

# NEGRIL WETLAND LAND USE MANAGEMENT PLAN

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## WETLAND MANAGEMENT PLAN FOR THE NEGRIL ENVIRONMENTAL PROTECTION AREA

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Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco)  
National Sub-Project 1.4 Biodiversity Mainstreaming in Coastal landscapes within the Negril Environmental  
Protection Area of Jamaica

Grant No.: UNEP/PCA/Ecosystems/2018/MCEB-CEP/00332GFL-11208-14AC0003-SB-006157.01

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National Environment  
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Environmentally Focused Engineering

**Date:** 15<sup>th</sup> July 2021

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**Document Title:** Wetland Land Use Management Plan for the Negril Environmental Protection Area

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## List of Acronyms

CEPF	Critical Ecosystem Partnership Fund
CEL	Caribbean Ecosystems Ltd.
EIA	Environmental Impact Assessment
EPA	Environmental Protection Area
GEF	Global Environment Facility
IUCN	World Conservation Union
KAP	Knowledge, Attitudes and Practices
KBA	Key Biodiversity Area
METT	Management Effectiveness Tracking Tool
NEPA	National Environment and Planning Agency
NEPT	Negril area Environment Protection Trust
NGM	Negril Great Morass
NGIAPA	Negril and Green Island Area Planning Authority
NRCA	Natural Resources Conservation Authority
NWMP	Negril (Environmental Protected Area) Wetlands Management Plan
PCJ	Petroleum Corporation of Jamaica
UDC	Urban Development Corporation
UNEP	United Nations Environment Programme



## 1 Executive Summary

**Vision:** The proposed vision for the wetlands of the Negril Environmental Protected Area (EPA) is that “**All the wetlands will be managed to support their ecological functions/service and promote their sustainable use by present and future generations**”. For the purpose of this vision, *sustainable use* is defined as “**Activities that provide for human needs while preserving or enhancing ecological functions**”.

**Goal:** The proposed goal of the management plan is “**The process of enhancing the ecological functions/services of wetlands in the Negril EPA should be understood, accepted and be implemented by stakeholders by 2024.**”

**Geographical scope and timeframe:** The geographical scope of the Negril EPA Wetlands Management Plan (NWMP) includes all the wetlands of the Negril EPA (Figures 1 & 2). The timeframe for the NWMP is three years after which it should be reviewed and updated using an inclusive participatory approach.

The NWMP is intended only to provide the broad context for management of the wetlands of the EPA. Detailed sub-area plans will be needed for each wetland, starting with the Negril Great Morass (NGM). Those plans should be developed with full participation from stakeholders (including landowners).

**Objective:** The objective of the land use management plan for the wetlands of the Negril Environmental Protected area is to “**Enhance the functions/services of the wetlands of the Negril EPA**”.

**Background:** The Negril Environmental Protected Area covers 37,800 ha of which 2,996 ha are wetlands. The majority of the wetlands (2,289 ha) are in the Negril Great Morass, which is the second largest freshwater wetland in Jamaica. The remaining area (758 ha) comprises of 10 small coastal wetlands. The wetlands include mangroves, herbaceous wetlands, swamp forests and freshwater ponds, streams and rivers. These ecosystems support important biodiversity, including globally threatened species such as the West Indian Whistling-Duck (*Dendrocygna arborea*) and

the American Crocodile (*Crocodylus acutus*). Land use in the wetlands and adjacent areas includes tourism, housing and commercial development, grazing, sugar cane and ganja (*Cannabis sativa*) cultivation.

**Ecosystem functions/services:** Important ecosystem functions/services of the wetlands include the following:

- Biodiversity conservation
- Reduction of soil loss
- Maintenance of water quality, thereby protecting aquatic biodiversity and coastal ecosystems such as coral reefs
- Maintenance of base flows in aquifers and water courses
- Reduction of the risk of salinization through water retention
- Support of coastal productivity and fisheries
- Flood retention
- Protection of coastal infrastructure from hurricanes and storms,
- Climate regulation through maintaining local microclimates, such as afternoon rain in Negril
- Carbon sequestration
- Support of rural livelihoods, providing opportunities for tourism, recreation and education, and supporting agriculture.

All the wetlands contribute importantly to biodiversity conservation and the well-being and security of adjacent communities.

**Threats to biodiversity and ecosystem services:** The wetlands of the EPA are threatened and decreasing in area due to the following factors:

- Habitat loss and degradation due to tourism and urban development
- Isolation of wetlands from the sea by roads
- Agriculture – especially ganja (*Cannabis sativa*) cultivation
- Illegal hunting – especially of ducks
- Harvest of timber and posts

- Charcoal burning & fire
- Changes in hydrology
- Invasive alien animals e.g. Small Indian Mongoose (*Herpestes auropunctatus*)
- Invasive alien plants that infest water bodies and are attacking the herbaceous wetlands (e.g. *Salvinia* spp.)
- Pollution from sewage and solid wastes
- Increasing extreme weather events caused by climate change.

#### Strategies and action plan:

- I. ***Building management capacity:*** Since the Negril EPA was declared in 1997, it has suffered from lack of leadership, political support, funding, staffing and resources; there are no regulations to support its management. The organizations that support it – including NEPA, Negril area Environment Trust and Negril Coral Reef Preservation Society – lack the capacity to carry-out necessary activities. Effective management of the wetlands can only occur in the context of effective management of the whole EPA, including staff, vehicles, equipment and training.
- II. ***Increasing legal protection:*** Additional legal protection is essential. Possibilities include developing the EPA regulations, additional protection under the Natural Resources Conservation Authority Act, declaration under the Ramsar Convention on Wetlands of International Importance – especially for Waterfowl – and declaration of a Biosphere Reserve. All remaining wetlands should be zoned for conservation under the Negril and Green Island Area Development Order (NGIADO). Private landowners should be encouraged to protect their wetlands by developing plans for sustainable management and voluntarily protecting them e.g. as private Forest Reserves or through Tree Preservation Orders.
- III. ***Education and awareness:*** Although a Knowledge, Attitudes and Practices (KAP) study in 2020 showed that the communities of Negril are environmentally aware, the scope exists for increase in all stakeholder groups. Environmental education and awareness are essential prerequisites for compliance and support of conservation. A comprehensive biodiversity campaign that targets all stakeholders – decision-makers to basic schoolchildren – is needed.

- IV. ***Enforcement:*** Increased enforcement of environmental laws and provisions related to development control is needed. This entails more, better-trained and equipped rangers, Honorary Game Wardens and improved coordination amongst the enforcement agencies, possibly through the formation of a 'Negril Enforcement Council'.
- V. ***Species management:*** Species management will focus on the restoration of the flagship species, West Indian Whistling-Duck (*Dendrocygna arborea*) and its habitats. Habitat management for this species will support other wetland species of concern.
- VI. ***Sustainable use and climate change adaptation:*** Sustainable use and climate change adaptation measures will include promotion of sustainable, community-based tourism, the development of a strategy for rewilding cane lands, reducing the impacts of ganja farming, demonstration projects, support for sustainable livelihoods (including a small grants programme) and improved planning and development control.
- VII. ***Research:*** Baseline surveys and research should focus on the hydrology of the non-NGM wetlands, a botanical reassessment of all swamp forests, and an economic valuation of the wetlands.
- VIII. ***Monitoring:*** Monitoring is an essential part of the adaptive management/ecosystem-based management cycle. It can be expensive thus, the selection of appropriate indicators is very important. Good indicators are related to management actions, cost-effective to collect and the likeliness that they will show responses in the time-scale of the management actions. Indicators will include changes in the extent of wetlands, status of indicator species, impacts of events such as hurricanes and fire. The impacts of the environment and awareness programme will be assessed through a KAP assessment. Overall management effectiveness will be assessed using the internationally recognized Management Effectiveness Tracking Tool scorecard.
- IX. ***Integrated participatory management planning:*** The Wetlands Management Plan provides the overall context for managing the wetlands of the EPA, but it does not include detailed recommendations, which should be developed on a site by site basis. Various studies of the

NGM, which are needed to develop a management plan are still in progress. Once the results have been completed, a fully participatory management planning exercise for the NGM should be undertaken. Management planning for the other wetlands will depend on the landowners. A comprehensive 'ridge to reef' management plan for the entire Negril EPA is essential to ensure the sustainability of ecosystem functions. Management plans that are developed with full participation of the stakeholders from the earliest stages are more likely to be accepted and implemented.

**Budget:** The indicative total cost of the measures to conserve wetlands over three years is estimated at J\$82,250,000 (US\$548,333). This does not include activities that are covered in the hydrological and ecological assessments, the West Indian Whistling Duck strategy and action plan or the business and management plans for the Royal Palm Reserve (RPR). It also does include the broad-scale enabling activities that will be needed for the Negril EPA as a whole.

## 2 Introduction

A land use management plan for the wetlands of the Negril EPA is the third deliverable under the contract for a wetlands specialist to prepare a wetlands management plan for the Negril Environment Protection Area (EPA) – excluding the Negril Great Morass. Previous deliverables included the literature review (Haynes-Sutton 2020) and the wetlands assessment (Haynes-Sutton 2021). The reader should refer to these documents for detailed background information that informed the preparation of the NWMP.

The NWMP supports the project *“Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco Project),”* which is financed by the Global Environment Facility (GEF). The lead implementing agency is The United Nations Environment Programme Caribbean Regional Coordinating Unit (UNEP CAR/RCU). In Jamaica, the National Environment and Planning Agency (NEPA) is carrying out the project *“Biodiversity Mainstreaming in Coastal Landscapes within the Negril Environmental Protection Area of Jamaica”* under an agreement with United Nations Environment Programme (UNEP).

## 3 Goal and objective of the land use management plan

The proposed goal of the management plan is **“The process of enhancing the ecological functions/services of wetlands in the Negril EPA should be understood, accepted and being implemented by stakeholders by 2024.”**

The objective of the land use management plan (as defined by the terms of reference) is to **“Enhance the functions/services of the wetlands of the Negril EPA”**.

## 4 Definition of wetlands

Jamaica is signatory to the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, which is usually referred to as the Ramsar Convention. The definition of a wetland developed by the Ramsar Convention is as follows:

**“Areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of**

**which at low tide does not exceed six metres”** (Ramsar 2007).

The Ramsar definition was adopted for the NWMP, except that marine ecosystems (such as sandy beaches, coral reefs and sea grass beds) that are included under the Ramsar definition, were excluded from the terms of reference.

## **5 Scope of the wetlands management plan**

The geographic scope of the management plan includes all the wetlands in the Negril EPA (Figures 1 and 2).





Figure 1: Map of the Negril EPA

Prepared by: Dr. Ann Sutton &amp;



Prepared For: NEPA





Figure 2: Wetland units of the Negril EPA

## 6 Methodology

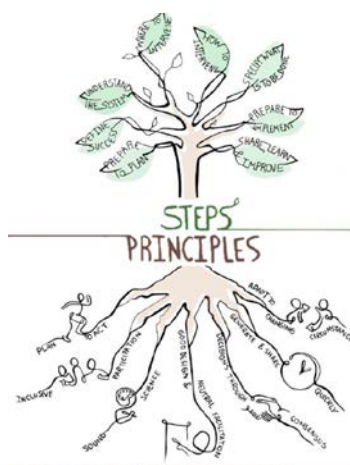


Figure 3: Conservation planning, principles and steps (Copsey 2021)

Prepared by: Dr. Ann Sutton &amp;

Prepared For: NEPA

This management plan was developed based on a literature review (Haynes-Sutton 2020), followed by field surveys of the non-NGM wetlands, and the preparation of a wetlands assessment (Haynes-Sutton 2021a) (Figure 4). The plan was reviewed by stakeholders at a workshop on June 30, 2021 (Haynes-Sutton 2021e).

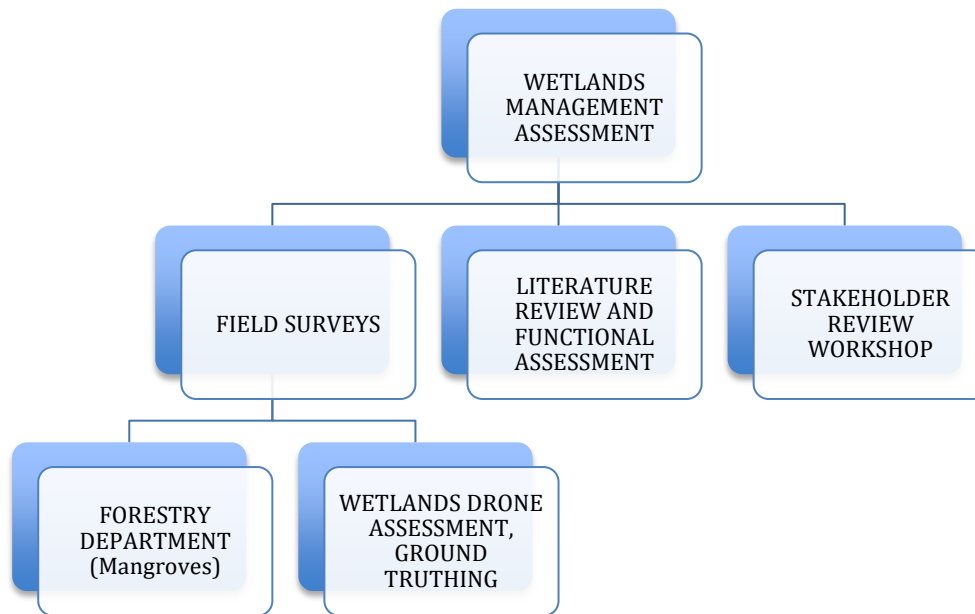


Figure 4: Methodology for preparation of the management plan

N.B. It is imperative to note there has been no recent assessment of the ecology of the NGM, although several studies are on-going under the IWEco project including, most importantly, a hydrological assessment. However, many of the recommendations for the non-NGM wetlands are also applicable to the NGM; therefore, it was decided to include the whole area in the NWMP. A more detailed sub-area management plan for the NGM should be prepared once the results of these studies are available. Other sub-area plans for the non-NGM wetlands may be developed by their owners in the future.

The NWMP was also guided by the Negril and Green Island Environmental Protection Plan (NEPT, 1995), the management plan for the Negril Morass Fish River Hills & Negril Hills (Caribbean Ecosystems Ltd. 2002), and an assessment of the Negril Environmental Protection Plan (Otuokon 2001). The most recent Management Effectiveness Tracking Tool (METT) assessment for the Negril Environmental EPA (2012-13) was also reviewed.

Additional essential inputs from the IWECO project included the strategic and action plan for the West Indian Whistling-Ducks (*Dendrocygna arborea*) in the Negril EPA (Haynes-Sutton 2021c, d, e). Management and business plans for the RPR are being prepared under a different consultancy.

Other expected relevant inputs from the IWECO project may include the hydrological assessment (including vegetation mapping) of the NGM, a land tenure survey of the EPA, land use assessment of the NGM, and management and business plans for the Royal Palm Reserve (RPR).

## 7 Description of the natural resources of the wetlands<sup>1</sup>

### 7.1 Location and landscape context

The locations of the wetland units of the Negril EPA are shown in Figure 2. The wetlands – which include mangroves, herbaceous wetlands and swamp forests – are set in a landscape of broad, fertile, alluvial, coastal plains framed by mangroves and herbaceous wetlands along the coast and limestone hills inland. The coastal plains are low and flat, with extensive areas less than 3 m above mean sea level (MSL). Historically, mainly sugar cane fields were supported. Rice fields were established in the Cabaritta wetlands in the 1970s and 1980s, but these have since been abandoned. There are two ranges of coastal limestone hills - Fish River Hills, which reaches a maximum elevation of 95m, and the Negril Hills with a maximum elevation of 133 m.

### 7.2 Hydrology <sup>2</sup>

The maintenance of the hydrological balance is fundamental to the maintenance of wetland functions, but most of the wetlands have been drained to some extent. Williams *et al.* (2012) provided a detailed description of the changes in fluvial geomorphology that have affected the NGM since 1804. They described how the hydrological balance of the NGM depends on freshwater inflows and outflows. Inflows come from the Fish River and Negril Hills from rivers, streams, seasonal gullies, springs, rainfall and the peat/alluvium aquifers. Inland, these aquifers are primarily fresh but towards the coast they are tidal. Thus, the groundwater becomes brackish near the mouths of the South and North Negril Rivers. Outflows from the morass include the rivers, evapotranspiration from vegetation and possibly submarine springs (Haggstrom undated; Williams *et al.* 2012).

### 7.3 Natural Ecosystems

The Negril Environmental Protected Area covers 37,800 ha of which 2996 ha (8%) are wetlands. The largest is the Negril Great Morass, which is the second largest wetland in Jamaica with an

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<sup>1</sup> This section is a summary of detailed information included in the literature review (Haynes-Sutton 2020) and the wetland assessment (Haynes-Sutton 2021a). The reader is advised to refer to these documents for more information.

<sup>2</sup> The hydrological assessment of the NGM that was commissioned as part of the IWEco project is still in progress. There have been no hydrological assessments of the other wetlands of the Negril EPA.

extent of 2289 ha. It is dominated by herbaceous wetlands of many types growing on peat (Coke 1982). The margins include mangroves, swamp forests and old growth lowland forests. Ten small coastal wetlands make up the balance of the wetland area (758 ha). They include mangroves, swamp forests, and herbaceous wetlands (Table 1). . There are also many freshwater bodies (rivers, streams, channels and ponds) whose areas were not included in this estimate. Maps of the wetlands (other than the NGM) are included in Annex 1.

**Table 1: Brief descriptions of wetland units of the Negril EPA**

NAME OF WETLAND UNIT	DESCRIPTION	MAIN THREATS
NGM	Second largest wetland in Jamaica, includes mainly herbaceous wetland, mangroves, swamp forest and agriculture.	Drainage, agriculture – ganja ( <i>Cannabis sativa</i> ), food crops, pasture, pollution, fire, invasive species
John's Point	Large herbaceous and mangrove wetland, almost contiguous with Cabaritta wetland to east. Important for WIWDs, gamebirds, crocodiles and sea turtles. Status of crabs and freshwater turtles not known.	Ganja cultivation, hunting
Salmon Point	Very small remnant of once extensive mangroves (NCRPS 1995). Small inland mangrove pocket.	Coastal erosion and development
JamWest	Three small inland lagoons surrounded by mature mangroves	None known
Little Bay, Homer's Cove and Blue Hole	Mature inland mangroves	Ganja farming and coastal development
Negril Spots	Herbaceous wetland, swamp forest remnants on limestone outcrops	Residential development, ganja farming
Rhodes Hall, Half Moon and SW Point	Small mangrove wetlands, patches of herbaceous wetland, small ponds	Coastal development
Green Island west	Mangroves and herbaceous wetland, small ponds	Coastal development
Green Island central	Mangroves and rivers	Coastal development including squatter settlements
Cove	Mangroves, herbaceous wetlands, ponds, formerly important for WIWDs, crocodiles, White-crowned Pigeons and other wildlife.	Hotel construction
Davis Cove	Mangroves, herbaceous wetlands	Coastal development

The area and percentage cover of wetlands types in the non-NGM wetlands are shown in Table 2. The vegetation mapping and analysis of percentage cover of the NGM is included in a separate consultancy and the data is not yet available. Forestry Department undertook detailed surveys of mangroves in the EPA in 2019-2021 and has supplied data, which are yet to be analyzed by the consultant.

Mangroves constitute approximately forty six (46%) of the total area of the non-NGM wetlands. The largest area of mangroves is located in the John's Point wetland (151 ha), followed by Cove (84 ha)<sup>3</sup>. In JamWest there are 32 ha of mangroves and Little Bay (including Homer's Cove and Blue Hole) with 74 ha. The largest area of herbaceous wetland is found in Negril Spots (69 ha). Ganja is being grown in 3 of the 10 wetlands that were studied. It covers about 5% of the total wetland area, including 23 ha (10%) of John's Point and 7 ha (16%) of the wetland at Little Bay/Homer's Cove/Blue Hole. Ponds make up about 4% of the wetlands, with the largest areas in Green Island Central.

**Table 2: Areas of wetlands units and habitat types**

WETLAND HABITAT	JP	SP	JW	LB	NS	HM	GIW	GIC	CV	DC	Total (Ha/%)
Area of Mangroves (Ha)	150.57	2.34	33.13	31.74	0.00	5.96	8.09	22.37	84.58	7.40	<b>346.18</b>
% Cover of Mangroves	69	100	97	74	0	35	32	55	84	47	<b>46</b>
Area of Herbaceous Wetland (Ha)	37.44	0.00	0.00	4.48	181.83	10.22	14.95	9.26	14.36	4.18	<b>276.72</b>
% Cover of Herbaceous Wetlands	17	0	0	12	69	59	26	23	14	27	<b>36</b>
Area of Swamp Forest (Ha)	0.00	0.00	0.00	0.00	58.63	0.00	0.00	0.00	0.00	0.00	<b>58.63</b>
% Cover of Swamp Forest	0	0	0	0	23	0	0	0	0	0	<b>8</b>
Area of Ganja Farm (Ha)	23.23	0.00	0.00	6.65	9.75	0.00	0.00	0.00	0.00	0.00	<b>39.63</b>
% Cover of Ganja Farms	10	0	0	16	4	0	0	0	0	0	<b>5</b>

<sup>3</sup> The mangroves at Cove have since been partly bulldozed.

WETLAND HABITAT	JP	SP	JW	LB	NS	HM	GIW	GIC	CV	DC	Total (Ha/%)
Area of Seasonal and Permanent Ponds (Ha)	8.98	0.00	0.64	0.00	10.71	0.45	2.19	8.58	2.22	2.92	36.68
% Cover of Ponds	4	0	2	0	4	1	8	9	2	20	5
Total Area of Wetland (Ha)	220.22	2.34	33.77	42.86	260.93	16.64	25.23	40.21	101.15	14.50	757.85
JP- Johns Point; SP – Salmon Point; LB – Little Bay, Homer’s Cove and Blue Hole; NS – Negril Spots; HM – Rhodes Hall, Half Moon Bay and SW Point; GIW – Green Island West; GIC – Green Island Central; CV – Cove; DC – Davis Cove.											

## 7.4 Natural ecosystems of the wetlands

### 7.4.1 Mangroves

The wetlands other than the RPR include a wide variety of habitat types of which mangroves are the most extensive (Table 2). There are large areas of old-growth basin mangroves, especially White Mangroves (*Languncularia racemose*) and Black Mangroves (*Avicennia germinans*), especially in John’s Point, Homer’s Cove/Little Bay and Cove. There are also patches of Red Mangroves (*Rhizophora mangle*) along the coast (fringing), around brackish lagoons (basin) and along watercourses (riverine) in the wetlands (e.g. along the North and South Negril Rivers, and John’s Point). On the landward side of the wetlands, there are patches of Buttonwood (*Conocarpus erectus*). Mature and relatively undisturbed mangroves are rare in Jamaica; therefore are very important. The mangrove wetlands have few areas of open water and there are not many streams or creeks that connect the mangrove lagoons to the sea. Mangroves at JamWest and Homers Cove/Little Bay are very unusual as they do not have any surface water connections to the sea, are set back from the coast, and are above MSL. In the NGM, mangroves occupy a relatively small percentage of the total area. They are mainly found along the North and South Rivers, at the mouth of the South River and near Orange Bay.

### 7.4.2 Herbaceous wetlands

The largest area of herbaceous wetlands occurs in the NGM, which includes a range of herbaceous habitat types. In the 1980s, these were mostly dominated by sedges such as Saw Grass (*Cladium jamaicensis*) (Coke *et al.* 1982; Haynes-Sutton 2020). Otherwise, the largest areas of herbaceous wetland lies to the west of the John’s Point wetland, but the majority is beyond the Negril EPA, as



such, it is not included in this study. Similar to the other herbaceous wetlands in the study area, it has been heavily impacted by ganja (*Cannabis sativa*) cultivation. Bullrush (*Typha domingensis*) appears to be the most abundant plant in many of the herbaceous wetlands apart from the NGM. There are also localized patches of Bulltongue Arrowhead (*Sagittaria lanceolate*), sedges, reeds (*Eleocharis* spp.) and Giant Swamp Fern (*Achrostichum* spp.).

Historically, all suitable wetlands were drained to create suitable conditions for growing sugar cane, which substantially altered the hydrology. Thus, the remnant herbaceous wetlands are associated with areas where it is too wet to grow cane, despite many drains and canal (e.g. at Negril Spots). There are small patches of herbaceous wetland – mostly Bullrush and Giant Swamp Fern – in Little Bay, Green Island West and Homer's Cove wetlands.

#### **7.4.3 Swamp forests**

Swamp forests are the rarest types of forest in Jamaica. They are characterized by the presence of Royal Palms (*Roystonea princeps*) and hardwood species, including Boar Wood (*Symphonia globulifera*) and the endemic Anchovy Pear (*Grias caulifera*), the only native relative of the Brazil nut (*Bertholletia excels*) in the West Indies. They previously supported a diverse array of hardwood species but most timber species have been extracted (G. Proctor, pers. comm.). In Jamaica, swamp forests are only found in the west of the island, especially the Royal Palm Reserve (RPR) in the NGM; on the property of Paradise, east of Savanna-la-Mar; and in the Black River Lower and Upper Morasses. The precise ecological conditions that they require for growth have not been assessed but they appear mainly to grow in slightly raised peat deposits in the wetlands. There are small, very disturbed patches of similar forest, including Royal Palms, on the western margins of the NGM (e.g. near the airport), in the Negril Spots/Keto wetland but the latter are mainly on limestone islands surrounded by wetlands.

#### **7.4.4 Other forests**

The wetlands are associated with various types of forests in addition to the characteristic swamp forests. In some places such as John's Cove, they are separated from the sea by a sandy berm on raised reef that supports coastal woodland, dominated by species such as Sea Grape (*Coccoloba uvifera*) as well as some endemic trees (Haynes-Sutton *et al.* 1999). Approaching the land, there



are patches of “primary moist limestone forest, regenerating Secondary Dry Limestone Forest and an advanced Secondary Dry Limestone Forest” (NEPA 2019). Remnants of primary or old growth forest (e.g. at Bloody Bay) are very rare and important (Haynes-Sutton *et al*, 1993; Haynes-Sutton *et al*. 1999; NEPA 2019).

