Technical Report

for the

Construction and Maintenance of Overwater Structure

at

Whitehouse, Westmoreland

Prepared for:

Sandals Resorts International

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in collaboration with:

TEM network | TECHNOLOGICAL & ENVIRONMENTAL MANAGEMENT NETWORK LIMITED

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1.0 EXECUTIVE SUMMARY

Sandals Whitehouse Management Limited has proposed to construct an Overwater Structure at Sandals South Coast Jamaica (SSCJ) in Westmoreland. The National Environment and Planning Agency (NEPA) provided Terms of Reference (TOR) for the compilation of a technical report that would address specific concerns related to the project proposal.

The purpose of the technical report is to gain an understanding of the physical, biological, natural and socio-economic environment of the Project area, that would provide the requisite information to benefit both the project designers and regulators. The main objectives of the report are to identify all the potential impacts of the project and to adequately mitigate against such impacts and develop monitoring plans to ensure mitigation are action.

1.1 Policy, Legislation and Regulatory Consideration

A detailed analysis of policy, legislative and regulatory environment that governs overwater structure development was conducted. The following instruments were found to be relevant to project.

- Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013
- Beach Control Act 1956
- Natural Resources Conservation Authority Act 1991
- The Fisheries Act
- The Fisheries Industry (Special Fishery Conservation Area) Regulations, 2012
- The Natural Resources (Marine Park) Regulations 1992
- The Wildlife Protection Act
- Town and Country Planning Act
- Town and Country Planning (Westmoreland Parish) Provisional Development Order, 1977
- The Noise Abatement Act
- The Building Act, 2011
- Planning Guideline – Overwater Structures 01/2016
- Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartegena Convention)

- Convention on the Prevention of Marine Pollution by Dumping of Wastes and other matter, 1972
- International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. (MARPOL)

The government has released policy guidelines in August 2016 that set out the management framework for the construction and operation of overwater structure in tourism development.

1.2 Project Design

The proposed project will build 12 Overwater Rooms off the coast of SSCJ, that are connected to the mainland via a boardwalk. The foundation of the structure will be 186 H-Piles driven into the bedrock of the sea, that will be protected within a concrete PVC jacket. There will be no dredging of the seabed in the construction of the proposed structure. The height of the buildings would be 7 feet above mean sea-level and designed to withstand a Category 3 hurricane.

Greenheart timber will be the main wood used to construct the structural component of the rooms and the entirety of the Boardwalk. Marine and pressure tested plywood along with fillings will be used to construction internal and external walls and the ceiling of the rooms. Resysta siding would be used to construct the outer wall of the buildings and Virothatch would be the finish on the external roof. Glass will meet hurricane resistance specification.

All utility pipelines and cables would be routed under the protected boardwalk, protecting them from all external elements. The rooms will have all the required utilities of a similar room on the mainland. The lighting design would use turtle approve lighting fixtures of lights to create a low impact light intensity. Sewage generated in the rooms will be gravity feed to the hotel's tertiary Wastewater Treatment Plant (WWTP).

Construction methodology will utilize cranes on a pontoon and on land to construction the pile foundation, prior to the rooms and boardwalk structures being built.

1.3 Water Quality

Water Quality survey was conducted on 16th February 2017, between the hours of 0830 and 1130. Samples were collected from 4 sample sites within the marine environment. Field measurements were done for Dissolved Oxygen, pH, Salinity and Temperature, while samples were taken for faecal coliform, Total Suspended Solids, nitrates and phosphates and BOD. Most of the water quality results were within the NEPA standard with a few outliers. Dissolved Oxygen at 2 samples site was below NEPA guideline, the pH of all samples was lower than NEPA's ambient standards, while there was one sample area where oil and fats level was high.

1.4 Coastal Dynamics/Oceanography

Bathymetric survey of the area in and around the project site was done, along with a beach profile of the coastline. Wave analysis was conducted using US NOAA WAVEWATCH III model for offshore analysis and CMS-WAVE model for nearshore waves. An analysis of the current was done, along with the effects of storm, storm surges.

The wave conditions at the shoreline along the SSCJ site is significantly controlled by the shallow barrier reef about 300 m from the protruding headland. The southeast incident wave is by far the most dominant, occurring over 82% of the time with an average significant wave height of 0.46 m and average peak wave period of 7.73 s. South west incident waves occur only 0.8% of the time however, the SW wave, which approaches the coastline from the open Caribbean Sea, is the most energetic, with the average significant wave height of 0.70 m and average top 2% and 1% wave height of 3.84 m and 3.97 m, respectively. The SW wave is significantly higher than waves from all the other directions under both average and storm conditions.

Sand accumulation along the east side of the groynes and erosion along the west side is apparent, especially at the long groynes to the west of the headland. This offset pattern, although not very significant at the shorter groynes, suggests a westward longshore sand transport, which is likely driven by the persistent easterly trade wind generated waves near the shoreline. The relatively small offset indicates that the net rate of sediment transport is not large.

Based on wave modeling results, under existing conditions, the SSCJ shoreline is well protected against the dominant southeasterly approaching waves by the nearshore barrier reef. However,

although the southwesterly approaching waves are not the dominant wave, they do occur at about 3% of the time and are therefore significant. More importantly, the southwesterly approaching waves are not obstructed by landmass and therefore have high storm waves. The southwesterly approaching waves arrive at the western flank of the Sandals Whitehouse headland largely unobstructed by the barrier reef and therefore, can result in quite energetic conditions.

1.5 Coastal and Terrestrial Assessment

A marine survey was conducted on 25, 26 and 28 February 2017, to identify the flora and fauna within the project location. A total of 5 Transect locations were surveyed. Seagrass type and density were captured and fish community was assessed using the Atlantic and Gulf Rapid Reef Assessment (AGRRA) belt assessment method. The terrestrial survey consists of a vegetation and avian survey conducted on 25 and 26 February 2017.

The project site (as represented by the 3 Transect within the immediate vicinity of the project) is dominated by dense seagrass bed comprised mostly of *Thalassia Testudinum* and some fringe *Halodule wrightii* and *Syringodium filiforme*. The shoot density within the project site range from 214 #/m^2 to 328 #/m^2 and maximum blade length between 25 to 30 cm. The most notable fauna was Variegated sea urchin found at a range of 2.6 to 4.4 per square meter. No coral was found within the project area. Only 7 species of fishes were seen within the seagrass area.

The terrestrial ecosystems surround the projects are mangroves, reefs, woodlands, natural pond and coastal vegetation. Hawksbill turtle and crocodiles were the only two protected species that utilize habitats within 1.2 km^2 of the project. Hawksbill turtle nested on the beach to the west of the development and crocodiles were observed in the natural pond about 1.2 km to the east of the development. Only two (2) of the 58 species of plants observed were endemic and none of the 51 species of bird seen was endemic.

1.6 Natural Hazard

The risk and vulnerability of natural hazards such as hurricanes, Tsunami, and earthquake were done. A total of 10 hurricanes passed within 60 km of the project location in the past 100 years, with the most impactful being an unnamed storm that affected the area in 1933.

1.7 Socio-Economic Environment

A socio-economic analysis of the parish was conducted with the focus on the two fishing villages nearest to the project location. A full-scale stakeholder consultation was done with social, community, political and regulatory organizations within the parish. The consultation consisted of presenting the project concept, construction methodology and proposed mitigation measures. The participants made comments, suggestions and asked questions that were addressed.

The community was generally supportive of the project and wanted assurance of adequate mitigation measures to protect the environment and the provision of jobs for community members. Fisherfolks organizations made suggestions on how to improve the Marine Sanctuary, including placing Fish Condos, Casitas and expanding the sanctuary.

1.8 Main Potential Impacts

An Impact risk assessment was conducted using the following parameters to assess risk,

- Impact
- Significance
- Duration
- Direct or Indirect
- Probability

1.8.1 Impact on Physical Environment

The main potential impacts during construction that can affect the physical environment are an oil spill and solid waste pollution. Oil storage will be bunded and spill kits would be onsite to conduct clean-up. There will be an obstacle barrier around the project site to trap any floating debris within the project work area and a solid waste plan in place to ensure all waste are disposed at the appropriate landfill.

The main potential impacts during operation are sewage and chemical spill. Environmental monitoring plan would be in place during operation to conduct regular visual checks of the system during operation and pressuring testing system after passage of any tropical weather condition.

Only phosphate free chemicals will be used to clean the rooms and cleaning water needs to be disposed within sewage system.

1.8.2. Impact on Biological Environment

The main potential impact during operation is on Seagrass, where approximately 53.7 m^2 of seagrass would be loss due to pile foundation. This project will be using turtle appropriating lighting and fixtures. Measures are proposed to improve the fish sanctuaries and there are discussions with the University of the West Indies to collaborate on a study on the effects of shading on seagrass.

The construction activities and project site is at the eastern end of a 2.4 km active Hawksbill turtle nesting beach. The hotel conducted turtle monitoring programme for years and this has continued by the Sandals Foundation through the Whitehouse Fish Sanctuary. The Sandals Foundation have also support turtle monitoring at Farm Beach through the Bluefields Bay Fishermen Friendly Society (Jamaica Observer). Sandals Foundation is committed to continue to lead this initiate.

The project construction and operation may impact the beach closest to the project due to construction noise and lighting. The project will mitigate against these potential impacts through the use of turtle appropriate lighting and fixtures and the use of low impact vibrating hydrodynamic hammer for pile driving. 111

1.8.3 Impacts due to Natural Hazards

Hurricanes and Tsunamis can result in damage and destruction of the structure, affecting the physical, biological and socio-economic environment. The structures are designed to withstand up to Category 3 hurricanes and storm surge below 7 feet. A bond of JA $25 Million would be lodged with NEPA that can be used for clean-up activities for any environmental damage that the developer fails to address.

1.8.4 Socio-Economic Impacts

There should be a beneficial impact of persons being employed from the surrounding communities. The overwater rooms will be all butler room, with 24-hour butler service available. An additional 60 jobs will be created with this investment.

2.0 INTRODUCTION

Sandals Whitehouse Management Limited applied to the National Planning and Environmental Agency (NEPA) in September 2016 to construction an Overwater structure that consist of twelve (12) rooms, 186 piles and 623 feet of boardwalk that is connected to the mainland at Sandals South Coast Jamaica (SSCJ) in Whitehouse, Westmoreland. The NEPA has requested that a Technical analysis be conducted of the project site and the findings be provided to the organization in the form of a Technical Report. The Terms of Reference (TOR) (**Appendix 1**) for the technical paper was presented to Sandals in December 2016 and was accepted as proposed.

2.1 Project Location

SSCJ is located at Whitehouse in the Parish of Westmoreland. The hotel is located 2.9 km from the Whitehouse Post Office in the township of Whitehouse, traveling west along Highway A2 (Figure 2.1).

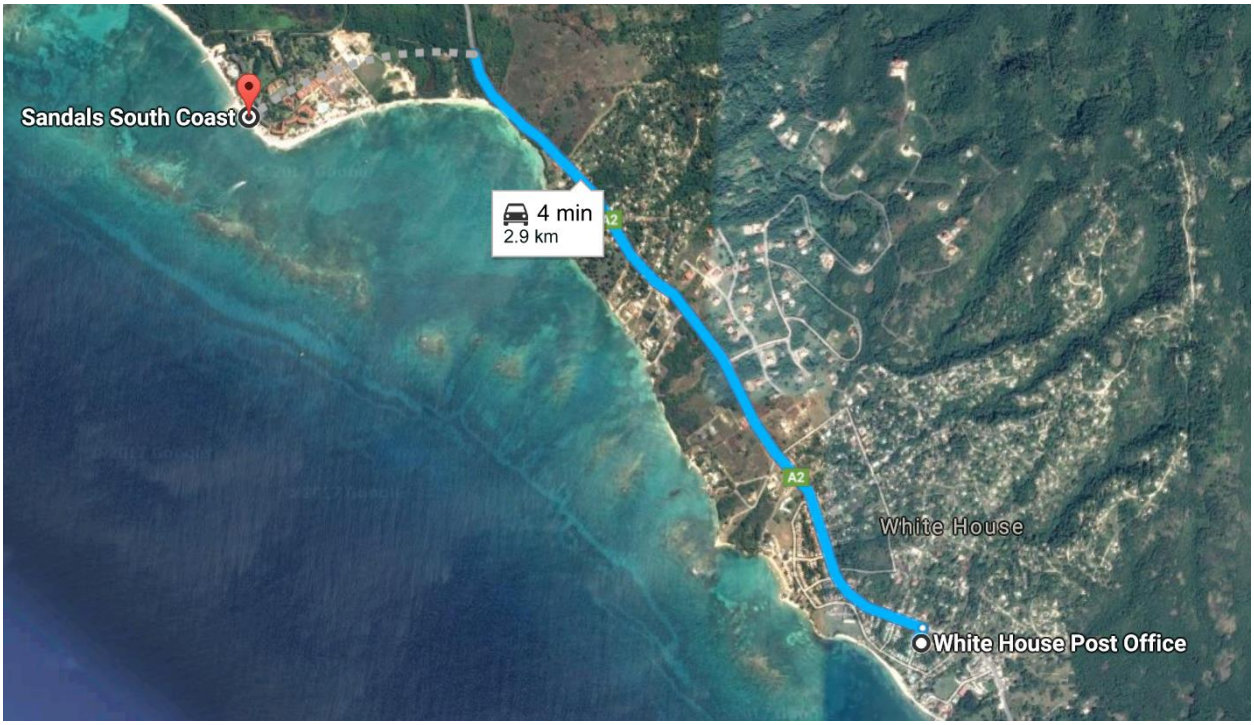

Figure: 2.1. Showing location of SSCJ from Whitehouse Post Office

The project site is located to the western end of the property, off the western most groyne leading from the beach (see Figures 2.2 and 2.3 below).

