ENVIRONMENTAL IMPACT ASSESSMENT

CRABBS BOATYARD AND MARINA

Antigua, West Indies

Prepared by:
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E N V I R O N M E N T A L I M P A C T ASSESSMENT: FINAL

CRABBS BOATYARD AND MARINA

Antigua, West Indies

Submitted to:
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Antigua

January 2025

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ETC Ltd. is grateful for the input of the Department of Analytical Services

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ABBREVIATIONS

EIA	Environmental Impact Assessment
DCA	Development Control Authority
DOE	Department of Environment
EAG	Environmental Awareness Group
SLR	Sea Level Rise
SST	Sea Surface Temperature
SIRMZP	Sustainable Island Resource Management Zoning Plan
NPDP	National Physical Development Plan
UNFCC	United Nations Framework Convention on Climate Change
Ha	Hectare
Ft	Feet
M	Metre
MSL	Mean Sea Level
MM	Millimetre
MRP	Mill Reef Properties Limited
OICP	Offshore Island Conservation Programme
sq. ft	Square feet
ToR	Terms of Reference
NEMMA	North East Marine Management Area
AOI	Area of Interest
PPA	Physical Planning Act
EPMA	Environmental Protection and Management Act
CBD	Convention on Biological Diversity
IUCN	International Union for the Conservation of Nature

EXECUTIVE SUMMARY

Dr. Nicholas Fuller has submitted a plan proposing the establishment of a boatyard and marina for the purpose of refuelling leisure boats on the Northeastern Coast of Antigua which lies within the Northeastern Marine Management Area (NEMMA). As a proposed construction site within the boundaries of the NEMMA, this project requires an Environmental Impact Assessment in order to inform a final recommendation for its approval.

The Crabbs Boatyard and Marina project proposes the development of a state-of-the-art marina facility within the industrial zone of Umbrella Point, North Sound. The development will include fixed and floating docks supported by pile foundations extending 500 feet into the water, a boatyard with permeable gravel surfacing for vessel storage and maintenance, and critical supporting infrastructure such as a fuel station, generator pad, and customer reception area. Designed to accommodate various vessel sizes, the marina integrates sustainability principles to minimise its ecological footprint while meeting the growing demands of the marine and tourism sectors.

Project Context

The site is strategically located within an area zoned for industrial activity, surrounded by similar operations such as the LNG terminal, North Sound Marina, and power plants. Adjacent to mangroves and nearshore marine ecosystems, the project's location underscores the need for rigorous environmental management to safeguard sensitive habitats while capitalising on its economic and recreational potential.

Key Findings

- The site drains into adjacent mangroves, which play a vital role in filtering sediment and pollutants, and into coastal waters supporting marine biodiversity.
- Hydrological studies confirmed the suitability of the site for development, with sandy soils providing effective natural drainage.
- Construction Phase: Potential impacts include sediment transport, noise pollution, and temporary disruptions to natural drainage patterns.
- Operational Phase: Risks include increased runoff volumes due to impervious surfaces, contamination from fuel storage and refuelling, and localised flooding during extreme weather events.
- The EIA concludes that while the project presents inherent environmental risks due to its proximity to sensitive ecosystems, these risks can be managed effectively with the implementation of the proposed design features and mitigation measures, keeping anticipated changes within acceptable environmental limits.

Mitigation Measures

To address identified risks, the project incorporates the following strategies:

- Installation of infiltration basins and permeable surfaces to manage stormwater and prevent flooding.
- Replanting mangroves in affected areas, maintaining buffer zones, and implementing sediment traps during construction.
- Double-walled tanks for fuel storage, spill containment systems, and robust waste management protocols.
- Infrastructure designed to withstand extreme storm events, including 1-in-100-year storms and associated surges.

Monitoring Framework

A comprehensive Environmental Monitoring and Management Plan (EMMP) ensures ongoing environmental protection and regulatory compliance. Key components include:

- Biannual monitoring of water quality, sedimentation, and mangrove health.
- Regular inspections of stormwater systems and pollution control measures.
- Adaptive management to refine strategies based on monitoring outcomes.

Conclusion

The Crabbs Boatyard and Marina project represents a balanced approach to sustainable development, leveraging its industrial context to minimise conflicts with residential areas while safeguarding sensitive ecosystems. The proactive integration of mitigation measures ensures that environmental risks remain well-managed and within acceptable limits.

This EIA endorses the project as a viable and development, capable of delivering significant economic and recreational benefits to the region. With its commitment to sustainability and compliance with regulatory standards, the Crabbs Boatyard and Marina development is positioned as a model for responsible marina operations in the Caribbean.

1. INTRODUCTION

1.1 Project Proponent

ETC Ltd. was retained by the project proponent, Dr. Nicholas Fuller, to prepare this Environmental Impact Assessment (EIA) for a marina and boatyard development at Umbrella Point, Parham, on the southern most end of Crabbs Peninsula.

Dr. Fuller is a practicing family physician and medical examiner with a long-standing connection to the marine environment. For over 25 years, he has salvaged stranded vessels around Antigua and Barbuda. His dedication to maritime history is further reflected in his authorship of The Salvaged History of Antigua and Barbuda, a work that documents the rich seafaring traditions of the islands. An accomplished Atlantic rower, Dr. Fuller embodies a deep understanding and appreciation of the ocean and its surrounding ecosystems.

In addition to his maritime pursuits, Dr. Fuller is a seasoned real estate developer, having spearheaded innovative projects across Antigua and Barbuda. He is also a businessman, and philanthropist, actively contributing to community development and environmental stewardship.

Contact Information:
Dr. Nicholas Fuller
Hodges Bay
Antigua

1.2 Purpose and Project Description

The purpose of this EIA is to assess the potential environmental impacts of the proposed marina and boatyard development at Crabbs Peninsula and provide recommendations to mitigate risks and ensure compliance with local and international standards. This report was prepared in response to a request from the Government of Antigua and Barbuda (GOAB) and the Department of Environment (DOE), which has identified key areas of environmental concern.

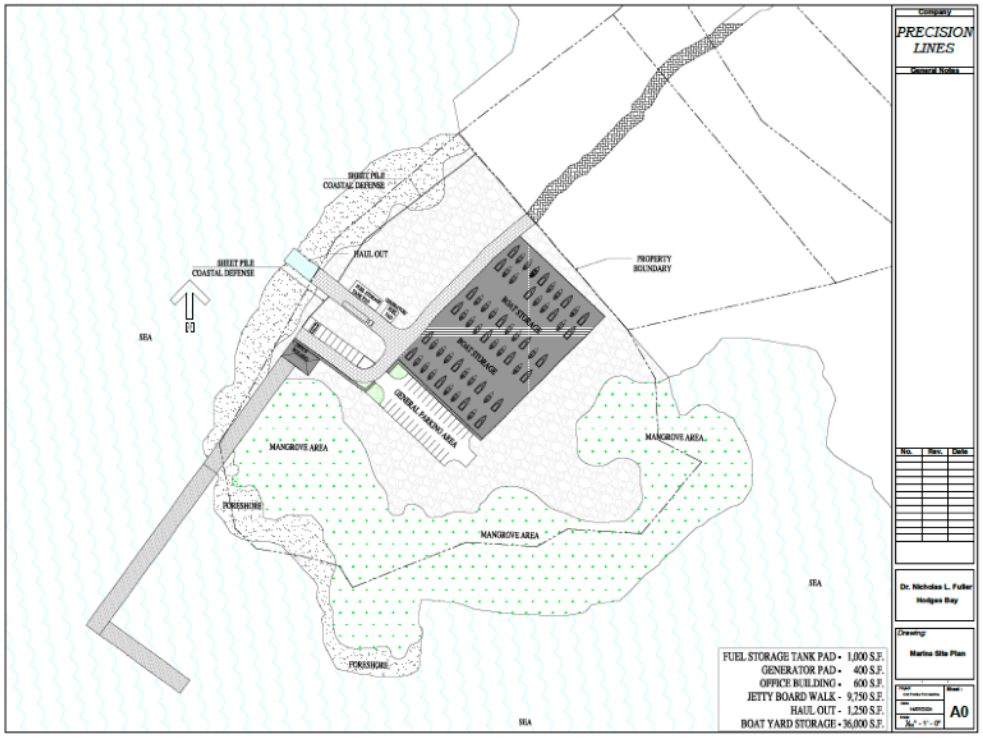
The proposed marina development at Crabbs Peninsula encompasses a comprehensive range of facilities, including both a boatyard and a marina. Key project components include:

- **Boatyard Area:** Covered with gravel stone for boat storage and maintenance.
- **Marina Infrastructure:** Supported by pile foundations extending 500 feet outward into the water, with a focus on limiting permanent concrete structures.

- **Mangrove Replanting:** Mangroves in affected areas will be replanted to mitigate environmental impact.
- **Docking Facilities:** Includes fixed and floating docks to accommodate various vessel sizes, constructed with pile foundations extending into the white mangrove area.
- **Haul-Out Well**: A 25-foot-wide haul-out well will be constructed on the north coastal boundary for yacht storage and repair.
- **Access Point:** A 25-foot-wide access pathway will connect the dock to a reception area on the southwestern tip of the peninsula.
- **Reception Office:** Serves as a central hub for marina operations, including customer service, boat logging, and activity coordination.
- **Fuel Station:** Installed for vessel refueling.
- **Generator Pad:** Constructed using concrete or a reinforced platform to house a generator.
- **Parking Facilities:** Ample parking spaces for customers and staff.

The development seeks to balance functionality with environmental stewardship through sustainable design practices.

Figure 1: Crabbs Boatyard and Marina Masterplan



1.3 Project Benefits

The proposed marina development at Crabbs Peninsula offers a wide range of benefits, including economic, environmental, and social contributions:

- Economic Growth: Creation of jobs for the local community, with Parham residents prioritized for employment opportunities.
- Improved Marine Services: Provision of a full-service marina, including docking, refueling, vessel maintenance, and repair.
- Community Integration: Enhancements to the area's infrastructure and resources for recreational and traditional activities such as fishing and boating.
- Environmental Commitment: A commitment to replanting mangroves and adopting sustainable construction techniques to minimize ecological impact.
- Tourism Development: Increased appeal for tourists and yacht owners, boosting the local economy through associated hospitality and marine activities.

By addressing the needs of both the local community and marine ecosystem, the development aims to position Crabbs Peninsula as a premier maritime hub in Antigua.

1.4 Limiting Conditions

Inherent in any EIA are limitations on the content and scope of work included in the report. Predicting future events is not an exact science but may be based on what has happened in the past, impacts that have occurred in similar situations or from scientific literature predicting future impacts such as those from climate change. Any time topography is altered or natural environments are removed, predictions may be well informed based on extensive modelling, but possibilities for error will still remain. Assumptions are made based on the willingness of the Developers to follow mitigation plans, monitoring and recommendations made by this report. There are also assumptions related to the effectiveness of these mitigation efforts in reducing environmental impacts to acceptable levels. The EIA will focus on the area within the property boundaries, as shown in Figure 1, in addition to neighbouring areas of high environmental sensitivity, such as the nearby mangrove forest.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The Developers have received “Approval in Principle'' from the Development Control Authority. They also have received a letter of support from the Prime Minister, which states that the Cabinet has granted preliminary approval for the lease of five acres of seabed in addition to its willingness to grant all the permits and other licenses required to operate the planned marina; all of which however, is subject to a satisfactory EIA.

There are several laws that are relevant to the Parham Marina Project and these are as follows:

- Physical Planning Act 2003
- The Fisheries Act 2006
- Environmental Protection and Management Act 2019
- The Sustainable Island Resource Management Plan (SIRMZP)
- NEMMA Management Plan
- National Solid Waste Management Authority Act 1995 and (Amendment) 2005
- Noise Abatement Act 1996

Physical Planning Act 2003

This act provides the main legal framework for orderly and progressive development as it outlines the conditions for the control of the use of the land as well as the regulates building construction and other related matters. Schedule 3 of the legislation outlines those projects for which Environmental Impact Assessments are required. These include:

- An airport, port or harbour including a yacht marina
- A wastewater treatment, desalination or water purification plant.
- An industrial estate development project; and
- A hotel or resort complex
- A power plant
- A crude oil or refinery facility or a petroleum and natural gas storage and pipeline installation;
- An incinerator, sanitary landfill operation, solid waste disposal site, sludge disposal site, toxic waste disposal site or other similar site;
- An industrial estate development project;
- An installation for the manufacture, storage or industrial use of cement, paints, chemical products or hazardous materials,
- A drilling, quarrying, sand mining and other mining operation;

Environmental Protection and Management Act 2019

The Environmental Protection and Management Act (2015) is an act created to the protection of the natural environment. The Act falls under the jurisdiction of the Minister in charge of the Environment. It states the functions and responsibilities of the Minister, the directors and the powers of the department, the appointment of inspectors and the delegation of powers.

Apart from detailing the special powers of the inspectors and directors it also considers the National Environmental Framework – implementation, review or policies and plans, framework for EIA's and compliance.

Pollution Control regulations are incorporated in the act as well as pollution sources, pollution control permits, registers on sources of pollution, pollution charges, permits and liability for historical pollution.

Environmental Management and monitoring guidelines are provided as well as the management of watersheds and wetlands. These have implications for the Runaway Bay Development Project because of the fragile ecosystem in which the development is taking place.

The act also covers financial provisions, compliance and enforcement, environment information, research and education as well as offences and penalties.

The Sustainable Island Resource Management Plan (SIRMZP)

The Sustainable Island Resource Management Zoning Plan (SIRMZP) was prepared by GENIVAR Trinidad and Tobago along with local consultants in Antigua namely Ivor Jackson and Associates as well as Kingdome Consultants. The main goal of the SIRMZP was to approach land development from a strategic and national perspective. It therefore addresses current development issues and provides a platform for private and public partnerships and development initiatives over the next 20 years. The document meets the criteria for the Physical Planning Act (2003) and serves as a revised Draft National Physical Development Plan (NPDP).

The Fisheries Act 2006

Fisheries Act, 2006 (Act No. 22 of 2006) makes provisions for the management and conservation of marine fisheries resources of Antigua and Barbuda, for the registration of local fishing vessels and the designation of Marine Reserves and Fishing Priority Areas and provides rules relative to aquaculture. The principal authority for purposes of this Act shall be the Minister. The Minister shall appoint a Fisheries Advisory Committee and may designate local fisheries management areas and appoint an authority for each area.

NEMMA Management Plan[1]

In August 2005, the NEMMA was declared a Marine Reserve under the 1983 Antigua and Barbuda Fisheries Act, Cap 173, in accordance with section 22 (1). The reasons for establishing marine reserves as outlined in Section 22 (1) of the Fisheries Act, 2006, are to:

- Protect flora and fauna of such areas and protect and preserve the natural breeding grounds and habitats of aquatic life
- Allow for natural regeneration of aquatic life

[1] Ivor Jackson Final NEMMA Management Plan

- Promote scientific study and research in the areas
- Preserve and enhance the natural beauty of such areas

The vision for the NEMMA (stated in Part Two of the Management Plan) is "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."

Management objectives reflect the multiple uses of the area and its environmental and socioeconomic importance. They seek to maintain biodiversity, promote scientific and socioeconomic research, and monitoring, preservation of coastal water quality, scenic and natural beauty, promote and manage tourism and recreational uses, public education, awareness and appreciation of the area‟s heritage, sustain traditional uses and livelihoods and generally promote economic and social benefits at the community and national levels.

National Solid Waste Management Authority Act 1995 and (Amendment) 2005

This act is an amendment of the Solid Waste Management Authority Act No. 10 of 1995. It is cited as the Solid Waste Management (Amendment) Act 2005. It establishes the National Solid Waste Management Authority with the responsibility for solid waste , storage, collection, treatment and disposal, and for matters incidental or otherwise.

The act outlines the main responsibilities and duties of the Solid Waste Management Authority which are as follows:

- To provide storage facilities for solid waste
- To provide collection and storage facilities at ports , harbours and anchorages
- To convert dumps into sanitary landfills
- To provide treatment and disposal for hazardous and medical waste
- To develop and manage sanitary landfill sites and other disposal methods
- To introduce measures to encourage recovery of recyclable items
- To introduce cost recovery methods for services provided by the Authority

Noise Abatement Act 1996

The Noise Abatement Act of Antigua and Barbuda makes provisions concerning the control of noise. In the case of this project the noise on construction sites will include but are not limited to erection, alteration or repairs to buildings, demolition work and any engineering construction. Under this act the Project Manager and contractor would have to apply for consent with the Ministry stating work to be carried out and efforts made to minimise noise.

International Conventions and Protocols

As it is necessary to consider the international arena and compliance on an international level, the following international agreements have bearing:

- United Nations Framework Convention on Climate Change (UNFCCC)
- Vienna Convention for the Protection of the Ozone Layer and Montreal Protocol on substances that deplete the Ozone Layer

- Convention on Biological Diversity (CBD), Nairobi 1992
- Convention on the Prevention of Marine Pollution (MARPOL) by dumping of wastes and other matter, 1972, and
- International Union for the Conservation of Nature (IUCN) which Antigua and Barbuda are member of.
- Kyoto Protocol to the UN Framework Convention on Climate Change December 11th 1997 Kyoto October 28th 1998
- UN Convention on Biological Diversity and its protocols. June 5th 1992
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity 2000
- Protocol Concerning Specially Protected Areas and Wildlife (SPAW Protocol to the Cartagena Convention) January 18th 1990 Jamaica
- Montreal Protocol on Substances that Deplete the Ozone Layer and its protocols. September 16th 1987 final accession Copenhagen 1993
- The Stockholm Convention on Persistent Organic Pollutants February 2004

3. APPROACH AND METHODOLOGY

3.1. Marine Surveys

Marine assessments were conducted to evaluate baseline conditions and predict project-related impacts on seagrass beds, mangroves, and avifaunal habitats.

3.1.1 Depth Surveys

Depth measurements were conducted using spatially referenced depth soundings collected with a vessel-mounted depth sounder and a Garmin GPS system. Data processing and interpolation were completed using QGIS and ArcGIS tools to create an accurate bathymetric map of the area.

3.1.2 Seagrass and Benthic Surveys

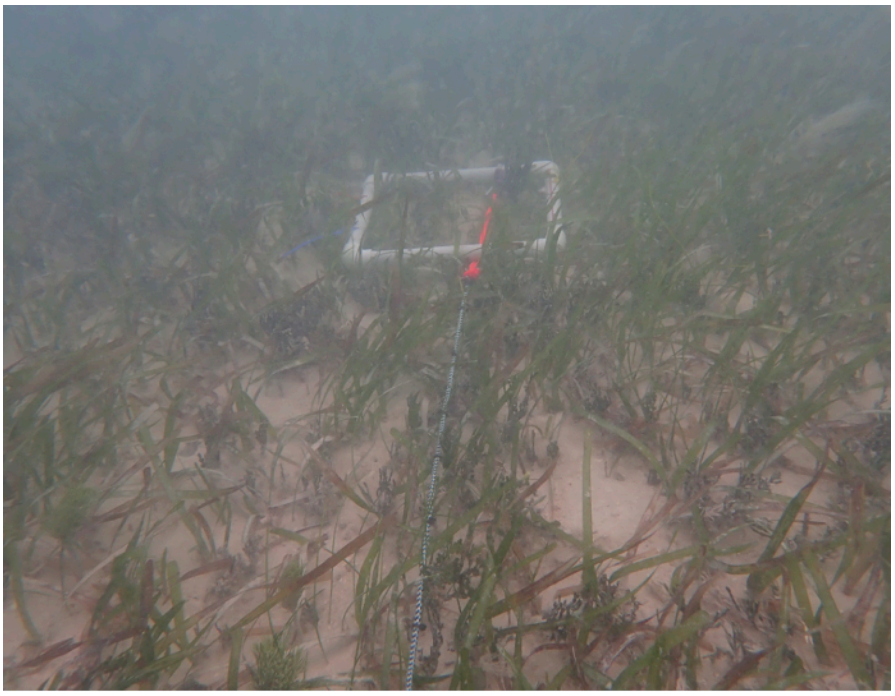


Figure 2: *Seagrass survey*

Seagrass surveys followed a standardized protocol, which included:

- Laying 50m transects parallel to the shore and recording conch, urchins, and other benthic fauna within a 1m belt.
- Quadrat-based measurements every 5m to determine:
- Percent cover of seagrass, live coral, sand, and invasive species.
- Species abundance, richness, and average canopy height of seagrass.

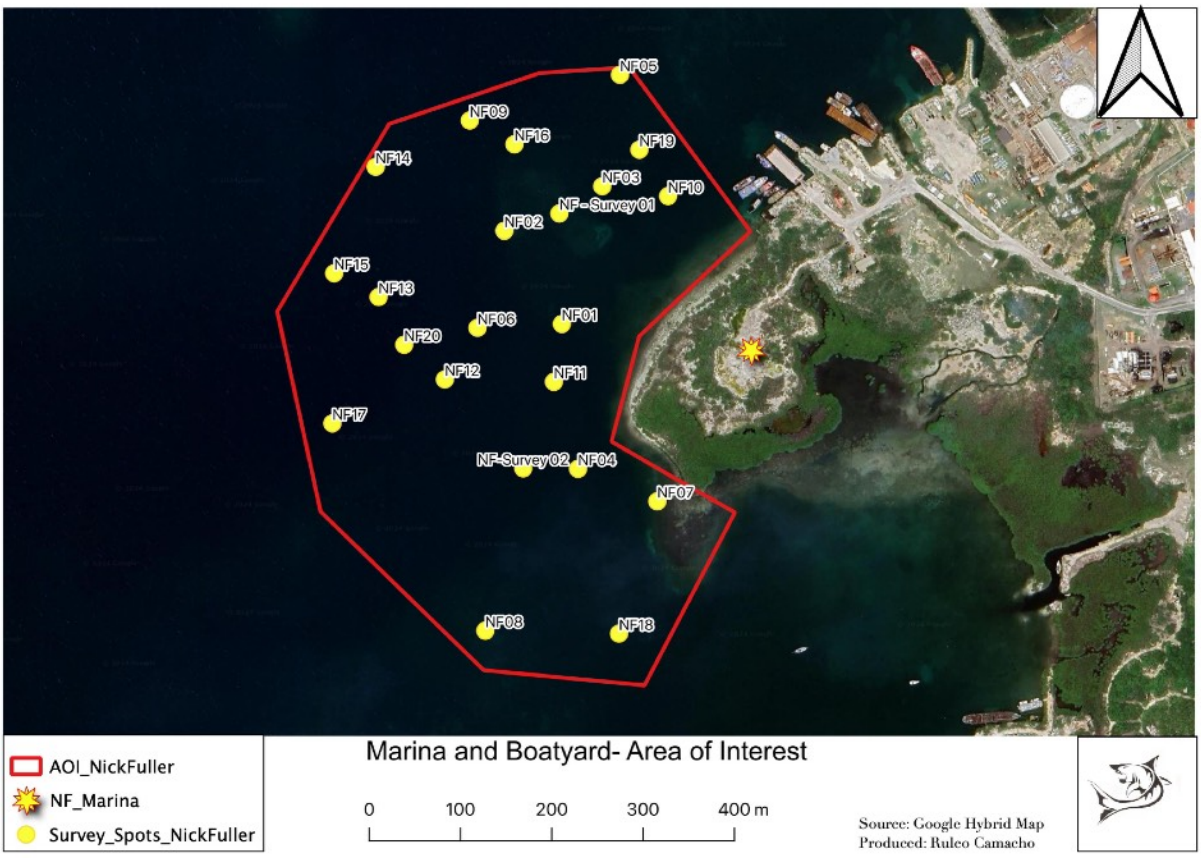


***Figure 3**: Survey points and detailed seagrass survey sites.*

3.2. Mangrove Mapping

Mangrove wetlands were mapped using Google Hybrid Maps and QGIS, validated through field observations to identify dominant vegetation types and assess habitat health.