#### 7.4.5 Freshwater habitats

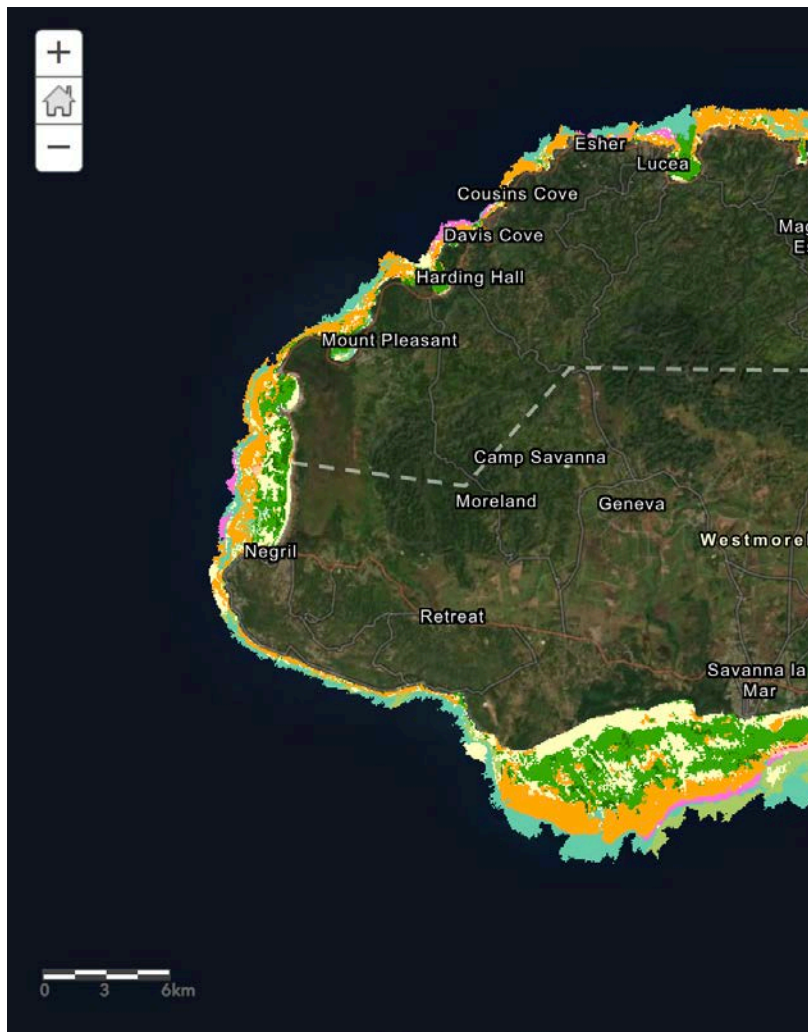
Freshwater habitats and their species are one of the most threatened types in Jamaica and globally (John 2006; WWF 2018). There are many springs, rivers and streams in the Negril EPA which have been altered by channelization to support cultivation of sugar and rice or occluded by alien invasive species. In most cases, the natural vegetation associated with these features has been removed or completely altered. Riverine forest is a habitat type that may have completely disappeared from this area and the rest of Jamaica. The dominant plant on the banks of the rivers and streams (riparian swale) is the non-native Guango, *Samanea saman*. The surviving freshwater ponds are mostly seasonally dry and are filled or partly filled with Bulrush (*Typha domingensis*). A few of the larger ones are permanently wet and support waterlilies (*Nymphaea* sp.), and other species.

#### 7.4.6 Coastal marine ecosystems

There is an important relationship between wetlands and coastal marine ecosystems. The wetlands provide nutrients for the coastal ecosystems (such as coral reefs and seagrass beds), whilst providing protection from the impacts of sediments and excessive freshwater outflows, which may contain pollutants and contaminants from surface runoff. Many commercially important species of fish and shrimp move between the sea and the wetlands in the course of their breeding cycles. Crabs migrate to the beaches from the wetlands and forests in the breeding season.

The coastal wetlands of the Negril EPA are associated directly or indirectly with economically important marine ecosystems including coral reefs and seagrass beds. Figure 5 shows a map of these ecosystems.

**Figure 5: Benthic habitats of the Negril EPA (TNC 2020)**



Jamaica Benthic Habitat 12Oct20

- Coral/Algae
- Dredged
- Hardbottom Dense Algae
- Hardbottom Sparse Algae
- Muddy Bottom
- Reef Back
- Reef Crest
- Reef Fore
- Sand
- Seagrass Dense
- Seagrass Sparse
- Spur and Groove

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### 7.4.7 Threatened and endangered species

#### Flora

There are relatively few endemic species in the wetlands of Negril compared to the forests (Table 2). Range restricted plants of the area include several endemics including *Broughtonia negrilensis*, *Hohenbergia negrilensis*, *Grias caulifer* and *Roystonea princeps*, which is classified as Near Threatened by IUCN (Zona 1998). The rare endemic tree, *Phyllanthus accuminatus*, is another endemic species that occurs in the coastal woodland (Haynes-Sutton 1996).

Three other species of plants in the Negril KBA are listed as threatened by the IUCN (Table 3). These are *Zamia erosa*, *Erithalis quadrangularis* and *Zanthoxylum negrilense*. None of these species appear to be found in the NGM. There have been no studies of the distribution and conservation needs of the threatened and endemic plants of the wetlands of Negril (Tables 3 & 4).

Table 3: Threatened species of the Negril EPA

CLASS	ORDER	FAMILY	SPECIES	COMMON NAME	RED LIST	PRESENCE	HABITAT
AMPHIBIA	ANURA	ELEUTHERODACTYLIDAE	<i>Eleutherodactylus luteolus</i>		EN	Hypothetical	Forest
AVES	ANSERIFORMES	ANATIDAE	<i>Dendrocygna arborea</i>	West Indian Whistling-duck	NT	Confirmed	Wetlands
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Amazona agilis</i>	Black-billed Amazon	VU	Hypothetical	Forest
MAMMALIA	CHIROPTERA	NATALIDAE	<i>Natalus jamaicensis</i>	Jamaican Greater Funnel-eared Bat	CR	Hypothetical	Caves and forest
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Lasiurus degelidus</i>	Jamaican Red Bat	VU	Hypothetical	Caves and freshwater
REPTILIA	CROCODYLIA	CROCODYLIDAE	<i>Crocodylus acutus</i>	American Crocodile	VU	Confirmed	Wetlands
REPTILIA	SQUAMATA	BOIDAE	<i>Chilabothrus subflavus</i>	Jamaican Boa	VU	Confirmed	Forest
REPTILIA	SQUAMATA	DIPSADIDAE	<i>Hypsirhynchus ater</i>	Jamaican Racer	CR	Hypothetical	Forest
REPTILIA	TESTUDINES	CHELONIIDAE	<i>Eretmochelys imbricata</i>	Hawksbill Turtle	CR	Confirmed	Beaches and reefs
REPTILIA	TESTUDINES	EMYDIDAE	<i>Trachemys terrapen</i>	Cat Island Freshwater Turtle	VU	Confirmed	Freshwater ponds
CYCADOPSIDA	CYCALES	ZAMIACEAE	<i>Zamia erosa</i>		VU	Confirmed	Forest

CLASS	ORDER	FAMILY	SPECIES	COMMON NAME	RED LIST	PRESENCE	HABITAT
MAGNOLIOPSIDA	RUBIALES	RUBIACEAE	<i>Erithalis quadrangularis</i>		VU	Confirmed	Forest
MAGNOLIOPSIDA	SAPINDALES	RUTACEAE	<i>Zanthoxylum negrilense</i>		EN	Confirmed	Forest
CR – critically endangered, EN Endangered, VU vulnerable, NT Near Threatened.							
Obligate wetland species are highlighted in Green							

Table 4: Plant endemism in the major habitats of the Negril EPA

HABITAT/DESCRIPTION	#	%
NEGRIL EPA		
Total number of species in Negril EPA	205	
Number of endemic species	15	7
SWAMP FOREST (RPR)		
Number of species	114	
Number of endemic species	8	7
MANGROVES		
Number of species	6	
Number of endemic species	0	0
HERBACEOUS WETLAND		
Number of species	59	
Number of endemic species	1	2
COASTAL WOODLAND		
Number of species	75	
Number of endemic species	9	12

## Fauna

The fauna of the wetlands of the Negril EPA includes several threatened species (Table 3). Notably, the West Indian Whistling-Duck (*Dendrocygna arborea*), American Crocodile (*Crocodylus acutus*), which recent genetic analyses suggest may be an endemic species, and the Jamaican (or Cat Island) Freshwater Turtle (*Trachemys terrapin*). Economically important species include land crabs and the White-crowned Pigeon.

## Birds

The only studies of the birds of the Negril EPA, were conducted in the NGM (1980-81 (NRCA 1981) and CEL (2001)). NRCA (1981) identified 52 species of birds in the NGM whilst CEL (2001) listed 43 species of which 4 were endemic to Jamaica. There have been several studies of the birds of the RPR in 1988 (Sutton 1987; Haynes-Sutton *et al.* 1995; Haynes-Sutton *et al.* 2007). In addition, the waterfowl population was surveyed regularly from the air in 1990-1993, as a part of national surveys of ducks (Haynes-Sutton *et al.* 1993.).

The avifauna includes endemic resident and migratory land birds, and resident and migratory waterfowl. Species of interest and concern include the West Indian Whistling-Duck (*Dendrocyna arborea*) which is classified by IUCN as near-threatened, Yellow-breasted Crake (*Hapalocrex*

*flaviventer*) and Limpkin (*Aramus guarana*) that are rare in Jamaica because of their dependence on freshwater habitats. The lack of permanent shallow open water habitats (apart from the artificial lakes of the RPR, and the Negril Sewage Ponds) means that there are few shorebirds.

## Reptiles

At least 16 species of reptiles are found in the Negril area (Haynes-Sutton 1992; NEPA 2019). At least four species classified as threatened by IUCN (2020) have been recorded in or near the NGM. These are the Cat Island Freshwater Turtle (Jamaican Slider) (*Trachemys terrapin*) considered vulnerable (Tortoise and Freshwater Turtle specialist group 1996), and the American Crocodile (*Crocodylus acutus*) is also Vulnerable (Ponce-Campos *et al.* 2012). The Yellow Boa (*Chilabothrus subflavus*) also occurs in the Negril EPA and is another species that is Vulnerable (Gibson 1996). Hawksbill Turtles (*Eretmochelys imbricate*) nest along the beaches, occasionally penetrating into the margins of the coastal woodlands adjacent to the RPR. They are critically endangered (Mortimer & Donnelly 2008). There is no recent information about the status of any of Jamaica's threatened reptiles. Though there have been several studies of marine turtles and a recovery action plan (Haynes-Sutton *et al.* 2011), there have been no studies of the Jamaican Slider (Cat Island) since 2005 (Tuberville *et al.* 2005), and its status, ecology and conservation needs are not known in Negril or any other part of Jamaica.

## Amphibians

At least 19 species of amphibians have been reported from the Negril EPA and the Hanover coastline (Haynes-Sutton 1992; NEPA 2019). Two introduced species – *Rhinella marinus* and *Eleutherodactylus johnstonei* – are common in or near the NGM but there is no information about whether the introduced Bullfrog (*Rana catesbiana*) is present. The invasive Cuban Tree Frog (*Osteopilus septentrionalis*) is spreading rapidly in St. Catherine and Clarendon and could become a threat in the Negril area.

## Fish

The only known study of the fish fauna of the NGM, was carried out in 1982. This study noted that 28 species of fish have been recorded from the canals and rivers of the NGM, including 26 marine species and 2 freshwater/brackish species. Notably, 12 of the marine species were reef fish (NRCA

1981). Aiken (1992) noted that the rivers and canals probably serve as nursery areas for commercially important species of fish. Wray's Top Minnow (*Gambusia wrayi*) – an endemic fish – is found in Negril. Ecologically important keystone species include the Atlantic Anchoveta (*Cetengraulis edulentus*) – a planktivore that depends on nutrients released into the water from the wetland – and Spotfin Mojarra (*Eucinostomus argenteus*) – a detritivore that depends on the abundant supply of plant particulates from leaves, roots and bark of riparian vegetation. Both species are found in large numbers in the Negril rivers near the sea (Aiken 1992) and thus, support the marine food chain. Invasive alien species that are established in the rivers and ponds include *Tilapia* sp. There is no information about whether species that have become established in the Black River system such as catfish (various species) or wolf cichlids (*Parachromis* spp.) have spread to the Negril system.

### Shrimp

The abundance of shrimp in the NGM has apparently declined since the rivers were canalized. Eight (8) species of shrimp were found in the NGM – *Macrobrachium acanthurus*, *M. faustinum*, *M. carcinus*, *Jonga serrei*, *Xiphocaris elongata*, *Micrata poeyi* and two unidentified species (NRCA 1981; Aiken 1992). It is unknown whether the invasive alien species, Australian Red Claw (*Cherax quadricarinatus*), has been introduced to Negril but it was not recorded by NEPA (2019).

### Land crabs

In Negril, the predominant species of land crab that exists is The Blue Land Crab (*Cardisoma guanhani*) while other species, such as the Black Land Crab (*Gecarcinus ruricola*), also occur. They are most often encountered in the breeding season (usually in May or June after heavy rain) when the females migrate across the road between the NGM and the sea, in order to lay their eggs in the sea. They are popular food and people go out at night with bottle torches to catch them (Haynes-Sutton, pers. obs.). However, residents report that crab populations are declining (e.g. Lenbert Williams, pers. comm.). Occasionally, there is a reverse migration when young *Gecarcinus* crabs return from the sea, to the morass. This mass migration across the beaches is infrequent and can cause concern (Anon. 2012). Migration of crabs is being disrupted by coastal development.

## 7.5 Ecological functions/Ecosystem services

Wetlands provide many important ecosystem services or functions, which contribute directly and indirectly to providing irreplaceable values that support human wellbeing in a variety of ways. The results of the qualitative evaluation of the ecological functions of the non-NGM wetlands of the Negril EPA are shown in Table 5. These results are derived from a desk study conducted as part of the wetland assessment for the non-NGM wetlands (Haynes-Sutton 2021). A preliminary assessment of the ecological functions of the NGM is shown in Table 6. These evaluations show the high probability that each of the wetlands are functionally important and valuable to the local communities in its own way. The most functionally important wetlands are the NGM, John's Point, Green Island (west and central) Cove and Davis Cove. The KAP survey confirmed that the people of the area recognize and appreciate these functions (Table 7).

**Table 5: Results of wetland functional assessment of non-NGM wetlands (Haynes-Sutton 2021)**

CRITERIA		WETLAND UNITS										
		JP	SP	JW	LB	NS	HM	GIW	GIC	CV	DC	FW
<b>Biodiversity conservation:</b>												
	Threatened, endangered or rare species	3	0	0	1	1	1	0		2	0	3
	Economically important species	3	1	1	1	1	1	1	1	3	2	2
	Close to nature reserves or protected areas	0	0	0	0	0	0	3	3	3	0	0
<b>Reducing soil loss:</b>												
	Capacity to trap sediments protects coral reefs	3	1	0	1	0	1	1	2	3	2	0
<b>Water quality:</b>												
	Downstream of major sources of pollution	2	0	0	1	2	0	1	1	1	1	0
<b>Maintenance of base flows/water retention:</b>												
	Support water table and reduce risk of salinization of aquifers	3	1	1	1	2	1	1	1	2	1	3
<b>Support for coastal productivity and fisheries:</b>												
	Support anadromous fishable resources	3	1	0	0	0	1	3	3	3	2	0



CRITERIA		WETLAND UNITS										
		JP	SP	JW	LB	NS	HM	GIW	GIC	CV	DC	FW
<b>Flood retention:</b>												
	Upstream of vulnerable areas	0	0	0	0	3	0	0	0	0	0	0
<b>Coastal protection:</b>												
	Protect coastal settlements and infrastructure from storm surge, hurricane damage and floods	0	0	0	0	3	1	2	3	2	2	0
<b>Climate regulation:</b>												
	Maintain local microclimates	3	1	1	1	1	1	1	1	1	2	1
<b>Carbon sequestration:</b>												
	Important for carbon sequestration	3	1	1	1	1	1	1	2	1	1	0
<b>Livelihoods:</b>												
	Used by communities, close to dependent areas of poverty	3	1	1	2	1	0	3	3	3	3	3
<b>Culture/Scenery:</b>												
	Close to tourist areas	0	0	3	2	0	2	0	0	0	0	0
	Destruction for urban development, hotels and villas	0	1	0	2	0	2	3	3	3	2	0
	Agriculture	3	0	0	3	2	0	1	0	0	1	2
	Invasive species	0	0	0	0	0	0	0	0	0	0	2
<b>Land ownership</b>												
	Government	0	0	0	0	0	0	0	0	0	2	0
	Private (mostly large parcels)	2	2	2	2	2	2	2	2	2	2	2
	Private (mostly small parcels)	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>		31	10	10	18	19	14	23	25	29	23	18
<b>KEY</b>		JP- Johns Point; SP – Salmon Point; LB – Little Bay, Homer’s Cove and Blue Hole; NS – Negril Spots; HM – Rhodes Hall, Half Moon Bay and SW Point; GIW – Green Island West; GIC – Green Island Central; CV – Cove; DC – Davis Cove; FW – Freshwater ponds, streams and rivers.										
	Low value											
	Medium value											
	High value											

Table 6: Ecological functions of the NGM (Haynes-Sutton 2020)

FUNCTION	DESCRIPTION	ENVIRONMENTAL SIGNIFICANCE	SOCIETAL SIGNIFICANCE
FLOOD CONTROL	The NGM potentially acts like a sponge, absorbing and detaining floodwaters and releasing them slowly.	Although the channelization of the Negril rivers has reduced this function, the wetlands still play a role in reducing the rate and quantity of freshwater outflows (Mandal <i>et al.</i> 2016). Flood cycles maintain germination conditions for plants (Williams <i>et al.</i> 2012). Wet conditions support soil saturation, and hence anaerobic soil condition, with reducing chemical reactions, that support the development of peat.	Some reduction of flooding after storms. Maintenance of the water table reduces the risk of peat fires.
GROUNDWATER RECHARGE	The water that is detained by the NGM, soaks down recharges the aquifers.	Replenishment of aquifers and maintenance of freshwater helps to reduce saline intrusion and maintains freshwater springs and conditions in the Morass and rivers.	Few properties in Negril still rely on wells. Water supplies come from the Blue Holes at Logwood that are fed from the Fish River Hills.
MAINTENANCE OF WATER QUALITY	NGM removes sediments and pollutants from runoff. Plants such as Water Hyacinth ( <i>Eichhornia crassipes</i> ) take up excess nutrients and pollutants from sewage and agricultural run-off.	The NGM reduces the amount of sediments and pollutants in the outflows (rivers and subsurface springs, if any) that can damage coastal ecosystems and reduce coastal water quality.	Reduction of this function means increased plumes from the rivers, which impacts coastal water quality.
BIODIVERSITY CONSERVATION	NGM provides freshwater and brackish habitat for threatened, endangered or rare species of birds – e.g. West Indian Whistling-Duck ( <i>Dendrocyna arborea</i> ), invertebrates and plants, migratory birds, very rare ecosystems such as the swamp forests and ecologically important ecosystems such as mangroves. The productivity of the morass supports food chains in the adjacent marine habitats.	Maintenance of biodiversity supports the ecological services of the wetlands and adjacent coral reefs.	Provision of natural resources including fish, timber, land crabs, thatch.  Support for fisheries, ecotourism and landscape conservation.
NATURAL BEAUTY,	Actual and potential tourism activities in the NGM include	Utilization of natural resources for recreational activities helps	Potentially provides funding for conservation.

FUNCTION	DESCRIPTION	ENVIRONMENTAL SIGNIFICANCE	SOCIETAL SIGNIFICANCE
HERITAGE, RECREATION AND EDUCATION	fishing, boating, bird watching and hiking.	to develop public support for conservation.	Increases support for wetland conservation.  The NGM has great educational value and spiritual renewal.
SUPPORT FOR SUSTAINABLE AGRICULTURE	There is the potential for low intensity sustainable agriculture in selected areas.		Supports communities and provides income.
COASTAL PROTECTION	The NGM is mostly separated from the coast by a road and a sandy berm. Mangroves come down to the sea and protect the coastline from erosion.	Mangrove roots prevent coastal erosion.	Protection for inshore structures.
NURSERY FOR MARINE FISHERIES	Mangroves, rivers and canals support coastal fisheries.	Many commercial varieties of fish and shrimp depend on mangroves and rivers during their life cycle.	Fisheries support the tourism industry.
CLIMATE CONTROL	Evapotranspiration from the NGM maintains the microclimate of Negril.	Regular rainfall supports biodiversity, and maintains the water balance of the morass.	Supports lush environment and water supplies.
UTILIZATION OF NATURAL RESOURCES	Communities harvest crabs, shrimp, freshwater fish, game birds, craft materials, medicinal plants, timber, building materials, charcoal, fuelwood and sticks from the wetlands.	Resource extraction (apart from game bird hunting) is not regulated.	The economic contribution of these products to community well-being has not been described or quantified.
Source: Adapted from Williams <i>et al.</i> 2012, with additional information from Mandel <i>et al.</i> 2016.			

## 7.6 Human activities in and around the wetlands of the Negril EPA

Land use in and around the wetlands is dominated by tourism, cultivation of sugar cane, farming and grazing of livestock (Figure 6). With the decline in the sugar industry, there is likely to be further abandonment of sugar lands and corresponding changes in employment patterns.

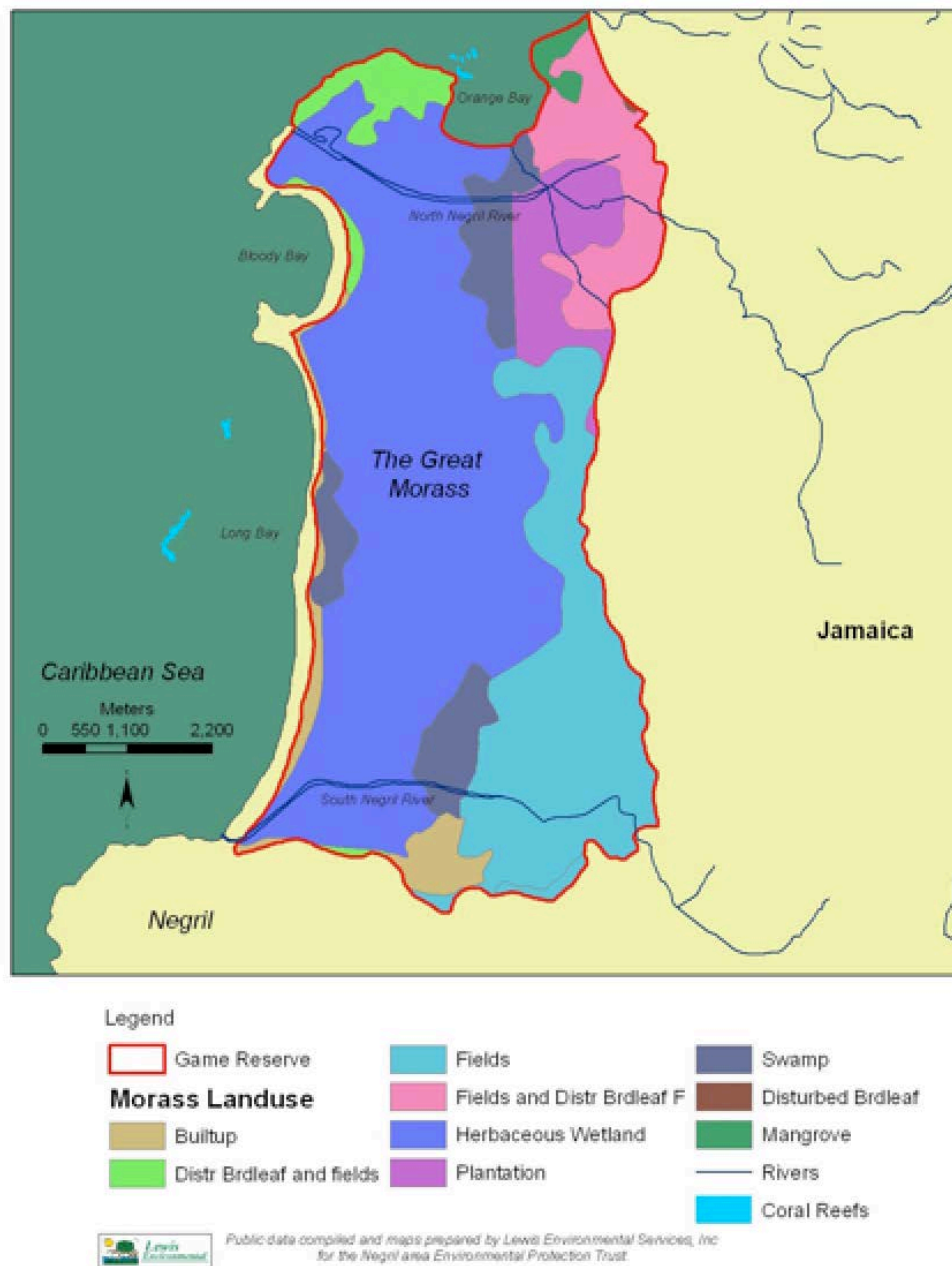


Figure 6: Land use map provided by WRA (Lewis et al. 2010)

Red and White Mangroves produce long straight poles that are harvested mainly as posts for chicken houses (e.g. at Homer's Cove and John's Point). The swamp forests once supported timber species such as *Hibiscus elatus*, Mahogany (*Swietenia mahagoni*) and other species but these have all been taken out since the 1960s. Royal Palms (*Roystonea princeps*) may be extracted for the

garden trade. Bees are kept in some area while cattle are grazed in drier herbaceous wetlands. People fish for native and introduced species of fish and shrimp in rivers, ponds, mangrove lagoons as well as the sea and catch crabs as they migrate from the wetlands to the sea to lay their eggs. Farming activities are mostly focused on ganja, but some other suitable crops, such as dasheen, are also cultivated.

Changes in land use include expansion of housing, hotels and commercial developments (NGM, Green Island, Cove) and in the adjacent land (e.g. Whitehall), expansion of farming (especially ganja) in herbaceous wetlands (mainly NGM, John's Point, and Negril Spots) or mangroves (Little Bay/Homer's Cove and Blue Hole).

## **7.7 Land tenure**

The NGM is mainly owned by the Commissioner of Lands (Figure 7). The RPR was previously owned by the Petroleum Corporation of Jamaica (PCJ) and is currently under the management of the Ministry of Science, Energy and Technology. On the Hanover side, the land on both sides of the road, as far as Orange Bay, is owned by the Urban Development Corporation (UDC) (Otuokon 2001). All the other wetlands are privately owned (Haynes-Sutton 2021) with the exception of part of wetlands to the east of Davis Coves. Many of them include one or two large parcels in the core surrounded by multiple small-holdings. A land tenure assessment has been proposed under the IWEco project. Figure 7 shows the government-owned lands in the EPA and the location of large parcels in the wetlands.