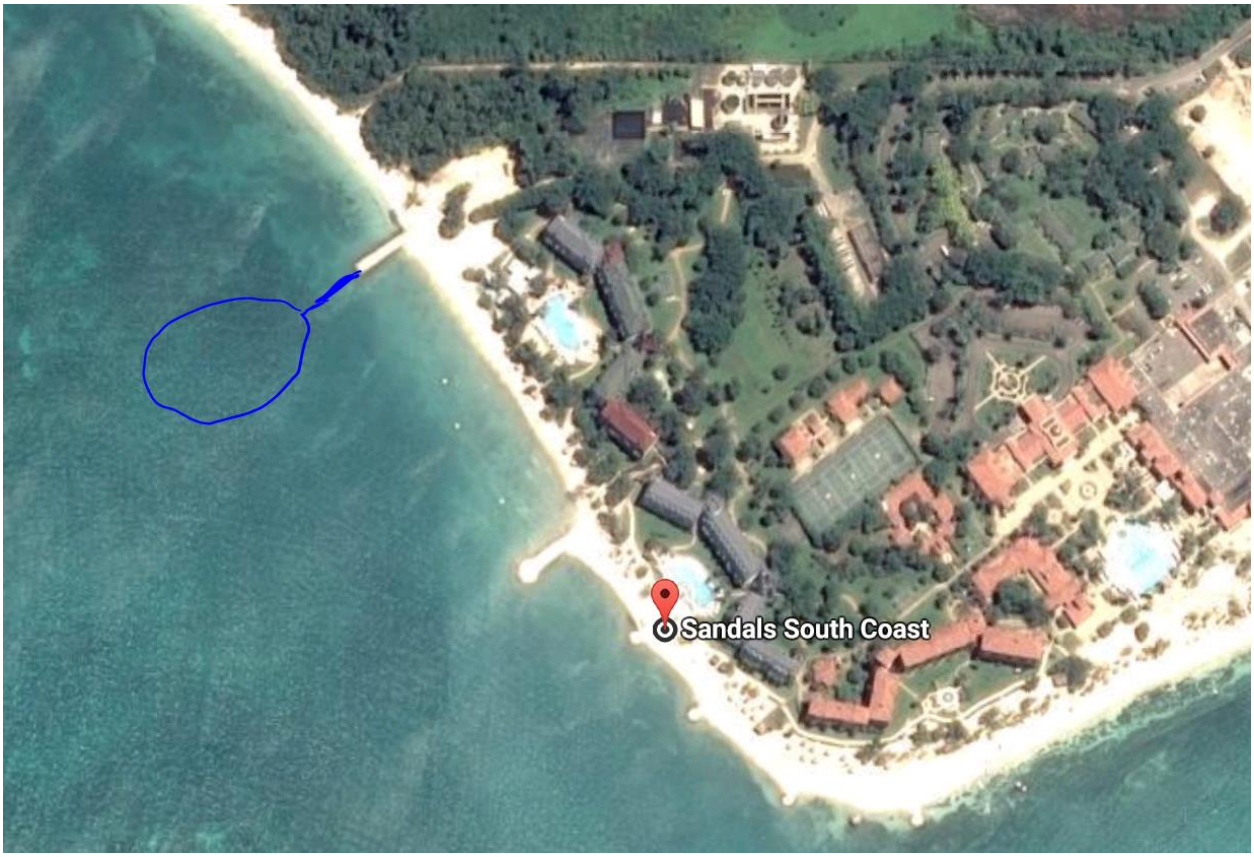

Figure: 2.2. Site Location: Line, shows project site location, not drawn to scale

The project site is within the Sandals Whitehouse Fishery Conservation Area (SWFCA). The Marine Sanctuary covers an area of 3,166,466.87 m^2 (782.45 acres). The total area that border the structure (i.e. all the area within the outer border of the Rooms & Boardwalk) over the water is 3964 m^2 i.e. 0.125% of the area of the Marine Sanctuary. The footprint of the piles on the seafloor is 53.7 m^2, which is 0.0002% of the area of the Marine Sanctuary.

Area of Project over the sea	**Square meter (m^2)**
Total Area bordering Project	3964
Total Area of the 12 Rooms over water	1070
Total Area of Rooms Boardwalk	353
Total Area of structure over water	1423 28.6%

Table: 2.1. Area of Project

The actual area of the Room structures and boardwalk is 1423 m^2, which represents 36% of the project area and the pile footprint represents 1.3% of the project area (Table 2.1 above).

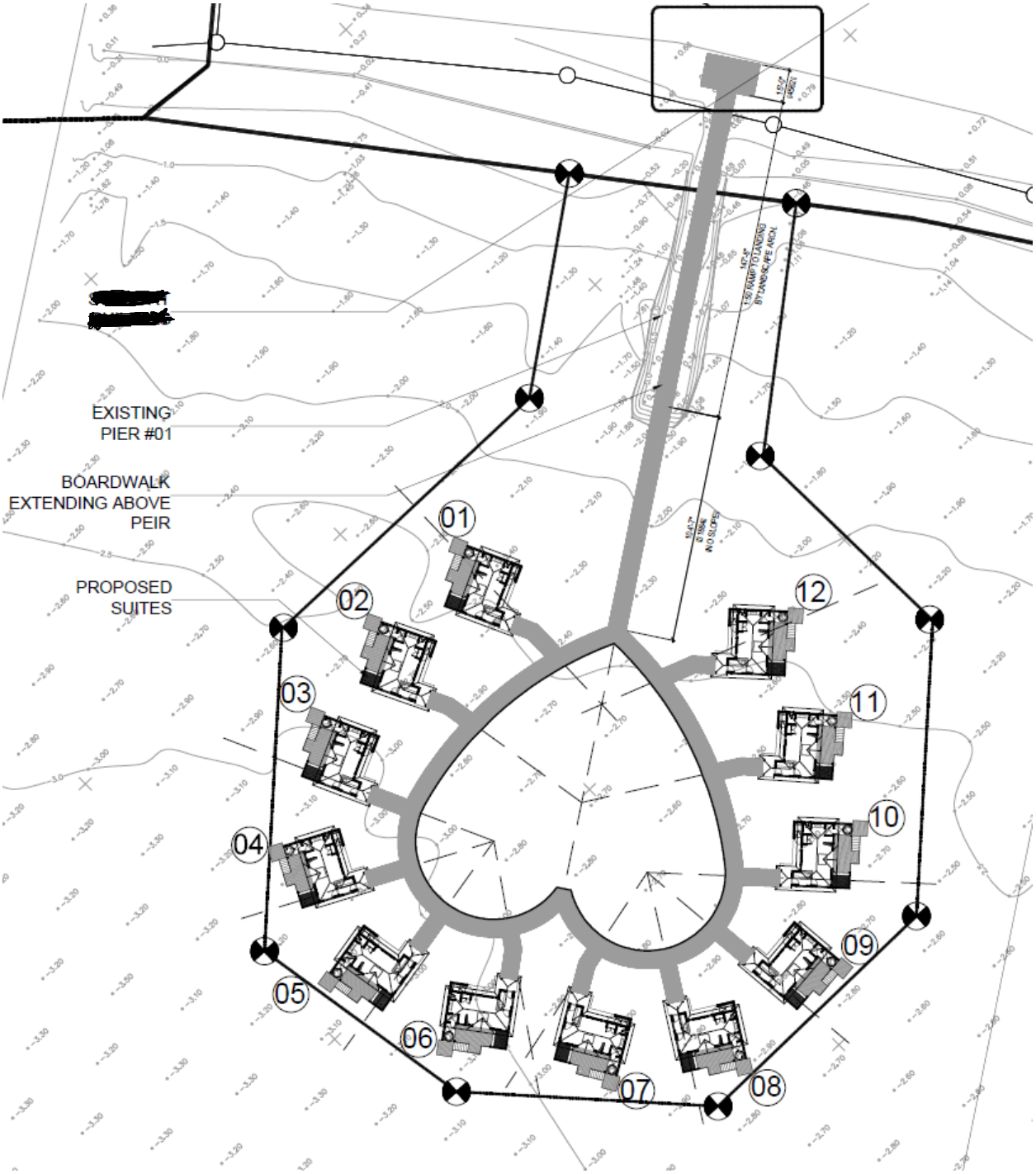

Figure: 2.3. Map of the Project Site

2.2 General Methodology

The description of the environment focused on areas within 1 km of the project site. The size of the area of focus was chosen because of the relative small footprint of the project and its potential impacts. The marine and coastal environment were heavily scrutinized due to the nature of the project. The socio-economic analysis took a broader view, looking at the project from a parish development prospective and focusing more on the two fishing villages closest to the project, Whitehouse and Bluefields. This was done because the project is located within the SWFCA and the fishers from both area are two of the main stakeholders in the development and management of the sanctuary. As such a wide scale stakeholder consultation approach was taken instead of doing a survey to both educate stakeholders and community leaders and to get input in the development stage of this project.

2.3 Constraints

One of the main constraints of the study was the lack of up to date socio-economic data in some areas for the Parish. Where this information was not available, the 2001 census data from the Statistical Institute of Jamaica (STATIN). Another constraint was the time of the ecological survey coincide with a period of high turbidity due to sea condition which provided poor visibility in contrast to when the water quality field work was done.

3.0 POLICY, LEGISLATION AND REGULATORY CONSIDERATION

The regulatory and legislation framework that govern this project is fully addressed below. It addresses regulatory agencies that regulate the project, as well as policies, standards, and regulations that govern the environmental quality, health and safety along with the identification of sensitive areas and protection of endangered species within the project area.

3.1 Legislations and Regulations

3.1.1 Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013

Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, regulates sewage and treated effluents from development. The project will generate sewage from the 12 rooms and associated butler building. SSCJ has a tertiary Wastewater Treatment Plant (WWTP) that is licensed to operate under these regulations. Part III of the Regulation requires the licensing of Wastewater Treatment Plan and address the issue of projects generating sewage.

Section 8

Section 8 requires permission to connect to license sewage, addressing the issue of capacity, stating

> *"8. (1) A person whose business, industry or manufacturing is likely to involve the discharge of trade effluent or sewage effluent into a sewage collection system, shall, prior to the connection to such a system, provide to the Authority written approval from the licensee for the making of the connection.*
>
> *8. (2) the person referred to in paragraph (1) shall submit to the Authority, documentation on the composition and volume of the wastewater generated from a business, industry, manufacturing or trade operation that the licensee intends to accept for treatment".*

All sewage from the overwater rooms will be piped under the boardwalk to a lift station prior to being pumped to the WWTP on the property. The developers have submitted an engineering report showing that the current WWTP has the capacity to undertake the additional sewage from the project.

3.1.2 Beach Control Act 1956

The Beach Control Act empowers NEPA to manage the use of the foreshore and floor of the sea. The following sections of the Act are relevant to the project.

Section 3

Section 3 declares that the foreshore of the sea and floor of the sea is vested in the Crown, stating

> *"3. (1) Subject to the provisions of this section, all rights in and over the foreshore of this Island and floor of the sea are hereby declared to be vested in the Crown".*

Section 5

Section 5.1 prohibits the use of foreshore or the floor of the sea without a license, stating

> *"From and after the 1st June, 1956, no person shall encroach on or use, or permit any encroachment on or use of, the foreshore or the floor of the sea for any public purpose or for or in connection with any trade or business, or commercial enterprise, or in any other manner (whether similar to the foregoing or not) except as provided by sections 3, 4, and 8, without a licence granted under this Act".*

Section 6

Section 6:1 requires an application to the authorities for use of foreshore or the floor of the sea, stating

> *"Where at the 1st June, 1956, any person is encroaching on or using or permitting any encroachment on or user of the foreshore or the floor of the sea except as authorized by this Act, such person may continue or may continue to permit such encroachment or user for a period not exceeding six months after the 1st June, 1956, but such person shall, if he intends to continue or to permit the continuance of such encroachment or user for any longer period, apply to the Authority for a licence under this Act within the aforesaid period of six months.*

Section 9

Sections 9:1 states that no structures should be constructed without a licence;

"Subject to the provisions of section 8, no person shall erect, construct or maintain any dock, wharf, pier or jetty on the foreshore or the floor of the sea, or any structure, apparatus or equipment pertaining to any dock, wharf, pier or jetty and encroaching on the foreshore or the floor of the sea, except under the authority of a licence granted by the Minister on behalf of the Crown".

Section 11

Section 11:1 empowers the authorities to issue a License for the construction and maintenance of structures that encroach on the floor of the sea, stating

"Subject to the provisions of section 3, 4, and 9, and of subsection (2), the Authority may , on application made in such manner as may be prescribed under section 18, grant licences (whether the exclusive in character or not) to any person, upon such conditions (including the payment of an annual fee) and in such form as they may think fit".

Section 11.2 requires the authorities to take into consideration the public interest with regards to fishing, bathing or recreation, stating

"Where an application is made for a licence under subsection (1), the Authority shall consider what public interests in regard to fishing, bathing or recreation, in regard to the protection of the environment or in regard to any future development of the land adjoining that part of the foreshore in respect of which the application is made, require to be protected, and they may provide for the protection of such interests by and in the terms of the licence or otherwise in accordance with the provisions of the Act".

3.1.3 Natural Resources Conservation Authority Act 1991

This act established the Natural Resources Conservation Authority (NRCA) and outlines the power and functions of the organization.

Section 3 and 4

Section 3:1 established the authority, stating

"There is hereby established a body to be called the Natural Resources Conservation Authority".

One of the functions of the authority as stated in Section 4:1 (a) is

> *"to take such steps as are necessary for the effective management of the physical environment of Jamaica so as to ensure the conservation, protection and proper use of its natural resources."*

Section 10

Section 10 empowers the authority to ask for the submission of any document to support application, with section 10:1 stating

> *"(a) to furnish to the Authority such documents or information as the Authority thinks fit; or*
>
> *(b) where it is of the opinion that the activities of such enterprise, construction or development are having or are likely to have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, an environmental impact assessment containing such information as may be prescribed".*

NEPA has asked for the submission of this technical paper in lieu of an Environmental Impact Assessment for this project.

Section 12

This section prohibits the discharge of sewage into the environment, Section 12:1 stating

> *"Subject to the provisions of this section, no person shall (a) discharge on or cause or permit the entry into waters, on the ground or into the ground, of any sewage or trade effluent or any poisonous, noxious or polluting matter".*

Section 31

This section emphasizes that the requirement for planning permission is still needed despite the granting of a permit under this Act. Section 31 states

> *"The grant of a permit or a licence under this Act does not dispense with the necessity of obtaining planning permission when such permission is required under the Town and Country Planning Act, and in such circumstances, an application under that Act for planning permission in respect of any development which, pursuant to an order under*

section 9 (I), is of a prescribed description or category shall be made thereunder simultaneously with the making
of an appIication for a permit or licence under this Act".