3.3. Avifaunal Surveys

Avifaunal assessments were conducted to determine baseline bird species richness and density, using a point-count method with pre-determined observation points. Surveys accounted for tidal variations, time of day, and site accessibility.

3.4. Hydrological and Stormwater Management Study

The hydrological study and stormwater management plan evaluated the potential impacts of the proposed Crabbs Boatyard and Marina development on the site's natural hydrology, adjacent ecosystems, and mangrove wetlands.

The study focused on:

- Rainfall Analysis: Historical rainfall data from the V.C. Bird International Airport were analysed to determine peak runoff conditions.
- Soil and Percolation Testing: Field and desktop analyses identified a sandy substrate with a moderate infiltration rate of 4.8 inches per hour and a shallow water table (4 feet), emphasising the need for groundwater protection.
- Drainage Patterns: Existing natural flow paths, tidal channels, and micro-catchment areas were mapped, with mangroves noted for their filtration benefits.
- Ecosystem Mapping: Mangroves, wetlands, and tidal flats were mapped using GIS and field surveys to assess their sensitivity to potential impacts.

4. ANALYSIS OF ALTERNATIVES

4.1 No-Action Alternative

Under the no-action alternative, the proposed marina and boatyard development would not proceed.

- *Environmental Benefits:* The natural hydrology, mangrove wetlands, and seagrass beds would remain undisturbed. The risks of habitat fragmentation, increased runoff, and water quality degradation would be avoided.
- *Social and Economic Drawbacks:* Local employment opportunities during the construction and operational phases would not materialize.
- Economic benefits linked to the tourism and marine industries would be foregone.
- The existing facilities in the Parham area may continue to struggle with limited capacity, potentially hindering the area's growth as a maritime hub.
- *Rationale:* While this alternative avoids all environmental risks, it does not address the increasing demand for improved marina infrastructure or the opportunity to generate economic benefits for the local community.

4.2 Alternative Site Location

Relocating the marina and boatyard development to an alternative site within the region was considered.

- *Environmental Feasibility:* Other locations may lack the protective features of Crabbs Peninsula, such as calm waters that are essential for marina operations. Additionally, moving the project further inland or to a less suitable coastal site may introduce new environmental challenges, such as impacts to alternative ecosystems or greater need for site modifications.
- *Economic Viability:* Relocating to another site would involve significant costs related to land acquisition, additional environmental studies, and infrastructure development.

- *Practical Challenges:* Sites further from the Parham area would limit the project's ability to support existing economic activities in the region.
- Accessibility for vessel operators and integration with local amenities might be reduced.

- *Rationale*: The strategic location of Crabbs Peninsula provides calm waters, existing infrastructure nearby, and accessibility for stakeholders. Alternative sites may reduce some environmental impacts but are not economically or logistically feasible.

4.3 Alternative Design and Phasing

An alternative phased approach to the project was considered to reduce immediate environmental impacts while achieving key project objectives.

- *Phase 1:* Develop core infrastructure, including the fixed docks, haul-out well, and essential facilities such as fuel services and the reception area.
- *Phase 2:* Gradual expansion to include additional facilities such as floating docks, enhanced parking, and workshops.

- *Environmental Benefits:* A phased approach reduces the immediate disturbance to sensitive habitats such as mangroves and seagrass beds. It allows for monitoring of potential impacts and adaptive management to mitigate risks before proceeding to future phases.
- *Economic Considerations:* Lower initial investment costs allow for financial flexibility while still achieving key milestones.

- *Rationale:* Phased development balances the need for environmental protection with the economic objectives of the project, providing time for stakeholder engagement and adaptive environmental management.

4.4 Alternative Construction Methods

Alternative construction methods were evaluated to minimize environmental impacts during development. The current proposal includes pile-supported docks, concrete generator pad, and gravel-covered surfaces for the boatyard area. Alternative methods could include the use of prefabricated, modular components for docks and infrastructure to reduce site disturbance. Using permeable surfaces such as porous pavers for parking areas to allow natural infiltration and reduce surface runoff. Using temporary platforms during construction could also protect mangrove roots and minimise sedimentation.

Rationale: Adopting alternative methods where feasible reduces construction-related impacts such as soil erosion, sediment transport, and habitat disturbance. These techniques align with best practices for environmentally sensitive areas.

4.5 Preferred Alternative

The preferred alternative is the current proposed marina and boatyard development with integrated mitigation measures.

Environmental Considerations:

- The project incorporates mangrove replanting to offset losses and enhance ecological resilience.
- A stormwater management plan, including Best Management Practices (BMPs), ensures effective control of runoff and water quality protection.

Economic and Social Benefits:

- The development will generate employment opportunities during both construction and operation phases.
- The marina will enhance Parham's appeal as a maritime hub, supporting tourism and related industries.
- Improved infrastructure will contribute to safer vessel operations, particularly during northern swells.

Rationale: The preferred alternative represents the most balanced option, addressing environmental concerns while achieving critical economic and community development goals. Mitigation strategies will ensure long-term environmental sustainability.

5. BASELINE ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT

Antigua and Barbuda currently have four declared Marine Protected Areas (MPAs), the oldest, Diamond Reef and Palaster Reef were declared since 1973 as no-take reserves for the purpose of fisheries conservation (Jackson, 2007). Cades Bay Marine Reserve (CBMR) and the North-East Marine Management Area (NEMMA) were declared in 1999 and 2005 respectively as larger, multiple use MPAs that include both coastal systems such as wetlands, mudflats, and beaches as well as marine habitats including seagrass beds and coral reefs. The NEMMA is currently legally protected by the Fisheries Act 2006 where the Fisheries Division serves as its managing authority (ECL, 2007). The management of the NEMMA is delegated to a not-for-profit company, the NEMMA Management Partnership, composed of government agencies and statutory bodies, the private sector, community groups and NGOs such as the Environmental Awareness Group (EAG) (ECL, 2007).

The NEMMA is known for its high economic value, hosting many industrial and tourism related activities contributing to the overall economy of Antigua & Barbuda. Figure 4 showcases the

extent of the NEMMA boundary. The NEMMA consists of numerous offshore islands, approximately 13 of which are privately owned and uninhabited except for Long Island which is home to luxury villas and Jumby Bay Island Resort. This section discusses the "Project Site" at hierarchical spatial scales to include the overarching historical circumstances of the NEMMA and the specific existing conditions of the area of interest, Green Island shown in figure 4.

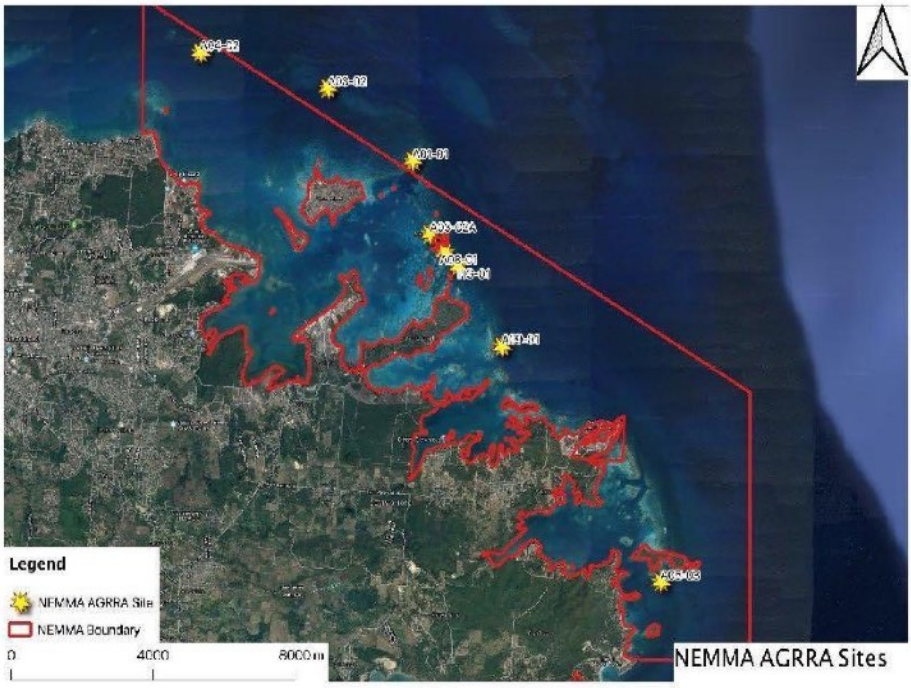


Figure 4: *Map Showing NEMMA Boundary (Camacho et al., 2020)*

5.1.North East Marine Management Area (NEMMA)

The NEMMA is an area both critically significant for its biodiversity conservation and role in the economic development of Antigua & Barbuda. Prized for its unique landscapes and natural beauty, the NEMMA comprises rich marine and coastal areas in the north-eastern coastline of Antigua spanning over 30 square miles including 28 named offshore islands. NEMMA was designated as a Marine Managed Area (MMA) in 2005 under the 1983 Antigua and Barbuda Fisheries Act, Cap 173.

A management plan was created for the NEMMA region in 2008 which detailed the objectives and the scope of the area. NEMMA is recognized as a "globally significant research and conservation site, a refuge for endemic, rare and globally important wildlife including the critically endangered Antigua Racer Snake *(Alsophis antiguae*), the Hawksbill Turtle (*Eretmochelys imbricata*) and the vulnerable West Indian Whistling Duck (Dendrocygna arborea). Consistent research, habitat restoration, and awareness-raising have been the cornerstones of over a decade of internationally supported conservation efforts.

The extensive coastal area within the NEMMA has a long history of multiple uses; relatively calm waters and various offshore islands have long attracted recreational boaters, for both day

trips and overnight excursions. Residents from bordering communities such as Seatons and Parham regularly ply the protected waters and shallow reefs in small-scale fishing efforts, joined in recent time by modernised sport fishing and fly-fishing enthusiasts. A soothing seascape interrupted by rugged coralline islands and very little else has attracted surging numbers of tourists each year, arriving on several day charter tour boats. Anchorages in the vicinity of Non-Such Bay and Great Bird Island have also become attractive among the yachting community.
In addition to the local communities bordering the NEMMA, small residential areas also exist on some offshore islands. Long Island is home to the Jumby Bay hotel and residences, while Maiden Island and Pelican Island are privately owned and currently under development. Guiana Island, the largest land mass within the NEMMA has been the site of several development proposals, often met with public controversy owing to the extensive local use of the area and the grand scale of the proposed developments.

Encompassing over 30 square miles rich in coastal and marine resources, the North East coast has been brought into sharp focus for management agencies. From an ecological perspective, the offshore islands offer a living laboratory, serving as indicators to allow for the measurement of changes that have affected local conditions and the rest of the Caribbean over time. Economically speaking, and provided that sustainable use is practiced, the area's resources can provide a viable source of income for local fishery and tourism sectors, as well as a playground for local recreationalists. In August 2005, the NEMMA was declared a Marine Reserve under the 1983 Antigua and Barbuda Fisheries Act, Cap 173, in accordance with section 22 (1). This legislation was welcomed by many groups, in fact many users referred to the area as a “park” or “reserve” for years before the designation became official.

DEMOGRAPHICS

Based on CIA World Factbook (September 2024), the following statistics are reflective of the most up to date national demographics of Antigua & Barbuda.

Population: *102,634 (July 2024 est.)*

Ethnic Groups: African descent: 87.3%, Mixed: 4.7%, Hispanic: 2.7%, White: 1.6%, Other: 2.7%, Unspecified: 0.9% (2011 est.)

Age Structure (2024 Estimates):

0-14 years: 21.8% (male 11,384 / female 11,034)
15-64 years: 67.6% (male 32,312 / female 37,094)
65 years and over: 10.5% (male 4,615 / female 6,195)

Median Age (2024 Estimates):

Total: 33.9 years
Male: 31.9 years
Female: 35.7 years

Population Growth Rate

1.11% (2024 est.)

Birth Rate

14.9 births/1,000 population (2024 est.)

Death Rate
5.7 deaths/1,000 population (2024 est.)
Net Migration Rate
2 migrants/1,000 population (2024 est.)
Parishes & Population
St. George: 8,193
St. Peter: 5,547
St. Philip: 3,648

LIVELIHOODS AND COMMUNITIES
Data availability at the appropriate spatial scale, i.e the NEMMA however, was not readily available due outdated population census. However, estimations can be drawn from the analysis of the 2001 Housing and Population Census in ECL (2007) which indicated that in this year, the NEMMA area constituted about 12 % of the population of Antigua and Barbuda, consisting of 22 communities.
The following communities can be found surrounding the NEMMA:

- Fitches Creek
- Hodges Bay
- Coolidge Airport
- Parham
- Vernons
- Glanvilles
- Seatons
- Willikies
- Long Bay
- Long Lane
- Browns Bay / Mont Pellier / Gaynors Mill Reef / Half Moon Bay
- Royals
- Cedar Grove
- New Winthorpes
- Piggots
- Crabbs
- Pares
- Jumby Bay (Long Island)

Equally, the main sources of employment and income generation within these communities are fishing and tourism activities (e.g., boat tours, diving and snorkelling, and yachting). as well as agriculture and commercial businesses and industry. Unemployment is at 8.4% in these communities and is slightly higher for women than men indicating other socio-cultural factors at play (Canari, 2017). Business activities were found to be most prevalent in New Winthorpes, Parham and Piggotts while Glanvilles, Seatons and Coolidge had the least business activity (Jackson, 2008).

5.2. **Resource Uses**

5.2.1.**Tourism**

Tourism is an important and growing activity within the NEMMA and is one of the top 5 tourist attractions in the country. Its pristine waters and scenery are major contributors of the tourism product and a prime example of the role of environmental resources in the performative aesthetic of places facilitating economic and recreational activities. The assets of the NEMMA which contribute to this are its beaches, mangrove wetlands and offshore islands (Camacho, 2021). For instance, boat excursions have become quite popular and attract many one-day cruise ship visitors where the focus is typically on the scenic waters of the North Sound, making stops at various islands or cays such as Great Bird Island, Prickly Pear, Green Island and Hell's Gate (Jackson, 2007).

According to Canari (2017), approximately 18 boating excursion companies were operating within the NEMMA's North Sound area, highlighting that it is a significant business activity. Tour boat operations are also regulated by law, requiring renewal of licenses and cruise permits annually. Updated figures, however, were unavailable at the time of this report, but trends between 2007-2017 indicate that tour boats are key contributors to the thriving environmental tourism market in the NEMMA (Canari 2017; Jackson, 2007). This coincides with findings in ECL (2007) with up to 300 people being accommodated per day during the peak season. Tourist attractions, such as Sting Ray City, have also been established within the NEMMA community (Canari, 2017). **Figure 5** below provides a spatial overview of the popular land and marine use activities occurring within the NEMMA.

Other tourism related activities include the following:

- Recreation: Swimming, diving, and snorkelling
- Water Sports Activities and Rentals: Jet-Skis, sail craft, kayaks, surfboards, kites, and snorkelling gear
- Marina and Jetties: Yacht anchorages typically occur around Nonsuch Bay, Green Island, and Great Bird Island. There is also a marina and boatyard at Shell Beach and private jetties at Jumby Bay (Long Island), Maiden Island, and Harmony Hall and Barnacle Point
- Hotels such as Jumby Bay Hotel on Long Island are serviced by two ferries which operate frequently throughout the day between Beachcomber Dock and Parham Harbour.

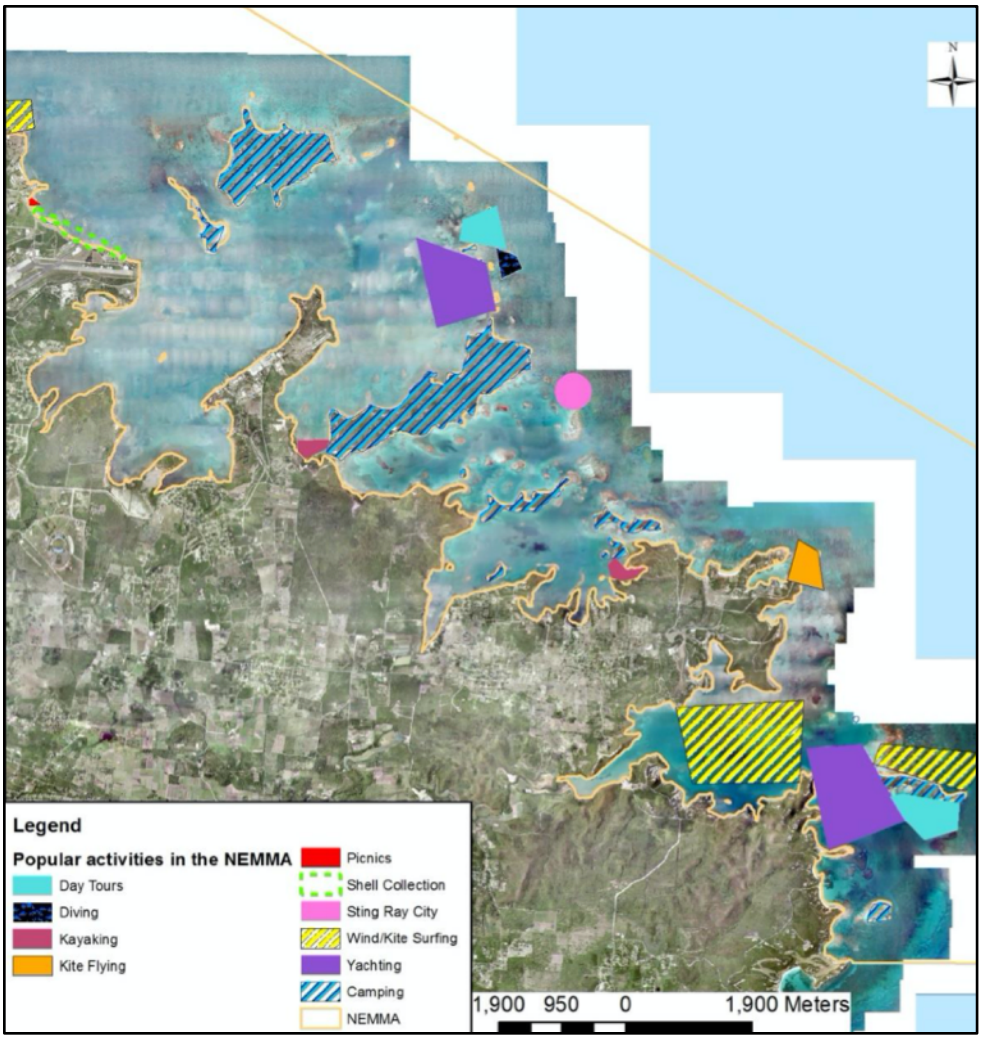


Figure 5: Popular Land and Marine Use Activity in the NEMMA (Lovell and Spencer, 2017)

5.2.2. Fishing

Fishing is a traditional activity within the NEMMA, operating on an informal basis with the majority of fisherfolk considered part-time or seasonal (Jackson, 2008). Within the NEMMA, Emerald Cove/Willikies and Mill Reef are primary landing sites as outlined in ECL (2007) and majority coincide with the major communities including: Beachcomber, Hodges Bay, Shell Beach, Fitches Creek, Parham, Seaton, Willikies, and Mill Reef where hotels are located. Local fishermen tend to derive most of their business for the "Fresh Catch" requirements of hotels along the coast. Most fishermen based within the NEMMA sell their catch in the villages as well as it is not large enough to warrant transport to the market in St. John's (ECL, 2007). Due to changes in the environment over the years however, the Fisheries Division has indicated the NEMMA has decreased in importance in terms of livelihood, but its importance as a key biodiversity habitat in the health of its reefs and wetlands which serve as fish nurseries and feeding grounds for birds (Canari, 2017). See **figure 6** below.

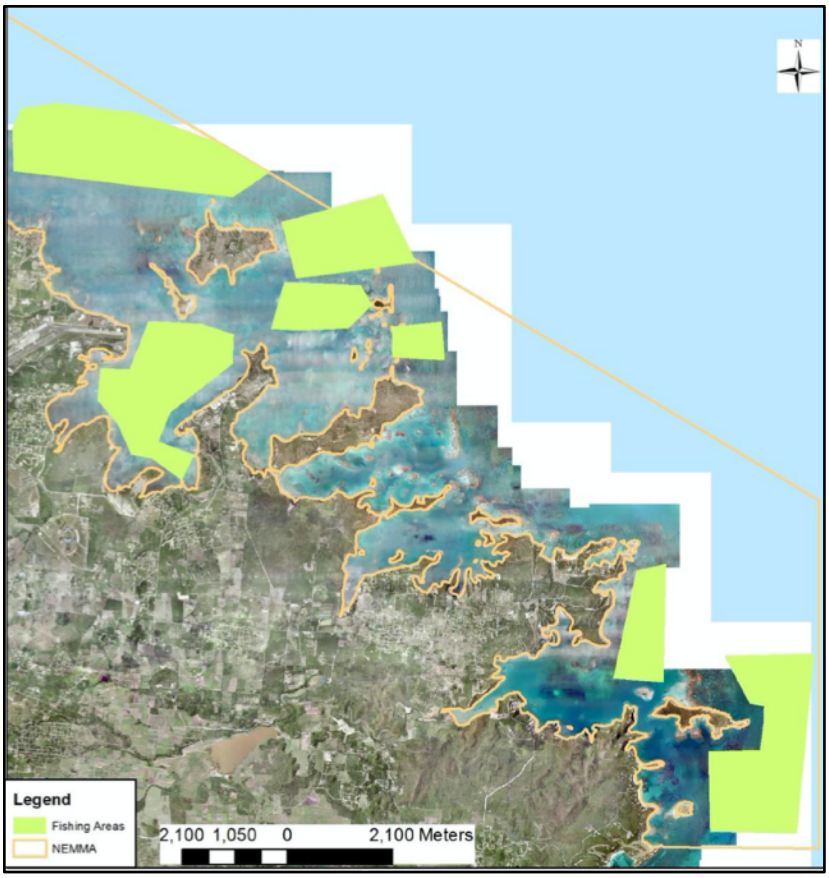


Figure 6: Important Fishing Areas in the NEMMA (Lovell and Spencer, 2017)

5.2.3. Industrial

Industrial activities in the NEMMA include two electricity power plants, a desalination plant, a brewery, a cement receiving facility and harbour all located on Crabbs Peninsula (Jackson, 2008). There are also industrial estates, at Coolidge and Tomlinson, within the watersheds draining into the NEMMA as well as the international airport at Coolidge.