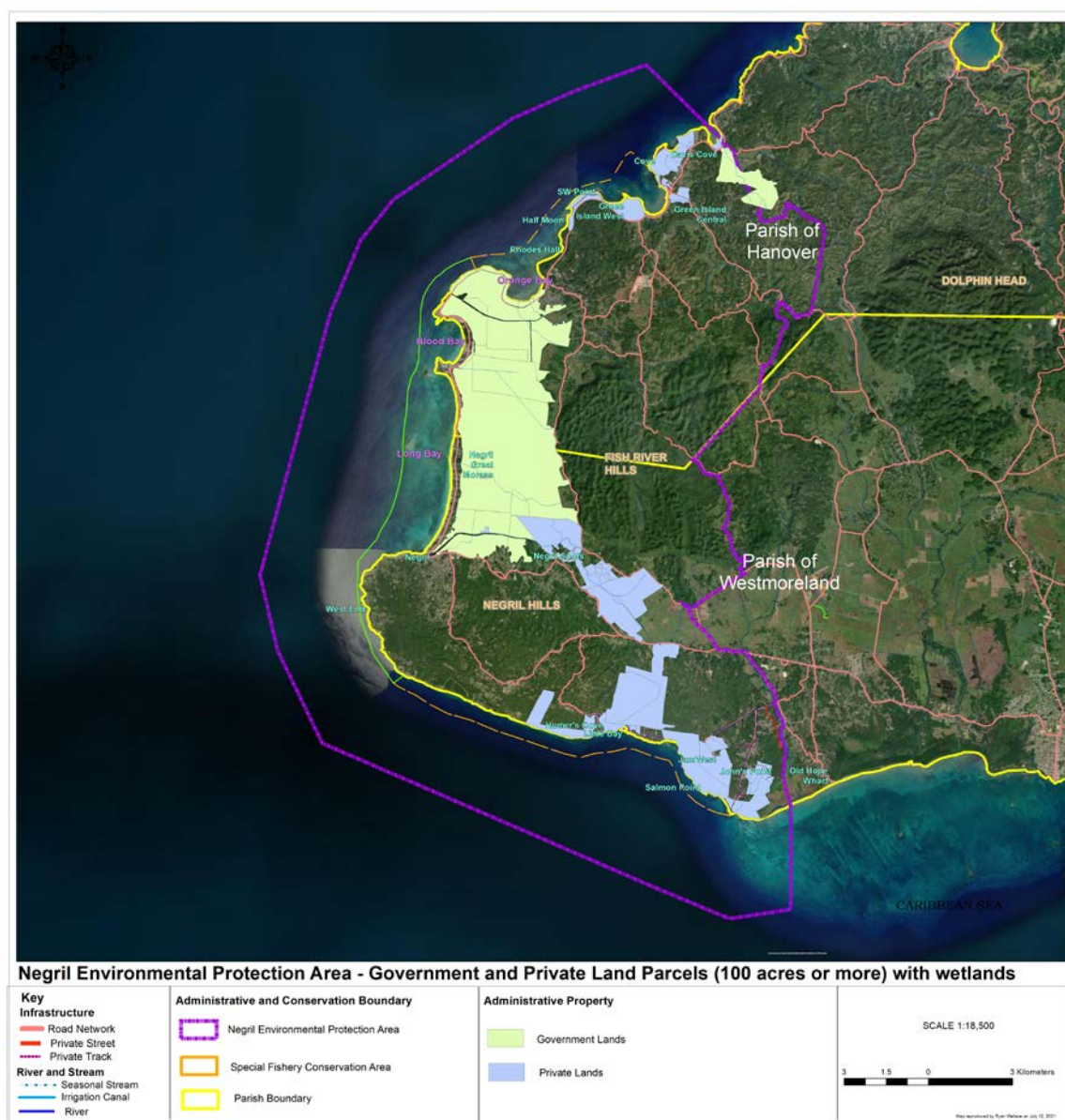


Figure 7: Map showing ownership of large parcels of wetlands in the Negril EPA

## 7.8 Knowledge and attitudes to the wetlands of the Negril EPA

The Knowledge, Attitudes and Practices survey (Hope Caribbean 2020) showed that the residents of the area generally appreciate wetlands, with males (87%) being slightly more aware than females (74%). The individuals understand that wetlands serve important functions as displayed in Table 8. Those older showcased a greater awareness than younger ones. In relation to an appreciation of wetland functions, 60% of the interviewees were aware of all the provisions of resource functions, 46% were aware of all the hydrological functions and 42% were aware of all the ecosystem functions of wetlands. Farmers were more aware of resource functions while the business people of hydrological functions. They also made many practical suggestions for conservation, including public participation in clean up days, tree planting, proper disposal of wastes, a ban or more control of fires and no fishing in the protected area (Haynes-Sutton 2021d).



Table 7: Knowledge of Ecosystem Services Provided by the Wetland: Strongly Agree/definitely yes by Respondent Type and percentage (%) of respondents

	% of respondents				
	Total Sample (N=700)	Farmers (n=100)	Business Owners (n=83)	Employees (n=113)	Residents (n=400)
<b>HYDROLOGICAL FUNCTION</b>					
Helps protect areas in Negril EPA from the full impact of storms*	35.1	42.0	39.8	31.0	34.0
Helps protect areas in the Negril EPA from flooding	33.1	39.0	36.1	30.1	32.2
Helps protect areas in the Negril EPA from beach erosion*	27.1	33.0	27.7	23.0	26.5
Prevents high tides from destroying the coastline and act as a buffer against strong winds	32.0	42.0	32.5	28.3	30.8
Improves water quality by filtering water passing through it to the sea*	31.0	43.0	38.6	24.8	28.2
The roots of mangroves hold soil firmly to prevent erosion by waves, rain and high tides	37.7	48.0	31.3	31.0	38.8
<b>PROVISION OF RESOURCES</b>					
Allow animals to feed and reproduce in a protected and safe area so they can increase in numbers*	43.6	53.0	38.6	42.5	43.0
Is important for maintaining fish stock of the area	38.9	46.0	39.8	38.1	37.5
Is important for the variety of animal and plants in the area	39.2	50.0	36.1	37.2	37.8
Provides a beautiful natural appearance/view in the area	38.0	50.0	37.3	36.2	36.0
Provides job opportunities e.g. Fishermen, Divers etc.	33.1	43.0	21.7	30.1	34.2
<b>ECOSYSTEM FUNCTIONS</b>					
Provide a home for and support and the survival of the unique plants and animals of the area	41.9	47.0	37.3	46.0	40.8
Removes and stores carbon dioxide from the atmosphere and so is important to help prevent global warming	35.3	42.0	32.5	36.3	34.2
Provide activities for fun and pleasure	17.1	26.0	16.9	15.0	15.8
Provides recreational activities linked to tourism	30.1	42.0	25.3	29.2	28.8
Provide sights for visitors who come to the country annually to view, which in turn generates income for the country*	35.4	47.0	26.5	36.3	34.5
Improve the overall beauty of the area	32.3	37.0	32.5	32.7	31.2

\*&lt;.005



## 8 Threats

This section summarises the main threats to the biodiversity and ecosystem functions of the NGM (Table 8) and the other wetlands of the EPA. The direct physical threats are compounded by political and social contributing factors, including the lack of political will to support sustainable development, fragmented government responsibilities, the power of special interest groups e.g. mass tourism and ganja farming, cultural resistance to change, a weak legal framework, and failure to engage local stakeholders at all levels from hoteliers to farmers (Haynes-Sutton 2021e).

Table 8: Summary of direct threats to the NGM

Threat	Summary of major impacts
<b>Development</b>	
Development (housing/urban areas)	Expansion of housing on the margins of the wetland mainly along the southern and western margins directly destroys wetlands (when wetland is cleared or dumped up) and also increases run-off, water pollution from sewage, and solid waste pollution.
Development (commercial/industrial areas)	Expansion of commercial development along the Nonpareil Road, increasing run off and pollution into South Negril wetland (Williams <i>et al.</i> 2012).
Development (tourism/recreation areas)	Expansion of tourism on both sides of the Norman Manley Boulevard is destroying forest ecosystems, interrupting exchange of water and movement of species between the wetland and the sea, contributing to pollution of groundwater (Williams <i>et al.</i> 2012).
Development (mining/quarrying)	Limestone quarrying on the Fish River Hills is damaging the hydrologic balance (Williams <i>et al.</i> 2012) and scarring the landscape (Haynes-Sutton, pers. obs).
Development (roads/railroads)	The Norman Manley Boulevard cut off the wetland from the sea and blocks migration of species.
Development (utility/service lines)	Utility lines are not a major threat.
Development (flight paths)	Flight paths over the NGM potentially affect birds, but the frequency of flights is very low (Haynes-Sutton, pers. obs).
<b>Agriculture</b>	
Annual/perennial crops (shifting)	Shifting cultivation in the Fish River Hills and the morass destroys forest cover and increases run-off and sediments into the NGM in times of heavy rain (Williams <i>et al.</i> 2012).
Annual/perennial crops (small-holder)	Wetlands are increasingly being cleared to plant crops including ganja, coco, dasheen, pawpaw and bananas. The area of ganja is increasing, perhaps as a result of the drying of the morass. Agro-chemicals are being used inappropriately, mainly on the southeast margins of the NGM. This activity increased between 2003 and 2010 (Williams <i>et al.</i> 2012). Ganja farming destroys natural vegetation, disrupts surface water flows, increases the drying of the morass, and restricts access to inner morass.
Annual/perennial crops (agro-industry)	Cane farming is carried out on the east and south of the NGM (Haynes-Sutton, pers. obs.). Some cane fields have been abandoned due to salinization of ground water (CEL 2001).
Livestock grazing/ranching/farming (small-holder)	Informal cattle grazing in the morass disrupts regeneration of vegetation (Haynes-Sutton <i>et al.</i> 2007)
Livestock grazing/ranching/farming (agro-industry)	No data on agro-industry.
Marine/freshwater aquaculture (subsistence/artisanal)	Small fish farms mostly abandoned on the east side of the NGM.

Threat	Summary of major impacts
<b>Unsustainable exploitation</b>	
Hunting (intentional)	The NGM is a Game Reserve, therefore no hunting is supposed to occur but some hunting takes place in adjacent areas (V. Turland pers. comm.)
Logging/wood harvesting (intentional; subsistence/small scale)	Harvest of hardwoods from the NGM and limestone islands in the morass and the Fish River Hills have destroyed forest communities, leaving mainly the non-commercial species (G. Proctor, pers. comm.).
Gathering plants (intentional)	Herbal medicines, garden plants are commonly collected from natural areas but there is no information about the extent of these practices in the NGM.
Fishing/aquatic harvesting (intentional; subsistence/small scale)	A small number of people fish illegally with nets in the rivers. This probably has a minor impact on the fish population (Aiken 1992).
<b>Habitat disturbance</b>	
Disturbance (recreational activities)	Boating, fishing on rivers causes some pollution and disturbance (e.g. Haynes-Sutton 1999).
Fire (increase in frequency/intensity)	Peat fires, usually anthropogenic, have reportedly increased in frequency and severity (Lewis 2010). Drying of the morass makes the peat more likely to catch fire and fires burn longer once started. The resulting smoke can be a major problem in the resort (Duever 2009).
<b>Changes in hydrology (Williams <i>et al.</i> 2012)</b>	
Surface-water abstraction (agricultural)	The distribution of surface water has been altered by construction of drainage channels, canalization of the North and South Rivers, and the construction of the East Canal. This has probably resulted in drying of the morass.
Ground-water abstraction (domestic)	Prior to a central water supply, the hotels and villas had utilized wells. The current impact is thought to be low.
Ground-water abstraction (commercial)	Currently, a water shortage exists in Negril. Water is supplied from wells at Logwood however, the impact of water abstraction on ground water levels is not known. Abstraction of water combined with reduced inflows have probably resulted in increased saline intrusion into the morass.
<b>Invasive alien species (Duever 2009)</b>	
Invasive alien plants	Changes in hydrology have facilitated the spread of invasive plants in all the habitat types. In the RPR, the main threats to open aquatic habitats are Water Hyacinth ( <i>Eichhornia crasipes</i> ) and aquatic ferns ( <i>Salvinia</i> spp.). Shallow wet peatlands are affected by the invasive fern ( <i>Lygodium microphyllum</i> ) and grasses ( <i>Panicum maximum</i> ), while drier areas – e.g. near Sheffield – are being taken over by trees including <i>Mimosa pigra</i> and African Tulip ( <i>Spathodea campanulata</i> ). Swamp forests are affected by the Red Bead Tree ( <i>Adenanthera pavonina</i> ) whilst Peripheral woodlands are being invaded by Poinciana <i>Delonix regia</i> and bamboo <i>Bambusa vulgaris</i> . Other invasive species include <i>Schinus terebinthifolius</i> and <i>Sphagneticola trilobata</i> (Duever 2009). Regeneration of swamp forests is being inhibited by overgrowth of vines ( <i>Ipomoea</i> spp.) but this is largely a response to the opening of the canopy following the removal of the large shade-providing timber trees such as Boarwood ( <i>Syngonium globulifera</i> ).
Invasive alien animals	Mongoose ( <i>Herpestes auropunctatus</i> ), cats, dogs, rats, Shiny Cowbird ( <i>Molothrus bonairensis</i> ) (Haynes-Sutton <i>et al.</i> 2007) and the Cane Toad ( <i>Rhinella marina</i> ) are common (Haynes-Sutton pers. obs.). The invasive alien fish, <i>Tilapia nilotica</i> , is

Threat	Summary of major impacts
	common in rivers and ponds. Similar habitats in the Black River Morass system are being severely affected by invasive shrimp, catfish and wolf cichlids, but there have been no assessments of these species in the NGM.
Problematic native species	<i>Ipomoea tiliacea</i> grows over trees and shrubs in the RPR and has been considered a threat (Duever 2009).
<b>Pollution</b> (e.g. Haynes-Sutton 1999; Williams <i>et al.</i> 2012)	
Domestic/urban waste-water pollution (sewage)	Before the construction of the central sewage system, most hotels disposed of their sewage through tile fields and soakaways. Consequently, this has polluted the ground water. The Negril Sewage Works has improved the situation but not all hotels are connected and there have been no upgrades in the last 5-6 years. There is a continuing massive increase in the construction and the capacity of the existing plant is vastly exceeded. The outflows from the sewage works are still high. Levels of <i>E. coli</i> in the South Negril River were above acceptable levels for recreation (e.g. Haynes-Sutton 1999). National Water Commission reported plans to expand the plant are in the concept stage.
Domestic/urban waste-water pollution (run-off)	No information on the scale and impacts of run-off.
Agricultural/forestry pollution (nutrients)	The impacts of use of fertilizer on pollution levels have not been assessed.
Agricultural/forestry pollution (sediment)	Run-off in the Sheffield area and into the East Canal, as well as sediments carried to the sea by the South Negril River.
Agricultural/forestry pollution (herbicide/pesticide)	Chemical sprays on ganja are suspected to pollute surface and ground water.
Garbage/solid waste pollution	Dumping of domestic wastes in wetlands disrupts the ecology and contributes to pollution.
Air pollution (smog)	This is a result from peat fires, which are occurring more frequently and over wider areas.
Light pollution	Lights from structures – including hotels, commercial developments, housing and roads – situated on and adjacent to the beach that are not shielded, shine out over the sea attracting sea turtles hatchlings inland.
<b>Geological events</b> (Climate Studies Group 2017)	
Geological events (earthquake/tsunami)	Increased tsunami risk to coastal vegetation and property.
<b>Climate change</b> (e.g. Climate Studies Group 2017)	
Climate/weather (habitat shifting/alteration)	Increased temperatures generally; sea level rise increases risk to properties and changes coastal vegetation. There is also increased salinization of aquifers.
Climate/weather (drought)	Drought increases risk of fire and suitability of habitats; more dry days.
Climate/weather (temperature extremes)	Increased mean daily temperatures; more hot days and hot nights.
Climate/weather (storm/flooding)	More frequent and intense flood events are expected.

## 8.1 Management capacity

The prosperity and security of the human population of the Negril EPA depends on the health of the wetlands, forests and marine environment of the area. Therefore, it is essential for development and environmental conservation to be planned, managed and monitored together. This was the principle on which the Negril EPA – and previously the Negril Area Land Authority – was established. However, the Negril EPA has not been managed as was expected (Otuokon 2003). Problems have included lack of political will, funding and gaps in the legal framework. The necessary generic or specific regulations for the EPA have not been developed or gazetted<sup>4</sup>. Meanwhile, the Negril Marine Park (declared under the NRCA Act and managed by NEPA) and the Orange Bay Special Fisheries Conservation Area (declared under the Fisheries Act and managed on behalf of the National Fisheries Authority by NEPT) have been set up but they are managed separately and both are under-funded.

Gaps in management capacity of the Negril EPA that were identified in the most recent Management Effectiveness Tracking Tool (METT) assessment conducted in 2013 (NEPA, in litt.), included lack of regulations, enforcement capacity, clear objectives for the EPA and inadequate design. Additionally, stakeholders are unaware of the boundaries thus, a management plan or a mechanism for updates are missing and monitoring results are not incorporated into planning. There is an absence of a work plan, inadequate resource inventory, lack of patrols, lack of a research programme, lack of any resource management activities, insufficient staff numbers, need for more training of staff, insufficient or non-existent budget, and insufficient equipment and facilities. These deficiencies are associated with deficiencies in programmes – the education and awareness programme is limited and *ad hoc*, there is no land and water planning for habitat conservation (landscape level water flows, corridors for migration, ecosystem specific needs). There is a need for more cooperation between stakeholders to manage water resources and more involvement of communities in decision-making as there is inadequate monitoring, inadequate

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<sup>4</sup> Annex 2 summarises typical provisions for management of an EPA, and specific recommendations for regulations contained in the 1995 EPA Management Plan (NEPT 1995).

visitor facilities, and severe degradation of some biodiversity and ecological values.

## 8.2 Development planning

The Negril EPA plan (1995) noted that the development order did not sufficiently take into account the environment and conservation; this still seems to be the case. The Negril Green Island Area Draft Development Order 2013 (NEPA 2013) zones many wetlands for development thus, they are at risk of destruction and unsustainable activities.

In Westmoreland, the John's Point, Salmon Point, Little Bay/Homers Cove/Bluefields and JamWest wetlands are not zoned for conservation (Figure 23). The wetland margins of the NGM are zoned for development. In Hanover, the wetlands on the edge of Bloody Bay, Orange Bay, Rhodes Hall, SW Point, parts of the Green Island West, Green Island Central and the Davis Cove wetlands are zoned for resort or commercial development (Figures 24 & 25). This is repeated in the Negril Master Plan (Figure 24). This includes a potential buffer zone for the Orange Bay Special Fishery Conservation Area.

Lands along the South Negril River that currently support functional and scenic mangroves (adjacent to the sewage works) are zoned for residential/agricultural use (Figure 26). Notably, in order to conserve wetlands effectively, it is essential to conserve adjacent lands (sometimes called buffer zones). However, development is encroaching on many wetlands and roads and developments cut them off from the beach and the sea. The Fish River Hills are zoned for limestone mining (Figure 25). Limestone mining destroys the watershed, puts adjacent land at risk from increased flash flooding and scars the landscape. The Negril Hills are zoned for development (Figure 25), without allowing adequate buffers to protect the watershed. This will also increase the risk of flash flooding, threatening development along the margins of the NGM.

Zoning. Which prioritizes development over ecological functions, results in the essential connections between the wetlands and the sea being lost along approximately the entire coastline of the Negril EPA. These connections support the exchange of nutrients that support coastal productivity, the movement of species, protect coral reefs and help maintain water levels thus, reducing the fire. Coastal protection services are being lost and coastal infrastructure, housing and

development will be at increasing risk. This is particularly important in the context of climate change. More detailed zoning could allow for ecological services as well as expanding development.

The New Negril Master Plan, which has been developed by the Ministry of Economic Growth and Job Creation and NEPA, covers coastal Hanover from Negril to Lucea, extending up to 5.5km inland (Annex 2). This same area needs particularly sensitive management to ensure that ecological functions are protected or enhanced (Figure 9). It envisages very high room densities of up to 75 habitable rooms per acre. The stated objective of “preserving the natural and fragile ecology of the area without compromising the opportunities for future generations” (Smith, 2021) may be difficult to achieve.

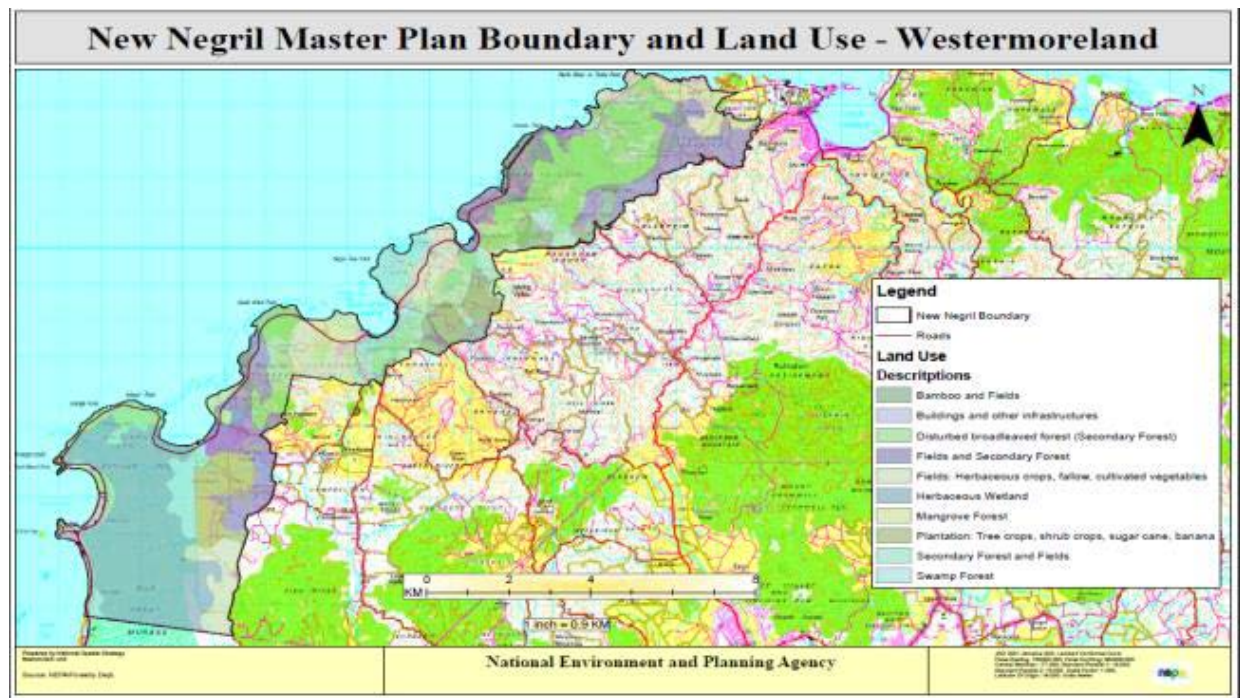


Figure 8: New Negril Master Plan boundary (highlighted in black outline) and land use (NEPA 2019)

### 8.3 Housing, urban areas and commercial development

Expanding population in the Negril EPA has led to increased demand for land for residential and commercial development. Dry land is expensive or not available, especially in accessible areas, and this has led to settlements and shops expanding along roads and into coastal mangroves. This is especially prevalent in coastal Hanover, including Green Island. The new settlements are very vulnerable to hurricanes and storms and sea level rise. Municipal Councils and landowners appear to be having difficulty controlling this trend. Expansion of housing and commercial development in the Whitehall area may be increasing run-off and pollution into the southern NGM (Haynes-Sutton pers. obs.). Unpermitted activities are allowed to continue even after they are reported by concerned citizens, and after stop orders are issued by NEPA (Haynes-Sutton 2021e).

### 8.4 Tourism and recreation areas

Given most of the beachfront land along the Seven-mile Beach in Negril has been developed, there is increasing pressure to develop adjacent areas. The most recent large development is the 2,000 room Princess Hotel, which is being constructed in mangroves in Industry Cove, despite the designation of this property as a conservation area in the Negril and Green Island Area Development Plan. Expansion of tourism along the beachfront on both sides of the Norman Manley Boulevard road is destroying forest ecosystems, interrupting exchange of water and movement of species between the wetland and the sea, contributing to pollution of groundwater (Williams *et al.* 2012) and thereby, threatening its own future. Development plans are not addressing these identified issues.

### 8.5 Pollution

#### 8.5.1 Ground and surface water pollution

The main sources of water pollution are outflows from the sewage treatment plant, agricultural run-off from cane fields (mainly sediments and fertilizers), ganja cultivation (pesticides and fertilizers) and domestic sewage as many homes still use pit latrines. Deforestation of the upper watershed may also be contributing. Most homes are situated on individual lots and there are few sewage treatment systems. This results in high nutrient loads in the rivers – e.g. South Negril River and the New Savannah River (Haynes-Sutton 1999). Sediments carried by rivers from agriculture



and deforestation in the upper watershed possibly contribute to surface water pollution. This is likely to have increased as a result of adjacent developments, such as housing schemes in Whitehall, close to the South Negril River. Unfortunately, water quality in the morasses is not being monitored.

#### **8.5.2 Solid wastes**

Although most hotels have private contractors for collection of waste, if they have an Environmental Permit, the contractor and their schedules have to be submitted to NEPA. Wetlands are still used as informal dumps for disposal of household and construction wastes in many places (e.g. Green Island West).

### **8.6 Agriculture**

#### **8.6.1 Sugar cane**

Historically, all suitable lands were used for sugar cane cultivation. An extensive network of canals and ditches was created to drain the margins of most wetlands, fragmenting the wetland and changing their hydrology. All the remaining wetlands on the coastal plains are adjacent to cane fields (e.g. John's Point, Negril Spots, Green Island west and central and Davis Cove, see maps in Annex 1). However interest in and support for sugar cane farming is declining and alternative uses may have to be identified for these lands.

#### **8.6.2 Ganja (*Cannabis sativa*) farming**

Ganja is one of the most profitable crops in Jamaica – and the tourist trade means there is a strong demand in the area. It requires good soil and a lot of water. Despite decriminalization, it remains difficult for small farmers to get licenced to grow ganja. These conditions provide incentives to grow ganja in the secluded, inaccessible wetlands of the Negril EPA where herbaceous wetlands (e.g. John's Point and Negril Spots) may be the first to be used. In other places (e.g. Little Bay), mangroves are cleared to create space for farms. The impact of ganja farming on Jamaican wetlands has never been assessed, but are likely to include destruction of herbaceous wetlands and mangroves, drying of the wetland through increased evapotranspiration, small-scale changes in surface water flows, pollution of groundwater by pesticides and fertilizers, and increased mortality of birds from the cats that are sometimes brought to the fields to control them.