3.1.4 The Fisheries Act

Section 18 of this Act empowers the Minister to declare an area a fisheries sanctuary. Section 18 states

(1) "The Minister may, from time to time by order declare any area specified in such order to be a fish sanctuary

(2) Any person who fishes or attempts to fish in any area declared by the Minister to be a fish sanctuary shall be guilty of an offence and liable, on summary conviction before a Resident Magistrate, to a fine not exceeding five hundred dollars and, in default of payment thereof, to imprisonment for a term not exceeding six months".

3.1.5 The Fisheries Industry (Special Fishery Conservation Area) Regulations, 2012

The project is located within the Sandals Whitehouse Bay Special Fishery Conservation Area (SWFCA). This regulation designates a number of areas as Special Fishery Conversation area.
Regulation 3 (m) declares

"in Part I of the thirteen schedule, and delineated in the map set out in Part II thereof and which shall be known as the Sandals Whitehouse Bay Special Fishery Conservation Area."

Regulation 4

This Regulation specified the conditions to fish in a Special Fishery Conservation Area, with Regulation 4:1 stating

"Subject to paragraph (2) and (3), no person shall fish in a special fishery conservation area except in accordance with –

(a) A licence issued by the Licensing Authority under the provisions of the Act; and

(b) the provisions of the directions issued by the Minister under regulation 5".

The Fisheries Act is administered by the Fisheries Division and to our knowledge no person has been given permission to fish in the Sandals Whitehouse Bay Special Fishery Conservation Area.

The SWFCA area was established through the support of Sandals Resorts International (SRI) in 2013 due to depletion of fisheries resource within the area. Sandals Foundation, which is the philanthropic arm of SRI, is responsible for the management of the SWFCA and has established an office at Whitehouse that is staffed by 6 wardens and a supervisor that patrol the area daily with motorized boat to ensure persons do not fish within (Figure 3.1 below).

Figure: 3.1. SWFCA Patrol Boat with 2 of the Wardens

The boundary of the Conservation Area is set out in the Thirteen Schedule, Part 1 of Regulation 3. (Figure 3.2 below)

> *"Starting at point A, a land-based mark with geographical coordinates N18^0 06.739' and W78^0 00.308'. the boundary shall proceed as follows –*
>
> *(a) from Point A, the boundary runs to Point B, a water-based mark at coordinates N18^0 06.618' and W78^0 and 00.423';*

(b) from Point B, the boundary runs to Point C, a water-based mark at coordinates N19^0 05.535' and W78^0 58.828':

(c) from Point C, he boundary then runs to Point D, a land-based mark at coordinates N19 05.712' and W78^0 58.774; and

(d) from Point D, the boundary follows the contours of the shoeline back to point A".

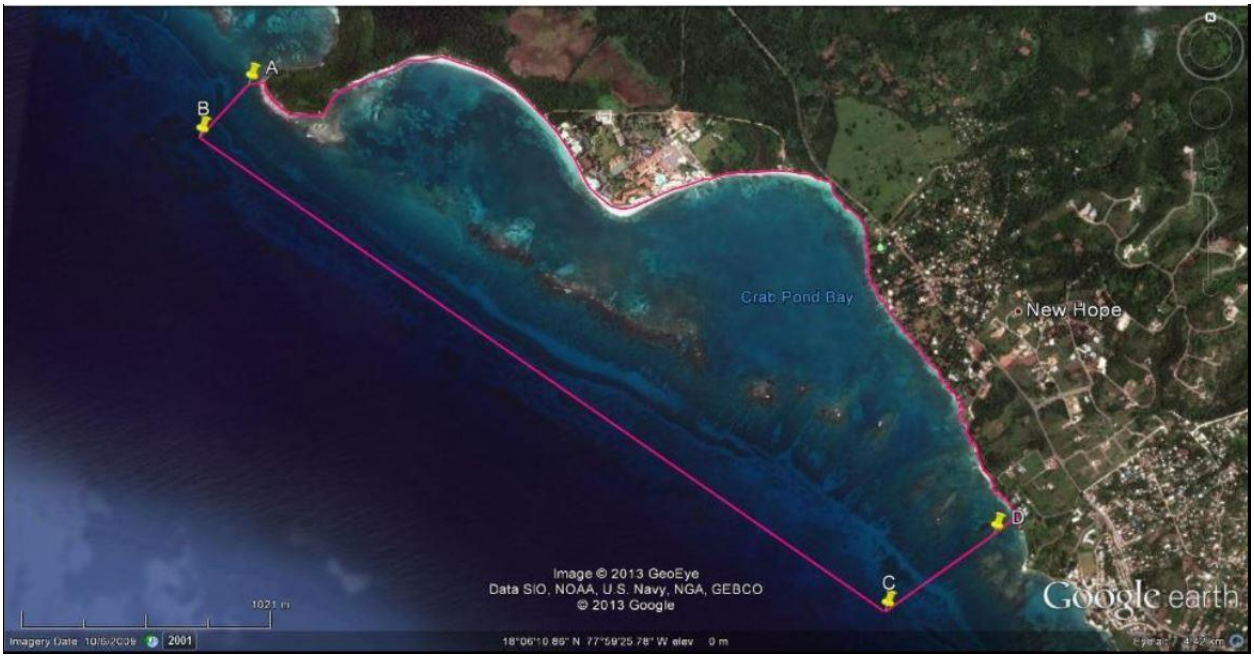

Figure: 3.2. Map showing boundaries of SWFCA

3.1.6 The Natural Resources (Marine Park) Regulations 1992

This Regulations make it illegal to pollute or litter a Marine Park, with Section 6: 1 stating,

"A person shall not discharge or deposit in or on the waters of a marine park any refuse, oily liquids or wastes, acids or other deleterious chemicals or any toxic or polluting substance of any kind injurious to plant or animal life".

Section 10:1 states

"A person shall not, in a marine park –

(a) deposit or leave any litter, bottle, broken glass, china, pottery, plastic articles, rubbish, refuse or other waste material, except in an area or receptable designated or provided for that purpose;

(b) deposit or leave any noxious, noisome, offensive substance, matter or thing;

(c) deposit or leave any offal, dead animal, dung or other filth;

(d) *deposit in any receptacle provided for litter any domestic garbage."*

3.1.7 The Wildlife Protection Act

This Act protects bird, animals and fishes, with the Second and Third Schedule naming animals and birds protected by this Act. The protected animals named in Third Schedule that are within the vicinity of the project are

- Crocodile – located in a pond to the East of the Project
- Hawksbill Turtle (*Eretmochleys imbricate*) – Lay their eggs to the west of the project

Section 6 of the Act make it illegal to hunt protected animals, stating

6. (1) No person shall hunt any protected animal or protected bird.

Section 11 of the prohibit the release of sewage and other pollutant into body of water containing fishes, stating

" Notwithstanding anything to the contrary every person who causes or knowingly permits to flow or puts or knowingly permits to be put, whether directly or indirectly into any harbour, river, stream, canal, lagoon or estuary, containing fish, any trade effluent or industrial waste or sewage or any noxious or polluting matter shall be guilty of an offence against this section and shall, upon conviction before a Resident Magistrate, be liable to a fine not exceeding one hundred thousand dollars or to imprisonment for a term not exceeding two years or to both such fine and imprisonment".

3.1.8 Town and Country Planning Act

This Act empowers Authority (NEPA) to prepare provisional development orders "in relations to any land, in any urban or rural area". Section 10 of the Act gives the Local Parish Council the authority to grant permission for the development of the land under the development order. Section 11 specifies the role of Parish Council and the Natural Resources Conservation Authority in the application process, stating

> *11. (1) Subject to the provisions of this section and section12, where application is made to a local planning local authority for permission to develop land, that authority may grant permission either unconditionally or subject to such conditions as they think fit, or may refuse permission; and in dealing with any such application the local planning authority shall have regard to the provisions of the development order so far as material thereto, and to any other material considerations.*
>
> *(1A) Where the provisions of section 9 of the Natural 9/1991 Resources Conservation Authority Act apply in respect of a development which is the subject of an application under subsection (l), planning permission shall not be granted unless*
>
> > *(a) an application to the Natural Resources Conservation Authority has been made as required by such provisions as aforesaid; and*
> >
> > *(b) that Authority has granted or has signified in writing its intention to grant, a permit under that Act.*

3.1.9 Town and Country Planning (Westmoreland Parish) Provisional Development Order, 1977

The Order address planning permission within the parish. Clause 5 prohibits development without the granting of planning permission, stating

> *"5. Subject to the provisions of this Order no development of land within the are to which this Order applies, shall take place except in accordance with the development plan and any planning permission granted in relation thereto;*

Provided that the local planning authority may in such cases and subject to such conditions as may be specified by directions given by the Minister under this Order grant permission for development which does not appear to be provided for in this Order or the development plan and is not in conflict therewith".

Clause 6 of the Order outline specification to apply for planning permission, inclusive of plans and drawing needed. The order states

6 (1) Every application to the local planning authority for planning permission shall be made in a form issued by the local planning authority and obtainable from that authority or from the Authority, and shall include the particulars required by such form to be supplied, and be accompanied by –

(a) a plan sufficient to identify the land to which the application relates; and

(b) such other plans and drawings are necessary to describe the development which is the subject of the application together with such additional number of copies not exceeding ten, of the form, plans and drawings

as may be required by the directions of the local planning authority and oriented on the form".

3.1.10 The Noise Abatement Act

This Act address noise on construction sites, with Section 3 stating,

3. (1) Subject to subsection (2) and section 5, no person shall, on any private premises or in any public place at any time of day or night –

(a) sing, or sound or play upon any musical or noisy instrument; or

(b) operate, or permit or cause to be operated, any loudspeaker, microphone or any other device for the amplification of sound,

in such a manner that the sound is audible beyond a distance of one hundred metres from the source of such sound and is reasonably capable of causing annoyance to persons in the vicinity so, however, that where during the period specified in subsection (4) such sound is audible beyond that distance in the vicinity of any dwelling house, hospital,

nursing home, infirmary, hotel or guest house, such sound shall be presumed to cause annoyance to persons in that vicinity".

3.1.11 The Building Act, 2011

Section 7 (b) The Building Act designates the local Parish Council as the Local Building Authority within a Parish. As such, the Westmoreland Parish Council, located in the capital Savannah-La-Mar, is the Building Authority in the Parish. Section 8 of the Act outlines the function of the Building Authority, stating;

"8. The functions of each Local Building Authority shall be to –

(b) accept and consider applications for building permission in respect of all proposed buildings to which this Act applies and to grant approval of such applications, subject to any conditions that may be deemed necessary, provided that such applications are in compliance with this Act and the provisions of the National Building Code;

(c) ensure that the erection, repair, extension, demolition, use or modification of any building within its jurisdiction are carried out in accordance with the provisions of this Act and the National Building Code;

(h) ensure that design submitted in respect of building application are in compliance with the provision of the relevant code and that works executed in respect of building permits are undertaken by persons competent to perform such task; and".

Part IV of the Act speak to the Building Permit process, with Section 17 informing that of the requirement for a building permit stating

"17. A person shall not carry out any building work unless

(a) a building permit in respect of the work has been issued to him;".

Section 18 addresses permit applications, stating,

"18. (1) A person who intends to carry out building work shall apply in the prescribed form and manner to the relevant Local Building Authority for the appropriate building permit".

While section 24 deals with the granting or refusal of permit, stating

> *"24. (1) A Local Building Authority may, in relation to an application for a building permit made under section 18-*
>
> *(a) grant the building permits;*
>
> *(b) grant the building permit subject to such conditions as it may specify therein; or*
>
> *(c) refuse to grant the permit".*

3.2 Government Policy

3.2.1 Planning Guideline – Overwater Structures 01/2016

With the advent of applications for overwater rooms, the government has issued "flexible" planning guidelines to govern these structures. These guidelines apply to structures that are "whole constructed unit suspended above the surface of a water body".

Section 3.1.4 of the guidelines determines that the Natural Resources Conservation Authority (NRCA) will issue permission for overwater structures stating

> *"The developer of any overwater structure must obtain the necessary licence and permit from the Natural Conservation Authority (NRCA) before proceeding with the development".*

Section 3.1.2. of the guidelines requires NEPA to approve terms of reference for an Environmental Impact Assessment to undertake the development, stating

> *"All potential developments will require an Environmental Impact Assessment (EIA). The Terms of Reference of the EIA will address concerns specific to the development and must be approved by the National Environment and Planning Authority (NEPA)".*

Section 3.1.6 stipulates the imposition of a Performance Bond is to be lodged with NEPA to ensure compliance with terms of Licence throughout the life of the project, stating

> *"A performance bond will be required for companies or persons permitted/licensed to construct an overwater structure. The performance bond seeks to ensure compliance with the terms of the permit/licence including environmental management, monitoring and decommissioning".*

Sections 3.1.13 and 3.3.9 vested power in the Commissioner of Lands to negotiate the terms of a long-term lease for the area the structures occupy, with Section 3.3.9 stating

> *"The Commissioner of Land is responsible for the vesting of lease of the sea floor or marine space over which the proposed development is to take place. The applicant should identify the location and extent of the land/marine space required for the proposed development by*

means of a suitably referenced description, map/chart/diagram, bounding coordinates or other appropriate means".

The National Land Agency has issued a no objection letter to proceed with the application to NEPA (see **Appendix 2**).

Section 3.1.1 of the guidelines identify10 criteria where overwater structures may not be permitted including a fish sanctuary. While the project falls within the Whitehouse Special Fisheries Conservation Area (WSFCA), the construction and operation will in no way affect the function of the sanctuary and further remediation efforts will actually enhanced the productivity of the sanctuary.

Section 3. 4 provides guidelines for the material use and design of overwater structures. Section 3.4.5 addressed the electrical and mechanical design, stating that the pipes should be shield from view.

"The electrical and mechanical engineered design of the overwater structure shoule be such that all electrical conduits, water supply, wastewater disposal and butane pipes, must be easily accessible yet shielded from view. The proposed system would need to meet the highest code of International Fire Safety and Systems regulations".

Section 3.4.6 looks at artificial lighting for the projection, stating

"The artificial lighting of the overwater structures must be shielded from direct transmission on the water and on the shoreline areas of natural habitats".

Section 3.4.10 addresses construction material recommended for use on the projection, stating

"All material for construction including roofing, roof structure walls, flooring, pipe works, wires and conduits, to be used in construction must be environmentally friendly and marine resistant".

Section 3.6 of the guidelines addresses recommendation for sewage and wastewater system and disposal, including that only phosphate free biodegradable chemicals are to be used during operation of the overwater structures.

