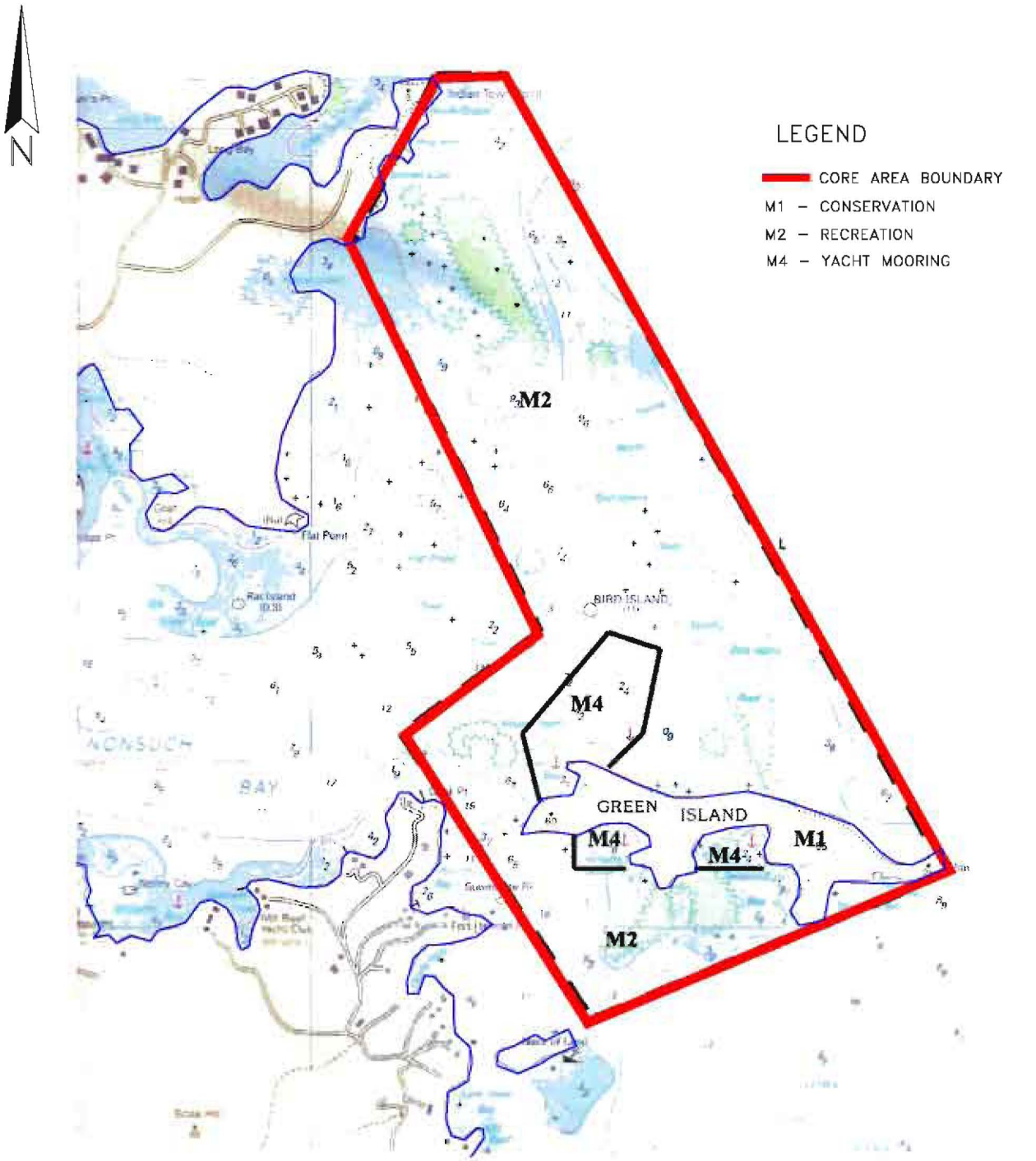
The intention is that zoning of the remainder of the NEMMA will be completed by December 2007 using the following basic principles: avoid use conflicts, promote mixed/multiple uses which can coexist without conflict, and ensure that uses are compatible with resource conservation. The process of zoning will involve:

- Additional stakeholder review of zoning designations.
- Application and testing of the zoning designations proposed for Great Bird Island and Green Island Cores.
- Completion of zoning for other parts of the NEMMA in accordance with the principles stated above.
- Use of digital aerial photographs for mapping zones with a GIS application that allows easy modification/changes to zones.
- Participation of key resource users and other stakeholders in review, application and testing exercises.
- Legislative review and changes necessary to apply the new zoning designations.



SOURCE: IVOR JACKSON & ASSOCIATES (2007)

Ecoengineering Caribbean Ltd.	Eco Report No. 10/2007	CLIENT: OECS – ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER 14
	DATE: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
		DWG. NAME: ZONE DESIGNATIONS, GREAT BIRD ISLAND CORE	



SOURCE: IVOR JACKSON & ASSOCIATES(2007)

SCALE

Ecoengineering Caribbean Ltd.	Eco Report No. 10/2007	CLIENT: OECS – ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER 15
	DATE: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
		DWG. NAME: ZONE DESIGNATIONS, GREEN ISLAND CORE	

6.6.1 Conservation Zones

These areas are for the protection of flora and fauna (particularly those that are endemic, threatened or endangered) and natural breeding grounds and habitats of aquatic life as well as for the promotion of scientific study and research important to the protection of such assets. These areas include mangrove, turtle nesting beaches, bird nesting areas and important seagrass areas.

Permitted activities in these zones will include research, surveillance, sediment sampling, and hurricane shelter for yachts/boats. Hiking and camping will be allowed by exception.

6.6.2 Recreation Zones

These are areas which will provide opportunities for recreation and tourism consistent with the conservation of natural resources of the NEMMA and objectives for sustaining livelihood and economic activities.

Permitted activities in these zones will include research, surveillance, sediment sampling, swimming, snorkelling, kayaking, hiking, camping, and yacht mooring. Anchoring by tour boats and fishing boats, skiing, windsurfing, line fishing, construction of jetties and wastewater discharge will be allowed by exception.

6.6.3 Fishing Priority Area Zones

Theses are areas designated to maintain fishing opportunities and livelihoods compatible with the sustainability of fishery resources.

Permitted activities in these zones will include research, surveillance, sediment sampling, fishing (pot, net and line) and hauling of fish boats. Anchoring of tour boats, jetty construction, dredging, excavation and discharge of wastewater will be allowed only by exception.

6.6.4 Yacht Mooring Zones

These areas are designated mainly to allow charter and cruising yachts to anchor in popular anchorages of the NEMMA critical to deriving economic and social benefits from the yachting sector.

Permitted activities in these zones will include research, surveillance, sediment sampling, swimming, snorkelling, diving, kayaking, and mooring of yachts. Mooring of tour boats, line fishing, construction of jetties, discharge of wastewater (including from the desalination plant) will be allowed by exception.

6.6.5 Resort/Residential Zones

These areas will accommodate existing and planned resort and residential uses on appropriate offshore islands of the NEMMA consistent with the protection of the resources of the NEMMA.

Permitted activities in these zones will include research, surveillance, sediment sampling, hiking and camping, hotels, residences, and restaurants. Construction of jetties, dredging, excavation, hauling of fishing boats and discharge of wastewater will be allowed by exception only.

6.6.6 Port/Harbour Zones

These areas will allow for the continuation of commerce, marine transportation, shoreline industrial activities in the port of Parham Harbour and Crabbs Peninsula consistent with the protection of the marine and other natural resources.

Permitted activities in these zones will include research, surveillance, sediment sampling, swimming, diving, kayaking, anchoring and mooring of tour boats, line fishing, marinas, mooring and anchoring of yachts, anchoring of tour boats, construction of jetties, hurricane shelters for yachts/boats, restaurants, berthing and anchoring of ships, hauling of fishing boats and anchoring of fishing boats. Dredging, excavation and discharge of wastewater and from the desalination plant will be allowed by exception.

6.6.7 Multiple Use Zones

Multiple uses allowed in other zones will be allowed to coexist in these areas without conflict in a manner consistent with the conservation of the natural resources of the NEMMA.

Permitted activities in these zones will include research, surveillance, sediment sampling, swimming, snorkelling, diving, kayaking, anchoring and mooring of tour boats, skiing, windsurfing, fishing (pot, net and line), marinas, mooring and anchoring of yachts, anchoring of tour boats, live aboard yachts, hurricane shelter for yachts/boats, hotels, residences, restaurant, and hauling and anchoring of fishing boats. Construction of jetties, dredging, excavation, anchoring of ships and discharge of wastewater and from the desalination plant will be allowed by exception.

6.6.8 Local Fisheries Management Areas

These will be areas designated Local Fisheries Management Areas (LFMA) provided for under Section 19(a) of the Fisheries Act.

Permitted activities in these zones will include research, surveillance, sediment sampling, and hauling and anchoring of fishing boats. Discharge of wastewater and from the desalination plant will be allowed by exception.

6.7 Monitoring and Evaluation

The Management Plan provides for monitoring and evaluation for management effective by the NEMMA Office with the involvement of NEMMA partners and/or stakeholders. The suggested tool for this exercise is the World Bank Alliance's Scorecard to Assess Progress in Achieving Management Effectiveness Goals for Marine Protected Areas (adapted for Protected Areas of the OECS) (see Appendix E). Indicators to be used in assessing management performance have been proposed in the Plan which also recommends that site personnel be trained in the use of the tool.

6.7.1 Monitoring and Evaluation Scorecard

A Monitoring and Evaluation Score Card has been adapted for use in Protected Areas in the OECS, and the Management Plan for NEMMA suggests that this tool may be used in assessing progress in achieving its management effectiveness goals. To this end, the Management Plan recommends training in the use of the tool. The Scorecard itself has been applied to NEMMA by the OECS, and a copy of that evaluation is included in Appendix E of this report. This section provides a summary of the tool, in preparation to recommendations which will be made in Chapter 9.

6.7.1.1 Overview

According to the information provided in Appendix E, the M & E Scorecard is a simple site-level tracking tool to facilitate reporting on management effectiveness of Protected Areas. It has been built around the Framework illustrated in Table 34. The Scorecard facilitates a basic level of assessment, and it requires little or no additional data collection. As shown in 34, the Scorecard focuses on the context of the PA along with the appropriateness of planning, inputs and processes of management. Because it relies largely on available data (through literature searches and informed opinions of site managers and/or independent assessors) this tool:

- takes a short period of time,
- costs little,
- issues are broadly covered, but
- depth of analysis is generally low.

It is recommended that the scorecard should be completed by PA Staff. Ideally, local stakeholders should be involved in the exercise to validate the scoring.

6.7.1.2 Scoring

The Scorecard consists of 34 Questions, arranged under the same 6 headings (Elements of Evaluation) listed in Table 34. A typical example is found in the section headed:

Context: Where are we now? Assessment of important threats and the policy environment

In this section, Question 6 asks:

Resource Inventory – Is there enough information to manage the area?

Under this question, there are 5 descriptors, with appropriate scores in each case:

- < There is little or no information available on the biophysical, socio-cultural and economic conditions associated with the protected area (0 points)
- < Information on the biophysical, socio-cultural and economic conditions associated with the protected area is not sufficient to support planning and decision making (1 point)
- < Information on the biophysical, socio-cultural and economic conditions associated with the protected area is sufficient for key areas of planning / decision making but the necessary survey / M&E work is not being maintained (2 points)
- < Information on the biophysical, socio-cultural and economic conditions associated with the protected area is sufficient for key areas of planning / decision making (3 points).

The user of the scorecard selects the applicable descriptor and the corresponding points is entered in the appropriate column. Provision is also made for additional points and for comments to be entered to allow a clearer understanding of the choice of descriptor. The scores are totalled to give a “snapshot” of conditions at the time of scoring.

TABLE 34: FRAMEWORK FOR THE M & E SCORECARD

(From documentation provided by ESDU. See Appendix E)

Elements of Evaluation	Explanation	Criteria that are Assessed	Focus of Evaluation
Context	**Where are we now?** Assessment of importance, threats and policy environment	Significance. Threats. Vulnerability. National context.	Status
Planning	**Where do we want to be?** Assessment of protected area design and planning	Protected area legislation and policy. Protected area system design. Reserve design Management planning.	Appropriateness
Inputs	**What do we need?** Assessment of resources needed to carry out management	Resourcing of agency. Resourcing of site. Partners.	Resources
Process	**How do we go about it?** Assessment of the way in which management is conducted	Suitability of Management processes.	Efficiency Appropriateness
Output	**What were the results?** Assessment of the implementation of management programmes and actions: delivery of products and Services	Results of management Actions. Services and products.	Effectiveness
Outcome	**What did we achieve?** Assessment of the outcomes and the extent to which they achieved Objectives	Impacts: effects of Management in relation to objectives.	Effectiveness Appropriateness

6.7.1.3 Limitations

According to the documentation in Appendix E, the Score Card tool has been adapted/developed to provide a quick overview of the initial state of management efforts and subsequent progress, over a period of years, in improving the effectiveness of management in a given marine protected area. Specifically, it is noted that:

- The tool does not allow a detailed evaluation of outcomes, but rather serves to provide a quick overview of the status of management steps;
- Therefore, the use of the scorecard should not replace more thorough methods of assessment for the purposes of adaptive management.

Of particular importance, it is noted that the whole concept of "scoring" progress is fraught with difficulties and possibilities for distortion. The current system assumes, for example, that all the questions cover issues of equal weight, whereas this is not necessarily the case. Accuracy might be improved by weighting the various scores, although this would provide additional challenges in deciding differing weightings.

In our professional practice, Ecoengineering has had extensive experience in the assigning of importance weights to environmental components, and we fully agree that there will be some challenges in assigning a system of weights to the various components. However, we do not believe that it would be either impossible or undesirable to do so. Indeed, we have seen examples where unweighted checklists have skewed the final decision in a particular (and not necessarily a desirable) direction. What we would recommend is the following:

- The present unweighted scorecard should be used when marine PAs are established, and for a period of perhaps 5 to 7 years thereafter.
- After this initial period, it is expected that the PA staff and key stakeholders will be sufficiently familiar with the scorecard to upgrade it to a weighted scorecard.
- Weightings should be assigned on a site-specific basis, to reflect local ecological and socio-economic conditions as well as local sensitivities.

- The actual importance weights should be assigned by the PA Staff and Key Stakeholders themselves, using a system of structured approach (such as the Delphi System), moderated by an experienced environmental / socio-economic practitioner. Our experience suggests that a regional practitioner is more likely to be effective in this work than an extra-regional practitioner.

7 STRENGTHS, WEAKNESSES, OPPORTUNITIES, THREATS (SWOT) ANALYSIS SWOT ANALYSIS

SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis is an extremely useful tool with which data is subjectively assessed and organized into a logical order. By identifying Strengths, Weaknesses, Opportunities and Threats associated with the Northeast Marine Management Area (NEMMA), it will be easier to identify appropriate measures for protecting the environment and specifically for addressing potential adverse impacts. In any SWOT Analysis, it is important to note that the categories are not mutually exclusive. It is quite possible for a single aspect to be associated with a strength and also with a threat.

7.1 SWOT Identification

The first step in the SWOT analysis involved an open discussion involving all members of the Study Team (except Ms. Cumberbatch) to identify Strengths, Weaknesses, Opportunities and Threats relevant to the NEMMA. Table 35 lists the results of the SWOT Identification. The remaining sections of this chapter each discuss one category.

TABLE 35: SWOT IDENTIFICATION

STRENGTHS	WEAKNESSES
NEMMA Management Plan	Lack of Policy Framework
Updated Fisheries Legislation	
Well-established Tourism Destination	
Buy-in by Stakeholders	Division of Responsibility
Level of Control over Development System	Lack of Management Structure
Protection of rare/endangered/ vulnerable species	Reef Quality
Internationally Recognised Research Destination	Presence of Industries
Sparsely Inhabited	Relative Ease of Accessibility
	Lack of Sufficient Patrols
	Private Islands seen as Development Potential

OPPORTUNITIES	THREATS
Harmonize MPA zones with existing Use	Hurricane / Surge Damage
Developers to Aid in Monitoring	Impaired Water Quality
NGOs as Researchers	Presence of Industries
Other employment for Fishers	Coastal habitat Destruction
	Reef Walking
	Spear Fishing

7.2 Strengths

The Strengths that are relevant to the NEMMA are discussed under the following headings:

- NEMMA Management Plan
- Updated Fisheries Legislation
- Well-established Tourism Destination
- Buy-in by Stakeholders
- Level of Control over Development System
- Protection of rare/endangered/ vulnerable species
- Internationally Recognised Research Destination
- Sparsely Inhabited

7.2.1 NEMMA Management Plan

A Management Plan for the NEMMA has been prepared by Mr. Ivor Jackson and is summarised in Chapter 6. Implementation of this Plan will assist in protecting the natural assets in the NEMMA many of which are presently under threat from over-use, ill-use and water pollution.

7.2.2 Updated Fisheries Legislation

The Fisheries Act and Fisheries Regulations have been revised (see Sections 2.2.1 and 2.2.2) which will give the Fisheries Division better, more effective control over the activities taking place within the NEMMA.

7.2.3 Well-established Tourism Destination

The attractive vistas offered by the rugged coralline islands of the northeast coast have attracted surging numbers of tourists each year, arriving on a number of day charter tour boats (Jackson, 2007). Additionally, anchorages in the vicinity of Non Such Bay and Great Bird Island have also become attractive among the yachting community. Over 200 tourists are expected to arrive on Great Bird Island each day via day tours. Studies estimate an average local crowd on weekends at Great Bird Island of about 70 persons, and a holiday crowd of up to 350 persons (Jackson, 2007). It was noted that there is a new large catamaran with a capacity of 125 people operating 5 days weekly, with extended full day tours (se Section 5.7.2.5).

International recognition of Antigua and specifically of the NEMMA as a tourist destination brings with it some level of respect. It is more likely that visitors to the region would obey the rules at an internationally recognized environmental asset (such as the NEMMA) than a relatively unknown asset. In like manner, it is more likely that local residents would treasure and protect an internationally recognized environmental asset than one which is only recognized locally.

7.2.4 Buy in by majority of stakeholders

The concept of a marine protected area in the north eastern areas has been around since the last 10 years (at least). In 1996, the concept of the Northeast Coast Management Area (NECMA) and Bird Island Marine Reserve and Wildlife Sanctuary was advanced by the Parham Harbour Facilitation Project, supported by the Organization of American States. Later, in 2003, a similar area of the North East coast was proposed to become a National Park site, an initiative which was not completed (Jackson, 2007).

As such the declaration of the NEMMA is acceptable to most stakeholders (see Section 5.8). These stakeholders include Management Agencies, Communities, Fishers, Tour Operators, Recreational Users, Private Developers and the General Public. Numerous meetings have been held with these stakeholder groups over the years by various NGOs (such as the EAG) and consultants. The most recent of these meetings have been held for different components of the OPAAL project (Jackson, 2007; Espeut, 2007) including this present assignment.

Jackson, 2007 from his discussions with stakeholder groups in formulating the Management Plan has noted that historically there has not been severe conflict between users and for years users have strongly supported the establishment of management guidelines for the area. This reflects a willingness to cooperate with each other and some stakeholder groups have even organized among themselves, promoting various forms of self-regulation and management, particularly in the tourism sector. Users have also worked together in voluntary conservation efforts, training workshops and management consultations and management agencies demonstrate good working relationships with area users who have willingly contributed to the management planning process. This level of acceptance of and commitment to the NEMMA is a benefit to the management effort.

Notwithstanding this there are conflicts with respect to land development and industrial uses within the NEMMA.

7.2.5 Government Control over Development

There is existing legislation which is enforced for the approval of new developments. The control of development is overseen by the Development Authority (DCA) and the Environment Division (see Section 2.5.3.1). The Physical Planning Act requires an environmental impact assessment (EIA) for certain types of developments, which are listed in the Third Schedule of the Act (see Section 2.2.8). Developers are required to make an application for planning permission to the DCA which is forwarded to the Environment Division for confirmation on whether or not an EIA is required and for the preparation of Terms of Reference (TORs). The Second Schedule identifies the matters for which provision may be made in Development Plans, including wildlife sanctuaries, national parks, environmental protection areas, marine parks, protection of historical and cultural objects, protection of forests, waste disposal and pollution prevention.

The National Physical Development Plan (DCA 2001):

- Proposes to ensure that all major tourism development proposals (including construction of hotels and associated facilities and additions to existing hotel rooms) are accompanied by objective environmental and social impact studies.

- Recommends that with respect to industrial development baseline studies be conducted and management plans be developed containing strict guidelines to regulate the discharge and disposal of industrial effluent and to monitor industrial plant activities to minimize the risk of contamination and other industrial accidents.
- Proposes that untreated effluent from domestic or industrial sources should not be discharged directly into drains, ponds or the sea.
- Proposes that where marine reserves are designated that development proposals within and surrounding these areas should be referred to the Fisheries and Environment Divisions for information and advise prior to confirmation of a decision.
- Recommends that significant mangrove sites be designated as conservation areas and these should not be cleared for construction and development proposals in and around these areas should be the subject of an EIA.
- Recommends that coastal sand dunes should be protected.
- Proposes setbacks for permanent coastal structures.
- Proposes that all development on the offshore islands and cays should reflect and be compatible with the requirements of a nature-based or eco-tourism industry, and that proposals for development of offshore islands be accompanied by an EIA.
- Proposes that facilities be provided to encourage the use of offshore islands and cays for bird watching, camping/picnics, out-door classrooms, etc. Such facilities should be detailed in environmental management plans prepared for the islands and cays.
- Proposes to phase out pit latrines in favour of properly designed and constructed septic tanks and soak pits and proposes the use of package sewage treatment plants for planned housing developments of more than 20 lots and new hotel developments of more than 20 rooms.

7.2.6 Protection to Rare / Endangered / Vulnerable Species

The relatively isolated nature of the off-shore islands (see Section 4.2) offer important habitats to many of these species, such as nesting sites for sea birds, and primary habitats for several endemics (see Section 4.6.2.3). Predator eradication from many of the islands and the relative inaccessibility of several islands makes them the best habitats for survival. The fact that these animals have been successful on the offshore islands does not mean that similar habitats on the mainland should not be protected. Some of the floral alliances on the islands are also endemic and may be uncommon and vulnerable (see Section 4.6.2.2).

7.2.7 Internationally Recognised Research Destination

The NEMMA is also recognized as a globally significant research and conservation site and as a refuge for endemic, rare and globally important wildlife including the critically endangered Antiguan racer snake (*Alsophis antiguae*), the hawksbill turtle (*Eretmochelys imbricata*), and the vulnerable West Indian whistling duck (*Dendrocygna arborea*) {Jackson, 2007}. Some offshore islands within the NEMMA are considered to be the last retreat for species that formerly existed in abundance on mainland Antigua. These species have attracted consistent research efforts aimed at habitat restoration and raising of awareness of the importance of these species (see Section 4.6.2).

This designation as a site for research and conservation is a powerful tool in ensuring that the establishment of the NEMMA as an MPA would receive favourable response from the international community. Again, it is more likely that visitors to the region would obey the rules once there is awareness of the endemism that exists in the NEMMA. In like manner, increasing awareness of the importance of the site for conservation will sell locals on the idea of establishing the NEMMA as an MPA.

7.2.8 Sparsely Inhabited

The NEMMA is located off the north eastern coast of the island of Antigua and comprises an area of over 30 square miles (see Section 4.1). Although there are several communities associated with the NEMMA (see Section 5.1.1), the population of these communities only represent 11.8% of the population of the entire island. Additionally, the NEMMA consists of numerous offshore islands approximately 13 of which are privately owned and uninhabited Long Island being the exception.

Although, there is evidence that some land-based activity is having a negative effect on the quality of the reefs in the NEMMA (see Sections 4.4.6 and 7.3.5), this problem would be far greater if the area had a larger population.

7.3 Weaknesses

The Weaknesses that are of relevance to the NEMMA are discussed under the following headings:

- Lack of Policy Framework
- Division of Responsibility
- Lack of Management Structure
- Reef Quality
- Presence of Industries
- Relative Ease of Accessibility
- Lack of Sufficient Patrols
- Private Islands seen as Development Potential
- Privately owned Islands earmarked for Conservation

7.3.1 Lack of Policy Framework

Gardner (2007) has concluded that Antigua and Barbuda does not have in place a comprehensive policy framework for protected areas development and management. As such, protected areas programming is being driven by sector and sub-sector needs rather than by any systematic planning process.

Some of the policy issues relating to the management of the NEMMA which need to be addressed include:

- Community management of resource assets and their use.
- Commercial activities within marine protected areas (for example leasing of the seafloor for activities such as stingray attraction).
- Wetlands management programme and integration of MEA obligations into a cohesive protected areas policy and plan.
- Watershed management (for example to control erosion, sources of pollution, etc).
- Ownership and development of the offshore islands.
- Industrial and tourism development along the northeastern coastline of the NEMMA.
- Emergency response (for example to oil, chemical and hazardous material spills, natural disasters, etc).

Additional recommendations are discussed in Section 9.1.

7.3.2 Division of Responsibility

There is at present no site management structure in place for the NEMMA (Jackson, 2007). As such resource management initiatives within the NEMMA (even before it was declared) over the last decade have been undertaken by a number of government, NGO and community agencies. Initiatives have been in the areas of:

- Conservation and Research (Fisheries Division, Forestry Unit, Environment Division, National Parks Authority, Ministry of Education, Environmental Awareness Group (EAG), community residents, local volunteers and the Antigua and Barbuda State College).
- Tourism and Recreation (Ministry of Tourism, Antigua and Barbuda Coast Guard, Antigua and Barbuda Marine Services, Development Control Authority, Tour Operators / Antigua and Barbuda Excursions Alliance, Powerboats Association, Offshore island recreational users, Hotels surrounding NEMMA, and EAG).
- Fishing (Fisheries Division, Antigua and Barbuda Coast Guard, Fishers / Fisherman's Alliance
- General Development. (Economic Planning and Policy Unit, Development Control Authority, Large private land owners such as Mill Reef Club and Jumby Bay

The National Physical Development Plan acknowledges that institutional coordination for protected areas development and management is lacking. Jackson (2007) and Gardner (2006) also emphasise the need for greater coordination, information sharing and general cooperation amongst management agencies; for capacity building among all resource management agencies; and for collaboration between agencies with overlapping responsibilities (see Section 2.6).

7.3.3 Lack of Management Structure

Although the NEMMA has been declared there is at present no management structure in place for the protected area (Jackson, 2007). The Fisheries Division with assistance from the Coast Guard continue to monitor the area and Jackson (2007) envisages that the Division will have ultimate responsibility for the management of the area in accordance with the Fisheries Act.

Without a formal management structure in place many of the activities being proposed in the draft Management Plan for implementation cannot proceed. It is therefore essential that the management arrangements as described by Jackson (2007) for the NEMMA be agreed and implemented as soon as possible.

7.3.4 Reef Quality

The following aspects of reef quality are discussed:

- Diseased coral/damaged coral
- Fish Populations
- Grounding and Anchoring Damage

7.3.4.1 Diseased Coral / Damaged Coral

The reefs of the NEMMA offer a diversity of habitats and great biodiversity, providing excellent snorkelling and diving. However, physical storm damage (associated with the passage of hurricanes and tropical storms), anchor damage, groundings, diseases, over-fishing and pollution have deteriorated the state of the reefs. Diseased coral heads are a common on the reefs, and include diseases such as black band disease, white banding, and bleaching (see Section 4.6.1.2).

Physical storm damage to the reef is immitigable, but other sources of physical damage (stemming from reef walking, spear fishing, over fishing, and anchor damage) can be controlled (or, if possible, eliminated). Further, the input of anthropogenic sources of organic pollution (land based and from yachts) on the reefs which promotes the growth of competitive alga, resulting in coral smothering can also be controlled.

Inadequate staffing and equipment have impeded the ability of the Coast Guard and Fisheries Division to monitor the reefs (see Section 7.3.3).

Mitigation measures are discussed in Section 8.3.1 and monitoring recommendations are discussed in 9.11.4.

7.3.4.2 Fish Populations

Reef fish are an essential component of the Antiguan marine ecosystem that supports commercial, recreational and aesthetic fisheries. The rate of mortality of these fish is increased by environmental stressors such as loss of habitat, deteriorating habitat and fishing. These stresses are ultimately reflected in adult populations (abundance, individual size and health). The tourism driven industry has also exacerbated the situation by placing more human demands of the fish populations and habitats (Richards and Bohnsack 1990).

Many reef species use inshore habitats as nursery and forage areas for part of their life history before moving out to reef habitats as adults e.g. groupers (Serranidae), snapper (Lutjanidae) and grunts (Haemulidae). However, fish populations noted during the ecological surveys (see Section 4.6.1.5) showed a significantly greater presence of juvenile fish and small adults e.g. parrotfish (Scaridae) suggesting depletion of fish stocks and hence the need for fisheries management policies to be implemented.

Mitigation measures are discussed in Section 8.3.4 and recommendations for fisheries management in Section 9.12.1.1.

7.3.4.3 Grounding and Anchoring Damage

The waters within the NEMMA contain numerous shallow reefs and sand bars (see Section 4.6.1.2). A history of severe hurricanes has resulted in the formation of shallow coral rubble shoals. Boatmen have indicated that many of these areas have not been mapped, and fewer have been marked, but the sites are common knowledge among those who use the areas regularly. This presents a potential threat to the safety of yachters and other boatmen who are unfamiliar with the waters.

The NEMMA is a multi-use area consisting of several environmental assets which are difficult to protect because of inadequate infrastructure (such as fixed moorings and markers) within the MPA making it difficult to protect these assets. Management regulations addressing safety are discussed in Section 9.2).

7.3.5 Presence of Industries

Industrial activity within a protected area is seen as a weakness as these industries generate wastes which are discharged into the protected area environment (see Section 5.2.11). With respect to the NEMMA, industrial activities are ongoing in areas adjacent to and within the watersheds draining into the NEMMA. These industries are sources of (in particular) water pollutants which can affect the quality of the waters of the NEMMA and hence the integrity of its marine resources. The industries at Crabbs are also serviced by a port which necessitates the maintenance of a shipping channel and basin and the traversing of the NEMMA by cargo vessels. The presence of ships within the NEMMA also opens up the problems of waste disposal and oil spills.

The National Physical Plan acknowledges the continued presence of industrial zones in these areas (see Section 5.5.2). Industrial activity of the present type is considered to be incompatible with the need to protect the integrity of the NEMMA. However if such activity must proceed in accordance with the country's proposed development plan, then very strict controls must be stipulated for the operation of the individual industries which must also be closely monitored by agencies such as the DCA, the Environment Division and the Central Board of Health.

Relevant mitigation measures are discussed in Section 8.2.4 and recommendations in Sections 9.4 and 9.5.3.

7.3.6 Relative Ease of Accessibility

Visitors both local and international have found the beaches and offshore islands within the NEMMA a popular recreational area. International visitors access the area on board yachts (see Section 5.2.5) or as members of tours or charters (see Section 5.2.4). While the number of charter that visit the site daily is not known, it is estimated that up to 300 persons visit the area daily during the peak season (Jackson, 2007). This number does not include visitors accessing the area by other means.

The majority of local visitors arrive by private powerboats, many camping overnight. Visitation to the islands is increasing steadily, perhaps more so on Great Bird Island than on other islands (Jackson, 2007).

Increase in visitor numbers can result in overcrowding, problems of waste disposal and water pollution. This relative ease of access has already resulted in a reduction in the quality of the reefs (see Section 4.6.1.2) as well as the beaches (see Section 4.6.2.1). Scientists have raised several concerns about carrying capacity levels on the islands and beaches, and potential impacts on wildlife habitats (Jackson, 2007). Additionally, several stakeholders are concerned about littering on the islands, which is unsightly and creates potential for rat re-infestation (Jackson, 2007).

Relevant mitigation measures are discussed in Sections 8.3.5 and 8.3.6 and recommendations in Section 9.5.2.

7.3.7 Lack of Sufficient Patrols

One of the potential weaknesses of the NEMMA is the lack of sufficient patrols. This is directly related to the limited number of personnel and equipment available to do so. Currently, through a collaborative effort between the Coast Guard Services and Fisheries Division, patrols are made in the NEMMA. There is as yet no agency whose sole responsibility it is to manage / monitor the NEMMA. The Management Plan proposed the designation of six wardens (see Section 6.4.3.1) and the Fisheries Division alluded to future plans to employ local fishermen as fisheries wardens to supplement that lacking personnel. Their knowledge and experience of the area will be a valuable asset to this initiative.