Shifting cultivation in the Fish River Hills and the morass destroys forest cover, and increases sediment run-off into the NGM in times of heavy rain (Williams *et al.* 2012).

### **8.6.3 Livestock farming**

Cattle, horses and goats are grazed in or around some of the wetlands (e.g. John's Point and east of North-South cut off canal in the NGM). This is a problem for regeneration of tree seedlings and damages soil structure in the morass (Haynes-Sutton 2021e).

### **8.6.4 Marine/freshwater aquaculture**

There are several small fish farms (mostly abandoned) on the east side of the NGM.

## **8.7 Limestone quarrying**

Limestone quarrying on the Fish River Hills is damaging the hydrologic balance, increasing run off into the wetland and scarring the landscape (Williams *et al.* 2012; Haynes-Sutton, pers. obs).

## **8.8 Roads**

Roads interrupt drainage, destroy connectivity between wetlands and coastal marine ecosystems and blocks migration of animals between the land and sea. Most of the wetlands in the Negril EPA are isolated from the sea by coast roads (e.g. NGM, Green Island west and central, Half Moon, Little Bay, Homers Cove, Salmon Point and John's Point. Reportedly, a new road has been proposed.

## **8.9 Unsustainable use of biological resources**

### **8.9.1 Hunting and collecting of terrestrial animals**

The NGM is a Game Reserve, therefore hunting is not permitted to occur, but some hunting takes place in adjacent areas (V. Turland pers. comm.). Hunting of White-crowned Pigeon occurs in many of the other wetlands, especially John's Point and Cove.

### **8.9.2 Fishing and harvesting aquatic resources**

Fishing for fish and shrimp mostly occurs in the rivers and streams of John's Point and the larger freshwater rivers, ponds and streams in Hanover. A small number of people fish illegally with nets in the rivers. This probably has a minor impact on the fish population (Aiken 1992). In other parts of Jamaica shrimp may be harvested by poisoning them with chemicals or toxic leaves. However, there is no data on these practices or their impacts. Crabbing is an unregulated activity whose

extent and impacts have not been assessed in Negril or in the rest of Jamaica. Crocodiles (*Crocodylus acutus*) occur in most wetlands and are probably illegally hunted for meat or killed because they are considered to be a threat. Jamaican Slider (*Trachemys terrapin*) also occurs and may be hunted for food; very little is known about the ecology and use of this species.

#### **8.9.3 Gathering plants**

Medicinal plants are commonly gathered from the wild in Jamaica but there is no specific information about whether medicinal plants are gathered from any of these wetlands. Traditionally, Typha was used to make sleeping mats. Phragmites is used to make fish pots, but it is not known whether this happens in the Negril area. The endemic orchid (*Broughtonia negrilensis*) is potentially at risk from plant collectors.

#### **8.9.4 Harvest of timber, posts and sticks**

Timber, post and stick extraction is widespread in all the wetlands. Historically, it led to the loss of large timber trees in the RPR, resulting in loss of shade, which in turn reduces natural regeneration and encourages the growth of vines. Charcoal burning occurs in mangroves (e.g. John's Point) and wood may be harvested for fuel. The extent and impacts of these activities have not been assessed.

#### **8.9.5 Habitat disturbance**

Boating and fishing on rivers causes some pollution and disturbance (e.g. Haynes-Sutton 1999). Fires, including peat fires, are reportedly increasing in frequency/intensity in the NGM although they are rare in other wetlands. Drying of the morass makes the peat more likely to catch fire and reportedly burn longer once started (K. Spencer pers. comm.). The resulting smoke can be a major problem in the resort (Duever 2009).

#### **8.9.6 Invasive alien species**

##### **Animals**

The Small Indian Mongoose (*Herpestes auropunctatus*) is widespread and preys on waterbird chicks, including West Indian Whistling-Ducks (*Dendrocygna arborea*). This issue is discussed in detail in the West Indian Whistling-Duck strategy and action plan (Haynes-Sutton 2021b). Cane Toad (*Rhinella marinus*) is assumed to be present in all wetlands. *Eleutherodactylus johnstonei* is widely distributed throughout the area. Cats are released in ganja farms to control rats and birds

and have recently become established at the RPR.

### Plants

Invasive aquatic plants occlude some wetlands and rivers often in response to increased nutrient levels (e.g. Water Hyacinth *Eichhornia crassipes*). *Salvinia* spp. have become a problem in the RPR and could spread to other freshwater bodies. An invasive shrub, *Acacia nigra*, is invading parts of the NGM near Sheffield and could spread more widely. African Tulip (*Spathodea campanulata*) and Red Bead Trees (*Adenanthera pavonina*) are problematic in and around the RPR.

### 8.10 Climate change and severe weather

Climate change is causing changes in the season such as reduced rainfall but increased flooding and vulnerability to flooding and storm surge, as well as increasing maximum temperatures and more hot days annually (UNEP 2010). The impacts of climate change may be less severe in western Jamaica than in other parts of the island (Figures 10 & 11), but are still expected to be severe. A detailed assessment was carried out under the Risk and Vulnerability Assessment Methodology Assessment project (RiVAMP) (UNEP 2010). Impacts of climate change are expected to include saltwater intrusion into freshwater wetlands and surrounding agricultural lands, reduced surface flows, increased duration and frequency of toxic algal blooms, increased soil erosion, increased sediments and nutrients flowing into water courses and damage to fish habitats such as mangroves (WetlandCare Australia 2008).

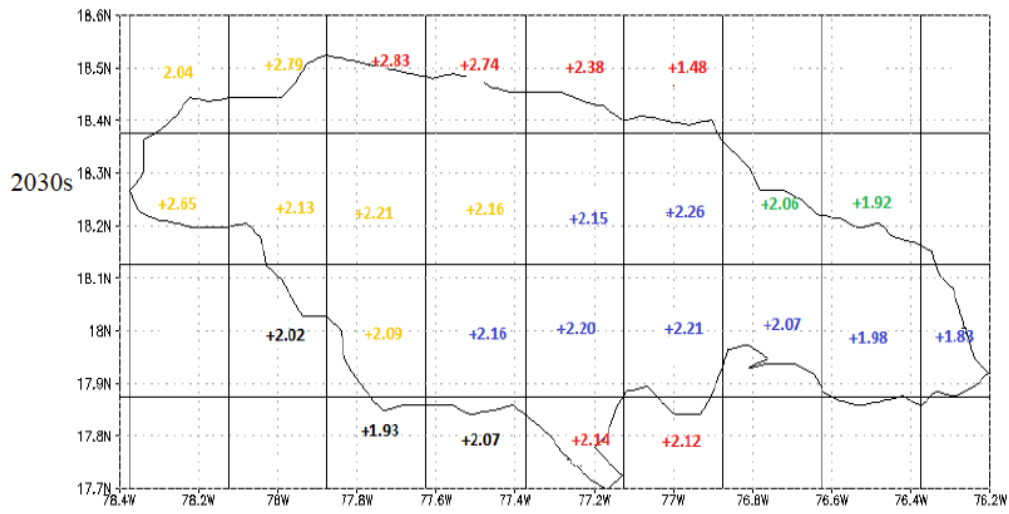


Figure 9: Summary map showing absolute change per grid box of annual mean temperature by the 2030s (colours indicate geographic regions) (Climate Studies Group 2017)

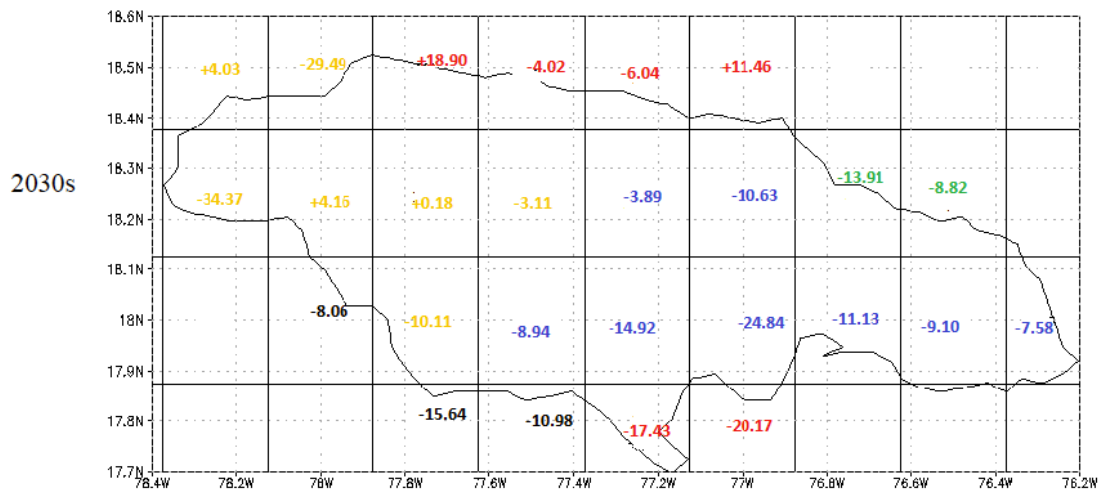


Figure 10: Summary map showing percentage change per grid box of annual mean rainfall by the 2030s (colours indicate geographic regions with similar meteorological conditions) (Climate Studies Group 2017)

### **8.10.1 Temperatures**

Figure 6 shows mean annual temperatures in the study area are expected to increase by up to 2.65°C by the 2030s.

### **8.10.2 Rainfall**

Seasonal rainfall during October is expected to show the greatest decrease. The decrease predicted for the Negril morass area is 37% by the 2030s, which is greater than in any other parts of the island (Figure 11). Though, there will be a slight increase in the Hanover wetlands. Declining rainfall and increased temperatures will contribute to reduce open water habitat and an increased risk of fires. Increased higher intensity storms could bring more large rainfall events, leading to more flash flooding in the wetlands and surrounding areas. Therefore, maintaining and increasing the absorption capacity of the wetlands and managing land uses in the upper watershed and immediate vicinity of the wetlands is very important.

### **8.10.3 Winds**

Negril is relatively sheltered from the high winds and suffers less from hurricane impacts than other parts. However, the risks of damage from hurricanes is expected to increase. This is particularly important for the old growth mangroves, which have survived better than in many other areas of the island (e.g. Portland Bight Protected Area) (Haynes-Sutton pers. obs.) as they have not been severely affected by hurricanes in the last 20 years.

### **8.10.4 Sea level rise and storm surge**

Sea level rise on the south coast of Jamaica could reach 0.25m (compared to levels in 1986-2005) by the 2030s and 1.08m by the end of the century. This is expected to result in coastal erosion and increased flooding which could be compounded by increased storm surge and tsunamis (e.g. Climate Studies Group 2018). Savanna-la-Mar and the west coast of Jamaica have been devastated by a wave event associated with a storm and an earthquake in 1780 (Robinson, 2005). Areas that are most vulnerable to storm surge and coastal erosion are the same as the coastal areas that are vulnerable to flooding (Figure 12). Currently, the residents of areas surrounding the NGM are not particularly concerned about flooding (Hope Caribbean 2020 and key informant interviews) but this could change if floods become more frequent with increased rainfall and decreased absorptive



(Haynes-Sutton 2021b).

## 9 Conservation Vision and Goal for the wetlands and indicator threshold

### 9.1 Vision and Goal

**Vision:** The proposed vision for the wetlands of the Negril EPA is that **“All the wetlands will be managed to support their ecological functions/service and promote their sustainable use by present and future generations”**.

For the purposes of this vision, sustainable use is defined as **“Activities that provide for human needs while preserving or enhancing ecological functions”**.

**Goal:** The proposed goal of the management plan is **“The process of enhancing the ecological functions/services of wetlands in the Negril EPA should be understood, accepted and being implemented by stakeholders by 2024.”**

Table 9 summarises the most important ecological functions/services of the wetlands, the wetlands that are most important contributors to those functions and the most important measures that are needed to preserve or enhance them. This shows that protecting the wetlands from degradation and any reduction in area is the single most important measure (Figure 12). Protection should be supported by public education, enforcement and threat reduction. The NGM is the largest of the wetlands in the Negril EPA and is the most ecologically important. The other wetlands all contribute to ecological functions/service. John’s Point and (formerly) (Industry) Cove, the two Green Island wetlands and Davis Cove are particularly important.

Many of the ecological functions are difficult to measure; therefore, proxy indicators were identified. In this case, the best proxy indicator is the change in area of the wetland (including the area of mangroves, herbaceous wetland, lagoons and ponds. These data can be derived from Google Earth images and standard drone photography.

The approach to management of the protected area should be based on the principles of ecosystem-based management (Figure 10) and adaptive management (Figure 11).



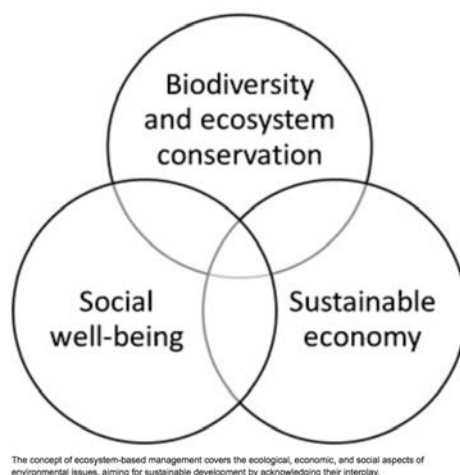


Figure 12: Ecosystem based management (generic diagram)



Figure 13: The adaptive management cycle (The Nature Conservancy)

Table 9: Ecological functions/services and the most important measures to conserve them

ECOLOGICAL FUNCTIONS/SERVICES	DESCRIPTION	MAIN WETLANDS	MOST IMPORTANT MEASURES TO PROTECT FUNCTIONS
Biodiversity conservation	Protect threatened endangered or rare species (e.g. WIWD, American Crocodile, Jamaican Slider, endemic fish)	NGM, John's Point, freshwater ponds	Public education, enforcement, habitat protection, monitoring
	Conserve economically important species (White-crowned Pigeon, crabs, fishable resources)	NGM, John's Point, Cove	Enforcement, habitat protection, monitoring
Reduce soil loss	Trap sediments and thus protect coral reefs and sea grass beds	NGM, John's Point, Cove	Protection of watersheds and wetlands including control of land use, reduction of deforestation and prohibition of conversion of wetlands
Improve water quality	Intercept pollution from major sources including agriculture and urban areas	NGM, John's Point, Negril Spots	Protection, reduction of pollution
Maintain aquifers	Supports water table and reduces the risk of salinization of aquifers	NGM, John's Point, freshwater ponds	Protection of wetlands
Support coastal productivity and fisheries	Rivers and streams connect to sea and support anadromous fish, crabs and shrimp	NGM, John's Point, Green Island West, Green Island Central, Cove, Davis Cove	Protection of wetlands
Retain floods	Intercept flood waters	NGM, Negril Spots	Protection of wetlands
Protect coastal developments	Protect coastal settlements and infrastructure from storm surge, hurricane damage and floods	NGM, Negril Spots, Green Island Central	Protection of wetlands and coastal woodlands
Regulate climate	Maintain local microclimates	NGM, John's Point	Protection of wetlands
Sequester carbon	Mangroves capture and store carbon	NGM, John's Point, Cove (formerly), Little Bay	Protection, control of timber extraction

ECOLOGICAL FUNCTIONS/SERVICES	DESCRIPTION	MAIN WETLANDS	MOST IMPORTANT MEASURES TO PROTECT FUNCTIONS
Support sustainable livelihoods	Tourism	NGM, John's Point	Protection
	Sustainable agriculture (e.g. bee keeping)	NGM, Cove	Protection
	Sustainable harvest of natural resources	No available information	Protection

## 10 Recommendations to address the threat/impacts on the wetlands.

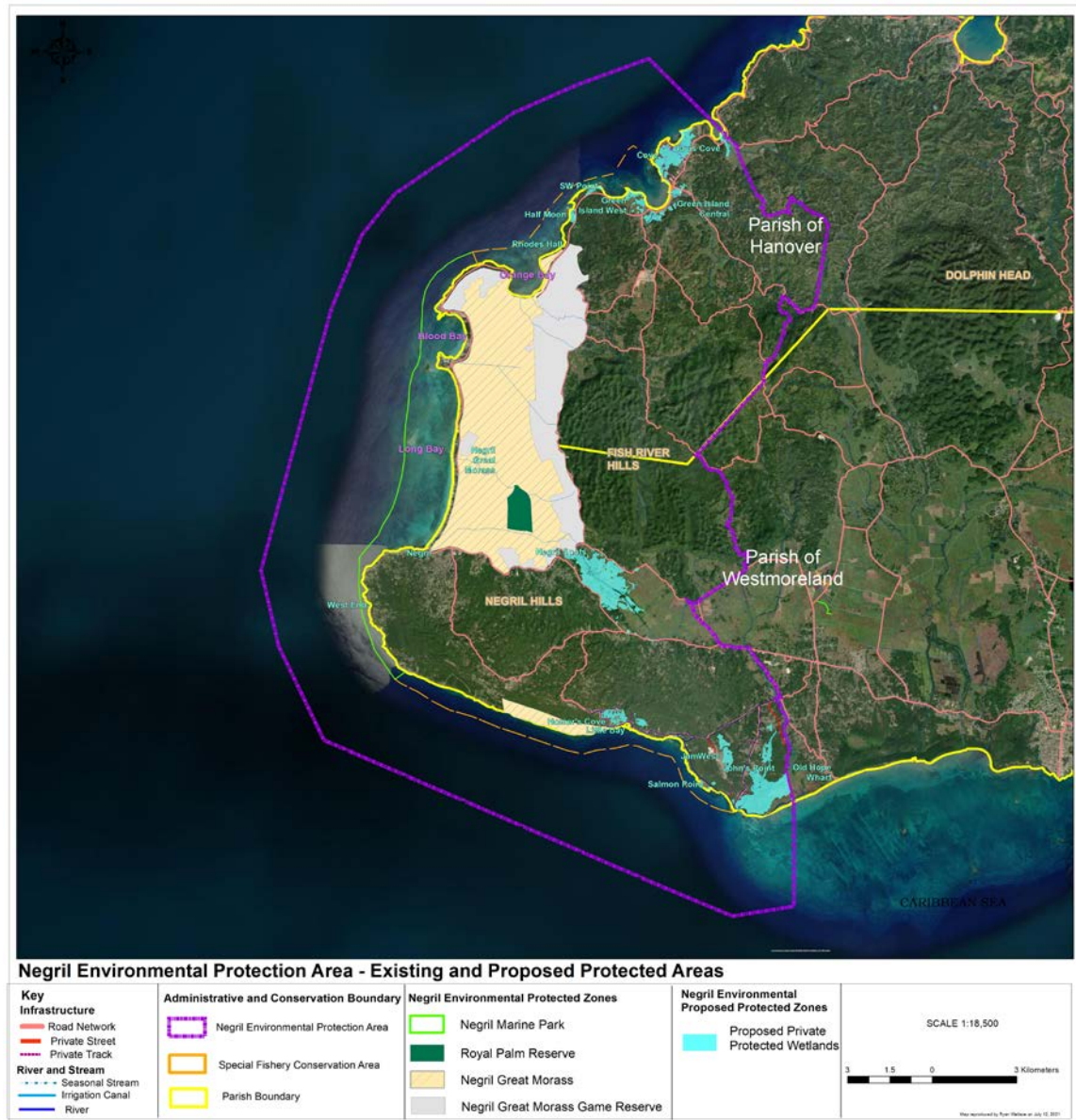
A broad suite of conservation measures at the national and site levels will be needed to address the threats to wetlands in the Negril EPA. Table 10 summarises the broad-scale measures. The most important site level measures are described below, while Table 11 identifies specific measures for the wetland units. Many of the recommendations are the same as those that were made in the 1995 EPA management plan (NEPT 1995), repeated at a stakeholders' workshop twenty years ago (Associates in Rural Development 2001), and in the Ecological Thematic Report on the New Negril Project (NEPA 2019).

### 10.1 Planning, protection and management

The basic recommendation of this report is that there should be no further conversion of wetlands to other uses and (wherever possible) lands that were previously wetlands should be restored (Figure 12). Similar recommendations were made in the Ecological Thematic Report for New Negril (NEPA 2019) (Annex 5).

However, the current situation provides no options for effective legal protection of the wetlands. Only the areas that are designated as conservation areas under the Negril and Green Island Area Development Order (i.e. the NGM, Cove and Duck Pond in the Negril Hills (Annex 3)) have nominal protection, but this is not legally binding on the government or private landowners. Decisions made by NEPA can be overruled by the Minister. Development or destruction of functionally important wetlands that contribute to the livelihoods of local communities are rationalized by the authorities. There is an understanding that if planning permission were to be denied the owner would have to be compensated or NEPA would have to purchase the land. The legal justification for this position

is unclear. Additional protection for wetlands is essential to ensure the conservation and sustainability of biodiversity and to secure their contribution to livelihoods and coastal protection.

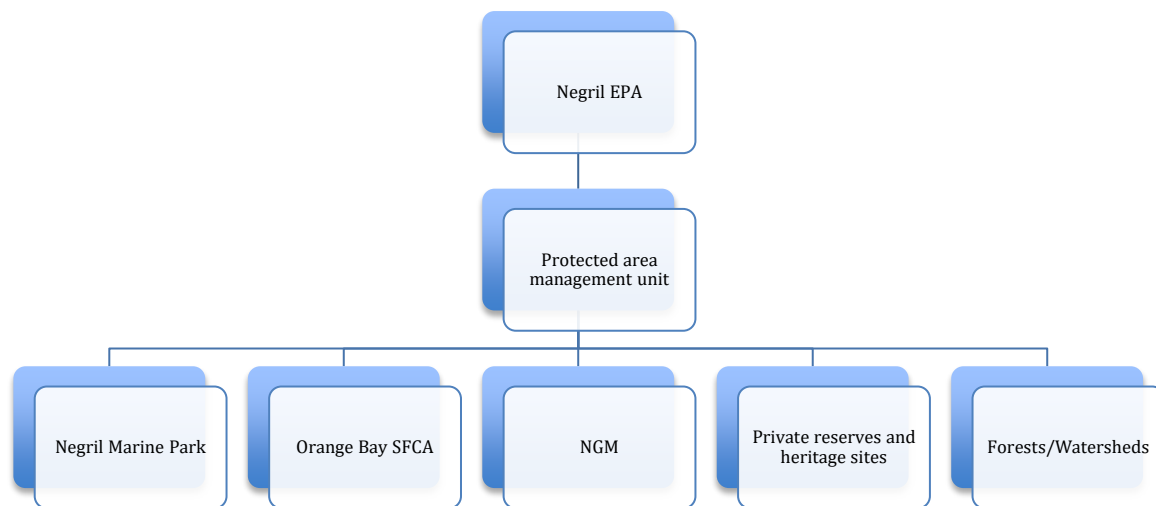


**Figure 14: Existing and proposed protected wetlands in the Negril EPA**

The Negril Master Plan (Figure 26) and the Negril Green Island Area Development Order (Figure 24 & 25) include development zones that overlap with important wetlands, thus set up scenarios that potentially threaten their functions.

**Recommendations:**

- The stakeholders suggested the formation of a designated entity for management of the morasses, including – at a minimum – a protected area manager, a sustainable development adviser, an ecologist a communications officer, and several law enforcement officers. The staff members will need vehicles and equipment, funding, training and political support (Annex 3).
- The technical and political feasibility of the most efficient approach to management of the Negril EPA as a protected area and establishing a Negril EPA protected area management entity or entities should be assessed. Possible models include either continuing the present, fragmented approach to protected area management – which would involve the morasses, wetlands and forests being managed separately with each having its own management unit – or establishing a Negril EPA management unit, which would support the integrated management of the whole EPA (Figure 15). The latter would appear to be the most efficient approach. It would bring the management of the wetlands, Marine Park, forests and resort together under a single management entity, which could be guided by a board including NEPA, Forestry Department, Fisheries Division, UDC, Municipal Corporations, NCC, NEPT, NCRPS, other NGOs and NGALPA. The management entity would have to be adequately staffed, equipped and funded by government subventions and a proposed new trust fund (see below). This could be implemented through new generic and specific regulations under the NRCA Act. This approach would reflect the close relationships between the forests, wetlands and marine ecosystems and would facilitate the protection of core areas and the essential buffer zones around them. For example, the Orange Bay SFCA is dependent on the conservation of the coastal wetlands on its eastern boundary, which is dependent on the management of the NGM, which further relies on the Fish River Hills.



**Figure 15: Proposed management structure for Negril EPA**

- Private landowners should be encouraged voluntarily to conserve their wetlands
- Government-owned lands at Davis Cove should be managed for conservation and demonstrations of community-based sustainable alternatives to sugar cane cultivation .
- The option of promoting conservation of wetlands and forests on private lands through payments for ecological services or conservation agreements should also be assessed. Conservation agreements involve deals between protected area or project managers and communities, through which communities receive benefits in return for making specific commitments to protect their lands ([www.conservation.org](http://www.conservation.org)).
- Specific and general regulations should be developed to support protection and zoning of the Negril EPA. Some suggestions for these regulations were contained in the 1995 Negril EPA Plan (NEPA 1995). These regulations should include provisions for buffer zones.

Improved protection should include:

- Protecting wetlands explicitly under the proposed regulations for the Negril Environmental Protection Area.
- Extending the NGM Game Sanctuary to include the whole EPA (if a preliminary study shows this to be feasible).

- Working with Forestry Department, NEPA, National Heritage Trust, Urban Development Corporation, National Land Authority and private owners of wetlands to explore options for zoning and voluntary protection e.g. as Private Forest Reserves (Forest Act), Protected National Heritage Sites (Jamaica National Heritage Trust Act) or Tree Preservation Area (Town and Country Planning Act).
- Declaring the NGM as a Wetland of International Importance under the Ramsar Convention on Wetlands of International Importance; especially as Waterfowl Habitat.

The impacts in Negril of changes in the Forest Act, which give Forestry Department responsibility of mangroves, or in the Fishing Act, which allow for the creation of terrestrial buffer zones for Special Fishery Conservation Areas, cannot be assessed at this time.

#### **10.1.1 Proposed amendments to the Negril Green Island Development Order and other plans**

As stated above, all the remaining wetlands are so functionally important that no further loss should be tolerated and where possible, wetlands should be encouraged to expand. This means that the boundaries of growth areas and resort areas should be adjusted so that mangroves are protected and connections to the sea are maintained or restored. Wetland functions are strongly influenced by land uses in the surrounding areas. This means that the adjacent forests should be conserved wherever possible.

A clear planning framework is essential to the success of conservation of the Negril EPA as a protected area, but developing it should not involve so much time and effort that nothing is done on the ground.