3.3 International convention/protocol/treaty

The following international agreements that Jamaica is a signatory to are applicable to the project.

3.3.1 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartegena Convention)

The convention obligates the parties to take action to prevent, reduce and control pollution caused by "ships, aircraft's, man-made structures at sea, coastal disposal or discharges emanating from rivers, estuaries, coastal establishments, outfall structures, land based sources, exploration of the sea bed and discharges from the atmosphere". The following three protocols have been developed under this convention and to which the country is a signatory.

- The Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region (The Oil Spills Protocol)
- The Protocols Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region (The SPAW Protocol)
- The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region (LBS Protocol)

3.3.2 Convention on the Prevention of Marine Pollution by Dumping of Wastes and other matter, 1972

This convention calls for contracting parties to control deliberate dumping of waste at sea from vessels, aircraft, platforms or other man-made structures at sea. The convention encourages the development of regional convention to supplant it. It doesn't cover pollution from land base source or pollution that occurs during normal operation.

3.3.3 International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. (MARPOL)

This convention and protocol seeks to preserve the marine environment, through the eliminating of pollution by oil and other harmful substance and reducing the possibility of accidental spillage of such pollutants.

4.0 PROJECT DESCRIPTION

4.1 History and Background of Project

Sandals Resort had applied to NEPA in 2009 to construct 8 Overwater Rooms at Sandals Royal Caribbean in Montego. This project came to fruition in 2015, when the project was resubmitted to NEPA and approval was given to construct 5 Overwater Rooms. This construction started in January 2016. The response from the tourism market was overwhelming and the company responded by applying and getting permission to construct 12 additional Overwater Rooms. The demand for these rooms continues to be excessive and Sandals Resorts International has decided to expand this development to the Sandals South Coast Jamaica Hotel that is located at Whitehouse in Westmoreland (Figure 4.1).

4.2 Project Location

Figure: 4.1. Location Map of Hotel

4.3 Project Overview

The project consists of the construction of 12 Overwater Rooms connected by a boardwalk that leads to a groyne that is connected to beach. The Overwater structure is supported by 186 Piles driven into the sea. Each of the Overwater Rooms has 700 ft^2 internal floor space and has a patio and step leading to a landing deck. Each Room is supported by six (6) piles and a seventh pile support swim-up platform. See Figure 4.2 showing diagram representing the structure.

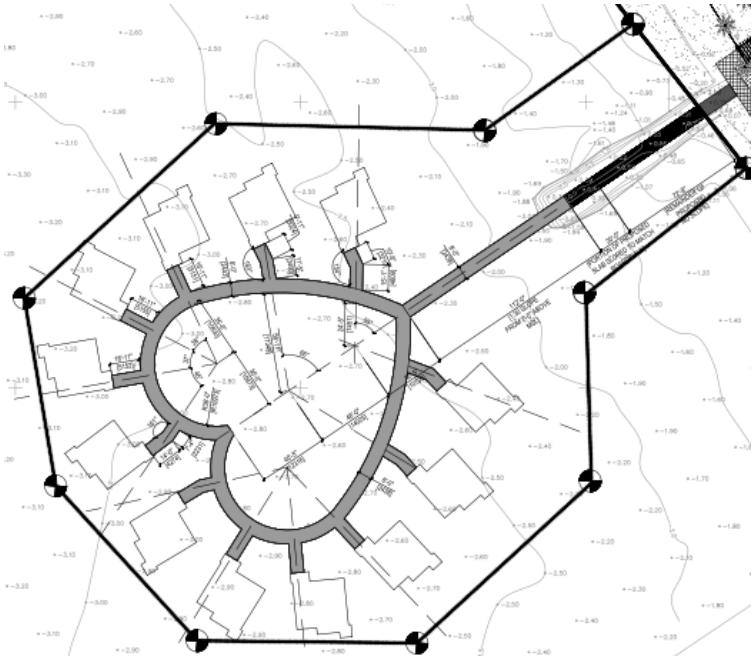

Figure: 4.2. Showing the boardwalk and Overwater Rooms

4.4 Overwater Structure Foundation

The structural foundation of the overwater structures will be supported by H-Steel Piles driven into the sea floor. These piles are designed to be used for deep foundation application. Generally, soil doesn't have the mechanical properties to support the weight of the buildings near the surface. As we penetrate deeper into the earth surface there is generally a stratum that can support the weight of buildings. The H-Piles are designed to transfer structural load to weight bearing soil below the earth surface. H-Piles generally have the advantage of high factored resistance and small soil displacement.

This project will be using 40 feet long, 14" x 14" x 73 Lb/Ft Steel H-Piles for the foundation of the rooms and 30 feet long, 12" x 12" x 65 Lb/Ft Steel H-Pile for the boardwalk. The tip elevation for the piles below sea level for the Rooms and Boardwalk are 33 feet and 24 feet respectively, the height of the pile above mean sea level being approximately 5 feet. The Factor of safety for the axial load and bending of the pile used for this project is > 2.0.

H-Piles are constructed with alloy steel and are susceptible to corrosion in the marine environment. Susceptibility to corrosion below the sea floor is not a problem due to the lack of oxygen. To protect the pile from corrosion above the soil, a 24" (600 mm) diameter PVC pipe sleeve with ½" (14mm) wall thickness will encircle the H-Pile from 2 inches below the sea floor to the beam of the structure. Concrete with cylinder strength of 20.6 MPa and water cement ratio of 0.40 will be used to cast the H-Pile within the PVC sleeve.

4.5 Height of Structure

An analysis of the near shore wave conditions was done using the Cms-Wave Model. This model revealed that due to the barrier reef located about 300 metres from the project site, the storm wave height will significantly reduce as it approaches the land mass. The Southeast approaching wave which occurs at frequency of 82.1% is expected to have an average top 2% wave height is 3.44 feet, the SSE approaching waves occurring at frequency of 3.0% is expected to have an average top 2% wave height is 4.9 feet. The Southwest approaching waves is the most energetic occurring at a frequency of 0.8%, with an average significant wave height of 2.3 feet and average top 2% and 1% wave height of 12.6 feet and 13.0 feet.

Based on this wave analysis, the typical hurricane will generate storm surge wave below 5 feet and it would take a catastrophic hurricane events to exceed this wave height. As such, a height of 7 feet above mean sea level was chosen to build the structure.

4.6 Foundation Beam & Floor Joist structures of Overwater Buildings

Steel I-Beam will be welded to the top of the H-Piles of the Overwater Room structure. The dimension of the I-Beam use will be 12" x 6.5" x 23 LB/Ft. To protect the I-Beam from corrosion, Rust Grip, a corrosion coating protection for steel and concrete surface will be applied to the I-Beam ex-situ. A 4" x 4" Greenheart plate will then be bolted down running parallel on to each I-Beam. A 2" x 6" Greenheart floor Joist will be placed perpendicular on the Greenheart plate. The Floor joists will be strapped to the 4"x4" plates by Simpson Strong-Tie Type H8SS Hurricane strap. (See Figures 4.3 and 4.4 below)

4.7 Boardwalk Design

Instead of the I-Beam that was used for the overwater buildings, a 2”x8” Greenheart Joist Girder will be bolted upon the H-Pile unit via a steel plate that is welded at the top of the pile unit. A 2”x10” Greenheart floor Joist will be placed perpendicular on the Joist Girder. The Floor joists will be strapped to the Joist Girder by Simpson Strong-Tie Type H8SS Hurricane strap. Six (6) pieces of Floor Joist will be use, running longitudinally along the boardwalk, with the outer each have a double Floor Joist. The maximum distance between the floor Joists will be 2 feet (see Figure 4.5 below).

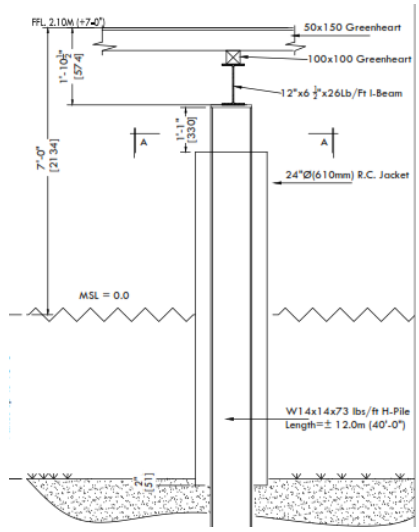

Figure: 4.3. Pile Design for Units

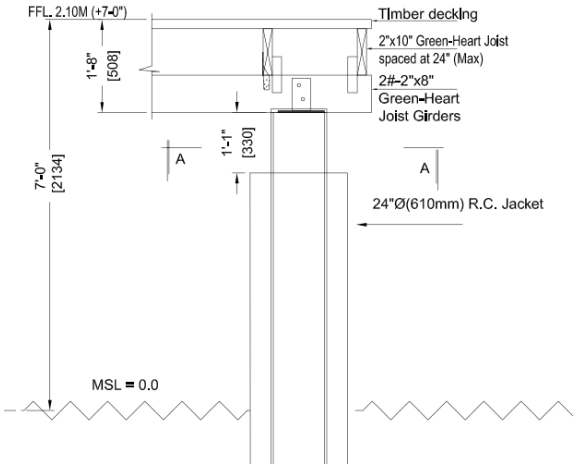

Figure: 4. 4. Pile Design for boardwalk

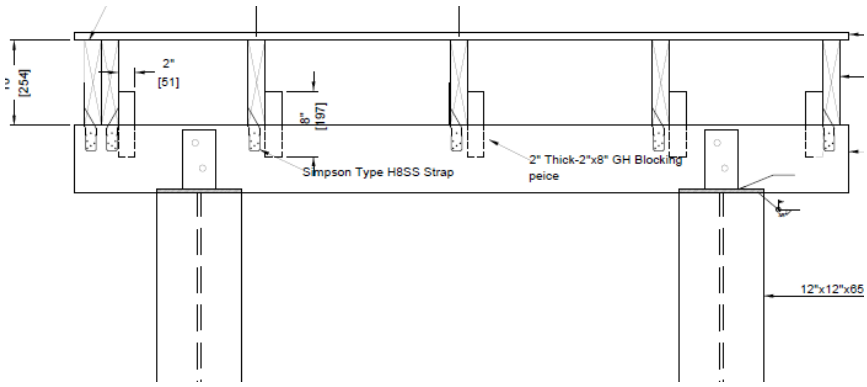

Figure: 4.5. Showing Section thru Boardwalk

The 8 feet wide boardwalk will be decked with 2” x 6” Greenheart Wood. There will be handrails on either side of the boardwalk as a safety measure for persons walking on the boardwalk. The handrails will be constructed with 6” x 6” Greenheart studs and 2” x 8” Greenheart railing.

4.8 Overwater Building Design

The overwater structure will be built with timber and other wood products (See Front and Rear elevation in Figures 4.6 & 4.7 below). The main structural frame exposed to the marine environment will be built with Greenheart timber and internal structural frame will be built with Pressure Treated (PT) wood and wood product (see Table 4.1 for the list of building material specification). Simpson Type Hurricane straps are used throughout the construction to secure structural members.

The exterior wall will be built with Resysta synthetic wood and the roof will be covered by ViroThatch synthetic fibre (see Figure 4.8 showing structure below). Stainless steel nails and screws will be used to secure wood and wood product. The walls and ceilings of the structure will be well insulated to reduce sounds, water and air intrusion and thermal energy. Turtle approved lighting will be used so as not to impact turtle nesting to the west of the building. Gravity feed sewage system would be installed, with sewage proceeding below the protected boardwalk to lift station on land.

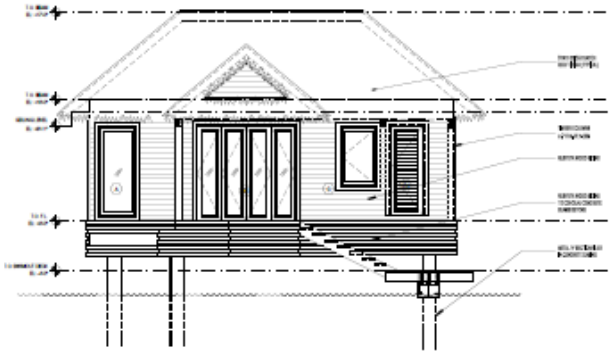

Figure 4.6: Front Rear Elevation

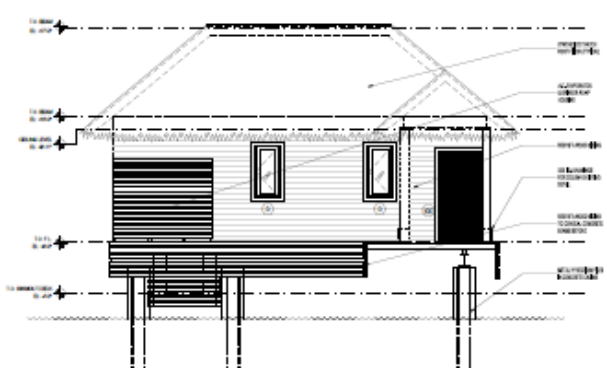

Figure 4.7: Front Elevation

Figure: 4.8. Showing Overwater Structure at SRC

4.9 Building Walls Design

The Wall studs would be approximately 24” apart strapped by Simpson Strong-Tie Type H8SS Hurricane strap to the plates and connect to ceiling beam with Simpson Type H2ASS hurricane strap. The outer wall of the suites is built with 5/8” PT Plywood that is nailed or screwed to the stud frame of the building. Perm-A-Barrier aluminum flashing is then placed on the plywood. Perm-A-Barrier Aluminum Flashing is used to protect building superstructure from the damaging effects of the elements. It functions to minimize air and water vapor flow through the building exterior at transition areas. ½” Furring is then placed vertically upon the Perm-A-Barrier aluminum flashing. Furring serves the function to reducing dampness coming through to the external plywood. Resysta wood siding is then secured to the furring, becoming the external wall of the structure.

The internal wall of the structure is finished with ¾” Cement Board secured to the Greenheart stud. Rigid Foam fills the void between the internal cement board wall and the plywood on the inner

external wall. The design of the building interior walls is comprised of 2” x 4” brace, with plywood on both sides.