A variety of activitiea surround the project site and are displayed in **figure 7**. These include:

- Commercial Entities
    - Parham Fisheries Complex
    - Crabs Raceway
    - North Sound Marina
    - YIDA Development area
    - Jumby Bay Resort on Long
    - VC Bird International Airport
- Industrial Areas
    - Reverse Osmosis Plant
    - Antigua Power Plant
    - Antigua Barbuda Defense Force

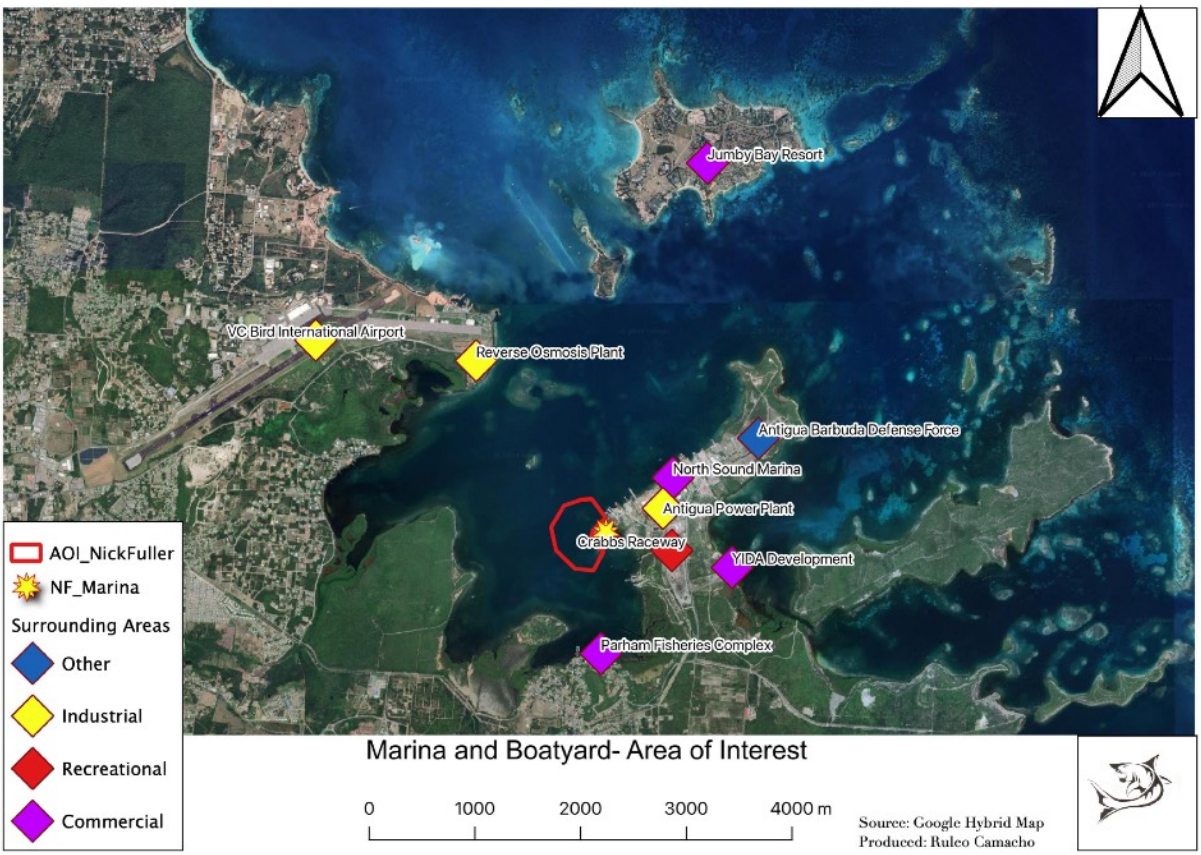


Figure 7: *Surrounding Influences*

5.2.4. Land Use and Zoning

The Sustainable Island Resource Management Zoning Plan for Antigua & Barbuda (SIRMZP, 2011) outlines the land-use specifications for development in the country. Land-uses within the NEMMA range from settlement in the north, to forest, institutional, transportation, environmental protection, tourism, and agriculture along the coastline southward. **Figure 8** below indicates the project site (circled), which is earmarked as a "Special Development Area" where settlement can also be found. Although the project would be in keeping with the zoning designation it should be noted that it is surrounded by protected mangrove wetlands.

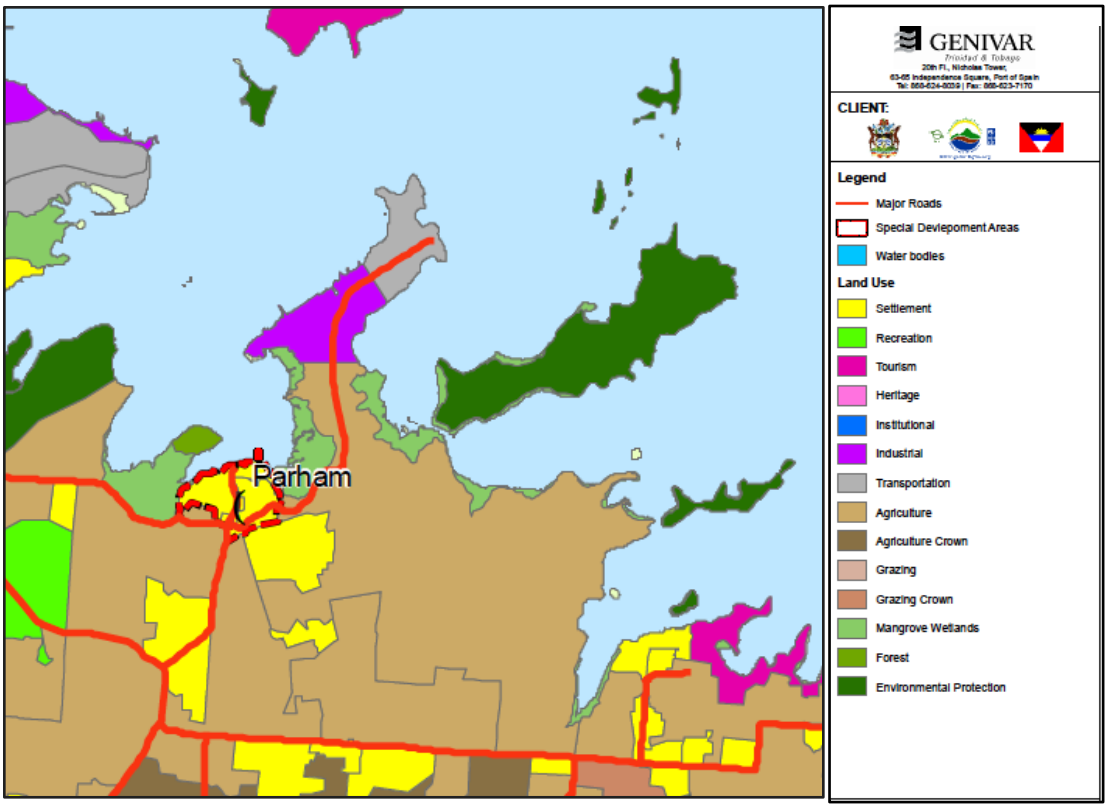


Figure 8: SIRMM Zoning

5.3. Climate

The project site is located, is situated on the northeastern coast of Antigua - Latitude 17°7'7.25", Longitude -61°46'6.84". Temperatures are usually high year round for the entire island, which is influenced by steady north-easterly trade winds. The closest weather station can be found at the North Sound and data supplied by the Antigua and Barbuda Meteorological Services for the past 12 months show that the average daily temperature was 26.8°C with January being the coldest month at 25.4°C and July, August and September being the warmest at 28.1°C. Measurements were taken from Cobbs Cross weather station.

The average rainfall was 2.425 mm over any 24 hour period with November being the wettest month with 7.1 mm and May the driest with 0.3 mm per day.

The average prevailing wind direction for the past 12 months has been 66.4°. The average speed was 4.88 knots.

5.3.1. Climate Change

Antigua and Barbuda is already experiencing some of the effects of climate variability and change through damage from severe weather systems and other extreme events, as well as more subtle changes in temperature and rainfall patterns. The 2017 Category 5 Hurricane which caused significant damage in Barbuda being a prime example. This was detrimental to the

economy, as more intense storms resulted in greater losses and damages particularly in the tourism, business, and housing sectors (GOAB, 2021).
Detailed climate modelling projections for Antigua and Barbuda predict:

- an increase in average atmospheric temperature;
- reduced average annual rainfall;
- increased Sea Surface Temperatures (SST); and
- the potential for an increase in the intensity of tropical storms[2]

Table 1 outlines the projected climatic changes in Antigua & Barbuda as per the Draft State of the Environment Report, which draws on multiple scientific evidence to determine climate prediction (GOAB, 2021). Specifically, for Parham Harbour, although all impacts are pertinent, hurricanes, SLR, coastal erosion and storm surge are significant threats to the livelihood within the NEMMA.

Table 1: Summary of Climate Impacts and Mitigation measures on Coastal Environment in the context of Parham Harbour

Impact	Brief Description	Risk Significance High/Medium/Low	Mitigation Measures
Extreme Rainfall Event	Extreme rainfall is only projected to occur during a tropical cyclone/ hurricane	Medium	Considerations given to elevation and adjustment to pile heights in accordance with SLR predictions, National Building Code
Extreme Atmospheric **Temperatures**	Increased Surface Temperatures are likely	Medium	Adequate ventilation within restaurant and kitchen facilities to ensure thermal comfort to staff and customers
Hurricanes	Hurricane intensity in Atlantic is likely to increase, thus indicating stronger winds and increased rainfall which causes damage to ecosystems and coastal developments	High	Ensure the utilisation of resilient building materials and techniques

[2] THE CARIBSAVE CLIMATE CHANGE RISK ATLAS (CCCRA), 2012. Climate Change Risk Profile for Antigua and Barbuda

Sea Level Rise (SLR)	Climate change due to increased GHGs causes SLR	High	Considerations given to elevation and adjustment to pile heights in accordance with SLR predictions, National Building Code
Other (Storm Surge/ Coastal Erosion)	Increased Hurricane activity results in Storm Surge and thus coastal erosion is likely for vulnerable and unhealthy coastlines	High	Adherance to suggested dock elevations and evacuation during storm events.

5.4. Biological Resources

5.4.1. Regional Overview

The primary marine assets found within the NEMMA region are coral reefs, mangrove wetlands and seagrass beds, all of which support a wide variety of marine life. Mangrove wetlands cover over 240 hectares within the NEMMA [2] and consists of 4 species: Red Mangrove (*Rhizophora mangle*), Black Mangrove (*Avicennia germinans*), White Mangrove (*Laguncularia racemosa*) and Buttonwood Mangrove (*Conocarpus erectus*). In total, eighteen (18) individual mangrove wetland sites have been recorded in the NEMMA region [1]. The mangroves around Parham Harbour are reported at 92 hectares, and dominated by the Red mangrove plant, and has been reported as healthy. Mangrove wetlands within the area have faced extensive threats from hurricanes, particularly the more seaward aspect of the mangrove wetlands, which are dominated by the Red Mangroves. Additional threats are in the form of land development, which has resulted in backfilling and removal of mangrove wetland areas [2].

Significant coral reef structures have been recorded in the NEMMA region, particularly in the outer regions of the area, and the area has been identified as having some of the most extensive coral reef systems of the mainland Antigua [3]. Coral reefs in these areas were reported to have the highest live coral cover, 13% Live Coral Cover, in surveys conducted in 2017, with reef types being primarily patchy and fringing reefs dominated by branching corals including the Acroporid species, including the critically endangered *Acropora palmata* [4]. Coral structures have been subjected to a variety of pressures over the years, which include hurricanes, anchors, fishing gear, sedimentation, eutrophication, pollution and diseases [2]. Coral reefs in the area have been found to provide habitat for a variety of marine species, including the commercially important fish like Grouper (Serranidae) and Snapper (Lutjanidae), as well as Caribbean Spiny Lobster (*Panulirus argus*) [2].

Seagrass beds are reported to be common within the NEMMA, primarily within the shallow lagoons. Dominant seagrass species observed included the Turtle Grass (*Thalassia testudinum*),

while other species such as Manatee grass (*Syringodium filiforme*) and Shoal grass (*Halodule wrightii*) have also been observed [2]. Algal overgrowth by the brown algae *Dictyota sp.* have been observed in some areas, particularly where there has been anchor scarring. These seagrass beds are also known to provide habitat for marine turtles, including the Green Sea Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Eretmochelys imbricata*).
Beaches are distributed throughout the NEMMA region and are important for recreation along with providing nesting habitats for marine turtles. beach monitoring does occur within the NEMMA region to assess impacts of erosion. Extensive turtle monitoring has occurred on the Long Island for over 30 years, with over 200 nesting females tagged since the start of the program [1].

The proposed development area is shallow, with marine nautical charts indicating a depth range between 4ft to 11ft (**Figure 9**).

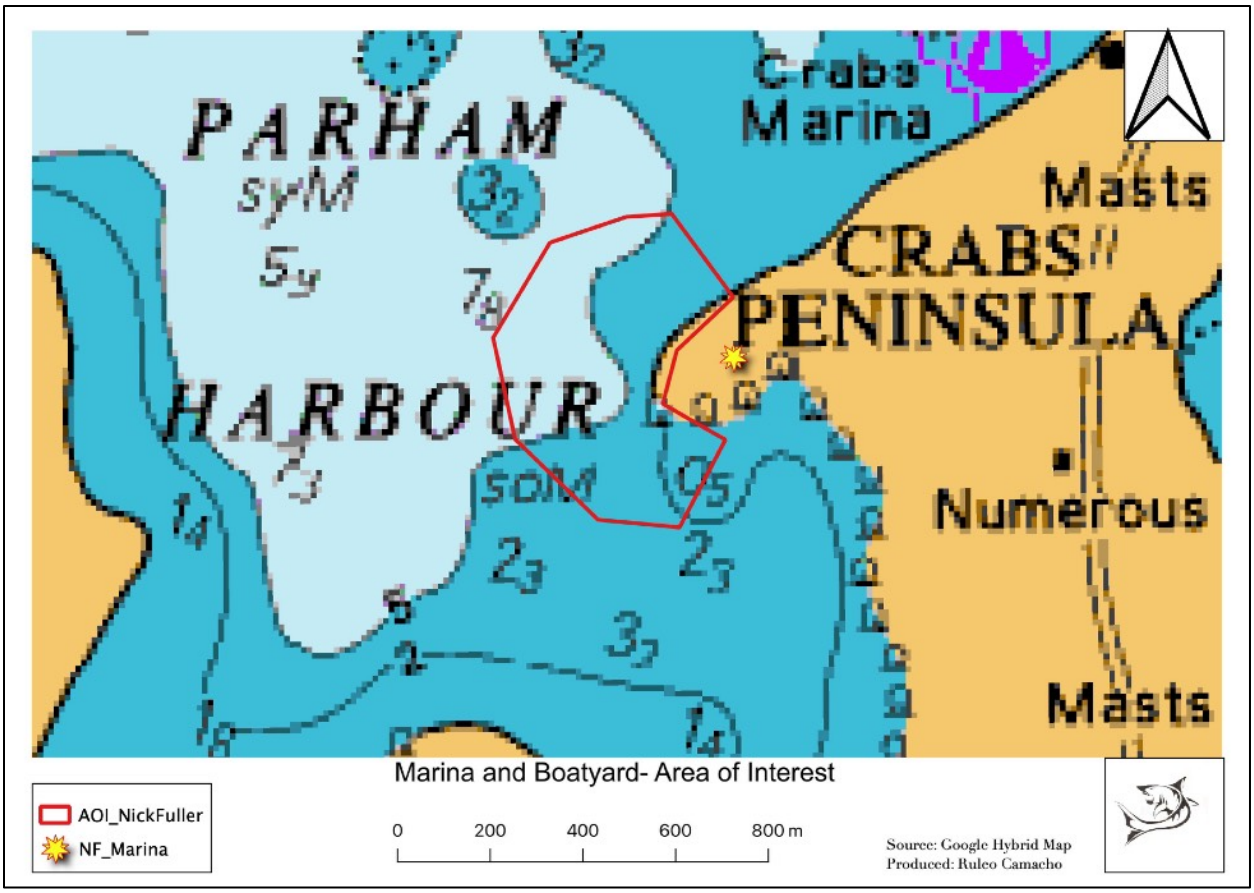


***Figure 9**: Study area and benthic charts*

5.4.2. Land Environment

Parham Harbour contains a coastal lagoon area located between Lat. 17.111510^0/Long. -61.763480^0, Lat. 17.111455^0 / Long. -61.758640^0 at the southern points and Lat. 17.117292^0/

Long. -61.763351^0, Lat. 17.117186^0/Long. -61.758447^0 at the Northern points. Ref. Map 1. The Mangrove Ecosystem in this study, has an approximate south to north long axis and the area of water and Mangrove under investigation has an approximate open water area of 0.19 Km^2 and an approximate area covered with mangrove plants of 0.14Km^2, giving a total area of 0.33Km^2 .
The ecosystem comprises primarily of Red Mangrove (Rhizophora mangle) fringed on the landward and eastern side with Black Mangrove (Avicennia germinans) and White Mangrove (Laguncularia racemose). Within the Mangrove are a number of winding inlets or water ways which can be exploited for recreational canoeing and exposed mudflats with ever changing levels of exposure coinciding with tidal fluctuations. These act as important feeding areas for waders.

5.4.4. Benthic Marine

Seagrass

The habitat observed throughout the AOI is seagrass habitat. This consisted primarily of the non-native broadleaf seagrass species (*Halophilia stipulacea*), which dominated the deeper areas. In shallower areas, nearer to the coastal areas, the native seagrass (Turtle Grass – *Thalassia testudinum*) was more common. Table 1 below highlights the data from the spot-checks.

Table 2: Marine spot check observations

Name	D e p t h (ft)	Habitat	Long	Lat
NF01	13	Broadleaf Seagrass and mud habitat	-61.765	17.1229902751523
NF02	11	Broadleaf Seagrass, Turtle Grass and mud habitat	-61.766	17.1239143759014
NF03	15	Broadleaf Seagrass, Turtle Grass and mud habitat	-61.765	17.1243481761126
NF04	14	Broadleaf Seagrass and mud habitat	-61.765	17.121557403446
NF05	17	Broadleaf Seagrass and mud habitat	-61.765	17.1254480282766
NF06	21	Broadleaf Seagrass and mud habitat	-61.766	17.1229569670914
NF07	2	Turtle grass with some sponges in the habitat. Feeding green turtle observed on approach to site.	-61.764	17.121231167166
NF08	13	Broadleaf Seagrass and mud habitat	-61.766	17.1199639511779
NF09	20	Broadleaf Seagrass and mud habitat	-61.766	17.1250062019014
NF10	14	Broadleaf Seagrass and mud habitat	-61.764	17.1242464780289
NF11	16	Broadleaf Seagrass and mud habitat	-61.765	17.1224183310474
NF12	21	Broadleaf Seagrass and mud habitat	-61.767	17.1224489527442
NF13	24	Broadleaf Seagrass and mud habitat	-61.767	17.1232676340126
NF14	22	Broadleaf Seagrass and mud habitat	-61.767	17.1245531848569
NF15	24	Broadleaf Seagrass and mud habitat	-61.768	17.1235049129786
NF16	17	Broadleaf Seagrass and mud habitat	-61.766	17.1247681893353
NF17	21	Broadleaf Seagrass and mud habitat	-61.768	17.1220224221475
NF18	13	Broadleaf Seagrass and mud habitat	-61.765	17.1199265288474
NF19	15	Broadleaf Seagrass and mud habitat	-61.765	17.124707213522
NF20	22	Broadleaf Seagrass and mud habitat	-61.767	17.1227948652705
N F - Survey 01	13	Detailed seagrass surveys. Mixture of native and non-native seagrass species	-61.765	17.124081623053
NF-Survey 02	17	Detailed seagrass surveys. Dominated by the non-native seagrass species	-61.766	17.1215658344325

***Figure 10**: Non-Native Broad-leaf seagrass*

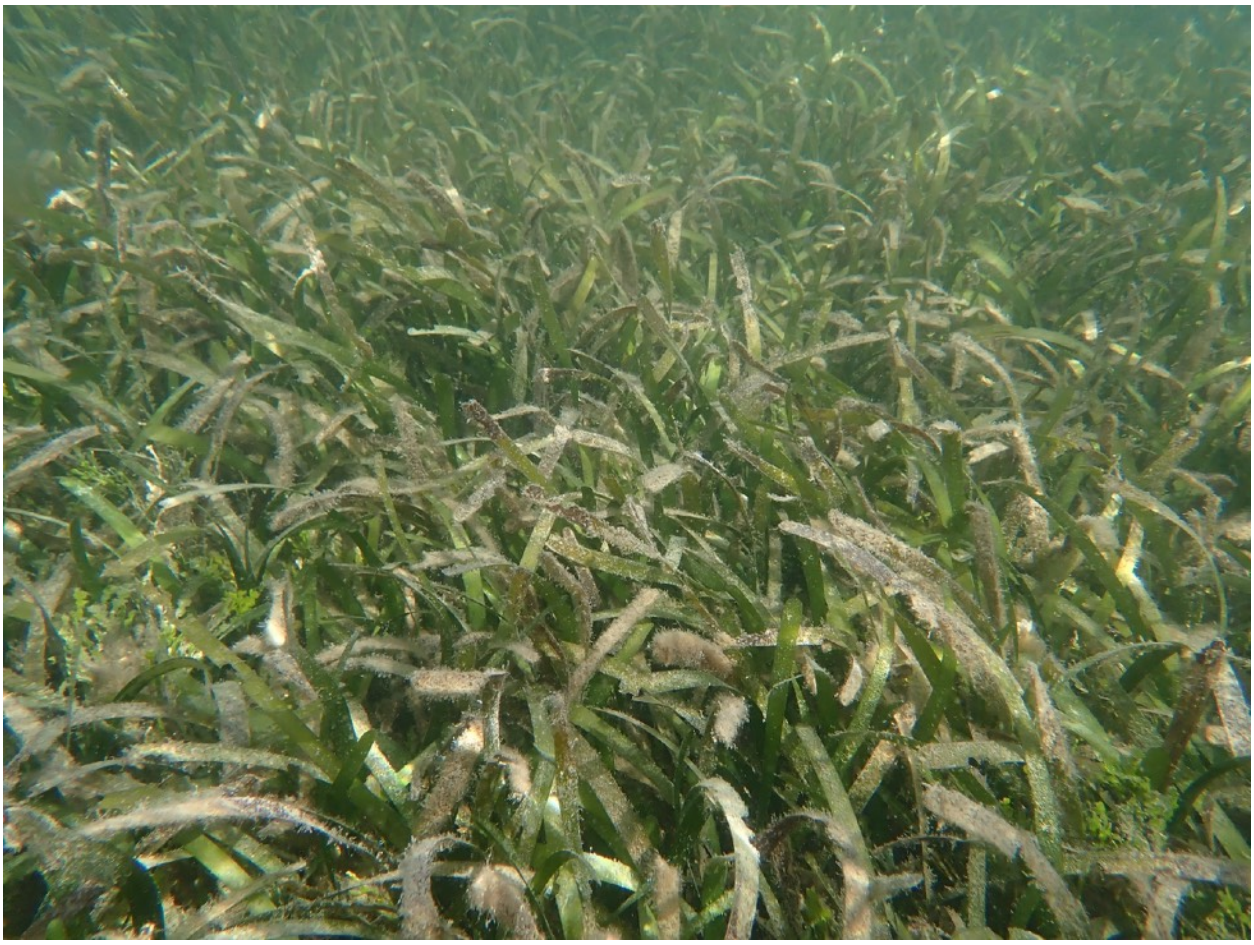


***Figure 11**: Native seagrass and NF-07*

Depth Analysis

During the spot-checks, depths were collected for each location. This information was collected to create a graph which highlights the distribution of benthic depths across the area of interest. The shallowest depth recorded was 2ft (NF07) while the deepest was 24ft (NF15) (Figure 12).