#### **Recommendation**

- Reassess development and protected area zoning to ensure the coastal corridors that link the hills to the sea are maintained or re-established in the most important areas including Davis Cove, Industry Cove, Green Island, Orange Bay, Bloody Bay, Long Bay, and John's Point. Davis Cove may be one of the most feasible locations to test this approach as some of the land surrounding the rivers is owned by the Commissioner of Lands (Figure 5).

The New Negril Plan, currently under development by the Ministry of Housing, Urban Renewal, Environment and Climate Change and NEPA, but not available for review, will reportedly cover the

Hanover coastal wetlands and freshwater ponds up to 5km inland (Figure 26) and will permit higher room densities (up to 75 habitable rooms/acre) than those currently allowed in Negril. There is a need to frame such initiatives within comprehensive landscape level including 'ridge to reef' planning and strict zoning for all the watersheds of the Negril EPA (see above). This would promote better coordination among agencies conducting planning and development initiatives with conservation initiatives. Better monitoring and enforcement are needed to ensure that zoning, setbacks and development permit conditions are respected, and that immediate action is taken against squatters especially in wetlands (Haynes-Sutton 2021e).

**Recommendations:**

- Review the development control process in Negril and make recommendations to address problems including lack of capacity and lack of political support.
- Establish no build zones along coast roads, including Green Island.
- Extend the Development Order to include all remaining wetlands as designated Conservation Areas.
- Ensure river corridors that are at least 40m wide are protected in the development order to ensure connectivity between the hills and the sea (NEPA 2019).
- NEPA and IWEco should establish a visible presence on the ground with visible leadership and enforcement (Haynes-Sutton 2021e)
- A user-friendly guide to planning laws and regulations should be developed and circulated (Haynes-Sutton 2021e) as part of a programme to increase awareness of planners and developers.
- The education and awareness programme (see below) should include materials and workshops specifically designed for planners, councilors, community leaders and other decision-makers.

**10.2 Education and awareness**

Increasing awareness is a crosscutting activity that supports all aspects of conservation programmes. Without support at all levels, the other strategies are unlikely to succeed. This can be achieved through an initial campaign, and by providing long-term support for staffing, transportation and production of materials.



### **10.2.1 Education and Awareness Campaign**

Design and implement an education and awareness campaign to increase awareness of the importance of the wetlands of the Negril EPA, develop support for measures to address the threats affecting them, increase compliance with environmental laws, promote sustainable livelihoods and climate change adaptation.

This campaign should be designed to influence the full complement of stakeholders at the national and local levels, including decision-makers, national environmental agencies (including planners), local planners, local community groups and NGOs, landowners, developers, enforcement officers, farmers, school teachers and students, hoteliers and hotel workers, tour operators, etc. It will include development of materials, social and mass media, videos, workshops and training sessions commencing with a yearlong blitz. Funding for at least one staff member will also be needed to continue the programme in the long-term, including the revival of the Junior Ranger programme.

### **10.2.2 Interpretation of the RPR**

The RPR should include a wetland interpretation centre that will be accessible for schools and community groups. The RPR should also be set up to host school field trips that are required in the curriculum.

### **10.2.3 Knowledge, Attitudes and Practices (KAP) survey**

The impact of the education programme should be assessed in 2024 through a repeat of the KAP carried out in 2020 (HopeCaribbean 2020).

## **10.3 Enforcement**

Increased enforcement of environmental laws is another essential crosscutting activity.

- Increased capacity for the proposed Negril EPA management entity, NEPA, municipal councils and NGOs.
- Additional funding for staffing, transportation and training, for NEPA and NGOs.
- Establishing an enforcement committee to improving liaison between enforcement agencies (including NEPA, NEPT, Jamaica Constabulary Force, National Fisheries Authority, Jamaica

Defence Force, Negril and Green Island Area Planning Authority and National Solid Water Management Authority) could increase the efficiency of enforcement operations.

- Honorary Game Wardens can play an important role in supporting law enforcement. The project should aim to appoint and train at least 5 new HGWs.
- Training for enforcement officers, to increase their capacity to enforce environmental laws.
- Monitoring gamebird hunting all year round, including residential and resort areas.

#### 10.4 Species management

The main focus for species management is the flagship WIWD. Detailed recommendations are included in the WIWD strategy and action plan (Haynes-Sutton 2021b). Other species that need assessment, followed by conservation planning and implementation include crocodiles, freshwater turtles, land crabs, endemic fish and shrimp and invasive species. Very little work has been done on invertebrates.

**Recommendations** (see also below):

- Continue work on population assessment and management of WIWDs (Haynes-Sutton 2021x).
- Include assessment of other species mentioned above in the ecological assessment of the NGM. Prioritize protection of known and suspected nesting habitats for crocodiles (e.g. Rhodes Hall, NEPA 2019).
- Assess land crab populations and develop recommendations for conservation and management including consideration of closed seasons and crab under or overpasses across roads (Haynes-Sutton 2021e).

#### 10.5 Habitats

All wetland habitats in Jamaica are threatened but swamp forests, herbaceous wetlands and freshwater ecosystems are particularly in need of assessment and conservation planning. Most wetland habitats will recover on their own once the hydrology has been restored; therefore, replanting is not expected to be a major strategy. Nevertheless establishing two nurseries, one for the production of mangrove seedlings and the other for native species, would support restoration efforts.

**Recommendations:**

- National assessment and conservation planning for swamp forests.
- Botanical assessment of all wetlands other than mangroves in the Negril EPA and development of specific recommendations for conservation.
- Establish and maintain two plant nurseries, one for mangroves and the other for native species. Note, this activity involves much more than building greenhouses. It requires several things currently not in place, including permanent sites for the nurseries (lease or purchase), technical expertise for new developments, water supply, source of seeds or seedlings, and long-term funding for gardeners and supplies. Until these issues have been addressed, a budget cannot be developed.

**10.6 Sustainable use and climate change adaptation****10.6.1 Tourism**

Ten years ago, nature-based tourism was often touted as one of the fastest growing segments of the tourism market. However, neither Jamaica in general nor Negril in particular has made much progress in developing it. There are several reasons for this, including the image of the Caribbean as a sun and sea destination (which leads to a lack of demand), lack of nature-based attractions, excessively complicated licensing and permitting arrangements, carrying capacity limitations and security issues. It will take more than the restoration of the RPR for the Negril EPA to develop nature-based tourism and to market itself as a natural destination, especially in the context of over-development of the beach, destruction of the coral reef and plans for more intensive development of the Hanover coastline.

The only wetland currently being used for tourism is at JamWest, where there is a boardwalk in the mangroves. The RPR was previously a wetland attraction, but it has fallen into disrepair. Other IWEco consultancies are developing a business plan and a management plan for it. Davis Cove and John's Point both have potential for nature-based tourism. Feasibility studies are needed.

The 2000-room Princess Hotel currently being constructed at Cove in Hanover includes a mangrove boardwalk. An assessment of the short and long term impacts on biodiversity and ecological functions of construction and operation of this hotel would make an interesting case study.

There is an urgent need for decision-makers, hotel developers and managers to be aware of the importance of wetlands and how they contribute to the long-term sustainability of the tourism product as well as the laws and regulations relating to planning (see below). This should be part of the education and awareness campaign.

Education and awareness will be particularly important in relation to ensuring the implementation of the New Negril Plan, (which is reportedly proposing intensive development of the Negril to Hanover coastline) (Smith 2020) fulfills its parallel objective of conserving biodiversity.

### Recommendations

- Increase capacity for education and awareness building in the NGOs and GOJ sectors.
- Develop and implement a comprehensive wetlands education and awareness programme for all the stakeholder groups, especially politicians and decision-makers as part of a comprehensive biodiversity education and awareness programme for the Negril EPA. This should include expanding the IWECo programme for school children, including Junior Rangers and school based activities. The stakeholders recommended the installation of signage around the NGM to make people aware of the importance of wetlands (Haynes-Sutton 2021e). This should be part of the wider campaign.
- Restore the interpretation centre at the RPR and develop an interpretation plan for the RPR<sup>6,7</sup>.

#### 10.6.2 Agriculture

Agriculture is likely to continue in the core and margins of the NGM, on private lands in and around most wetlands. In order to make it more sustainable the following actions are needed. Farmers are concerned about the potential impacts of rewetting of the NGM on their activities.

- Development of an integrated ecological, social and economic strategy for sustainable use of cane lands as they go out of sugar production including lands at Davis Cove. This should include the options of rewilding or lease to small farmers and should avoid use for housing.

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<sup>6</sup> The cost of the restoration of the building and the development of the interpretation plan and interpretation materials, were assumed to be part of the RPR business and management plans but this does not appear to be the case.

<sup>7</sup> There is a draft interpretation plan (Haynes-Sutton 2010).

- Demonstration project for sustainable wetland management.
- Workshops, training, small grants for sustainable use of wetlands.
- Sustainable livelihoods' workshop.
- An assessment of the impacts of ganja farming on wetlands, with recommendations to increase sustainability.

The IWEco project includes funding for promotion of sustainable agriculture, therefore it is assumed that most of these activities (except the ganja assessment) are already included in project activities and budgets.

#### **10.7 Baseline surveys in the Negril EPA leading to the development of recommendations for conservation and management <sup>8</sup>**

Although some progress has been made, information necessary for conservation planning in the Negril EPA remains incomplete. The following additional studies are among those that are needed:

- Hydrology of the non-NGM wetlands
- Continuing assessments of status and distribution of WIWDs (see Haynes-Sutton 2021d)
- Crocodiles
- Sea Turtles
- Botanical assessment of swamp forests (including all remnants in the EPA) (including a comparison with previous assessments of the RPR (Anderson 1986)
- Botanical assessment of the herbaceous wetlands of the NGM, to identify changes since 1982, and the need for restoration of mangroves and control of invasive species.
- Jamaican freshwater turtle/Jamaican Slider
- Land crabs
- Conservation plan for freshwater habitats and wildlife, based on an ecological assessments.

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<sup>8</sup> A hydrological assessment of the NGM is underway and an ecological assessment of the NGM is planned under the IWEco project. A participatory management planning exercise for the NGM should be undertaken once this and other studies have been completed.

The John's Point wetland is part of a continuum of wetlands that includes the Cabaritta wetlands extending to Paradise in the east. Management in isolation from these areas does not make ecological sense as these wetlands have never been scientifically assessed. An ecological assessment is long overdue.

## 10.8 Resource management

### Recommendations

- An economic valuation of the wetlands of the NGM is needed to support decision-making and education and awareness programmes.
- An assessment of the status, management needs and potential for sustainable harvest of land crabs.

**Table 10: Specific conservation measures for the wetland units**

WETLAND UNIT	SPECIFIC MEASURES FOR WETLAND UNITS		
	PROTECTION	RESTORATION TYPE	
		REHABILITATION	RE-ESTABLISHMENT
Negril Great Morass including RPR <sup>9</sup>	Develop recommendations for additional protection under the NRCA Act to prevent any further conversion of wetlands (e.g. EPA general and specific regulations).		
	Review proposals for designation as RAMSAR site.		
	Develop zoning plan based on inputs from hydrological assessment, land tenure and land use assessments, botanical and ecological surveys.		
		Rewetting (restore hydrological balance)  Rewilding  Species management (including WIWD, crocodiles and turtles) Invasive alien predator control  Reduction of water pollution (note that this should also benefit coral reefs and seagrass beds)	Swamp forests  Forests on limestone islands  Freshwater ponds and natural vegetation on river banks (includes detailed surveys, identification of priority species, development of nurseries and methods of cultivation and planting)

<sup>9</sup> Detailed recommendations for the NGM and the RPR are expected to be developed in separate reports.

WETLAND UNIT	SPECIFIC MEASURES FOR WETLAND UNITS		
	PROTECTION	RESTORATION TYPE	
		REHABILITATION	RE-ESTABLISHMENT
		Use of outflows from Negril sewage plant to rewet morass and treat effluents naturally.  Control invasive alien aquatic plants	Assessment of potential for sustainable harvest of crabs and shrimps.
Specific measures for the RPR	<p>Zone all remaining wetland and marginal forest east of the Norman Manley Boulevard for conservation in the Development Order.</p> <p>Assess the need for additional legal protection for the RPR to confirm its status.</p> <p>Examine the need to transfer ownership of the RPR from the Ministry of Environment, Science and Technology and wetland lands held by UDC and the Commissioner of Lands to a single entity such as NEPA or another organization in support long-term conservation.</p>	<p>Reassess the ecological status of the swamp forest and its endemic and threatened species as part of a national reassessment and develop a conservation plan.</p> <p>Ensure that conservation (not tourism or economic development) is the primary objective for all activities at the facility. If kayaking and fishing and other aquatic activities are proposed, these should be in areas that are specially created for the purpose.</p>	<p>Re-establish tree canopy cover if possible.</p> <p>Restore and expand open water habitats, with a variety of benthic profiles to attract wildlife.</p>
John's Point	Zone wetlands for conservation in the Development Order.	<p>Restore abandoned ganja fields to wetland.</p> <p>Restore connectivity by installing culverts under coast road.</p> <p>Identify potential for sustainable uses.</p>	
	Assess feasibility of declaration as of whole EPA or all wetland as Game Sanctuary (ies).		
	Identify major landowners and discuss voluntary wetland conservation with them and adjacent communities.		
Salmon Point	Zone wetlands for conservation in the Development Order.		
JamWest	Zone wetlands for conservation in the Development Order.	Discuss voluntary wetland conservation, Tree Preservation Order or Private Forest Reserve declaration and restoration measures with landowners.	
		Promote and demonstrate wetland tourism.	

WETLAND UNIT	SPECIFIC MEASURES FOR WETLAND UNITS		
	PROTECTION	RESTORATION TYPE	
		REHABILITATION	RE-ESTABLISHMENT
		Determine whether WIWDs are present and develop a feeding programme, if necessary.	
Little Bay/Homer's Cove. Blue Hole		Deal with illegal ganja plantations according to a national policy to be developed.	
		Enforce requirement for permits for conversion of wetlands to agriculture under NRCA Act.	
Negril Spots	Zone wetlands for conservation in the Development Order. Explore options for voluntary conservation.	Discuss voluntary wetland conservation and restoration measures with landowners.	Re-establish wetlands on adjacent cane lands.
Half Moon/Rhodes Hall/SW Point	Change 'designation for development' to 'conservation' in the Development Order. Explore options for voluntary conservation, including proposing a Tree Preservation Order (NEPA 2019). Protect crocodile habitat.	Discuss voluntary wetland conservation and restoration measures with landowners.	Restore swamp forest on wet pasture lands.
Green Island West	Zone wetlands for conservation in the Development Order. Explore options for voluntary conservation.	Remove informal garbage dump. Prevent further expansion of housing into wetland.	
Green island Central	Zone wetlands for conservation in the Development Order.	Enforce requirements for permits for wetland clearance.	
		Work with landowners to reduce squatting.	
Cove	Already zoned for conservation in the Development Order but most of the area has been bulldozed in 2021 for the Princess Hotel.	Work with hotel developers to minimise damage.  Monitor impacts as case study.	Require developers to carry out restoration and rehabilitation measure required in permit
Davis Cove	Zone wetlands for conservation in the Development Order. Once the development has been completed, assess whether this zoning still makes sense and whether there is any potential for additional protection for the remnants.	Prevent any further clearance of mangroves.  Explore options for wetland tourism.	Demonstration of wetland conservation, river bank restoration, rewilding and sustainable alternatives to sugar cane.
Freshwater ponds, rivers, streams and springs	Ensure riverbanks and ponds and their immediate catchments are zoned for conservation in the development order.	Work with communities to maintain freshwater ponds, and where possible develop them for sustainable use.	Restore riverine vegetation where possible. Reestablish natural vegetation on river banks.
		Monitor and control invasive plants where necessary.	
<b>KEY</b>			
Low value			
Medium value			



WETLAND UNIT	SPECIFIC MEASURES FOR WETLAND UNITS		
	PROTECTION	RESTORATION TYPE	
		REHABILITATION	RE-ESTABLISHMENT
High value			

## 10.9 Monitoring

Monitoring is an essential part of the adaptive management/ecosystem-based management cycle. It can be expensive, therefore the selection of appropriate indicators is very important. Good indicators are related to management actions, cost-effective to collect and likely to show responses in the time-scale the management actions.

- **Land use changes:** Indicators include the changes in the area and extent of developments (residential and commercial), mangroves, herbaceous wetlands, ganja, farming for food crops and grazing.

- **Specific threats:**

- Extent, frequency, causes and impact of fires; a detailed study is needed (Lewis 2010).
- Infractions of environmental and planning laws, regulations and permit conditions.
- Indicator species: Distribution and status of WIWDs, crocodiles, waterbirds, migratory birds and selected invasive plants and animals.

- **Water quality** is important to maintain biodiversity as well as to ensure health standards are met. Water quality in the wetlands is not currently monitored. A water quality assessment and management and monitoring plan is needed for the NGM, to assess current status of ground and surface water, identify point sources, work with property owners to develop solutions, design a monitoring programme, and work with the NWC as they develop plans for tertiary treatment, to ensure that the possibility of using the NGM as part of the strategy is considered.

Recommendations for monitoring are summarized in Table 11. The indicative budget is included in Table 13. In order to support an adaptive management/ecosystems-based management approach, it is expected that at the end of the first three years the results of the monitoring programme will be collated into a report and compared against the objectives. A METT scorecard process should also be undertaken. This will allow for the assessment of the effectiveness of management, and will support planning for the next three-year cycle.

Table 11: Recommendations for monitoring

TARGET	INDICATOR	METHODS	LOCATIONS	FREQUENCY	THRESHOLDS
Habitat/land use changes	Extent of mangroves, swamp forest, herbaceous wetlands, ganja, encroachment on wetlands, fire, invasive species	Analysis of Google Earth images, supplemented by drone photography	All wetlands	Every three years	More than 5% change, positive or negative
Fires and natural disasters	Date, extent	Reports on incidents, photographs	All wetlands	When they occur	N/A
Water quality	To be determined by water quality assessment	Water quality sampling and analysis	Rivers, streams, and ponds	Starts once programme designed and funded	To be determined based on proposed assessment and plan
WIWD	Counts of numbers being fed at RPR (including numbers of marked birds)	Reports	RPR	Daily	Annual change in numbers, population estimate from mark and recapture
	Passive Acoustic Monitoring (if feasible)	Swift units	South Negril River, North Negril River, Johns Point, Davis Cove	Annual	Annual changes in numbers
	GSM tracking of WIWD	GSM trackers	Negril EPA	Continuous	Habitat use
Migratory birds	Tracking of species of concern	MOTUS tower(s) and tags	RPR	Continuous	Occurrence of migratory species
Crocodiles	Nocturnal surveys on rivers and ponds			Annual	Changes in numbers
	Number of reports of incidents involving crocodiles	Reports from community members	As necessary	N/A	Annual increase
	Number of crocodiles tagged and recovered and locations	Reports from enforcement teams	As necessary		
	Number of patrols during hunting season	Reports from enforcement teams	Johns Point, NGM margins,	Annual	N/A
	Number of infractions of	Reports from enforcement	EPA	Year round	N/A

TARGET	INDICATOR	METHODS	LOCATIONS	FREQUENCY	THRESHOLDS
	environmental laws reported	teams			
Mangroves status	Permanent plots in mangroves	Select 10 sites for 10 x 10 m quadrats. Permanently mark sites.  Assess diameter base height (DBH), species, number of stems, number of seedlings, signs of damage/threats.	RPR, John's Point, Green Island, Davis Cove	Monitor every 3 years.	N/A
Swamp forest status	Permanent plots in swamp forest	See mangroves above,	RPR	Annual	N/A
Beaches	Changes in beach profiles and width at standard locations	Sandwatch (see Sandwatch website)	Johns Point, Negril Beach, Green Island	Quarterly	10%
Management effectiveness	METT score	Stakeholder workshop.	Negril EPA	Every 3 years	Increase from 2013 baseline of 36 to 46 points

### 10.9.1 Funding and incentives

There is a need for long-term sustainable funding for conservation and management of biodiversity and ecological services in Negril. Possible sources include direct funding for government agencies, government subventions for NGOs and a proposed new conservation trust fund that could leverage funds locally and internationally from foundations and private donors. Mechanisms for fund-raising could include voluntary contributions from visitors, regular donations from hotels and businesses, payments for ecological services, concessions and user fees for activities inside a protected area. This recommendation was based on commendations from the stakeholders (Haynes-Sutton 2021e) and is similar to recommendations in the 1995 Environmental Protection Plan (NEPT 1995). Funding from local and international grant-making agencies and foundations can supplement these sources, but cannot be provide the main source of recurrent funding.

It is important to remember that support for conservation finance measures goes beyond direct monetary payments and includes incentives for positive actions (such as through tax breaks and conservation agreements) and disincentives for harmful actions (Figure 15).

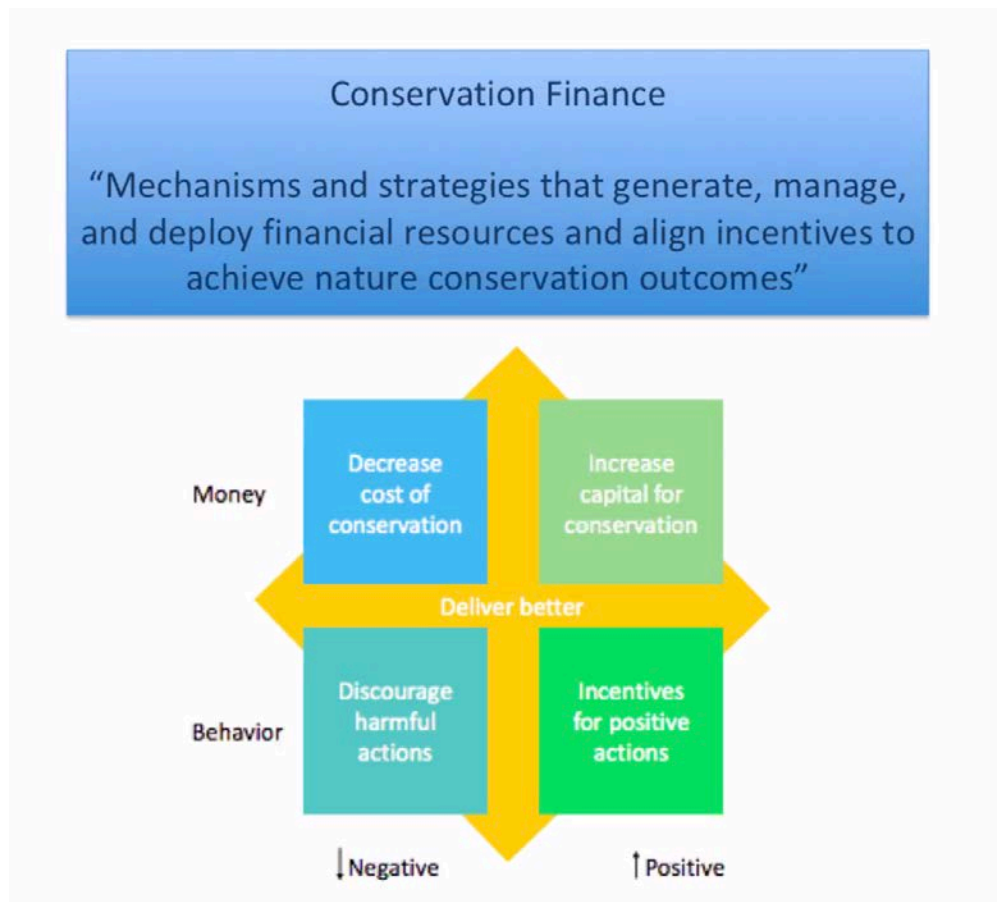


Figure 16: Conservation finance mechanisms

## 11 Implementation and monitoring plans, timeline and indicative budget for the wetland management plan

Implementation of enhanced protection and improved management for the wetlands of the Negril EPA is expected to begin under the IWEco project, which includes some funds for this purpose. It is to be hoped that the recommendations will also be taken into account in the final design and implementation of the New Negril Master Plan that was recently announced by the Ministry of Economic Growth and Job Creation and NEPA (Smith 2021).

The activities that are necessary to support wetland conservation in the Negril EPA can be divided into two main groups:

- The high level enabling activities (such as establishing the policy, management and legal framework at the international and national level) are needed to support implementation of the wetlands plan. Examples are listed in Table 12. They are beyond the scope of the wetlands plan and will not be included in the action plan or budget; and
- The specific conservation activities that are needed in and around the wetlands of the Negril EPA (Table 13).

**Table 12: High level enabling goals, strategies and actions to support wetland conservation<sup>10</sup>**

GOAL	STRATEGIES	ACTIVITIES	Y 1	Y 2	Y 3
1. Plans for the Negril EPA are integrated and support sustainable development and conservation					
	1.1 Develop an integrated planning framework for sustainable development and biodiversity conservation in the Negril EPA.	1.1 Develop landscape level plan for the Negril EPA.			
2. The Negril EPA is financially sustainable by 2025					
	2.1 By 2023, establish an independent trust fund to solicit, receive and distribute conservation funding for the Negril EPA.	2.1.1 Get legal advice about establishing a trust fund.			
		2.1.2 Hire a consultant to advise and build consensus on establishing fund, selection of members, publicizing fund.			
		2.1.3 Hire a Financial advisor to guide investments.			
		2.1.4 Hire trust fund administrator.			
		2.1.5 Fund raising training for administrator and partners.			
		2.1.6 Support for administrator (materials and supplies, computer, printer, office space).			
	2.2. By 2023, the feasibility of payments for ecological services and/or conservation agreements as a means to promote conservation of private lands in the Negril EPA has been assessed.	2.2.1 Engage a consultant to carry out the feasibility assessment (including community consultations).			
3. The stakeholders of the Negril EPA are aware of the importance of biodiversity, support conservation and are willing to take appropriate action.					

<sup>10</sup> Costs for high-level activities are not included. Note that some of these activities are repeated in Table 12.