7.3.8 Private Islands seen as Development Potential

The majority of the offshore islands within the NEMMA are privately owned. Some land owners have opted for conservation (for example, Green Island). Others (such as at Long Island) although there is private development still promote a certain level of conservation through programmes such as the Jumby Bay Hawksbill Programme. Still others have undertaken development on islands such as Maiden Island which have caused damage. Development activities on the islands have the potential to cause adverse impacts on wetlands, island vegetation, inhabiting fauna, etc and should be strictly controlled.

Relevant mitigation measures are discussed in Section 8.4.7 and recommendations in Section 9.1.

7.3.9 Privately owned Islands Earmarked for Conservation

Land tenure can create quite a barrier in trying to establish a PA if the land owner is private and not inclined to cooperate. While this is recognized as a potential weakness the conservation efforts of some land owners must be acknowledged (see Section 7.3.9). The owner of Green Island has indicated the intention to comply with the designation of the island as a conservation zone. There is also developmental control legislature which is enforced by the DCA for new land development projects.

Relevant mitigation measures are discussed in Section 8.4.7 and recommendations in Section 9.1.

7.4 Opportunities

The Opportunities are discussed under the following headings:

- Harmonize MPA zones with existing Use
- Developers to Aid in Monitoring
- NGOs as Researchers
- Other employment for Fishers

7.4.1 Harmonize MPA Zones with Existing Use

At present, the NEMMA is accessed for the following uses:

- Fishing
- Diving and Snorkelling
- Beach Recreation and Swimming
- Kayaking and other Water Attractions
- Boat Tours
- Yachting
- Ferries
- Shipping
- Marinas and Jetties
- Industries
- Hotels
- Research, Awareness and Education

It is therefore imperative that the proposed zones for the NEMMA (see Section 6.6) should be harmonized with these uses. The zones proposed include:

- Conservation Zones,
- Recreation Zones,
- Fishing Priority Area Zones,
- Yacht Mooring Zones,
- Resort / Residential Zones,
- Port / Harbour Zones,
- Multiple Use Zones, and
- Local Area Management Zones

In the main, the zones proposed cover all the present activities occurring within the NEMMA. However, apart from specific reference to the discharge of wastewater associated with the Desalination Plant, no mention is made of a zone to include the other industrial activity at Crabbs Peninsula. The Zoning Plan as it evolves will also have to consider the proposed land use plan for the area as proposed by the DCA (see Section 5.5.2).

Relevant recommendations are discussed in Section 9.4.

7.4.2 Developers to aid in Monitoring

As noted in Section 5.6, there are established monitoring programmes for research on the Antiguan Racer (*Alsophis antiguae*) as well as on several species of birds. In the case of the Antiguan Racer, this monitoring has been facilitated by the developer/owner of Great Bird Island and the Jumby Bay Hotel facilitates the Jumby Bay Hawksbill programme on long Island. In a meeting held on February 23, 2007 to discuss the Management Plan for the NEMMA, hoteliers present at the meeting expressed their interest in liaising with the management of the NEMMA (when instituted) to report any infringements they may observe.

7.4.3 NGOs as researchers

The establishment of the NEMMA will engender an environment that supports continuous research and monitoring on the environmental assets found within it. Continuous assessment of the assets within the MPA is a necessary programme, which can be used to determine the success of the management plan and to determine whether the objectives are met. At present groups such as the Environmental Awareness Group (EAG) have been monitoring the status of the sea birds, sea turtles, mangroves, reptiles and vermin problem on mainland Antigua and offshore islands and this should be encouraged as an on-going beneficial activity.

Recommendations on monitoring of assets are discussed in Section 9.11 and livelihoods opportunities are discussed in Section 9.12.1.1.

7.4.4 Employment

The establishment of the NEMMA as an MPA is an excellent opportunity for the inclusion of the fishermen who may otherwise lose their means of livelihood in jobs associated with the Park and for other residents of the area who may be unemployed or seeking new job opportunities in the tourism sector. The fishermen would add their expertise and knowledge of the physical conditions of the NEMMA as well as the environmental assets. Some fishermen are already employed with a tour boat operator and the possibility exists for them to be trained as NEMMA wardens.

Recommendations on employment opportunities relating to the NEMMA are discussed in Section 9.12.

7.5 Threats

The threats to the assets in the NEMMA are discussed under the following headings:

- Hurricane / Surge Damage.
- Impaired Water Quality.
- Presence of Industries.
- Coastal habitat Destruction.
- Reef Walking.
- Spear Fishing.

These threats are mapped in Figure 16.

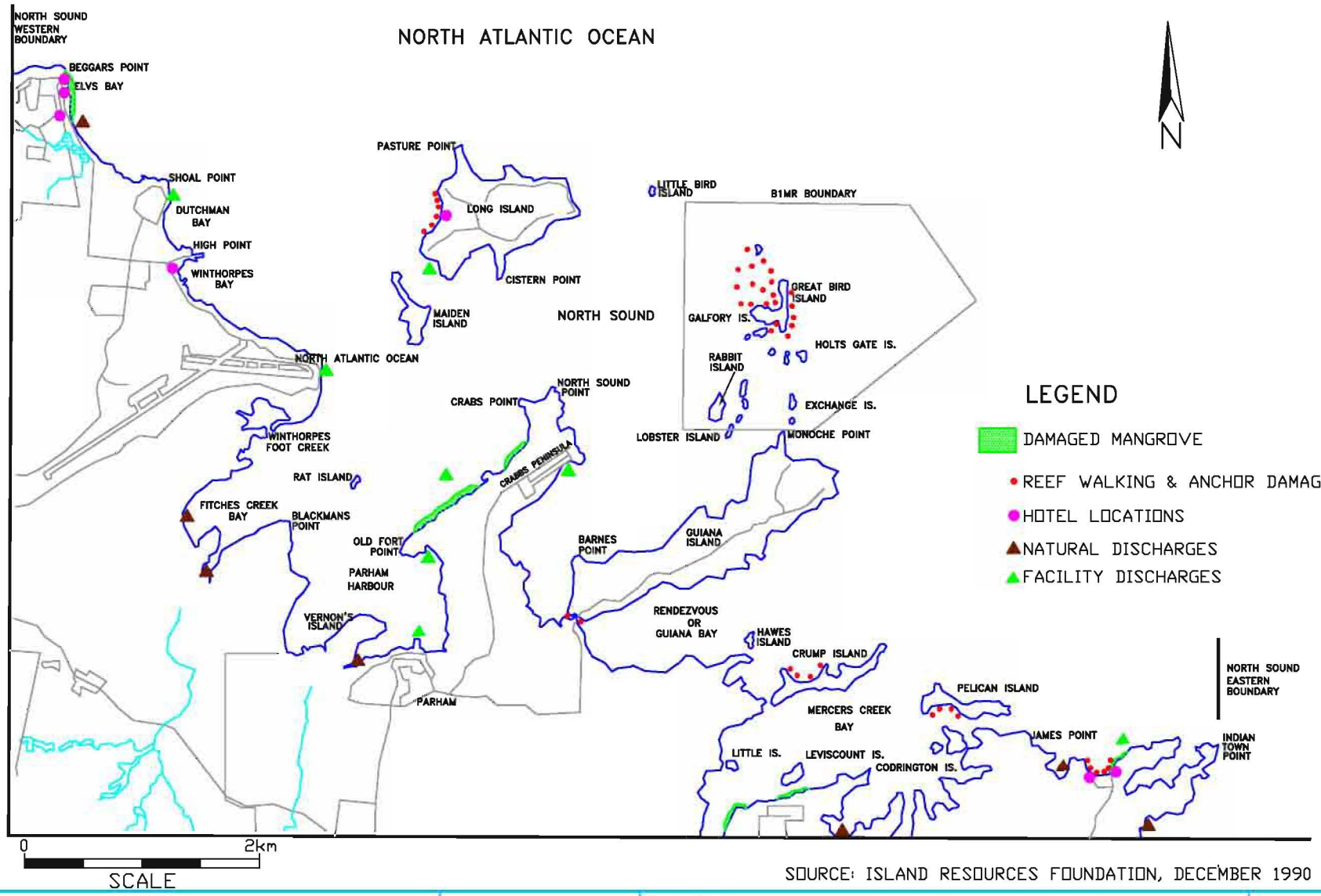
7.5.1 Hurricane/ Surge Damage

Antigua has a history of hurricane damage (see Section 4.4.1), and an increased incidence of hurricanes and tropical storms, experienced over the 15 years, has also had a deleterious effect on the coastal zone, reefs, plant and animal life and respective ecosystems of watersheds (Cooper et al 2001). Increased beach erosion may result in the loss of vulnerable ecosystems such as seagrass beds, mangroves and reefs. These tropical depressions could also result in infrastructural damage to coastal communities, fishing ports and facilities, hotels and resorts. While these extreme weather conditions will cause damage to reefs and wetland areas, their preservation will help mitigate against coastal destruction in such times. Following an extreme weather event it is important that a damage assessment of the resources in the NEMMA be conducted soon following the event and plans put in place for assisting in the recovery of the area.

Relevant mitigation measures are discussed in Section 8.2.2 and recommendations on disaster management in Section 9.5.5.

7.5.2 Impaired Water Quality

The continued deterioration of water quality in the NEMMA is a very real threat (see Sections 4.4.6 and 8.2.4). Poor water quality will result in the loss of the very resources that attract visitors to the area. Potential contributors to poor water quality include the following:



SOURCE: ISLAND RESOURCES FOUNDATION, DECEMBER 1990

Ecoengineering Caribbean Ltd.	Eco Report No. 10/2007	CLIENT: OECS -ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER 16
	Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
		DWG. NAME: ENVIRONMENTAL THREATS IN THE NEMMA	

- Discharges from Industries.
- Discharge of Sewage from Coastal Residences, Sewage Treatment Plants and Yachts and other vessels.
- Runoff from land-based Sources.

7.5.2.1 Discharges from Industries

As noted in Section 5.2.11, Crabbs Peninsula is considered an industrial area within the NEMMA. Again, no information on the discharges from these industries was available. As there are no local standards used to regulate the quality of the discharges, this is also potentially a source of pollution into the nearshore environment. There is evidence that such discharges are adversely impacting on assets with the NEMMA (See Section 4.6.1.4.3)

These discharges are mapped in Figure 17.

7.5.2.2 Discharge of Sewage

The discharge of sewage or effluent from sewage treatment plants into the NEMMA comes from hotels and restaurants, coastal residences and housing settlements within the adjacent watersheds, industries and yachts and other vessels operating in the NEMMA. These discharges have the potential for impacting adversely on water quality within the NEMMA which can in turn adversely affect other assets such as bathing water quality, seagrass beds and coral reefs..

Information gathered during field reconnaissance indicates that there are about nine hotels (some with restaurants on the same premises) within the study area with capacities ranging from 6 rooms to over 100 rooms (see Section 5.2.10). While no information was obtained on the type of sewage treatment used on their premises, there are indications that improperly treated sewage is discharged into the nearshore environment.

The three main settlements within the NEMMA are Parham, Seatons and Willikies. Information obtained from field reconnaissance indicates that there are central sewage systems that service these areas. Again, no information was received on the treatment

methods used or the discharges, however, improperly treated sewage from these systems are a potential source of pollution.

Most of the industries surrounding the NEMMA are equipped with sewage treatment plants some of which may be overloaded and/or malfunctioning. As a result there is the potential for incompletely treated sewage to be discharged into the waters of the NEMMA.

The wastes generated from yachts, cruise ships and charter boats can cause deterioration of the water quality and water clarity and by extension the reefs and other marine life.

Marine water quality concerns are not just confined to the NEMMA but must be recognized as a national priority (see Section 9.1).

7.5.2.3 Runoff from land-based Sources

Agricultural chemicals such as pesticides, herbicides and fertilizers are widely used in agricultural production (see Section 5.4). In some areas, agricultural production is carried out adjacent to surface water storage facilities and given the shortness of even the main watersheds, distances between most agricultural activity and water storage facilities are quite small, giving rise to concerns about possible contamination of the water sources, through chemical wash or percolation. The possibility is increased during heavy runoff (see Section 4.4.3).

The CBH has also undertaken a programme of monitoring water quality at several of the main beaches around the island. Details of analyses are not published but do provide the possibility to the authorities to detect problems of water pollution at an early stage.

Relevant mitigation measures are discussed in Sections 8.2.3 and 8.2.4 and recommendations in Sections 9.1, 9.5.3 and 9.11.1.

7.5.3 Presence of Industries

As noted in the Management Plan (Jackson, 2007), the following industries are located within the NEMMA:

- V.C. Bird International Airport
- Crabbs Electric Power Plant
- Crabbs Desalination Plant
- Crabbs Brewery
- Crabbs Slipway and Marina
- Crabbs U.S. Navy Communications Facility
- Piggot Quarry

Efforts to obtain information on the operations of these industries and in particular the discharges proved futile (see Section 3.5.2) but it is expected that several of them would have outfalls that eventually discharge into the NEMMA. In fact, during field reconnaissance at the site, the outfall of the desalination plant was observed to have a negative impact on the surrounding mangrove community (see Section 4.6.1.4.3).

The impact of these industries discharging into the marine environment is an inevitable decline in water quality (see Section 4.4.6). This is exacerbated by the fact that there are no local water quality / effluent standards applicable to the discharges of these industries. Additionally, since attempts to have meaningful dialogue with these industries proved difficult, no information is available on whether there is any individual internal monitoring at these industries.

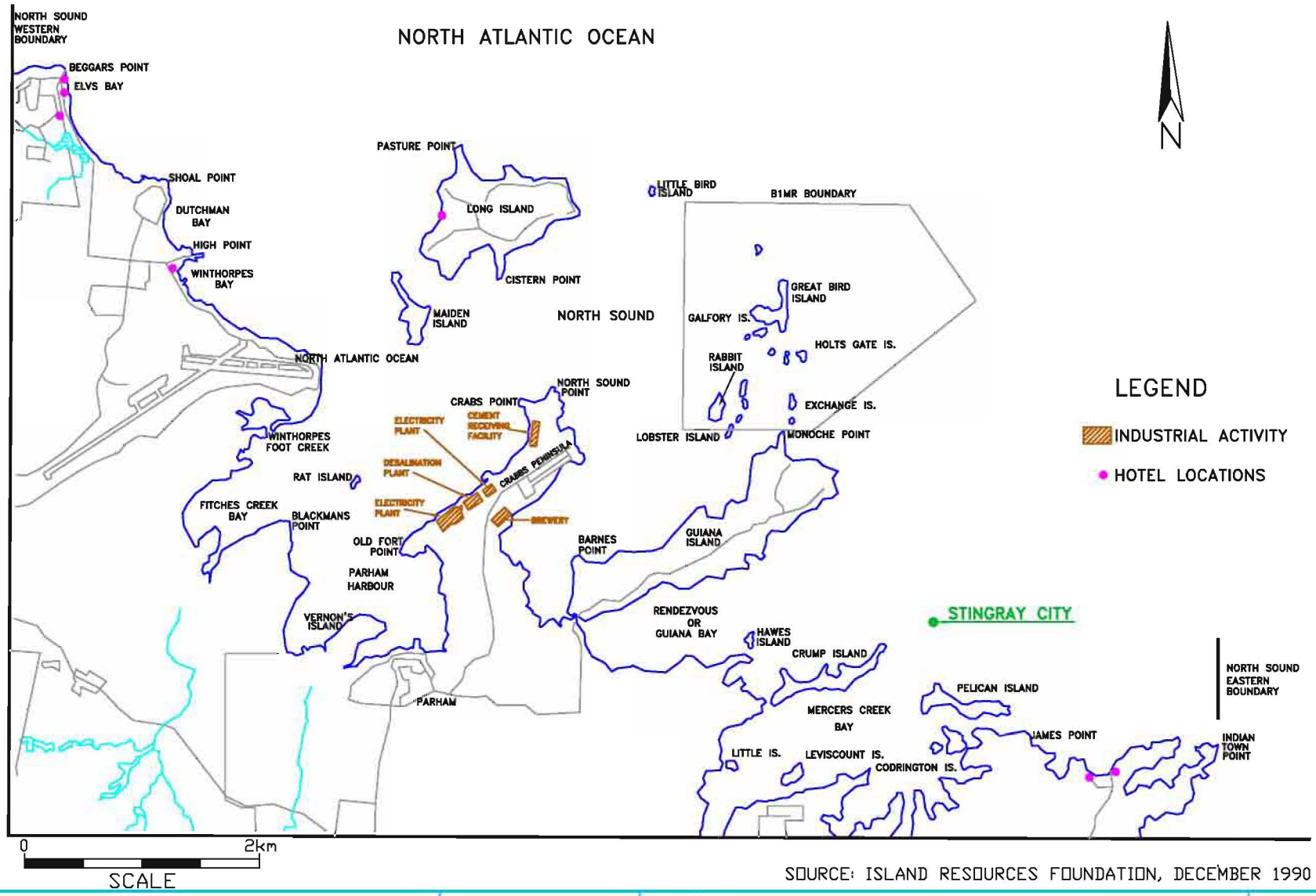
Relevant mitigation measures are discussed in Section 8.2.4 and recommendations concerning future studies on discharges from industries in Section 9.5.3.

7.5.4 Coastal Habitat Destruction

Coastal habitats that are in danger of being lost within the NEMMA include:

- Mangroves; and
- Beaches.

These are shown in Figure 16.



SOURCE: ISLAND RESOURCES FOUNDATION, DECEMBER 1990

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Eco Report No. 10/2007	CLIENT: OECS -ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER 17
Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
	DWG. NAME: LOCATION OF COMMERCIAL & INDUSTRIAL ACTIVITIES IN THE NEMMA	

7.5.4.1 Mangroves

Mangrove destruction comes about as a result of natural disasters (see Section 7.5.1) disease and human impact. In recent years there has been an increase the loss of mangrove areas for tourism related development. Fisheries officials indicated that at Long Bay there was a controversial clearing of a significant amount to mangrove trees for resort development. It was also claimed that the privately owned Maiden Island was "cleared" for tourism development and that the construction of a hotel at Emerald Cove also resulted in loss of mangrove. Wetlands have been particularly vulnerable to conversion to hotel and marina sites, with consequent loss of fish habitat and sedimentation protection for offshore reefs

Focus should be placed on public awareness of the importance of coastal ecosystems and effect their removal will have on coastal zone health.

Relevant mitigation measures are discussed in Section 8.3.2 and recommendations in Sections 9.7 and 9.11.2.

7.5.4.2 Beaches

The beaches of Antigua and Barbuda are perhaps the most valuable physical asset the country possesses (Cooper B. and Bowen V., 2001). There is no doubt that they are the major attraction for many of the tourists whose visits fuel the economy. Traditionally beaches have been threatened by sand mining and hotel development.

Although sand mining is more practiced on the West coast and on Barbuda there is the potential for mining on the beaches within the NEMMA. Hotel development on beach fronts without adequate setbacks has resulted in beach erosion (Cooper B. and Bowen V., 2001). Additionally, several beaches within the NEMMA are important turtle nesting sites (see Section 4.6.2.1). The loss of these beach areas could reduce the number of turtles that currently nest within the NEMMA.

Section 6.6.1 recommends a conservation zone which is proposed as an area where conservation of flora, fauna is a priority. This area is expected to include mangrove areas, nesting beaches, bird nesting areas and important seagrass areas.

Relevant mitigation measures are discussed in Section 8.3.5 and recommendations in Section 9.11.2.

7.5.5 Reef Walking

Many of the reefs within the NEMMA are relatively inaccessible to the general public and require boat transport. Shallow fringe reefs (1-2 m in depth) are found around several of the islands, which include Great Bird Island, Guiana Island, Pelican Island and Crump Island (see Section 4.6.1.2). As part of the recreation service offered by "Paddles" kayak and Snorkel Eco Adventure, the tour culminates with a day of leisure on Great Bird Island. Reef walking by snorkelers and sea bathers were observed on the reefs around Great Bird Island. Fisheries officers indicated that this is a persistent problem that is encountered in Antigua. This activity is difficult to control because of the absence of regular patrols. It takes several years for corals to recover from the physical damage as a result of reef standing or reef walking.

Relevant mitigation measures are discussed in Section 8.3.1 and recommendations in Sections 9.2, 9.4, 9.5.2, 9.7 and 9.11.4.

7.5.6 Spear Fishing

Fishing is a traditional activity within the NEMMA and except for the prohibition of spear fishing, there are currently no formal restrictions of this activity within the area. Several fishing methods are used, including fish traps, gill nets, trolling and even spear fishing (see Sections 5.2.2.4 and 5.7.2.1.3). Spear fishing in the vicinity of the coral reefs can result in physical damage to the corals. In other Caribbean Islands, it has been noted that spear fishing can also result in a change in the physical behaviour of the fish making them 'shy'. Additionally, excessive spear fishing will lead to diminished fish populations and, if unregulated, to a loss of the very fish species that snorkellers want to see (French Mission for Cooperation, 1995).

In several instances, spear fishing was observed in the shallow reefs off Pelican Island and Great Bird Island. In one instance the survey team was allowed to view the day's catch from a spear fisher. Target species include important grazers such as parrotfish (Scaridae), surgeonfish (Acanthuridae), grunts (Haemulidae) and groupers (Serranidae).

Relevant mitigation measures are discussed in Section 8.3.4 and recommendations in Sections 9.7 and 9.11.9.

8 ANALYSIS OF IMPACTS AND MITIGATION MEASURES

This chapter describes potential environmental impacts of the establishment of the NEMMA and the use of the resources on the natural and socio-economic environment. Both adverse and beneficial impacts are identified in this chapter along with appropriate mitigation measures. . For convenience, impacts are divided into the following:

i Impacts associated with the Natural and Physical Environment, and
ii Impacts associated with the Socio-Economic Environment.

The final section of the chapter is a summary of the classification of impacts.

8.1 Classification System

Impacts are classified on a systematic basis both before the application of mitigation measures as well as after the successful implementation of mitigation measures (see Section 3.8). Having established the significance of impact, it was classified on a structured basis. The Classification method (see Appendix B) was based on three criteria: extent, intensity, and nature. Based on this, impacts (both without and with mitigation) were classified as low, moderate or high. Where adverse impacts were considered to be insignificant, no classification was applied. The Classification of each impact is indicated in the respective sub-section of this chapter, and a summary of the Classification is provided in Section 8.5.

8.2 Impacts of the Physical Environment

While the implementation of the NEMMA will not affect the physical components of the environment these may have impacts on the NEMMA. Impacts of the following components of the physical environment on the NEMMA are discussed under the following headings:

- Other Protected Areas,
- Climate
- Drainage, and
- Water Quality.

8.2.1 Other Protected Areas

There is an existing public park at Long Bay and several proposed park reserves, marine parks, wild life sanctuaries, wild life reserves and beaches within the NEMMA (see Section 4.3). The marine areas of some of these proposed areas appear to have been incorporated within the NEMMA. Concern for impacts on the assets in the NEMMA arises if there is conflicting use or management of these other special use areas should they be declared.

The Management Plan makes the following provisions for addressing such potential conflicts and ensuring coordination of protected areas management within the NEMMA:

- Commission legal review and evaluation of statutory deficiencies adverse to the management of the NEMMA.
- Engage legal assistance to assemble and further draft a comprehensive package of management regulations governing various activities and uses in the NEMMA.
- Establish MOUs with stakeholder organizations, associations or individual service providers in partnership management in areas of monitoring, surveillance and environmental awareness.
- Design and execute a series of radio and TV public awareness programs for awareness building and education.

Once these measures are implemented, conflict in the use and management of multiple protected areas within the NEMMA is not expected to be significant.

8.2.2 Climate

Climate will not be affected by the NEMMA but extreme events such as hurricanes which may result in storm surge damage. Heavy rainfall which may occur during hurricanes as well as outside of extreme events may result in an increase in silt-laden runoff from surrounding areas into the marine area.

In the event of a hurricane the damage to marine and coastal areas may be inevitable depending on the characteristics of the event and cannot be mitigated. An Emergency Response Plan should be developed for the NEMMA which would include response to

natural disasters. The various elements of this plan should be activated once there is warning of an approaching hurricane. The draft Management Plan for the NEMMA at present does not address disaster planning and should be strengthened in this respect.

The rate and volume of run-off from surrounding areas (watershed and coastal) will be influenced by conditions such as presence of vegetative cover, steepness of slopes, presence of dams, etc. Discharge of watersheds along the north east coastline into the waters of the NEMMA is through mangroves which slow the flow and traps silt so reducing the silt load entering the NEMMA which can cause smothering of seagrass and coral (see Section 4.4.3). Without watershed and coastal protection the impact of heavy rainfall on the assets in the NEMMA is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Medium	Reversible	Moderate

Watershed protection and preservation of coastal mangroves measures are discussed in Sections 8.2.3 and 8.3.2. The Management Plan recommends incorporating regulations governing common practices such as:

- Vegetation clearing and removal;
- Excavation associated with road and building construction and related site works;
- Fertilizers and chemicals used for resort and residential landscaping; and
- Storm water drainage.

In addition, the plan recommends the following:

> **"Any person or company seeking to construct buildings or undertake any form of development as defined in the Planning Act in the NEMMA must submit a copy of the plans submitted to the Development Control Authority for Review and Approval of the NEMMA Office acting on behalf of the NEMMA Partnership."**

Given the fact that the watersheds which discharge into the NEMMA extend beyond the boundaries of the NEMMA, consideration should be given to extending this requirement to the Potworks and Parham watersheds which are dammed to provide potable water.

With these measures in place the residual impact of heavy rainfall on the assets in the NEMMA is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Minor	Reversible	Low

8.2.3 rainage

The watersheds which drain into the waters of the NEMMA are discussed in Section 4.4.3. The Potworks and Parham watersheds are dammed to provide potable water and water for crop irrigation. Mangrove wetlands provide the transition for freshwater exiting from the watersheds and its entry to the sea and the health of the mangroves depends in part on the maintenance of this flow of freshwater. The wetland system at Ayers Creek which is presently dominated by red mangrove was disturbed by the 1988 construction of a damn along Black Ghaut which caused a restriction in the flow of water.

There appears to be competition for freshwater from these watersheds for potable and agricultural use on the one hand and for maintenance of the health of the mangrove at the mouth of the points of discharge channels. These mangroves and wetland systems are an integral part of the NEMMA and are earmarked for conservation. Any drainage restrictions to the flow of freshwater flowing into these will result in further disturbance to these assets and their functions within the NEMMA.

If flow restrictions along the ghauts serving the coastal mangrove stands continue the impact of drainage on these assets of the NEMMA is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Minor	Reversible	Moderate

It is recommended (see Section 9.1) that the watershed management policy for the country should take into consideration the health of the wetlands on the northeast coastline which are fed by the relevant watersheds. The recommendation (in the Management Plan) for the review and approval of any developments within the NEMMA by the management of the NEMMA as well as the extension of the zone of influence to the nearby Potworks and Parham watershed is also applicable here. These measures will sustain the continued growth of the fringing mangroves at the mouth of the ghauts.

Once implemented, the classification of the impact of restricted drainage on the mangrove systems is expected to be:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

8.2.4 Water Quality

Threats to water quality are discussed in Section 7.5.2. There is acknowledgment by a number of regulatory agencies and literature sources that water quality in the NEMMA is poor (see Section 4.4.6). Although it has been reported that the CBH has undertaken a programme of monitoring water quality at several of the main beaches around the island details of these analyses are not published (Cooper and Bowen, 2001). Requests for water quality data relevant to the NEMMA were also made to the Environment Division and the Central Board of Health as part of this study but no results were forthcoming.

Industrial activity is concentrated in the Antigua north east (see Section 5.2.11) and significant agriculture is practiced in the watershed draining into the NEMMA (see Section 5.4). Water pollutants include sewage from residential areas, yachts and sewage treatment plants (high biochemical oxygen demand, nutrients and bacteria), industrial discharges (oil and grease, hot water and toxic chemicals), and runoff from surrounding watersheds (nutrients and sediments).

These pollutants are the cause of eutrophication, damage to corals, sea grass beds and mangrove within the NEMMA (see Sections 4.6.1.2, 4.6.1.4 and 7.5.2). That is they are the cause of damage to biological assets within the NEMMA. Protection of ambient water quality within the NEMMA is therefore critical to maintaining the integrity of the NEMMA.

If allowed to continue unabated the impact of impaired water quality on the assets in the NEMMA is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Major	Reversible	Moderate

The Management Plan has addressed water quality impacts within the NEMMA in the following manner:

- Implementation of a Zoning Plan (see Section 6.6) which designates zones into which discharge of wastewater and from the desalination plant will be allowed. The excepted zone is the Conservation Zone.
- Introduce and maintain erosion control measures for trails at Great Bird Island.
- Install an eco-type toilet facility on Great Bird Island.
- Collaborate with the Environment Division, the Development Control Authority and the Fisheries Division in monitoring marine impacts from development projects in the NEMMA.
- Design and implement an ongoing programme to monitor (with other partners) land based discharges from wastewater treatment plants and reverse osmosis plants.
- Monitor pollution changes to threatened, rare or endangered species.
- Engage legal assistance to assemble and further draft a comprehensive package of management regulations governing various activities and uses in the NEMMA.

Although zonation will prevent direct discharge of wastewater into the conservation area, it is more than likely that this area will still be affected because of oceanographic conditions. Complete prohibition or stricter controls are necessary to address this water quality concern. As discussed in Chapter 9, priority has to be given at a national level to:

- Develop standards for ambient marine water quality which will be used to help interpret monitoring results and identify problems, and
- Develop standards for effluents from sewage treatment plants, industry, agriculture and other sources against which effluent monitoring will be compared.
- Develop regulations which will allow the effluent standards to be enforced. Such regulations should stipulate monitoring of discharges by respective operators.
- Control and monitor watershed activities which would affect the quality of runoff from the watersheds. Such activities would include agricultural practices, earthworks, clearing of vegetation, etc.

Additionally periodic independent monitoring of marine water and effluent quality is recommended to verify the on-going, routine monitoring conducted by operators. The implementation of these measures is expected to bring about some improvement in water quality. However, there is not sufficient information about the oceanographic conditions (circulation, flushing, mixing patterns, etc) within the NEMMA. As such the residual impact cannot be determined at this time and is unknown.

8.3 Impacts on the Natural Environment

Impacts on the marine and terrestrial environment of the NEMMA are discussed under the following headings:

- Coral Reefs,
- Mangrove,
- Sea Grass Beds,
- Commercial Marine Species,
- Beaches,
- Flora, and
- Fauna.

8.3.1 Coral Reefs

The reefs within the NEMMA consist of a series of coral patches, reef crests and one horseshoe reef (see Section 4.6.1.2). Reef crests and the horseshoe reefs are found in deeper waters, whereas in shallower and more inshore areas coral patches dominate. Concerns regarding the status of coral reefs are discussed in Sections 7.3.4.1 and 7.3.4.3 and threats to this asset are discussed in Sections 7.5.1 and 7.5.5. Historical baseline studies of the reefs within the North Sound area concluded:

- Most hard corals in shallow waters are dead (IRF 1997, Goreau et al 1996),
- Deeper reefs tended to be healthier (IRF 1997, Bunce, 1995),
- There has been a significant deterioration of the hard and sort corals with replacement of marcoalgae and seagrass (IRF 1997), and
- Some reefs are showing considerable signs of stress (CIDA 1988).

Eutrophication and pollution from sewage discharge are frequently cited as concerns, despite some improvement in the maintenance by hotels of their sewage treatment plants (Cooper et al 2001). Stressors on the reef include physical storm damage (associated with the passage of hurricanes and tropical storms), anchors, sedimentation and fishing gear, as well as from white-band disease, other diseases, and localized nutrient pollution from yachts (Wells, 1988; Smith et al, 1997). Hurricane Hugo in 1989 and Hurricanes Luis and Marilyn in 1995 caused extensive damage to reefs on the south and southeast coasts of Antigua, particularly to *Acropora sp*. on shallow reefs. (Smith et al. 1998). Fishermen who were interviewed (see Section 5.7.2.1) felt that hurricanes had most

affected the reef and that the most common changes which they had observed were reef breakage and decrease in water clarity.

Without minimizing or eliminating any of the stressors (in particular those of anthropogenic origin) which are affecting the coral reefs the classification of the impacts on the coral reefs in the NEMMA is expected to be:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Major	Irreversible	High

The Management Plan identifies the following measures for addressing this impact:

- Implementing a Zoning Plan which prohibits activities such as anchoring and mooring of yachts and tour boats which are one cause of coral reef damage from certain zones while allocating designated areas for such activities, as well as for dredging, excavation, etc (see Section 6.6).
- Work towards building stakeholder support for prohibited activities defined by zones of the Zoning Plan.
- Design, construct and deploy boundary buoys for zones to help manage uses as prescribed in the Zoning Plan.
- Design, construct and deploy fixed moorings for tour boats and yachts to implement no anchor regulations and reduce anchor damage.
- Work with Fisheries Division and the Antigua & Barbuda Fisheries Alliance in seeking government approval on limits in the export of parrot fish.
- Strengthen collaborative procedures with Customs to monitor exports of parrot fish.
- Devise and implement a plan to gather reliable data on levels of resource uses in the NEMMA: ships, yachts, tour boats, kayaking, fishing.
- Design and implement a monitoring programme for selected reef areas with high levels of recreational snorkelling or diving in collaboration with tour operators.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Commission & deploy facilities & equipment for surveillance & enforcement (including patrol boats, VHF radio).
- Submit draft legislation providing appropriate authority to NEMMA Wardens.
- Design and execute a series of radio and television public awareness programs for awareness building and education.