Areas of Building	Specification of Material to be used
Floor	2” x 6” Greenheart Wood Floor Joist 2” x 4” Greenheart Wood Plate ¾” Marine Plywood
Exterior Wall	2” x 4” PT Wood Studs Polyisocyanurate board as rigid insulation 5/8” PT Plywood (Interior) 5/8” PT Plywood (Exterior) Perm-A-Barrier aluminum flashing ¾” Cement Board (Interior Finish) 1" X 2" PT Furring Resysta wood siding
Interior Wall	2” x 4” Wood Brace 5/8” PT Plywood Batt Insulation
Corner Post	2 pcs 2” x 4” Greenheart Wood studs 6” x 6” PT Wood column for outer patio
Roof & Ceiling	2” x 10” PT Wood Beam 2” x 10” PT Wood Ridge Rafter 2” x 10” PT Wood Hip Rafter 2” x 8” PT Wood Common Rafter 2” x 6” PT Wood Beam Over Patio Virothatch Synthetic Fibre Soprema Lastobond Shield HT 5/8” PT Plywood (Exterior) R-19 Batt insulation between rafters ½” PT Plywood (interior) Raffia Fabric Finish
Boardwalk	2” x 6” Greenheart plank for deck 6” x 6” Greenheart stud 2” x 8” Greenheart Coping 2” x 10” Floor Joist 2” x 8” Greenheart Joist Girder Resysta wood siding

Table 4:1. List of materials used for construction of Overwater structure

4.10 Building Roof and Ceiling Design

The structural members of the roof will comprise of PT Wood. The exterior roof will have a layer of 5/8” Plywood attached to the building rafters. An adhesive shield will be placed on the plywood to reduce the possibility of a leak, and then ViroThatch synthetic fibre will be laid down on this. The ceiling will be constructed with plywood, with raffia fabric finished applied. There will be Batt insulation between the rafters.

4.11 Building Floor

The outer floor will be built by ¾” Marine Plywood that is secured to the floor joist, with Greenheart panel floor finish. A glass panel will be installed in the living room that provides an unvarnished view of the sea below to the occupants of the room (see Figure 4.9).

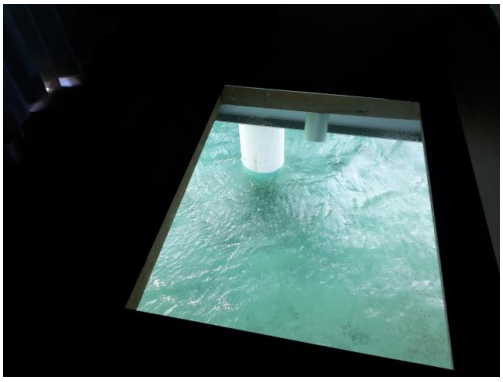

Figure: 4.9. Glass panel in Rooms

4.12 Doors

Each overwater room has five doors, as described below.

- Entrance Door, which is made from solid wood and will be outfitted with an electronic lock.
- Pantry Door, which is between the entrance door and the guest living room.
- Closet Door
- Toilet Door
- Bathroom Door that separates internal bath from the patio bath

- Living Room Door, which is a combination of wood and glass, and serve as the entrance to the patio.

4.13 Windows

Each Room has seven (7) glass windows built into wooden frames each. (See table 4.2 below).

Location of windows	Types of Windows	Size of Frame
Pantry	Fixed	5'-0" X 7'-4"
Foyer	Fixed	5'-0" X 7'-4"
Study Nook	Awning	3'-0" X 4'-10"
Bedroom (2)	Awning	2'-0" X 4'-10"
Water Closet	Awning	2'-0" X 2'-0"

Table 4:2. List of windows used for Overwater Rooms

4.14 Methodology to Construction Foundation

A steel pile gate will be constructed that will demarcate the exact position of each pile for the building units. The pile gate will be placed on the seafloor and lined up by a surveyor to ensure the location is correct. The H-Pile will be hoisted by a crawler crane and placed within the pile gate on the sea floor. A hydraulic vibrating hammer suspended from the boom of the crane will be used to vibrate the pile into the seafloor to the desired depth. This process will be repeated to drive all the piles for the units and the boardwalk. Once the piles are driven to the requisite depth, the piles will be cut the desired length by Oxygen Acetylene cutting torch.

The PVC Sleeve will be placed over the H-Pile and placed at least 2” below the sea floor, to further protect the H-Pile. Ready mixed concrete will be brought to the staging area by concrete mixer truck. The Ready mixed concrete would be poured from the mixer to large containers at the staging area. These containers would be taken up by crawler crane on the beach and placed on the pontoon, where another crawler crane on the pontoon will pick up the container and place same over the sleeve and pour the concrete. This process will be done in a manner to reduce the possibility of the concrete getting into the sea. Workmen would be on floating platform to perform the tasks required to facilitate this process.

4.15 Building and Walkway Construction Methodology

The construction of the Rooms and boardwalk would commence when the pile foundation is completed. The material would be taken to the building site from the beach via a custom-built floating barge. A skilled crew of tradesmen (carpenters/electricians, plumbers etc) and labourers will be utilized to construction the rooms and boardwalk structure. The construction will begin with the laying down of the beam and floor joist on the pile foundation, then construct the main structural frame of the building and boardwalk.

A temporary platform of plywood would be laid on the floor joist along the boardwalk to aid the flow of material and workmen to the buildings. Once the structural frames are completed, the roof of the building will be built, before proceeding to build the flooring and putting up the internal and external walls of the building. The Mechanical, Electrical and plumbing fittings and equipment would also be working in tandem as the building construction is being done. The external and internal finishes and would then be done.

4.16 Utilities

All the required utilities that are expected in a typical hotel room will be provided to the rooms of this structure. The conduit for all utilities will run under the boardwalk as required by the planning guidelines for the overwater structure (See figures 4.10 and 4.11 below). All the pipelines and cables rest on the 2" x 8" Greenheart joist girder, except the Sewage pipelines which will rest on a specially built bracket. Resysta siding will shield both sides of the boardwalk, providing an additional shield of protection. The conduits are well protected from environmental elements within the boardwalk and cannot be easily reached accidentally. The following conduits are found under the boardwalk;

- 2" PVC Conduit for Cable Television
- 2" PVC Conduit for Data/Voice
- 2" PVC Conduit Fire Protection Cable
- 1 1/2" PVC Schedule 40 cold water supply
- 1 ¼" CPVC Schedule 40 hot water supply (insulated)
- 1" CPVC Schedule 40 hot water return (insulated)

- Two (2) x 25mm PVC Conduits for walkway lighting
- Eight (8) – 35mm 4 Core XLPE electrical cables
- Two (2) - 50mm 4 Core XLPE electrical cables
- Two (2) – 25mm 4 Core XLPE electrical cables
- 4” and 6” PVC schedule 40 Sewage pipelines

Figure: 4.10 Photo, showing utilities under boardwalk at SRC

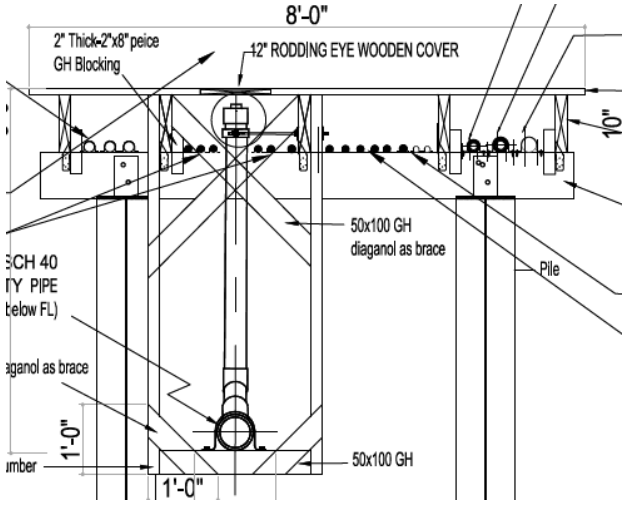

Figure: 4.11. Diagram, showing utilities under boardwalk

4.17 Sewage System Design

Sewage is generated from the following for each of the overwater rooms,

- One (1) Toilet
- Two (2) Bathrooms (Indoor and outdoor)
- On2 (1) Circular Soaking Tub on patio
- Two (2) Bathrooms sinks
- One (1) Pantry Sink

A gravity feed sewage system will be used to take the sewage from the structure to a lift station located on the mainland, which will then be pumped to the tertiary Wastewater Treatment Plant located on the property (see **Appendix 3**). The gravity feed system will be using a combination of 4” and 6” PVC schedule 40 sewage pipelines, with slopes of 1:80 and 1:100 at varying points. The pipelines are secured within a Greenheart wooden bracket and metal hanger every 5 feet. The pipelines would be aided by a flushing system from either side of the heart shape structure.

The sewage will leave the units in 4” sewer pipelines, gravity feeding at slope 1:80. For Rooms 4 through Room 9 (which represents the southern half of the heart shape structure), the 4” sewer pipeline would connect into another 4” sewer pipeline below the boardwalk, continuing to slope at 1:80. This 4” main pipe will change to 6” pipelines adjacent to Room 3 and Room 10 of the structure (this is at opposite side of the structure) and will slope at 1:100. As such the 4” pipe from Rooms 1 – 3 and Rooms 10 – 12 would connect to 6” pipes. The 6” pipes will meet at the intersection where the heart shape meets the straight portion of the boardwalk that connects to the land (See Figure 4.12). At this point, the pipes coming from left and right side of the boardwalk will go into a prefabricated manhole (See Figure 4.13).

The gravity feed will continue from the prefabricated manhole, with a 6” pipeline proceeding from the manhole, down the boardwalk at slope 1:100. This pipeline would lead into a prefabricated manhole on the mainland, exiting via another 6” pipeline, sloped at 1:100 and go into another prefabricated manhole. The sewage would exit this second manhole on the mainland via 6” pipeline at slope 1:80 and enter into an existing Lift station. The lift station would be equipped with two (2) 5hp Gorman Rupp Sewage pumps (one of which would be a stand-by pump) that will be controlled by a float switch that would automatically pump sewage from the lift station to the WTTP.

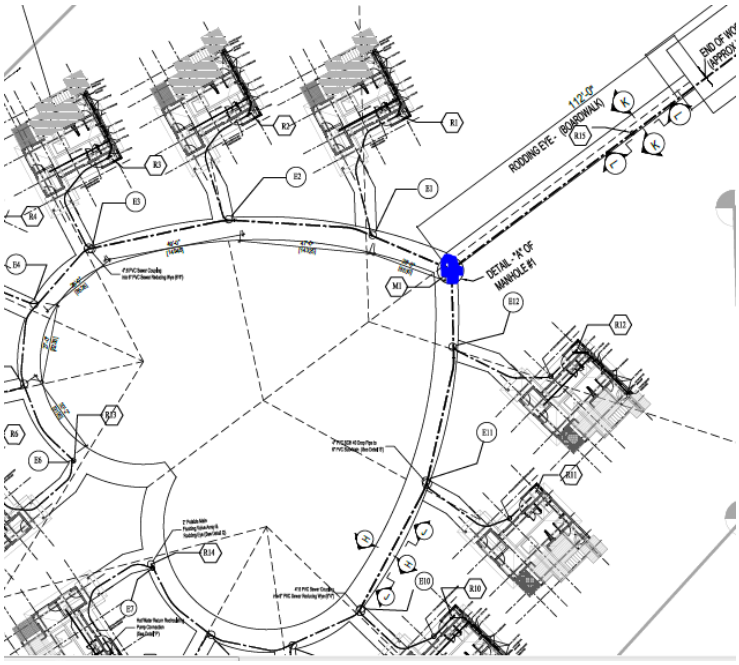

Figure: 4.12. Showing sewage pipe under boardwalk, the blue represents the prefabricated manhole.

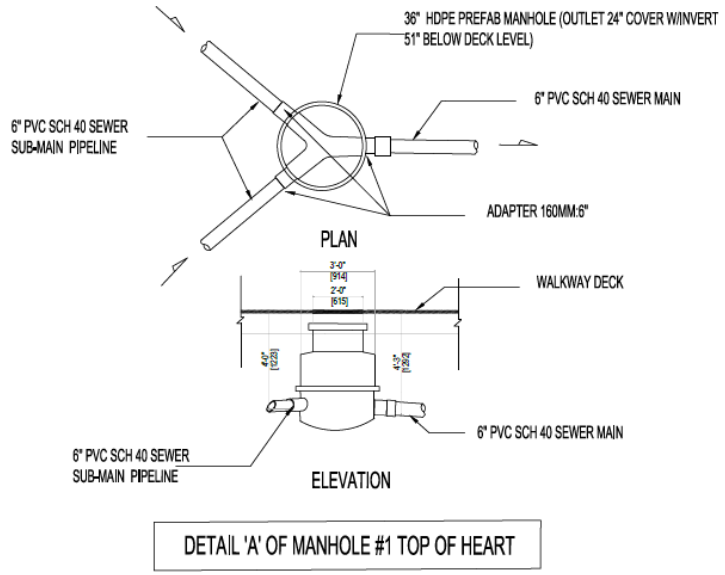

Figure 4:13. Showing Design of Manhole under the boardwalk

4. 18 Lighting

The buildings are designed with 4 main external lighting. Two (2) of these would be the entry lights to the rooms, coming off the boardwalk. The other two (2) outside light will be either side of the patio door. All of these lights would have the required lamp shade as shown in Figures 4.14 and 4.15 below.

Figure: 4.14. Patio Lights at SRC

Figure: 4.15. Lamp Shade

The outdoor bathroom will have six (6) small recessed lights that done illuminate much beyond the bathroom. There will be five (5) Amber led flood light on the landing of the patio (2) and going down the steps towards the Swim-up Platform (3). There will be two (2) lights interior black baffles design lamp that will be placed under the villa (see Figure 4.16), along with two led underwater lights.

Figure: 4.16. Under Rooms Light Fixture

The boardwalk will be lit with a low impact red LED light that is recessed within the Greenheart studs along the boardwalk. The boardwalk light as designed will not focus behind the boardwalk. (See current installation at SRC in Montego Bay in Figures 4.17 and 4.18.