GOAL	STRATEGIES	ACTIVITIES	Y 1	Y 2	Y 3
	3.1 Develop and maintain a social media campaign including post creation, page management and boosting of posts on various platforms.	3.1.1 Hire and equip a social media person; establish relevant accounts.			
	3.2 Develop capacity of project and NGO staff in meeting facilitation, social media, and development of materials.	3.2.1 Hire trainers, set up workshops or identify existing on-line courses.			
	3.3. Increase general awareness of the importance of biodiversity and climate change adaptation.	3.3.1 Design and implement a biodiversity, climate change and planning awareness campaign for decision-makers.			
	3.4 Increase support for wetland conservation through direct experience and interpretation, including activities targeted to meet school curriculum requirements.	3.4.1 Develop a wetlands interpretation programme for the RPR including a real (not virtual) interpretation centre.			
	3.5 Increase compliance with planning laws	3.5.1 Develop a user-friendly guide to planning laws in Negril.			
	3.6 Develop a conservation ethic amongst young people.	3.6.1 Revive Junior Ranger programme for schools and youth groups (design, support).			
	3.7 By 2024, assess the effectiveness of the public education and awareness programmes.	3.7.1 In 2024, carry out a KAP survey.			
4. The conservation of the biodiversity of the Negril EPA (including species, habitats and functions) are legally protected.					
	4.1 Establish the management framework for the Negril EPA	4.1.1 Establish a strong lead agency for the Negril EPA (including staff, equipment, office, vehicle, and training) with a visible presence on the ground.			
		4.1.2 Develop, review and gazette generic and specific regulations for the Negril EPA under the NRCA Act			
5. The communities of the Negril EPA are engaged in conservation efforts.					
	5.1 Make full participatory engagement integral to all planning efforts.	5.1.1 Provide training in participatory planning and partnerships for government agencies and NGOs.			
6. Environmental laws are respected in the Negril EPA.					
	6.1 By 2024, increase survival of protected species through increased enforcement of wildlife laws.	6.1.1 Form a Negril EPA enforcement committee that meets quarterly to coordinate enforcement of environmental laws.			
		6.1.2 Hold a training workshop for enforcement officers			
		6.1.3 Increase awareness of the Honorary Game Warden system, and increase the number of HGWs			

Table 13 shows the strategies, activities, timeline and indicative budget for the implementation and monitoring of the wetland specific aspects of the plan over the first three years. The assumptions for the preparation of the budget included that existing funding arrangements would continue. Budgets that are being prepared under other consultancies, e.g. for implementation of the WIWD conservation strategy, rewetting of the NGM and implementation of the management plan for the RPR were not included. The total indicative cost over three years is expected to be in the order of J\$70,520,000. This includes several activities that could be developed as projects and funding sought from other sources. At the end of three years, there should be an evaluation of performance, based on which a long-term recurrent budget can be prepared.

Table 13: Goals, strategies, activities, monitoring and budget

GOALS	STRATEGIES	ACTIVITIES	TOTAL COST J\$ (3 years)	Y1 2022	Y2 2023	Y3 2024
7. Develop the institutional capacity necessary to support effective conservation of the wetlands of the Negril EPA.						
	7.1 By 2023, expand the capacity of NEPA, NEPT and NRCPS and other organizations to enable them to support the wetlands conservation programme.					
		7.1.1 Hire Protected Area manager (salary x 3 years)	10,800,000			
		7.1.2 Hire Education officer (salary x 3 years)	6,120,000			
		7.1.3 Hire Science officer/ecologist (salary x 3 years)	7,200,000			
		7.1.4 Hire 2 Rangers (salary x 3 years)	3,600,000			
		7.1.5 Hire administrative/financial support (salary)	5,040,000			
		7.1.6 Travelling and subsistence (fuel for vehicles, accommodation, meals)	6,000,000			
		7.1.7 Purchase vehicles (3)	18,160,000			
		7.1.8 Purchase equipment (laptops, printer, field equipment, optical equipment)	2,000,000			
		7.1.9 Purchase materials and supplies	300,000			
		7.1.10 Implement training workshops	1,000,000			
8. Develop broad based support for wetland conservation and compliance with environmental and planning laws through education and awareness.						
	8.1 By 2024, increase awareness of the importance of wetlands through an education and awareness campaign, targeting all major stakeholder groups	8.1.1 Consultant team to develop wetlands campaign as part of a broader biodiversity education plan (see Table 10)	1,000,000			
		8.1.2 Deliver wetlands programme for planners and decision-makers (cost of workshops, materials)	1,000,000			
		8.1.3 Deliver wetland materials for tourist industry (workshops and materials)	1,000,000			



		8.1.4 Deliver wetland materials for communities (workshops and materials)	1,000,000			
		8.1.5 Design and install an actual (not virtual) wetland interpretation centre for the RPR (cost estimation not part of this consultancy) (see above)	0			
		8.1.6 Design a wetland interpretation programme for the RPR (cost not part of this consultancy)	0			
		8.1.7 Wetlands component of schools programme (assumed to be included in on-going IWeco work)				
		8.1.8 Hold West Indian Whistling -Duck and wetland train the trainers workshop (provided by BirdsCaribbean) (includes travelling, subsistence, venue and materials, refreshments) (Included in WIWD budget)	0			
9. Ensure effective conservation of biodiversity and ecological functions through enforcement of laws.						
	9.1 By 2024, increase survival of protected species through enforcement of wildlife laws		0			
		9.1.1 Provide crocodile handling training to enforcement officers and game wardens (venue and refreshments)	60,000			
		9.1.2 Implement outreach to communities re Honorary Game Wardens (HGWs), to get more volunteers	0			
		9.1.2 Appoint at least additional 5 HGWs	0			
		9.1.3 Provide funding for monitoring year-round not just in hunting season (included above)	0			
	9.2 By 2024 increase enforcement of planning laws	9.2.1 Enforce provisions of building permits in wetlands	0			

		9.2.2 Assess bottlenecks that prevent the implementation of enforcement notices issued by NEPA	0			
		9.2.3 Enforce requirement for permits for clearing forests and mangroves under NRCA Act and Forest Act	0			
	9.3 By 2022, develop a strategy to prevent any further squatting in wetlands in Green Island	9.3.1 Assess squatting distribution, causes and dynamics of squatting in wetlands, consult with communities and other stakeholders to develop a workable approach (Consultant fees).	500,000			
	9.4 Establish no build zones along the coast including wetlands in Green Island	9.4.1 Engage relevant agencies including NEPA, ODPEM and local government. Hold public consultations. Carry out detailed mapping of present conditions and based on the above, develop zoning map. Make the necessary legal changes. Design, produce and install signage. Hold awareness sessions for communities. Ensure capacity exists for monitoring and enforcement. (Consultant fees, workshops) (assume parish planner prepares maps)	1,000,000			
10. Ensure the long term survival of biodiversity and ecological functions through creating and managing public and private protected areas.						
	10.1 By 2024, at least one wetland land-owner has implemented voluntary conservation of a wetland	10.1.1 Identify major landowners (Land use survey already included in IWEco project)	0			
		10.1.2 Hold a sensitization workshop for wetland landowners, introducing options of Tree Preservation Orders, National Heritage Trust Act, private Forest Reserve	500,000			

		(Forests Act) (facilitator, venue, refreshments)				
	10.2 By 2024, proposals for conservation zoning under the NGIDO for all wetlands adopted	10.2.1 Engage local and national government Agencies in revision of NGIDO – no project cost	0			
	10.3 By 2024, options for increased protection developed and accepted	10.3.1 Hold public consultations about protection and zoning	230,000			
	10.4 By 2024 Environmental Protection Area Regulations gazetted	10.4.1 Government Agencies – no project cost	0			
	10.5 By 2022, the NGM Game Reserve is expanded to include the whole Negril EPA (or additional areas)	10.5.1 Get legal opinion about procedure for extending the Game Reserve over private lands				
		10.5.2 Hold public consultations about proposed new boundaries	30,000			
		10.5.3 New boundaries gazetted	0			
		10.5.4 Awareness campaign for new boundaries implemented	160,000			
	10.6 By 2024, soil erosion and pollution are reduced by zoning all river corridors conservation in the Development Order	10.6.1 Awareness campaign for NGIALPA and landowners	100,000			
	10.7 By 2024, management of the NGM is guided by a fully participatory management plan	10.7.1 Development and acceptance of a management plan for RPR (Inputs from existing consultancies, planner, workshops and meeting costs, map development)	1,000,000			
	10.8 By 2022 assess the potential for declaring the NGM as a Ramsar site as a means to increase support for wetland conservation	10.8.1 Determine whether the NGM meets Ramsar criteria (Government agencies – no additional cost)	0			
11. Ensure the survival of threatened, endangered, endemic and economically important species.						
	11.1 Implement WIWD conservation strategy	11.2 Included in WIWD strategy	0			

	11.3 Control of invasive species of plants – recommendations to be developed following mapping of NGM	11.3.1 To be developed by ecological assessment consultants (cost to be determined as part of the study)	0			
12. Critically important wetland habitats are restored.						
	12.1 By 2024 the hydrology of the NGM has been restored	12.1.1 Recommendations for rewetting and rewilding to be developed following hydrological assessments	0			
13. Communities that depend on wetlands and wetland functions adapt to climate change and adopt sustainable livelihoods.						
	13.1 By 2024, demonstration projects established in at least 2 wetlands	13.1.1 Feasibility assessment for Johns Point community-based wetland tourism	500,000			
		13.1.2 Feasibility study for Davis Cove community-based wetland	500,000			
	13.2 By 2024, demonstration projects for sustainable use/climate change adaptation/agriculture established for artificial wetlands, rainwater harvesting and beekeeping	13.2.1 Training workshop followed by small grants for community projects	1,000,000			
		13.2.1 Demonstration projects for artificial wetland for domestic and hotel sewage disposal at RPR	100,000			
		13.2.2 Demonstration projects for rainwater harvesting at RPR	250,000			
		13.2.3 Beekeeping training and provision of equipment	500,000			
14. Conservation action and planning is based on the best available scientific research.						
	14.1 By 2024, fill data gaps and inform development of conservation planning, action and monitoring programmes	14.1.1 Hydrological assessment of Johns Point, Davis Cove wetlands	1,000,000			
		14.1.2 Botanical assessment of swamp forests	1,000,000			
		14.1.3 Botanical assessment of herbaceous wetland of NGM	1,000,000			
		14.1.4 WIWD status, distribution and habitat use (included in WIWD budget)	0			
		14.1.5 Baseline crocodile status, distribution, plan	500,000			

		(N.b. Some crocodile assessments are already planned)				
		14.1.6 Baseline Sea Turtle status and distribution design of monitoring programme	500,000			
		14.1.7 Extinct species search (Red Rail, Giant Gallywasp, Jamaican Rice Rat, Least Pauraque)	500,000			
		14.1.8 Wetland functional assessment – Cabaritta wetland	1,000,000			
		14.1.9 Wetland ecosystem function valuation for Negril	1,000,000			
		14.1.10 Assessment of impacts of ganja farming on wetlands and how to reduce them	1,000,000			
15. Adaptive management of biodiversity is based on cost-effective monitoring of selected indicators.						
	15.1 By 2022, a comprehensive monitoring programme is in place to assess the progress toward achievements of conservation goal	15.1.2 Monitor areas of major habitat types in all wetland areas	100,000			
		15.1.3 Identify changes in land use and encroachment in all wetland areas	100,000			
		15.1.4 WIWD presence or absence (Included in WIWD budget)	0			
		15.1.5 KAP before and after educational campaign (see above)	0			
		15.1.6 Beach erosion monitoring ( <a href="http://www.sandwatchfoundation.org">www.sandwatchfoundation.org</a> ), purchase of equipment)	250,000			
		15.1.7 Monitoring plots in mangroves (cost includes consultancy on number and location, installation, monitored by PA staff and volunteers)	500,000			

		15.1.7 Monitoring plots in swamp forests (cost includes consultancy on number and location, installation, monitored by PA staff and volunteers)	500,000			
		15.1.8 Monitoring programme for sea turtle nesting includes number of beaches and nests (cost of traveling and community stipends)	200,000			
		15.1.9 Crocodile tagging and data analysis (cost of tags, and readers) assuming that data analysis and training are carried out by NEPA	200,000			
		15.1.10 Install MOTUS tower at RPR, tag selected bird species, monitor numbers	250,000			
	15.2 By 2022 a pollution control and monitoring strategy and action plan and budget has been developed	15.2.1 Develop pollution control and monitoring strategy	2,000,000			
	15.3 By 2024 assess management effectiveness	15.3.1 Carry out METT scorecard process every 3 years (virtual workshop)	0			
<b>TOTAL J\$</b>			<b>\$82,250,000</b>			
<b>TOTAL US\$</b>			<b>\$548,333</b>			

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## 12 Annexes

### Annex 1: Maps of the wetland units

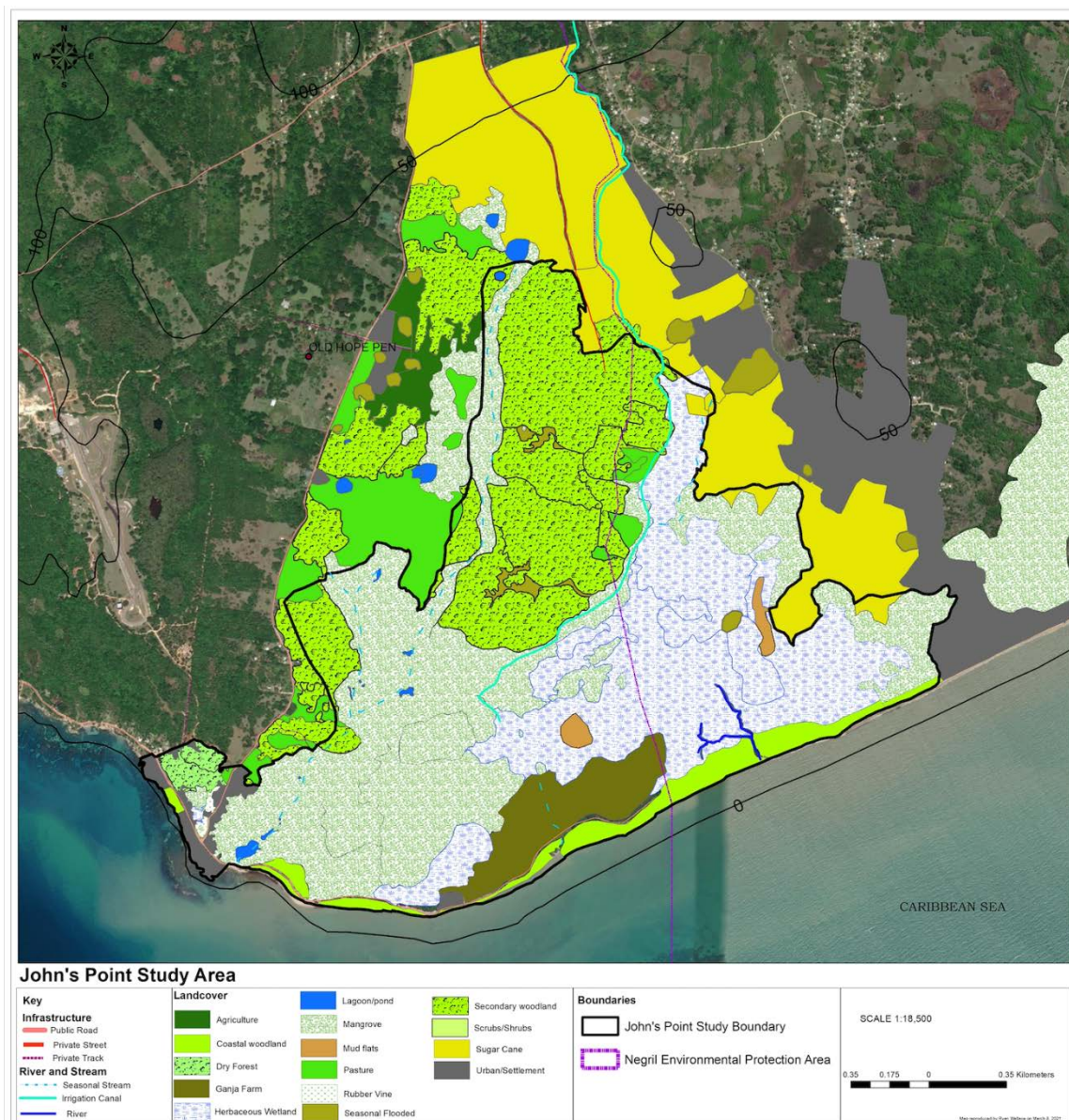


Figure 17: John's Point wetland (Haynes-Sutton 2021a)



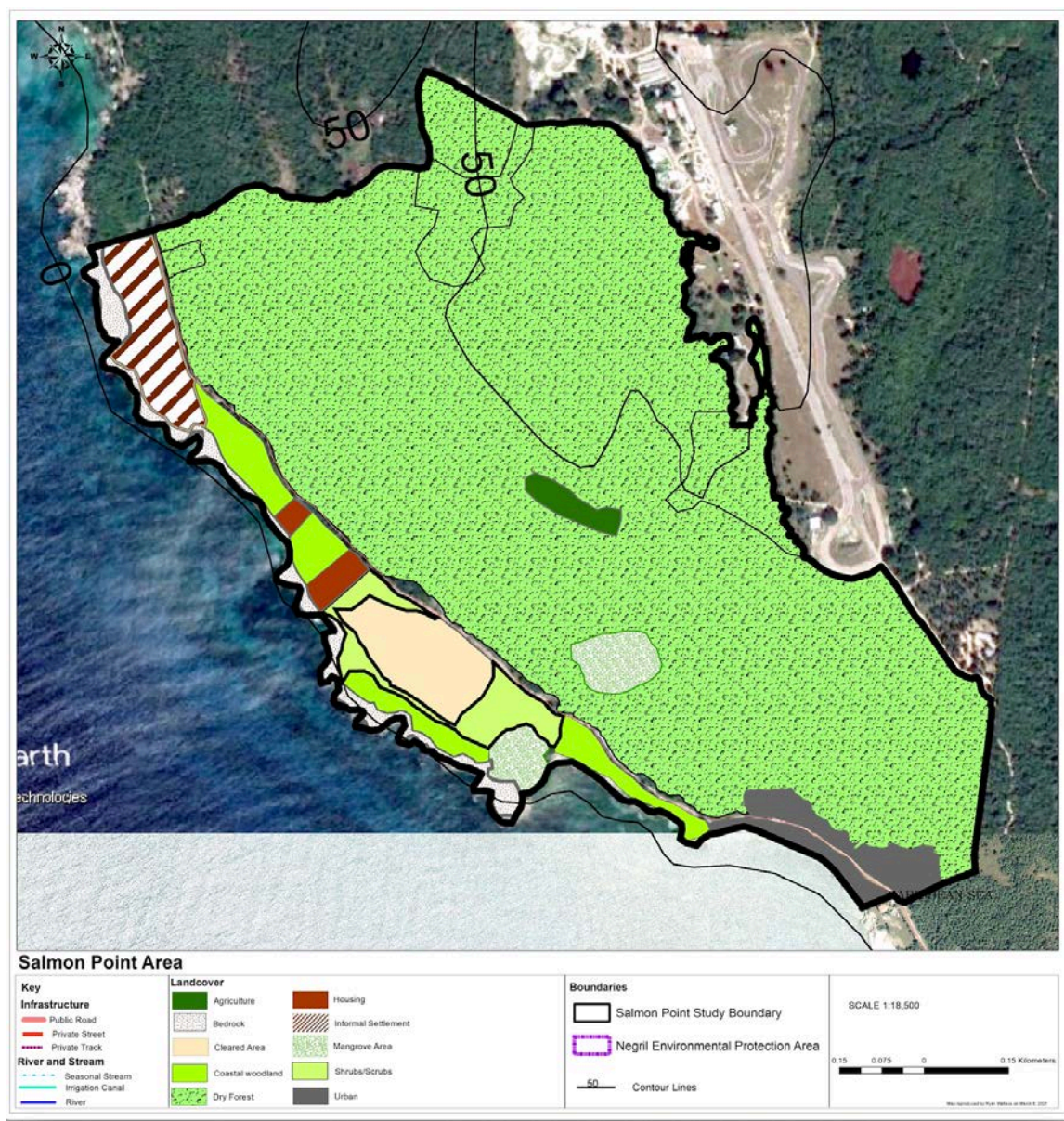


Figure 18: Salmon Point wetland (Haynes-Sutton 2021a)



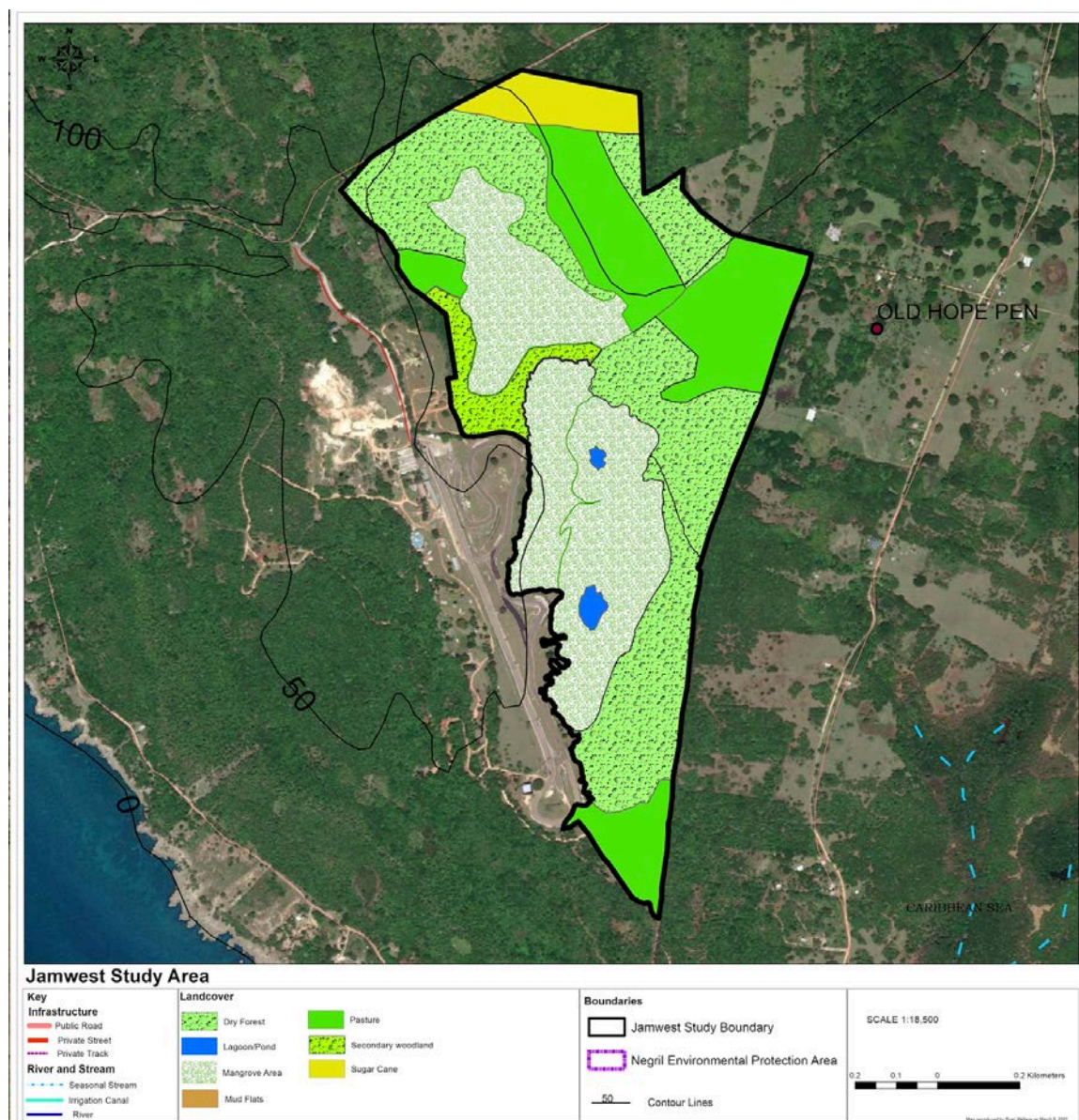


Figure 19: JamWest wetland (Haynes-Sutton 2021a)



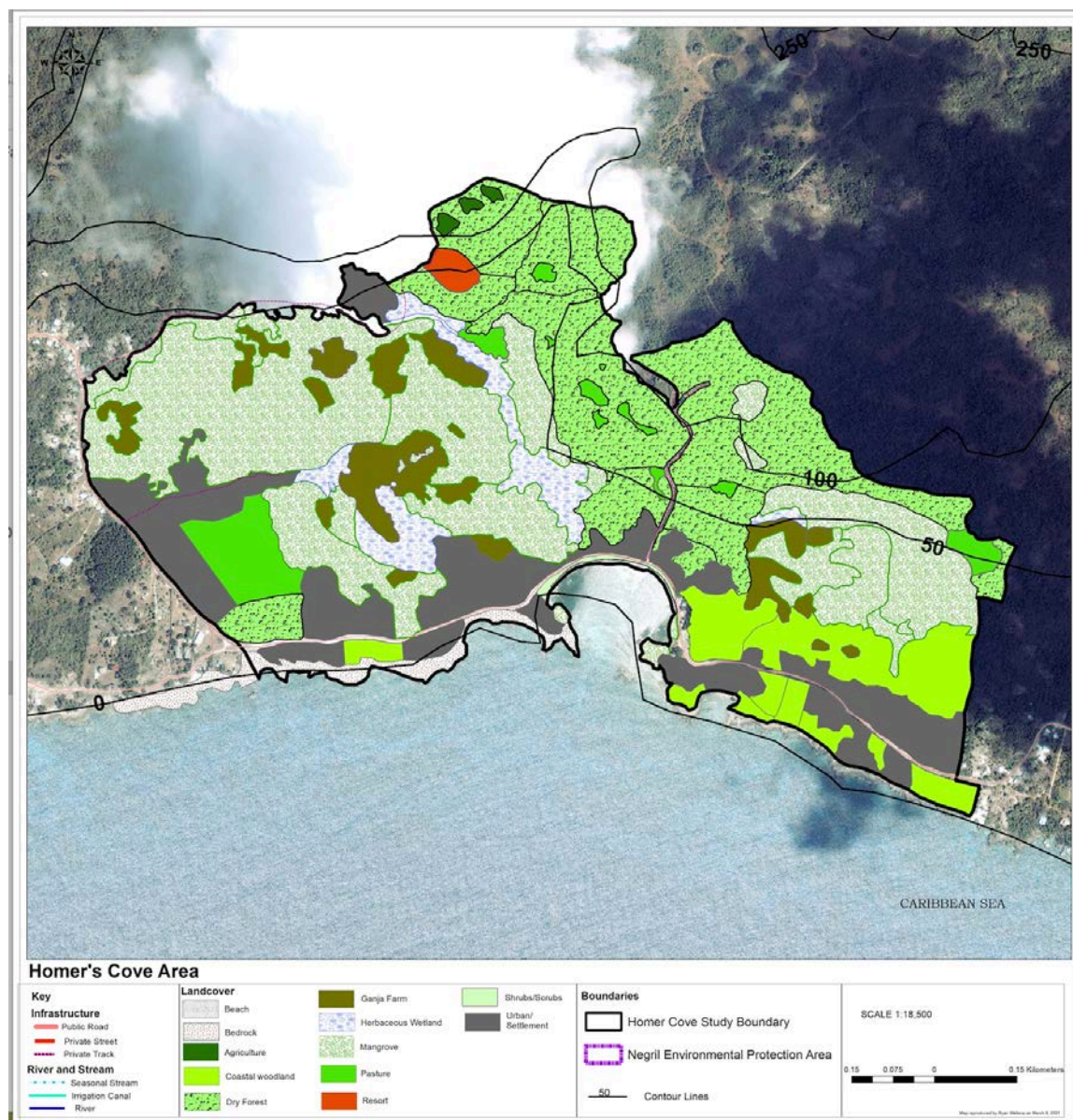


Figure 20: Little Bay/Homer's Cove/Blue Hole wetland (Haynes-Sutton 2021a)