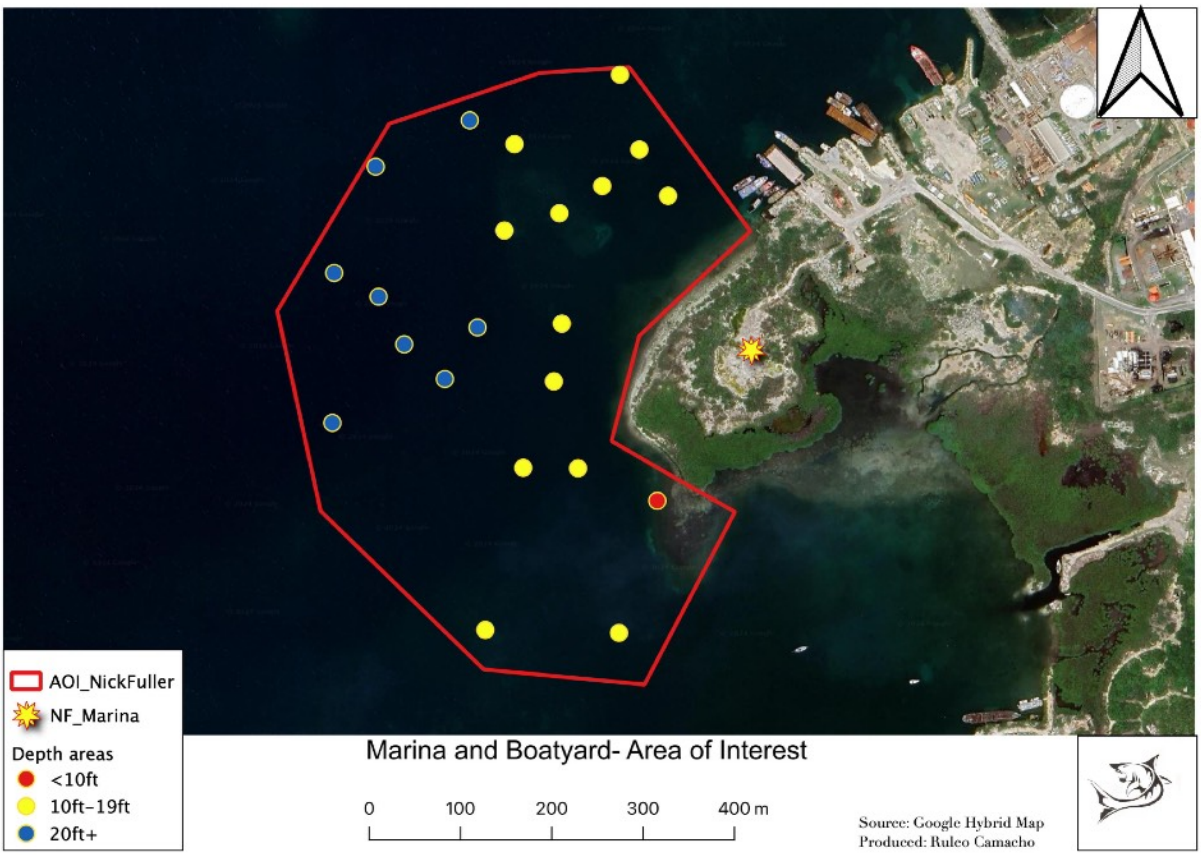


Figure 12 *depth distribution across the study area, in 10ft classifications.*

Detailed seagrass surveys were carried out at two sites Figure 13).

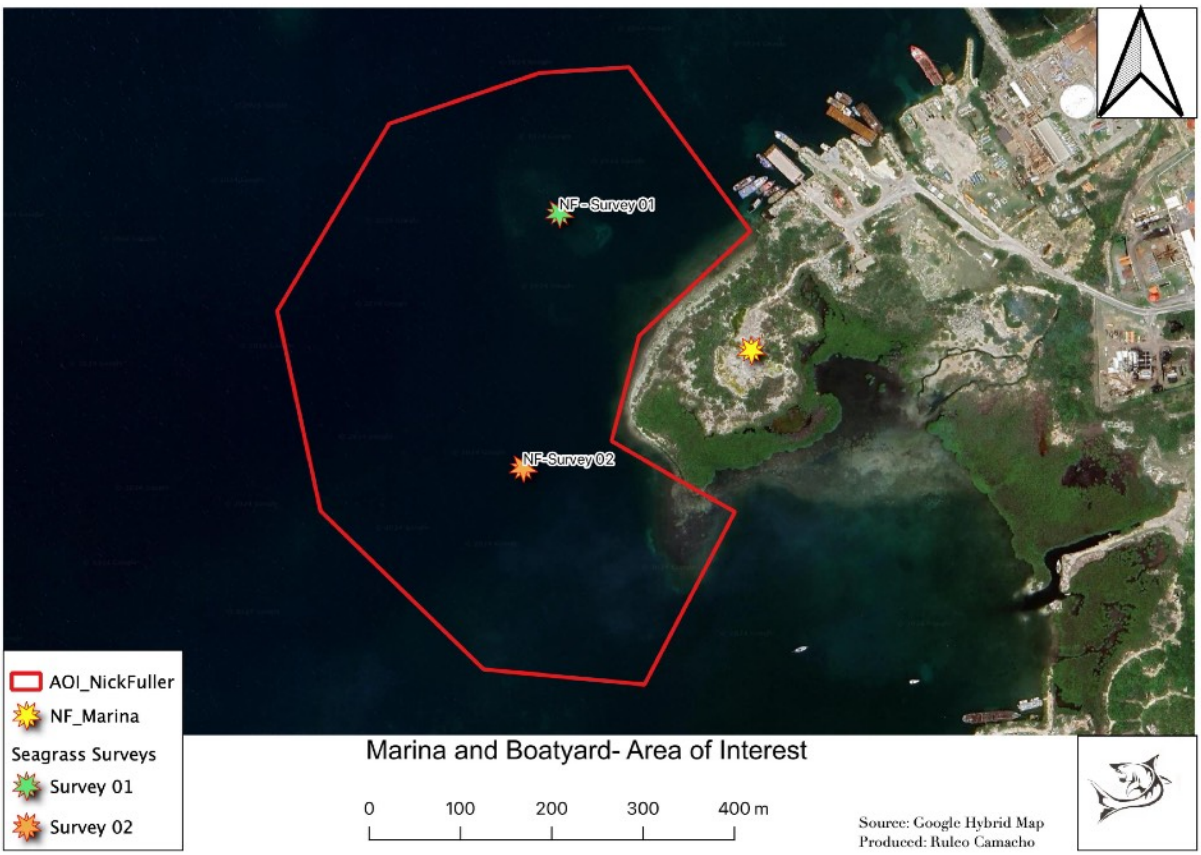


***Figure 13**: Seagrass surveys site locations*

Both sites assessed were dominated by seagrass, with greater than 70% cover observed at each site. The remaining substrate consisted primarily of mud, with some Cyanobacteria (Site T1) and Macroalgae (both sites) also observed (Figure 1). Among the seagrass diversity, the shallower site, NF- Survey 01 (Map 5) had predominantly native seagrass (<50%), while NF-Survey 02 had only the non-native species (Figure 2). Some Halimeda was observed at Survey 01, and a small portion of other seagrass species was observed at each site.

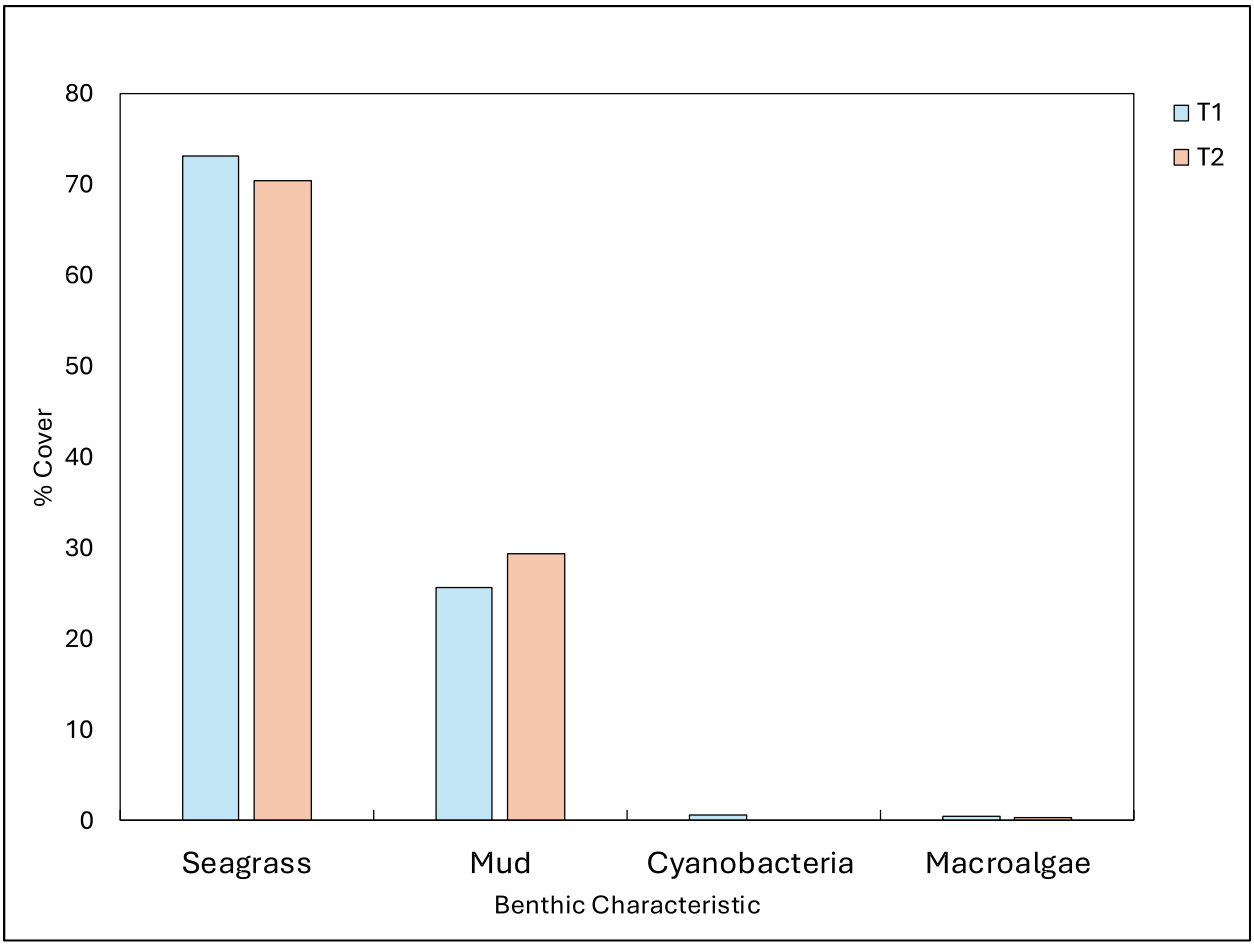


Figure 14: *Percent (%) cover of benthic characteristics across sites. T1 = NF-Survey 01, T2 = NF-Survey 02*

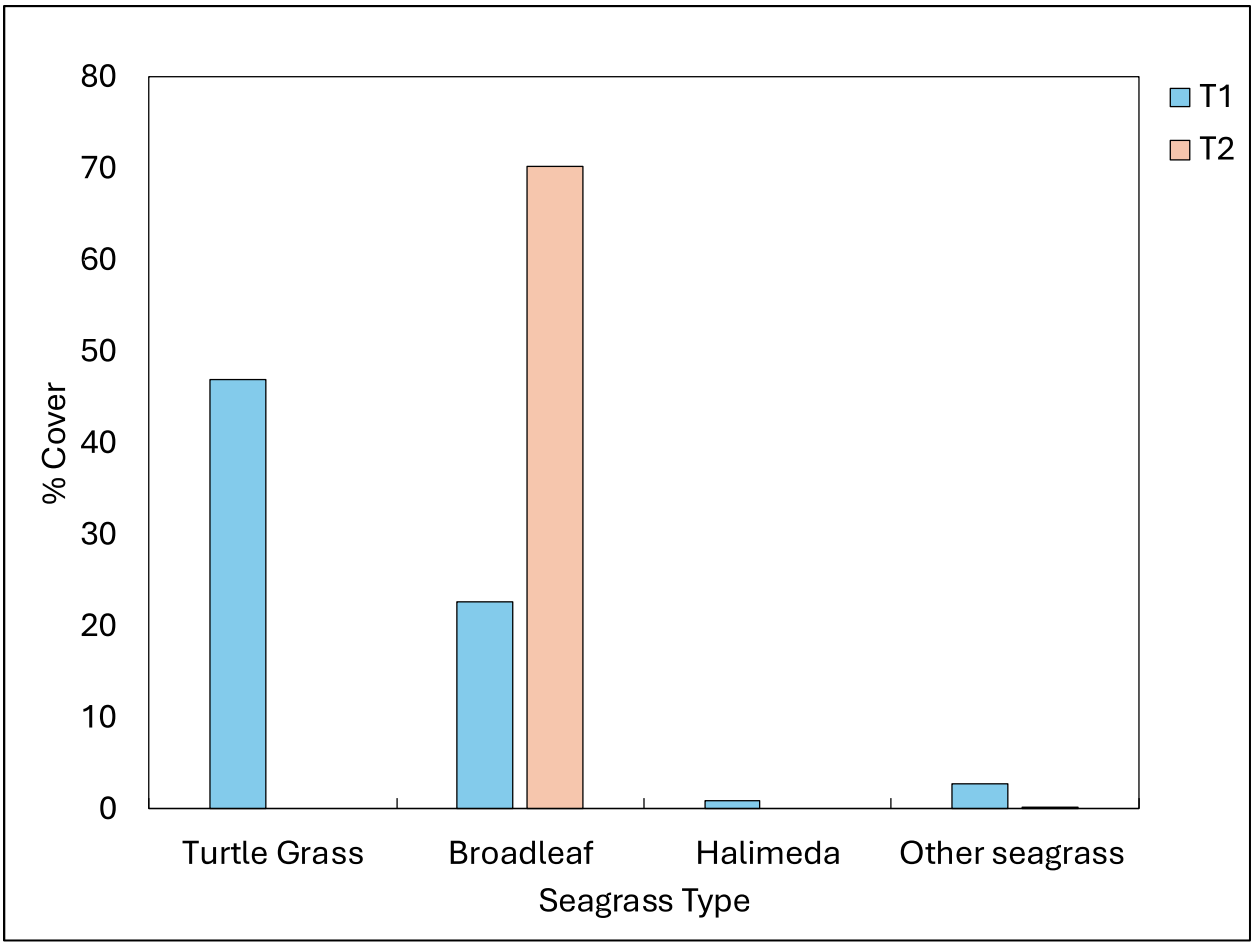


***Figure 15**: Percent (%) cover of seagrass species across sites. T1 = NF-Survey 01, T2 = NF-Survey 02*

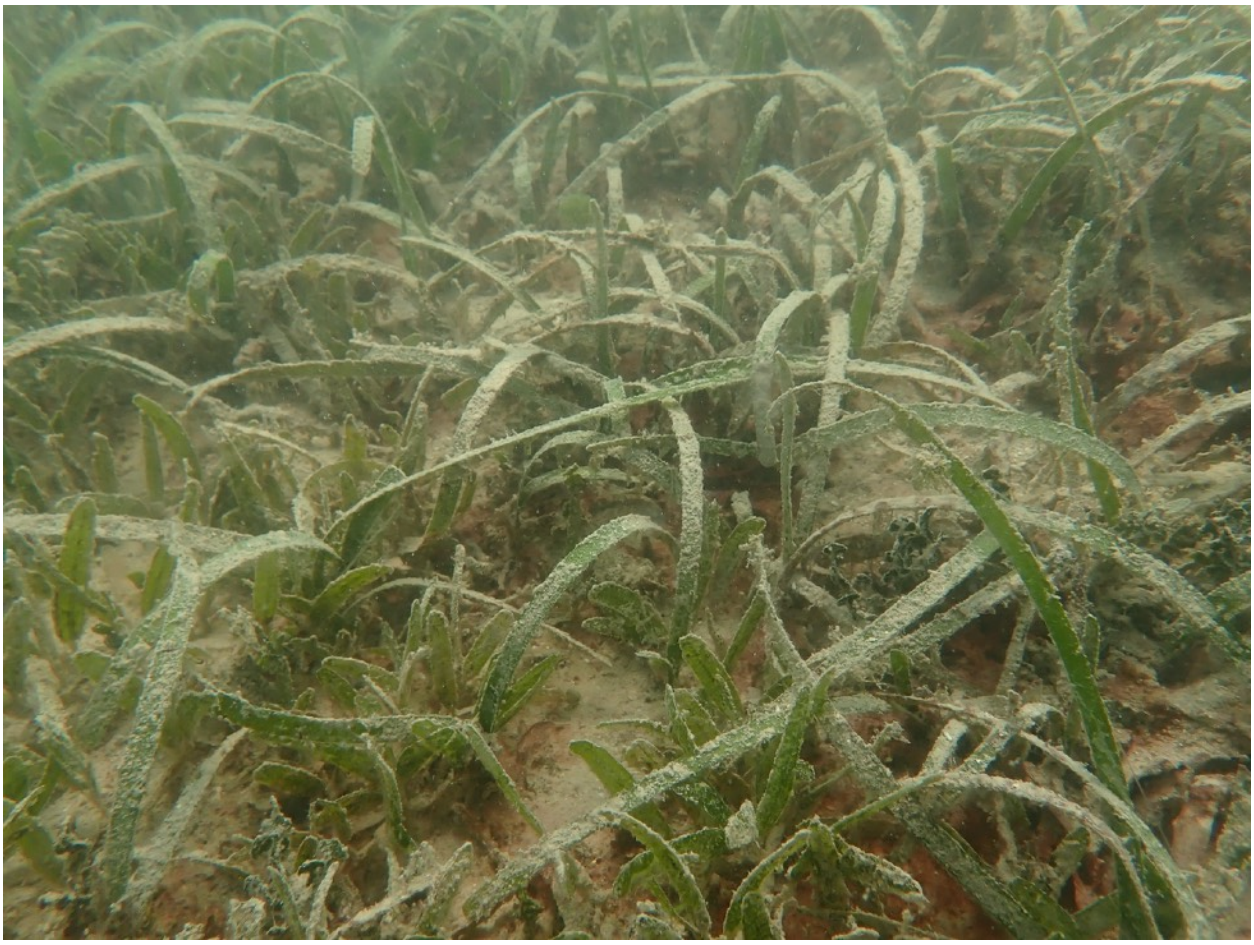


Figure 16: Native and Non-Native seagrass

Other Observations

Upside-down jellyfish (Cassiopea sp.), and Green urchins (*Lytechninus varigatus)* were observed among spot checks, but no sea-cucumbers, Queen conch or Starfish were seen during the surveys. No coral reef areas were encountered during the spot-checks or detailed surveys.