Figure: 4.17. Showing Light installation at SRC

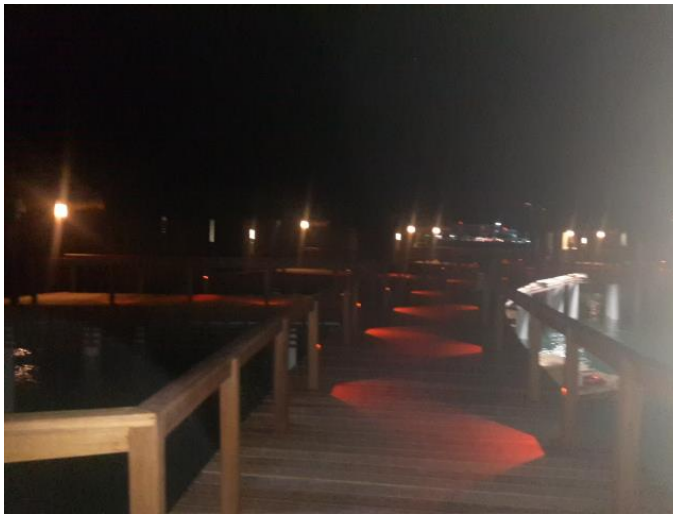

Figure: 4.18. Showing light along boardwalk and general light impact at SRC

4.19 Fire Plan and Equipment

To protect the buildings and structure from fire adequate fire equipment will be installed within each suite. Each suite will be outfitted with the following equipment (see Figure 4.19 below)

- One (1) 10ABC Fire Extinguisher
- Pull Station & Strobe light
- Three (3) Smoke Detectors

A central fire control panel will be installed and manned 24 hours by security personnel.

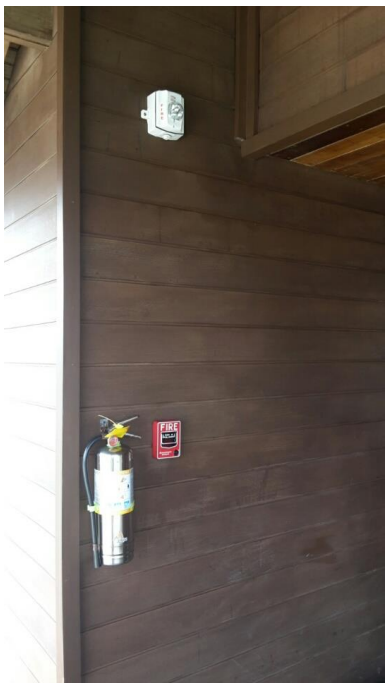

Figure 4.19. Fire equipment at SRC

4.20 Transporting Material to the site

Material and equipment will be transported to the worksite along the South Coast Highway and via Montego Bay. The pontoon will be transported via the sea from Montego Bay around the south coast. All trucks that are transporting material needs to be licensed and well maintained, observing all the relevant traffic laws of Jamaica. All equipment that the contractors have on site needs to be in good working condition and well maintained. Operators of machines and equipment need to be licensed to operate such equipment where applicable and use the requisite personal protective equipment (PPE) as required.

4.21 Project Parking Area

Parking will be provided at the Staging area, which is located west of the hotel. This site will only be used by the Project team and is manned by 24 hours security that operates the entrance gate. The parking area of the staging area needs to be clearly defined and be away from the active work area.

4.22 Storage and security

The project material will be stored in two locations.

- At the staging area that will have 24 hours security that will man a locked gate and be provided with adequate lighting. The storage needs to be done in an orderly manner so that material can be easily located and the safety of workers is not jeopardized.
- The Project Department has a large storage area to the East of Property that will be used to store material that needs internal storage or that the construction team is not ready to use. This area is also well secured with 24 hours security that operates the locked gate.

Hawkeye Security is providing security services to the property and will put plans in place to ensure the perimeter of the property is not breached. They will be responsible for ensuring the safety of equipment, material, and personnel for the life of the project.

4.23 Health & Safety

The contractors are required to ensure their workforce is equipped with the relevant PPE for the required tasks that they are carrying out. Medical First aid kit needs to be available on the site to for initial treatment of any injury. SSCJ has 24 hours nursing serving available that can be utilized if the need arise. The contractors are responsible for ensuring that the requisite actions are taken to reduce and eliminate hazards on the project site.

4.24 Project Equipment

- Deck Barge 140 feet x 50 feet x 9 feet
- Two (2) – Link Belt LS 518 lattice boom crawler crane (140 Ton Capacity)
- Clam shell bucket (2 Cubic Yard Capacity)
- ICE Variable moment vibrating piling hammer
- Komatsu 380 front end loader
- Komatsu PC 300 excavator
- 2 Welding plants
- 2 Cutting torches
- Miscellaneous tools
- Tender 15 feet in length with a 25 hp outboard
- 24 foot Boston whaler with twin 150 hp engines
- Two (2) – 22 foot long push boats
- Isuzu Tipper
- Isuzu ELF box body truck
- Isuzu bus
- 20 Ton Grade all Sky track
- JCB Back Hoe
- Bobcat mini Excavator
- 6660lb dumpster
- Two (2) Concrete mixer
- Genie TML Lighting Plant
- Miller Generator 1
- Black and Decker Arc Compressor

4.25 Main Construction Material Used on Project

4.25.1 Rust Grip

Rust will be used to coat the exposed I-Beam to protect it from corrosion due to the influence of the marine environment (see brochure in **Appendix 4**). Rust Grip is described as "a tough, one-part, moisture-cure polyurethane coating that absorbs atmospheric". When it is cured Rust Grip provides a protective coating film of superior adhesion and flexibility and is resistant to abrasion and impact. It is typically used as a one-coat system on new or existing bridges, oil platforms, roofs, and other commercial/industrial surfaces with minimal surface preparation. This product received a number of successful certifications including, marine approvals for salt water/maritime use by:

- ✓ DNV (Det Norske Veritas)
- ✓ ABS (American Bureau of Shipping)
- ✓ IMO (International Maritime Organization)
- ✓ US Coast Guard

4.25.2 Greenheart Timber

Greenheart (*Chlorocardium rodiei*) timber is the main external structural wood that will be used to construct the overwater rooms and boardwalk structure. Greenheart is a tropical hardwood that is attractive, durable, versatile and environmentally friendly. It is world renowned for its strength and durability. It is highly resistant to decay, termites, fire, and marine organisms. Greenheart requires no treatment to enhance its natural resistance and is ideally suited for marine construction. Greenheart has a higher fire rating than any other wood in its class (see Figure 4.20 and full specification in **Appendix 5**).

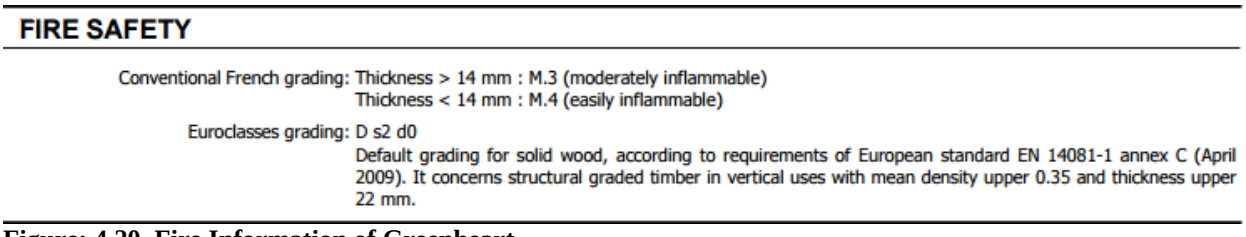

Figure: 4.20. Fire Information of Greenheart

4.25.3 ViroThatch

ViroThatch will be used to cover the roof of the overwater buildings. ViroThatch is made from HDPE (high-density polyethylene) and is Class A fire resistance according to ASTM E 108 below are the characteristics of this product (http://www.virobuild.com/virothatch.html) (see Figure 4.21).

Specification of ViroThatch

- Maintenance Free, Will not remold, rot, or shed.
- Resists termites, birds and other pests that normally infest and breakdown natural thatch.
- Virothatch is 100% waterproof and weatherproof.
- No season shortages because it is factory produced.
- 100% recyclable. Made of HDPE, high-density polyethylene.
- Built-in fire retardant.
- Virothatch will not fade or discolor. Each strand varies in color from brown to honey, giving Virothatch a very natural authentic look.

Figure: 4.21. Showing Virothatch on roof at SRC

4.25.4 Resysta Siding

Resysta is a fiber-reinforced hybrid material, is made to about 60% of rice husk, about 22% of stone salts and about 18% of mineral oil that is extremely water resistant. It is used to construct the external wall, patio floor, and deck of lower of swim-up landing of the overwater buildings. It would also be used as lattice work to shield foundation and boardwalk.

Resysta is extremely durable and at the same time sustainable, which add to the environmental friendly nature of this construction. The product is extremely resistant to external influences, such as sun, rain, or salt water. It is easy to care for, and cannot be optically distinguished from genuine tropical wood (http://www.resysta.com/material-resysta.html). Figure 4.22 below shows some specification of Resysta.

MATERIAL	
Material	Resysta Homogenous extrusion
RAW MATERIALS USED	
Raw materials used	Rice husks Common salt Mineral oil
MATERIAL CHARACTERISTICS	
Density	ASTM D2395:2002
Coeffivient of linear thermal expansion	ASTM D696
Water Absorption & Humidity	ASTM D1037:2006a
Weathering and UV Resistance	QUV Test
Slippery Test (wet area barefoot)	DIN 51097
Fire Rating (german/european norm)	EN ISO 11925-2
Fire rating according NFPA (US Norm)	ASTM E84
Fire rating (British standard)	BS 476 Teil 6&7

Figure: 4.22. Resysta Specification

25.4.5 Polyisocyanurate rigid foam

This is a petroleum derivative that is produced as foam and used as a rigid installation in walls, roof, and foundation. It is used to reduce thermal bridging in buildings, raising the R-Value and reducing or eliminating or reduce air leaks.

4.25.6 Lastobond Shield HT

Lastobond Shield HT (high temperature) is a SBS-modified bitumen underlayment for use in approved steep slope assemblies, and is designed to withstand service temperatures up to 239°F (115°C). Lastobond Shield HT is composed of a proprietary formulation of elastomeric styrene-butadiene-styrene (SBS) polymer modified bitumen in combination with high tack self-adhesive. The topside is surfaced with a high strength tri-laminate polyethylene film and the underside is surfaced with protective polyolefin release film that is removed during application.

4.26.7 Batt insulation

Batt insulation is generally made from fiberglass and comes in pre-cut panels and is used to insulate floors, walls, and ceilings.

FINAL REPORT

5.0 DESCRIPTION OF THE ENVIRONMENT

PREPARED FOR:

Sandals

PREPARED BY:

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April 4, 2017

Document No.: TEMN/SW-2017-02

PREPARED FOR:

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5.0 DESCRIPTION OF THE ENVIRONMENT

5.1 METHOD STATEMENT

The assessment is conducted through literature review as well as fieldwork.

5.1.1 Literature review

Literature review included:

- Aerial photography available from satellite imagery;
- Information on groundwater available from the Water Resources Authority;
- Site maps and development plans provided by the client
- Relevant standards and criteria

5.1.2 Fieldwork

Fieldwork was conducted to determine baseline environmental conditions with emphasis on coastal/marine ecology, coastal dynamics and water resources. This exercise provides a snap shot of existing conditions as well as establishes protocols for future monitoring exercises.

5.1.3 Ecological Survey

The purpose of the ecological survey at Sandal's South Coast was to:

I. Carry out a baseline assessment of existing coastal habitats (marine and terrestrial) and associated flora and fauna in the vicinity of the proposed expansion project (Sandal's South Coast Overwater Bungalows); and
II. Identify potential adverse effects that the proposed overwater structures may have on the environment during project construction and subsequently, during the operation of the facility.

5.1.4 Marine Survey

The marine survey focused on documenting the spatial extent and condition of seagrass beds and the presence/absence of endemic, protected and ecologically and/or commercially important species of flora and fauna in or immediately adjacent to the proposed project site.

5.1.4.1 Marine Transects

A survey of the marine flora and fauna was carried out on February 25, 26th and 28th. Transect locations were selected within and adjacent to the project footprint. A total of five 100 m long transects were surveyed (**Figure 5.1**); three transects (T1, T2, T3) were immediately within the project footprint, while two were at reference sites, one (T5) located near the reef crest ~500m seaward from the project site, and another (T4) ~300m west of the project area where the beach remains undeveloped.

5.1.4.2 Seagrasses, Fishes and Macroinvertebrates

Seagrass density was quantified using quadrats (0.5 m^2 and 1 m^2) placed at 5m intervals along the length of the transects, alternating on the left and right sides of the tape. These quadrats were also used to estimate the density (#/m^2) of fauna including sea urchins, starfish, conch, and any other indicator species encountered. Due to the paucity of fauna along the reef crest (T5), fauna were enumerated within a 2m belt area along the length of transect.

The fish community was assessed using the Atlantic and Gulf Rapid Reef Assessment (AGRRA) belt transect method at the reef crest (T5) and Roving Diver Technique (REEF[1]) along the nearshore transects where the visibility was poor and fish less abundant. The RDT survey data provided species lists and frequency of occurrence for species encountered (i.e., Single, Few, Many, Abundant).

A supplemental Manta tow survey was conducted from the western property boundary to the eastern boundary line of the resort, to document the presence and condition of the seagrass within the sanctuary.

[1] Reef Environmental Education Foundation (http://www.reef.org)

Figure 5.1 Location of fish, invertebrate and seagrass survey transects in and around the project area.

5.1.4.3 Sediment

Given the turbid conditions which persisted throughout the surveys, sediment samples were collected at inshore and offshore locations in order to quantify sediment particle size.

5.1.5 Terrestrial

5.1.5.1 Vegetation

For the purpose of this EIA the boundaries of the study area were determined from Google Earth satellite imagery, site maps and development plans provided. A "walk-through" survey was conducted on February 25 and 26th, 2017 to determine the presence or absence of ecologically and/or commercially important species of flora and fauna on the site. Flora was identified on location, and selected samples photographed for further verification. Six, 5m wide belt transects, of varying lengths were conducted to create a comprehensive plant species list for the vegetation found on and adjacent to the proposed development site.

5.1.5.2 Avifauna

A survey of avifauna was carried out to:

a) Determine the bird species found on and in the vicinity of the proposed development site;

b) Identify the potential impacts of the proposed development on avifauna.

The line transect method was selected for the avifauna assessment as a result of the number of accessible foot paths, trails, and roads in the vegetation. The line transect method entails walking slowly for a given distance or time period along selected routes, noting all the birds seen or heard in the area (Wunderle, 1994). The bird survey was carried out over two days. Night assessments were also carried out for the identification of nocturnal bird species.