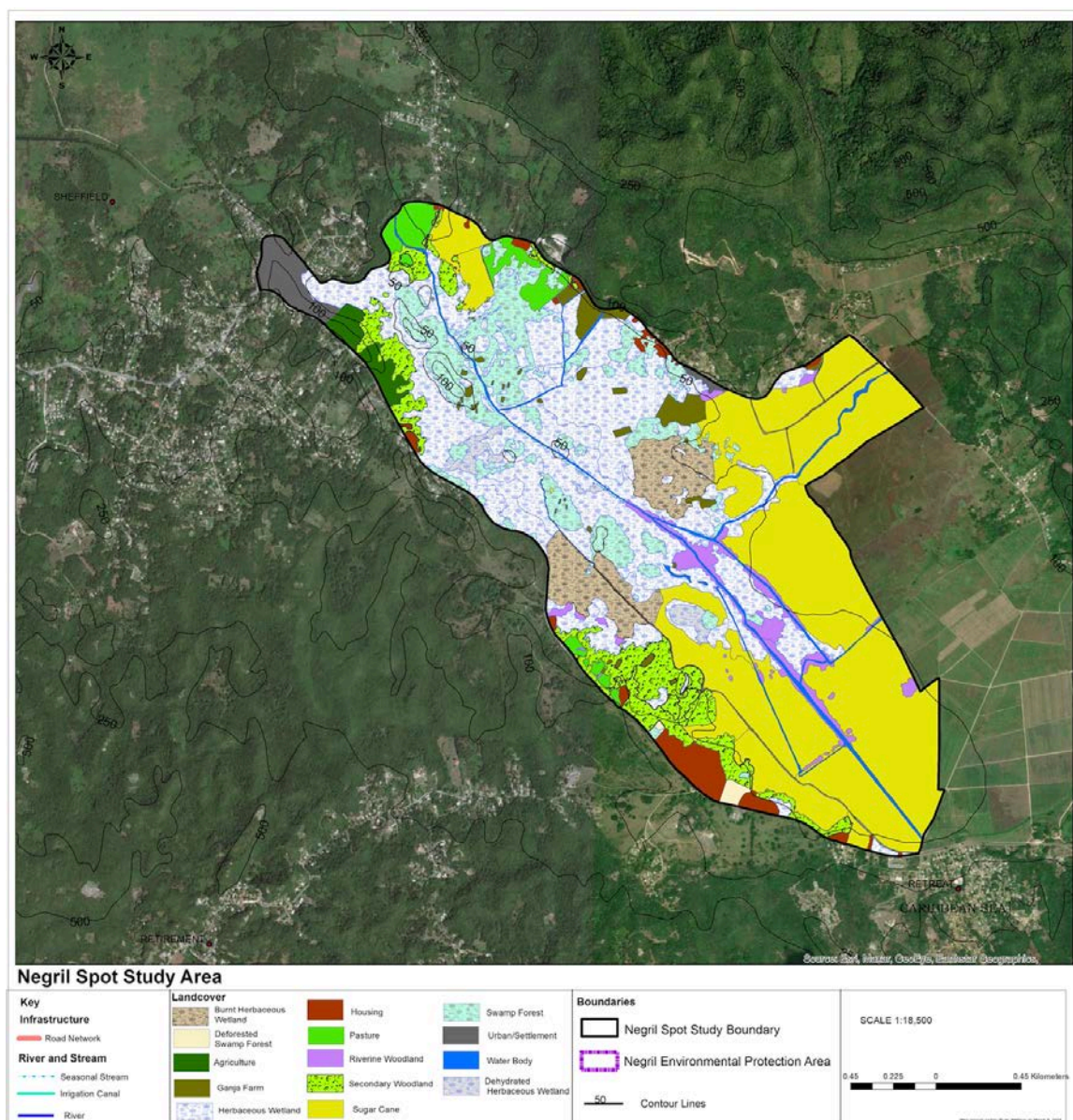


Figure 21: Negril Spots/Keto/South Negril River wetland (Haynes-Sutton 2021a)



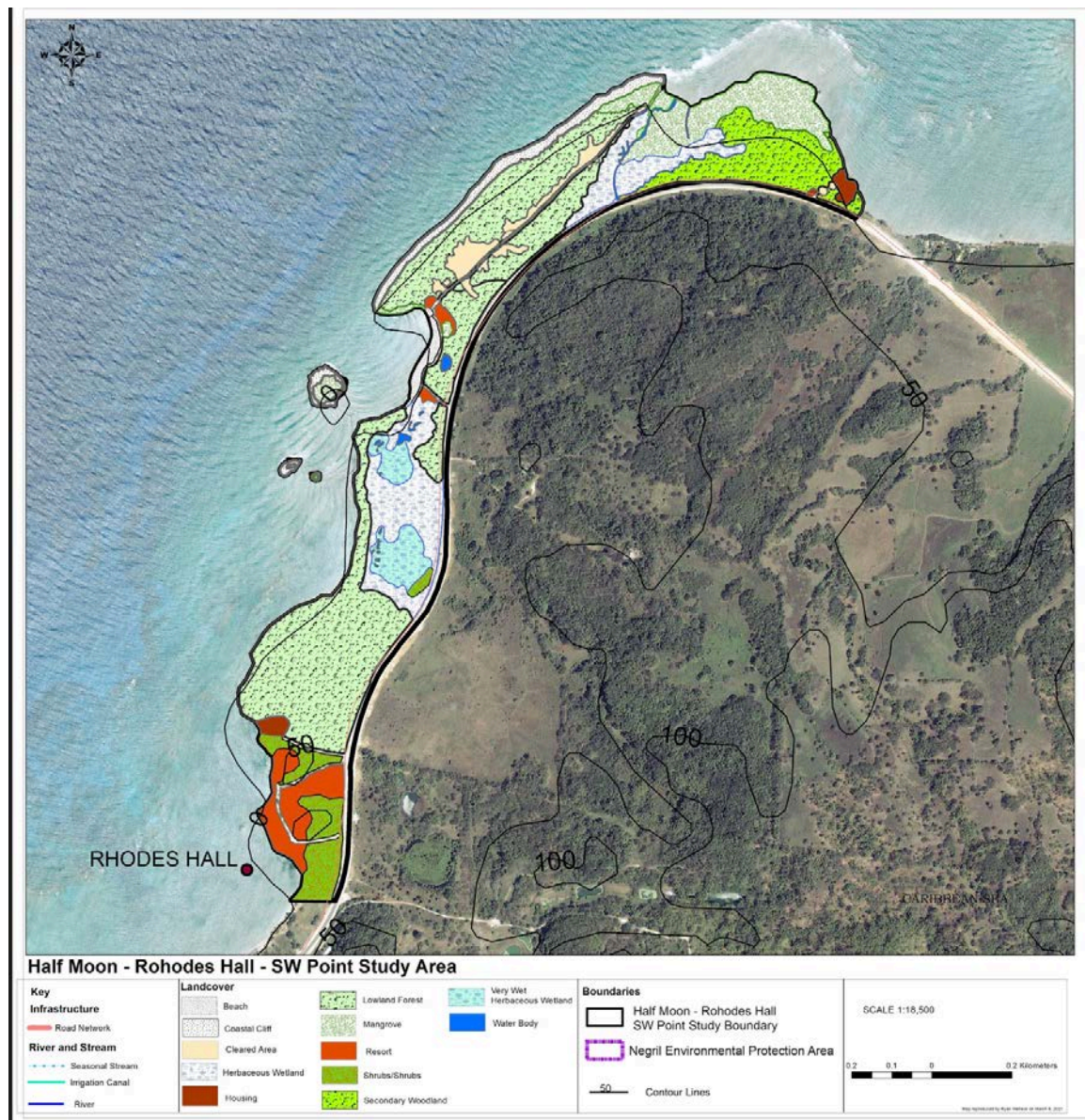


Figure 22: Rhodes Hall/Half Moon/SW Point wetlands (Haynes-Sutton 2021a)



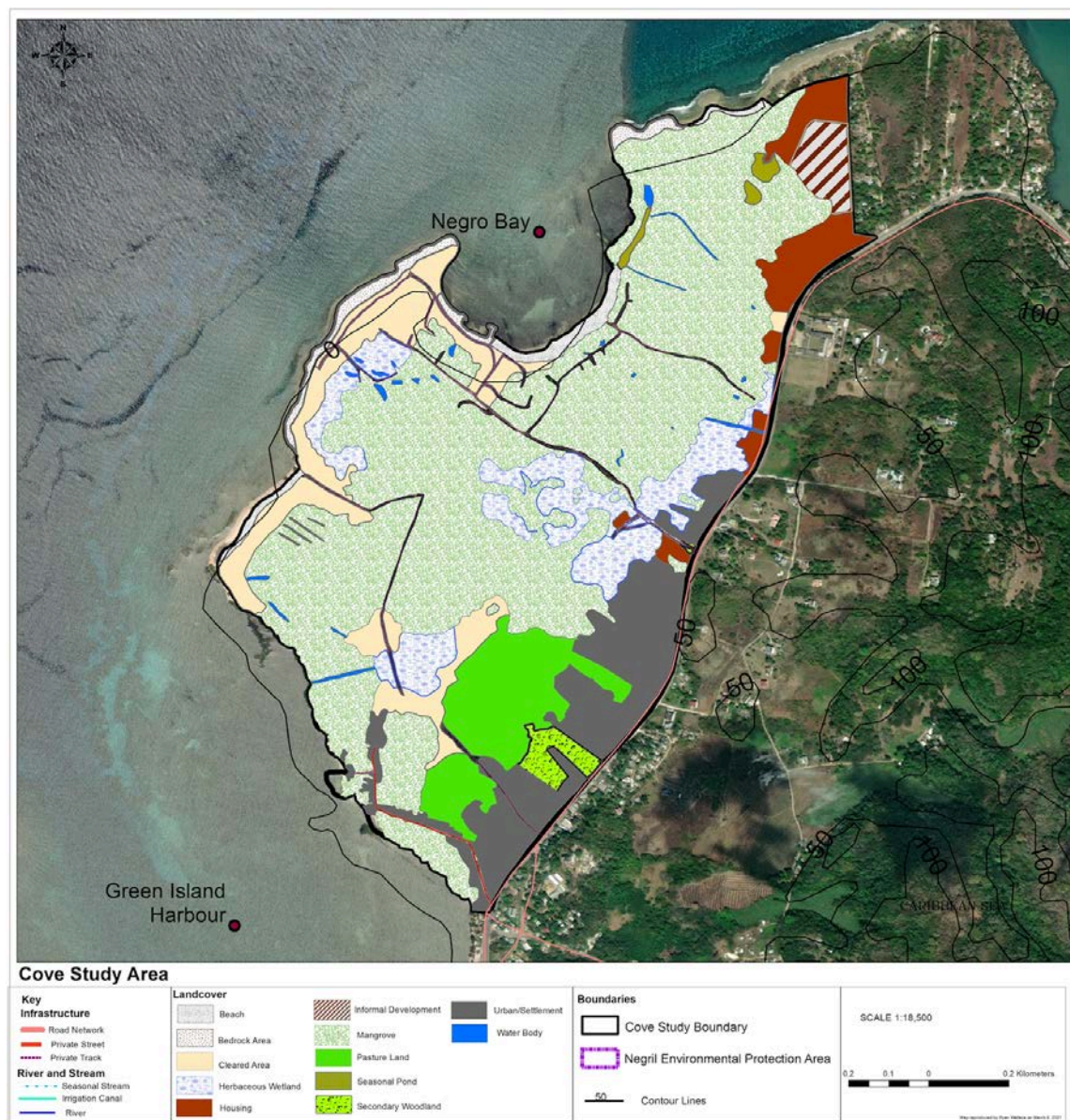


Figure 23: Green Island west



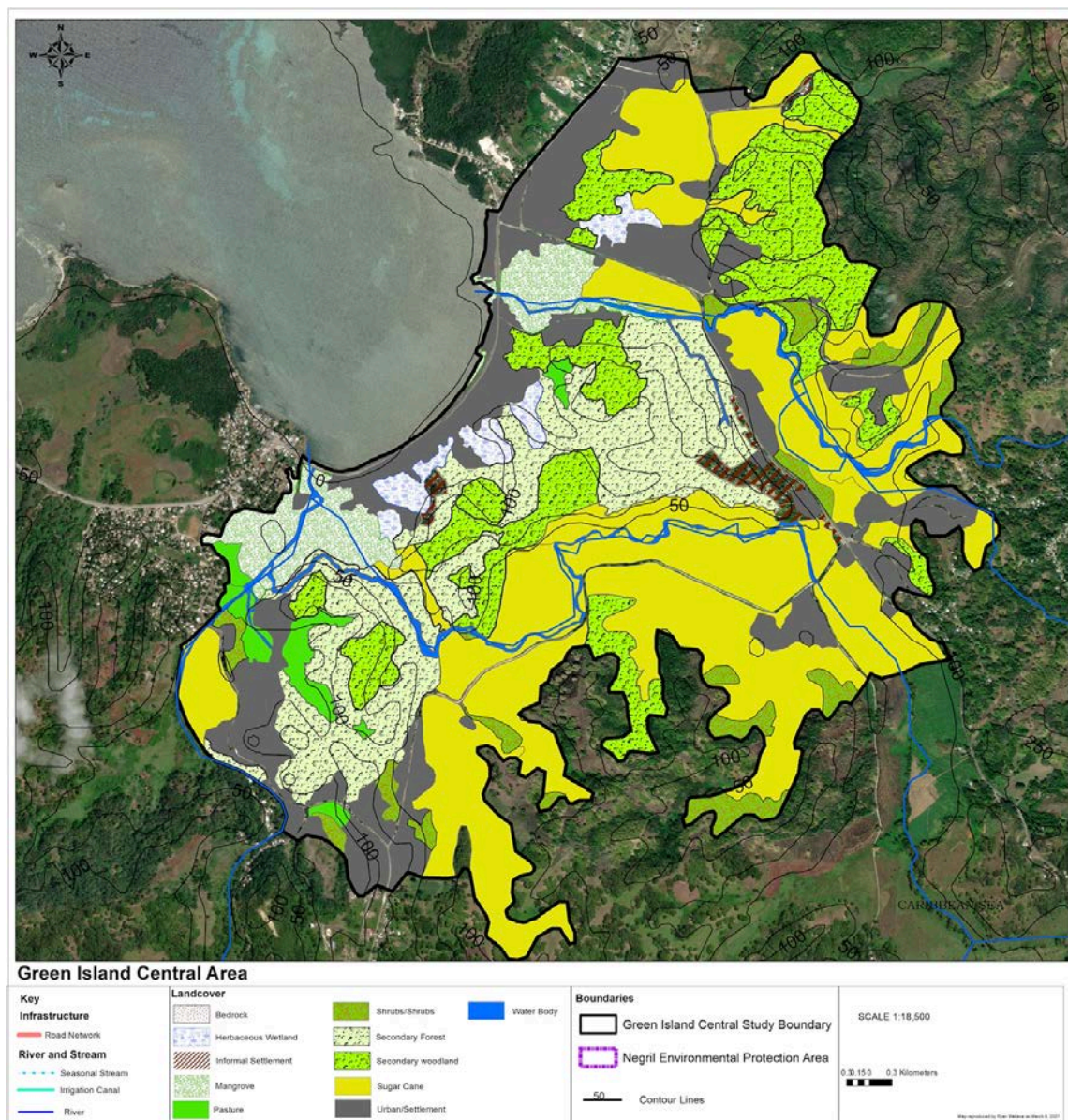


Figure 24: Green Island central (Haynes-Sutton 2021a)



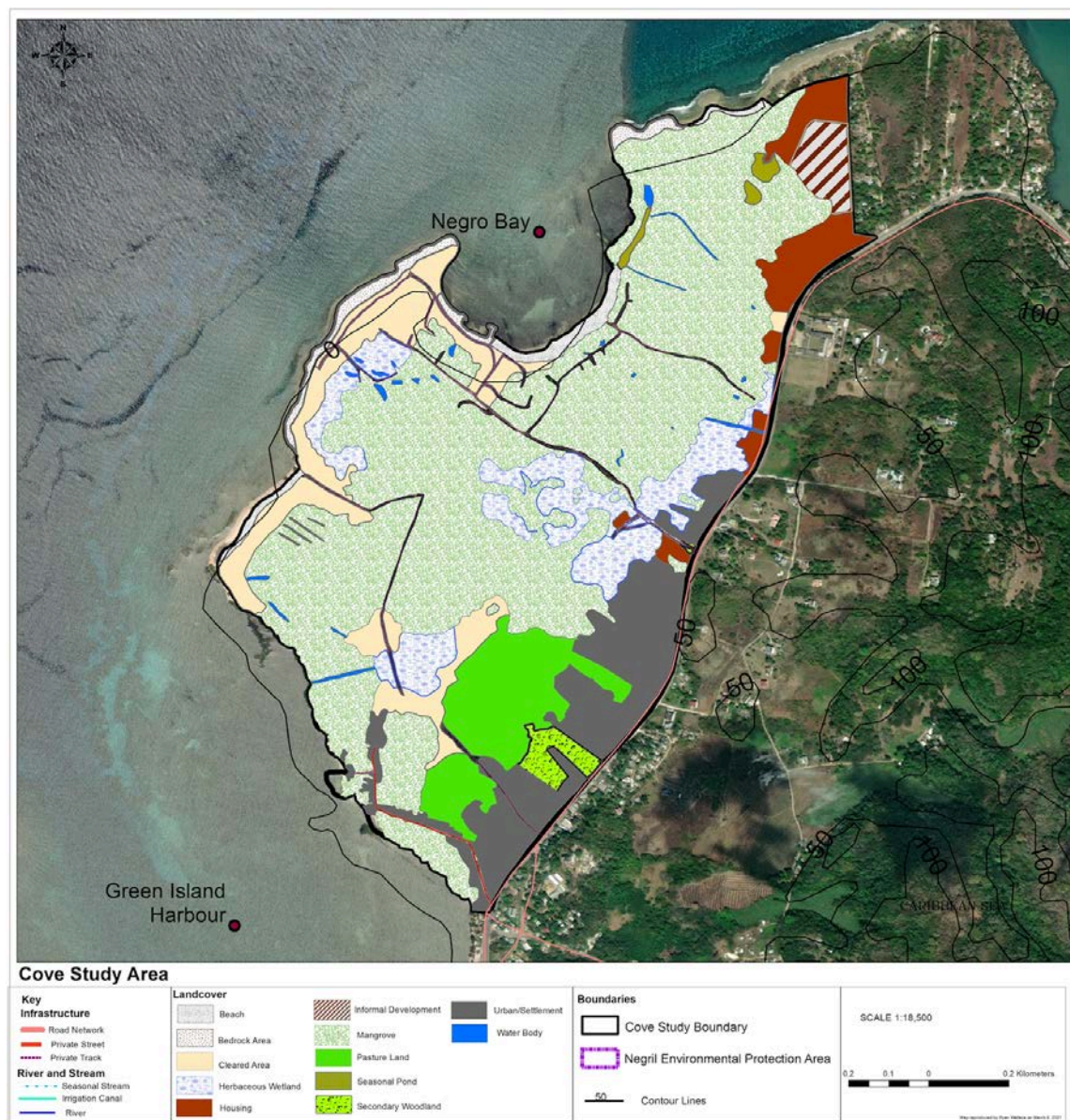


Figure 25: Cove wetlands before hotel construction began in 2021 (Haynes-Sutton 2021a)



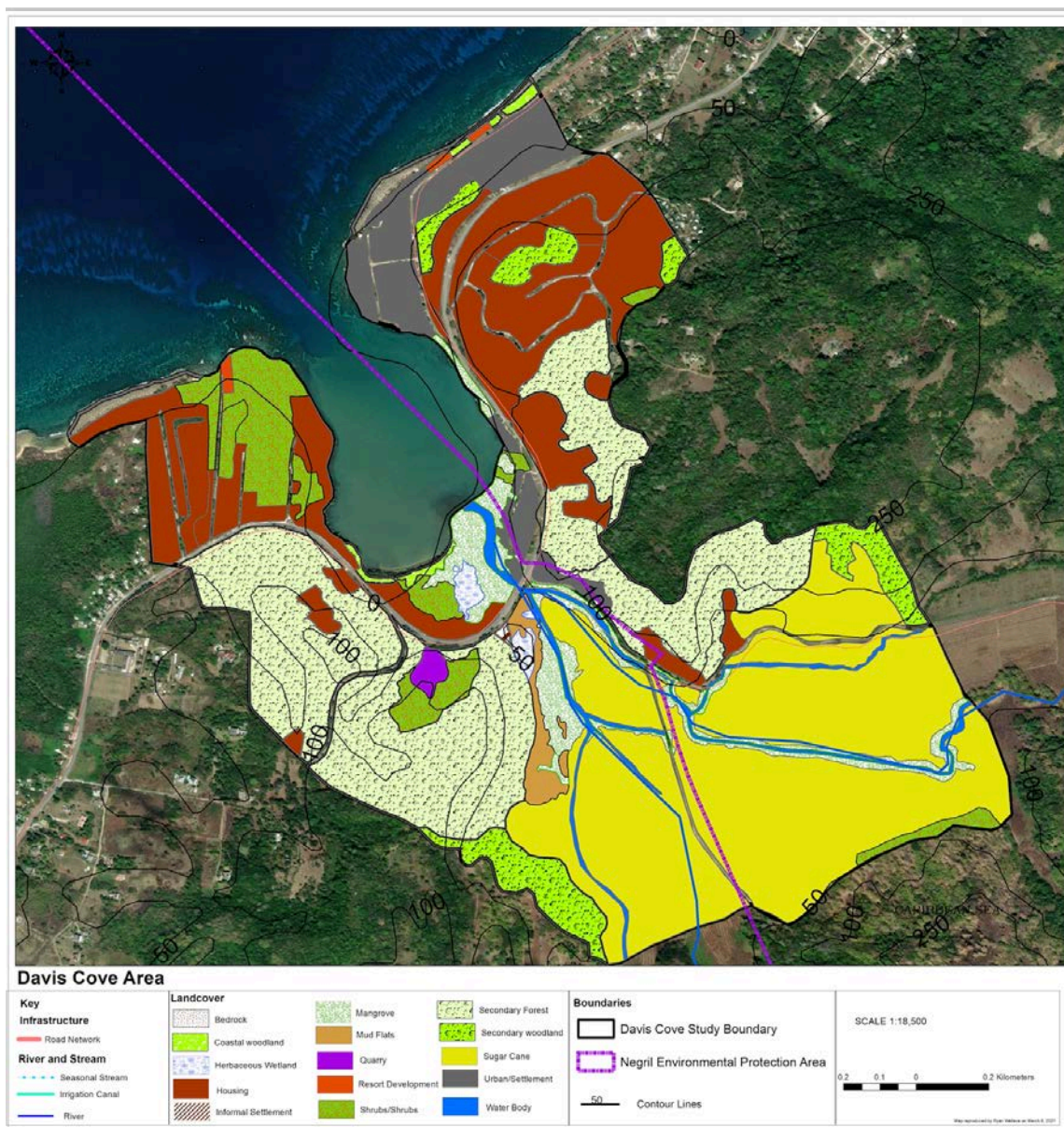


Figure 26: Davis Cove wetlands (Haynes-Sutton 2021a)

## Annex 2: Land use maps from development orders and Negril Master Plan

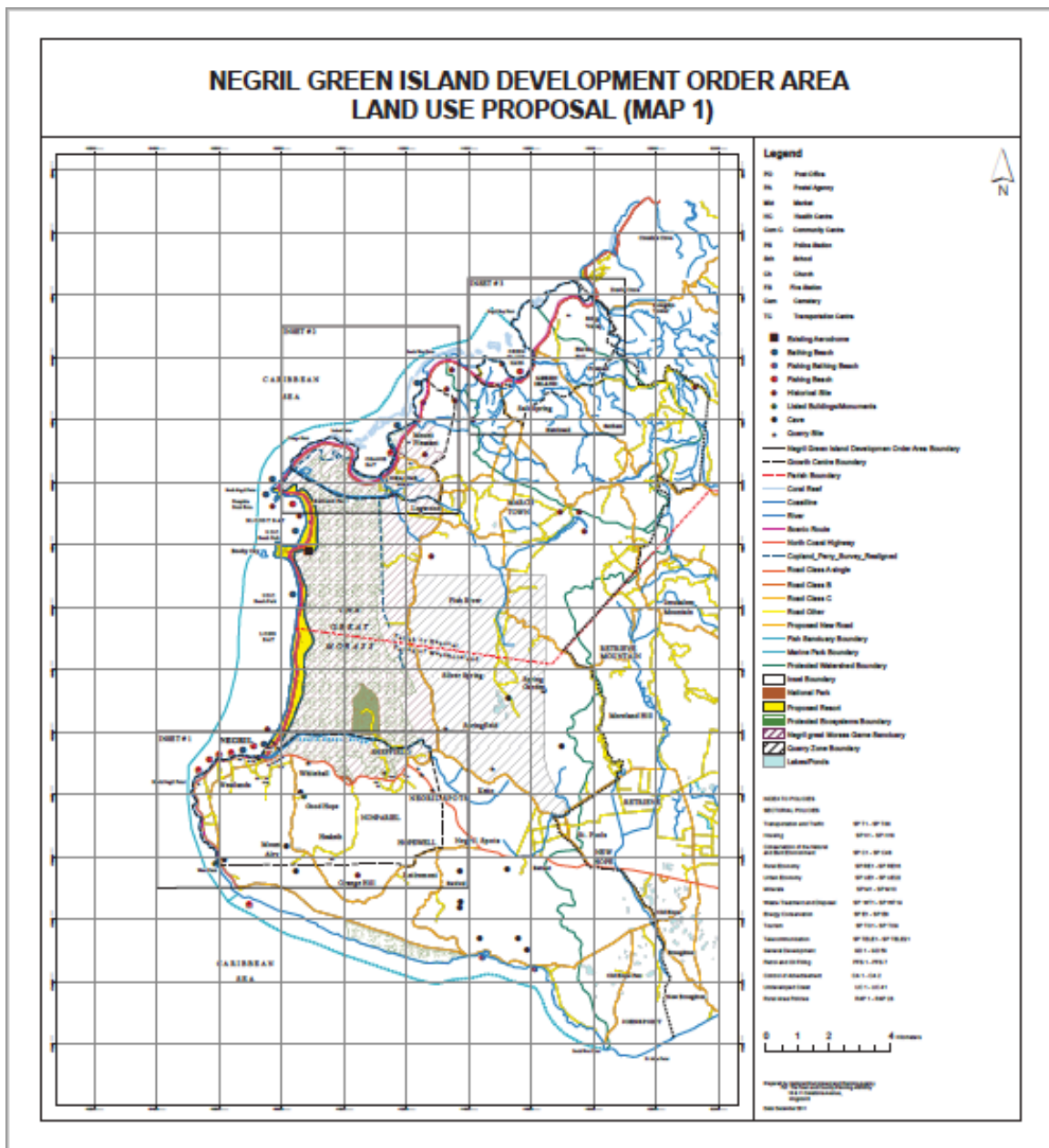


Figure 27: Negril Green Island Development Order Area Land Use Proposal (Map 1)