- Have NEMMA brochures and Fact Sheets designed and published for specific target groups including tourists, other visitors to the NEMMA, school teachers and children.

Additionally, fishermen proposed the following measures to protect the quality of the reefs during interviews for this study (see Section 5.7.2.1.5):

- Spear fishers should be given a seasonal period to fish.
- Proper mooring should be provided for yachts.
- Provide proper waste disposal facilities for tourists using the area.
- Zoned management.

Tour boat operators agreed that making the reef a protected area would have a positive impact on it, if properly managed (see Section 5.7.2.5.3). They suggested the following measures for protecting the NEMMA:

- Zoned management.
- Proper supervision and policing of the area.
- Installation of facilities on Great Bird Island to prevent garbage build-up.
- Installation of reef markers so boats and yachts would not run aground, resulting in further damage to the coral.
- Restrictions on fishing.

Finally, the tourists interviewed suggested that a rotational system should be implemented for activities such as snorkelling and diving (see Section 5.7.2.3.4).

Monitoring of coral reefs around Antigua is currently carried out by international research agencies such as ENCORE and consideration should be given to collaborating with such agencies when designing and implementing reef monitoring programmes for the NEMMA (see Section 9.11.4).

Areas already damaged (broken or diseased) cannot regenerate and are permanently lost (that is, the impact is irreversible). New areas of coral growth can be encouraged through improving water quality, maintaining an optimum herbivore fish population and creating new habitats such as artificial reefs. The residual adverse impact on the coral reefs is unknown.

8.3.2 Mangrove

There are over 240 ha of mangroves and associated wetlands occurring in the NEMMA. (see Section 4.6.1.4.1). Within the last two decades the mangroves of Antigua have been severely affected by hurricane damage, as well as coastal development (see Section 7.5.4.1). Historical damage to the mangroves within the NEMMA include:

- Localised mangrove die back along the eastern part of the Parham harbour just west of Crabb's peninsula due to effluent discharged from the desalination plant (see Section 4.6.1.4.3).
- Clearing of fringing mangrove at Mercers Creek in the localized area close to Seatons for housing and development (see Section 4.6.1.4.4).
- Clearing of mangrove at Ayers Creek in 1988 for the damming of the Black Ghaut (see Section 4.6.1.4.6).
- Damage of the mangroves at Elys Bay and Green Island by various hurricanes over the last 12 years (see Sections 4.6.1.4.7 and 4.6.1.4.10).
- Finally, mangrove was destroyed at Emerald Cove during the construction of a hotel.

Additionally, some residents made the link between loss of mangroves and the deterioration of the coral reefs (see Section 5.7.2.7).

Without any mitigation measures the classification of impacts on the mangrove assets of the NEMMA is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Minor	Reversible	Low

Measures proposed in the Management Plan for addressing impacts to mangroves within the NEMMA include:

- Implementation of a Zoning Plan (see Section 6.6) which designates all mangrove areas for conservation. Activities permitted in these zones will include research, surveillance, sediment sampling, and hurricane shelter for yachts/boats. Hiking and camping will be allowed by exception.

- Map and measure all mangrove areas of the NEMMA as the basis for monitoring changes.
- Work towards building stakeholder support for prohibited activities defined by zones of the Zoning Plan.
- Collaborate with the Environment Division, the Development Control Authority and the Fisheries Division in monitoring marine impacts from development projects in the NEMMA.
- Design and execute a series of radio and television public awareness programs for awareness building and education.
- Have NEMMA brochures and Fact Sheets designed and published for specific target groups including tourists, other visitors to the NEMMA, school teachers and children.
- Design, construct and deploy boundary buoys for zones to help manage uses as prescribed in the Zoning Plan.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Commission & deploy facilities & equipment for surveillance & enforcement (including patrol boats, VHF radio).
- Submit draft legislation providing appropriate authority to NEMMA Wardens.

In addition it is expected that under the Physical Planning Act and according to the proposed land use plan for the north east coast, the Development Control Authority will not authorize projects which will impact negatively on the mangrove in the NEMMA (see Sections 2.2.8, 2.5.3.2 and 9.6). Monitoring recommendations are also discussed in Section 9.11.2.

Once the above measures are implemented, the residual impacts on the mangroves can be classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Very Small	Reversible	Low

8.3.3 Sea Grass Beds

Seagrass beds were common to the shallow lagoons formed within the NEMMA, such as at Mercers Creek, Ayres Creek and off the coast of Guiana Island) (see Section 4.6.1.3). Important sea grass beds exist along the northern coast of Long Island and off Mills Reef where hawksbill turtles are known to feed and nest. They provide important feeding grounds, shelter and breeding areas for several species of fish, sea turtles, spiny lobsters and other marine organisms (see Section 4.6.1.3). However recreation activities on the island beaches are a constant source of stress for this habitat (GEF 2004). The dragging of anchors, accidental groundings and intentional pulling of boats onto beaches have all impacted on sea grass beds. Sea grass beds are further threatened by impaired water quality (see Section (8.2.4) and increased silty run-off from inland and coastal development.

The classification of existing impacts on the seagrass within the NEMMA before any mitigation measures are implemented is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Very Small	Reversible	Low

The Management Plan identifies several measures to address negative impacts affecting sea grass beds. They include:

- Implementation of a Zoning Plan (see Section 6.6) which prohibits activities such as anchoring and mooring of yachts and tour boats (causes of sea grass damage from certain zones while allocating designated areas for such activities), as well as for dredging, excavation, etc.
- Design, construct and deploy fixed moorings for tour boats and yachts to implement no anchor regulations and reduce anchor damage.
- Devise and implement a plan to gather reliable data on levels of resource uses in the NEMMA: ships, yachts, tour boats, kayaking, fishing.
- Design and implement a monitoring programme for selected sea grass areas with high levels of recreational snorkelling or diving in collaboration with tour operators.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Commission & deploy facilities & equipment for surveillance & enforcement (including patrol boats, VHF radio).
- Submit draft legislation providing appropriate authority to NEMMA Wardens.

Recommendations on monitoring of this asset are also discussed in Section 9.11.3.

With these measures in place there will be insignificant residual adverse impacts on seagrass in the NEMMA.

8.3.4 Commercial Marine Species

51 species of fish fauna were noted during the survey and 22 other species of fauna excluding corals (sponges, echinoderms, sea worms, cnidarians, and molluscs). Fish, lobsters and conchs have been traditionally fished in the NEMMA and continue to be exploited recreationally within the NEMMA. The threats to this asset are discussed in Section 7.3.4.2.

The results of a 2005 coral reef survey in the North Sound (Brandt, et al., 2005) show a relatively healthy benthic community but an unhealthy and disturbed fish community. The study concluded that the fish community is severely under-populated relative to the potential provided by the amount of available habitat in the North Sound area. These low abundances could be due to multiple factors, including increased adult mortality due to fishing pressures, as well as potentially a lack of larval fish supply from nearby reef areas. The unsustainable exploitation and degradation of marine biological resources and habitats from over-fishing and improper fishing practices are problems facing Antigua's fisheries. Fishermen who were interviewed (see Section 5.7.2.1) also noted a decline in fish and fish nurseries. Water quality and its impacts on assets in the NEMMA were discussed in Section 8.2.4 and these discussions are applicable to the commercial fisheries.

The classification of existing impacts on the fisheries within the NEMMA before any mitigation measures are implemented is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Medium	Reversible	Moderate

The following measures proposed in the Management Plan would reduce the adverse impacts on fisheries in the NEMMA:

- Zoning of the NEMMA which includes Fishing Priority Areas designated to sustain fishing without conflicts from other users, Local Management Areas and Multiple Use Areas (see Section 6.6). None of these areas are within the Great Bird Island Core or the Green Island Core as proposed in the Plan. The Plan also provides for pot, line and net fishing in fishing priority and multiple use areas and line fishing only (by exception) in recreation and yacht mooring zones.
- Zonation which designates important fisheries nursery areas as "no-take" zones for conservation. Activities permitted in these zones will include research and surveillance.
- Zonation which prohibits activities such as spear fishing, trawling and other destructive fishing methods within the NEMMA.
- Devise and implement a plan to gather reliable data on marine resources used in the NEMMA.
- Design and implement a monitoring programme for important fisheries areas with high levels of recreational snorkelling or diving in collaboration with tour operators.
- Increase the number of wardens and therefore patrols to enforce proposed zonation.
- Conduct reef fish population and community assessments, monitoring programs must collect abundance and size-frequency distribution data for distinct fish taxa. Concurrently collected data on benthic habitat and water quality are desirable as well, and can be assimilated in a survey design to improve survey performance
- Work with Fisheries Division and Antigua/Barbuda Fisheries Alliance in seeking government approval on limits in the export of parrot fish.
- Strengthen collaborative procedures with Customs to monitor exports of parrot fish.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Provide guidance in the use of fish aggregation devices (FADs) to enhance the productivity of the marine environment in appropriate areas of the NEMMA.

Espeut (2006) who feels that there is a decline in the fisheries sector in the north east suggested that this decline could be reversed by putting appropriate fisheries management strategies in place and enforcing the following measures:

- A ban on destructive gear (including seine nets).
- A ban on small mesh in nets and traps.
- A ban on SCUBA or hooka.
- No-take zones.
- Closed seasons on certain species such as lobster and conch.
- A system of limiting new entrants into the fishery.
- Effluent discharge standards to protect fish habitat.

One section of the questionnaire used to interview stakeholders within the NEMMA requested responses on issues relating to the importance of coral reefs, seagrass beds etc. The findings identified in Section 5.7.2.7 are important in identifying the feelings of stakeholders to the assets within the NEMMA. Key findings applicable to commercial marine species included:

- 92% of respondents disagreed with the statement that coral reefs are only important if you fish or dive.
- 94% of respondents disagreed with the statement that fishing would be better if corals were cleared.
- 92% of respondents agreed that fishing should be restricted to certain areas just to allow the fish and coral to grow.
- 85% of respondents agreed that we should restrict development in some coastal areas even if no one ever fishes there just to allow the fish and coral to grow.

From the above it is clear that the majority of stakeholders have a clear understanding of the importance of the environmental assets within the NEMMA. The challenge is therefore to educate them on their role in ensuring that these assets are not further degraded.

Implementation of these measures as well as enforcement of the provisions of the Fisheries Act, 2007 and related regulations and mitigation measures for addressing water quality (see Section 8.2.4) will reduce the adverse impacts on the fisheries in the NEMMA. Recommendations relating to the fisheries are also discussed in Chapter 9.

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Minor	Reversible	Low

8.3.5 Beaches

One of the greatest attractions to Antigua and Barbuda is the sandy beaches. There are several popular beaches within the NEMMA which are utilized by tourists and locals specifically on and around Prickly Pear, Guiana Island, Long Island, Maiden Island, Great Bird Island, and Green Island (see section 4 6.2.1). Many of these sandy beaches depend on coral reefs and algal beds for a constant supply of base material. They also provide recreation and nesting sites for marine turtles.

The beaches within the NEMMA are under threat from oceanic erosion, hotel development and to a lesser extent sand mining. In addition, in areas where hotels have been developed where no beach exists, artificial beaches have been created (see Sections 7.5.1 and 7.5.4.2). This may lead to a disturbance of littoral drift processes as well as the natural erosion and accretion cycles along the shoreline.

Interviews with the tour boat operators also indicated that the beaches on Great Bird Island are under threat due to the disposal of solid waste (see Section 5.7.2.5.2).

The present impact on the beaches in the NEMMA is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Minor	Reversible	Low

The Management Plan proposes the following activities which would result in minimizing human impacts on the beaches in the NEMMA:

- Implementation of a Zoning Plan (see Section 6.6) which designates all nesting beaches as conservation areas.
- Encourage the use of beaches on other islands apart from Great Bird Island such as on Green Island.
- Undertake carrying capacity studies to determine the maximum allowable number of visitors on the beaches within the NEMMA at any point in time.
- Work towards building stakeholder support for prohibited activities defined by zones of the Zoning Plan.
- Establish MOUs with stakeholder organizations, associations or individual service providers in partnership management in areas of monitoring, surveillance and environment awareness.
- Devise a mechanism to collaborate with the Environment Division, the DCA and the Fisheries Division in monitoring marine impacts from development projects in the NEMMA.
- Design and execute a series of radio and TV public awareness programs for awareness building and education.
- Have NEMMA brochures and fact sheets designed and published for specific target groups.

The beaches in the NEMMA can also be protected by enforcing the provisions of the Physical Planning Act (see Section 2.2.8), the Beach Control Act, and the Beach Protection Act (see Section 2.2.10)and associated regulations. The Fisheries Division has been monitoring some 25 beaches around Antigua and Barbuda noting changes in profile area and width. These include beaches within the NEMMA at Jabberwock Bay, Dutchman Bay and Long Bay (James, 2003) (see Section 4.6.2.1). This should be continued and perhaps expanded to include more of the critical beaches in the NEMMA.

With these mitigation measures the classification of the residual impacts on the beaches in the NEMMA is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Very Small	Reversible	Low

8.3.6 Vegetation

The dominant flora present in the NEMMA was described from information documented in a Vegetation Classification of Antigua-Barbuda-Redonda (Kevel Lindsay and Brian Horwith 1997, see Section 4.6.2.2). Terrestrial vegetation while it is not included in the definition of the NEMMA are none the less of importance to the integrity of the area. Clearing of terrestrial vegetation in watersheds and on the offshore islands may result in land erosion and siltation of the surrounding waters. The vegetation on the offshore islands is also important to those ecosystems which are an attraction of the NEMMA. Therefore terrestrial vegetation is also of relevance to the NEMMA.

Clearing of vegetation in areas which are of relevance to the NEMMA occurs for agriculture, tourism related developments (resorts, hotels etc) and private development and housing. While few of the floral alliances found on the offshore islands are considered stable the majority are described as vulnerable (even though they may be common in some cases) due to coastal development while other alliances are described as uncommon.

The present impacts on terrestrial vegetation are classified as Extreme because several of the floral alliances are endemic to Antigua and some of them to the offshore islands and are therefore considered environmentally sensitive.

The following proposed measures in the Management Plan would help protect the terrestrial vegetation in the NEMMA:

- Designate all islands within the Great Bird Island and Green Island Core areas of the Zoning Plan for conservation (see Section 6.6).
- Work toward building stakeholder support for prohibited activities defined by zones in the Zoning Plan.
- Commission legal review and evaluation of statutory deficiencies adverse to the management of the NEMMA.
- Devise a mechanism to collaborate with the Environment Division, the DCA and the Fisheries Division in monitoring marine impacts from development projects in the NEMMA.
- Design and execute a series of radio and TV public awareness programs for awareness building and education.

- Have NEMMA brochures and fact sheets designed and published for specific target groups.
- Regulate activities of camping and other land-based recreation.

Damage to terrestrial vegetation which may result in adverse impacts on the assets in the NEMMA can also be minimized by enforcing the provisions of the Forestry Act (see Section 2.2.5)and the Physical Planning Act (see Section 2.2.8).

With these measures the classification of the residual impacts on terrestrial vegetation is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

8.3.7 Fauna

As noted before (see Section 4.2), the portions of the offshore islands above the high water mark were not included in NEMMA as it was defined. The offshore islands are however an important aspect of the attraction of the NEMMA and are therefore of relevance. These islands are home to a number of faunal species that are considered rare or endangered (see Section 4.6.2.2). The isolated nature of the off-shore islands offer important habitats to many sea birds, sea turtles and other reptiles such as the Antiguan Racer and the Antiguan ground lizard. The major threats facing these species include the loss of habitat, invasive species and hunting. Several conservation initiatives on the offshore islands over the last decade include an invasive predator species eradication programme, a programme to reintroduce the Antiguan Racer Snake and monitoring of the hawksbill turtle have benefited these species (see Section 5.6).

The present impacts on the fauna of the offshore islands are classified as Extreme because several of the faunal species are considered environmentally sensitive.

The Management Plan proposes the following measures for minimizing the impacts on the offshore island fauna:

- The Zoning Plan designates the islands within the Great Bird Island Core and Green Island Core as conservation areas with some recreational use.

- Work towards building stakeholder support for prohibited activities defined by zones in the Zoning Plan.
- Engage legal assistance to assemble and further draft a comprehensive package of management regulations governing various activities and uses in the NEMMA.
- Monitor population changes to rare, endangered or vulnerable species.
- Install prohibitive signage to prevent visitors from trespassing in sensitive Antiguan Racer Snake habitat areas, and critical bird nesting on Great Bird Island.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Establish MOUs with stakeholder organizations, associations or individual service providers in partnership management in areas of monitoring, surveillance and environmental awareness.
- Establish visitor information points/centers at selected points of the NEMMA.
- Design and execute a series of radio and TV public awareness programs for awareness building and education.
- Have NEMMA brochures and fact sheets designed and published for specific target groups.

In addition to these measures, enforcement of applicable legislation such as the Wild Birds Protection Act (see Section 2.2.9) and the Physical Planning Act (see Section 2.2.8) and meeting the requirements of international treaties pertaining to terrestrial fauna to which Antigua and Barbuda are signatory will assist in protecting the fauna on the offshore islands in the NEMMA. Recommendations for monitoring of this asset are discussed in Section 9.11.

With these mitigation measures the impacts on the fauna of the offshore islands are classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Minor	Reversible	Low

8.4 Impacts on the Socio-Economic Environment

The socio-economic environment in the NEMMA was described in Chapter 5. Approximately 11.8% (representing just over 7500 persons) of the national population reside in the 22 communities adjacent to the NEMMA. There is no significant difference in unemployment between the NEMMA and the country or between genders. The majority of persons are employed as various types of professionals, technicians, clerks, machine operators, craftsmen and service workers; only 1.1% are employed in agriculture and fishery. Impacts of implementing the NEMMA on the following components of the socio-economic environment are discussed under the following headings:

- Fishers,
- Divers,
- Tour Operators,
- Vendors,
- Water Sporting,
- Hotels,
- Industries,
- Agriculture,
- Research, and
- Land Use.

8.4.1 Fishers

There are approximately 132 fishers and 53 registered fishing boats operating out of seven fish landing sites within the NEMMA (Emerald Cove/Willikies, Mill Reef, Beachcomber, Shell Beach, Fitches Creek, Parham and Seatons). There is however no available documented information about the number of fishers who actually fish in the waters of the NEMMA (see Section 5.2.2).

Limited interviews were conducted with fishermen at these landing sites (see Section 5.7.2.1). These were all main income earners with dependants. They owned their own licensed boats fishing in the NEMMA for over sixteen years (at varying frequencies). Most felt that catch size had not changed or had improved over the years.

Espeut (2006) concluded from his assessment of the livelihood of fishers in the NEMMA that the fisheries sector in northeast Antigua is in slow but appreciable decline. Some of the related reasons include overfishing and habitat destruction. There may be other economic reasons contributing to the declining fisheries but these are outside the scope of this present study. However it was noted during the course of interviews with tour boat operators (see Section 5.7.2.5) that a significant number of them were once fishermen. Boat trips have a high commercial value with costs of tours ranging from US$40.00 per person to US$1200 for day charters (Jackson, 2007). Financially tour boating may therefore be more lucrative than fishing. Some fishers also have alternative skills to which they can turn (see Section 5.7.2.1.1).

From the information gathered the present impacts on fishing as a means of livelihood in the NEMMA relate to the availability of fish stocks and the opportunity of alternative forms of more lucrative means of employment (such as tour boating) and are classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

The Management Plan proposes measures for addressing the management of the fisheries (see Section 6.4.1 and 6.6) and these should improve the sustainability of the resource to support fishermen who are desirous staying in the sector. The Plan does not seek to exclude fishermen from the NEMMA (as is true in other protected areas in the region) but rather proposes the following measures for encouraging and monitoring fishing:

- Fishing Priority Areas designated to sustain fishing without conflicts from other users. The Plan also provides for pot, line and net fishing in fishing priority and multiple use areas and line fishing only (by exception) in recreation and yacht mooring zones.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Devise and implement a plan to gather reliable data on levels of resource uses in the NEMMA (including fishing activities).
- Provide guidance in the use of fish aggregation devices to enhance the productivity of the marine environment in appropriate areas of the NEMMA.
- Plan and manage discussions leading to decisions on revenue options to be pursued, along with user fees and license to be charged for operating in or using the NEMMA.

Additional information on the impact of the establishment of the NEMMA on the livelihoods of fishermen is included in Section 9.12.1.

Regulation of fishing in the NEMMA will continue under the Fisheries Act and subsidiary regulations and then by the new expanded fisheries legislation when these are enacted. A draft Fisheries Development Plan for 2006 - 2010 is also to be implemented and this discusses measures for institutional support to the fisheries sector.

When these measures are implemented there should be a beneficial increase in the opportunity for fishing as a livelihood not only within the NEMMA but at the national level.

8.4.2 Diving/Snorkelling Operators

There are no dive shops in the communities adjacent to the NEMMA (Espeut, 2006) but divers and snorkellers do visit the area (brought there by tour boat operators and hotels) (see Sections 5.2.3 and 5.7.2.5.2).

Espeut (2006) suggests that there is an opportunity for dive shops in the NEMMA as the tourism sector develops in the north east. The Management Plan in fact proposes to arrange to have NEMMA profiled in relevant user targeted publications and websites which would increase interest in and numbers of visitors to the area.

It must be noted that the continued use of the NEMMA for sustaining diving and snorkelling operations is of course dependent on maintaining the integrity and quality of the asset and that some of these impacts are caused by the very diving and snorkelling. Measures for addressing the adverse impacts on the assets in the NEMMA are discussed in Section 8.3.

The Management Plan proposes measures for addressing livelihood development and sustainability designed to support and develop compatible uses within the NEMMA and provide education and technical support to micro-enterprises and these would apply to diving and snorkelling operations. These are further described in Section 9.12.1.

Implementation of all of these measures should provide opportunities for the opening of dive shops in the northeast where at present there are none.

8.4.3 Tour Boat Operators

There are about eighteen boating excursion companies operating within the NEMMA (Jackson, 2007) and boating tourism appears to be the most intensive use of the area. Based on interviews with tour boat operators (see Section 5.7.2.5) they are all male and a significant number are from Seatons and Willikies which are communities adjacent to the NEMMA. It appears that some of these operators were once fishermen.

Present tour boat operations as a means of livelihood in the NEMMA may be adversely affected by impacts on the assets, some of which are caused by these very operations and their patrons. These impacts are discussed in Section 8.3

Without the NEMMA management plan in place the livelihoods of these tour boat operators will be threatened as the quality of the assets continue to be degraded. This impact is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
National	Very Small	Reversible	Low

Measures to address impacts on the assets in the NEMMA are discussed in Section 8.3. The Management Plan proposes measures for addressing livelihood development and sustainability designed to support and develop compatible uses within the NEMMA and provide education and technical support to micro-enterprises and these would apply to diving and snorkelling operations. These are further discussed in Section 9.12.1.

When these measures are implemented there will be stricter control over tour boating operations (and associated activities) but this should not have significant adverse impacts on tour boating. There is need also to determine the carrying capacity of the area for diving and snorkelling as this will determine the feasibility of increasing the number of tour boat operators to service the NEMMA.

Implementation of these measures should at least sustain the livelihoods of the existing tour boat operators. There are also opportunities in this sector for the addition of glass-bottom boat tours and training in tour guiding and nature tourism marketing.

However consideration needs to be given to the proposed fee structure for using the NEMMA. In other protected areas in the region these fees have proven to be prohibitive and cumbersome for the tour boat operators (see Section 9.8).

Assuming that the fee structure is satisfactory and the asset maintains its attraction to visitors, there should be no significant adverse impact on the livelihood of tour boaters once the NEMMA is instituted.

8.4.4 Vending

Vendors within the NEMMA were found at Long Bay and Mercers Creek (see Section 5.7.2.4). All nine who were interviewed were women and lived in nearby communities. Most had attained primary school level education and half of them had no other skills. They were the main income earners and had dependents which included children of school age. They had been engaged in vending for between 10 to 30 years and sold souvenir items, wraps, T-shirts and jewellery. The majority indicated that business had decreased since they started vending. None of them used the reef but they had heard from persons who use the reef that there was breakage of coral and decrease in water quality. They believed that damage to the reef was due to hurricanes so did not understand the need to protect it through managing resource use.

Vending is not discussed by Espeut (2006). However his report quotes unemployment statistics in the NEMMA of 8.7% for women (almost the same as for Antigua which is 8.8%). It is expected that north east Antigua will experience an increase in tourism activity when the NEMMA is profiled in relevant resource user targeted publications as proposed by the Management Plan. With this will come increased business opportunities for vending which could target unemployed women within the NEMMA. Espeut (2006) also discusses the potential for the production and sale of high quality art and craft items. He warns however that raw materials should not be harvested from the NEMMA for this purpose and recommends training of unemployed young men and women for this activity.

While the Management Plan has some provisions for encouraging community micro-enterprises, a more in-depth investigation of vending within the NEMMA needs to be conducted before any further conclusions and recommendations can be made concerning this livelihood activity.

8.4.5 Other Marine Based Businesses

Other marine-based business activities in the NEMMA include sting ray attraction, water sporting and seamoss farming and impacts on these livelihoods are discussed in the following sections.

8.4.5.1 Stingray City

One tour boat operator has fenced off an area of the beach at Seatons where visitors are allowed to interact and feed live stingrays. This operator has received a permit for his operation and employs over twenty persons (some of whom were fishermen, see Section 5.2.9). This activity is providing alternative employment for persons such as fishermen.

Espeut (2006) has concluded that this operation will meet the criteria for sustainability. However there are significant environmental concerns regarding this attraction. There are reports that the defence mechanism of the rays (barbs) are removed and they are kept in captivity where they are fed. Without their defence mechanism the rays have become dependent on humans and can never be released back into the wild. It is also reported that after a time the rays die (possibly from disease) and the stock has to be replenished. This operation has adverse impacts on an asset (the rays) that requires further investigation. The operator has indicated his intention to expand his operations and to also apply the same concept to a dolphin attraction. The environmental impacts of this proposed operation also needs to be investigated before permission is given, as it is understood that these dolphins are to be introduced.

There needs to be a better understanding of the environmental impacts of the operations of Stingray City and the implementation of greater controls and management of the process to minimize these impacts and to make the operation truly sustainable. If the practice is found to be detrimental to the overall population of the species which is the subject of the attraction then the project should be discontinued.

8.4.5.2 Water Sporting

There are several water sport operations within the NEMMA which rent speedboats, sailcraft, kayaks, wind surfboards, kites and snorkelling gear for use within the NEMMA (Espeut, 2006) (see Section 5.2.7). Again as the popularity of the NEMMA escalates, there is the potential for increased demand for these services and hence the opportunity for providers of these different water sporting gear. However there is need to regulate the use of these amenities as the question of compatibility may arise (or example, speedboats are a hazard to snorkelers). The Management Plan proposes regulations for watersports (see Section 6.4).

8.4.5.3 Seamoss Farming

One (inactive) seamoss farmer was identified in the NEMMA by Espeut (2006) who has intentions of exporting his product. However Espeut argues that economic sustainability (not environmental sustainability) may be the overriding issue in this situation. He is also of the opinion that seamoss farming should be encouraged as it will take the pressure off the harvesting of wild seaweed stock and may help the lobster fisheries by promoting the recruitment of post-larvae. However although mariculture may be a desirable activity for the NEMMA and it may be technically feasible he does not believe there is a future in expanding seamoss farming in the NEMMA mainly because of the availability of cheaper competitive products on the world market. The Management Plan does however provide for technical support for marine based enterprises such as seamoss farming (see Section 6.4.2).

8.4.6 Commercial and Industrial Activities

Commercial and business activities on lands adjacent to the NEMMA relate to hotels, restaurants and industries. These activities depend to varying extents on the assets within the NEMMA.

8.4.6.1 Hotels

There are at present nine hotels on the north east coastline adjacent to the NEMMA and on Long Island with a total of 350 to 400 rooms (see Section 5.2.10). These hotels also have restaurants and provide services such as ferry transport (Jumby Bay Hotel) and recreational facilities (boat tours, snorkelling, water skiing, etc). While some of the smaller hotels purchase fish from local fishers, others do not depend on this source. Wastewater from hotels which is discharged into the nearshore areas of the NEMMA is a contributor of water pollutants (see Section 4.4.6).

Hotel operations may at present be adversely impacted as a result of degradation of the assets (water quality, natural features, etc) of the NEMMA as visitor health may be affected and their satisfaction with using the other assets may decline.

In the absence of the NEMMA these hotels can continue to operate unaffected. However it is expected that the adverse impacts which their operations are having on the assets in the NEMMA (see Sections 8.2.4 and 8.3) will also eventually impact negatively on their operations. The classification of potential impacts on adjacent hotel operations is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

The mitigation measures for addressing adverse impacts on the assets in the NEMMA are discussed in Sections 8.2.4 and 8.3. Reducing these impacts will be beneficial to hotel operations. However implementation of some of these mitigation measures will require the hotel operators to improve the efficiency of their sewage treatment plant and to monitor the quality of their effluents which are discharged into the NEMMA. Satisfying

these requirements will require changes in procedures and methods, training of staff, testing, purchase of equipment, etc which will have cost implications. However it is expected that regulatory agencies will approach the requirement for compliance in a phased manner and so these costs should not be prohibitive to the continued operation of these enterprises.

The classification of impacts on adjacent hotel operations when the NEMMA is instituted is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

8.4.6.2 Industries

It is significant that industrial activity is concentrated in the north east of Antigua (see Section 5.2.11). These industries depend on assets within the NEMMA for their continued operation. For example, the desalination plant extracts water from the sea for treatment to produce potable water and discharges the effluent from its process (brine) into another area of the sea; the power generating plant pumps water from the sea to be used as cooling water for its turbines and then discharges the resulting hot water back into the sea; all of the industries discharge wastewater from their processes and their sewage treatment plants into the surrounding waters within the NEMMA; and finally some of the industries are serviced by ships which traverse the NEMMA.

Most industrial operations may not be adversely affected by the declining water quality conditions which it must be noted they are contributing to (see Section 7.3.4). The exception are the desalination and power generating plants which depend on water of a certain quality for producing potable water used for human consumption and for cooling. The classification of potential impacts on the desalination and electricity generating plants which provide the island with essential services is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
National	Major	Reversible	High

The mitigation measures for addressing adverse impacts on the assets in the NEMMA are discussed in Sections 8.2.4 and 8.3. Reducing these impacts will be beneficial to the operations of these industries. However all the industries which discharge wastewater into the NEMMA (whether or not they are affected by impaired water quality) will be required to improve the efficiency of their sewage treatment plant and to monitor the quality of their effluents which are discharged into the NEMMA. Satisfying these requirements will require changes in procedures and methods, training of staff, testing, purchase of equipment, etc which will have cost implications. However it is expected that regulatory agencies will approach the requirement for compliance in a phased manner and so these costs should not be prohibitive to the continued operation of these enterprises.

The classification of impacts on adjacent industrial activities when the NEMMA is instituted is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
National	Minor	Reversible	Moderate

Shipping may also be affected if there are conflicts between shipping routes and the use of the area by other vessels such as fishing boats and tour boats. Coordination of shipping in the waters of Antigua is carried out by the Port Authority. The zoning plan for the NEMMA must take into consideration the presence of the shipping channels and turning basin within the NEMMA and recreational and fishing zones placed safely out of the way of these high risk areas. Recommendations regarding this are contained in Section 9.4.

The classification of impacts on shipping within the NEMMA both before and following the institution of the NEMMA is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
On-site	Very Small	Reversible	Low

8.4.7 Land Ownership and Use

Landownership and land use in the NEMMA are described in Section 5.5 and the impacts in relation to the NEMMA are discussed in the following sections.

8.4.7.1 Land Ownership

Land ownership in the NEMMA is a mixture of private and government-owned. Of the 30 (plus) islands, islets and rocks in the NEMMA a significant number are privately owned (see Section 4.2). Land tenure could be a barrier to conservation efforts (see Sections 7.3.8 and 7.3.9) and activities on these islands may be in conflict with the objectives of the NEMMA and its management.