Avifaunal species observed between point counts were also recorded. Avifauna identified were ranked according to the following criteria: R = resident; E = endemic; I = introduced; W = winter migrant; S = summer migrant Abundance was based on the DAFOR Scale (Table 5.1):

Abbreviation	Meaning	Value
D	Dominant	9 - 10
A	Abundant	7 - 8
F	Frequent	4 - 6
O	Occasional	2 – 3
R	Rare	1

Table: 5.1. Avifaunal Ranking

5.1.6 Coastal Dynamics/Oceanography

A baseline bathymetric survey and beach profile of the coastline were performed

In situ current and waves were analyzed to provide information on the important coastal processes at work and how they interact with existing structures.

The structural integrity of existing coastal engineering structures is appraised. Recommendations to the optimal configuration of the coastal system will be produced to chart a course for future development

1) Wave analyses: Wave propagation models were used for the analysis of the influence of the nearshore reef on wave conditions. In addition computed wave model, the US NOAA's WAVEWATCHIII model was also consulted. An approximately 10-year wave record in a numerical station that is close to the study site will be analyzed statistically, to evaluate information about wave features.

2) Current: The analysis of currents has been used to determine the extent to which tidal current influences conditions at the study site.

3) Storm and storm surge analysis: the hurricane database at the US National Hurricane Center was utilised to obtain and analyse information on historical hurricanes that have passed the study area within 150 km since 1850. In addition the impact of significant and nearby hurricanes was examined. Potential storm surge by historical hurricanes and hypothetical future hurricanes were modeled using a storm surge model. A storm surge model that is most suitable to the study area's oceanographic and morphologic conditions was selected from existing broadly used models. The selected model was used to simulate storm surge at the study site for historical hurricanes and for future hypothetical hurricanes.

4) Tsunami risk analysis: Literature review on Caribbean tsunami research was conducted to gather published information on Tsunami risks.

5.1.7 Water Quality

Baseline water quality was established using portable equipment as well as collection of samples for analysis in the laboratory. Dissolved oxygen, temperature, salinity, pH and turbidity were determined in the field using portable Instrumentation, while nutrients and microbiological analyses were conducted using accredited laboratory facilities/methods. Analytical methods are summarised in **Table 5.2.**

Parameter	**Method**
Field Work	
Dissolved Oxygen	YSI Meter
Turbidity	Horiba Water Quality Checker U-10
pH	Horiba Water Quality Checker U-10 (Glass Electrode)
Depth	Speedtech Portable Depth Sounder
Salinity	Horiba Water Quality Checker U-10
Temperature	Horiba Water Quality Checker U-10
NON METALS	
BOD	5210 B. 5-Day BOD test
Faecal Coliform	9222 D. Fecal Coliform Membrane Filter Procedure
Nitrates	Colourimetric Automated Cadmium Reduction 353.2
Ortho-phosphate	Colourimetric Automated Ascorbic Acid Method 365.1
TSS	2540D Total Suspended Solids Dried at 103-105◦C

Table: 5.2. Summary of Water Quality Methods

The water quality survey was conducted on Thursday, February 16 between 0830 and 1130 hours. Samples were collected from a 20 ft. Boston Whaler Boat, “Foundation”, operating out of the Whitehouse Marine Sanctuary. Water sampling locations are shown in **Figure 5.2.** Samples were collected and field measurements conducted at the marine sites, Stations 1 to 4. At these sites, field measurements were made for Dissolved Oxygen, pH, Salinity and Temperature at the surface and

at the bottom of the water column. Field measurements were also conducted at the Water Sports pier and in the pond just east of the resort.

Figure 5.2: Water Samplings Points

Samples were placed on ice immediately on collection and taken to the laboratories, on the same day, to be analysed for faecal coliform, suspended solids, nutrients (nitrates and phosphates) and BOD.

Three laboratories were utilised for conducting the analyses:

- Scientific Research Council (BOD and ortho-Phosphate);
- Bureau of Standards (faecal coliform, Total Suspended Solids, and Oil and Grease);
- Environmental Health (Seawater Nitrate).

5.1.8 Carrying Capacity

A rapid appraisal methodology was employed to conduct the carrying capacity analysis.

The rapid appraisal methodology for the carrying capacity analysis used the following process:

1. A definition of the area of Impact and Analysis
2. Identification of Issues and Concerns
3. Reviewing of existing assessments, information and studies including those assessments and information gathered as part of this project and related to, but not limited to, the ecology, vegetation, culture, social-economics, transportation, hazards, hydrology, and biology.

5.1.9 Natural Hazards

A **Phase 1 rapid natural hazards risk assessment** was undertaken based on the types and scale of the input data available, to look at the types of atmospheric and geological hazards that could realistically affect the proposed site.

A **preliminary risk analysis** to identify the impacts and likelihood of each hazard, as applicable based on available data was done and the risks associated with the proposed site were identified.

A **vulnerability analysis** was conducted based on published reports, academic papers and experience and knowledge of members of the community. Additionally **climate change** effects on each hazard were assessed and analysed.

5.1.10 Hydrogeology

The site reconnaissance was then verified against the published data, referenced below:

- A Geotechnical Classification of Jamaican Rocks, formerly the Geological Survey Division (currently the Mines and Geology Division), 1983
- Satellite Photographs taken from Google Earth's
- Topographic Plans of the architects for the site
- 1: 50,000 (Provisional) Metric Series Geological Sheets 10 (1984, revised 2008).

- Water Resources Authority (WRA) Data

All occurrences material to the site, such as hydrologic events, groundwater pollution incidents, flooding incidents, and other critical events within a 1 km radius centre of the site.

The hydrological assessment was conducted using the rational method which is used around the world for peak flow estimation of small rural drainage basins and is the most widely used method for small urban drainage design.

5.1.11 Data Analysis

Baseline data was compared with available relevant historical data, data from similar sites and NEPA standards.

Based on analysis of the data an evaluation of level of impact has been made, as well as a projection of future impacts of planned development. Where appropriate, mitigation strategies have been recommended.

5.2 Observations & Results

5.2.1 Marine

5.2.1.1 Inshore Ecosystem-Seagrass

The project site is located on a sandy shelf with a shallow backreef area (2-5m) that extends ~500m seaward towards a low-lying reef crest. The backreef area supports extensive seagrass beds that extend across the entire reef flat. The seagrass beds appear marbled in satellite imagery (Google Earth 2001-2016) which is consistent with the variable seagrass densities observed throughout the bay. The dense seagrass meadows are dominated by *Thalassia testudinum*, and fringed by *Halodule wrightii and Syringodium filiforme* closer to shore. Small 1 to 2m diameter bare patches observed in the meadows on the eastern side of the bay are indicative of bioturbation, due to the feeding behavior of the Southern Atlantic Stingrays (*Dasyatis americana)* frequently seen in the area (source Whitehouse Sanctuary Staff).

The habitat (T1-T4) within the project footprint can be described as shallow (2-4m) dense, mature *Thalassia* seagrass beds with densities ranging between 173 and 328 shoots/m^2, and blade lengths from 15-30 cm (**Table 5.3)**. *Thalassia* meadows that surround the groyne in the project area are interspersed with *Halodule* and *Syringodium* species which are observed closer to shore. Algal species associated with *Thalassia* beds include various species of green algae (*Halimeda, Penicillus, Udotea*) found growing between seagrass shoots, as wells as brown (*Sargassum, Dictyota, Padina, Rosenvingea* spp.) and red algae (*Spyridia, Hypnea, Wrangelia spp.*) found closer to shore growing amidst *Halodule* and *Syringodium* shoots.

Transect	**Depth (m)**	***Thalassia testudinum* Shoot Density (#/m2)**	**Seagrass Maximum Blade Length (cm)**
T1	3-4	214	25
T2	3-4	275	25
T3	3-4	328	30
T4	3-4	87-135	20
T5 (Reef Crest)	4	173	15

Table 5.3 *Thalassia testudinum* shoot density (#/m2) found along transects surveyed near the project area.

Invertebrates

Thalassia meadows provide an important habitat and feeding grounds for many marine species (**Figure 5.3**). Seagrass blades are consumed by turtles, some fish species, and urchins. The epiphytes which grow on the grass blades (e.g. algae, diatoms and bacteria) serve as a source of food for conch and many small invertebrates. Seagrass meadows provide vital habitat to juvenile fish as well as bivalves, other molluscs, polychaete worms, crabs, shrimp and urchins which hide among the seagrass blades.

Common fauna found in the seagrass beds within the project footprint included the Variegated Sea Urchin (*Lytechinus variegatus*) occurring at 2.6-4.4 individuals per m^2, West Indian Sea Egg Urchin (*Tripneustes ventricosus*) occurring at <1 individual/m^2, the occasional Cushion Star (*Oreaster reticulatus*), Apple murex sea snails (*Phyllonotus pomum*), hermit crabs, as well as various species of bivalves (**Table 5.4**). No conch were observed in the project footprint, but were found scattered in the sparse seagrass beds in the vicinity of the reef crest (T5) and throughout the seagrass beds in the bay.

Common Name	**Scientific name**	**T1**	**T2**	**T3**	**T4**	**T5 Reef Crest**
Long-Spined Urchin	*Diadema antillarum*	-	-	-	-	0.1
Rock Boring Urchin	*Echinometra lucunter*	-	-	-	-	0.1
West Indian Sea Egg Urchin	*Tripneustes ventricosus*	0.2	-	-	-	0.02
Variegated Sea Urchin	*Lytechinus variegatus*	4.4	2.6	3.0	0.6	0.08
Pencil Sea Urchin	*Eucidaris tribuloides*	-	-	-	-	0.03
Cushion star	*Oreaster reticulatus*	0.18	0.04	-	-	0.07
Brittle star	*Ophiuroidea ssp.*	-	-	-	-	0.02
Common Comet Star	*Linckia guildingii*	-	-	-	-	0.01
Sea cucumbers	*Holothuroidea*	-	-	-	0.02	-
Conch	*Lobatus gigas*	-	-	-	0.02	0.01
Spiny Lobster	*Panulirus argus*	-	-	-	-	0.01

Table 5.4 Macroinvertebrates found along seagrass transects (T1-T4) and along the reef crest (T5).

Figure 5.3 Seagrass beds provide habitat and feeding grounds to various juvenile fish species, shrimp, crabs, urchins and other echinoderms, gastropod molluscs and bivalves.

5.2.1.2 Reef Crest

The substrate in the reef crest area, located ~500m seaward of the project site can be described as predominantly rubble and pavement, with sporadic coral heads. Moving east along the 100m transect (parallel to the shore), the substrate transitioned into sparse seagrass and coral reef (~4% coral cover). The visibility at the reef crest was notably better relative to the inshore seagrass area (~5-7 m) at the time of investigation.

Invertebrates- Reef Crest

Coral species observed along the surveyed segment of the reef crest included *Siderastrea siderea, Diploria strigosa, Orbicella annularis, Porites astreoides, Proites porites, Agaricia agaricites, Siderastrea radians* and fire coral, *Millepora*.

Invertebrate species associated with the reef crest habitat included: five urchin species Long-Spined Urchin *(Diadema antillarum),* Rock Boring Urchin *(Echinometra lucunter),* West Indian Sea Egg Urchin *(Tripneustes ventricosus*), Variegated Sea Urchin (*Lytechinus variegatus*) and Pencil Sea Urchin (*Eucidaris tribuloides);* Cushion and Common Comet sea stars; the cryptic Brittle stars, as well as the occasional conch and lobster. *Diadema antillarum* were the dominant urchin species on the reef crest (**Figure 5.4**).

Figure 5.4 Whitehouse reef crest community.

Fish

Seven fish species were observed during the transect and roving surveys (**Table 5.5**). It is likely that the low number of observations can be attributed to poor visibility (< 0.5m) resulting from turbid conditions that persisted throughout the survey. The observed number of species, especially

juvenile fish, is therefore considered to be an underestimation of the fish community associated with the seagrass beds in the Whitehouse Sanctuary area. By contrast, 11 and 21 fish species were observed during the transect and roving surveys on the reef crest and surrounding areas. Of these, Parrot fish (Scaridae) were the dominant family.

Common Name	Scientific Name	Reef Transect #/200m^2	Reef Roving	Seagrass Transects
Butterflyfish				
Foureye	*Chaetodon capistratus*		S	
Grunt				
Caesar	*Haemulon carbonarium*		F	
Porkfish	*Anisotremus virginicus*		S	
Parrotfish				
Greenblotch	*Sparisoma atomarium*			S
Princess	*Scarus taeniopterus*	10	A	
Queen	*Scarus vetula*		S	
Redband	*Sparisoma aurofrenatum*	1	F	
Stoplight	*Sparisoma viride*	1	F	
Striped	*Scarus iseri*	26	A	
Grouper/Hind				
Graysby	*Cephalopholis cruentata*		S	
Surgeonfish				
Blue Tang	*Acanthurus coeruleus*	4	F	
Doctorfish	*Acanthurus chirurgus*	31	A	F
Wrasse				
Slippery Dick	*Halichoeres bivitattus*	26	A	M
Spanish Hogfish	*Bodianus rufus*		S	
Bluehead wrasse			A	
Yellowhead Wrasse	*Halichoeres garnoti*	17	A	
Filefish				
Scrawled Filefish	*Aluterus scriptus*	1	S	
Porcupinefish				
Porcupinefish	*Diodon hystrix*	1	S	
Other Fishes				
Bar Jack	*Caranx ruber*			F
Yellowtail Damselfish	*Microspathodon chrysurus*	3	F	
Butter hamlet	*Hypoplectrus spp.*		S	
Goatfish			S	

Longspine squirrelfish	*Holocentrus rufus*		S	
Lionfish	*Pterois sp.*			S
Remora	*Echeneidae*			S
Mojarra	*Gerreidae*			F
Total number of species		11	21	7

Table 5.5. Fish species abundance observed during transect and roving-diver surveys in Whitehouse Sanctuary.

5.2.1.3 Sediment/Sieve Analysis

Groynes have been placed along the shoreline in order to minimize coastal erosion due to storm waves. The placement of these groynes has been successful in building up the beach, particularly along the eastern side however, there is concern that the presence of the long "bar" groyne, may in fact, be preventing natural circulation of water circulation immediately to the west (**Figure 5.5**). The turbid water is not only a deterrent for

Error! Reference source not found.**5.5 Aerial view of groynes placed along French and Dutch Beach segments of the beach. Inshore turbidity following days of rough weather (TEMN 2017 Aerial Photo).**

visitors wishing to swim in clear tropical waters, but it also prevents light from reaching

the seagrass beds and acts to smother the seagrass with fine sediments. Furthermore, the lack of circulation may contribute to the development of undesirable smelly (anoxic), muddy sediments due to lack of flushing and the subsequent accumulation of organic material.