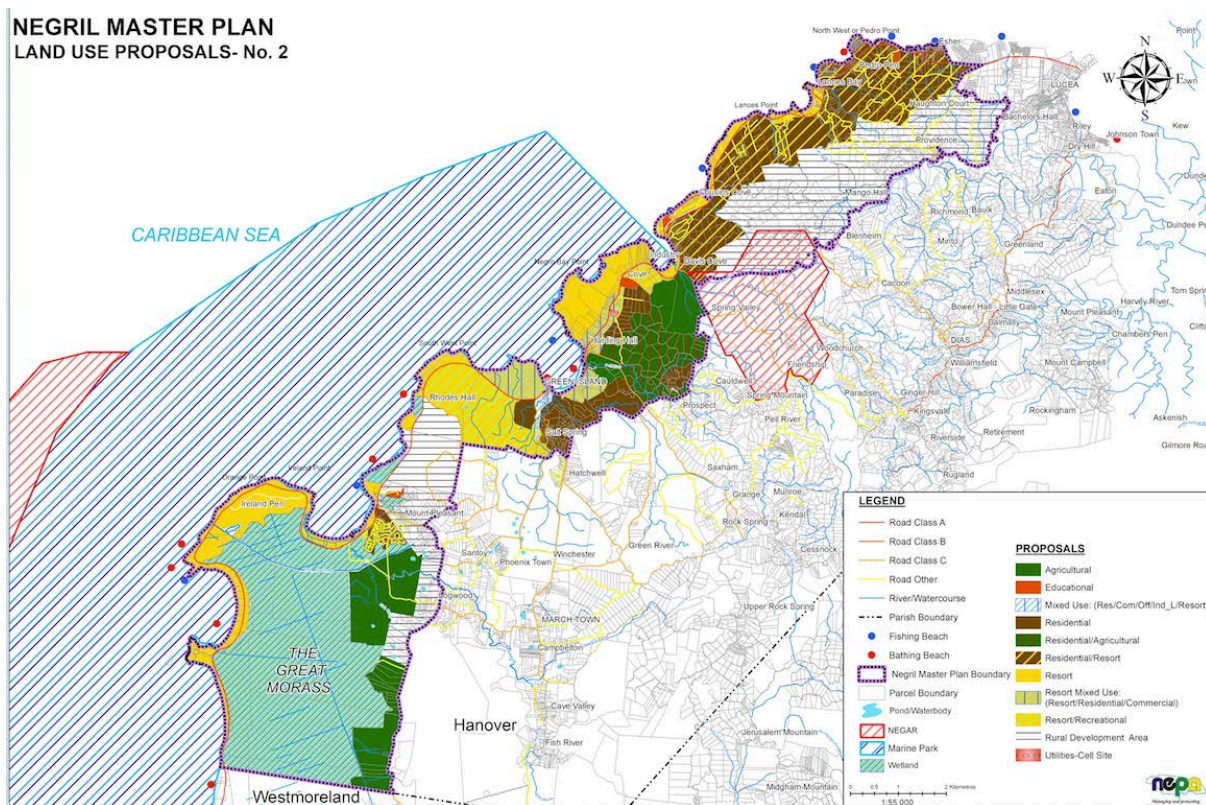


Figure 28: Negril Master Plan Land Use Proposals - No. 2

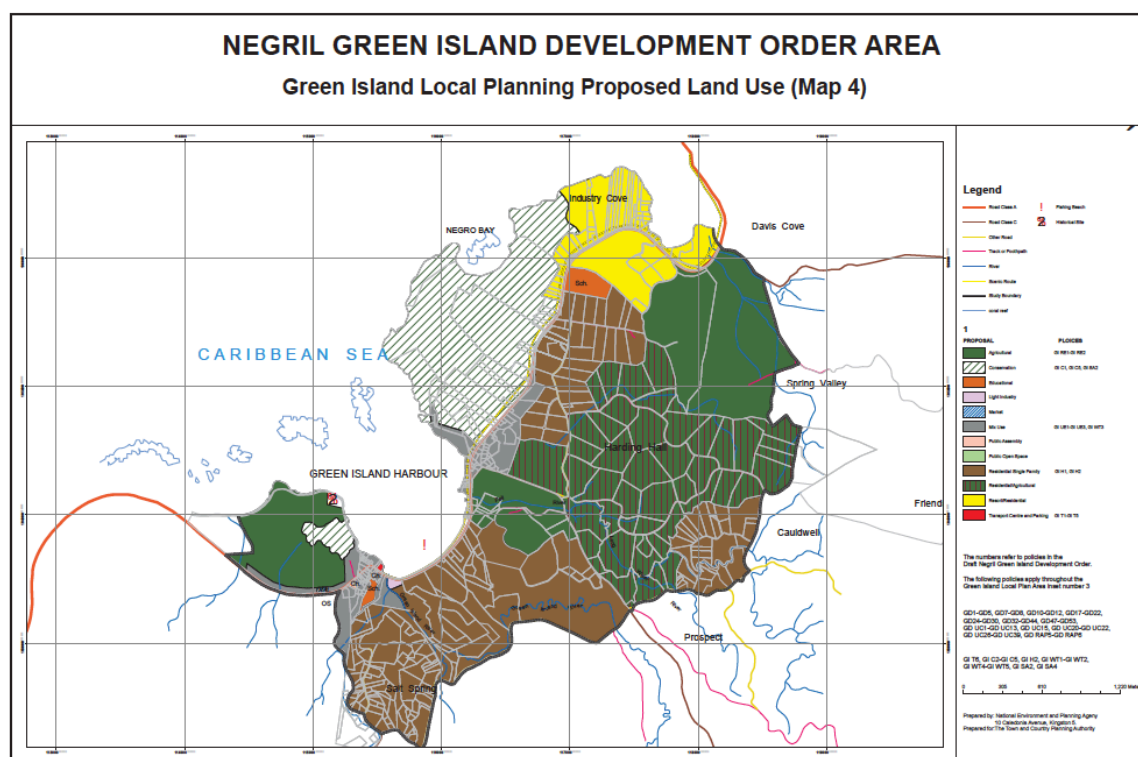
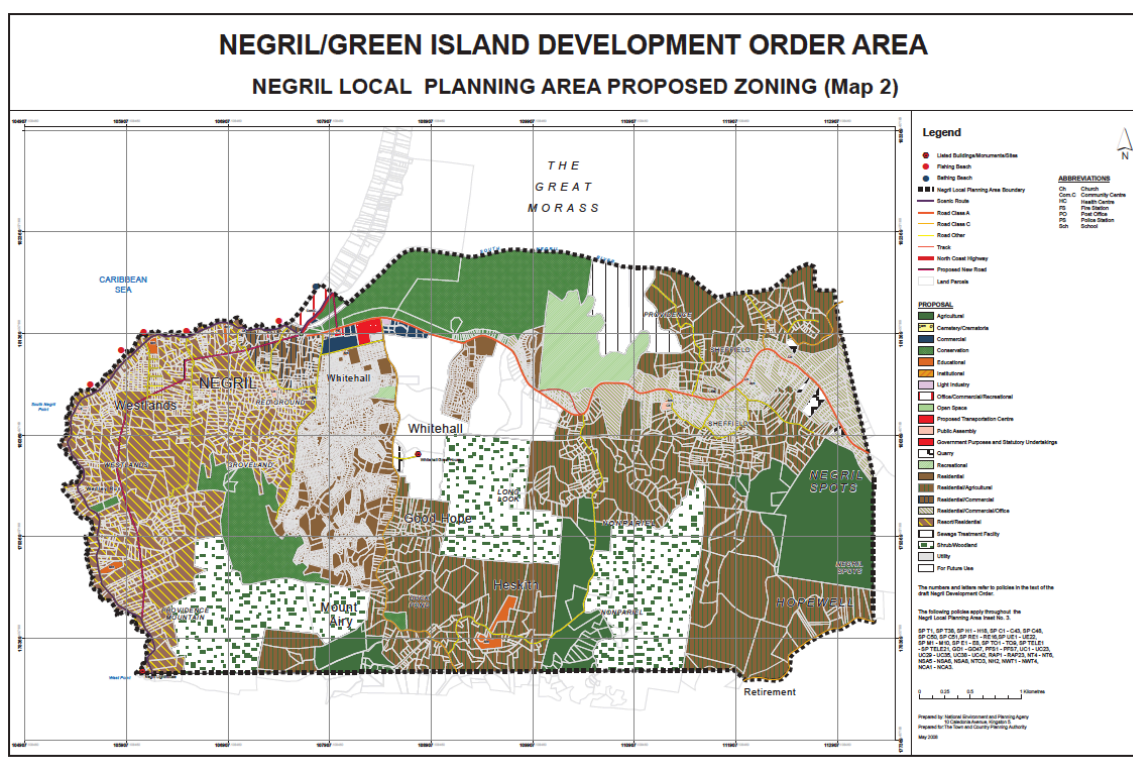


Figure 29: Green Island Local Planning Proposed Land Use (Map 4)





### Annex 3: Community suggestions for ways to protect the NGM and Negril EPA (Hope Caribbean 2020)

	% of respondents							
	Hanover (n=324)	Westmor eland (n=376)		Farmers (n=100)	Business Owners (n=83)	Employees (n=113)	Residents (n=400)	Total (N=700)
Public clean up days	85.5	83.8		85.0	88.0	87.6	82.8	84.6
Planting Trees whether fruit, timber, Palms and Mangroves	77.5	76.9		81.9	81.9	75.2	73.0	77.1
Proper disposal of household waste	72.2	74.5		74.0	75.9	79.6	70.8	73.4
Proper waste disposal (chemical, solid waste and garbage)	67.6	70.7		70.0	74.7	76.1	65.8	69.3
Proper disposal of animal waste/manure	61.4	66.8		72.0	66.3	69.0	60.2	64.3
No lighting /Controlled lighting of fires	56.8	60.6		72.0	57.8	61.1	54.8	58.9
No fishing in protected areas	56.8	60.6		59.0	61.4	62.8	53.2	56.9
Replanting trees in the wetlands/mangrove areas	54.6	55.3		66.0	63.9	57.5	49.5	55.0
No overfishing of an area	51.2	55.9		58.0	57.8	53.1	51.5	53.7
Reduce over fertilizing or use organic fertilizer (no chemical is used at all and takes a longer time to grow)	46.0	45.5		65.0	44.6	50.4	39.2	45.7
Placing fish pots at the edge of the mangrove/ wetland	22.5	23.9		39.0	19.3	23.0	19.8	44.6
No fishing in the mangrove	45.1	44.1		47.0	47.0	49.6	42.0	44.6
None of the above	2.5	2.7		3.0	1.2	2.7	2.8	2.6

## Annex 4: Environmental Protection Areas

Quotation from NEPT (1995)

Section 33 of the NRCA Act states

"(1)...the Minister may, on the recommendation of the Authority, and if he is satisfied that it is in the public interest to do so, by order published in the Gazette declare any area to be an environmental protection area and direct the Authority to prepare and to submit to him for approval an Environmental Protection Plan for that area....

(2) The undertaking of any activity in an environmental protection area shall be subject to such provisions as may be prescribed by regulations, subject to negative resolution, in relation to the protection of the environment and the natural resources in that area."

The Environmental Protection Area designation is typically used for large, diverse areas such as a watershed or parish. Within it, smaller and more specific protected areas may be identified and properly managed, such as a Marine Park, Fish Sanctuary or National Nature Reserve. The Environmental Protection Plan is a guide for how the important natural resources within the area should be used. Negril is expected to be Jamaica's first Environmental Protection Area.

Typical outcomes from the process of preparing an environmental protection plan....

1. Identifying important environmental problems, as well as actions to respond to some of them.
2. Setting community environmental priorities.
3. Improving public awareness of the area and its environmental concerns, through workshops, meetings, signs, maps, press coverage, etc.
4. Providing greater environmental focus to Development Plans and Development Orders.
5. Establishing local land trusts or land banks to acquire and manage important areas.
6. Establishing local environmental trust funds to help finance environmental protection activities.
7. Strengthening of existing environmental organizations and establishing new "umbrella groups" representing most of the other NGOs within the plan area.
8. Improved opportunities for assistance (technical, financial) as a result of clear community priorities and a cooperative spirit.

Typical outcomes from designating an Environmental Protection Area, and implementing the Plan include...

1. A clear action program for what will be done to protect and improve environmental conditions within the area.
2. Improved and better coordinated environmental monitoring activities by both government and community organizations.
3. Formation of a Local Advisory Committee to monitor environmental conditions and development activities within the area, and recommend actions by government and community groups.
4. Delegation by NRCA of some powers, such as authority to manage specific designated parks and protected areas within the Environmental Protection Area, and authority to enforce some environmental laws and regulations.
5. Greater awareness and enforcement of existing environmental laws and regulations.
6. New "environmental protection area" regulations, and a listing of uses or developments requiring environmental impact assessments.
7. Appointment of one full time NRCA Environmental Officer to provide leadership and coordination with environmental protection and management.
8. Commissioning and deployment of paid or voluntary enforcement officers to work with the NRCA Environmental Officer.
9. Identification of possible sites to be designated and managed as local parks, open space reserves, conservation zones. etc.
10. Identification and schedule of additions to the National Parks and Protected Areas system.

Some proposed regulations for the NEGRIL EPA

Beach Sand Mining: Prohibition of any removal of sand within 1000 ft. of shoreline without a permit from the NRCA. Establish NRCA responsibility for monitoring and enforcement (with the possibility to delegate this authority to some other entity).

Mangroves: Declare a moratorium on all cutting, filling or encroachment of mangroves within the Environmental Protection Area until NRCA policies and regulations related to mangrove protection, restoration, and sustainable use are in place. At that time, such policies and regulations would be applied to the Environmental Protection Area.

Sanitation: Requires that all developments which can be feasibly connected to the central collection and treatment system do so. Describes acceptable on-site sanitation solutions for all new developments within the Environmental Protection Area. Sets a date for compliance by existing developments.

Dumping of Garbage: Dumping only permitted at official sanitary landfill, establishes fines and enforcement responsibilities (NRCA).

Disposal of Toxic or Hazardous Wastes: No disposal within Environmental Protection Area, authorizes identification of collection-transfer station to store wastes until transferred to the National Toxic and Hazardous Waste site; establishes fines and enforcement responsibility.

Environmental Impact Assessments: Declare the Environmental Protection Area a "Prescribed Area", requiring Environmental Impact Assessments for the following developments and uses:

Land subdivision, roads, and utility services into undeveloped, unroaded areas

Mining, quarrying, manufacturing, extraction of sand and gravel, and industrial processing

Major infrastructure facilities such as power plants, transmission corridors, incinerators, solid waste disposal landfills, airports, oil refineries, sewerage projects, etc.

Port and harbor projects, piers, marinas, seawalls, sea terminals, other shoreline protection structures, dredge spoil disposal, coastal discharge

Dredging, canalization, dams, water impoundments, etc.

Shopping complexes, hotels and other commercial developments.

Major public facilities including hospitals, transportation centers, schools, recreation complexes, etc.

Intensive agriculture, aquaculture, Mariculture

New residential developments at proposed densities greater than those permitted in the Development Order

Activities and uses, which generally will not require an EIA, include expansions and additions to existing buildings, new private residences, public parks and recreation areas, and agriculture.

## Annex 5: Extract from the recommendations of the Ecological Thematic Report (NEPA 2019)

N.B. Recommendations that are endorsed in the NWMP are highlighted in **bold**.

### 5.1 HIGH PRIORITY AREAS FOR CONSERVATION

The biodiversity mapped in areas assessed allows for the identification of high priority areas for conservation. Recommendations are also being made to prevent further erosion of the biodiversity of these areas.

#### 5.1.1 THE NEGRIL GREAT MORASS

- No development in the Great Morass – The Negril Great Morass is within the Negril Environmental Protection Area. It is Jamaica's second largest remaining wetland and should **remain solely as a conservation area** to provide habitat for the threatened American crocodile and West Indian Whistling Duck, as well as many other native and threatened species. Wetlands cover less than two percent of the island, which is declining due to land use change and degradation. **Remaining wetlands should be prioritised as conservation areas, the Great Morass being a prime candidate.**

#### 5.1.2 INDUSTRY COVE

##### 5.1.2.1 Flora

- Industry Cove has high conservation value due to the unique stand of 'giant' Black Mangrove trees, as well as, the presence of endemic *Hohenbergia spp.*, which may be important microhabitats for fauna.

##### 5.1.2.2 Wetland<sup>11</sup>

- The mangrove forest consists of mature mangrove trees ranging 10 - 15m in height. Sections of the parcel of land have been identified for conservation as a part of the pending resort development. The recommendation is for the area to be conserved be clearly demarcated in Environmental Permit to be issued for the development.

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<sup>11</sup> Note that these recommendations have been superseded by the approval of the 2,000 room Princess Hotel.

- Based on previous assessments conducted and documented in a report titled 'Industry Cove, Hanover Conservation Area - Development Planning Guidelines (2015)' the following recommendations were put forward by the Branch.

*"Based on this assessment and recognising that development activity can pose a significant and irreversible threat to the ecological character of the area, it is recommended that:*

- I. *Any development activity inclusive of land clearing must be subject to an environmental impact assessment (EIA) and approval must be obtained from the relevant authorities prior to the commencement of any works. A comprehensive mitigation plan inclusive of compensatory, restorative or rehabilitative actions to be taken, where applicable, must be provided and approved for all activities that will prove injurious to the wetland habitat and or species present on the development site.*
- II. *The development activity, (if considered), should be low impact and if possible an eco-type resort, where the operation and maintenance of this facility would not be injurious to the environment and in keeping with the recommendations of the EIA document.*
- III. *Development activity should be limited to the previously cleared land areas and there should be no further fragmentation to the existing extent of the wetland areas at the site. The boundaries for this area (cleared and fragmented) should be clearly demarcated upon the completion of a detailed land survey.*
- IV. *The fragmented sections of mangroves forest consisting of approximately 4.7ha and the proposed development zone, may be considered for release for development providing that all environmental considerations are addressed and the requisite approvals obtained.*
- V. *A conservation zone is established as outlined.*
- VI. *A tree preservation order is to be placed on the area to preserve the forest within the recommend conservation area.*
- VII. *The Minister allows for and approves the proposed development zone and conservation zone as outlined."*

### 5.1.2.3 Fauna

- Conservation of the area can continue to reduce the displacement of the threatened West Indian Whistling Duck, as well as many other native and threatened species.

.....

- The enforcement of the 30m setback limits from the water's edge.** There should be no further development within the riparian zone of the rivers investigated. This is to be implemented along the banks of all rivers in Negril where feasible.
- Public education and awareness programmes to increase public understanding and awareness.** Public knowledge of the impacts of freshwater pollution should be implemented. This will aid in preventing future persons from negatively disrupting the rivers. One of the advantages of this approach is to foster the integration of different kinds of sustainable use of natural resources at a landscape and community level.

### 5.1.6 RHODES HALL

#### 5.1.6.1 Flora

- The landward side is a highly developed area which consisted of disturbed vegetation with low species significance and cultivated plants. The endemic, threatened orchid *Brassavola cordata* that was found at the location should be integrated and conserved by in situ conservation in a nursery<sup>12</sup>.

#### 5.1.6.2 Wetland

- The Rhodes Hall mangrove forest on the coastal side of the main road is an intact mangrove forests with an average canopy height of 12 meters stretching for roughly 700 meters.
- As previously mentioned, the area is a habitat for the endangered American Crocodile species.
- Changes in land use especially in wetland areas must be carefully managed in order to retain the existing areas and in doing so halt the loss of this coastal habitat.**
- Any development activity inclusive of land clearing must be subject to an Environmental Impact Assessment (EIA) and approval must be obtained from the relevant authorities prior to the

<sup>12</sup> This recommendation is unclear.



commencement of any works. A comprehensive mitigation plan inclusive of compensatory, restorative or rehabilitative actions to be taken, where applicable, must be provided and approved for all activities that will prove injurious to the wetland habitat and or species present on the development site.

- The development activity, (if considered), should be low impact and if possible an eco-type resort, where the operation and maintenance of this facility would not be injurious to the environment and in keeping with the recommendations of the EIA document.
- **Where possible a Tree Preservation Order is to be placed on the area to preserve the forest within recommended conservation area safeguarded from developments.**

#### 5.1.6.3 Fauna

- The population appears to be declining in some areas. Rhodes Hall wetland, known as one of the largest crocodile reserves in western Jamaica. According to Rhodes Hall staff, only around four crocodiles are known to remain in that wetland habitat today and only one was observed during the survey. Active crocodile nesting has been documented by NEPA as recent as 2018.

### 5.3 FURTHER CONSIDERATIONS

#### 5.3.1 FRESHWATER SYSTEMS

Freshwater systems are widely impacted by a variety of human activities. Nevertheless there is an abundance of ways in which these impacts can be reduced or ultimately discontinued in a bid to promote a healthy freshwater ecosystem.

The following suggestions should be considered so as to mitigate against further degradation of the freshwater system and associated riparian zones:

- The implementation of restoration schemes. These could include the **replanting of native and indigenous trees to the area, within 30m of the river banks**. This will stabilize soil within the immediate vicinity of the rivers and decrease the deposition of silt. The vegetation will also reduce impacts of nutrients leached from agricultural lands to river during times of rainfall. These activities will help to identify, stop or mitigate against activities negatively impacting the freshwater system and allow for the river to recover over a period of time.

- **The continuous and effective monitoring of the watershed area.** Healthy watersheds results in healthy waterways as it not only supports the maintenance of the physical attributes of the river but also the biological function of the system. **This includes the conservation of lands adjacent to river systems from vegetation clearance, point pollution and economic activities such as extraction and agricultural activities.**
- **The enforcement of the 30m setback limits from the water's edge.** There should be no further development within the riparian zone of the rivers investigated. This is to be implemented along the banks of all rivers in Negril where feasible.
- **Public education and awareness programmes to increase public understanding and awareness.** Public knowledge of the impacts of freshwater pollution should be implemented. This will aid in preventing future persons from negatively disrupting the rivers. One of the advantages of this approach is to foster the integration of different kinds of sustainable use of natural resources at a landscape and community level.

## 5.2 LOW PRIORITY AREAS FOR CONSERVATION

### 5.2.1 BLENHEIM, DAVIS COVE

- The area that was assessed was highly disturbed and can be considered for development and further bolstering of the already existing infrastructure. Permitted activities in these areas should not negatively impact the Forest Reserve and buffer zones.

### 5.2.2 ORANGE BAY

- This area may be suited for development based on the high level of disturbance observed; however, care must be taken to ensure that **any development that occurs does not encroach on any wetland areas with ecologically sensitive mangroves or crocodiles.**
- The mangrove stands stretch from Orange Bay to Ireland Pen with red mangroves being the dominant species with an average height of 13 meters.
- Despite the disturbances that exist in the area the wetland forest borders the Orange Bay Special Fishery Conservation Area (formerly known as Fish Sanctuary). **The ecological function of the Orange Bay SFCA is contingent on maintenance of the coastal environment surrounding the SFCA.**

### 5.3.2 FAUNA

- **Proposed development near or within wetland areas should not only assess the environmental impact, but also make reference to the established flood zones.** Wetland species such as crocodiles will expand their range during prolonged periods of rainfall. This will ensure the reduction in human-wildlife encounters and produce a buffer zone around wetland habitats. Buffer zones accommodate both the interest in preserving the natural processes and the need to have sustainable human development.
- To mitigate the impact of habitat loss and fragmentation on biodiversity, **wildlife corridors can be developed to facilitate the movement of native wildlife whose habitat may become fragmented due to the New Negril development.** Wildlife Corridors can be both overpasses and underpasses, which will aim to link two or more areas of similar wildlife habitat separated by human activity or structures. For example, a large culvert can be placed under a road that has cut through a wetland to facilitate the movement of species such as American crocodiles, Jamaican Sliders, Land crabs etc. between the fragmented habitats. Not only will this reduce road kill, but it will ensure the maintenance of ecological processes and the continuation of viable populations.
- To ensure the conservation of natural habitats and species, **community based initiatives could include training in sustainable farming practices, replanting programs and alternative livelihood workshops.**

### 5.3.3 COASTAL & MARINE ECOSYSTEMS

The coastal ecosystems within the study area are considered fragile and therefore the following recommendations should be considered to prevent further loss and degradation of these areas.

- **The further conversion of coastal wetlands in Orange Cove, Bulls Bay and Green Island to hard, non-porous surfaces (should) be restricted.**
- **Development activity should be limited to the previously cleared land areas and there should be no further fragmentation to the existing extent of the wetland areas at these sites.** Although not flagged as sites for high priority for conservation, change in land use especially in wetland areas must be carefully managed in order to retain the existing areas and in doing so, halt the loss of

this coastal habitat. **Developments that are likely to impact coastal resources in these areas should conduct coastal rehabilitation projects.**

- **Current land-use practices (should) be modified to reflect best practices.**
- In times of heavy rainfall plumes of muddy water, which result in sedimentation and eutrophication on sensitive coastal resources, occurs. **Good farming practices inclusive of slope stabilization and sediment containment needs to be initiated and sustained.**
- Assessment of status and extent of seagrass ecosystems.
- Seagrasses are an important component of the coastal ecosystem as they are important nursery grounds for several species of commercial non-commercial fin and shellfish. An island-wide assessment of the areal coverage is needed so that interventions to restrict the decline and loss can be implemented. These interventions are necessary to safeguard the fishery, the diversity of natural resources, as well as preserving linkages between coastal ecosystems.