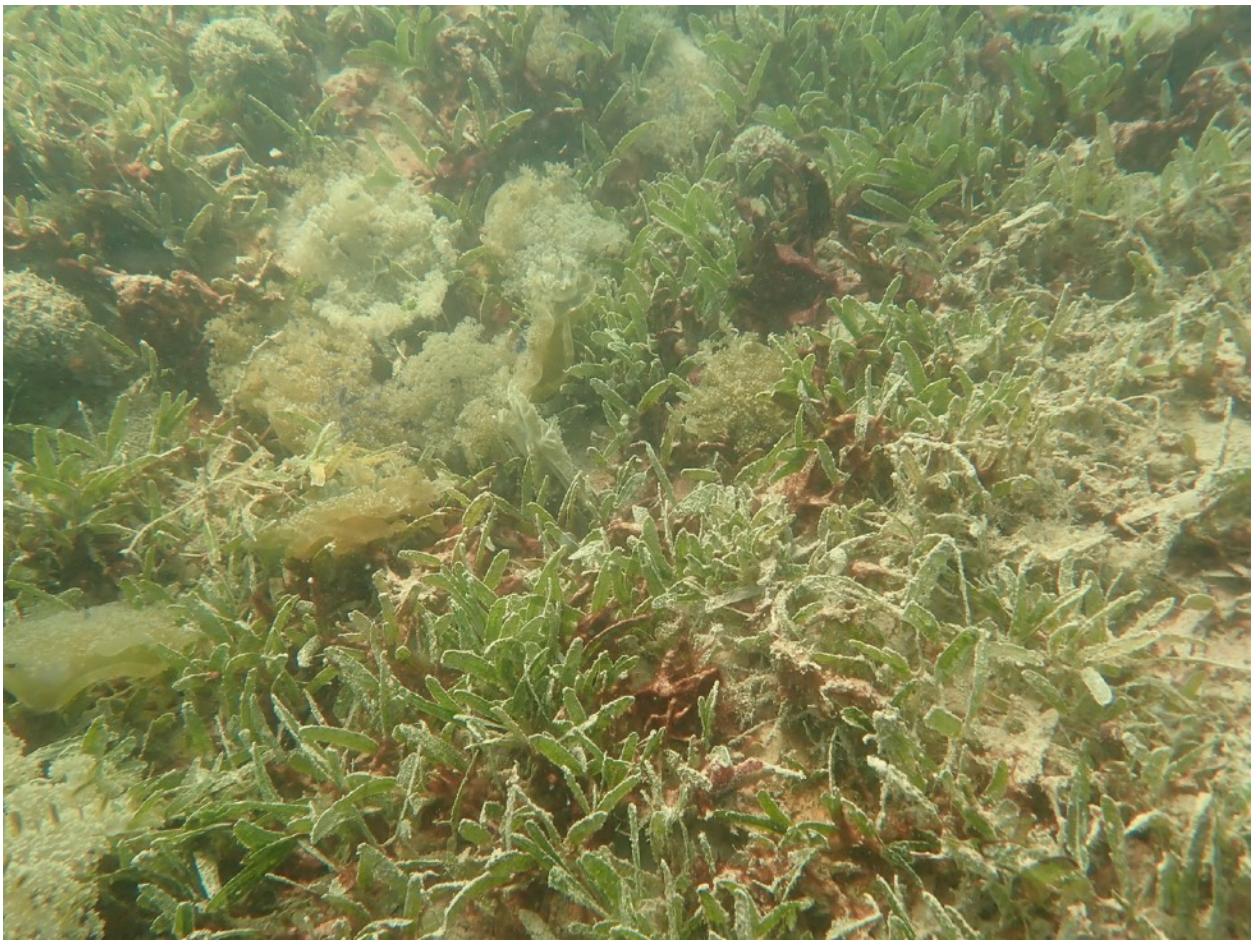


***Figure 17**: Seagrass and Upside-down jellyfish*

***Figure 18**: Green Sea-urchin*

Mangrove Wetland Analysis

An extensive mangrove wetland system was observed during the terrestrial surveys. The four (4) known species of mangrove flora found in Antigua & Barbuda were observed during the surveys: Red Mangrove (*Rhizophora mangle*), Black Mangrove (*Avicennia germinans*), White Mangrove (*Laguncularia racemosa*), and Buttonwood Mangrove (*Conocarpus erectus*). No canopy height information was collected on the mangrove wetland flora. Map 6 below highlights the extent of the mangrove wetland in the study area.

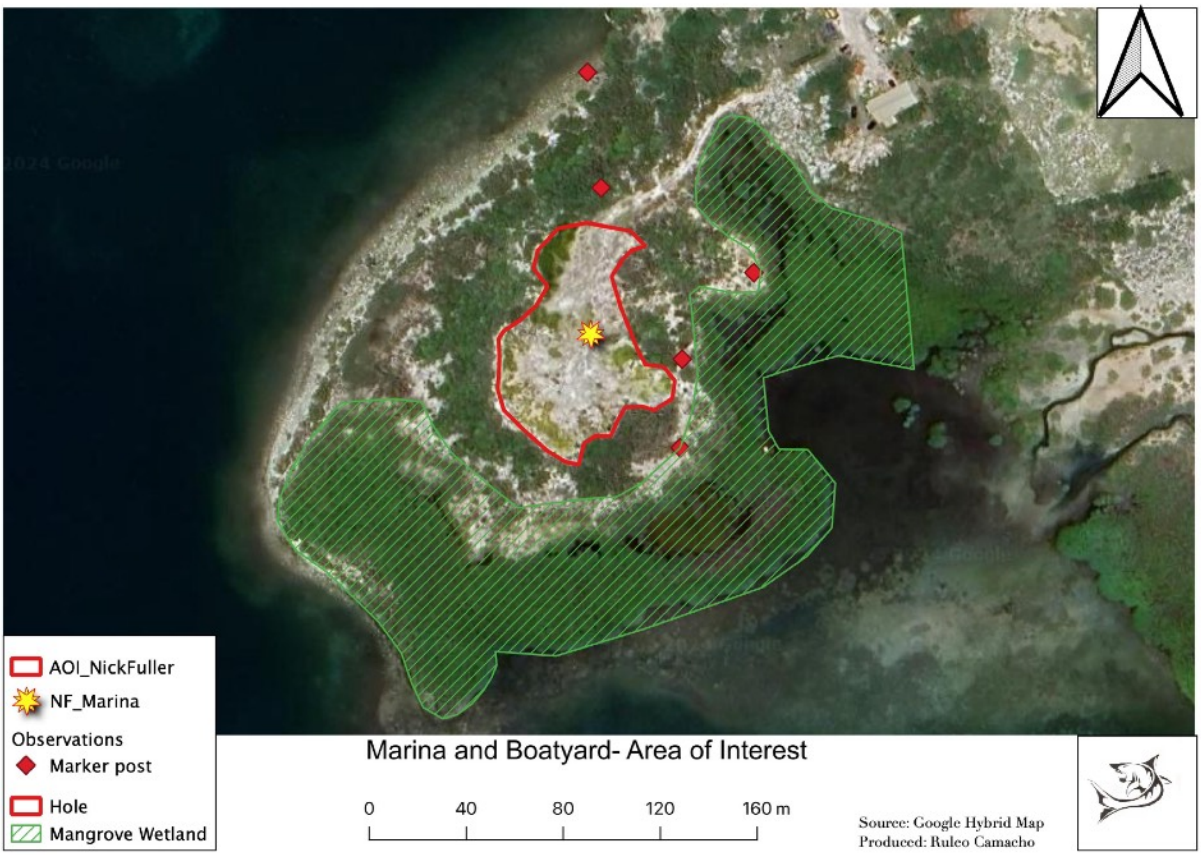


Figure 19: Mangrove Distribution and other observations.

Figure 20: Observed Mangrove wetlands

In the center of the proposed development area, there was a large depression that is being backfilled. No evidence of mangrove flora was observed in this area. Boundary markers were observed during the data collection, and these are noted in Figure 19.

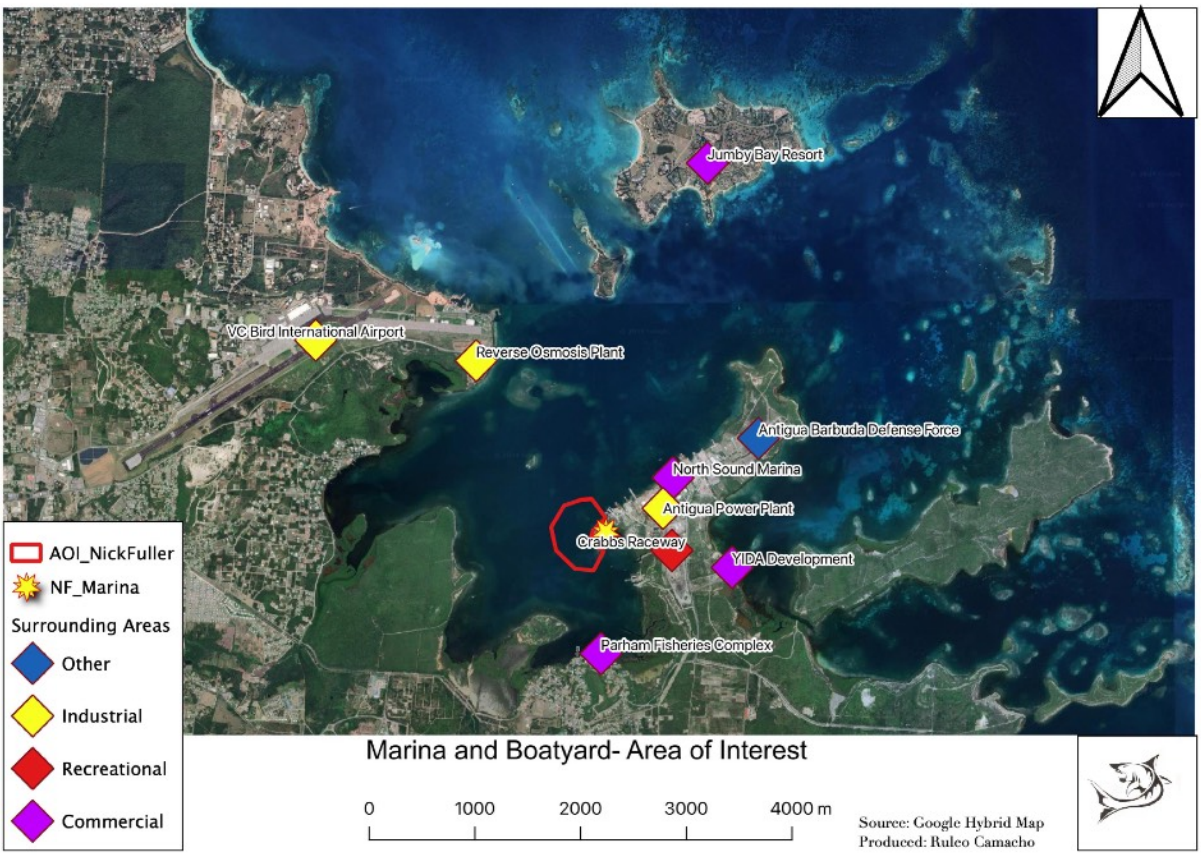
Figure 21: Boundary marker with surrounding mangrove flora

Figure 22: "Hole" that is being filled in with waste material.

Surrounding Influences/Concerns

A variety of influences surround the project site and are displayed in Map 7. These include:

- Recreational
    - Crabs Raceway
- Commercial Entities
    - Parham Fisheries Complex
    - North Sound Marina
    - YIDA Development area
    - Jumby Bay Resort on Long
    - VC Bird International Airport
- Industrial Areas
    - Reverse Osmosis Plant
    - Antigua Power Plant
    - VC Bird International Airport
- Other
    - Antigua Barbuda Defense Force



Map 7: *Surrounding influences*

Additionally, commercial vessels, including tugs and barges, were observed adjacent to the proposed development (Picture 10).

Figure 23: Tugs and Barges adjacent to the proposed development area.

Birds

At least 21 species of terrestrial, wetlands and seabirds were observed over the period of the survey. It is important to note that the number of species seen during field operations reflects a short time frame in the day and within the season, and offers only a sample of the numbers of species that may occur there throughout the year. The list will undoubtedly expand considerably if surveys were done more frequently covering all seasons, and as part of a systematic study, which would monitor the area's bird population. Previous reports suggest that approximately 72 species of migrating and resident bird species have been spotted in the area. In fact Parham Harbour was designated an important bird area (IBA) by Birdlife International.

Bird numbers and species fluctuate greatly, depending on the season, the amount of rain, the availability of food, and nesting habitat. North American migrant arrival on island during the fall usually coincides with the heaviest rains of the year when there is an explosion of insects, foliage, young plant shoots, fruits and flowers. On the northward migration in the spring, when

species fly up the Lesser Antillean chain from South America, birds arrive at the end of the dry season and when the short but sustaining spring rains usually begin.

There are three bird species of special conservation concern that occur within the area. These species include:

Magnificent Frigatebird (*Fregata magnificens*) - this bird is renowned for nesting in the thousands in the northwestern area of Codrington Lagoon. However, over the past few decades human disturbance as well as impact of hurricanes on the mangrove trees upon which the species relies for nesting have negatively impacted the species, making any auxiliary nesting areas, such as Parham Harbour, more significant to its conservation.

West Indian Whistling Duck or WIWD (*Dendrocygna arborea*) - This West Indian endemic has declined so dramatically in the region over the last 100 years that it is now listed as Vulnerable (V) under the International Union for the Conservation of Nature Species Survival Commission (IUCN SSC) categories, and is a bird targeted for conservation efforts by BirdsCaribbean, the regional bird conservation non-government organisation as well as the Environmental Awareness Group (EAG) in Antigua.

The species needs wetlands, both fresh and marine-based, to survive and the habitats of the Lagoon and surrounding communities offer excellent opportunities for the species. However, the species remains exceedingly vulnerable to disturbance, hunting, invasive species and human harassment.

White-crowned Pigeon (*Patagioenas leucocephala*) - though widespread throughout Antigua and Barbuda, occurring across most habitats on both islands, this species has become quite rare, and even extinct, on most of the other islands of the region. The species is a regional migrant, and disperses to as far as Puerto Rico and other islands to the west, and will eventually colonize other islands from which it has disappeared due to over-hunting.

Tables 2 and 3 below provide the list of birds observed from land and water observation points respectively, along with their densities. **Table 2** provides the full species list of birds known to be either visitors to or residents within the mangrove ecosystem.

Table 3: Bird Densities - Water Observation Points

Species	S1	S2	S3	S4	S5	S6	S7	S8	Mean Density/km square
Area in square meters i.e. π x 20^2 meters	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	
BANAQUIT						1			
BROAD-WINGED HAWK		1							
BROWN PELICAN				1					
CARIB GRACKLE		1					1	1	
CARIBBEAN ELAENIA								1	
GRAY KINGBIRD		1		1					
GREAT EGRET					1		1		
GREEN HERON		1		1		2			
LEAST SANDPIPER								4	
LESSER ANTILLEAN BULLFINCH							2	2	
LESSER YELLOWLEGS			2	1			15	1	
LITTLE BLUE HERON					1				
MAGNIFICENT FRIGATEBIRD	1		1						
SEMIPALMATED PLOVER			2		20		4		
SEMIPALMATED SANDPIPER							11	25	
SHORT-BILLED DOWITCHER							2		
Spotted Sandpiper	1						1		
TRICOLORED HERON							1		

WHITE-CROWNED PIGEON			1					1	
YELLOW WABBLER					1				
YELLOW-CROWNED NIGHT-HERON						1	2		

Table 4: Bird Densities - Land Observation Points

Species	L1	L2	L3	L4	L5	L6	L7	Mean Density/km square
Area in square meters i.e. π x 20^2 meters	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	1256.6 M^2	
ANTILLEAN CRESTED HUMMINGBIRD		1			2			
BANAQUIT						2		
BLACK-FACED GRASSQUIT	1	2	1		1	1	1	
CARIB GRACKLE	1				1	1		
CARIBBEAN ELAENIA	1		1	1	1	2	1	
CATTLE EGRET						2		
COMMON GROUND-DOVE		1		1	10	6	6	
GRAY KINGBIRD		1	1	3	2	1		
LESSER ANTILLEAN BULLFINCH		1	1	1	2	1		
YELLOW WABBLER							2	
YELLOW-CROWNED NIGHT-HERON	2							
ZENAIDA DOVE							1	

Bird List for Parham Harbour Mangrove Ecosystem (Birds species observed in the survey are highlighted in red)

1. AMERICAN COOT Fulica Americana
2. AMERICAN KESTREL Falco sparverius
3. ANTILLEAN CRESTED HUMMINGBIRD Orthorhyncus cristatus
4. BANAQUIT Coereba flaveola
5. BARN SWALLOW Hirundo rustica
6. BELTED KINGFISHER Ceryle alcyon
7. BLACK-BELLIED PLOVER Pluvialis squatarola
8. BLACK-CROWNED NIGHT-HERON Nycticorax nycticorax
9. BLACK-FACED GRASSQUIT Tiaris bicolor
10. BLACK-NECKED STILT Himantopus mexicanus
11. BLACK-WHISKERED VIREO Vireo altiloquus
12. BLUE-WINGED TEAL Anas discors
13. BRIDLED TERN Sterna anaethetus
14. BROAD-WINGED HAWK Buteo platypterus
15. BROWN PELICAN Pelecanus occidentalis
16. CARIB GRACKLE Quiscalus lugubris
17. CARIBBEAN COOT Fulica caribaea
18. CARIBBEAN ELAENIA Elaenia martinica
19. CARIBBEAN MARTIN Progne dominicensis
20. CATTLE EGRET Bubulcus ibis
21. COMMON GROUND-DOVE Columba passerine
22. COMMON MOORHEN Gallinula chloropus
23. COMMON SNIPE Gallinago gallinago
24. COMMON TERN Sterna hirundo
25. EURASIAN COLLARED-DOVE Streptopelia decaocto
26. GRAY KINGBIRD Tyrannus dominicensis
27. GREAT BLUE HERON Andea herodias
28. GREAT EGRET Ardea alba
29. GREATER YELLOWLEGS Tringa melanoleuca
30. GREEN HERON Butorides virescens
31. GREEN-THROATED CARIB Eulampis holocericeus
32. GREEN-WINGED TEAL Anas carolinensis
33. LAUGHING GULL Larus atricilla
34. LEAST SANDPIPER Calidris minutilla
35. LEAST TERN Sterna antillarum
36. LESSER ANTILLEAN BULLFINCH Loxigilla noctis
37. LESSER ANTILLEAN SWIFT Chaetura martinica
38. LESSER BLACK-BACKED GULL Larus fuscus
39. LESSER YELLOWLEGS Tringa flavipes
40. LITTLE BLUE HERON Egretta caerulea
41. LITTLE EGRET Egretta garzetta
42. LONG-BILLED DOWITCHER Limnodromus scolopaceus
43. MAGNIFICENT FRIGATEBIRD Fregata magnificens
44. MANGROVE CUCKOO Coccyzus minor
45. OSPREY Pandion haliaetus
46. PEREGRINE FALCON Falco perigrinus
47. PURPLE-THROATED CARIB Eulampis jugularis
48. ROSEATE TERN Sterna dougallii
49. ROYAL TERN Sterna maxima
50. RUDDY DUCK Oxyura jamaicensis

51. RUDDY TURNSTONE arenaria interpres
52. SANDERLING Calidris alba
53. SANDWICH TERN Sterna sandvicensis
54. SEMIPALMATED PLOVER Chradrius semipalmatus
55. SEMIPALMATED SANDPIPER Calidris pusila
56. SHORT-BILLED DOWITCHER Limnodromus
57. SNOWY EGRET Egretta thula
58. SOLITARY SANDPIPER Tringa solitaria
59. SPOTTED SANDPIPER Actitis macularia
60. TRICOLORED HERON Egretta tricolor
61. WEST INDIAN WHISTLING-DUCK Dendrocygna arborea
62. WHIMBREL Numenius phaeopus
63. WHITE WINGED DOVE Zenaida asiatica
64. WHITE-CROWNED PIGEON Patagioenas leucocephala
65. WHITE-RUMPED SANDPIPER Calidris fuscicollis
66. WHITE-CHEEKED PINTAIN Anas bahamiensis
67. WILLET Catoptrophorus semipalmatus
68. WILSON'S PHALAROPE Phalaropus tricolor
69. WILSON'S PLOVER Charadrius wilsonia
70. YELLOW WABBLER Dendroica petechia
71. YELLOW-CROWNED NIGHT-HERON Nyctanassa violacea
72. ZENAIDA DOVE Zenaida aurita

5.5. Water quality

In March 2021, a comprehensive water quality sampling exercise was conducted to establish baseline conditions for the project area. Seven marine water samples were collected and analyzed for key parameters, including bacterial contamination, nutrients, pH, turbidity, dissolved oxygen, and salinity, see Figure 24 below**.** The findings indicated good water quality suitable for supporting marine ecosystems, as summarized below:

- *Bacteria:* Enterococci levels were low (≤20 cfu/100ml), indicating minimal fecal contamination. Escherichia coli (E. coli) levels were below detection limits (<200 mpn/100ml), meeting acceptable thresholds.
- *pH*: Ranged from 7.88 to 8.25, within the acceptable range of 6.5–8.5 for marine environments.
- *Dissolved Oxygen:* Measured between 5.81 ppm and 7.01 ppm, with oxygen saturation levels of 71.2% to 86.3%, supporting healthy marine life.

Nutrients*:*

- Nitrate-Nitrogen levels were consistently low (<0.07 ppm), indicating minimal nutrient enrichment.
- Phosphate concentrations ranged from 0.31 ppm to 0.58 ppm, reflecting nutrient conditions typical for coastal waters.
- *Turbidity:* Low levels (0.49 to 1.47 NTU) suggest clear water conditions, conducive to seagrass growth and marine biodiversity.

- *Salinity:* Stable levels between 36,500 and 36,880 ppm align with expected values for marine environments in the region.

These results reflected a pristine marine environment, with no significant signs of pollution or ecological stress at the time of testing.

5.5.1. Relevance of 2021 Data

The water quality results from 2021 remain relevant to the current assessment due to the following considerations:

- *Stable Ecological Indicators:* The 2024 benthic survey recorded observations of seagrass habitat, species richness, and bioindicator species (e.g., Upside-down Jellyfish and Green Sea Urchins) that align with the conditions described in 2021. These findings suggest that water quality parameters have not significantly shifted.
- *Minimal Anthropogenic Changes:* Since 2021, the project area has remained largely undisturbed, with no significant developments or activities likely to alter water quality.
- *Baseline Utility:* The 2021 sampling exercise captured a wide range of critical parameters, providing a robust dataset for evaluating current and future conditions.