Before the NEMMA is instituted the impacts of land ownership on the NEMMA is classified as:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

There is general buy-in to the conservation effort and the concept of the NEMMA by owners of some of the islands (for example, Green Island and Long Island). The Management Plan does not specifically address the question of land ownership as it may affect the management process. However the following measures may be applied:

- Commission legal review and evaluation of statutory deficiencies adverse to management of the NEMMA.
- Devise a mechanism to collaborate with Environment Division, DCA & Fisheries Division in Monitoring marine impacts from development projects in the NEMMA.

When the management plan for the NEMMA is implemented the offshore islands which are presently not inhabited will be excluded from development. Some of these islands are privately owned and this will have financial implications for the owners. Recommendations on policies for overcoming potential land ownership barriers to management of the assets in the NEMMA are discussed in Sections 9.1 and 9.6.

Once these measures are implemented, the classification of impacts of land ownership on the assets in the NEMMA is expected to be:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

8.4.7.2 Land Use

Present land use adjacent to the NEMMA includes agriculture, housing and industry in watersheds draining into the NEMMA, tourism, industry and housing in coastal areas and tourism and housing on one of the offshore islands (see Section 5.5.2). The remaining offshore islands are uninhabited.

The classification of impacts on present land use before the NEMMA is instituted is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

The Management Plan proposes the following measures relating to adjacent land use:

- Implementation of a Zoning Plan (see Section 6.6) which designates all islands, wetlands and turtle nesting sites in the NEMMA for conservation. This will exclude the offshore islands from development. It also designates a Resort/Residential zone for residences, hotels and restaurants, a Port/Harbour zone in which restaurants and berthing and anchoring of vessels will be allowed and a Multiple-use zone where hotels, residences and facilities for fishing boats will be allowed.
- Work towards building stakeholder support for prohibited activities defined by zones of the Zoning Plan.
- Commission legal review and evaluation of statutory deficiencies adverse to the management of the NEMMA.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Devise a mechanism to collaborate with the Environmental Division, the DCA and the Fisheries Division in monitoring marine impacts from development projects in the NEMMA.

- Design and implement an ongoing programme to monitor with other partners land based discharges from wastewater treatment plants and RO plants.
- Any person or company seeking to construct buildings or undertake any form of development as defined in the Planning Act in the NEMMA must submit a copy of the plans submitted to the DCA for review and approval of the NEMMA Office acting on behalf of the NEMMA Partnership.
- Application of penalties for contravening laws and regulations for offences committed in the NEMMA.

Control of land use in areas adjacent to the NEMMA as it pertains to built development is under the Development Control Authority (see Section 2.5.3.2) and the provisions of the Physical Planning Act (see Section 2.2.8). The present land use generally coincides with those shown on the proposed land use map which is used by the DCA to give approvals in principle for projects (see Section 5.5.2). Sensitive areas such as turtle nesting sites and wetland areas are protected by existing legislation. Regulatory control mainly applies to construction phase of the facility (hotel, industry, dwelling house, etc) and focuses on environmental impact assessment. Once the facilities have been constructed there are at present no regulatory controls or standards governing their operation. The Management Plan makes recommendations for the conduct of periodic environmental audits of existing hotels and manufacturing operations.

It does not appear that there are any conflicts between the Proposed National Land Use Plan and the NEMMA Zoning Plan. However the potential for such conflict exists which necessitates collaboration with the DCA in completing the Zoning Plan. As far as practical the two plans should be in harmony. Where there are conflicts these should be resolved in a manner that will not compromise the NEMMA. Recommendations have been made for the carrying out of a Regional Environmental Assessment (REA) which would assist in this exercise (see Section 9.5.1).

When the management plan for the NEMMA is implemented the classification of impacts on surrounding land uses is:

EXTENT	INTENSITY	NATURE	CLASSIFICATION
Localised	Very Small	Reversible	Low

8.4.8 Research and Education

There are several on-going research initiatives within the NEMMA. These are undertaken by local NGOs and community groups and international agencies and focus on the coral reefs, the hawksbill turtle and the Antiguan Racer snake (see Section 5.6). Some of these research efforts are facilitated by the Fisheries Division. There are no controls governing research and education within the NEMMA. However there is no evidence that such activities have caused adverse impacts on the NEMMA. Rather it is expected that educational initiatives would be beneficial in raising environmental awareness among surrounding communities, nationals and resource users as well as to the assets in the NEMMA.

The Management Plan proposes the following measures for managing research in the NEMMA (see Section 6.4.1.3):

- Implementation of a Zoning Plan which will permit research in all eight proposed zones.
- Engage legal assistance to assemble and further draft a comprehensive package of management regulations governing various activities and uses in the NEMMA.
- Draft and submit for passage, management regulations to protect resources within agreed zones of the NEMMA.
- Collaborate with selected partners in building a management data base for the NEMMA.
- Monitor population changes to threatened, rare or endangered species.
- Design and implement a monitoring programme for selected reef areas with high levels of recreational snorkelling and diving.
- Design and execute a series of radio and TV public awareness programs for awareness building and education.
- Have NEMMA brochures and fact sheets designed and published for specific target groups.

Recommendations for future studies and education are contained in Sections 9.5 and 9.7, respectively. When mitigation measures are implemented research and education within the NEMMA are expected to be beneficial to the management of the area.

8.5 Summary of Impact Classification

The classification of environmental impacts is summarised in the following sections. Some of these impacts were beneficial and others which were considered adverse were classified before and after the application of mitigation measures.

8.5.1 Beneficial Impacts

Implementing the NEMMA is expected to provide livelihood opportunities for Fishers, Dive Shops, Vending, Water Sports and Seamoss Farming. Research and Education within the NEMMA will have mutual benefits.

8.5.2 Adverse Impacts

The classification of the potential adverse impacts associated with the NEMMA is summarised in Table 36.

TABLE 36: CLASSIFICATION OF POTENTIAL ADVERSE IMPACTS

CLASSIFICATION OF POTENTIAL ADVERSE IMPACTS					
ENVIRONMENTAL COMPONENT / STAKEHOLDER	WITH MITIGATION				WITHOUT MITIGATION
	EXTENT	INTENSITY	NATURE	CLASSIFICATION	CLASSIFICATION
Heavy rainfall	Localised	Minor	Reversible	LOW	MODERATE
Drainage	Localised	Very Small	Reversible	LOW	MODERATE
Water quality	Unknown	Unknown	Unknown	UNKNOWN	MODERATE
Coral reefs	On-site	Major	Irreversible	UNKNOWN	HIGH
Mangrove	On-site	Very Small	Reversible	LOW	LOW
Seagrass	On-site	Very small	Reversible	INSIGNIFICANT	LOW
Fisheries	Localised	Minor	Reversible	LOW	MODERATE
Beaches	On-site	Very Small	Reversible	LOW	LOW
Terrestrial vegetation (sensitive species)	Localised	Very Small	Reversible	LOW	EXTREME
Fauna (sensitive species)	Localised	Minor	Reversible	LOW	EXTREME
Fishers	National	Minor	Reversible	BENEFICIAL	LOW
Tour boat operators	Localised	Minor	Reversible	INSIGNIFICANT	LOW
Hotels	Localised	Very Small	Reversible	LOW	LOW
Industries (Desalination and power plants)	National	Minor	Reversible	MODERATE	HIGH
Shipping	On-site	Very Small	Reversible	LOW	LOW
Land ownership	Localised	Very Small	Reversible	LOW	LOW
Land use	Localised	Very Small	Reversible	LOW	LOW

9 RECOMMENDATIONS AND COMMENTS

This chapter proposes recommendations based on the SWOT Analysis conducted and documented in Chapter 7 and the analysis of impacts contained in Chapter 8. These recommendations are discussed under the following headings:

- Policy and Legal Framework,
- Management Plan,
- Water Quality and Effluent Standards
- Zoning
- Future Studies
- Control of Development
- Building User Awareness
- Fee Structure
- Training,
- Management Effectiveness
- Monitoring of Natural Assets
- Sustainable Livelihoods Projects

The final section in this chapter is the application of a matrix adapted from the Canadian Environmental Assessment Act.

9.1 Policy and Legal Framework

The Review of Protected Areas Management Framework in Antigua and Barbuda (Gardner, 2007)identifies the need for an integrated approach to protected areas management. Although, there are several pieces of legislation that are considered relevant to the establishment and management of the NEMMA, these instruments provide only a piecemeal coverage. Gardner (2007) highlights the following major issues associated with protected areas development and management:

- Absence of National Policy Framework;
- Lack of Institutional Coordination;
- Absence of Data Management Systems for Protected Areas; and
- Inadequate Institutional Capacity.

It is therefore recommended that the actions listed for improvement of the protected areas management be repeated here. It follows that once the policy and legal framework is in place that implementation of any management plan for the NEMMA would be fairly easy to implement. These actions include:

- Initiate a protected areas system planning process to develop a comprehensive policy framework and rationalise the legislative and institutional frameworks.
- Undertake institutional assessment of protected areas management institutions for the purpose of designing a capacity development programme for said institutions.
- Establish an institutional coordinating mechanism to assist with oversight of the current initiatives, and support the system planning process.
- Establish a funding mechanism (such as a trust/development fund) to provide a consistent source of financing for protected areas development and management.

The importance of policies for wetlands and watersheds to controlling water quality is discussed in Section 8.2.4.

9.2 Management Regulations

The Management Plan highlights the need for management regulations for some of the uses occurring within the NEMMA (Jackson, 2007). The Plan makes recommendations for regulations relating to watersports, yachts, camping and other land-based recreation, buildings and infrastructure, resource extraction and pollution and safety to be drafted and subjected to stakeholder consultations before passing into law.

There are environmental and ethical concerns surrounding the present practices used at Sting Ray City. Protocols and standards of operation must be established for this present activity and any proposed similar activities. Areas of concern include entrapment, mutilation, dependency, and health of the animals.

9.3 Water Quality and Effluent Standards

Ambient water quality standards for the marine environment and effluent discharge standards for industrial operations and sewage treatment plants must be established as a matter of priority (see Section 9.3). The quality of the waters of the NEMMA is important for protecting the integrity of the resources such as coral reefs, mangrove and sea grass beds, for the safety of users who may come into contact with the water, for the safety of food harvested from the NEMMA and for industrial use. The development of these standards should be seen as priority not only at the level of the NEMMA but also at the national level.

9.4 Zoning

9.4.1 Management Plan Proposals

The Management Plan proposes a system of zoning (see Section 6.6) and has focussed on two core areas for trial: Great Bird Island and Green Island. The zones proposed include:

- A Conservation Zone;
- A Recreational Zone;
- A Yacht Mooring Zone;
- A Multiple Use Zone;
- A Fishing Priority Zone;
- A Resort / Residential Zone;
- A Port / Harbour Area; and
- A Local Management Area.

Zoning of the rest of the NEMMA is to be completed in consultation with stakeholders and based on application and testing of the zoning designations proposed for the two core areas. In completing the zoning of the NEMMA areas considered critical for conservation should include:

- Wetlands on the Antiguan coastline within the NEMMA and on some of the islands (particularly Long Island). These wetlands have been identified as the habitat of the endangered Whistling Duck (see Section 4.6.2.3.4), and

- Turtle nesting sites at Jumby Bay (on Long Island), on Green Island, and on the Antiguan mainland at Jabberwock in the north are key areas for conservation.

9.4.2 Creation of a Buffer Zone

An inconsistency that was noted in the proposed zoning plan relates to the discharge of wastewater into any of the proposed zones except the conservation zone. Even if there is no discharge directly into the conservation zone it is expected that with circulation and currents there will be some mixing between zones.

Based the description of the baseline conditions and the activities which are on-going in and adjacent to the NEMMA it is noted that several land-based activities (in particular agriculture, residences, hotels and industries at Crabbs Peninsula) are impacting on assets within the NEMMA and there is the potential for these impacts to escalate if such activities continue (see Sections 5.2.10, 5.2.11, 7.3.5, 7.5.2, 8.2.4 and 8.4.6).

Environmental impacts relate to impaired water quality (see Section 8.2.4) and a number of mitigation measures were discussed to improve water quality in the NEMMA. However even with mitigation there is still a concern for impaired water and residual impacts on the assets in the NEMMA may still be unacceptable. Shipping routes which also traverse the NEMMA for servicing the industries raise additional concerns for marine traffic safety and the impacts associated with maintenance of a shipping channel and turning basin as well as for water quality.

It would appear that there is an inherent incompatibility between some of the activities within and around the NEMMA and the concept of a protected area. This incompatibility cannot be easily resolved as according to the physical planning proposals for Antigua the areas in the north east will continue to be used for agriculture, tourism and industry. It is therefore recommended that an additional zone be created called a “Buffer Zone” which will be placed around the natural assets which are to be protected and will take into account:

- The aerial extent of the impacts to water quality in the NEMMA which are the result of discharges from all existing and potential sources.
- The operation off a shipping channel and turning basin within the protected area.
- Provision of an adequate buffer zone around the protected area from these impacts.

There is not sufficient information presently available to facilitate this assessment and the following specific environmental studies will be required:

- The results of the Regional Environmental Assessment (REA) (see Section 9.5.1);
- An in-depth inventory of the types, quantities and characteristics of all the sources of water pollutants for the north east of the island;
- A study of the oceanographic conditions off the north eastern coast (see Section 9.5.3.4);
- Oceanographic modelling of the discharges from the various into the waters in the area of the NEMMA (see Section 9.5.3.4).

9.5 Future Studies

Arising out of the field studies conducted for this project as well as the information provided in the Management Plan, the following future studies are recommended for sustainability of the NEMMA:

- Regional Environmental Assessment;
- Carrying Capacity Studies;
- Water Quality Assessment;
- Oceanographic Patterns;
- Vending within the NEMMA; and
- Disaster Management Plan.

9.5.1 Regional Environmental Assessment

The baseline studies suggest that a higher level environmental assessment of the land development plan (which will include hotel operations) should also be undertaken for the north eastern region of Antigua. Such a study {termed Regional Environmental Assessment (SEA)} will be consistent with Gardner's recommendation to *initiate a protected areas system planning process to develop a comprehensive policy framework and rationalise the legislative and institutional frameworks* (see Section 9.1) and will consider the impacts of existing and planned development of the agricultural, tourism and industrial sectors in north east Antigua. In conducting this study consultants and researchers will be required to focus on the cumulative impacts of these sectors on the NEMMA with a view to recommending preferred development arrangements (for example, number and sizes of hotels, siting of hotels and industries, wastewater

treatment and discharge, etc). Such a study will assist in minimizing conflict between development of the north eastern areas of Antigua that can potentially impact on the NEMMA and the operation of the NEMMA as a protected area.

The results of Carrying Capacity (see Section 9.5.2), Water Quality (9.5.3) and Oceanograhic studies (see Section 9.5.3.4) will be required as inputs to this SEA.

9.5.2 Carrying Capacity Studies

The major tourism-related activities in areas within (at Long Island and Prickly Pear) and adjacent to the NEMMA (on the north eastern coastline of the mainland) is the operation of hotels, restaurants, marinas, etc, the operation of tour boats and yachts which bring visitors into the NEMMA and visitor activities such as snorkelling, picnicking, etc. Vending currently takes place on a small scale.

There are at present approximately nine hotels and restaurants, eighteen tour boat operators and at least 300 visitors per day visiting the site on tour boats. Land development projects such as hotels and marina are under the control of the Planning Development Authority which considers each application for planning permission on the basis of the land use plan for the north east and an environmental impact assessment which the developer may be required to conduct (see Section 7.2.5).

Carrying capacity studies will help the Site Implementing Entity to regulate the numbers of tour boats and visitors to the area.

9.5.3 Water Quality Assessment

As noted in Section 4.4.6, water quality within the NEMMA is deteriorating. Poor water quality in turn has been identified as one of the reasons for the degradation of the environmental assets within the NEMMA. As will be discussed in Section 9.11.1 below, monitoring of water quality is critical to management of the resources of the NEMMA, however, a water quality assessment should be conducted to form the basis of continuous water quality monitoring within the NEMMA. The objective of this exercise would be:

- to determine the ambient water quality of the seawater in the NEMMA;
- to identify the sources of pollution entering the marine environment,
- to determine the quality of water leaving the various industries and discharging into the marine environment, and
- to determine the quality of the fresh water entering the marine environment from the various watercourses.

In order to meet these objectives the following is recommended:

- Assessment of existing discharges;
- Sampling and testing of marine water;
- Sampling and testing of fresh water.

9.5.3.1 Assessment of Existing Discharges

Section 5.2.11 details the industries, hotels and restaurants that discharge into the NEMMA. While there has been discussions indicating that water pollution from these developments is a serious issue, there has been no study to assess the ambient water quality in the NEMMA as well as to identify the sources of pollutants. It is recommended that the Central Board of Health in collaboration with the Environmental Division undertake the monitoring of the effluent from the industries that discharge into the NEMMA.

9.5.3.2 Ambient Marine Water Quality

In order to determine the present water quality within the NEMMA, ambient water quality monitoring should be conducted. Sampling undertaken should include but not be limited to a range of parameters including pH, temperature, salinity, turbidity, conductivity, total and faecal coliforms, BOD, COD, nitrates and phosphates. This information should be conducted in the dry season as well as in the wet season to account for the changes that occur. This information will be the baseline data that can be compared to a comprehensive continuous monitoring programme that will be discussed below in Section 9.11.1.

9.5.3.3 Ambient River Water Quality

It is also important to conduct ambient water quality testing within the rivers that enter the NEMMA. This monitoring should be conducted just upstream of the mouths of the rivers. A similar range of parameters should be tested in the river water as for the marine sampling. Again, this information will form the baseline fresh water quality conditions.

9.5.3.4 Assessment of Physical Oceanographic Conditions

In conjunction with the assessment of water quality, a study should be conducted to determine the physical oceanographic conditions that presently exist within the NEMMA. A description of the oceanographic conditions within the project area would include:

- Current velocities and directions at different tidal states;
- Tidal heights and capacity for tidal flushing of nearby rivers and wetlands;
- Capacity for tidal flushing of the mouth of any existing rivers
- Prevailing wind/wave directions and heights.

The information collected above would be useful in determining the dispersion of effluents within the NEMMA. This in turn would inform decision making processes.

9.5.4 Status of Vending

The livelihoods assessment report conducted by Espeut does not make mention of vending as a livelihood within the NEMMA. However, during the field visit for this study, vendors at Long Bay and Mercers Creek Bay indicated that they have been vending for between 20 to 30 years (see Section 5.7.2.4). Our interviews revealed that the majority are women and many did not have any other skills apart from vending. Due to time constraints we were only able to speak 4 vendors and were unable to determine the total number of vendors. A survey specifically targeting these vendors should be conducted to determine their role within the NEMMA. This stakeholder should be properly assessed to ensure that they are included in the management of the NEMMA and the livelihoods opportunity captured.

9.5.5 Disaster Management

The NEMMA has had a history of hurricane damage which has had significant impacts on the resources (see Sections 4.4.1 and 7.5.1). The Management Plan for the NEMMA does not address disaster management. Such a plan is considered critical since the NEMMA has proven to be extremely vulnerable to natural disasters in the past.

9.6 Control of Development on Offshore Islands and Adjacent Coastline

- Development within and surrounding the NEMMA is inevitable. Offshore islands are seen by developers as potential for development and the National Physical Development Plan has zoned certain coastal areas and the islands for industrial, tourism and residential development. Such development must be strictly controlled by the DCA and the Environment Division. Development within watersheds must also be closely controlled as some of these activities and their consequences are likely to adversely impact the NEMMA.

9.7 Build Awareness among Users

As noted in Section 7.2.4, there is 'buy-in' by the local population to the establishment of the NEMMA. Consistent with MPAs in the region and around the world, there needs to be a public awareness campaign to sensitize the public on the park. Means which can be used to sensitize the public include the use of:

- Flyers,
- Brochures,
- Handbook,
- Website,
- Information Boards,
- Posters,
- Park Entry Signs, and
- Infomercials.

These various communication tools should be implemented on a phased basis as the management plan for the NEMMA is formalised.

9.8 Fee Structure

One of the aims for the NEMMA as outlined in the Management Plan is financial self-sufficiency. This is expected to be achieved by user fees and other sources of income. Table 37 provides the suggested user fees for the NEMMA as detailed in the Management Plan.

The Management Plan has however made it clear that these fees are proposed and should not be implemented until adequate consultation has taken place. A comparison of these fees with those currently in place at the Tobago Cays Marine Park (see Table 38) shows that the fees proposed for the NEMMA are slightly higher for some groups (mooring yachts) and significantly higher for others (commercial filming). In addition user fees recommended for the parks of the OPAAL project are much more detailed than for other parks in the region.

It is therefore recommended that a "willingness to pay" study be undertaken to determine whether the fees proposed as well as the fee structure is acceptable to users of the NEMMA. On another park in the region, there has been some unwillingness by certain stakeholders to pay what is termed 'too high' fees. It is therefore critical that extensive consultation be conducted on the proposed fee structure with the various stakeholders before implementation.

TABLE 37: USER FEES

USES	UNIT OF CHARGE	AMOUNT	
		$EC	$US
kayaking	Daily	5.00	2.00
	Weekly	25.00	10.00
Snorkelling	Daily	5.00	2.00
	Weekly	25.00	10.00
Interactive Experiences			
Stingray	Daily	5.00	2.00
Dolphin	Weekly	25.00	10.00
	Daily	5.00	2.00
	Weekly	25.00	10.00
Tour Operators	Annual License		
Tour Passengers	Per Tour	5.00	2.00
Yachts		25.00	10.00
Mooring	Nightly	50.00	20.00
Passengers	Daily	5.00	2.00
Vendors	Annual License		
Sport Fishing	Daily		
Commercial Filming	Daily	1,000.00	400.00
Camping (overnight?)	Daily	50.00*	20.00
	Weekend	100.00	40.00
Jetties	Yearly		
Marina Berths	Yearly per berth	5% of fees	
Kite Surfing	Daily		
Wind Surfing	Daily		
Tent Rentals	Daily		
*fee for groups or 6 person or less; each additional person $10			

TABLE 38: USER FEES FOR THE TOBAGO CAYS MARINE PARK

TYPE OF FEE / PERMIT	RATE	AMOUNT ($EC)	AMOUNT ($US)
Entry Fees (includes visitors on private yachts, charter boats, cruise ships, for diving etc)	Per person	$10 per day (up to 24 hours)	$3.74
Moorings (where used, anchoring also proposed to be allowed at no charge inside anchoring zones)	Yachts 40 ft and under	$40 per 24 hours	$14.98
	Yachts 41-70 ft	$50 per 24 hours	$18.72
	Yachts 71-100 ft	$60 per 24 hours	$22.47
	Dinghies	$15 per 24 hours	$5.61
	Dives	$10 per 24 hours	$3.74
Local operators licenses	Vendors	$20 per month or $200 per year	$7.50 per month or $74.90 per year
	Water Taxis	$30 per month or $300 per year	$11.23 per month or $112.36 per year
	Charter Boats	$40 per month or $400 per year	$14.98 per month or $149.81 per year
	Dive Shops	$25 per week or $80 per month or $800 per year	$9.36 per week or $29.96 per month or $299.62 per year
Permits	Filming	$300 per permit (terms and provisions to be prescribed)	$112.36 per permit (terms and provisions to be prescribed)
	Wedding Ceremonies	$300 per ceremony	$112.36 per ceremony
	Local excursion	$2 per person	$0.75 per person
	Duplicate permit	¾ of original fee	
Barbeque		$25 for a barbeque for up to 10 persons, or 10$ per person for larger sized groups	$9.36 for a barbeque for up to 10 persons, or $3.74 per person for larger sized groups

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9.9 Training

Critical to the management of the park is the need for extensive training of park staff. The Management Plan proposes the following staff members for running of the NEMMA:

- NEMMA Manager
- Administrative and Accounting Officer
- Research and Monitoring Officer
- Product Development and Interpretation Officer
- Education and Awareness Officer
- Pubic Relations, Marketing & Sales Officer
- Maintenance Supervisor
- Wardens (6)

Training opportunities should be focussed on the following key areas:

- Administrative Training, and
- Biological Assessment.

9.9.1.1 Administrative Training

In order for the wardens to effectively function, the following training needs to be conducted on a continuous basis:

- First Aid / CPR,
- Lifeguard,
- Certified Diving,
- Boat Maintenance and Repair
- Seamanship,
- Boat Handling/Navigation, and
- Enforcement Skills.

9.9.1.2 Biological Assessment

A comprehensive monitoring programme to assess the status of the biological resources within the NEMMA is critical. To properly assess these resources the wardens need to be trained in biological monitoring (see Section 9.11).

9.9.1.3 Training Needs Assessment

A Protected Areas Training Needs Assessment study (Parsram, 2007) was conducted for this project and the training recommendations made by the consultant should be implemented.

Training for national agencies should include:

- Ecosystem specific Monitoring and assessments
- Species Identification
- Ecosystems based management tools e.g. GIS
- Enforcement
- Organizational Management and Leadership
- Project development and management
- Site operations and Management
- Protected area planning methods and management plan development
- Education awareness and outreach.

Site Management should be trained in the areas of:

- Ecosystem specific Monitoring and assessments
- Species Identification
- Ecosystems based management tools e.g. GIS
- Enforcement
- Organizational Management and Leadership
- Project development and management
- Site operations and Management
- Protected area planning methods and management plan development
- Education awareness and outreach

NEMMA Sustainable Livelihoods Stakeholders should be trained in:

- Customer Service and relations
- Health and Safety
- Tour guiding
- Enforcement and Monitoring
- Trail design
- Sustainable fisheries
- Boat handling and Navigation

9.10 Management Effectiveness

Ecoengineering anticipates that the new information gathered as part of this assignment will considerably assist NEMMA staff and key stakeholders in applying the M & E Scorecard described in Section 6.7. This section identifies questions in the Scorecard to which the information in this report is particularly applicable, and comments on on-going data-collection to continually update this information. Throughout this section, reference to the ESDU Scorecard refers to a scorecard evaluation undertaken by ESDU prior to this assignment). That scorecard is included in Appendix E.

9.10.1 Context

The following questions appear under the Section of the Scorecard headed:

> **"Context: Where are we now? Assessment of Important Threats and the Environmental Policy."**

9.10.1.1 Unsustainable Human Activities

Question 2 asks whether unsustainable human activities (eg poaching) are controlled within NEMMA. The ESDU Scorecard indicates that ***"Mechanisms for controlling unsustainable human activities in the protected area exist but there are many problems in effectively implementing them"*.**

Examples of unsustainable human activities include:

- Spear Fishing, which is prohibited within NEMMA but was noted as an on-going activity during this assignment (see Section 7.5.6).
- Reef Walking, which is reported to be difficult to control in the absence of regular patrols (see Section 7.5.5).
- Destruction of Mangroves (see Section 7.5.4.1).

Changes in the occurrence of such activities will have to be tracked over time to allow future updates of the scorecard.

9.10.1.2 Law Enforcement

Question 3 asks whether rules are effectively enforced, and the ESDU Scorecard indicates that ***"there are major deficiencies in capacity / resources and activities to enforce protected area legislation and regulations"***. In the case of NEMMA, where there is tourism, residential and industrial activity on the adjacent coastline (see Sections 5.2 and 5.3), this concern should be extended to planning and industrial regulations as well. As before, changes in these activities will have to be tracked over time to allow future updates of the scorecard.

9.10.1.3 Boundary Demarcation

Question 4 asks whether boundaries of the PA are known and demarcated. The ESDU Scorecard indicates that ***"the boundary of the protected area is known by the management authority but not by other stakeholders"***. In the case of NEMMA, where there are privately-owned islands within the PA, the need to demark and publicize the limits of the various zones is also important.

Even though there is buy-in to the concept of NEMMA by the majority of stakeholders , there are some conflicts with regard to land development and industrial use (see Sections 7.2.4, 7.3.5 and 7.5.3). This may be addressed by:

- Effectively demarking and publicizing the limits of NEMMA,
- Completing the zoning of the entire PA (beyond the two core areas identified in the Management Plan),
- Applying achievable zoning targets in areas where there is existing residential, tourism and industrial activity (see Section 9.4.2), and
- Effectively demarking and publicizing the different zones.

9.10.1.4 Resource Inventory

Question 6 asks whether there is enough information to manage the protected area. The ESDU Scorecard indicates that ***"Information on the biophysical, socio-cultural and economic conditions associated with the protected area is sufficient for key areas of planning / decision making but the necessary survey / M&E work is not being maintained"***. Ecoengineering considers this evaluation to be somewhat optimistic, based on our review of pre-existing data. Notwithstanding, the information gathered on this assignment has strengthened the data-base somewhat; so that the evaluation is probably now accurate. It cannot be over-emphasized, however, that continual updating of the data-base is essential both to keep current the description of conditions within NEMMA and also to track changes with a view to addressing and rectifying adverse changes.

9.10.1.5 Stakeholder Awareness and Concern

Question 7 asks whether stakeholders are aware and concerned about resource conditions and concerns. The ESDU Scorecard indicates that ***"Over 75% of stakeholders are aware or concerned about the resource conditions and threats"***. This evaluation was clearly supported by the findings of this study, among all primary stakeholder groups (see Chapter 5). Having achieved this high level of awareness and concern, however, one challenge would be to maintain it over time. Another challenge relates to sectoral interests. While the high level of concern was uniform, the projected solutions to the problems were not. An excellent example relates to spear fishing. The fishermen were of the view that there should be controlled spear fishing within NEMMA, but other stakeholders supported a complete ban. Such sectoral differences must be carefully managed to maintain the present uniformly high levels concern about preserving NEMMA.

9.10.2 Management Plan

The second Section of the Scorecard is headed:

> **"Planning: Where do we want to be? Assessment of Protected Area design and planning."**

In this section, Question 9 asks whether a management plan exists and is being implemented. The ESDU Scorecard indicates that ***"a management plan is being prepared or has been prepared but is not being implemented"***. Clearly, this has moved to the stage where a management plan has been prepared, but it is too early to comment on implementation. Ecoengineering supports the approach in that plan to zone two core areas initially, and use lessons learned from that exercise to inform the zoning of the remaining areas (see Section 6.6). However, we strongly recommend that care be taken to control activities in the as-yet unzoned areas as well as the zoned areas. If this is not done, the possibility exists that development and activity in the unzoned areas can progress so far in the interim that rational zoning becomes impossible at a later stage (see Section 9.4.2).

9.10.3 Survey and Research

The third Section of the Scorecard is headed:

> **"Input: What do we need? Assessment of resources needed to carry out management."**

In this section, Question 10 asks whether there is a program of management-oriented survey and research work. This is an extremely apposite question in the context of protected areas, where the attraction is nature itself. The ESDU Scorecard indicates that ***"there is some ad hoc survey and research work"***. Ecoengineering expects that the new information gathered on this assignment, and the methods used in that data-gathering, will form the basis for a more structured program of on-going data collection within NEMMA (see Sections 9.5 and 9.11).

9.10.4 Process

A series of questions pertaining to Education, Communication, Staffing and Equipment appear under the Section of the Scorecard headed:

> **"Process: How do we go about management? Assessment of the way in which management is to be conducted."**

The Management Plan discusses Community Involvement in Management and Infrastructure and Equipment. Ecoengineering's recommendations on these topics are contained in the following sections:

- Building awareness among Stakeholders in Section 9.7.
- Staff Training in Section 9.9.
- Monitoring in Section 9.11.

9.11 Monitoring of Natural Assets

The Management Plan discusses the need for continuous monitoring of the biological resources within the NEMMA (see Section 6.4.1.3). Monitoring of the following are considered critical for the success of the NEMMA

- Water Quality
- Mangroves,
- Seagrass Beds,
- Coral Reefs
- Marine Turtles
- Antiguan Racer
- West Indian Whistling Duck,
- Sea Birds, and
- Fisheries

The monitoring plans developed for the NEMMA should also be in collaboration with the already existing regional efforts of these broader initiatives such as the Wide Cast Project.

9.11.1 Water Quality

The need for a baseline study of the ambient water quality in the marine and fresh water environment was discussed in Section 9.5.3. As a means of measuring change in the water quality over time, continuous monitoring should be conducted throughout the NEMMA. The monitoring locations should be chosen to coincide with those used to provide the baseline data. It is recommended that the same parameters should also be monitored. As a first instance monitoring of water quality within the NEMMA should be on a quarterly basis. After the first year of monitoring, a report should be generated to determine the changes in the water quality over time. It is at this time that the frequency of monitoring and the monitoring parameters should be re-assessed before any changes are made.

9.11.2 Mangroves

Mangrove forests regulate biological exchanges between land and marine systems, and they are an important source of nutrients to the marine community. They also stabilize the shoreline, trap pollutants, and their roots provide shelter for juvenile fish and some invertebrates. Despite their importance, there is not formal monitoring of the state of this system in Antigua. It cannot be stressed enough how important mangroves are to the stability of coastal zones (see Section 7.5.4.1) and these coastal zones are the basis of the tourism industry in Antigua. A significant percentage of the coastal areas within the NEMMA is under mangrove vegetation however some of these areas are threatened due to industrialisation and tourism related developments.