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Date of Issue	:2021-03-30
Client	:Environmental Tourism Consulting
Report #	:ETC001
Sample Submission Date	:2021-03-22
Temperature on Arrival (°C)	:<25
Sample Type	:Marine Water

Lab ID	Sample ID	Sample Description	Enterococci (35) cfu/100ml	Escherichia coli (<200) mpn/100ml	pH (6.5-8.5)	Salinity ppm	Turbidity NTU	Dissolved Oxygen (>4) ppm	% Oxygen Saturation ppm	Nitrate-Nitrogen ppm	Phosphate ppm	Temperature °C
ETC-202103-01	Seawater	WQ4	1	≤20	7.88	36840	1.02	5.81	71.2	0.04	0.58	25.7
ETC-202103-02	Seawater	WQ2	ND	≤20	8.22	36880	1.47	6.20	77.0	0.06	0.53	25.7
ETC-202103-03	Seawater	WQ1	ND	≤20	8.23	36790	0.67	7.01	86.3	0.02	0.55	25.9
ETC-202103-04	Seawater	WQ5	ND	≤20	8.25	36740	0.62	6.74	82.8	0.07	0.49	25.8
ETC-202103-05	Seawater	WQ6	ND	≤20	8.20	36590	0.76	6.61	81.2	<0.02	0.46	25.8
ETC-202103-06	Seawater	WQ7	3	≤20	8.16	36500	0.49	6.69	82.3	0.07	0.33	25.9
ETC-202103-07	Seawater	WQ3	ND	≤20	8.24	36820	0.94	6.72	82.7	0.02	0.31	25.9

Approved by:
Dr Linroy Christian
Director

Figure 24. Water quality sampling results

5.6.Hydrology

The project site lies within a 315-hectare catchment area, subdivided into five primary sub-catchments. The specific micro-catchment containing the proposed project measures 4,204 square meters. Natural drainage patterns direct surface runoff through adjacent mangroves into coastal waters, where natural filtration processes help reduce sediment and pollutant loads.

Watershed Dynamics

- The site is integral to a broader watershed system that supports sensitive mangrove habitats and nearshore marine ecosystems.
- The proximity of industrial activities heightens cumulative risks to water quality, underscoring the need for robust stormwater management systems.

Stormwater Flow Analysis

Using the Rational Method, hydrological modelling of pre- and post-development conditions reveals the following:

- Pre-Development Peak Flow (1-in-100-Year Event): 0.05 m^3/s.
- Post-Development Peak Flow (1-in-100-Year Event): 0.26 m^3/s.

While the micro-catchment itself is expected to produce minimal runoff, the sensitivity of the mangrove ecosystem necessitates enhanced stormwater containment and diversion systems. Furthermore, flows from the upper Parham catchment must be diverted away from the site, and storm surge inflow minimised to prevent additional stress on the system.

Percolation Characteristics

- Field tests reveal an infiltration rate of 12.5 minutes per inch, influenced by the sandy substrate's moderate infiltration capacity.
- The presence of a dark clay layer at a depth of 2 feet provides additional natural protection against potential groundwater contamination.

Flood Hazard and Runoff

- Flood hazard mapping indicates minimal risk for the site under normal conditions. However, localised flooding can occur due to tidal influences and extreme weather events.

Ecosystem Interactions

The adjacent mangrove ecosystems are vital for maintaining hydrological and ecological balance by:

1. Filtering sediments and pollutants from surface runoff.
2. Stabilising shorelines and reducing erosion risks.

3. Supporting biodiversity, including critical marine and avian species.

Development without mitigation could lead to:

- Sediment buildup in mangroves and nearshore areas.
- Reduced water quality from elevated pollutant loads.

Baseline Conditions

- Existing mangroves effectively filter runoff, contributing to the stability of adjacent coastal ecosystems.
- Limited infrastructure allows for high infiltration rates and minimal runoff volumes.
- Mangroves appear healthy but remain vulnerable to stressors from industrial activity within the watershed.
- Minimal under current conditions, though post-development and extreme weather events could elevate risks.

6. POTENTIAL IMPACTS AND MITIGATION MEASURES

6.1.Noise

6.1.1. Impacts

Construction Phase

- Noise pollution during construction, specifically from pile driving and dock extensions, could disturb and displace nesting birds in the surrounding mangrove trees.
- Elevated noise levels may also disrupt marine fauna, including fish and invertebrates, which are sensitive to sound vibrations.
- Nearby residents may experience disturbances during construction activities, particularly if conducted outside standard working hours.

Operational Phase

- Noise pollution caused by boat engines, restaurant operations, and maintenance activities could disturb nesting birds in the surrounding mangrove areas and disrupt nearby communities.
- Increased marina activity may impact tourists staying in nearby accommodations or recreational visitors seeking a quiet coastal experience.

6.1.2. Mitigation Measures

Construction

- Use advanced, noise-dampening technologies or alternative methods for pile driving (e.g., vibratory hammers) to reduce decibel levels.
- Install temporary acoustic barriers around high-noise equipment to minimize sound propagation.
- Restrict construction hours to daylight periods, avoiding weekends and peak tourist seasons.
- Conduct regular noise monitoring at sensitive receptor locations (e.g., mangroves and residences) to ensure compliance with established limits.

Operations

- Implement ongoing community engagement to notify locals of expected noise levels and schedules for high-noise activities.
- Establish noise standards for boats using the marina, prohibiting excessively loud engines or racing activities within the marina.

- Plant vegetation buffers or install permanent acoustic barriers near sensitive areas to mitigate operational noise.
- Limit hours for entertainment activities and boat maintenance to reduce nighttime disturbances.

6.2. Coastal processes

The tidal range in the project area is minimal, varying by approximately ±0.3 meters. This limited range results in relatively stable water levels, reducing the potential for significant tidal currents and their associated impacts on sediment transport or marina operations.

Bathymetric surveys conducted within the area and its approaches revealed depths ranging from 5 to 20 feet, with a mean depth of 11.27 feet and a standard deviation of 3.03 feet. These measurements, collected from 162 data points, were analysed and used to generate a raster overlay in QGIS, offering a detailed visualisation of depth variations across the site. The bathymetric profile confirms the site's suitability for marina development, providing adequate depths for small to medium-sized vessels without the need for extensive dredging.

The site's relatively shallow coastal profile, combined with the minimal tidal range, suggests limited wave-induced sediment transport. The stable bathymetric conditions support the natural accumulation of sediments in certain areas, while adjacent mangroves play a critical role in stabilising the shoreline and reducing erosion risks.

The combination of a low tidal range and suitable bathymetry underscores the viability of the proposed marina development. These coastal characteristics minimise potential risks to marina operations and reduce the likelihood of significant modifications to existing sediment dynamics.

Figure 25: Tidal fluctuation at adjacent dock indicated by darkened area.

6.2.1. Potential Impacts

Construction Phase

- *Sediment Disturbance:* The primary interaction with the seabed during construction will be the installation of the jetty boardwalk and associated docks, covering an area of 9,750 square feet. The jetty will extend 500 feet outward into the water, utilising pile foundations within the white mangrove area. Pile driving may temporarily disturb sediments, leading to localised increases in turbidity.
- *Shoreline Stability:* Construction activities near access pathways and other areas of limited built infrastructure may result in minor disturbances to surrounding mangrove areas and adjacent shorelines.
- *Visual Disturbance:* Construction activities may cause temporary visual disturbances in the project area, particularly at various angles affecting aesthetic views from neighbouring locations.

Operational Phase

- *Wave Energy:* The bay's naturally calm conditions provide inbuilt protection against significant wave activity. However, increased boat traffic could still lead to localized wave disturbances, primarily near docking areas.
- *Storm Surge Risks:* While the development is in a naturally sheltered bay, storm events could still pose risks of localised flooding and sediment displacement.

6.2.2. Mitigation Measures

Construction Phase

Sediment Control:

- During construction, the developer will limit seabed interactions to pile-driven foundations for the jetty and docks, reducing overall disturbance to sediments.
- The planned 500-foot dock length ensures minimal disruption to mangroves and seagrass beds.

Shoreline Protection:

- The developer will replant any impacted mangroves to maintain the shoreline's natural stabilization and ecological benefits.
- By limiting built infrastructure, the design minimizes direct impacts on the coastal landscape and mitigates erosion risks.
- *Permeable Surfacing:* Use of permeable surfaces throughout the development will reduce runoff and maintain natural drainage patterns.

Operational Phase

- *Wave Energy:* The bay's naturally calm waters inherently protect against significant wave activity, reducing the need for additional wave attenuation measures.
- *Storm Preparedness:* The development's limited built infrastructure and the incorporation of permeable surfaces and mangrove replanting enhance resilience to storm surge impacts. These features preserve the natural protections already provided by the site.

6.3. Water Quality

The 2021 water quality results establish a strong baseline for the project area, confirming favorable conditions for marine ecosystems. Observations from the 2024 benthic survey support the conclusion that these conditions have remained stable. Ongoing water quality monitoring is essential to ensure the long-term health of the marine environment, particularly as development progresses.

Construction Phase:

- Employ silt curtains during construction activities to minimise sediment suspension and turbidity.
- Implement a spill response protocol to address potential fuel or chemical spills.

Operational Phase:

- Ensure that marina facilities include centralised wastewater management systems to prevent untreated discharges.
- Prohibit the disposal of grey water or sewage into the marina.
- Establish a quarterly water quality monitoring program, measuring key parameters such as bacteria, nutrients, dissolved oxygen, and turbidity.
- Incorporate adaptive management strategies to address any identified degradation in water quality.

6.4. Benthic Resources

The diversity and extent of seagrass beds and benthic organisms highlight the ecological value of the marine resources in the area, while the absence of coral reefs reduces the sensitivity of the habitat to physical disturbances.

6.4.1. Potential Impacts

Construction Phase

Disturbance to Seagrass Habitats:

- The installation of the jetty boardwalk and floating docks, extending 500 feet into the water, could disturb seagrass beds in the construction footprint.
- Sediment suspension during pile driving may lead to reduced light penetration, affecting seagrass photosynthesis.
- Direct loss of seagrass habitat in areas where piles are installed may impact species dependent on these habitats, such as Green Sea Urchins and Upside-down Jellyfish.
- Construction activities, such as pile driving, may temporarily displace marine fauna, particularly species sensitive to vibrations.

Operational Phase

- Increased boat activity could disturb seagrass beds through propeller scarring and anchor damage, particularly in shallow areas.
- Boat traffic may also increase the risk of accidental fuel or oil spills, degrading water quality and impacting marine resources.
- Shading caused by the jetty and floating docks may reduce light availability for seagrass growth, leading to localised declines.
- Reduced water flow beneath the dock structures may lead to sediment buildup, potentially altering the benthic substrate composition.

6.4.2. Mitigation Measures

Construction Phase

Seagrass Protection:

- Use silt curtains to minimise sediment plumes and prevent turbidity impacts on nearby seagrass beds.
- Limit construction activities to designated areas to avoid unnecessary habitat disturbance.

Design Considerations:

- Minimise the number of piles to reduce the direct impact on seagrass habitats.
- Conduct pre-construction surveys to identify high-value seagrass zones and avoid these areas where possible.

Noise Management:

- Utilise quieter construction methods, such as vibratory pile driving, to reduce noise and vibration impacts on marine fauna.

Operational Phase

- Designate specific anchoring zones away from seagrass habitats and provide mooring buoys to prevent propeller scarring and anchor damage.
- Implement a robust spill prevention and response plan for marina operations to mitigate fuel or oil contamination risks.
- Use light-permeable decking materials for the jetty to reduce shading impacts on seagrass beds.
- Establish a long-term monitoring program to track changes in seagrass cover, species richness, and substrate composition.

6.5. Mangroves

The Marine Benthic Report highlights the importance of the mangrove ecosystem within the project area, which spans 0.33 km², consisting of 0.19 km² of open water and 0.14 km² of mangrove-covered areas. This ecosystem supports critical ecological functions and biodiversity through its unique composition:

- Red Mangrove (Rhizophora mangle), forming the seaward fringe, serves as the primary stabiliser of shorelines and a habitat for juvenile marine species.
- Black Mangrove (Avicennia germinans) and White Mangrove (Laguncularia racemosa), occupying landward edges, contribute to nutrient cycling and support wading birds that forage on exposed mudflats.

The mangrove system is also noted for its recreational value (e.g., canoeing) and its role in providing essential ecosystem services, including coastal protection, water filtration, and carbon sequestration. The ecologist emphasized the vulnerability of this habitat to sedimentation, hydrological changes, and pollution, particularly during the construction and operational phases of development.

6.5.1. Potential Impacts

Construction Phase

The Marine Benthic Report identifies several risks to mangroves during construction, including:

- Sediment plumes generated by construction activities could smother mangrove root systems, leading to reduced oxygen exchange and overall health.
- Unregulated storage of materials and equipment near mangrove edges poses a direct risk to vegetation.
- Alterations to tidal flows and nutrient exchange may arise from improper design or mismanagement of the construction process.

Operational Phase

Key risks during the operational phase include:

- Pollution from fuel spills, wastewater discharge, and runoff from the marina could introduce toxins to the mangrove ecosystem, affecting its filtration capacity and biological productivity.
- Marina infrastructure, such as docks and jetty extensions, may impede natural water circulation, impacting nutrient delivery to mangroves.
- Incremental habitat loss due to shading, compaction, or unregulated human activities in adjacent areas.

6.5.2. Mitigation Measures

Construction Phase

- Establish a 40-foot exclusion buffer around mangroves, prohibiting construction activities, equipment storage, or material handling within this zone.
- Deploy silt curtains to contain sediment plumes and prevent deposition in mangrove waterways.
- Schedule construction during dry periods to reduce runoff risks.
- Maintain tidal flow pathways during construction to ensure uninterrupted nutrient exchange and hydrological balance.

Operational Phase

- Implement robust spill prevention and response systems for fuel handling and wastewater.
- Prohibit all forms of waste discharge into mangrove areas.
- Replant mangroves in areas disturbed during construction to restore ecosystem functionality and biodiversity.
- Conduct regular monitoring of mangrove health, focusing on root zone conditions, species diversity, and canopy coverage.
- Use baseline data from the Marine Benthic Report to track changes over time.
- Incorporate designs that allow tidal flow beneath structures, minimising hydrological impacts.

6.6. Hydrology

6.6.1.Impacts

Construction Phase:

- Clearing and grading activities will disturb soil, increasing surface runoff and sediment transport into adjacent mangroves and nearshore waters.
- Without effective controls, sedimentation could degrade water quality and harm mangrove ecosystems.
- Exposed sandy soils are prone to erosion, particularly during rainfall events, exacerbating sedimentation risks.
- Improper handling of materials such as oils, paints, and hazardous chemicals may contaminate surface and groundwater.
- Temporary alterations to drainage channels during construction may impede water flow to mangroves, affecting their ecological functions.

Operational Phase:

- The addition of impervious surfaces, including paved areas and the jetty, will increase surface runoff, potentially leading to localised flooding.
- Higher flow velocities and pollutant loads from increased runoff could disrupt mangrove filtration processes and degrade nearshore habitats.
- Refuelling activities and fuel storage present significant contamination risks, particularly during spills or leaks, affecting groundwater and adjacent ecosystems.
- Without appropriate stormwater infrastructure, runoff from 1-in-100-year and higher storm events could overwhelm drainage systems, leading to widespread flooding and environmental impacts.

6.6.2. Mitigation Measures

Construction Phase:

- Install sediment traps and silt curtains around construction zones to contain sediment runoff.
- Conduct phased construction activities to minimise exposed soil areas, particularly during the rainy season.
- Maintain natural drainage channels during construction and establish temporary pathways where necessary to avoid water-logging.
- Implement strict protocols for the handling, storage, and disposal of construction materials, including hazardous substances, to prevent contamination.

Operational Phase:

- Design and install infiltration basins capable of handling runoff from 1-in-100-year storm events.
- Use permeable surfaces for parking areas and pathways to reduce runoff and support groundwater recharge.
- Equip fuel storage areas with double-walled tanks and secondary containment systems.
- Develop and regularly test spill response protocols to ensure rapid containment of leaks.
- Incorporate mangrove buffer zones to attenuate flow velocities and reduce the impact of storm surges.
- Stabilise embankments with native vegetation to minimise erosion risks and promote habitat integration.

6.7.Community Relations

The project site is located within a designated industrial zone in the North Sound area, which aligns with the land-use guidelines for Antigua and Barbuda. The surrounding area is predominantly industrial in nature, featuring facilities such as:

- The North Sound Marina Boatyard, which provides marine services and repairs.
- The LNG Terminal, handling liquefied natural gas operations.
- The Power Plants, contributing to the country's energy grid.

The site's location within this industrial hub minimises the likelihood of significant disruptions to residential communities. The nearest residential area is situated across Parham Harbour, a considerable distance from the project site. This separation serves as a natural buffer, reducing the potential for noise, air, and visual disturbances from the development.

6.7.1. Potential Impacts

While the project's industrial setting mitigates many community-related concerns, the following issues may warrant attention:

- The combined activities of the existing industrial operations in the area and the proposed development could contribute to cumulative effects, such as noise, air emissions, or increased traffic.
- Increased boat activity associated with the marina may lead to heightened traffic in the waterway, potentially affecting small-scale fishing activities or recreational boaters in Parham Harbour.
- Though minor, the visual impact of the new development may alter the view from residential areas across the bay.

6.7.2. Mitigation Measures

Given the project's alignment with the existing industrial character of the area, its overall impact on the surrounding community is expected to be low. However, the following measures can ensure positive community relations and minimise any potential concerns:

- Provide channels for community members to raise concerns or suggestions.
- Coordinate with existing marine operators and stakeholders to manage waterway traffic efficiently and minimise conflicts.
- Incorporate vegetation and design elements to soften the visual impact of the development, particularly as seen from across the bay.
- Ensure the project adheres to environmental guidelines and operational standards to limit emissions, noise, and other disturbances.
- Highlight the project's contributions to the local economy through job creation, infrastructure improvements, and enhanced services.

6.8. Solid Waste

6.8.1. Potential Impacts

Construction Phase

- Improper disposal of construction waste, such as excess concrete, wood, and packaging materials, could lead to marine pollution, affecting water quality and marine life.
- Debris from construction activities could damage mangrove ecosystems or become entangled in roots, affecting habitat health.

Operational Phase

- Garbage and other forms of solid waste produced during operations could attract pests, create odour issues, and degrade the visual appeal of the area if not properly managed.
- Mismanaged waste could accumulate within mangrove roots, impacting their ecological functionality and ability to filter water.

6.8.2. Mitigation Measures

Construction Phase

- Designate specific, clearly marked areas for the collection and segregation of construction waste, ensuring separation of recyclables from non-recyclables.
- Regularly transport waste materials to a certified landfill or recycling facility to minimize on-site accumulation.
- Implement barriers or containment systems to prevent accidental spillage of waste into the sea.
- Train contractors and workers on proper waste handling and disposal practices to ensure compliance with environmental regulations.

Operational Phase

- Establish a schedule for regular waste collection and transportation to the landfill to prevent waste buildup and pest attraction.
- Implement a recycling program for operational waste, including plastic, glass, and paper, to reduce overall waste generation.
- Install litter traps or nets near mangrove areas to capture any stray debris before it becomes entangled in roots.
- Maintain ongoing monitoring of waste management practices to ensure compliance with environmental standards.

6.9. Transport Route

6.9.1. Potential Impacts

Construction Phase

- The narrow roads within the community would be at risk of becoming overrun with heavy duty trucks and other equipment travelling to and from the site creating an unsafe environment for residents during the course of construction.

Operational Phase

- No significant impacts are predicted during the operational phase of the project.

6.9.2. Mitigation Measures

Construction Phase

- The shortest route through with the least interface with the community will be used.
- Equipment and materials will be transported in smaller vehicles as much as possible at defined times throughout the weekday avoiding peak hours when most of the residents are active within the community.
- The delivery of oversized equipment and materials will be concentrated to prevent any undue stress to the community.
- Boulders for the dock extension will be barged in to limit risk to the community.
- Clear and defined pathways must be left open to avoid the total obstruction of the normal passageway for fishermen or other stakeholders of the Parham Harbour.

Operational Phase

- No significant impacts are predicted during the operation phase of the project.

6.10. Building Materials and Technologies

6.10.1. Potential Impacts

Construction Phase

- During construction, heavy duty machinery can produce oil spills if not well serviced. This can have deleterious effects on the marine environment.

Operational Phase

- Constant anchoring of boats inside the Parham marina area can have damaging effects to seagrass communities and other benthic organisms over time.
- Oil/fuel spills can occur from the fuel dock, and also from boats into the marina. This can have deleterious effects on the wildlife and the water quality within the harbour.

6.10.2. Mitigation Measures

Construction Phase

- All heavy duty machinery used during the construction phase of the project must be well serviced and checked to ensure that there is no leakage or spillage of any effluent.

Operational Phase

- Appropriate codes of practice should be instituted in an effort to decrease damage done to the benthic habitat by anchoring.
- Spill control and servicing of fuel docks and boats should be practiced regularly to avoid the spillage of any effluent into the marine habitat.
- Educational programmes or material should be offered to the stakeholders of the marina about the importance, safety and protection of the environment against any possible harm as a result of this project.

6.11. Energy Conservation

6.11.1. Potential Impacts

Construction Phase

- Construction activities, including equipment operation and material transport, may consume significant amounts of fossil fuels, contributing to greenhouse gas emissions.
- Inefficient use of construction machinery and vehicles could increase overall energy demand and waste resources.

Operational Phase

- Marina facilities, including lighting, air conditioning, and fuel stations, may require substantial energy inputs.
- Poor energy management could lead to unnecessary costs and increased carbon footprint.

6.11.2. Mitigation Measures

Construction Phase

- Construction activities, including equipment operation and material transport, may consume significant amounts of fossil fuels, contributing to greenhouse gas emissions.
- Inefficient use of construction machinery and vehicles could increase overall energy demand and waste resources.
- Regularly maintain equipment to ensure optimal performance and minimise unnecessary fuel use.
- Integrate solar-powered lighting for temporary construction zones and security purposes.
- Conduct regular energy audits during construction to identify inefficiencies and implement corrective actions.

- Educate construction teams on energy-saving practices, such as turning off machinery when not in use.

Operational Phase

- Install solar panels on marina rooftops or open spaces to power key facilities like reception areas, offices, and lighting systems.
- Implement energy-efficient lighting systems, such as LEDs, throughout the marina and dock areas.
- Incorporate building designs that maximise natural ventilation and daylighting to reduce reliance on air conditioning and artificial lighting.
- Educate marina users and staff on energy conservation practices, including minimising electricity use and avoiding unnecessary fuel consumption.
- Install automated systems to monitor and control energy use in real-time, ensuring that energy demand is matched with supply efficiently.

6.12. Risk Analysis

The risk analysis evaluates the potential environmental and operational hazards associated with the Crabbs Boatyard and Marina development. Using a qualitative approach, each identified risk has been assessed based on its likelihood of occurrence and severity of impact. These risks span both the construction and operational phases, with particular attention to hydrology, pollution control, and ecological sensitivities.

The tables below summarise the likelihood and severity ratings for key hazards and outline corresponding mitigation measures to minimise risks. The analysis confirms that, with the implementation of the recommended mitigation strategies, the project poses a low overall risk and aligns with regulatory standards for sustainable development.

Table 5: Likelihood and Severity of Hazards or Impacts

Hazard/Impact	Likelihood	Severity
Sediment transport during construction	Medium	Medium
Increased runoff volumes (post-construction)	High	Medium
Fuel spills or contamination	Medium	High
Localized flooding (extreme events)	Low	Medium
Groundwater contamination from fuel storage	Low	High
Erosion from disturbed soils	Medium	Medium
Waterlogging due to disrupted drainage	Low	Low

Table 6: Summary of Risks and Mitigation Measures

Identified Risk	Potential Impact	Mitigation Measures
Sediment transport during construction	Sedimentation in mangroves and nearshore waters, affecting marine ecosystems.	Install silt curtains and sediment traps; schedule construction during dry seasons.
Increased runoff volumes (post-construction)	Overloading of natural drainage systems, potential for localized flooding.	Install infiltration basins; use permeable surfaces for paved areas.
Fuel spills or contamination	Groundwater and marine contamination, harm to sensitive habitats.	Equip fuel storage with double-walled tanks and secondary containment; develop and test spill response protocols.
Localized flooding (extreme events)	Damage to infrastructure and adjacent ecosystems.	Design stormwater systems to manage runoff from 1-in-500-year storm events.
Groundwater contamination from fuel storage	Long-term degradation of water quality, affecting nearby ecosystems.	Establish robust containment systems and conduct regular inspections.
Erosion from disturbed soils	Increased sedimentation in coastal waters, degrading water quality and habitats.	Stabilize embankments with vegetation; limit exposed soil areas during construction.
Waterlogging due to disrupted drainage	Temporary pooling of water, affecting construction timelines.	Maintain natural drainage paths; create temporary channels as needed.

7. Pollution Response and Waste Management Plan (PRWMP)

7.1 Overview

The PRWMP provides a structured framework for managing pollution and waste throughout the construction and operational phases of the marina. It outlines actions, responsibilities, and verification processes necessary to meet environmental standards, safeguard ecosystems, and ensure regulatory compliance.

Construction activities have the potential to generate a range of pollution and waste sources that require proper planning from the outset to avoid resulting in impacts to human, biological or other environmental receptors. These include accidental emissions to air, water and soil, amongst others. The Project seeks to proactively manage such potential pollution sources.

The potential pollutants that could arise from the Project requires careful management to avoid negative impacts on human health, and environmental factors such as groundwater, soils, surface water and ecology.

Key objectives:

1. Prevent pollution and manage solid and hazardous waste effectively.
2. Minimise environmental risks associated with construction and operations.
3. Establish a robust verification process to monitor compliance and maintain records.

This PRWMP applies to all contractors, subcontractors, and operational staff. This PRWMP covers all construction activities and is applicable to all contractors, sub-contractors and staff, who will be working on the Marina and Boatyard. Whilst this PRWMP will act as a 'framework' to determine what the Contractors will be expected to produce, Contractors are required to ensure that all the PRWMP requirements are adopted within their own management plans. Further information on Roles and Responsibilities is provided in Section 5 of this PRWMP.

7.3 Management Actions and Verification Processes

7.3.1 Construction Phase

Potential Impacts:

- Contamination from fuel, oil, and chemical spills.
- Pollution from improper disposal of construction debris.
- Sediment runoff into sensitive marine environments.

Mitigation Measures:

1. Pollution Prevention:

- Inspect equipment regularly to prevent leaks and ensure safe operations.
- Store hazardous materials in secured, labeled containers with secondary containment.

Verification:

- Maintain daily inspection logs for equipment and material storage.
- Record all refuelling activities and spill response drills.

2. Waste Management:

- Establish clearly designated waste segregation areas for recyclables, hazardous waste, and debris.

- Transport waste to certified disposal or recycling facilities.

Verification:

- Keep records of waste transport receipts and disposal certificates.
- Supervise waste collection areas during site inspections.

3. Sediment Control:

- Use silt curtains and erosion control measures during construction near waterways.
- Avoid construction activities during heavy rainfall to minimise runoff.

Verification:

- Conduct site inspections to confirm proper installation and maintenance of silt curtains and erosion controls.
- Document corrective actions taken to address sedimentation issues.

7.3.2 Operational Phase

Potential Impacts:

- Waste accumulation, leading to pest infestations and habitat degradation.
- Pollution from oil, grease, and fuel spills during marina operations.
- Untreated wastewater discharge affecting water quality.

Mitigation Measures:

1. Solid Waste Management:

- Provide bins for waste segregation (e.g., recyclables, food waste).
- Regularly dispose of waste at certified facilities.

Verification:

- Maintain records of waste collection schedules and receipts from disposal facilities.
- Perform routine checks of waste collection areas for cleanliness.

2. Wastewater Management:

- Install septic systems or holding tanks for wastewater, ensuring regular maintenance.
- Prohibit grey water or sewage discharge into marine areas.

Verification:

- Keep detailed maintenance logs for septic systems, including service dates and issues resolved.
- Require annual inspections by certified wastewater professionals.

3. Oil and Hazardous Waste:

- Use designated storage for oil and hazardous substances with spill containment measures in place.
- Regularly clean grease traps to prevent overflows.

Verification:

- Record all hazardous waste removal and cleaning schedules.
- Document staff training sessions on spill response protocols.

7.4 Monitoring and Reporting

This PRWMP includes a robust monitoring and verification process to ensure compliance:

1. Construction Phase:

- Weekly site inspections to verify implementation of sediment controls, waste segregation, and spill prevention measures.
- Maintain a logbook for all corrective actions taken.

2. Operational Phase:

- Quarterly audits to assess waste and wastewater management practices.
- Annual reporting of waste generation, recycling rates, and wastewater system performance.

3. Record-Keeping:

- Maintain all documentation, including inspection records, correspondence with regulatory authorities, and waste transport receipts, for a minimum of five years.

7.5 Management Actions

A range of management actions (and other mitigation measures) are required to be implemented in respect of pollution prevention and waste management. The specific management actions and measures required of Mill Reef Club staff and its Contractors (and sub-contractors) are described in **Table 5** below.

Table 7. Management Actions

Issue	Actions	Responsibility	Verification process
Pollution			
Chemical contamination prevention	All equipment shall be brought to the site in perfect state of operation. Maintenance and oil changes will be done on the mainland.	Contractor	Internal audit program
	All plants, vehicles and equipment should be regularly inspected to prevent leakage/ emissions.		Physical inspections and periodic reporting on activities
	Standard industry refueling protocols should be followed. Secondary spill containment such as drip trays, rags and sand should be used wherever refueling.		Physical inspections and periodic reporting on activities
	Should a spill occur, polluted soils will be cleaned up or removed for appropriate disposal. Diesel and other potentially polluting liquids will be stored in appropriate containers, fitted with secondary containment.		Detailed incident reports outlining the cause of the accident, response measures and what was done to prevent future occurrences.
	All pumps, motors and combustion engines to be operated with drip trays underneath and set back from watercourses (minimum of 20m).		Physical inspections and periodic reporting on activities

	Use non-toxic cleaning supplies for dishes, linens, tables, floors, etc. Properly maintain grease traps and hoods to prevent overflows and emissions		
Dust control	All powdery/dusty materials to be stored in enclosed containers or covered to avoid wind dispersal. Dust producing activities to be reduced during strong winds or to be controlled by dust suppression techniques e.g. water sprinkling.	Contractor	Physical inspections and periodic reporting on activities
Light Pollution	Prepare a Lighting Plan including actions to minimize the need for and amount of lighting on structures. Minimize illumination of the project and its immediate vicinity by including use of motion detectors or other controls to have lights turned off unless needed for security or safety		Staff training Educate visitors to the low lighting philosophy
Noise control	Provision of noise barriers for static equipment where appropriate especially when noisy work (eg. hammering) is being conducted.	Contractor	Physical inspections and periodic reporting on activities

	Silent generators and water pumps will be screened/located as appropriate to reduce noise; Any cranes, pulley wheels, telescopic sections and moving parts of working platforms will be adequately lubricated in order to prevent undue screeching. Locating noise sources to less sensitive areas to take advantage of distance and shielding Selecting equipment with lower sound power levels enclosures for equipment casing radiating noise such as diesel generator sets		
Wastewater	All working areas to have appropriate ecologically sensitive toilets to be emptied by authorized operators off island on a regular basis		Activities of record keeping, correspondence, supervision and site inspector.
	Septic system will be carefully maintained strictly respecting the timing of maintenance and emptying.		Septic system maintenance manual
Waste Management			

	The Contractor should produce a Waste Management plan outlining how they will incorporate 'best practices' to reduce the risk of impacts arising from waste. The plan should include the following activities: Inventory of likely wastes; Specific disposal procedures should be produced for all waste streams identified; Designated area for storage of waste receptacles, collection, and transfer; Reuse/recycling opportunities should be maximised; Waste segregation (liquid and solid/reusable and recyclable) should be undertaken using appropriate storage and labelling;		

	Waste from the work fronts will be stored within a dedicated area covered bins within trash bags and will be transferred daily from the construction site, where there will be dedicated collection points with different containers provided for each type of waste.		
	No waste material will be spilled/disposed of/ abandoned in mangrove areas.		
	Waste will not be stored in the proximity of watercourses		
	Clearly defined areas for the safe storage of all types of waste will be established at the construction sites and work fronts. Use biodegradable or recyclable take – out containers Compost food wastes Recycle – glass, plastics, metal, cardboard, and aluminum Purchase goods in returnable, reusable or recyclable containers		

	Separate recyclables from waste stream and dispose of responsibly on the mainland		

8. DISASTER MANAGEMENT PLAN (DMP)

8.1. Purpose

The Disaster Management Plan (DMP) aims to identify foreseeable emergencies and natural hazards associated with the marina project and to establish comprehensive strategies to address, mitigate, and manage such risks. The DMP is critical for minimising disruptions to operations, reducing environmental impacts, and ensuring the safety of all stakeholders.

8.2. Identified Emergencies and Risks

Based on the site's environmental and operational context, the following hazards have been identified:

Natural Hazards:

- Hurricanes and storm surges
- Earthquakes
- Flooding and heavy rainfall
- Tsunamis
- Coastal erosion

Technological or Operational Hazards:

- Oil and fuel spills
- Boat-related accidents
- Fire hazards at fuel docks or maintenance facilities
- Hazardous materials handling

8.3. Organisational Structure

A Disaster Management Team (DMT) will be established to oversee the implementation and execution of the DMP. The DMT will consist of representatives from:

- Project management
- Contractors (during construction)

- Key staff (operations phase)
- Local community representatives (where applicable)

The responsibilities of the DMT include:

1. Preparing emergency response plans, including communication protocols.
2. Supervising emergency measures during disasters.
3. Conducting hazard monitoring and updates.
4. Organizing regular training and simulations for disaster preparedness.
5. Maintaining up-to-date contact lists and resources for emergency use.

8.4. Mitigation Measures

Natural Hazards

- Elevate critical infrastructure such as fuel tanks and generator pads.
- Elevate critical infrastructure, including fuel storage tanks and generator pads, above projected flood levels.
- Use double-walled fuel storage tanks and secondary containment systems to minimise contamination risks.
- Develop a detailed evacuation plan for staff and boats during severe weather events.
- Install permeable surfaces and rain gardens to manage stormwater.
- Design drainage systems to ensure infiltration basins are designed to handle runoff from extreme storm events (up to 1-in-100-year scenarios).
- Regularly maintain drainage systems to prevent blockages and optimise flow capacity.
- Identify and mark safe evacuation routes and assembly points above the expected inundation zone.
- Train staff on recognising early tsunami warning signs and initiating evacuation protocols.

Technological Hazards

- Maintain spill response kits at all fuelling and maintenance areas.
- Train staff on spill containment and cleanup procedures.
- Conduct regular inspections of fuel storage tanks and distribution lines.

- Equip facilities with fire suppression systems, including extinguishers and automatic sprinklers.
- Ensure emergency shutdown mechanisms for fuel pumps and electrical systems.
- Implement a no-smoking policy in high-risk areas.
- Establish navigation guidelines for marina users, including speed limits and restricted zones.
- Provide safety briefings and emergency contact information to boat operators.

8.5 Verification and Monitoring

The DMT will implement a robust verification process to ensure the effectiveness of mitigation measures:

- Conduct regular audits and inspections of emergency preparedness equipment.
- Maintain detailed records of training sessions, response drills, and inspections.
- Update the DMP annually based on lessons learned and changes in site conditions.

8.6 Post-Disaster Recovery and Reporting

Following any disaster or emergency, the DMT will:

1. Conduct a detailed assessment of damages and environmental impacts.
2. Oversee cleanup operations and restoration activities.
3. Prepare a post-disaster report, including:
    - The source and cause of the disaster.
    - A timeline of response activities.
    - Recommendations for improving mitigation strategies.

9. ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN (EMMP)

The Environmental Monitoring and Management Plan is a framework for environmental monitoring on the project site. It ensures that the mitigation measures outlined within this document are put in place before and after construction and outlines the roles of those responsible for its implementation.

ETC Ltd. will continue to act as the Developers' Environmental Representative to ensure the environmental integrity of the site is maintained before, during and after construction works and that all works adhere to Planning regulations. ETC Ltd. will be responsible for production of the required EMMP and for implementation of its procedures.

The Environmental Monitoring and Management Plan (EMMP) provides a framework to monitor and manage environmental impacts during the construction and operational phases of the marina. It outlines responsibilities, monitoring protocols, and reporting mechanisms to ensure the project complies with environmental standards and safeguards sensitive ecosystems.

Objectives

The key objectives of the EMMP are to:

1. Monitor significant environmental impacts identified in the EIA.
2. Ensure adherence to regulatory requirements and mitigation measures.
3. Provide a structured approach for evaluating the effectiveness of mitigation measures.
4. Submit monitoring reports to the Department of Environment for review and regulatory oversight.

9.1. Monitoring Framework

The following table outlines the proposed environmental monitoring framework, specifying key parameters, methods, and responsibilities:

Component	Parameters	Monitoring Methods	Frequency	Responsibility
Water Quality	Turbidity, bacterial contamination, nutrient levels (nitrates, phosphates), dissolved oxygen, salinity.	Sampling at designated points near mangroves and marina operations.	Biannual	Project Manager, Contractor
Marine Life	Seagrass coverage, canopy height, bioindicator species (e.g., Green Sea Urchins, Upside-down Jellyfish).	Visual surveys, species counts, and transect assessments.	Biannual	Environmental Representative
Mangrove Health	Replanted mangrove survival rates, canopy density, and root health.	Transect surveys and photo documentation.	Biannual	Contractor
Sediment Control	Sediment plume extent and deposition patterns.	Visual inspections and sediment sampling.	Biannual (construction)	Contractor
Waste Management	Compliance with waste segregation protocols, hazardous material storage, and disposal practices.	Site inspections and waste tracking logs.	Biannual	Contractor
Structural Compliance	Elevations of infrastructure (e.g., fuel tanks, generator pads) and storm surge resilience.	On-site inspections and measurements.	Annual (construction)	Project Manager

Table 8: Proposed Environmental Monitoring Framework

9.2. Roles and Responsibilities

- Project Manager: Oversees the implementation of the EMMP and ensures compliance with all monitoring requirements.
- Contractors: Responsible for conducting monitoring activities, maintaining records, and implementing mitigation measures.
- Environmental Representative: Conducts independent audits of monitoring activities and submits reports to the Department of Environment for review.

9.3.Reporting

- Frequency: Monitoring reports will be prepared biannually and submitted to the Department of Environment.
- Content: Summary of monitoring results; analysis of trends or deviations from baseline conditions; and recommendations for corrective measures, if necessary.

9.4. Adaptive Management

Monitoring results will inform adjustments to mitigation measures if significant deviations or risks are detected. Adaptive management will ensure the project remains responsive to unforeseen environmental challenges while maintaining compliance with regulatory requirements. See **Table 7** below.

Table 9: Proposed Adaptive Management Framework

Impacts	**Objective**	**Priority EIA Recommendations**	**Monitoring Activity**	**Monitoring Frequency**	**Indicators of Change**	**Potential Impacts**
Water Quality	Maintain water quality levels	Prevent increased sedimentation from runoff over paved areas	turbidity and nutrient measure-ments	annually	Diminished water quality	Increased turbidity and bacterial nutrient load
			permeable parking lots, silt fences, etc.	weekly		
		Prevent wastewater and sewage from entering the nearshore environment	bacterial water quality tests (Enterococci)	Bi-annually		
		Prevent chemical spills from boats and barges into the marine environment	Water quality testing for organic compounds	Bi-annually		Ecological decline of nearshore environment
Marine	Ensure effectiveness of threatened species monitoring measures	Establishing mooring buoys and prohibit anchoring	monitoring include seagrass beds, and reefs	Annually	Changes in distribution and population of threatened species	Decrease in distribution or population size of threatened species

	Maintenance of planned elevation levels	Building elevation verified	before and during construction	Elevations not adhered to	Storm surge inundation

10. CONCLUSION AND RECOMMENDATIONS

The proposed Crabbs Boatyard and Marina development has been carefully assessed in the context of its environmental and ecological setting. Located within a sensitive zone characterised by mangrove ecosystems and nearshore marine habitats, the project carries inherent risks, particularly in terms of sedimentation, hydrological changes, and habitat disturbance. However, the Environmental Impact Assessment (EIA) has demonstrated that these risks are manageable and fall within acceptable limits when the proposed mitigation measures are implemented.

Key findings indicate that:

1. The site's zoning as an industrial area aligns with the nature of the proposed development, minimising conflict with surrounding land uses.
2. The project site lies within a watershed that drains into mangroves and coastal waters, which serve as natural filters for sediment and pollutants.
3. Hydrological modelling indicates an increase in runoff due to impervious surfaces, with peak flows increasing from 0.05 m^3/s to 0.26 m^3/s during a 1-in-100-year storm event.
4. Soil tests confirm a percolation rate of 12.5 minutes per inch, moderated by a shallow water table (4 feet).
5. The project design incorporates measures to reduce its ecological footprint, including the replanting of mangroves, the use of permeable surfaces, and stormwater management systems tailored to the site's hydrology.
6. Activities associated with the marina are consistent with existing uses in the North Sound area, and similar developments in the region have coexisted with comparable ecological sensitivities. Mitigation strategies such as sediment traps, infiltration basins, permeable surfaces, and double-walled fuel storage tanks are designed to address identified risks.
7. Mangrove replanting and stormwater management systems will ensure long-term environmental resilience.

Overall, this EIA concludes that the project is deemed suitable for development within its environmental and industrial context. The site's location in an industrial zone reduces conflicts with residential areas, while the project design demonstrates a strong commitment to mitigating potential impacts.

While the proximity to sensitive ecosystems necessitates careful planning, the implementation of robust mitigation measures and ongoing monitoring ensures that the environmental risks are well-managed. The level of change anticipated is within acceptable limits, and the project aligns with national environmental standards and long-term planning objectives.

The hydrological assessment confirms that the project is low-risk, particularly due to its integration of sustainable design elements and adaptive management strategies. This development represents a balanced approach to economic growth and environmental stewardship, ensuring that the ecological integrity of the surrounding area is preserved.Recommendations

To ensure the successful implementation of the project while safeguarding the surrounding environment, the following recommendations are made:

1. Adherence to Mitigation Measures:

- The client should implement all proposed mitigation measures, particularly those related to sedimentation control, mangrove protection, and spill management.
- Construction activities should remain within designated zones and timelines to minimize disruptions to local ecosystems.

2. Environmental Monitoring:

- Execute the Environmental Monitoring and Management Plan (EMMP) with biannual assessments to track the effectiveness of mitigation measures.
- Monitor water quality, sedimentation, and ecosystem health to promptly address any deviations from baseline conditions.

3. Community Engagement:

- Continue engaging stakeholders and nearby communities to maintain transparency and address concerns proactively.
- Share updates on project progress and key environmental outcomes with the Department of Environment (DOE) as required through the submission of periodic monitoring reports.

4. Sustainability Commitments:

- Prioritise the integration of energy-efficient designs to minimise the operational carbon footprint.
- Maintain mangrove replanting efforts and monitor their success to ensure the long-term health of the coastal ecosystem.

Closing Statement

The proposed Crabbs Boatyard and Marina development is a thoughtfully designed project that has taken into account its sensitive environmental context. By addressing key risks through proactive design and mitigation measures, the project demonstrates a strong commitment to sustainable development. It has been evaluated as a project that aligns with regional land use policies and environmental standards. With proper implementation and monitoring, the development has the potential to serve as a model for balancing economic growth and environmental stewardship in the region.

11. REFERENCES

1. Jackson I. *North East Marine Management Area (NEMMA)*.; 2008. http://parkscaribbean.net/wp-content/uploads/2013/11/North-East Marine Management Area (Antigua) Management Plan 2007-2010.pdf.
2. ECL. *North East Marine Management Area (NEMMA), Antigua Site Report*.; 2007.
3. Kramer P, Roth L, Constantine S, et al. *Antigua & Barbuda's Coral Reef Report*.; 2016.
4. Camacho R, Steele S, Challenger S, Archibald M. Status of coral reefs in Antigua & Barbuda: using data to inform management. *PeerJ*. 2020;8:e9236. doi:10.7717/peerj.9236
5. Camacho R. *NDNP Biological Assessment Report - Seagrass*.; 2019.
6. Winters G, Beer S, Willette DA, et al. The tropical seagrass halophila stipulacea: Reviewing what we know from its native and invasive habitats, alongside identifying knowledge gaps. *Front Mar Sci*. 2020;7(May):1-28. doi:10.3389/fmars.2020.00300
7. Willette DA, Ambrose RF. Effects of the invasive seagrass Halophila stipulacea on the native seagrass, Syringodium filiforme, and associated fish and epibiota communities in the Eastern Caribbean. *Aquat Bot*. 2012;103:74-82. doi:10.1016/j.aquabot.2012.06.007
8. Brodersen KE, Lichtenberg M, Paz L, Kühl M. Epiphyte-cover on seagrass (Zostera marina L .) leaves impedes plant performance and radial O 2 loss from the below-ground tissue. 2015;2(August):1-11. doi:10.3389/fmars.2015.00058
9. Fourqurean JW, Muth MF, Boyer JN, Keys F. Epiphyte loads on seagrasses and microphytobenthos abundance are not reliable indicators of nutrient availability in oligotrophic coastal ecosystems. *Mar Pollut Bull*. 2010;60(7):971-983. doi:10.1016/j.marpolbul.2010.03.003
10. Todd BD, Thornhill DJ, Fitt WK. Patterns of inorganic phosphate uptake in Cassiopea xamachana : A bioindicator species. 2006;52:515-521. doi:10.1016/j.marpolbul.2005.09.044
11. Camacho R, Hay B. *Mangrove Wetland Surveys of the Nelson Dockyard National Park*.; 2020. doi:https://www.nationalparksantigua.com/eco-wetlands/
12. Joseph, Victor. *Parham Harbour Avifauna Assessment; 2021*
13. Alpha Engineering & Design (2012) Ltd. (2017). Final Hydrological Report for Three Watersheds: Hydrological Analysis and Drainage Designs in Antigua & Barbuda. Prepared for the Department of Environment, Ministry of Health and the Environment, Antigua and Barbuda. September 19, 2017.