As well as for the stability of the coastal zone, these mangroves provide habitats for a host of animals, including the endangered West Indian whistling duck (*Dendrocygna arborea*). NGOs such as the Environmental Awareness Group have conducted comprehensive inventories of the wetlands of Antigua, inclusive of the NEMMA, and monitor the status and habitat of *D. arborea*.

The inclusion of such environmentally sensitive areas within a Conservation Zone (see Section 6.6.1) of the NEMMA would engender scientific research into the health of the mangroves, sea grass beds and the fauna within.

9.11.3 Seagrass Beds

Seagrass beds are found through out the NEMMA area help to stabilize loose sand thereby retarding coastal erosion and also function to trap sediment from water entering coral reefs. However recreation activities on the island beaches are a constant source of stress for this habitat (GEF 2004). The dragging of anchors, accidental groundings and intentional pulling of boats onto beaches have all impacted on seagrass beds. Seagrass beds have further threatened but the impaired water quality and increased silty terrestrial run-off due to coastal development. They are help sustain the local fisheries, but providing habitats for juveniles of commercially important fish and sea turtles, such as the hawksbill turtle (*Eretmochelys imbricata*) and Green Turtles (*Chelonia mydas)* (see Section 4.6.1.3).

It is recommended that these sites should be included within the conservation zone, and monitored in conjunction with the mangroves. Where sea grass beds exist outside this zone, it is recommended that moorings should be installed to prevent anchoring on the seagrass beds. Also an education programme should be established to explain to visitors the negative impacts of damaging the seagrass beds.

9.11.4 Coral Reefs

NEMMA contains several patchy and fringe reefs, and several of which are deteriorating due to pollution, physical damage (anthropogenic and natural), overfishing and disease. Several reefs surveyed were found to be in a poor health, with relatively low species diversity and abundance of indicator reef fish. There is a dominance of algae and reduction in coral cover, possibly as a result of the reduction of herbivore populations due to overfishing.

The coral reefs are one of the most important environmental assets within the NEMMA and important to the tourism industry. Areas of high biological diversity should, such as Guiana Island reef should be included within the conservation zone and considered “no-take zones areas”. Reefs outside of recreation and yachting zones can be used for scientific research.

Suitable training (Reef Check, AGRRA) should be given to park rangers to monitoring abundance of key reef species. The information from monitoring provides a quantitative view on overall reef health and condition, with an emphasis on visible effects of human impact. This may also involve the recruitment of local fishermen or other capable divers.

9.11.5 Marine Turtles

Green Turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) feed nest in near shore waters of the NEMMA. Other turtles occasionally visiting in the NEMMA are loggerhead turtles (*Caretta caretta*) and leatherback turtles (*Dermochelys coriacea*) are seen occasionally. Hawksbill turtles have been reported breed and nesting off the coast of Long Island and Mill Reef beach. Both locations are inhabited and utilised for tourism, including snorkelling and turtle watching. Karen et al 1992 indicated that Antigua has shown a history of declining turtle populations due to harvesting of eggs, and the active hunting of turtles.

It is recommended that the sensitive turtle nesting site should be included within the conservation zone, and monitored in conjunction with the mangroves. Currently, ongoing monitoring of hawksbill populations has been on going for the last 17 years at Jumby Bay on Long island. Such monitoring is a fundamental component for effective management, and one of the highest levels of environmental monitoring.

The inclusion of such environmentally sensitive areas within a Conservation Zone (see Section 6.6.1) of the NEMMA would engender further scientific research into the health of the turtles and the sea grass beds. Tagging exercises could also be undertaken to monitor the migration patterns of the turtles and population dynamics. Sea turtle habitat usage should be taken into account in any management plans developed for coastal or marine parks.

9.11.6 Antiguan Racer

The Antigua Racer (*Alsophis antiguae*) is a critically endanger snake endemic to Antigua (IUCN 2006). Antiguan racers used to be abundant and widespread across Antigua and its numerous satellite islands, a total area of 282km2 (Sajdak & Henderson, 1991). However, today they are restricted to Great Bird Island and due to recent re-introductions to Rabbit Island and Green Island (Daltry et al 2003). For more than 10 yrs the Antiguan Racer Conservation Project (ARCP) has been established a research programme monitoring the on the snake, monitoring populations dynamics, ecological needs, and have successfully been able to re-introduce *A. antiguae* on other satellite islands.

It is recommended that the GBI, Rabbit Island and green Island be included within CEZs, and any other island with potential for reintroduction of *A. antiguae*. Any other conservation scheme should be able to mesh with the already proved successful ARCP. The inclusion of environmentally sensitive areas within a Conservation Zone (see Section 6.6.1) of the NEMMA would further reinforce need for conservation for *A. antiguae* and engender further scientific research its status.

9.11.7 West Indian Whistling Duck

The endangered West Indian Whistling Duck (*Dendrocygna arborea*) is indigenous to the wetlands of mainland Antigua (The Flashes, Hansons Bay; Valley Church Pond, Jolly Harbour) and critical off-shore islands (including Great Bird, Rabbit and Long Islands). *D. arborea* have been encountered in mangroves, beaches, saline mudflats, freshwater ponds, coastal woodlands, lawns and even inland reservoirs surrounded by forests (EAG, 2003). This suggests that they use most of the remaining natural and semi-natural habitats of Antigua, at some stage of their life cycle, whether for feeding, nesting, chick-rearing or loafing (EAG, 2003).

Threats facing *D. arborea* include habitat destruction (loss of mangroves for coastal settlements and tourism development, coastal pollution, dumping of rubbish, drainage, dumping of dredge spoil and contamination with oil and industrial wastes), introduced predators especially by mongoose and the black rat and habitat disturbance through tourism related activities.

Currently the EAG monitors the population and habitat status of *D. arborea*. However, for greater protection of the bird and its habitats, it is recommended that these areas should be included within CEZs or areas for scientific research. The habitats of these birds should be protected, and an education campaign, based on using *D. arborea* as the tool to make people more aware of the importance of wetland conservation (EAG 2003).

9.11.8 Sea Birds

The offshore island within the North Sound area are breeding and nesting grounds for several species of sea birds, such as the brown pelican (*Pelecanus occidentalis*), the red-billed tropic bird (*Phaethon aethereus*), Hesperiidae (skippers), brown booby (*Sula*

leucogaster), laughing gull (*Larus atricilla*), magnificent frigatebird (*Fregata magnificens*), sooty tern (*Sterna fuscata*). However several of these island habitats are disturbed due to the tourism industry. Great Bird Island is a popular tourist destination, with walking trailing extended to the rocky outcrops where many of these species nest.

Disturbance activity should be limited on these islands as best as practical. It is also recommended that they areas should be designated scientific research areas and their habitats protected. The EAG has started an education campaign based on these sea birds as the tool to make people more aware of the importance of the island habitats and raising awareness of the threats facing them.

9.11.9 Fisheries

Espeut 2006 makes the point that at present fisheries within the NEMMA is unsustainable. He further states the reason for this is because the ecosystems which are the primary habitat for fish (sea grass, mangroves and coral reefs) are being slowly degraded by land-based sources of marine pollution (Espeut, 2006).

Apart from the following strategies which need to be employed to achieve a sustainable fishery, there needs to be continual monitoring of the fisheries stocks to determine the population dynamics of this important resource:

Strategies which need to be enforced include:

- the enforcement of a ban on destructive gear (including seine nets);
- the enforcement of a ban on small mesh in nets and traps;
- the enforcement of no fishing with SCUBA or hooka;
- the enforcement of no-take zones;
- the enforcement of closed seasons on certain species (like lobster and conch);
- the enforcement of a system of limiting new entrants into the fishery.

9.12 Sustainable Livelihoods Projects

The Tourism Master Plan suggests increasing opportunities for small business/enterprise participation in the management and maintenance of natural resources and the provision of services at public sites. This will require development of mechanisms, rules, standards for participation of such groups (Gardner, 2007). There should also be protocols for determining the management competence for NGOs and CBOs to manage the NEMMA

Espeut (2006) has made recommendations for new sustainable livelihoods and for strengthening the sustainability of existing livelihoods and Parsram (2007) recommended that NEMMA Sustainable Livelihoods Stakeholders should be trained in:

- Customer Service and relations
- Health and Safety
- Tour guiding
- Enforcement and Monitoring
- Trail design
- Sustainable fisheries
- Boat handling and Navigation

9.12.1 New Sustainable Livelihoods

The new livelihood opportunities as determined by Espeut include:

- Carrying capacity studies of the NEMMA for tourism-related activities
- Sustainable art and craft
- Tour guiding
- Development and maintenance of walking trails on the offshore islands
- Boat handling
- Glass-bottom boat tours
- Marketing of NEMMA as a nature tourism site

9.12.1.1 Carrying Capacity Studies

The recommendations for carrying capacity studies are discussed in Section 9.5.2. Opportunities exist for researchers and consultants to undertake such environmental assessments. These studies will assist in managing the adverse impacts of the construction and operation of individual facilities on the NEMMA.

Opportunities also exist for determining the optimum number of tour boats and for each type of visitors (based on the types of activities in which they are involved) that can be accommodated in the NEMMA on a daily basis without impairing the quality of the assets. These studies will help the Site Implementing Entity to regulate the numbers of tour boats and visitors to the area.

9.12.1.2 Sustainable Art and Craft

The manufacture of craft items takes place on a small scale at present. If as expected the number of visitors to the NEMMA increases, there will be the potential for increased demand for art and craft items from local material. Interested persons will require training in the use of suitable local material for making saleable items. This activity therefore provides opportunities for trainers, person employed to make the art and craft items and vendors.

9.12.1.3 Tour Guiding

As noted in Section 5.2.4, the operation of tours to the NEMMA is a significant business activity. Tours are conducted by operators for some 300 visitors per day to snorkel, dive, hike, picnic, etc. As part of the management of the NEMMA visitors should be properly guided on their visits. This requires trained tour guides who will provide information to visitors about the NEMMA, advise them on appropriate codes of conduct and monitor their activities. Training of tour guides will enhance visitor experience and provide them with the skills for minimizing damage to the assets within the NEMMA. Tour guiding will provide employment opportunities for young, unemployed and knowledgeable persons. As before there are also employment opportunities for suitably qualified person to train these tour guides.

9.12.1.4 Walking Trails

The Management Plan proposes the improving walking trails on Great Bird Island, carving steps and installing handrails. These walking trails must be appropriately designed, constructed and maintained in a manner that minimizes erosion of the soil. Once the trails have been designed in collaboration with the Forestry Division, persons will have to be trained in the use of appropriate methods for their construction and maintenance and then employed to carry out these activities under the supervision of the Forestry Division.

9.12.1.5 Boat Handling

The only means of touring the NEMMA is by boat. Boat operators taking visitors to the NEMMA must therefore do so safely and without damaging the assets in the NEMMA. This requires the recruitment of trained boat handlers by tour operators. Persons from surrounding communities could take advantage of this opportunity to become trained and certified boat handlers. It is apparent that some fishermen have already taken this path (see Section 5.7.2.5) and there is the potential for other fishermen as well as unemployed persons to enter the tourism industry in this manner.

9.12.1.6 Glass-bottom Boat Tours

Glass-bottom boat tours are popular in other protected areas in the Caribbean such as Buccoo Reef in Tobago. The use of such boats presents an alternative to diving and snorkelling which will help minimize damage to corals and sea grass beds in the NEMMA. The operation of glass-bottom boats then presents itself as an additional employment opportunity.

9.12.1.7 Marketing

Section 9.7 contains recommendations for building user awareness. It is also expected that the NEMMA will be included in the marketing of Antigua as a nature tourism destination. The opportunity therefore exists for suitably qualified persons to be trained in marketing of the NEMMA as a nature tourism attraction.

9.12.2 Existing Livelihoods

Espeut also recommends ensuring sustainability of the existing livelihoods such as:

- Sustainable fisheries sector
- Carrying capacity studies of the NEMMA for existing livelihoods
- Resource, environmental and business management training

Opportunities in the area of carrying capacity studies are discussed in Sections 9.12.1.1.

This study in addition identified livelihoods opportunities in the areas of:

- Vending (see Section 8.4.4)
- Water Sports (see Section 8.4.5.2)
- Seamoss Farming (see Section 8.4.5.3)

9.12.2.1 Fisheries Sector

As noted in Section 5.2.2, the fisheries sector in the north east of Antigua is undergoing an appreciable decline. In addition, it is suggested by Espeut and confirmed by interviews with fishermen, that most fishermen in the area consider fishing as a part-time activity and many hold other full-time jobs during the week. One of the reasons put forward for this is the lure of better paying jobs in the tourism sector (see Section 5.2.2.2). The fishery itself has shown some signs of stress. Results of the diving surveys for example, indicate that there is an abundance of juveniles and few adult fish. This is suggested to be the result of over fishing.

The sustainability of the existing fisheries has been discussed as a primary objective in the draft Antigua and Barbuda Fisheries Development Plan 2006-2010. The stated goal of the Fisheries Sector is “to ensure its development occurs in a manner, which is “sustainable” and capable of contributing its full potential to the overall development of the national economy.” In order to achieve this, the plan outlines the following objectives:

- Improvement of the Fisheries Division management capabilities,
- Integration of the sub-sector concerns of the Fisheries Division into the wider framework of Coastal Zone Management and Development Planning.

- Increase the role that the fishing industry plays in the building of the national economy.
- Develop products to reduce importation.
- Increase incomes and returns to fishers and other members of the fishing community.
- Improve marketing infrastructure.
- Upgrade fishing capabilities and strengthen fisheries infrastructure.
- Upgrade training and extension programmes.

There is also an ongoing project to prepare a comprehensive Fishery Management Plan which will target both the marine habitat as well as the stakeholders.

It is therefore felt that the implementation of the Fisheries Development Plan and the Fishery Management Plan will ensure the sustainability of the fisheries of the island and therefore by extension in the NEMMA.

9.12.2.2 Training

Training will be required for all users, surrounding residents and livelihoods operators within the NEMMA in the areas of resource, environmental and business management. There are therefore opportunities for trainers in these specialised areas to design and deliver appropriate training courses to the various target groups (see Section 9.9).

9.13 Evaluation Matrix

Matrices have been developed under the Canadian Environmental Assessment Act (CEAA) to evaluate Environmental Issues, Social Issues and Livelihood Issues. Notes on the use of these matrices have been prepared by the Canadian International Development Agency (CIDA, 2002), and an excerpt from these notes forms Appendix F of this report.

Tables 39, 40 and 41, adapted from the CEAA originals, evaluate environmental issues, social issues and livelihood issues, respectively. The Project Undertakings in each case are the actions in the Management Plan and Livelihood Reports for the North East Marine Management Area. The ratings for each project undertaking are shown on the appropriate matrix.

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APPENDIX A

STRUCTURED QUESTIONNAIRE TEMPLATES

ATTITUDE SURVEY - VENDORS

ECOENGINEERING CARIBBEAN LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY – VENDORS

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of the survey is to gather social data on vendors who operate in this area, which will enable us to determine how managing the protected area might impact on you. Are you available for an interview?

RESPONDENT INFORMATION

This questionnaire seeks information on how you think management of the protected area would affect you.

Name (optional):_____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Address: _____

What is the highest level of education received?

- ☐ Primary
- ☐ Secondary
- ☐ Technical / Vocational
- ☐ Tertiary

Do you have any other skills?

☐No ☐Yes (*Please Specify*) _____

HOUSEHOLD INFORMATION

The next set of questions concerns your household. This is basic demographic data, the sort that is normally collected by the Central Statistical Office during a Census.

1. Are you the main income earner in your household?

   ☐ Yes ☐ No ☐ No response

2. How many people are reliant on your income? _____

3. Do all of these persons reside in one household?

   ☐ Yes ☐ No *(please indicate no. of households)*_____ ☐ No response

   Please indicate their ages:

AGE GROUP	GENDER		TOTAL
	Female	Male	
0 to 5 years			
6 to 11 years			
12 to 17 years			
18 to 29 years			
30 to 45 years			
46 to 60 years			
More than 60 years			
Total			

4. Number of adults in the family currently employed outside of the household:
   _____

5. Type of occupation:

Member of Household	Occupation/ Skill	Duration in Occupation	Location of Workplace

6. Number of children/young adults currently at school _____

Please indicate level:
☐ ____ Kindergarten / Pre-school
☐ ____ Primary
☐ ____ Secondary
☐ ____ Technical / Vocational
☐ ____ Tertiary

INFORMATION ON CURRENT USE OF PROTECTED AREA

The next set of questions seeks to identify the current use of the reef.

7. Type of product being sold
☐ T-shirts ☐ Souvenirs ☐ Craft items
☐ Other _____ ☐ No response

8. How long have you been vending in this area?
☐ less than 5 years
☐ 5 to 10 years
☐ more than 10 years but less than 20 years
☐ more than 20 years but less than 30 years
☐ more than 30 years
☐ no response

9. What is the average amount of customers daily? _____

10. What months of the year do you have the most amount of visitors to the reef?

_____
_____
_____

11. How has your business changed within the last ten years:

☐ Increased ☐ Decreased ☐ Stayed the Same ☐ More Operators
☐ Other (specify):_____

12. For what purpose do you use the reef?

_____

13. How do you access the reef?
☐ Private boat ☐ Water taxi ☐ Other (specify) _____
☐ No response

14. Are you faced with any constraints in using the protected area?

_____

ACTIVITIES

15. Please describe the activities that you know takes place at the Reef:

_____
_____
_____
_____

☐ Diving
☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenier)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing
☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify) _____

16. What activities have negatively impacted on the quality of the reef?

_____
_____
_____

17. What efforts have been made to protect this area?

_____
_____
_____

QUALITY

18. Has the quality of the reef changed?

☐ Yes ☐ No

If yes, please describe the changes noticed:

_____
_____
_____
_____

☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

MANAGEMENT

19. What measures do you recommend to protect the quality of the coral reef?

_____
_____
_____
_____

20. Do you think that making the reef into a marine protected area (MPA) would help protect the coral reefs?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

ATTITUDES AND PERCEPTIONS

Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

21. Do you think the reef should become a marine protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

ATTITUDE SURVEY FOR TOURISTS

ECOENGINEERING CARIBBEAN LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY FOR TOURISTS

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of the survey is to gather social data on your community, which will enable us to determine how managing the protected area might impact on you. Are you available for an interview?

RESPONDENT INFORMATION

This questionnaire seeks information on how you think management of the protected area would affect tourists who visit this location.

Name:(optional)_____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Nationality: _____

INFORMATION ON CURRENT USE OF THE PROTECTED AREA

1. Is this your first visit to this country?
☐ Yes ☐ No ☐ Don't Know ☐ No Response

If the response is yes, please skip question 2.

2. How often have you visited this particular country?
_____

3. What is the purpose of your visit?
☐ Pleasure ☐ Work
☐ Other

4. How did you hear about this place?
☐ Travel agent ☐ Friends / Family ☐ Internet ☐ Television
☐ Newspaper / Magazine ☐ Other

5. Number of people currently with you: _____

6. How many nights are you staying in the country? _____

7. Type of occupation:

Male / Female	Occupation/ Skill	Duration in Occupation

ACTIVITIES

8. What type of activities do you normally engage in when you visit this country?
_____
_____
_____

9. What activities on the reef have you noticed in the duration of your stay?
_____
_____
_____
_____

☐ Diving
☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenier)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing

☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify _____

QUALITY

10. Have you visited the reef during your visit ?

☐ Yes ☐ No
(If No, skip to next section

11. By what means did you visit the reef?

☐ Tourboat ☐ Diving ☐ Snorkeling ☐ Catamaran
☐ Other _____

12 What did you enjoy most about the reef?
_____
_____
_____

13 Has the quality of the reef changed since the last time you visited?
☐ Yes ☐No

Please describe the changes noticed:
_____
_____
_____

☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

MANAGEMENT

14. Do you think that making the reef into a marine protected area (MPA) would help protect the coral reefs?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

15. Do you think that the development of a marine park management system will improve the quality of the coral reefs?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

ATTITUDES AND PERCEPTIONS

Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

16. If the reef becomes a marine protected area (MPA) what impact do you think it would have on your vacation experience?

_____
_____
_____

17 Do you think the reef should become a marine protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

ATTITUDE SURVEY - TOUR BOAT OPERATORS

ECOENGINEERING CARIBBEAN LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY – TOUR BOAT OPERATORS

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of the survey is to gather social data on your community, which will enable us to determine how managing the protected area might impact on you. Are you available for an interview?

RESPONDENT INFORMATION

This questionnaire seeks information on how you think management of the protected area would affect you.

Name (optional):_____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Address: _____

What is the highest level of education received?

- ☐ Primary
- ☐ Secondary
- ☐ Technical / Vocational
- ☐ Tertiary

Do you have any skills other than tour boat operations?

☐No ☐Yes (*Please Specify*) _____

HOUSEHOLD INFORMATION

The next set of questions concerns your household. This is basic demographic data, the sort that is normally collected by the Central Statistical Office during a Census.

1. Are you the main income earner in your household?

   ☐ Yes ☐ No ☐ No response

2. How many people are reliant on your income? _____

3. Do all of these persons reside in one household?

   ☐ Yes ☐ No *(please indicate no. of households)*_____ ☐ No response

   Please indicate their ages:

AGE GROUP	GENDER		TOTAL
	Female	Male	
0 to 5 years			
6 to 11 years			
12 to 17 years			
18 to 29 years			
30 to 45 years			
46 to 60 years			
More than 60 years			
Total			

4. Number of adults in the family currently employed outside of the household: _____

5. Type of occupation:

Member of Household	Occupation/ Skill	Duration in Occupation	Location of Workplace

6. Number of children/young adults currently at school _____

   Please indicate level:
   ☐ ____ Kindergarten / Pre-school
   ☐ ____ Primary
   ☐ ____ Secondary
   ☐ ____ Technical / Vocational
   ☐ ____ Tertiary

INFORMATION ON CURRENT USE OF PROTECTED AREA

The next set of questions seeks to identify the current use of the reef.

7. How long have you been a tour-boat operator in this area?
   - ☐ less than 5 years
   - ☐ 5 to 10 years
   - ☐ more than 10 years but less than 20 years
   - ☐ more than 20 years but less than 30 years
   - ☐ more than 30 years
   - ☐ no response

8. Do you own your own boat?
   ☐ Yes ☐ No ☐ No response

   If yes how many? _____

9. What material is your boat made of?
   ☐ Fibreglass ☐ Wood ☐ Both ☐ Other ☐ Don't know ☐No response

10. How is your boat propelled?
    ☐ Motorised ☐ Non-motorised ☐ Other ☐ No response

11. Are the boat(s) licensed?

    ☐ Yes ☐ No ☐ Don't Know ☐ No Response

12. What is the average amount of people per trip? _____

13. How many trips do you make daily?

    ☐ 1 ☐ 3 ☐ Don't Know
    ☐ 2 ☐ > 3 ☐ No Response

14. What is the length of a trip (hours)?

    ☐ 1- 1hr. 30 mins
    ☐ 1 hr. 30 mins – 2 hrs
    ☐ 2 hrs – 2hrs 30 mins
    ☐ 2 hrs 30 mns – 3 hrs
    ☐ > 3 hrs

15. What months of the year do you have the most amount of visitors to the reef?

    _____
    _____
    _____

16. What is your primary route?

_____

17. Are you faced with any constraints in using the protected area?

_____

18. What is your rate? _____

ACTIVITIES

19. Please describe the activities that you know takes place at the Reef:

_____
_____
_____
_____

☐ Diving
☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenier)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing
☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify) _____

20. What activities have negatively impacted on the quality of the reef?

_____
_____
_____

21. What efforts have been made to protect this area?

_____
_____
_____

22. How has the of reef tour business changed within the last ten years:

☐ Increased ☐ Decreased ☐ Stayed the Same ☐ More Operators
☐ Other (specify):_____

QUALITY

23. What makes this reef attractive to reef touring?

_____
_____
_____

24. Has the quality of the reef changed?

☐ Yes ☐ No

If yes, please describe the changes noticed:

_____
_____
_____
_____

☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

MANAGEMENT

25. What measures do you recommend to protect the quality of the coral reef?

_____
_____
_____
_____

26. Developing the reef into a marine protected area (MPA) would help protect the coral reefs.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

ATTITUDES AND PERCEPTIONS

Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

27. Do you think the reef should become a marine protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

ATTITUDE SURVEY - RESIDENTS

ECOENGINEERING CARIBBEAN LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY – RESIDENTS

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of this survey is to gather social data on your community, which will enable us to determine how managing the protected area might have an impact on you. Are you available for an interview?

RESPONDENT INFORMATION

Name: _____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Family Status: ☐ Mother ☐ Father ☐ Other (specify) _____

Address: _____

What is your highest level of education received?

- ☐ Primary
- ☐ Secondary
- ☐ Technical / Vocational
- ☐ Tertiary

HOUSEHOLD INFORMATION

The next set of questions concerns your household. This is basic demographic data, the sort that is normally collected by the Central Statistical Office during a Census.

1. How long has your family lived at this address?
   - ☐ less than 5 years
   - ☐ 5 to 10 years
   - ☐ more than 10 years but less than 20 years
   - ☐ more than 20 years but less than 30 years
   - ☐ more than 30 years
   - ☐ no response

2. No. of people in this household: _____

3. Please indicate the number of persons in your household within the following groups:

AGE GROUP	GENDER		TOTAL
	Female	Male	
0 to 5 years			
6 to 11 years			
12 to 17 years			
18 to 29 years			
30 to 45 years			
46 TO 60 years			
More than 60 years			
Total			

4. Number of adults in the family currently employed outside of the household _____

5. Type of occupation:

Member of Household	Occupation/ Skill	Duration in Occupation	Location of Workplace

6. Number of children/young adults currently at school _____

   Please indicate level:
   - ☐ ____ Kindergarten / Pre-school
   - ☐ ____ Primary
   - ☐ ____ Secondary
   - ☐ ____ Technical / Vocational
   - ☐ ____ Tertiary

INFORMATION ON CURRENT USE OF THE PROTECTED AREA

7. How often do you visit the reef?

☐ Daily ☐ monthly ☐ yearly
☐ weekly ☐ never ☐ No response

8. Do you visit the reef at a particular time of the year?
☐ No ☐ Yes , (*Please specify*) _____
☐ no response

9. How do you access the reef?
☐ Private boat ☐ Water taxi ☐ Other ☐ No response

ACTIVITIES

10. Please describe the activities that you engage in when you visit the reef:

_____
_____
_____
_____

☐ Diving
☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenier)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing
☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify _____

QUALITY

11. The Reef been an ideal location for recreation.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

12. Has the quality of the reef changed?

☐ Yes ☐ No ☐ Don't know ☐ No response

Please describe the changes noticed:

_____
_____
_____
_____

☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

MANAGEMENT

13. Are there any activities that you think should be prohibited or controlled on the reef?
☐ Yes _____
☐ No ☐ Don't know ☐ No response

If yes, please indicate a reason for your answer:

_____
_____
_____
_____

14. How do you think having a marine protected area would impact the reef?

_____

ATTITUDES AND PERCEPTIONS

Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

15. If the reef becomes a marine protected area (MPA) what impact do you think it would have on your livelihood?

_____
_____
_____

16. Do you think the reef should become a marine protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

ATTITUDE SURVEY FOR FISHERMEN

ECOENGINEERING CARIBBAEAN LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY FOR FISHERMEN

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of this survey is to gather social data on the fishermen who live and work in the area, which will enable us to determine how managing the protected area might have an impact on you. Are you available for an interview?

RESPONDENT INFORMATION

Name: _____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Family Status: ☐ Mother ☐ Father ☐ Other (specify) _____

Address: _____

What is the highest level of education received?

- ☐ Primary
- ☐ Secondary
- ☐ Technical / Vocational
- ☐ Tertiary

Do you have any skills other than fishing?

☐No ☐Yes (*Please Specify*) _____

HOUSEHOLD INFORMATION

1. Are you the main income earner in your household?

   ☐ Yes ☐ No ☐ No response

2. How many people are reliant on your income? _____

3. Do all of these persons reside in one household?

   ☐ Yes ☐ No *(please indicate no. of households)*_____ ☐ No response

   Please indicate their ages:

AGE GROUP	GENDER		TOTAL
	Female	Male	
0 to 5 years			
6 to 11 years			
12 to 17 years			
18 to 29 years			
30 to 45 years			
46 to 60 years			
More than 60 years			
Total			

4. Number of adults in the family currently employed outside of the household:
   _____

5. Type of occupation:

Member of Household	Occupation/ Skill	Duration in Occupation	Location of Workplace

6. Number of children/young adults currently at school _____

   Please indicate level:
   ☐ ____ Kindergarten / Pre-school
   ☐ ____ Primary
   ☐ ____ Secondary
   ☐ ____ Technical / Vocational
   ☐ ____ Tertiary

INFORMATION ON CURRENT USE OF THE PROTECTED AREA

7. How long have you fished in this area?
☐ < 1 year ☐ 1- 5 years ☐ 6- 10 years
☐ 11-15 years ☐ 16 – 20 years ☐ > 20 years

8. How often do you go out to fish?
☐ Every morning ☐ many times a day ☐ once a month
☐ Every evening ☐ once a week ☐ many times a month
☐ once a day ☐ many times a week ☐ No response

9. What is the location of your primary fishing ground?

☐ Yes ☐ No ☐ Don't know ☐ No response

10. Do you own your own boat?
☐Yes ☐No ☐No response

If yes how many boats do you own? _____

11. What material is your boat made of?
☐ Fibreglass ☐ Wood ☐ Both ☐ Don't know ☐No response

12. How is your boat propelled?
☐ Motorised ☐ Non-motorised ☐ Other *(specify)* _____
☐ No response

13. Are the boat(s) licensed?

☐ Yes ☐ No ☐ Don't Know ☐ No Response

14. Is your fishing seasonal?
☐No ☐Yes (Please specify the particular months)
_____
_____

15. What type of fish do you catch?
_____

16. What is your average catch size per week?
_____

17. Do you use a particular fishing method?

☐ Yes *(please specify):* _____
☐ No ☐ Don't Know ☐ No Response

ACTIVITIES

18. Do you use the reef for any activity other than fishing?
☐ Yes *(please specify):* _____

19. How do you think fishing has impacted on the reef over the period that you have been fishing in this area?

_____
_____
_____

20. Please describe the activities that you know take place at the Reef:

☐ Diving
☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenier)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing
☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify _____

21. Can you identify any activities that may have a negative impact on the reef?

_____
_____
_____

QUALITY

22. Has your catch size:

☐ Increased ☐ Decreased ☐ Remained the same

since you started fishing?

23. Has the quality of the reef changed since you started fishing?

☐ Yes ☐ No ☐ Don't know ☐ No response

Please describe the changes noticed:

☐ Decrease in fish
☐ Fish Nurseries
☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

MANAGEMENT

24. What measures do you recommend to protect the reef or improve the quality of the reef?
_____
_____
_____
_____

25. How do you think having a marine protected area would impact the reef?
_____
_____
_____

ATTITUDES AND PERCEPTIONS

26. Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

27. If the reef becomes a managed protected area (MPA) what impact do you think it would have on your livelihood?

_____
_____
_____

28. Do you think the reef should become a managed protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

ATTITUDE SURVEY - DIVERS

ECOENGINEERING CARIBBEAN LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY - DIVERS

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of this survey is to gather social data on divers who use the reef, which will enable us to determine how managing the protected area might have an impact on you. Are you available for an interview?

RESPONDENT INFORMATION

Name *(optional)*:_____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Nationality: _____

What is the highest level of education received?

- ☐ Primary
- ☐ Secondary
- ☐ Technical / Vocational
- ☐ Tertiary

INFORMATION ON CURRENT USE OF THE PROTECTED AREA

1. For what purpose do you dive? *(If for leisure skip next section)*
   ☐ Leisure ☐ Commercial ☐ Other *(please specify)*_____

2. How long have you dived in this area?
   ☐ < 1 year ☐ 1- 5 years ☐ 6- 10 years
   ☐ 11-15 years ☐ 16 – 20 years ☐ > 20 years

3. How often do you go out to dive?
   ☐ once a day ☐ several times a day ☐ 1 – 3 times a week
   ☐ 4-7 times a week ☐ once a month ☐ more than once a month
   ☐ No response

4. Is the reef your primary diving ground?
   _____

5. How do you access the reef?
   ☐ Private boat ☐ Water taxi ☐ Other ☐ No response

HOUSEHOLD INFORMATION

6. Are you the main income earner in your household?

   ☐ Yes ☐ No ☐ No response

7. How many people are reliant on your income? _____

9 Do all of these persons reside in one household?

   ☐ Yes ☐ No *(please indicate no. of households)*_____ ☐ No response

Please indicate their ages:

AGE GROUP	GENDER		TOTAL
	Female	Male	
0 to 5 years			
6 to 11 years			
12 to 17 years			
18 to 29 years			
30 to 45 years			
46 to 60 years			
More than 60 years			
Total			

9. Number of adults in the family currently employed outside of the household:_____

10. Type of occupation:

Member of Household	Occupation/ Skill	Duration in Occupation	Location of Workplace

11. Number of children/young adults currently at school _____

Please indicate level:
☐ ____ Kindergarten / Pre-school
☐ ____ Primary
☐ ____ Secondary
☐ ____ Technical / Vocational
☐ ____ Tertiary

ACTIVITIES

12. What activities are you interested in other than diving?
_____

13. What activities have you noticed other people doing when you go on your dives?

☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenier)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing
☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify _____

QUALITY

14. Has the quality of the reef changed since you started diving?

☐ Yes ☐ No ☐ Don't know ☐ No response

Please describe the changes noticed:

_____
_____
_____
_____

☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

15. What activities might have contributed to these changes?

_____

MANAGEMENT

16. How do you think having a marine protected area would impact the reef?

_____

ATTITUDES AND PERCEPTIONS

Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

17. If the reef becomes a marine protected area (MPA) what impact do you think it would have on your livelihood?

_____
_____
_____

18. Do you think the reef should become a marine protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

ATTITUDE SURVEY - (Yachties)

ECOENGINEERING CONSULTANTS LIMITED

STUDIES FOR OPAAL DEMONSTRATION PROJECTS

ATTITUDE SURVEY-(Yachties)

Date: _____ Name of Interviewer: _____

We are working on the OECS Protected Areas and Associated Livelihoods Project which aims to collect information that will help OECS member states to better manage their coral reefs, fish and other natural resources. This project is being coordinated by the OECS ESDU. Our firm, Ecoengineering has been asked to collect information to put together a baseline on the environment, social and economic situation in this area and to identify any possible impacts that could affect the resources.

The purpose of this survey is to gather social data about the yachters who use this area, which will enable us to determine how managing the protected area might have an impact on you. Are you available for an interview?

RESPONDENT INFORMATION

Name *(optional)*:_____

Gender: ☐ Male ☐ Female

Age: ☐ 18 – 25 ☐ 26 – 35 ☐ 36 – 45 ☐ 46 – 55 ☐ 56 – 65
☐ > 66 ☐ No response

Nationality: _____

INFORMATION ON CURRENT USE OF THE PROTECTED AREA

1. How many nights are you spending in this country? _____

2. How often do you visit this area?
☐ Weekly ☐ Monthly ☐ Yearly ☐ Other _____

3. How many persons traveled on your yacht on this trip? _____

4. Is this your first visit to this country?
☐ Yes ☐ No ☐ Don't Know ☐ No Response

If the response is yes, please skip question 2.

5. How often have you visited this country?

_____

6. How did you hear about this place?
☐ Travel agent ☐ Friends / Family ☐ Internet ☐ Television
☐ Newspaper / Magazine ☐ Other

ACTIVITIES

7. What activities do you engage in while in this country?
☐ beaches ☐ diving ☐ fishing ☐ snorkeling
☐ other *(please specify)* _____

8. How often have you visited the reef on this trip? _____

9. How did you access the reef?

☐ Private boat ☐ Water taxi ☐ Diving ☐ Snorkeling
☐ Catamaran ☐ No response ☐ Other (specify) _____

10. What activities have you engaged in at the reef?

☐ Diving
☐ Snorkelling
☐ Reef Walking
☐ Swimming/Sea Bathing
☐ Anchoring
☐ Mooring
☐ Natural Impacts
☐ Collecting coral (souvenir)
☐ Glass-Bottomed Boating
☐ Water Skiing
☐ Wind Surfing
☐ Over-fishing
☐ None
☐ No Response
☐ Other (specify) _____

QUALITY

11. Has the quality of the reef changed since the last time you visited? (*If this is the first visit, skip this question*)

☐ Yes ☐ No ☐ Don't know ☐ No response

Please describe the changes noticed:

☐ Coral Bleaching
☐ Algae
☐ decrease in water quality
☐ decrease in water clarity
☐ reef breakage
☐ None
☐ No Response
☐ Other (specify) _____

MANAGEMENT

12. Do you think that making the reef into a marine protected area (MPA) would help protect the coral reefs?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

ATTITUDES AND PERCEPTIONS

Indicate degree of agreement with the following statements using the scale: agree strongly (5); agree (4); neither agree nor disagree (3); disagree (2); strongly disagree (1)

	1	2	3	4	5	NR
The reefs are important for protecting land from storm waves						
Coral reefs are only important if you fish or dive						
In the long run fishing wound be better if we cleared the coral						
Fishing should be restricted in certain areas just to allow the fish and coral to grow						
Future generations should be able to enjoy the coral reefs						
We should restrict development in some coastal areas even if no one ever fishes in those areas just to allow the fish and coral to grow						
Seagrass beds have no value to people.						

13. If the reef becomes a marine protected area (MPA) what impact do you think it would have on you, if any?

_____
_____
_____

14. Do you think the reef should become a marine protected area?

☐Yes ☐No ☐No Response

THANK YOU FOR YOUR COOPERATION

APPENDIX B

CLASSIFICATION OF IMPACTS

APPENDIX B

CLASSIFICATION OF ENVIRONMENTAL IMPACTS

B.1 OBJECTIVE AND APPLICATION

B.1.1 Objective

This system provides a structured method of mitigation classification of the environmental impacts related to the establishment of the Northeast Marine Management Area (NEMMA), Antigua. The objective is to have a unified classification structure which can then be used to determine the significance of environmental impacts of the proposed project.

B.1.2 Application

While it is recognized that beneficial environmental impacts can also arise from this development, this classification system will be used only to rate adverse environmental impacts. In addition, this system rates impacts both before the application of mitigation measures and after available and realistic mitigation measures have been applied to minimize adverse impacts.

B.2 PARAMETERS

In this system, environmental impacts are rated on the basis of three parameters:

- Extent,
- Intensity, and
- Nature.

B.2.1 Extent

"Extent" describes the geographical area likely to be impacted by the project. In this classification system, four classes of extent (see Figure B-1) have been defined:

On-Site	Within the boundaries of the NEMMA as declared.
Localized	Areas above the high water mark; beyond the land edge of fringing mangrove; or within the relevant watersheds,
National	The country of Antigua and Barbuda

B.2.2 Intensity

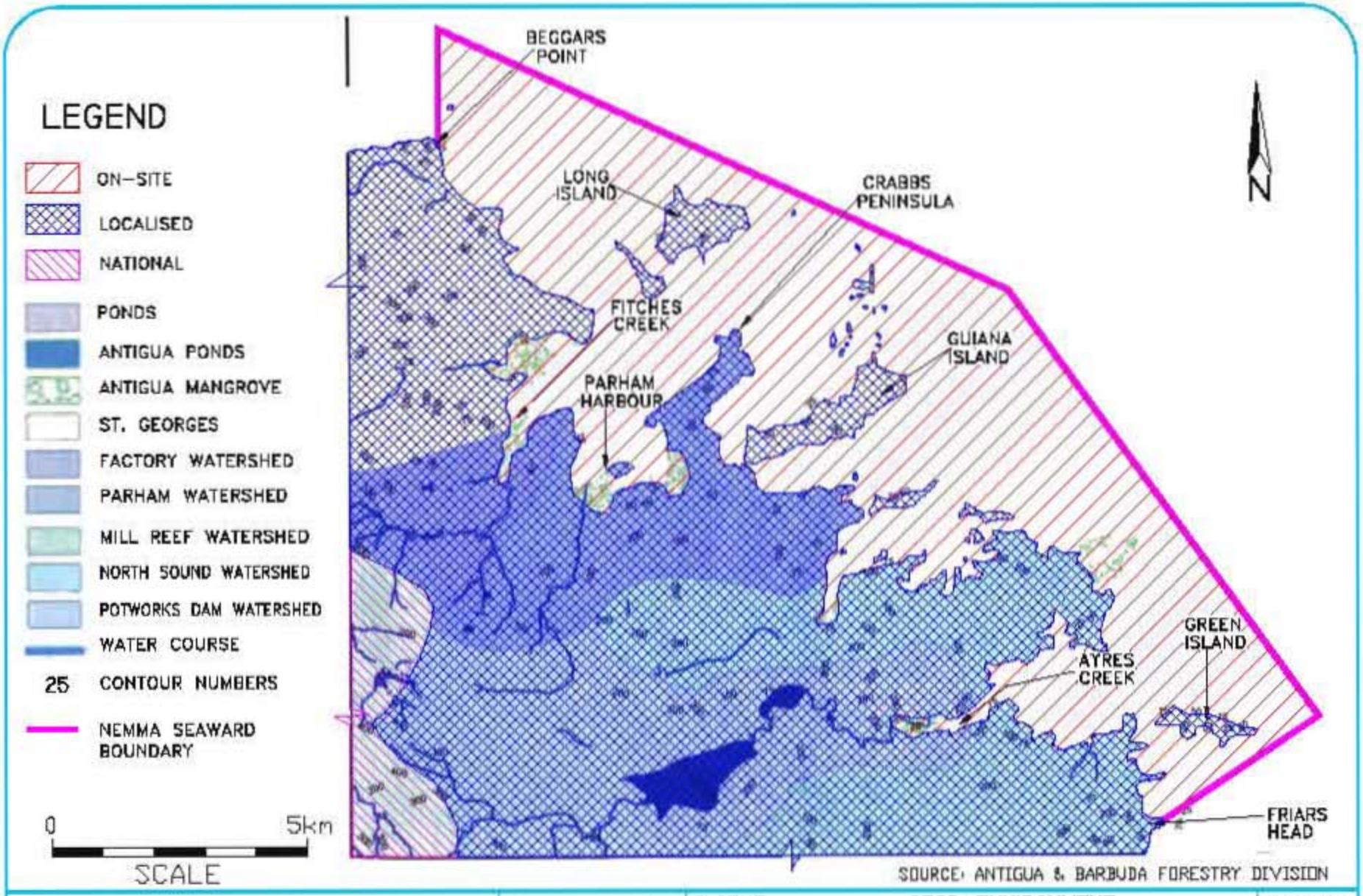
"Intensity" describes the degree of change which may result from the potential impact. In this classification system, intensity has been based on ecosystem effects and the effects to social groups, and four classes have been defined:

Very Small	Effects on a few persons or individual organisms, but no significant effects on the functioning or sustainability of social groups, specific ecosystems or services.
Minor	Marked effects on several individuals, and limited effects on the functioning or sustainability of social groups, specific ecosystems or services.
Medium	Significant effects on the functioning or sustainability of social groups, specific ecosystems or services.
Major	Serious impairment of the functioning or sustainability of social groups, specific ecosystems, or services.

B.2.3 Nature

"Nature" considers the whether the potential impact is expected to be reversible or irreversible. In this classification system, these have been defined as:

Reversible	Impacts which can be reduced or modified by applying appropriate mitigation measures.
Irreversible	Impacts which are considered to be unavoidable and cannot be reduced or modified.



Ecoengineering Caribbean Ltd.

Eco Report No. 10/2007	CLIENT: OECS -ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNIT	FIGURE NUMBER B-1
Date: 31/07/07	PROJECT: NORTHEAST MARINE MANAGEMENT AREA (NEMMA), ANTIGUA	
	DWG. NAME: CLASSES OF EXTENT	

B.3 CLASSIFICATION OF IMPACTS

Tables B-1and B-2 indicate the classifications of impacts on a scale of "Low", "Moderate", "High" and "Extreme", based on extent, intensity and nature. However, the following are rated as "Extreme" regardless of extent, intensity or nature:

- < impacts which exceed the limits set in environmental standards or rules,
- < impacts which violate Antigua and Barbuda's international commitments, and
- < impacts which affect environmentally sensitive areas or species.

TABLE B-1: CLASSIFICATION OF REVERSIBLE IMPACTS

INTENSITY	AREA		
	On-Site	Localized	National
Very Small	LOW	LOW	MODERATE
Minor	LOW	LOW	MODERATE
Medium	LOW	MODERATE	MODERATE
Major	MODERATE	MODERATE	HIGH

TABLE B-2: CLASSIFICATION OF IRREVERSIBLE IMPACTS

INTENSITY	AREA		
	On-Site	Localized	National
Very Small	LOW	MODERATE	MODERATE
Minor	MODERATE	MODERATE	HIGH
Medium	MODERATE	HIGH	EXTREME
Major	HIGH	HIGH	EXTREME

Environmental Impacts are evaluated following the implementation of appropriate mitigation and control practices. Assigning a consequence severity and likelihood to each event qualitatively rates the risk of each environmental impact. The risk level is determined by the position on the risk matrix where the event falls. An appropriate response and prioritization to each environmental risk has been developed:

- Extreme: Intolerable environmental risk with significant and urgent actions required to reduce risk.
- High and Moderate: Implement actions necessary to reduce risk to as low a level as reasonably practical.
- Low: Monitor and manage risk to the extent necessary.

APPENDIX C

SPECIES LISTS AND NOTES OF AQUATIC FLORA AND FAUNA

APPENDIX C:

SPECIES NOTES FOR AQUATIC FAUNA AND FLORA

This appendix contains the following:

- Lists of aquatic fauna and abundance noted in the NEMMA,
- List of aquatic flora noted in the NEMMA,

Fauna are separated into the following headings:

- Fish fauna,
- Corals, and
- Other fauna

Flora is separated into the following headings:

- Seagrass, and
- Algae, and

C.1 FAUNA

C.1.1 Fish Fauna

A total of 9 roving diver surveys were conducted for this study and a total of 51 species were noted. Tables C-1 to C-5 below list the fish fauna and the relative abundances within the NEMMA. The species notes to these species are present in the annex to this appendix.

TABLE C-1: MAIDEN ISLAND ARTIFICIAL REEF

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Beaugregory	*Stegastes leucostictus*				X
Barred Hamlet	*Hypoplectrus puella*	X			
Blue tang	*Acanthurus coeruleus*			X	
Bluehead Wrasse	*Thalassoma bifasciatum*			X	
Bluestriped grunt	*Haemulon sciurus*		X		
Bucktooth parrotfish	*Sparisoma radians*		X		
Clown Wrasse	*Halichoeres maculipinna*		X		
Doctorfish	*Acanthurus chirurgus*		X		
Foureye Butterfly	*Shaetodon capistratus*		X		
French Grunt	*Haemulon flavolineatum*				X
Hamlet	*Hypoplectrus sp.*		X		

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Lane Snapper	*Lutjanus synagris*			X	
Longspine Squirrelfish	*Longspine squirrelfish*		X		
Ocean Surgeon	*Acanthurus bahianus*			X	
Red band parrotfish	*Sparisoma aurofrenatum*		X		
Red Hind	*Epinephelus guttatus*	X			
Sergeant major	*Abudefduf saxatilis*		X		
Slippery Dick	*Halichoeres bivittatus*			X	
Southern Stingray	*Dasyatis americana*	X			
Spotted Eagle Ray	*Aetobatus narinari*	X			
Spotted Goatfish	*Pseudupeneus maculatus*			X	
Squirelfish	*Holocentrus adscensionis*				X
Stoplight Parrotfish	*Sparisoma viride*			X	
Striped Parrotfish	*Scarus iseri*			X	
Three spot Damsel	*Stegastes planifrons*		X		
White Grunt	*Haemulon plumieri*			X	
Yellow Goatfish	*Mulloidichthys martinicus*			X	
Yellowhead Wrasse	*Halichoeres garnoti*		X		
Yellowfin Mojarra	*Gerres cinereus*		X		
Yellowtail Snapper	*Ocyurus chrysurus*		X		

Note: S- 1, F – 2-10, M-11-100, A - >100

TABLE C-2: GREAT BIRD ISLAND

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Beaugregory	*Stegastes leucostictus*				X
Barred Hamlet	*Hypoplectrus puella*		X		
Blue tang	*Acanthurus coeruleus*			X	
Bluehead Wrasse	*Thalassoma bifasciatum*			X	
Bucktooth parrotfish	*Sparisoma radians*			X	
Clown Wrasse	*Halichoeres maculipinna*			X	
Doctorfish	*Acanthurus chirurgus*			X	
Foureye Butterfly	*Shaetodon capistratus*			X	
French Grunt	*Haemulon flavolineatum*				X
Green Moral Eel	*Gymnothorax funebris*	X			
Longspine Squirrelfish	*Longspine squirrelfish*		X		
Ocean Surgeon	*Acanthurus bahianus*			X	
Nasseau Grouper	*Epinephelus striatus*	X			
Red band parrotfish	*Sparisoma aurofrenatum*		X		
Sergeant major	*Abudefduf saxatilis*			X	
Slippery Dick	*Halichoeres bivittatus*				X
Schoolmaster Snapper	*Lutjanus apodus*		X		
Smooth Trunkfish	*Lactophrys triqueter*	X			
Spotted Goatfish	*Pseudupeneus maculatus*			X	
Squirelfish	*Holocentrus adscensionis*			X	

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Stoplight Parrotfish	*Sparisoma viride*			X	
Striped Parrotfish	*Scarus iseri*			X	
Three spot Damsel	*Stegastes planifrons*				X
White Grunt	*Haemulon plumieri*			X	
Yellowhead Wrasse	*Halichoeres garnoti*		X		
Yellowtail Snapper	*Ocyurus chrysurus*		X		

Note: S- 1, F – 2-10, M-11-100, A - >100

TABLE C-3: BIRD ISLAND REEF

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Beaugregory	*Stegastes leucostictus*				X
Barjack	*Caranx rubber*		X		
Bermuda Chub	*Kyphosus sectatrix*		X		
Blue tang	*Acanthurus coeruleus*				X
Bluehead Wrasse	*Thalassoma bifasciatum*				X
Bucktooth parrotfish	*Sparisoma radians*		X		
Clown Wrasse	*Halichoeres maculipinna*				X
Doctorfish	*Acanthurus chirurgus*		X		
Foureye Butterfly	*Shaetodon capistratus*		X		
French Grunt	*Haemulon flavolineatum*				X
Longspine Squirrelfish	*Longspine squirrelfish*		X		
Ocean Surgeon	*Acanthurus bahianus*				X
Nasseau Grouper	*Epinephelus striatus*		X		
Red band parrotfish	*Sparisoma aurofrenatum*			X	
Saucereye Porgy	*Calamus calamus*		X		
Sergeant major	*Abudefduf saxatilis*		X		
Slippery Dick	*Halichoeres bivittatus*				X
Schoolmaster Snapper	*Lutjanus apodus*		X		
Spotted Goatfish	*Pseudupeneus maculatus*		X		
Squirelfish	*Holocentrus adscensionis*			X	
Stoplight Parrotfish	*Sparisoma viride*			X	
Striped Parrotfish	*Scarus iseri*			X	
Three spot Damsel	*Stegastes planifrons*			X	
White Grunt	*Haemulon plumieri*				X
Yellow Goatfish	*Mulloidichthys martinicus*		X		
Yellowhead Wrasse	*Halichoeres garnoti*			X	
Yellowfin Mojarra	*Gerres cinereus*		X		
Yellowtail Parrotfish	*Sparisoma rubripinne*		X		
Yellowtail Snapper	*Ocyurus chrysurus*			X	

Note: S- 1, F – 2-10, M-11-100, A - >100

TABLE C-4: GREEN ISLAND

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Beaugregory	*Stegastes leucostictus*				X
Barred Hamlet	*Hypoplectrus puella*			X	
Bicolor damsel	*Stegastes partitus*		X		
Blue tang	*Acanthurus coeruleus*				X
Bluehead Wrasse	*Thalassoma bifasciatum*				X
Clown Wrasse	*Halichoeres maculipinna*		X		
Doctorfish	*Acanthurus chirurgus*			X	
Dusky Squirrelfish	*Sargocentron vexillarium*	X			
Fairy Basslet	*Gramma loreto*		X		
Foureye Butterfly	*Shaetodon capistratus*			X	
French Grunt	*Haemulon flavolineatum*			X	
Gray angelfish	*Pomacanthus arcuatus*	X			
Hamlet	*Hypoplectrus sp.*			X	
Harlequin bass	*Serranus tigrinus*		X		
Lane Snapper	*Lutjanus synagris*		X	X	
Longjaw squirrel	*Neoniphon marinus*		X		
Nasseau Grouper	*Epinephelus striatus*	X			
Ocean Surgeon	*Acanthurus bahianus*				X
Porcupinefish	*Diodon hystrix*	X			
Puddingwife Wrasse	*Halichoeres radiatus*		X		
Red band parrotfish	*Sparisoma aurofrenatum*			X	
Red Hind	*Epinephelus guttatus*	X			
Rosy Blenny	*Malacoctenus macropus*		X		
Sharpnose Puffer	*Canthigaster rostrata*			X	
Slippery Dick	*Halichoeres bivittatus*			X	
Spotted Goatfish	*Pseudupeneus maculatus*	X			
Squirrelfish	*Holocentrus adscensionis*			X	
Stoplight Parrotfish	*Sparisoma viride*			X	
Striped Parrotfish	*Scarus iseri*				X
Three spot Damsel	*Stegastes planifrons*				X
Trumpetfish	*Aulostomus maculatus*		X		
Tobaccofish	*Serranus tabacarius*		X		
Tomtate	*Haemulon aurlineatum*			X	
White Grunt	*Haemulon plumieri*		X		
Yellow Goatfish	*Mulloidichthys martinicus*		X		
Yellowhead Wrasse	*Halichoeres garnoti*			X	
Yellowfin Mojarra	*Gerres cinereus*		X		
Yellow tail Damsel	*Microspathodon chrysurus*		X		
Yellowtail Parrotfish	*Sparisoma rubripinne*		X		
Yellowtail Snapper	*Ocyurus chrysurus*			X	

Note: S- 1, F – 2-10, M-11-100, A - >100

TABLE C-5: PRICKLY PEAR

COMMON NAME	SCIENTIFIC NAME	ABUNDANCE			
		S	F	M	A
Beaugregory	*Stegastes leucostictus*				X
Barred Hamlet	*Hypoplectrus puella*			X	
Bicolor damsel	*Stegastes partitus*			X	
Bermuda Chub	*Kyphosus sectatrix*		X		
Blue tang	*Acanthurus coeruleus*		X		
Bluehead Wrasse	*Thalassoma bifasciatum*				X
Brown chromis	*Chromis multilineata*				X
Creole Wrasse	*Clepticus parrai*				X
Foureye Butterfly	*Shaetodon capistratus*			X	
French Grunt	*Haemulon flavolineatum*		X		
Great Barracuda	*Sphyraena barracuda*				
Hamlet	*Hypoplectrus sp.*			X	
Harlequin bass	*Serranus tigrinus*			X	
Nasseau Grouper	*Epinephelus striatus*	X			
Ocean Surgeon	*Acanthurus bahianus*			X	
Queen Parrotfish	*Scarus vetula*			X	
Red band parrotfish	*Sparisoma aurofrenatum*			X	
Sand Diver	*Synodus intermedius*	X			
Schoolmaster Snapper	*Lutjanus apodus*	X			
Sergeant major	*Abudefduf saxatilis*			X	
Sharpnose Puffer	*Canthigaster rostrata*		X		
Slender Filefish	*Monacanthus tuckeri*			X	
Slippery Dick	*Halichoeres bivittatus*			X	
Spotted Goatfish	*Pseudupeneus maculatus*		X		
Squirrelfish	*Holocentrus adscensionis*			X	
Stoplight Parrotfish	*Sparisoma viride*				X
Striped Parrotfish	*Scarus iseri*				X
Three spot Damsel	*Stegastes planifrons*				X
Trumpetfish	*Aulostomus maculatus*		X		
White Grunt	*Haemulon plumieri*			X	
Yellow Goatfish	*Mulloidichthys martinicus*			X	
Yellowhead Wrasse	*Halichoeres garnoti*			X	
Yellow tail Damsel	*Microspathodon chrysurus*			X	
Yellowtail Snapper	*Ocyurus chrysurus*			X	

Note: S- 1, F – 2-10, M-11-100, A - >100

C.1.2 CORALS

A total of 7 roving diver surveys were conducted for this study and a total of 22 species were noted. Table C-2 below lists the corals within the NEMMA.

TABLE C-6: LIST OF CORALS IN NEMMA (ECOENGINEERING 2007)

COMMON NAME	SCIENTIFIC NAME	SPECIES NOTES
Staghorn Coral	*Acropora cervicornis*	Colonies form antler-like racks of cylindrical branches. Most common on reefs, preferring shallow to intermediate depths between 10-60 ft in clear, calm water.
Elkhorn coral	*Acropora palmata*	Colonies form flattened branches resembling the horns of moose or elk. Surface covered with small, protruding, tubular corallites. They prefer shallow areas of constant water movement. Branches usually orient parallel to surge direction.
Fused Staghorn	*Acropora prolifera*	Colonies similar to *A. cericonis*, however toward the tips of large branches, a spray of shorter branches fuse forming flattened ends. They prefer areas of surge, on for reefs.
Finger Coral	*Porites porites*	Colonies of this genus form smooth branches, with embedded corallites. *P. porites* has stout, irregular, stubby branches with blunt and often enlarged tips. *P. divaricata* has finger-like, widely spaced branches that often divide near the tip. *P. furcata* has finger-like, tightly compacted branches. All three forms are common to most reef environments and depths. Brittlestars, sea urchins and chitons often live among tightly compacted braches.
Thin Finger Coral	*Porites divaricata*	
Branched Finger coral	*Porites furcata*	

COMMON NAME	SCIENTIFIC NAME	SPECIES NOTES
Yellow Pencil coral	*Madracis mirablis*	Colonies form densely packed clumps of small pencil-sized branches with blunt tips. Common to the Caribbean and generally inhabit deeper, clear water, outer reefs.
Lamarck's Sheet Coral	*Agaricia lamarcki*	A common Caribbean species, this coral inhabits sloping reef faces and walls. It is one of the most abundant coral on deep reefs and walls. Colonies form large, thin sheets or flattened plates that often overlap. Colonies' undersides have no polyps and are quite smooth.
Star coral	*Madracis pharensis*	Thinly encrusting oral, spreading in long ribbons or may form numerous small knobs. This coral grows in dark areas and most common in water deeper than 60ft.
Ten-ray Star coral	*Madracis decactis*	Usually thinly encrusting forming small colonies with tightly bunched lobes and knobs. Inhabit most reef environments and form irregular encrustations in shaded, protected areas of the reef.
Boulder Star Coral	*Montastrea annularis*	A very common and often predominant coral species to reef environments and the Caribbean. Surface densely covered with small, protruding corallites. Colours range from green to brown to yellow-brown to grey.
Boulder Brain coral	*Colpophyllia natans*	Generally inhabiting reef tops and seaward reef slopes. Colonies generally form rounded domes, but also encrust constructing large rounded plates. The surface is covered with convoluted system of ridges and valleys.
Starlet Coral	*Siderastrea siderea*	Both species are common to the Caribbean and inhabit reef environments. *S. siderea* tends to inhabit shallow to moderate reefs, generally in protected areas of shallow reefs and all deep reef environments. Coral heads tend to form rounded boulders or domes, generally symmetrically
Lesser Starlet Coral	*Siderastrea radians*	

COMMON NAME	SCIENTIFIC NAME	SPECIES NOTES
		round and pitted corallites. *S. radians* usually form flat colonies, encrusting plates, and occasionally grow in small irregular and rounded domes. They usually inhibit areas shallower than *S. siderea*, in shallow reefs and back reefs.
Grooved Brain Coral	*Diploria labrinthiformis*	Colonies form hemispherical heads with deep, narrow, polyp bearing valleys. Valleys are highly convoluted and often interconnected. These inhabit seaward slope of reefs, most common between 15-50 ft.
Symmetrical Brain Coral	*Diploria strigosa*	An abundant reef coral, they inhabit many marine environments. Most commonly between 20-40 ft. Colonies form contoured plated with long valleys, often connected and convoluted. Green to brown, yellow-brown and bluish gray with valleys often brighter or of contrasting colour.
Rose Coral	*Manicina areolata*	Common to coral reefs with colonies that grow in two patterns. The more common elliptical colonies and the less common hemispherical heads. Both patterns exhibit different habitats and behaviours.
Golfball Coral	*Favia fragum*	A common coral, which inhabits shallow reefs and rocky substrates. They usually form hemispherical domes and occasionally encrusting. Easily distinguished from similar Elliptical and start corals by colonies' smaller size and less protrusion of corallites.
Blade Fire Coral	*Millepora complanata*	Colonies form thin, upright blades or plates that extend from an encrusting base. M*. complanata* inhabits shallow water reef tops, usually in areas with some water movement and most common in areas with constant surge.

COMMON NAME	SCIENTIFIC NAME	SPECIES NOTES
Branching Fire Coral	*Millepora alcicornis*	This hydrocoral forms colonies of multiple branching structures, often encrusting and overgrow gorgonian colonies and taking their shape. They inhabit all marine environments and common in depths greater than 30 ft.
Bipinnate Sea Plume	*Pseudopterogorgia biplinnata*	Colonies generally inhabit moderate to deep, clear water patch reefs. Branches most commonly purple to violet occasionally bright yellow to whitish.
Common Sea Fan	*Gorgonia ventalina*	Common in the Caribbean, this species prefers clear water with some movement. Inhabits the seaward side of shallow slopes and patch reefs. Colonies form large fans that grow in single planes. Fans are composed of meshed interconnected network of branches that are round or slightly flattened on the outer surface.

C.1.3 OTHER FAUNA

PORIFERA

Branching tube sponge (*Pseudoceratina crassa*)
Yellow tube sponge (*Aplysina fistularis)*
Brown tube sponge (*Agelas conifera)*
Brown clustered tube sponge (*Agelas wiedenmyeri*)
Pink Vase Sponge (*Niphates digitalis)*
Loggerhead sponge (*Spheciospongia verparium*)
Green finger sponge (*Iotrochota birotvlata)*
Azure vase sponge (*Callyspongia plicifera*)

TUBE WORMS

Christmas tree worm (*Spirobanchus giganteus*)
Variegated feather duster (*Bispira variegata*)

CRUSTACEANS

Scarlet-striped cleaning shrimp (*Lysmata grabhami*)
Caribbean Spiny lobster (*Panulirus argus*)
Smooth goose-neck barnacle (*Lepas anatifera*)

MOLLUSCS

Queen Conch (*Strombus gigas*)

ECHINODERMS

Cushion Sea Star (*Oreaster reticulates*)
Long-spine (*Diadema antillarum*)
Slate-pencil Urchin (*Eucidaris tribuloides*)
Red Heart Urchin (*Meoma ventricosa*)
West Indian Sea Egg (*Tripneustes ventricosus*)

CNIDARIANS

Mangrove Upside-down Jelly (*Cassiopea xamachana*)
Mat Zoanthid (*Zoanthus pulchellus*)
Giant Anemone (*Condylactis gigantea*)

C.2 FLORA

C.2.1 Seagrass:

Turtle Grass (*Thalassia testudinum)*: A very abundant sea grass to sandy bottoms and areas of mixed sand and coral rubble. The leaves are generally erect, flat, ribbon-shaped and green with rounded tips. Leaves are usually covered with sediment and encrusting organisms.

Manatee Grass (*Syringodium filiforme*): Manatee grass shares the same habitat as Turtle grass, and is generally found mixed in with the latter. Leaves are erect, thin, stem-like, green and cylindrical.

Shoal grass (*Halodule wrightii*): Shoal grass shares similar habitat as Turtle grass and Manatee grass. Leaves are erect, thin, stem-like, green and cylindrical.

C.2.2 Algae

Sargassum algae (*Sargassum sp*): *Sargassum* is a very common reef algae. They attach to substrate and grow in a bushy, upright form. Leaves are long, oval shaped blades and vary from smooth to striated edged. Along the stems are spherical gas filled floats.

Encrusting Fan-Leaf Algae (*Lobophora variegate*): *Lobophora* is an abundant Caribbean alga, growing in most reef environments, encrusting great areas of shaded, rocky substarte. Blade surfaces often covered with sediment and encrusted with other growths (epiphytes)

Leafy flat blade alga (*Stypopodium zonale*): A bushy brown alga with trap-like blades that have distinctive points along their edges. They grow in most reef environments, attaching to rocky substrates, often in areas exposed to surge.

Y branched alga (*Dictyota sp*): Another alga abundant within the Caribbean, growing in most reef environments. This brown algae grows on rocky substrates, often covering boulders around the base of coral heads and vertical rock faces. They are easily recognised by the fork near their ends. Generally they form mats of dense to loose packed flat leaves that overgrow the substrate.

White Scroll Alga (*Padina jamaicensis*): abundant brown algae that forms large, dense clumps of leafy blades with rounded and often semicircular outer margins. They attach to rocky substrates in most marine environments, especially in shallow reef flats.