ANNEX 1 Disclosure of consultants engaged

RESUMÉ: LUCIA MINGS

PROFESSIONAL EXPERIENCE

5/2007 – present Environment Tourism Consulting Ltd.: *Founder & Managing Director*

ENVIRONMENTAL COMPLIANCE RELATED

- **Led team of professionals to carry out a Scoping and Baseline Assessment of Valley Church Beach for a proposed hotel development.**
- **Led team of professionals to carry out an Environmental Impact Assessment for a proposed Courtyard by Marriot Hotel at the VC Bird International Airport, Antigua**
- **Led team of professionals to carry out an Environmental Impact Assessment for Falmouth Harbour Restaurant and Jetty.**
- **Led team of professionals to conduct an Environmental Impact Statement for Barbuda Belle Hotel Development, Cedar Tree Point Barbuda.**
- **Environmental compliance monitoring for a proposed Autograph/Marriott Resort in Yeptons, Antigua.**
- **Carried out an environmental audit of the Gilberts Agricultural and Rural Development Center (GARD)**
- **Environmental compliance monitoring for a proposed Callaloo Cay Resort development on Morris Bay, Antigua and engaging the adjacent community of Old Road along with relevant government agencies to address existing storm water runoff, erosion and beach access issues.**
- **Assisted Ivor Jackson and Associates with implementing Environmental Impact Assessments by assessing project impacts on wildlife and habitats; assessing socio-economic and cultural impacts and advising on best practices for solid waste, wastewater, energy supply, land use and stakeholder involvement.**
- **Stakeholder outreach in St. Kitts and Nevis to find solutions to biodiversity loss and diminished ecosystem functions within its terrestrial national parks under a UNDP-managed project to carry out an ecological survey of its protected areas.**
- **Monitored EIA compliance of major hotel and other developments on Antigua on behalf of the Environment Division, Ministry of Agriculture and Environment.**
- **Assisted the GEF SGP with carrying out Vulnerability Risk Assessments in several communities in Antigua & Barbuda and wrote corresponding Disaster Risk Reduction grant proposals to Australian AID and UNDP.**

OTHER

- **National Project Coordinator of FAO's CC4Fish climate adaptation in the fisheries sector project in Antigua and Barbuda.**
- **Led consultancy team to prepare an "Updated Ecosystem Assessment and Land Use Zoning Plan for the Body Ponds Watershed" under the UNDP full size project - Sustainable Island Resource Management Mechanism (SIRMM) where GIS maps, biodiversity and natural resources inventory, social impact assessment, cost-benefit analysis, land use management plan and an environmental impact assessment were developed.**
- **From 2013 – 2014 facilitated negotiations between The Nature Conservancy (TNC) and the Government for establishing a National Protected Areas Trust Fund under the World Bank implemented project - Sustainable Financing and Management of the Eastern Caribbean Marine Ecosystem Project in Antigua and Barbuda.**

- **Developed Communities Adapting to Climate Change Training Programme and worked with four Antiguan communities to develop projects aimed at building their resilience to the effects of climate change.**
- **Project Manager for the Environmental Awareness Group's "Protection of Watershed Functions and Sustainable Use of Plant Biodiversity in Antigua and Barbuda" project.**
- **Led consultancy to zone and GIS map the newly formed Codrington Lagoon National Park in Barbuda.**
- **As a senior consultant for the Island Resources Foundation (IRF) conducted socio-economic**

research and prepared environmental, socio-economic and livelihoods assessments for Grenada and St. Kitts for the OECS' Protected Areas and Associated Livelihoods Project. Developed creative mechanisms to enhance livelihoods through creation of new forest reserves.

- **As a senior consultant for IRF facilitated surrounding communities' inputs in developing natural resource maps for the "Assessing and Mapping the Southwest Region of Antigua" under the SIRMM's Ridge to Reef Demonstration Project.**
- **Assisted Antigua and Barbuda GEF SGP with carrying out Vulnerability Risk Assessments in several communities; wrote corresponding Disaster Risk Reduction grant proposals to Australian AID and UNDP and facilitated GEF OP6 National Consultation where priorities, targets, indicators and project ideas were developed.**
- **As National Researcher for the International Union for the Conservation of Nature (IUCN) conducted an assessment of Antigua and Barbuda's National Biodiversity Strategy and Action Plan development and review processes and prepared a monograph for presentation at the Convention on Biological Diversity's COP12.**
- **Advised the Development Control Authority on the establishment of regulations for its Physical Planning Act 2003. Conferred with relevant stakeholders to understand their challenges, discuss possible solutions and made recommendations to the Authority on how these could be remedied within the Regulations.**
- **Country-based Researcher in support of UNHABITAT and OECS project to develop a "Country Level Land Policy Issues Paper". Information and documents relevant to developing land policy were collected and collated from public and civil society sectors for further use in developing the Land Issues Policy Paper for Antigua and Barbuda.**
- **As primary trainer for Global Water Partnership trained water management technicians across Antigua on Water Use Efficiency in the tourism and water sectors.**
- **Prepared Communications Strategy for the SIRMM.**

1/2005 – 6/2007 Antigua LOC, ICC Cricket World Cup West Indies 2007: *National*

Hosting Programme Coordinator (Communications)

- **Developed key priorities, strategies and budgets on the event's execution in collaboration**

with the CEO and ICC Cricket World Cup West Indies 2007 (CWC 2007) in areas such as

airport renovations and visitor experience, licensing, merchandising and volunteer

management.

- **Worked closely with the Government's Tourism, Aviation and Information departments to**

coordinate the country's visitor experience, accommodations, marketing and public

information preparations for CWC 2007 by either chairing or participating on executive

committees.

- **Worked with various stakeholder groups such as vendors, crafts people and merchants to explain the benefits of the event to them and provided guidance for their involvement**
- **Spearheaded and participated in the LOC and Ministry of Tourism's tour of the United States, Canada and Britain to promote the Country's hosting of ICC CWC 2007.**
- **Managed 5 technical and 1 administrative staff.**

1/2004- 12/2004 Environmental Awareness Group: *Executive Director*

- **Managed this NGO day to day, including accounting, public relations, contracting consultants, liaising with governing executive council. Represented the organization at national and regional consultations to establish and strengthen partnerships.**
- **Facilitated strategic planning and financial reviews for the organization.**
- **Designed Antigua and Barbuda's CREP project for over EC$360,000 (€100,000), for the development and implementation of a management plan for the Codrington lagoon, Barbuda; trained community members in stakeholder identification and analysis; and coordinated the island's Stakeholder Management Board.**
- **Implemented a EC$123,500 (€34,000) ecotourism project, funded by the European Union, which facilitated ecotourism training, sustainable livelihoods and protected areas management workshops for tour operators and community groups.**
- **In close collaboration with the writer produced a Wildlife Guide for the organization.**
- **Acquired a grant for EC$94,000 (US$35,000) from the Caribbean Natural Resources to improve civil society organizations' participation in governance and national decision-making.**
- **Coordinated the organization's implementation of other environmental education, management and conservation projects funded by the GEF, Organization of American States, Fauna and Flora International, International Fund for Animal Welfare among others.**
- **Editor of the organization's newsletter, the EAG'er.**

10/2002-12/2003 Environmental Awareness Group: *Assistant and Acting Executive Directors*

- **Responsibilities as above.**

EDUCATION

2016 Institute of Environmental Management and Assessment

- **ISO 14001:2015 Lead Environmental Auditor Course**

2015 **Cousera.org: University of Geneva**

- **Statement of Accomplishment in Pathways to Climate Change Adaptation: The Case of Small Island Developing States**

2003 – 2015 **Certificates in the following areas:**

- **Traditional Knowledge and Customary Sustainable Use under the Convention on Biological Diversity**
- **Proposal writing for OECS and GEF grants; Caribbean bird conservation (developing national policies, public awareness and monitoring); Communications and Crisis Management; Protected Areas planning and Management; Participatory Planning and Collaborative Management; Environmental Management; Data Collection Protocols and Participatory Research Techniques.**

2008 **University of Bath, Bath, England**

- **Continuing Professional Development Certificate in Environmental Impact Assessment.**

1999-2000 **Canterbury Christ Church University, England**

- **MSc in Tourism and Environmental Management. Course work included GIS, tourism marketing, human resource management, tourism management in developing countries and issues in tourism and environmental management.**

1996-1999 **University of the West Indies, Cave Hill Campus, Barbados**

- **BA (Hons) in History. Course work included Caribbean political economy, business law, economic history of West Africa since 1880, women and gender in the history of the English speaking Caribbean, society and economy in the British Caribbean 1830-1870 and West Indian literature 1.**

ADDITIONAL INFORMATION

- **Amateur bird watcher;**
- **Past board member of the EAG;**

Ruleo Camacho
Marine Ecologist (MSC: Marine Biology, MSC: Marine Policy)

Skill Sets:
UAS operation:

- Extensive experience in the operation of Unmanned Aerial Systems (drones) in biodiversity and ecosystem assessments. The use of drones allows for an aerial overview of ecosystems, which allows for a unique perspective of the pressures facing these ecosystems while reducing the impact footprint of the investigation and assessment.

Marine Surveys:

- Trained in the assessment of marine ecosystems to assess health, biodiversity and to determine pressures facing them. Trained in Atlantic Gulf Rapid Reef Assessment (AGRRA) survey methodologies. The following ecosystems can be assessed: Coral Reefs, Rocky Reefs, Seagrass Beds, and Mud Flats. Assessments can be carried out via snorkel/ scuba methods, or from the surface.
- Assessment of Mangrove Wetlands to determine status of the wetland ecosystem, including: Identification of Mangrove types and distribution, general health of the mangrove wetlands, identification of point sources of pollution and other pressures facing the mangroves, impacts of development on the wetland ecosystem.
- Pollution Sources: Experience in assessing marine ecosystems to determine the point sources of pollution and/or potential point sources of pollution and trained in the collection of water samples to determine water quality.
- Experience in assessing beaches for turtle nest and turtle nesting potential, impact of development on nesting beaches, and mitigation measures.
- Knowledge of ecosystem habitats in Antigua & Barbuda, and the pressures they face from anthropogenic and natural systems.
- Interview of marine resource users and stakeholders, and analysis and write-up of data.

Terrestrial Surveys

- Experience in assessing species richness of terrestrial fauna, inclusive of endangered reptiles and bird counts.
- Experience in calculating density of forest cover.
- Experience in following methodologies to establish terrestrial ecosystem habitat assessment. I have assisted and conducted

Writing

- Skilled in drafting, editing and reviewing peer-reviewed literature. I'm experienced in conducting background research on various ecological issues and impacts, while determining mitigation suggestion for various development and environmental pressures.Experience in review of development applications, using an understanding of the environmental conditions and regulations in Antigua & Barbuda to determine potential outcomes and best-practices.
- Scientific reports and data and statistical analysis.
- Media reports to help to explain science in everyday terms. Experience in writing science articles for newspapers, teaching science, and explaining scientific outputs to the public.

Bernard Nation

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Overview of Key Qualifications

Mr. B. Nation P.E. has accumulated over 25 years of professional experience in technical project development and management in both the public and private sector, with a focus on community oriented natural resource development ventures.

Personal

Nationality:	Dominican
Language:	English – Excellent French Creole – Good
Date of Birth	10 Sep- 1972

Education, Licenses

Professional Engineer, P.E.
Partner, Global water Partnership – Caribbean (GWP-C)

Mexico Institute for Water Resources (IMTA) – 2014, Certificate in Water resource development and management.

Center for Sustainable Development, US.
Diploma in Integrated Community-based Adaptation to Climate Change, disaster risk reduction, and rural Development-, **2012**

FAO & US Irrigation Association
Cert. Water management and Practice, 2006

Silsoe College, Cranfield University, UK
- *MSc Water Management (specializing in Soil & Water Engineering)-* , 1999-2001

- *Dip. Project management & Evaluation*

University of the West Indies
- Cert. Manipulation and application of Geographic Information System (GIS) and Automated Land Evaluation System (ALES), 2002

Sinotech Inc, Taipai, Taiwan
- *Cert. Slope land Development and Water Management, 1997*

ECIAF, Trinidad
Dip. (Hons,) General Agriculture, 1992

Selected Professional Experience

Main Countries:

- **UK**- England
- **Carribean** –Dominica, Grenada, St. Vincent & the Grenadines, St. Lucia, Anguilla, Montserrat

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Principal of EnviroPlus Consulting Inc, (ECI) 2008 – Present

Contractor for the restoration of World Bank funded Salisbury Irrigation project in Dominica - Feb 23 - Sep 23

Design and supervision consultant for OECS-EU funded Coastal Resilience Works in Montserrat and St. Vincent. Feb 23 - Jan 25

Consultant to OECS - EU funded Development of ILM - Based Physical Adaptation Climate Change Initiatives to Reverse Land Degradation in Anguilla, Dominica and Grenada 2022 - 2024

Environmental Consultant to ReMLit project – Building resilience in the Eastern Caribbean through the reduction of Marine litter- Kalinago Territory zero waste community project – March 2021

Sustainable land Management Consultant to PiSLM project Dominica – Agricultural and Forestry SLM technologies and approaches - Dec 2020 - Sept 2022.

Consultant to UNEP DTU Partnership – Technical Needs Assessment of Adaptation and Mitigation measures for climate change in Dominica - 2018

Consultant Engineer to OECS – GCCA projects: Slope-land stabilization and ecosystem restoration in Dominica and Streamlining green waste into appropriate soil ameliorant in Anguilla – 2016 - 2019

Consultant WA-1 water treatment upgrade – installation of pre-treatment and final pressure filtration system for 1000 m^3/hr. – 2016 - 2019.

Consultant – Third national communication for Dominica – LULUCF. Also formed part of the team responsible for the preparation of PPCR and SPCR for Dominica, promoting a low carbon approach - 2015.

SLM Technical Consultant in Agriculture and Forestry to Partnership Initiative for Sustainable Land Management (PiSLM) project in Dominica - Identification and demonstration of best practices and appropriate technologies September 2021 - August 2022

Resident Supervision Engineer for INROS LACKNER SE, GIZ funded– Construction of Berthing Jetty at Soufriere, Dominica – December 2020 – July 2021

Consultant Engineer – Technology Needs Assessment for Climate Change Reduction in Dominica – UNEP DTU Partnership – October 2019 – September 2020

Consultant WA-1 water treatment upgrade – installation of pre-treatment and final pressure filtration system for 1000 m^3/hr- July 2017 – Feb 2019

Design and supervision consultant engineer for EU funded OECS Global Climate Change Alliance (GCCA) projects in Anguilla – Streamlining green waste through composting; Dominica – Ecosystem restoration and slope stabilization – Model Off- Grid agricultural production centre to

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include hybrid (solar n wind) renewable energy system and rainwater harvesting and treatment. 2016 - 2019

Consultant – Third national communication for Dominica – LULUCF. Also formed part of the team responsible for the preparation of PPCR and SPCR for Dominica, promoting a low carbon development strategic approach. -

Consultant Disaster Risk Mitigation (DRM) within the Agricultural sector in St. Vincent and the Grenadines – Specific action pilots (rain water harvesting and storage, composting and soil conservation) to mitigate the impact of climate change. - FAO of the UN - Dec 2015 – 2017.

Water Engineer Consultant – SEC. Installation of water purification plant for local communities post tropical storm Ericka to include rainwater harvesting facilities in Dominica. September 2015

Consultant Engineer for design of technologically appropriate non-soil production system demonstration in Dominica – Introduction of Hydroponics – OAS funded. 2015; 2019

Consultant Engineer with SBI Trinidad, for review of water management protocol in the Agricultural sector in St. Vincent and the Grenadines. 2016

Consultant Engineer to FAO funded Community based disaster risk mitigation project in Dominica – Phase 1.- Disaster Risk Assessment and Vulnerabilities: Flooding, Landslides.

Consultant Engineer with the OECS-SSDD RRACC project to develop a Rain Water Harvesting and Bio-Gas System on the Central Livestock Facility at Londonderry Dominica to improve climate resilience and on-farm waste disposal. 2012 - 2014

Environmental Consultant to ECLIPSE OECS- USAID funded project for the development of climate change adaptation (Disaster Management) Plan for local Communities.

Consultant Engineer with the World Bank Funded Pilot Program for Climate Resilience in Dominica: - Undertaking review of policy, legal and institutional frameworks for climate change adaptation planning and management, Assessment of risk, determination of priority action, Cost benefit analysis and design of implementation modalities.

- Climate proofing of critical infrastructure to include communication, water, and housing.

Design of sewage treatment facilities and drainage and flood management plans in support of E. U funded Eco-tourism development programme in St. Vincent and the Grenadines 2012 – 2014

- Botanical Gardens
- Salt Pond
- Black Point
- Belmont

Design of sewage treatment system for Government Housing projects in Dominica in support of Housing revolution project - 2012

- Hillsborough
- Lily Valley
- Jimmit phase I & II (high water table)

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Feasibility study of gravity water system to Emerald Pool Eco-Tourism Facility in Dominica – 2011

Feasibility Study, Design and supervision of Irrigation system in Botanic Gardens – Roseau – 2010 – 2012

Hydrological study of Morne Diablotin National Park Catchment and Feasibility Study and Design of water and protected agriculture system as part of adaptation measures to climate change in the Morne Diablotin National Park, Dominica – Caribbean Community Climate Change Centre & World Bank. funded - 2009 - 2010

Hydrological study of Belfast River catchment for flood mitigation plan for Petro Caraibes Fuel Facility, Dominica 2009

Consultant Water Engineer – West Coast Water & Sewage Project in Dominica – Hydrologic studies, Water needs assessment, Modelling pipe network & river catchment for designing intake, water treatment plant and other storage structures. 2008 – 2010

Feasibility Study, Design and Construction supervision of 360-acre smallholder Irrigation system for farmland at Calibishie, Dominica

Consultant Water Engineer to Farmex Technologies Sarls of France on Rehabilitation of 7 water treatment plant and transmission and Distribution Network in Grenada - 2007

Consultant Engineer with Landell Mills Consulting Team to the E.U funded Agricultural Diversification Project in St Vincent and the Grenadines. 2007 - 2008

Team member of:

1. Agri-business Development.
2. Public and Private Sector Investment to promote Commercialization.

Main Accomplishments:

- Review of management system for sustainability of Government Implemented Irrigation system
- Analyzed agribusiness enterprises for commercial viability.
- Analyzed agribusiness environment, diagnosing constraints and designing systems for improving agribusiness firms for small to medium sized enterprises.
- Advised on appropriate institutional mechanisms for fostering agribusiness development to include registration.
- Identified and advised on priority strategies and investments required for increasing commercialization within the agricultural sector by Private and Public Sector.

Design and Construction Supervision of Water system and Land Development Plan for the Savanne Catchment in Penville, Dominica 2008 - 2009

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Design of soil-based sewage treatment system in Smectoids clays (location with high water table and shallow soils)
- NCH

Rosalie Nature Resort Development Consultant.

- Review of portable water system to include water treatment plant and commissioning of same.
- Review of drainage and waste disposal system (VSB waste water treatment).
- Soil Conservation and management plan

Preparation of GAP code of practice to include solid waste disposal systems in Green house production

Design and supervision of construction of various agro – processing facility to include
- Bee Association extraction facility
- Citrus Facility at Botanic Gardens
- Banillo processing facility
- Giraudel Flower House facility

March 2003 – Aug 2008 **E.U funded Project Engineer/Technical Officer; Executive Officer (Ag.) - Dominica Banana Industry Trust**

- Management of BIT operations in absence of executive officer – Financial, Human Resource & Technical
- Design and Supervision of construction of 12 miles of Farm Access Road
- Design and Implementation of Soil Conservation Management Plots within the Main Banana Growing Belt
- Preparation of Contractual documents and management of Supply, Works and Service Contracts for Agriculture infrastructural projects in excess of E.C. $ 17 million.
- Preliminary design of IRDCs in Fond Cole, Portsmouth & Marigot
- Supervision of implementation of works contract for a Gravity Fed Irrigation and Drainage project at Castle Bruce, Dominica to serve 250 acres of farmland costing E.C $ 4.5 million.
- Drafting of guidelines for the establishment of water user's association for the irrigation project areas.
- Completion of feasibility studies for irrigation in the NE of Dominica utilizing GIS data for determination of land capability.
- Review and recommendations for updating existing national water legislation and development of water policy. Mapping major catchment areas using GIS.
- Design and Supervision of construction of E.C $ 350,000.00 Tissue Culture Weaning and hardening Facility.

Nov 01 – Mar 03 **Team Leader of the Agricultural Engineering Unit – Dominica & Land Use and Evaluation consultant.**

- Design and implementation of on farms irrigation and drainage system.
- Design of on-farm solid waste disposal system

- Evaluation, Design and rehabilitation of feeder and farm access road.
- Provision of technical support for the development of appropriate models using ALES and GIS to evaluate optimum land use.

July 01 – Nov 01 **Water Engineering Consultant with the Department for the Environment, Fisheries and Rural Affairs (DEFRA) in the UK.**

- Determination of drainage requirement and design and supervision of construction of appropriate water storage structures.
- Evaluation of potential pollution risk to surface and sub-surface water sources from disinfecting disease quarantined sites.
- Management and operation within infectious disease quarantine site

ANNEX 2 Declaration of Completeness and authenticity

I, Lucia Mings, Managing Director of Environment Tourism Consulting limited (ETC ltd.), hereby declare that the report entitled "**Crabbs Boatyard and Marina: Environmental Impact Assessment"** submitted to the Development Control Authority, is true and complete.

Ms. Lucia Mings

Managing Director ETC Ltd.

ANNEX 3 Enclosures:

Enclosure 1. Hydrological & Drainage Assessment Report: Proposed Crabbs Boatyard and Marina Development, 2025. Bernard Nation, EnviroPlus Consulting Inc.

Enclosure 2. Marine Assessment: Umbrella Point Marina And Boatyard, Ruleo Camacho Marine Ecologist

Enclosure 3. Department Of Environment Review Of Plan Application #A509-2024 (Marina - Crabbs)

Enclosure 4. Percolation Test And Soil Description Report G. Payne And Associates, Consulting Engineers, Construction And Project Managers December 2024