Watercress Alga (*Halimeda sp.*): These Green Algae grows in this, profusely branched clumps of rounded, three-lobed or ribbed leaf-like segments. They grow in shallow depressions, cracks and crevices between hard corals. The calcified leaves of this and other species of *Halimeda* are considered major contributors of calcium carbonate to the reefs and sand.

ANNEX TO APPENDIX C

FISH SPECIES NOTES

ANNEX 1

FISH SPECIES NOTES

Banded Butterflyfish (*Chaetodon striatus*) inhabit coral reefs. Occur singly or in pairs. Feed on polychaete worms, coral polyps, crustaceans and mollusc eggs. Form pairs during breeding. Adults may form plankton-feeding aggregations of up to 20 individuals, and occasionally clean other reef fishes which join the group, such as grunts, parrot fishes and surgeon fishes. Depth range 3 – 55 m.

Bar Jack (*Caranx ruber*): Bright blue and black border on back runs along dorsal fin and onto tail fin. Silvery. Swim in open water over reefs in small groups to large schools. Opportunistic feeders, they often follow or mix with goatfish and stingrays as they dig in the sand.

Barred Hamlet (*Hypoplectrus puella*): This is one of the most common Hamlets in the Caribbean. They swim about reefs and near the bottom.

Beaugregory (*Stegastes leucostictus*): This damselfish is common to reef habitats, with a pale yellowish tail. It inhabits sand, grass anD rocky coral rubble areas, occasionally reeftops. They are territorial and aggressive to other damselfish.

Bermuda Chub (*Kyphosus sectatrix*): Gray to silver, football shaped body. Common in Caribbean reefs. Medium sized schools swim rapidly about over reefs and along walls. Shy to approach.

Blue Chromis (*Chromis cyanea*) is common above deep outer reefs and feeds in aggregations of the small zooplankton, primarily copepods. It is often with creole wrasse. Distribution includeS the Western Atlantic: Bermuda, southern Florida (USA), and the Caribbean Sea.

Blue head Wrasse (*Thalassoma bifasciatum*): Body elongate; 3 primary colour phases, the smallest with a black mid-lateral stripe which continues as pale red blotches on head; back above stripe yellow on reef fish and whitish on fish from inshore non-reef areas, and body below white. The largest phase has a bright blue head and a green body with two broad vertical black bars anteriorly which are separated by a light blue interspace; this phase is always male. The small yellow phase with the black stripe may be either male or female. Inhabits reef areas, inshore bays and seagrass beds. Feeds mainly on zooplankton and small benthic animals, but may also feed on ectoparasites of other fishes.

Bluestriped Grunt (*Thalassoma bifasciatum*): Blue stripes over yellow and a dark tail and rear dorsal fin are characteristic features of this fish. It is common throughout the Caribbean and drifts in small to mid-sized schools on reefs.

Blue Tang (*Acanthurus coeruleus*) is a deep-bodied surgeonfish with a conspicuous yellow caudal spine. It has the most distinctive coloration of all western Atlantic surgeonfishes. It inhabits coral reefs (2-40m), inshore grassy or rocky areas. Forms small groups and is mainly diurnal, feeding entirely on algae.

Bicolor Damselfish (*Stegastes partitus*): Inhabits shallow coral reefs and isolated patch reefs in deeper water. Feeds primarily on algae but also on polychaetes, hydroids, copepods and ascidians. Aggressively territorial but only around a small area.

Brown Chromis (*Chromis multilineata*): like the blue chromis, is common above deep outer reefs and feeds in aggregations of the small zooplankton, primarily copepods.

Bucktooth Parrotfish (*Sparisoma radians*): The body is marked with fine white speckles and poorly defined reddish stripes. They prefer sea grass beds and occasionally inhabit coral rubble near sea grasses (rarely living on the reef). The colour allows them to camouflage into the bed floor.

Caribbean Sharpnose-puffer (*Canthigaster rostrata*) inhabits reefs and marginal habitats such as seagrass beds. Diet consists of seagrass, sponges, crabs and other crustaceans, molluscs, polychaete worms, sea urchins, starfishes, hydroids and algae. Distribution included Western Central Atlantic: South Carolina, USA and Bermuda to Tobago and the Lesser Antilles. Depth range 1 – 40 m.

Clown Wrasse (Halichoeres maculipinna): Wide black stripe through eye to base of tail, bordered above by prominent gold line. Large black spot on mid-side. Large black spot on mid-side above origin of anal fin. Three transverse red bands on top of head; large adult males become primarily rose and green, lose the dark lateral stripe, gain a prominent black spot on mid-side, and have a larger black spot in the spinous portion of the dorsal fin. Abundant on reef tops and in shallow rocky areas. Found to depths of at least 25 m. Also found in *Sargassum* beds. Solitary and wary and can be difficult to approach.

Creole Wrasse (*Clepticus parrai*): Abundant on reef tops and in shallow rocky areas. Found to depths of at least 25 m. Also found in *Sargassum* beds. Solitary and wary and can be difficult to approach

Doctorfish (*Acanthurus chirurgus*) is usually found in waters 2 – 25 m in depth, with a global distribution spanning the Western Atlantic: Massachusetts (USA), Bermuda, and the northern Gulf of Mexico to São Paulo, Brazil. Eastern Atlantic: Senegal. It inhabits shallow reefs or rocky areas and found in loose aggregations,mainly diurnal. Ingests sand when feeding on algae.

Dusky Squirrelfish (*Sargocentron vexillarium*): Occurs in shallow coral reefs, as well as deeper offshore waters. A nocturnal species, hiding in deep crevices or under coral ledges during the day; at night it usually moves over sand and grass beds, taking mainly crabs and other small crustaceans

Fairy Basslet or Royal Gamma (*Gramma loreto*) is bicolored with purple (appearing blue underwater) in front, bight orange-yellow behind. Often found in caves or under ledges. Swims with belly toward substratum, thus under ledges seen upside down. Feed on ectoparasites of other fishes.

Foureye Butterflyfish (*Chaetodon capistratus*) found within the Western Atlantic: Massachusetts, USA and Bermuda to West Indies and northern South America. Also Bahamas, Gulf of Mexico, and Antilles. Inhabit shallow reefs and generally occurs singly or in pairs. Feeds mainly on zoantharians, polychaete worms, gorgonians and tunicates. Easily approached.

French Grunt (*Haemulon flavolineatum*): Mostly yellow, paler below. Scales are below lateral line in oblique rows and much larger than those above lateral line. No other grunt has enlarged scales below the lateral line. Occurs in large schools on rocky and coral reefs, often under ledges or close to elkhorn coral. Juveniles are abundant in near-shore seagrass beds. Feeds mainly on small crustaceans.

Gray Angelfish (*Pomacanthus arcuatus)*: Pale gray around mouth, and pale gray margin on caudal fin. Inside of pectoral fin yellow. Juveniles are black with two light yellow bars on body and three on head; caudal fin yellow with a vertically elongate, nearly rectangular or hemispherical black spot in middle. Common in coral reefs, usually solitary, occasionally in pairs. Juveniles are part-time cleaners. Feed mainly on sponges, but also takes tunicates, algae, zoantharians, gorgonians, hydroids, bryozoans, and seagrasses.

Great barracuda (*Sphyraena barracuda*): Distinguished by the double emarginate tail fin with pale tips on each lobe, and (usually) the presence of a few scattered black blotches on the lower sides. Top of head between eyes flat or concave; mouth large. Found predominantly at or near the surface. Juveniles occur among mangroves, estuaries and shallow sheltered inner reef areas; adults occur in a wide range of habitats from murky inner harbours to open seas. Diurnal and solitary, but can also be found in small aggregations. Feeds on fishes, cephalopods and sometimes on shrimps.

Green Moral Eel (*Gymnothorax funebris):* Uniform green to brown. Hides during the day in recesses. Constant opening and closing of mouth.

Harlequin bass (*Serranus tigrinus*): Most common in areas with rock or scattered coral. Solitary or in pairs. Feeds mainly upon crustaceans. Synchronously hermaphroditic. The most common member of the genus.

Lane Snapper (*Lutjanus synagris*) found over all types of bottom, but mainly around coral reefs and on vegetated sandy areas. In turbid as well as clear water. Often forms large aggregations, especially during the breeding season. Feeds at night on small fishes, bottom-living crabs, shrimps, worms, gastropods and cephalopods. Good food fish, it is marketed fresh.

Longjaw Squirrelfish (*Neoniphon marinus*): Occurs in shallow coral reefs, as well as deeper offshore waters. A nocturnal species, hiding in deep crevices or under coral ledges during the day; at night it usually moves over sand and grass beds, taking mainly crabs and other small crustaceans

Longspine squirrelfish (*Holocentrus rufus*): Nocturnal, inhabits clear reefs. Found near mouths of caves and holes; at night they usually move to sandy areas and grass beds to feed on crabs, shrimps, gastropods and brittle stars

Ocean Surgeon (*Acanthurus bahianus*) is a reef-associated, non-migratory fish found in waters ranging between 2 – 40 m in depth. This species inhabits shallow bottoms with coral or rocky formations. Usually occurs in groups of five or more individuals. Mainly a diurnal species and feeds on algae. The spine on both sides of the caudal peduncle may inflict painful wounds

Porkfish (*Anisotremus virginicus*) is a reef-associated, non-migratory fish found in waters ranging between 1 – 15 m in depth. This species is strictly an Atlantic species found in the Atlantic Ocean: Rhode Island, USA to Uruguay in the western Atlantic, abundant on Caribbean reefs; around islands of the mid-Atlantic, Cape Verde, and along the tropical coast of western Africa south to Angola. Juveniles are common in tide pools while adults found over shallow reef tops. Adults frequently form large feeding aggregations of up to several hundred individuals. Food items include algae, small crustaceans and fish, and various invertebrate larvae.

Puddingwife Wrasse (*Halichoeres radiatus*): This fish occurs throughout the Caribbean region, bearing greening-blue scrawls on the head. They are constantly found about reefs and are often quite shy hen approached.

Queen Parrotfish (*Scarus vetula*): Young adults of both sexes dark gray overall, with broad white stripe slightly below mid-side. Super males have upper pectoral fin margin and upper and lower margins of tail dusky with submarginal band of brownish orange. Inhabits coral reefs and adjacent habitats. Feeds on algae scraped from rocks or dead coral. Sleeps in a mucus cocoon. Often seen in groups of one super male with several young adults, most of which are probably females. A protogynous hermaphrodite.

Nassau Grouper (*Epinephelus striatus*) occurs from the shoreline to at least 90 m depth. Usually close to caves. Juveniles are common in seagrass beds. Diet comprises mainly of fishes (54%) and crabs (23%) and lesser amounts of other crustaceans and molluscs. It is solitary and mainly diurnal; but may sometimes form schools. The least wary and most friendly of all the groupers. Heavily fished and vulnerable to overfishing, particularly when migrating or aggregating to spawn. The most important commercial grouper in the West Indies.

Redband Parrotfish (*Sparisoma aurofrenatum*): Inhabits coral reefs, young usually in adjacent seagrass beds. Often rests on the bottom. Feeds on plants. Solitary or in small groups.

Red Hind (*Epinephelus guttatus*): similar to the grasby grouper with wither / paler skin colour. It is also commercially important.

Rosy Blenny (*Malacoctenus macropus*): A very inconspicuous fish, usually resting on the sea bottom. Very common in the Caribbean.

Sand Diver (*Synodus intermedius*): Rest on orbury themselves I sand, sometimes with only head visible. Also rests atop reefs. Common to Caribben reefs ad most commonly aboserved member of the Lizardfish family.

Saucereye Porgy (*Calamus calmus*): Swim and hover above reefs and adjacent sandy areas. Can rapidly change colouation and show a striped or blotched pattern.

Schoolmaster snapper (*Lutjanus apodus*): Occurs in shallow, clear, warm, coastal waters over coral reefs. Often near the shelter of elkhorn corals and gorgonians. Juveniles are encountered over sand bottoms with or without seagrass (*Thalassia*), and over muddy bottoms of lagoons or mangrove areas. Young sometimes enter brackish waters. Sometimes forms resting aggregations during the day. Feeds on fishes, shrimps, crabs, worms, gastropods and cephalopods.

Sergeant Major (*Abudefduf saxatilis*): Colours vary greatly, most often yellow upper body and silvery-gray below. Swim in all habitats, most often in mid-water, usually in loose aggregations.

Slippery Dick (*Halichoeres bivittatus*) The dominant colour markings are two dark stripes, one running from snout through eye to caudal base and the other, less pronounced, on lower side of body; a bicoloured spot at edge of gill cover within upper dark stripe; large adult males green on back, shading to light greenish yellow on sides, the two stripes usually purplish; irregular light red bands on head and on caudal fin. Commonly found in rocky and reef areas in shallow waters. Less common in seagrass beds. Feeds on other fishes and gastropods. Forms leks during breeding. A protogynous hermaphrodite.

Slender Filefish (*Monacanthus tuckeri*): Can change from brown to gray. Often drift vertically among branches or gorgonians. Their camouflage ability makes them difficult to spot.

Smooth trunkfish (*Lactophrys triqueter)*: Dark body covered with white spots. No spine above the eye and/or near anal fin. Swims above reefs, occasionally over sand. Normally solitary but occasionally swim in small groups.

Spot-fin porcupinefish (*Diodon hystrix*) occur in lagoon and seaward reefs to at least 50 m. commonly seen in caves and holes in shallow reefs. Juveniles to about 20 cm are pelagic. Adults are benthic. They are also a solitary and nocturnal fish that feeds on hard shelled invertebrates like sea urchins, gastropods, and hermit crabs. Generally common and not normally used as food.

Spotted eagle Ray (*Aetobatus narinari*): Body covered with numerous white spots, with a pronounced head with flattened, tapered snout. Long thin tail with one to five venomous spines at base. Cruise walls and sandy area. Occasionally pair and on rare occasions school.

Southern Stingray (*Dasyatis americana*): Vary from brown to grey and black, underside white. Whip like tail, with one or two venomous spines at base. Inhabit sand area and lie on the bottom, often covered with sand.

Spotted Goatfish (*Pseudupeneus maculates*): Inhabits shallow waters to depths of 90 m, especially over sand and rock bottoms in reef areas. Young juveniles often found on beds of seagrass, e.g. *Thalassia.* Feeds on small invertebrates.

Squirrelfish (*Holocentrus adscensionis*): Occurs in shallow coral reefs, as well as deeper offshore waters. A nocturnal species, hiding in deep crevices or under coral ledges during the day; at night it usually moves over sand and grass beds, taking mainly crabs and other small crustaceans.

Stoplight Parrotfish (*Sparisoma viride*): A distinctive, colorful and abundant fish. Young adults and females with scales outlined in darker gray; often bright red below. Super males green, with bright yellow spot at upper edge of gill cover, yellow bar at base of tail, curved orange-yellow mark on caudal fin rays. Initial phase fish with a brown head, the scales of the upper two-thirds of the body with pale centers and dark brown edges, the lower third of body and fins bright red. Terminal phase males are green with three diagonal orange bands on upper half of head. Inhabits coral reefs with clear water. Young may be found in seagrass beds and other heavily vegetated bottoms. Feeds mainly on soft algae, but has been observed to graze on live corals like, *Montastraea* annularis. Produces a significant amount of sediment through bio-erosion using its strong beak-like jaws and constantly re-growing teeth

Striped Parrotfish (*Scarus iseri*): Found over shallow, clear waters, generally over Thalassia beds. Also found rocky or coral areas. A schooling species. Feeds on plants. A protogynous hermaphrodite. Super males spawn individually with striped females, while sexually mature males in the striped phase spawn in aggregation.

Threespot damselfish (*Stegastes planifrons*): Inhabits inshore and offshore coral reefs. Found within caves at night.Often found in tangles of staghorn coral; anywhere there are abundant algae on reefs. Feeds mainly on algae but also on harpacticoid copepods, small gastropods, eggs of molluscs, sponges, polychaetes and hydroids. Juveniles subsist on the external parasites of fishes. Pugnaciously guards large territories, will chase and nip intruders of all sizes, including divers.

Tobaccofish (*Serranus tabacarius*): Vary from brownish-orange to bright orange (particularly along mid-line). Tail often darkly bordered. Markings of juveniles tend to be more distinct. Inhabit reefs and adjacent areas of sand and coral rubble.

Tomtate (*Haemulon aurlineatum*): Silvery-white body. Black stripes of juvenile change to yellow-gold with maturity. Slimmest and smallest of grunts. Schools over shallow sea grass beds, sand flats and occasionally reefs.

Trumpetfish (*Aulostomus maculatus*) is commonly found in weedy areas and especially around reefs, where they usually swim snout-down among sea whips (gorgonians). A solitary ambusher of small fishes and crustaceans that lurk among branching coral or gorgonians. Often swims behind large herbivorous fishes to sneak up on prey. Mouth opens to diameter of body to suck in prey. depth range 2 – 25 m.

White Grunt (*Haemulon plumieri*): Head stripes yellow and bluish silver. Scales on body form checkered pattern of yellow and bluish silver. Common through out Caribbean. Drifts in small groups to large schools, often along edges of shallow patch reefs or in shade of large coral formations.

Yellow Goatfish (*Mulloidichthys martinicus)* White, upper body may have shadings ranging from olive to red. Yellow tail and mid body stripe and to barbells on the upper tip of chin. Very common. Digs up sand and areas of rubble for food.

Yellowfin Majarra (*Gerres cinereus*): Characteristic yellow ventral fins. Swim and hover near reefs, stopping occasionally to dig for small invertebrates.

Yellowtail Damselfish (*Microspathodon chrysurus*): Tail bright yellow. Juveniles dark blue with transparent tail and electric blue spots on side. Adults dark yellowish brown, the edges of the scales darker. A common territorial species that inhabits coral reefs, juveniles usually encountered among branches of yellow stinging coral, *Millepora*. Found in very shallow waters of coral reefs, usually near top of outer edge where there are caves, holes, and abundant fire coral. Feeds primarily on algae but also on polyps of fire coral and other invertebrate animal material. Juveniles occasionally pick parasites from other species of fish

Yellowtail Hamlet (*Hypoplectrus chlorurus*): Body blackish in color (intensity of the black can vary from bluish to brownish). All fins pigmented. Pectoral fins rarely yellow. Caudal fin bright yellow. A solitary species found near the bottom of coral rich areas. Feeds on crustaceans and fishes.

Yellowtail Snapper (O*cyurus chrysurus*): Silvery to white, often tinged with blue. May have yellow spots on upper body. Tail deeply forked. Abundant in the Caribbean. They usually swim alone or in loose schools, well above reefs.

APPENDIX D

SPECIES LISTS AND NOTES OF TERRESTRIAL FLORA AND FAUNA

APPENDIX D

TERRESTRIAL VEGETATION FOR THE ISLANDS IN THE NEMMA

The terrestrial vegetation present on the islands in the NEMMA and on the adjacent coastal mainland was described in Section 3.6.2 based on a Vegetation Classification of Antigua-Barbuda-Redonda by Kevel Lindsay and Brian Horwith (1997). Table D-1 is a checklist of vegetation species which was prepared by the Island Resource Foundation (1997).

NOTES:
GBI Great Bird Island
EI Exchange Island
HGI Hell's Gate Island
JI Jenny Island
GrI Green Island
HwI Hawes Island
RdI Red Head Island
LI Laviscount Island
RI Rabbit Island
CrI Crump Island
GII Galley Islands
Gu Guiana Island
Taxa organized according to Howard

TABLE D-1

FLORA OF THE OFF-SHORE ISLANDS: Volume 1
Prepared by IRF: Revised May 6, 1997

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
POLYPODIACEAE												
Nephrolepis sp.					+							
POACEAE												
Panicum maximum	+											
Paspalum sp.		+										
Sporobolus virginicus	+	+							+	+		+
(Unidentified grass species)	+				+							
CYPERACEAE												
Sedges (unidentified species)	>4	+	+	+	+					+		
PALMAE												
Cocos nucifera	+											+
BROMELIACEAE												
Tillandsia usneoides	+							+		+		
T. utriculata	+							+		+		
COMMELINACEAE								+				
Commelina sp.												
LILIACEAE												
Aloe vera	+									+		?

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
AGAVACEAE												
Agave karatto	+				+			+		+		+
ORCHIDACEAE												
Tetramicra canaliculata								+				
Oncidium urophyllum								+				
MORACEAE												
Ficus citrifolia	+				+				+	?		?
POLYGONACEAE												
Coccoloba diversifolia										+		
C. uvifera	+				+	+				+		+
C. swartzii										+		
AMARANTHACEAE												
Blutaporon vermiculare					+					?		?
NYCTAGINACEAE												
Boerhavia sp.	+											
B. erecta	+						+					
Pisonia fragrans	+						+			+		?
P. subcordata	+				+	+		+		+		+
PHYTOLACCACEAE												
Rivina humilis	+				+	+	+	+	+	+		
AIZOACEAE												
Sesuvium portulacastrum	+	+	+	+			+			+		+

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
PORTULACACEAE												
Portulaca oleracea	+				+	+	+					
P. quadrifida	+											
Talinum fruticosum	+						+		+		+	
T. paniculatum												
PAPERVERACEAE												
Argemone mexicana			+		+		+	+				
CAPPARACEAE												
Capparis cynophallophora	+					+	+	+	+	+		+
C. flexuosa	+	+	+			+	+	+	+	+		+
C. indica						+	+	+	+	+	+	+
LEGUMINOSAE -												
MIMOSOIDEAE												
Acacia farnesiana	+											
A. macrantha	+									?	?	?
A. nilotica								+				
A. tortuosa										?		+
Desmanthus virgathus	+									+		
Leucaena leucocephala					+		+			+		
Pithecellobium unguis-cati	+	+			+	+	+	+	+	+		+
CAESALPINIOIDEAE												
Caesalpinia ciliata	+				+		+			+		+
Chamaecrista glandulosa var. swartzii	+					+		+		+		
Haematoxylon campechianumo												+
Tamarindus indica	+						+		+			

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
FABOIDEAE												+
Canavalia rosea					+							
Dalbergia ecastaphyllum					+							
Piscidia cathagenensis								+		?		?
Rynchosia minima	+											
Stylosanthes hamata	+									+		+
Tephrosia sp.	+				+			+				
Desmodium sp												
Unknown vine								+				+
ZYGOPHYLLACEAE												
Kallstroemia pubescens	+											
RUTACEAE												
Amyris elemifera										+		
Triphasia trifolia								+				
Zanthoxylum spinifex												+
SIMAROUBACEAE												
Castela erecta	+	+				+	+	+	+	+		+
SURIANACEAE												
Suriana maratima	+				+	+						+
BURSERACEAE												
Bursera simaruba					+	+		+		+		?
MELIACEAE												
Azadarachta indica	+				+							+

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
MALPHIGIACEAE												
Malphigia emarginata	+											+
M. linearis	+							+		+		+
Stigmaphyllon sp.	+				+		+	+	+	+		+
EUPHORBIACEAE												
Chamaesyce sp.					+	+	+					
Croton flavens	+				+		+	+	+	+		+
Euphorbia mesembrianthemifolia					+							
Euphorbia sp.	+											
Gymnanthus lucida	+				+							
Hippomane mancinella	+				+	+		+	+	+		+
Jathropa gossypifolia												+
Pedilanthus tithymaloides					+			+				
Phyllanthus epiphyllanthus	+		+		+	+		+		+		+
Unidentified sp.	+								+	+		
ANACARDIACEAE												
Comocladia dodonea					+	+				+		+
CELASTRACEAE												
Crossopetalum rhacoma	+				+	+	+			+		
Gyminda latifolia												?
SAPINDACEAE												
Dodonaea viscosa	+				+					+		?
RHAMNACEAE												
Colubrina arborescens	+				+	+			+	+		+
Krugiodendron ferreum						?				?		

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
MALVACEAE												
Thespesia populnea						+	+	+				+
Sida sp.						+						
STERCULIACEAE												
Melochia tomentosa	+				+				+			
Waltheria indica	+								?	+		?
CANELLACEAE												
Canella winterana	+				+	+	+	+		+		+
CARICACEAE												
Carica papaya	+							+				
CACTACEAE												
Mammilaria nivosa			+		+							
Opuntia dilenii	+						+					
O. rubescens	+						+					+
O. triacantha	+						+		+			+
O. sp.					+	+			+			
Pilosocereus royeni	+				+	+	+	+	+	+	+	+
RHIZOPHORACEAE												
Rhizophora mangle	+					+	+	+	+	+		+
COMBRETACEAE												
Conocarpus erectus	+				+	+	+	+		+		+
Laguncularia racemosa						+	+	+	+	+		+

THEOPHRASTACEAE												
Jacquinia amillaris	+				+		+	+		+	+	+

FLORA	GBI	EI	HGI	JI	GrI	HwI	RdI	LI	RI	CrI	GlI	GuI
APOCYNACEAE										+		
Plumeria alba												
Rauvolfia nitida					+		+	+		+		?
OLEACEAE												
Jasminum fluminense	+	+		+		+			+			
ASCLEPIADACEAE												
Metastilma plarviflorum	+				+		+	+	+			
CONVOLVULACEAE												
Evolvulus jamaicensis	+											
E. sp.					+							
Ipomea macrantha	+											+
I. pes-capreae	+				+				+			+
Jacquemontia solanifolia	+									+		+
BORAGINACEAE												
Bourreria succulenta						+		+				+
C. martinicensis					+	+						
C. obliqua			+	+								
C. sebestena												+
Heliotropium angiospermum	+			+		+		+				
H. microphyllum	+											
H. sp.		+										
Rochefortia spinosa										+		+
AVICENNIACEAE												
Avicennia germinans	+								+	+		+

A. schaueriana						?	+	+		+		
VERBENACEAE												
Clerodendrum aculeatum	+				+							+
Lantana involucrata	+	+			+	+	+	+	+	+	+	+
Phyla sp.	+											
Stachytarpheta jamaicencis	+								+	+		
SOLANACEAE												
Datura sp.	+											
Lycium americanum	+						+				+	?
Solanum racemosum	+		+	+	+	+	+	+	+			+
S. sp.												
SCROPHULARIACEAE												
Capraria biflora	+				+							?
BIGNONIACEAE												
Tabebuia heterophylla	+				+		+	+		+		+
ACANTHACEAE												
Justica sp.	+						+		+		+	
RUBIACEAE												
Erithalis fruticosa		+			+	+	+		+	+		?
E. odorifera	+			+								?
E. sp.					+			+				
Ernodea littoralis	+				+							?
Exostema caribeum										?		
Randia aculeata					+			+				
Spermacoce verticillata (?)	+											+
Strumphia maritima	+											+
LOBELIACEAE												

Borrichia arborescens	+											
B. frutescens		+			+	+						
ASTERACEAE												
Eupatorium sp.								+				
Panthenium hysterophorus								+				
Pectis humifusa					+							
Wedelia sp.						+	+					
FAMILY UNKNOWN												
unidentified vine	+					+						

APPENDIX E

MONITORING AND EVALUATING SCORECARD

The WWR-World Bank Alliance's Scorecard to Assess Progress in Achieving Management Effectiveness Goals for Marine Protected Areas adapted for Protected Areas of the Organisation of Eastern Caribbean States

Presentation of the Score Card (SC)

The Score Card has been adapted from a tool developed by the World Bank – WWF Alliance for terrestrial Protected Area (Stolton S. et Al. 2003) and from other tools (Hocking M. et Al. 2000: Mangubhai S 2003). It is a simple site-level tracking tool to facilitate reporting on management effectiveness of Protected Areas (Pas). It has been built around the application of the WCPA Framework document has provided its basic structure (the WCPA framework aims both to provide some overall guidance in the development of assessment systems and to encourage standards for assessment and reporting).

TABLE 1

Summary of the WCPA Framework

Elements of evaluation	*Explanation*	*Criteria that are assessed*	*Focus of evaluation*
Context	**Where are we now?** Assessment of importance, threats and policy environment	Significance. Threats. Vulnerability. National context.	Status
Planning	**Where do we want to be?** Assessment of protected area design and planning	Protected area legislation and policy. Protected area system design. Reserve design Management planning.	Appropriateness
Inputs	**What do we need?** Assessment of resources needed to carry out management	Resourcing of agency. Resourcing of site. Partners.	Resources
Process	**How do we go about it?** Assessment of the way in which management is conducted	Suitability of management processes.	Efficiency appropriateness
Output	**What were the results?** Assessment of the implementation of management programmes and actions: delivery of products and Services	Results of management Actions. Services and products.	Effectiveness
Outcome	**What did we achieve?** Assessment of the outcomes and the extent to which they achieved Objectives	Impacts: effects of management in relation to objectives.	Effectiveness appropriateness

Source: Hockings et al. (2000)

The WCPA Framework[1] is based on the idea that good protected area management follows a process that has six distinct stages, or elements:

1. context
2. planning
3. inputs
4. processes
5. outputs
6. outcomes

Table 1 contains a very brief summary of the elements of the WCPA Framework and the criteria that can be assessed. The Score Card has been designed to fulfill the elements of evaluation included in the Framework.

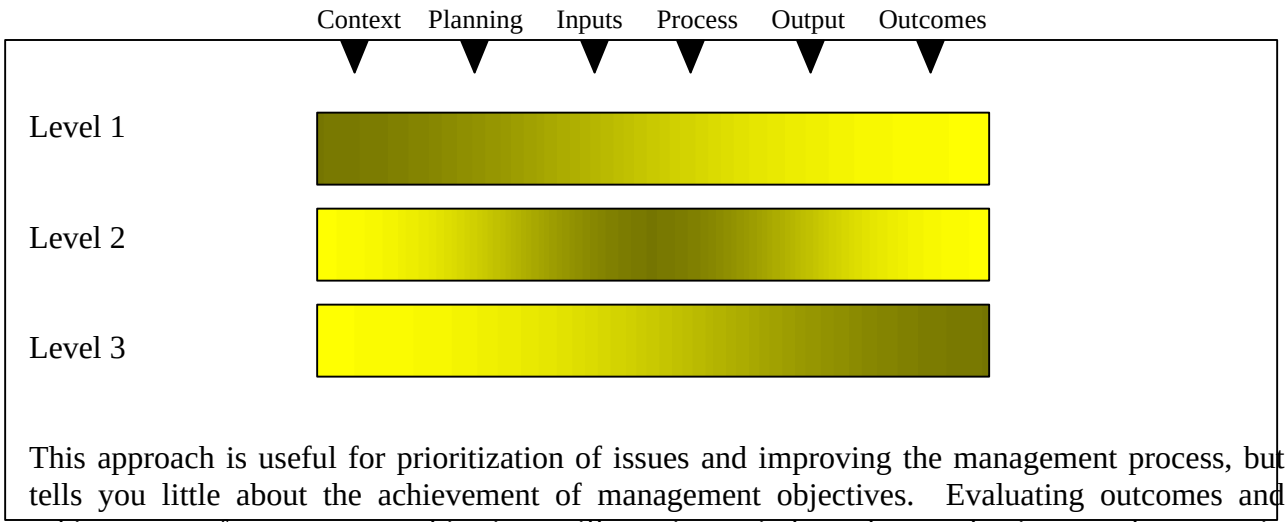
The original version of the Score Card is also available (in English, French and Spanish) online at the following web site: www.mpascorecard.net. Results may also be made available online if PA managers are willing to share them.

Level of detail in the assessment

Hockings et al.2000 identified 3 possible levels of evaluation, each requiring different amounts of data collection and financial input. The scorecard presented here is a level 1 assessment (see figure 2). This type of assessment (level 1) requires little or no additional data collection and focuses on the context of the PA along with the appropriateness of planning, inputs and processes of management. It relies largely on available data through literature searches and informed opinions of site managers and/or independent assessors, takes a short period of time and costs little. Issues are broadly covered, but depth of analysis is generally low.

FIGURE 2

Three levels of assessment



This approach is useful for prioritization of issues and improving the management process, but tells you little about the achievement of management objectives. Evaluating outcomes and achievement of management objectives will require an independent evaluation or other more in depth assessment tool (such as the WCPA-Marine/WWF Management Effectiveness Guidelines available at http://effectivempa.noaa.gov).

[1] For a copy of the WPCA Framework or a more detailed summary please visit the WCPA web-site at: www.iucn.org/themes/wcpa

Limitations and disclaimer

The Score Card is aimed at helping managers report progress on management effectiveness from a given baseline. It should not replace more thorough methods of assessment for the purposes of adaptive management. The Score Card tool has been adapted/developed to provide a quick overview of the initial state of management efforts and subsequent progress, over a period of years, in improving the effectiveness of management in a given marine protected area. The Score Card is designed to be filled in the manager or other relevant site staff.

The tool does not allow a detailed evaluation of outcomes, but rather serves to provide a quick overview of the status of management steps identified in the WCPA Protected Area Management Framework, up to and including outputs.

The whole concept of "scoring" progress is fraught with difficulties and possibilities for distortion. The current system assumes, for example, that all the questions cover issues of equal weight, whereas this is not necessarily the case. Accuracy might be improved by weighting the various scores, although this would provide additional challenges in deciding differing weightings. In the current version a simple scoring system is maintained, but the limitations of this approach should be recognized.

Guidance notes for using the Score Card

The Score Card has many uses as an orientation tool to help managers of new protected areas scope out issues to be addressed in establishing an effective PA, or as tracking tool to provide managers with a sense of "where they are" along the management continuum. It also serves as a use-friendly reporting tool on PA status based on information largely already collected without any additional field level research.

The Score Card should be completed by protected area staff and, ideally, local stakeholders to validate the scoring. It is designed to be completed within relatively short period, such as during a staff meeting or other routine meeting, by referencing available reports or datasets.

Further written guidance to facilitate application of the Score Card to assess progress in achieving management effectiveness goals in OECS Protected Areas is given on the following page.

Written Guidance to Facilitate Application of Scorecards to Assess Progress in Achieving Management Effectiveness Goals in OECS Protected Areas

Background:
One objective of the recently completed regional OECS workshop[2] on "Designing Tools for Monitoring and Evaluating the Effectiveness of Protected Areas in the OECS" was to review the utility of the WWF/WB Alliance protected area management tool (scorecard) in measuring management effectiveness in protected areas (PAs). During the workshop, the proposed scorecard was evaluated and a number of suggestions were proposed and agreed in order to enhance the relevance of the methodology to the specific needs of PA sites in OECS generally, and the OPAAL-supported sites, specifically. Following the incorporation of the suggested changes in the scorecard, a main recommendation from the participants was to develop additional guidance in its application supported with a follow-up regional training workshop. The scorecards are projected to be finalized by March 2006.

Objective:
To provide additional written guidance to facilitate the application of scorecards to OECS protected areas.

Score card: a summary
A few brief points to be highlighted with respect to intent and application of PA scorecards. They were developed to be: (i) simple, (ii) easy and quick to use, (iii) applied at the level of the site, (iv) focused on measuring "management effectiveness" measured by predefined parameters, (v) give all questions equal weight, and (vi) filled out by site managers (or similarly trained professionals). There are two sections to the scorecard: (i) a data sheet, and (ii) the scorecard itself. The scorecard in turn, is divided into two parts: (i) Sections A – D which support the data sheet in describing the existing situation (or baseline), and (ii) Sections E – F which are applied at some future date to assess changes over time in management effectiveness. For purposes of OPAAL-supported PAs, after completing the baseline information (Data Sheet and Sections A - D), Sections E - F should be applied in anticipation of mid-term and end of project evaluations.

Approach:
A case study approach (available under separate cover from OECS ESDU) has been adopted based on the hypothetical Paradise Mountain National Park (PMNP), an IUCN Category II protected area, in the mythical country of Serendib. The PMNP has been described in a one page profile (Attachment 1). Based on this description, the scorecard Data Sheet has been filed out (Attachment 2) as have Sections A - D of the scorecard itself (Attachment 3). The Data Sheet plus Sections A-D, provide the baseline or existing situation in terms of management effectiveness in PMNP. From this baseline, a modest investment program to improve PMPA was assumed (Attachment 4). Following the implementation of the investment program, sections E - F of the scorecard were applied and the final scores tallied (Attachment 3).

In addition to the examples described above, further guidance is provided in the "Comments" column of the scorecard. There are three types of comments: (i) Comments based on clarifying/justifying the score selected, (ii) Issues based on possible problems one may encounter in attempting to decide between parameter rankings due in part to the qualitative ambiguity associated with such terms as "adequate", "significant" , "acceptable"), and (iii) Recommendations that may clarify how best to address the associated Issue.

[2] This was held in St. Lucia over the 17th and 18th of January 2006.

Description of forms

After the profile information on the Protected Area has been recorded (attachment 1), two forms need to be completed:

- *Datasheet* (attachment 2)
  The datasheet provides key information on the site, its characteristics and management objectives.
- *Assessment Form* (attachment 3)
  The assessment form includes distinct sections, all of which should be completed.

  - ❖ Questions and scores

    The main part of the assessment form is a series of questions grouped by management stage or element (i.e. context, planning, inputs, processes, outputs, outcomes). Each question should normally be ranked between 0 (low) and 3 (high) based on level of performance. A series of answers is provided for each question to help assessors determine the appropriate ranking.

    Questions that are not relevant to a particular marine protected area should be omitted, with a reason given in the comments section.

    This is, inevitably, an approximate process and there will be situations in which none of the four alternative answers appears to fit conditions in the protected area very precisely. We suggest that users choose the answer that is nearest and use the comments section to elaborate.

  - ❖ Comments
    The comments box allows qualitative judgments to be justified by explaining why they were made (this could range from personal opinion, a reference document, monitoring results or external studies and assessments – the point being to give anyone reading the report an idea of why the assessment was made).

    In this section we also suggest that respondents add any useful information that should be shared with other MPA managers (for example good practices or successful activities).

Final Score

Users will have a score for each of the six elements of evaluation and a final score after completing the assessment form. If some questions are not scored (e.g., not relevant), the maximum score should be changed to an adjusted score (maximum possible score minus points for question that are not applicable). Your final score will be a percentage of your score over the adjusted maximum score.

Investments (attachment 4)

Users will list the investment activities determined as a consequence of the need to improve the management effectiveness score

Attachment 1.
North East Marine Management Area (Antigua and Barbuda): a profile
(baseline conditions)

Location and Basic Characteristics: Located in the country of Antigua and Barbuda, the North East Marine Management Area was established in 2005. The Park's/Area's boundaries were demarcated in the year 2005. The total area is not yet estimated, but includes the 3,100 ha area subtended by the North Sound Islands, and varies in range from sea level to over 50 m above sea level. It is Antigua and Barbuda's largest protected and borders the north east coast of Antigua.

Biodiversity and other significant characteristics: limestone islets with associated coastal and marine ecosystems that include mangroves, coral reefs, seagrass beds, rocky shores, sandy beaches, coastal and dry scrubland vegetation. The area supports numerous endemic and globally threatened species that include the critically endangered Antigua Racer Snake *(Alsophis antigua*e), marine turtles and other sea birds.

Management Planning: North East Marine Management Area's conservation objectives are equivalent to a combination of different IUCN Categories [TO BE INCLUDED] (i.e., a protected area managed mainly for [explain management category]). Specifically, North East Marine Management Area was designated for historical, cultural, economic, biological diversity conservation and fisheries management reasons.

The area has no management plan at present nor has there been any effort to develop a national systems plan to date, however work has commenced on developing a management plan for the area. Enabling regulations exist within the context of the Fisheries Act (no. of 1983) under which the Area has been designated.

Management Staff: The Area is, at present, managed by the Fisheries Division of the Ministry of Agriculture, Marine Resources and Agro-Industries. [break-down of staffing]. The Area has no specific budget at this time, however it is expected that ths may be forthcoming as a consequence of investments from the OPAAL project. A consultative Site Implementation Entity (SIE) within the context of the OPAAL project, composed of, *inter alia*, EAG, Forestry, National Parks, AHTA, and private land owners has recently been designated by Cabinet, however a wider form is utlised by the Fish Div when consultation is required

Infrastructure and Equipment: The Area has no control posts at present. Motorized vehicular transport of the Fisheries Division are utilised for the area and procurement of a vessel is currently in process. No communications equipment is available at present, however it is anticipatedt hat this will be built into the investment plan coming out of the management planning exercise.

Population: The Area has a variable population given that most are short term residents and tourists.

Land Tenure: Some land areas are State owned while other fall under private ownership. The private owners have accepted the designation of the area and are represented on the SIE.

Main Economic Activities*:* Tourism (hotels, day tours, snorkelling, yachting), fisheries, Industrial transportation, water desalination and power generation. The mainland area adjacent to the NEMA is also used for military activities by the national defence force.

Main threats to biodiversity: Inappropriate tourism and residential infrastructural development; industrial, tourism and domestic effluent; inappropriate/unmanaged (solid and liquid) waste disposal; rats and other pests; miscellaneous human interventions including nearby military activity; invasive flora and fauna (e.g. white wing doves and Eurasian collared dove); vessel anchoring and grounding damage.

North East Marine Management Area Data Sheet

Name of the protected area: North East Marine Management Area
Location of protected area: (country and, if possible, map reference): Antigua
Date PA was established: Dec 2005 Agreed: Gazetted: √
Ownership details (i.,e. owner, tenure rights etc): **Some** land areas: State; others: private
Management Authority: Fisheries Division, Ministry of Agriculture, Marine Resources and Agro-Industries
Contact information and web site (if any): 268 (462 1372 email: fisheries@antigua.gov.ag
Size of protected area (ha): not available (=3,100 ha)
Percent of PA that is respectively terrestrial/marine (%): terrestrial: not available marine: not available
Number of staff: 3 Permanent: 3 Temporary: Volunteers:
Annual budget: EC$ (US$)
Designation (IUCN category, World Heritage, Ramsar, etc.):
Reasons for designation:
historical, cultural, economic and biological diversity conservation and fisheries management
The PA is part of a larger management zoning plan: Yes No Ö
Brief details of World Bank funded project or projects in PA: OPAAL
Brief description of the primary habitats represented in the PA *
(rain forest, wetlands, dryland forest, reefs, seagrasses, mangroves etc.)
Habitat 1: Coral reef .
Habitat 2: Mangroves
Habitat 3: Sea grasses
Habitat 4: Dry land forest
Habitat 5: beaches
Two primary protected area objectives:
Objective 1: Protection and preservation of biodiversity, heritage and archaeological resources;
Objective 2: Provide framework for sustainable management and use of the resources of the area
Two most important threats to the PA (and reasons why):
Threat 1: "Inappropriate" tourism development (and related Solid and liquid wastes, effluents and run-offs)
Threat 2: "Inappropriate" industrial development
Top two critical management activities:
Activity 1: Establish an effective and functional management authority for the area
Activity 2: Develop and implement management plan
Top 4 stakeholder groups:
Stakeholder group 1: Traditional users/communities
Stakeholder group 2: Day tour operators
Stakeholder group 3: Residents and property owners
Stakeholder group 4: Research community incl. GOAB, EAG, etc
Resources conditions: Poor Average √ Good
Date assessment was carried out: 11 August 2006
Name/s of assessor: Stakeholder Group – coordinated by FishDiv
Role (position):
Contact information: 1 268 462 1372
Date (s) of previous score card assessments (s): no previous assessment

***Note: a number of significant archaeological sites exist within and near the area**

ANU

Attachment 3. A. Context: Where are we now? Assessment of important threats and th

1. Legal status - Does the protected area have legal status? ***Note: see fourth option for private reserves***		***Your Score***	***Comme***
The area is neither gazetted nor given cabinet approval	0		
The government has agreed that the protected area should be gazetted but the process has not yet begun	1		
The protected area is in the process of being gazetted but the process is still incomplete	2		
The protected area has been legally gazetted (or in the case of private reserves is owned by a trust or similar)	3	3	
Additional Point			
a. The PA has received national and/or international recognition for its importance (in the comments column, describe the recognition in detail)	+1	1	Recogr scientifi
2. Protected area regulations - Are unsustainable human activities (e.g. poaching) controlled?		***Your Score***	***Comme***
There are no mechanisms for controlling unsustainable human activities in the protected area	0		
Mechanisms for controlling unsustainable human activities in the protected area exist but there are many problems in effectively implementing them	1	1	
Mechanisms for controlling unsustainable human activities in the protected area exist but there are a few problems in effectively implementing them	2		
Mechanisms for controlling unsustainalbe human activities in the protected area exist and are being effectively implemented	3		
3. Law enforcement - are enforcement rules effectively enforced?		***Your Score***	***Comme***
No effective capacity/resources and activities to enforce protected area legislation and regulations	0		
There are major deficiencies in capacity/resources and activities to enforce protected area legislation and regulations (e.g. lack of skills, no patrol budget, etc.)	1	1	

Acceptable capacity/resources and activities to enforce protected area legislation and regulations but some deficiencies remain	2		
Excellent capacity/resources and activities to enforce protected area legislation and regulations	3		
Additional Point			
a. There are additional sources of control (e.g. volunteers, national services, local communities, etc.)	+1		
b. Infractions are regularly prosecuted and fines levied	+1		
4. Protected area boundary demarcation - Are the boundaries known and demarcated?		***Your Score***	***Comme***
The boundaries of the protected area are not known by the management authority or other stakeholders	0		
The boundary of the protected area is known by authority but is not known by other stakeholders	1	1	
The boundary of the protected area is known by both the management authority and others but is not appropriately demarcated	2		
The boundary of the protected area is known by the management authority and stakeholders and is appropriately demarcated	3		
5. Integration of the PA in a larger management plan - Is the PA part of a PA systems plan?		***Your Score***	***Comme***
There is no discussion about the integration of the PA in a larger management or systems plan	0		
There is some discussion about the integration of the PA into management or systems plan but the process has not yet begun	1	1	
The protected area is in the process of being integrated into a larger management or systems plan but the process is still incomplete	2		
The protected area is part of a larger management or systems plan	3		
Additional Point			
a. The PA is part of a network of PAs which collectively sustain larger ecosystem functions	+1	1	Networ been pe

b. The PA is part of a network of PAs which collectively represent the range of bio-geographic variation in a eco-region	+1	1	Networ the gene
6. Resource inventory - Is there enough information to manage the area?		***Your Score***	***Comme***
There is little or no information available on the biophysical, socio-cultural and economic conditions associated with the protected area	0		
Information on the biophysical, socio-cultural and economic conditions associated with the protected area is not sufficient to support planning and decision making	1		
Information on the biophysical, socio-cultural and economic conditions assoicated with the protected area is sufficient for key areas of planning/decision making but the necessary survey/M&E work is not being maintained	2	2	
Information on the biophysical, socio-cultural and economic conditions asscociated with the PA is sufficient for key area of planning and decision-making	3		
7. Stakeholder awareness and concern - Are stakeholders aware and concerned about resource conditions and threats?		***Your Score***	***Comme***
Less that 25% of stakeholders are aware or concerned about the resource conditions and threats	0		
Approximately 25% - 50% of stakeholders are aware or concerned about the resource conditions and threats	1		
Approximately 50% - 75% of stakeholders are aware or concerned about the resource conditions and threats	2		
Over 75% of stakeholders are aware or concerned about the resource conditions and threats	3	3	
TOTAL for Context (A):	**15 /26 or adjusted score**		

B. Planning - Where do we want to be? Assessment of protected area desing

8. Protected area objectives - Have objectives been agreed and the area managed to achieve them?		***Your Score***	***Comme***
No firm objectives have been agreed for the protected area	0		

The protected area has agreed objectives that are not yet implemented	1		
The protected area has agreed objectives but these are only partially implemented	2	2	
The protected area has agreed objectives and is managed to meet these objectives	3		
9. Management plan - Is there a management plan and is it being implemented?		***Your Score***	***Comme***
There is no management plan for the protected area	0		
A management plan is being prepared or has been prepared but is not being implemented	1	1	
An approved management plan exists but it is only being partially implemented	2		
An approved management plan exists, includes the agreed objectives and is being implemented	3		
Additional Points for Planning			
a. There is also a long term master plan (at least 5 years)	+1		
b. The planning process allows adequate opportunity for key stakeholders to influence the management plan	+1	1	
c. Stakeholder participation includes representation from the various ethnic, religious and user groups as well as representation from both genders	+1	1	
d. The socioeconomic impacts of decisions are considered in the planning process	+1	1	
e. The local culture, including traditional practices, social systems, cultural features, historic sites and monuments, is considered in the planning process	+1	1	
f. There is an established schedule and process for periodic review and updating of the management plan	+1		
g. The results of monitoring, research and evaluation are routinely incorporated into planning	+1	1	
h. The management plan is tied to the development and enforcement of regulations	+1		
TOTAL for Planning (B): 8/14 or adjusted score			

C. Input - What do we need? Assessment of resources needed to carry out m

10. Research - Is there a program of management-oriented survey and research work?		***Your Score***	***Comme***
There is no survey or research work taking place in the protected area	0		
There is some ad hoc survey and research work	1	1	
There is considerable survey and research work but it is not directed towards the needs of protected area management	2		
There is a comprehensive, integrated program of survey and research work which is relevant to management needs	3		
Additional Point a. Carrying capacity studies have been conducted to determine sustainable use levels	+1		
11. Staffing - Are there enough people deployed to manage the protected area?		***Your Score***	***Comme***
There are no staff	0		
Staff numbers are inadequate for critical management activities	1	1	Specifi manag assess
Staff numbers are below optimum level for critical management activities	2		
Staff numbers are adequate for the management needs of the site	3		
12. Current budget - Is the current budget sufficient?		***Your Score***	***Comme***
(In the comments column; please detail of the sources of funding)			
There is no budget for the protected area	0	0	Specifi howeve way in
The available budget is inadequate for basic management needs and presents a serious constraint to the capacity to manage	1		
The available budget is acceptable, but could be further improved to fully achieve effective management	2		
The available budget is sufficient and meet the full management needs of the protected area	3		

Additional Points			
a. There is a secure budget for the protected area and its management needs on a multi-year basis.	+1		
b. The budget is not entirely dependent on government funding: instead, funding also comes from NGO contributions, taxes, fees, etc.	+1		
TOTAL for Inputs (C): 2/14 or adjusted score			

D. Process - How do we go about management? Assessment of the way in which mana

13. Education and awareness program - Is there a planned education program?		***Your Score***	***Comme***
There is no education and awareness program	0		
There is a limited education and awareness program, but no overall planning for this component	1	1	
There is a planned education and awareness program but there are still serious gaps	2		
There is a planned and effective education and awareness program fully linked to the objectives and needs of the protected area	3		
14. Communication between stakeholders and managers - Is there communication between stakeholders and managers?		***Your Score***	***Comme***
There is little or no communication between managers and stakeholders involved in the PA	0		
There is communication between managers and stakeholders but this is not a planned or scheduled program	1	1	
There is a planned communication program that is being used to built support for the PA amongst relevant stakeholders but implementation is limited as yet	2		
There is a planned communication program that is being implemented to build support for the PA amongst relevant stakeholders	3		
Additional Point			
There is some communication with other PA managers (for			

example, exchanges of good practices)	+1		
15. Stakeholder involvement and participation - Do stakeholders have meaningful input to management decisions?		***Your Score***	***Comme***
Stakeholders have no input into decisions relating to the management of the protected area	0		
Stakeholders have some input into discussions relating to management but no direct involvement in the resulting decisions	1		
Stakeholders directly contribute to some management decisions	2	2	
Stakeholders directly participate in making decisions related to management	3		
Additional Point			
a. There are clear financial contributions/agreements between PA and tourism operators to recover PA resources rents for local benefits	+1		
16. Indigenous people - Do indigenous and traditional peoples resident or regularly using the PA have input to management decisions?		***Your Score***	***Comme***
Indigenous peoples and traditional users have no input into decisions relating to management of the protected area	0		
Indigenous peoples and traditional users have some input into discussions relating to management but no direct involvement in the resulting decisions	1		
Indigenous people and traditional users directly contribute to some decisions relating to management	2	2	
Indigenous people and traditional users directly participate in making decisions relating to management	3		
17. Staff training - Is there enough training for staff involved in the management of the PA?		***Your Score***	***Comme***
Staff are untrained	0		
Staff training and skills are low relative to the needs of the protected area	1		
Staff training and skills are adequate, but could be further improved to fully achieve the objectives of management	2	2	Requir specific

Staff training and skills are in the tune with the management needs of the protected area, and with the anticipated future needs	3		
18. Equipment - Is the site adequately equipped?		***Your Score***	***Comme***
There are little or no equipment and facilities	0		
There are some equipment and facilities but these are inadequate	1	1	
Most of equipment and facilities are adequate and maintained	2		
There is adequate equipment and facilities and it is well maintained	3		
19. Monitoring an evaluation - Are biophysical, socioeconomic and governance indicators monitored and evaluated?		***Your Score***	***Comme***
There is no monitoring and evaluation of the biophysical, socioeconomic and governance context of the PA	0		
There is limited monitoring and evaluation, but no overall strategy and/or no regular production of results	1	1	
There is an agreed and implemented monitoring and evaluation system but results are not systematically used for management	2		
A planned and effective monitoring and evaluation system exists and is well implemented and used in adaptive management	3		
Additional Points			
a. The PA participates as a site in national or international environmental monitoring programs such CARICOMP, CPACC, GCRMN, AGGRA or similar (Provide the name of the program(s))	+1	1	Reef K
b. There is an Emergency Response Capability in place to mitigate impacts from threats	+1		
TOTAL for process (D): 11/25 or adjusted score			

E. Outputs - What were the results? Assessment of the implementation of ma programs and actions; delivery of products and services

N. B. : The outputs should be assessed based on progress since the last assessement. If this is the first time the Score Card is be should assess outputs over the last 3 years. For newly establish PAs, respondents may have to skip this section.

20. Context indicators - have there been improvements in context indicators ?		***Your Score***	***Comme***
a. Legal status has improved (refers to question 1. Legal status)	+2		

b. Regulations have improved (refers to question 2. PA regulations)	+2		
c. Law enforcement has improved (refers to question 3. Law enforcement)	+2		
d. Boundary demarcation has impoved (refers to question 4. PA Boundary demarcation)	+2		
e. The PA has been integrated into a PA systems plan (refers to question 5. Integration of the PA)	+2		
f. The resource inventory has improved (refers to question 6. Resource inventory)	+2		
g. Stakeholder awareness and concern has improved (refers to question 7)	+2		
21. Products and services		***Your Score***	***Comme***
a. Signs - signs are now available, or new one have been installed	+1		
b. User related infrastructure and services are now available, or have been installed	+2		
c. Education materials - education materials are available, or new ones have been developed	+1		
22. Mechanisms for stakeholder participation in decision -making and/or management activities (e.g. advisory council) - are mechanisms available to ensure stakeholder participation?		***Your Score***	***Comme***
There are no mechanisms for stakeholder participation in decision-making and/or management activities	0		
There are some mechanism for stakeholder participation in decision-making and/or management activitites, but not sufficient	1		
There are sufficient mechanisms for stakeholder participation in decision-making and/or management activities	2		
23. Environmental education and awareness activities for stakeholders (e.g. public outings at the PA)- have education activities been developed for stakeholders?		***Your Score***	***Comme***
There are no education and awareness activities available for stakeholders	0		
There are some education and awareness activities available for stakeholders, but they are not sufficient	1		
There are sufficient education and awareness activities available for stakeholders	2		

24. Management activities - have the two critical management activities (listed in the data sheet) been improved to address threats		***Your Score***	***Comme***
Management activities have not been improved	0		
Some measures have been taken to improve management activities	1		
Management activities have been sufficiently improved	2		
25. Visitor facilities - does the PA have sufficient visitor facilities?		***Your Score***	***Comme***
There are no visitor facilities and services	0		
Visitor facilities and services are inappropirate for current levels of visitation or are under construction	1		
There are some visitor facilities and services, but they could be improved	2		
Visitor facilities and services are sufficient for current levels of visitation	3		
26. Fees - If fees (entry fees - tourism, fines) are applied, do they help protected area management?		***Your Score***	***Comme***
Although fees and/or fines systems exist, they are not collected	0		
The fees/fines are collected, but they go straight to central government and are not returned to the protected area or its environs	1		
The fees/fines are collected, but they are disbursed to the local authority rather than the protected area	2		
There are fees and/or fines for the protected area that help to support this and/or other protected areas	3		
27. Staff Training		***Your Score***	***Comme***
Staff was trained but could be further improved to fully achieve the objectives of management	2		
Staff was trained in tune with the management needs of the protected area, and with anticipated future needs	3		
TOTAL for outputs (E) /33 or adjusted score			
F. Outcomes - What did we achieve? Assessment of the outcome and the			

to which we achieved objectives

28. Objectives - Have PA objectives (listed in the data sheet page) been addressed?		***Your Score***	***Comme***
Management objectives have not been addressed	0		
Management objectives have been addressed somewhat	1		
Management objectives have been sufficiently addressed	2		
Management objectives have been significantly addressed	3		
29. Threats - Have threats (listed in the data sheet page) been reduced?		***Your Score***	***Comme***
Threats have increased	0		
Threats have stayed at approximately the same levels	1		
Threats have been reduced somewhat	2		
Threats have been largely reduced	3		
30. Recource conditions - Have resource conditios improved?		***Your Score***	***Comme***
Resource conditions have declined	0		
Resource conditions have stayed at approximately the same levels	1		
Resource conditions have improved somewhat	2		
Resource conditions have improved significantly	3		
31. Community welfare - Has community welfare improved?		***Your Score***	***Comme***
Livelihoods and standards of living in the community have declined	0		
Livelihoods and standards of living in the community have stayed approximately the same	1		
Livelihoods and standards of living in the community have improved somewhat	2		
Livehoods and standards of living in the community have improved significantly	3		
Additional points			

a. PA management is coPAtible with the local culture, including traditional practices, relationships, social systems, cultural features, historic sites and monuments linked to resources and uses	+1		
b. Resource use conflicts have been reduced	+1	1	
c. Benefits from the PA are equitably distributed	+1		
d. The non-monetary benefits of the resources to society have been maintained or enhanced	+1		
32. Environmental awareness - Has community environmental awareness improved?		***Your Score***	***Comme***
Environmnetal awareness of resource conditons, threats and management activities has declined	0		
Environmental awareness has stayed approximately the same	1		
Environmental awareness has improved somewhat	2		
Environmental awareness has improved significantly	3		
33. Compliance - Are users complying with PA regulations?		***Your Score***	***Comme***
Less than 25% of users are complying with regulations	0		
25% to 50% of users are complying with regulations	1		
50% - 75% of users are complying with regulations	2		
Over 75% of users are complying with regulations	3		
34. Stakeholder satisfaction - Are the stakeholders satisfied with the process and outputs of the PA?		***Your Score***	***Comme***
Less than 25% of stakeholders are satisfied with the process and outputs of the PA	0		
25% to 50% of stakeholders are satisfied with the process and outputs of the PA	1		
50% to 75% of stakeholders are satisfied with the process and outputs of the PA	2		
Over 75% of stakeholders are satisfied with the process and outputs of the PA	3		
Additional points			

a. Stakeholders feel that they are able to effectively participate in management decisions	+1		
b. Stakeholders feel that they are adequately represented in the PA decision-making processes	+1		
TOTAL for outcomes (F): /27 or adjusted score			

Attachment 4. Investment Plan

[name of park/area]: 3 years later following the Implementation of a PA Investment Program
(Components/activities)

1. Institutional Strengthening

[list]

2. Infrastructure and Equipment

[list]

3. Environmental Education and Public Awareness

[list]

4. Livelihood Activities

[list]

APPENDIX F

EXCERPT FROM USER OTES FOR CIDA'S ENVIRONMENTAL ASSESSMENT FORMS

14. Public Concern

People may be concerned about the effects of a project whether or not the environmental assessment concludes that the effects are significant. If these concerns are substantial, further public consultation, redesign of the project, or referral of the project to a mediator, a review panel, a joint review panel or an advisory committee may be warranted.

All public comments received on a project must be documented in the screening report.

15. Significance of Adverse Environmental Effects

For projects subject to environmental assessment, determinations of how CIDA will proceed are based on an assessment of the significance of likely, adverse environmental effects. Guidelines of the Canadian Environmental Assessment Agency (CEA Agency 1994) identify the following factors that should be taken into account when deciding whether an adverse environmental effect is significant:

(a) Magnitude of the effect;
(b) Geographic extent of the effect;
(c) Duration and frequency of the effect:
(d) Degree to which the effect is reversible; and
(e) The environmental context of the effect. (An effect may be significant if it occurs in areas/regions that are already degraded, or are ecologically fragile with little resilience to stress.)

An adverse environmental effect is significant if, in the judgement of the assessor, it is not insignificant -- there is no middle ground.

The CEA Agency (1994) directs that project proponents should always submit information on the five factors listed above, and that criteria used to determine significance should be based on them. The assessor must use his/her own judgement in determining the significance of environmental effects, based on the above factors (15 (a) - (e)). In addition to the factors listed by the CEA Agency, assessors might also consider if:

Physical components:

- An established standard (e.g., air or water quality) would be exceeded for unreasonable lengths of time.
- The effect would reduce the carrying capacity for biological components of the environment.
- The effect would pose an unacceptable risk to human health or safety.

Biological components

- The effect would be outside the range of natural variation in the size or distribution of the component population.

- The effect would persist for an unreasonable length of time (e.g., longer than one generation).

Resource use components

- The effect represents a reduction in use lasting an unreasonable length of time (e.g., a year or more).
- The effect would result in a significant socio-economic change.

Health components

- The magnitude of the effect would be outside the range of natural variation in the component.

Socio-economic components

- The effect would be of sufficient magnitude and duration that people, communities or governments could not adapt to the effect relatively quickly in a way that leaves them no less well off than they were previously.

Cultural/heritage components

- A locally or regionally important component is permanently affected.

16. Completing the Matrix of Environmental Issues

The purpose of the matrix of environmental issues is twofold:

(a) working methodically through the matrix assists in the assessment of potential effects of a project. Thus, the matrix can be used as a checklist when identifying potential effects for analysis; and

(b) the matrix provides an overview of the results of the assessment.

Completing the matrix of environmental issues involves several steps:

1. Develop a complete list of project undertakings which may cause environmental effects and enter them in the first column of the top part of the matrix. Ensure you consider all project phases (e.g. pre-construction, construction, operation, closure, and accidents and malfunctions). Use more than one matrix if the number of undertakings exceeds the number of rows in the matrix. Assign sequential numbers to each undertaking you list (Column "No."). Example lists of undertakings for different project types are given in Appendix A.
2. Based on the effects analysis, read across the row for each undertaking and code each cell where the undertaking is expected to cause a direct or indirect effect on a biophysical environmental component. Use the codes shown in **Table 1** below (e.g., "B"). Blank columns are provided in the matrix for specifying other biophysical environmental components.

Review each column corresponding to the various biophysical environmental components. Where effects are coded in more than one cell of a column, consider if there will be an interactive effect on that component. If so, code it in the "Interactive Effects" row as above.

3. For each coded biophysical effect where there would be a consequent (i.e., indirect) non-biophysical (NBP) effect, complete the bottom part of the matrix. First, from the examples in **Table 2**, identify the NBP components which might be affected and enter them in the first column. Then, write the relevant undertaking number(s) (Column "No." in the top part of the matrix) in the appropriate NBP cell in the bottom part of the matrix and add the appropriate significance code (e.g., "2B").

   Review each row corresponding to the various NBP components. Where effects are coded in more than one cell of a row, consider if there will be an interactive effect on that component. If so, code it in the "Interactive Effects" column as above.

   Click on the following link to view examples of completed matrices.

Table 1 — Codes Used for the Matrix of Environmental Issues

Code	Meaning
Blank	No significant negative environmental effect *and* there is no significant public concern
A	Significant positive environmental effect
B	Significant negative environmental effect that can be mitigated
C	Potential significant negative environmental effect unknown
D	Significant public concern
E	Significant negative environmental effect that cannot be mitigated

Table 2 — Standard Non-Biophysical (NBP) Environmental Components

Group	Environmental Component
Resource Use	Water Supply / Use
	Agriculture / Animal Husbandry
	Forestry
	Hunting
	Fishing
	Gathering / Trapping
	Visual Features
	Tourism / Recreational Activities
	Land Uses by Aboriginals
	Use of Resources by Aboriginals
	Other (Specify)
Health	Individual / Community
	Occupational
	Services
	Other (Specify)
Socio-Economic	Population / Demographics
	Housing / Accommodation
	Community Infrastructure / Services
	Employment / Incomes
	Education / Training
	Access / Transportation
	Government Costs / Revenues
	Other (Specify)
Cultural / Heritage	Historic Sites / Features
	Archaeological / Paleontological Sites
	Traditional Sites / Uses
	Sites of Architectural Significance
	Other (Specify)

17. Cumulative Environmental Effects

A cumulative environmental effect is an effect that is likely to result from the project *in combination with* effects due to other projects or activities that have been or will be carried out.

The purpose of analyzing cumulative effects is to identify and avoid situations where the effects of discrete projects or activities act together to create significant adverse effects. For example, one tube well project may not effect ground water supply, but should more tube well projects be implemented in the same area, the cumulative effect could be that ground water supplies would not be sustainable.

When a *likely* and *significant* cumulative biophysical effect is expected, code the appropriate cell in the "Cumulative Effects" row in the top part of the matrix. Again, use the codes shown in **Table 1**.

When a *likely* and *significant* cumulative non-biophysical (NBP) effect is expected, code the appropriate cell in the "Cumulative Effects" column in the bottom part of the matrix.