During the seagrass surveys the nearshore waters were notably turbid due to the resuspension of fine sediments following days of rough weather conditions, with winds and waves from the south-west (**Table 5.6**). At the time of the survey, visibility in the immediate vicinity of the groyne field was less than 1 m compared to 2-5 m beyond the groynes where the water circulated freely. The accumulation of fine sediments and organic debris (**Figure 5.6**) in "blowout" pockets (in very shallow water, <2 m deep), the continued resuspension of these sediments, and foot traffic from bathers, are contributing to the erosion and fragmentation of inshore seagrass beds. In certain areas along the beach, the inshore edge of the seagrass beds are receding which contributes to further destabilize the sandy substrate.

Station Name	Lat	Long	% Gravel	% Sand	% Silt/Clay
T0_Inshore	18.111726°	-77.994824°			
T0_Offshore	18.111452°	-77.995086°	0	65.8	34.2
T1W_Inshore	18.110611°	-77.993636°	1.9	93.5	4.6
T1E_Inshore	18.110174°	-77.993245°	0.3	97.7	2
T1 Groyne_Offshore	18.110117°	-77.993732°	1.5	64	34.5
French Beach_Inshore	18.109511°	-77.992765°	6	79.2	14.8
French Beach_Offshore	18.109342°	-77.993066°	1.7	75	23.3
Chapel Inshore	18.107234°	-77.990297°	0.1	50.9	49
Chapel_Offshore	18.107002°	-77.990162°	0.1	49.6	50.3
Italian Beach_Inshore	18.107755°	-77.989143°	0.3	41.4	58.3
Italian Beach_Offshore	18.107504°	-77.988984°	0	80.9	19.1

Table 5.6. Percent particle size distribution at sites along Sandals South Coast Resort shoreline.

.6. Turbidity in the shallow nearshore waters. Accumulation of organic debris at the base of the groynes.

5.2.2 Terrestrial Ecology

5.2.2.1 Site Description

The vegetation on the property was categorised into two main groups: 1) mixed wetland and 2) woodland. There were also three waterbodies on the property.

5.2.2.2 Water Bodies on the Property

Natural Pond

The natural pond was located near the Sandals Hotel property (lat17.868012, long-76.908714). It is surrounded by mangroves with a salinity of 8 ppt. The salinity indicates that the pond is influenced by sea water (see **Figure 5.12**).

Figure 5. 12. The Large natural pond located near Sandals Hotel.

5.2.2.3 Flora and Fauna

5.2.3.4 Flora

Botanical surveys were carried out along trails representing the two main vegetation types. Plant specimens were identified in the field by using plant keys (Adams 1972; Parker 2003). If the plant specimen could not be identified in the field, pictures and voucher specimens were collected and identified at the University of the West Indies Herbarium.

Fifty eight species of plants (n=58) were identified during the vegetation survey on the property (see **Table 5.7**). The plant categories observed were herbs (n=2), shrubs (n=2), orchids (n=1), trees (n=34), grasses (n=4), and vines (n=5.). Only two endemics were identified: 1) Bull Thatch (*Sabal maritime)* and 2) Mountain cabbage (*Roystonea altissima*). Both endemic species are classified as palms and were common on the property. It should be noted that neither species are considered threatened or requiring any special conservation needs.

Table 1.7 The plants identified during the walkthrough of the Sandals, Westmoreland property

	Family	***Species***	**Common name**	**Habit**	**Status**	**Mixed wetland**	**Woodland**
1	Acanthaceae	*Ruellia tuberosa*	Duppy Gun	Herb			A
2	Amaryllidaceae	*Hymenocallis latifolia*	Lily	Shrub		D	O
3	Anacardiaceae	*Magnifera indica*	Mango	Tree			O
4	Apocynaceae	*Plumeria obtusa*	Wild Frangipani	Shrub			O
5	Araceae	*Syngonium auritum*	Arrow head plant	Vine			O
6	Araceae	*Philodendron scandens*		Vine			O
7	Araliaceae	Dendropanax arboreus	Woman Wood	Tree			R
8	Asparagaceae	*Sansevieria trifasciata*	Snake plant, Tiger Cat	Shrub		O	F
9	Asteraceae	*Bidens cynapiifolia*	Spanish needle	Herb			O
10	Avicenniaceae	*Avicennia germinans*	Black mangrove	Tree		F	
11	Bombacaceae	*Ceiba pentandra*	Cotton Tree	Tree			R
12	Boraginaceae	*Cordia sebestena*	Scarlet Cordia	Tree		O	

	Family	***Species***	**Common name**	**Habit**	**Status**	**Mixed wetland**	**Woodland**
13	Boraginaceae	*Cordia gerascanthus*	Spanish Elm	Tree			R
14	Bromeliaceae	*Hohenbergia penduliflora*		Shrub			O
15	Burseraceae	*Bursera simaruba*	Red Birch	Tree			R
16	Caesalpiniaceae	*Caesalpinia bonduc*	Nickernut	Shrub		F	R
17	Caesalpiniaceae	*Delonix regia*	Poinciana	Tree			R
18	Caricaceae	Carica papaya	Pawpaw	Tree			R
19	Combretaceae	*Terminalia catappa*	Almond	Tree		A	O
20	Combretaceae	*Conocarpus erectus*	Button Mangrove	Tree		F	
21	Combretaceae	*Laguncularia racemose*	White mangrove	Tree		D	
22	Commelinaceae	*Commelina diffusa*	Water grass	Grass			O
23	Convolvulaceae	*Ipomoea tiliacea*	Wild potato	Vine		F	
24	Euphorbiaceae	*Ricinus communis*	Castor oil plant	Shrub		O	
26	Fabaceae	*Haematoxylum campechianum*	Log wood	Tree		R	O
25	Fabaceae	*Centrosema plumieri*	Clitoria	Vine			R
28	Gramineae	*Gynerium sagittatum*	Wild Cane	Grass		O	
27	Gramineae	*Bambusa vulgaris*	Bamboo	Tree			F

	Family	***Species***	**Common name**	**Habit**	**Status**	**Mixed wetland**	**Woodland**
29	Lauraceae	*Nectandra sp.*	Sweet wood	Tree			O
30	Leguminosae	*Bauhinia divaricata*	Bull Hoof tree	Tree			R
31	Leguminosae	*Samanea saman*	Guango	Tree		O	F
32	Leguminosae	*Lucina leucocephala*	Lead tree	Tree		O	F
33	Malvaceae	*Guazuma ulmifolia*	Bastard (Baseda) cedar	Tree		R	F
34	Malvaceae	*Thespesia populnea*	Seaside Mahoe	Tree		F	
35	Moraceae	*Cecropia peltata*	Trumpet Tree	Tree			O
36	Myrtaceae	*Pimenta dioica*	Pimento	Tree			R
37	Nyctaginaceae	*Pisonia aculeate*	Cock Spur	Tree		O	F
38	Orchidaceae	*Oeceoclades maculata*	Ground orchid	Orchid			F
39	Palmae	*sabal maritima*	Bull Thatch	Tree	Endemic	R	
40	Palmae	*Cocos nucifera*	Coconut	Tree		A	
41	Palmae	*Roystonea altissima*	Mountain cabbage	Tree	Endemic		O
42	Palmae	*Unknown*	Palm	Tree			F
43	Passifloraceae	*Turnera ulmifolia*	Ram goat dash along	Shrub		F	O
44	Piperaceae	*Piper amalago*	Peper elder	Shrub		R	O

	Family	***Species***	**Common name**	**Habit**	**Status**	**Mixed wetland**	**Woodland**
45	Poaceae	*Pennisetum purpureum*	Elephant grass	Grass		O	
46	Polygonaceae	*Coccoloba uvifera*	Sea Grape	Tree		A	
47	Polypodiaceae	*Adiantum pyramidales*	Fern	Shrub			O
48	Rhizophoraceae	*Rhizophora mangle*	Red Mangrove	Tree		F	
49	Rubiaceae	*Morinda citrifolia*	Duppy sour sop	Tree		O	
50	Rutaceae	*Zanthoxylum martinicense*	Prickly yellow	Tree			R
51	Rutaceae	*Citrus sp*		Tree			O
52	Sapindaceae	*Blighia sapida*	Ackee	Tree			O
53	Sapindaceae	*Melicoccus bijugatus*	Guinep	Tree			O
54	smilacaceae	*Smilax balbisiana*	Sasiperilla, chainey root	Vine			F
55	Solanaceae	*Solanum erianthum*	Wild susumber	Shrub		R	O
56	Typhaceae	*Typha orientalis*	Cattail	Grass		D	
57	Verbenaceae	*Lantana involucrata*	Wild Mint	Shrub			O
58	Verbenaceae	*Lantana camara*	Wild sage	Shrub			F

5.2.3.4 Fauna

Bird surveys

Fifty one (51) species of birds were identified during the assessment (**Table 5.8**): Terrestrial (n=30), Wetland (n=13) and Coastal (n=8). Of the 51 species there were 9 endemics, 32 residents, 4 resident/migrant, 5 migrants and 1 introduced.

Coastal and wetland birds

None of the coastal and wetland bird species were endemic. Only a few shore birds were observed during the study. The Ruddy Turnstone (*Arenaria interpres*) was the most abundant coastal species in the study area (see **Figure 5.13**). Semipalmated plover and Ruddy Turnstone were the other shore bird species observed.

The cattle egret and Yellow warbler were the most abundant birds within the mangrove wetland. Only a few species of egrets and herons were observed with the cattle egret being the most dominant wetland species - several were observed in the mangroves surrounding the ponds on the property (see **Figure 5.14**). It should be noted that no ducks or wading birds, which are mainly migrant waterfowls, were observed during the assessment. It is possible that they were not observed in the ponds as the may have already returned to North America. Thirteen terrestrial species were also encountered in the wetland, which includes a few of the migrant warblers.

Figure 5.13. A flock of Ruddy Turnstone, Arenaria interpres seen on the beach.

Figure 5.14. Little blue heron observed foraging on the beach.

Woodland Birds

Thirty one terrestrial bird species were identified in the woodland (**Table 5.8**). The species composition observed on the property was typical of a dry limestone forest (Downer and Sutton 1990). These birds included the Caribbean Dove, parakeets, hummingbirds, Jamaican Woodpeckers, orioles, and warblers. Of the 9 endemic birds identified, 5 were forest dependent. It should be noted that the woodland and the surrounding forest provide a habitat for birds classified as forest specialists. No birds with special conservation status were observed on the property during the assessment.

Only 5 migrant warblers were observed during the assessment as they begin to depart in late February.

Table 5.8. The birds observed during the assessment on the property.

	Proper Name	***Scientific Name***	**Status**	**Habitat**	**Coast**	**Wetland**	**Woodland**
1	American Kestrel	*Falco sparverius*	Resident	Terrestrial		R	O
2	American Redstart	*Setophaga ruticilla*	*Migrant*	Terrestrial		O	O
3	Antillean Palm Swift	*Tachornis phoenicobia*	Resident	Terrestrial		F	F
4	Bananaquit	*Coereba flaveola*	Resident	Terrestrial		R	F
5	Barn Owl	*Tyto alba*	Resident	Terrestrial			R
6	Belted Kingfisher	*Ceryle alcyon*	Migrant	Wetland		R	
7	Black and White Warbler	*Mniotilta varia*	Migrant	Terrestrial		O	O
8	Black-Crowned Night Heron	*Nycticorax nycticorax*	Resident	Wetland		O	R
9	Black-faced Grassquit	*Tiaris bicolor*	Resident	Terrestrial		R	O
10	Black-necked Stilt	*Himantopus mexicanus*	Resident	Wetland		R	
11	Brown Pelican	*Pelecanus occidentalis*	Resident	Coastal		R	
12	Cattle Egret	*Bubulcus ibis*	Resident	Wetland		F	

	Proper Name	***Scientific Name***	**Status**	**Habitat**	**Coast**	**Wetland**	**Woodland**
13	Cave Swallow	*Pterochelidon fulva*	Resident	Terrestrial		R	O
14	Chestnut Mannikin	*Lonchura malacca*	*Introduced*	Terrestrial			A
15	Common Ground Dove	*Columbina passerina*	Resident	Terrestrial			O
16	Great Blue Heron	*Ardea herodias*	Migrant	Wetland		R	
17	Great Egret	*Casmerodius albus*	Resident / Migrant	Wetland		R	
18	Greater Antillean Grackle	*Quiscalus niger*	Resident	Terrestrial		R	O
19	Green Heron	*Butorides virescens*	Resident	Wetland		R	
20	Jamaican Euphonia	*Euphonia Jamaica*	Endemic	Terrestrial		R	O
21	Jamaican Mango	*Anthracothorax mango*	Endemic	Terrestrial		R	R
22	Jamaican Oriole	*Icterus leucopteryx*	Endemic	Terrestrial			R
23	Jamaican Owl	*Pseudoscops grammicus*	Endemic	Terrestrial			R
24	Jamaican Vireo	*Vireo modestus*	Resident	Terrestrial			R
25	Jamaican Woodpecker	*Melanerpes radiolatus*	Endemic	Terrestrial			O
26	Kildeer	*Charadrius vociferus*	Resident	Wetland	R	R	
27	Laughing Gull	*Leucophaeus atricilla*	Resident	Coastal	R		
28	Least Sandpiper	*Calidris minutilla*	Resident	Coastal	R		
29	least sanpiper	*Calidris minutilla*	Resident	Coastal	R		
30	Little Blue Heron	*Egretta careulea*	Resident	Wetland	R	R	
31	Loggerhead Kingbird	*Tyrannus caudifasciatus*	Resident	Terrestrial			R

	Proper Name	***Scientific Name***	**Status**	**Habitat**	**Coast**	**Wetland**	**Woodland**
32	Louisiana Waterthrush	*Seiurus noveboracensis*	*Migrant*	Terrestrial			R
33	Magnificent Frigatebird	*Fregata magnificens*	Resident	Coastal	R		
34	Northern Mockingbird	*Mimus polyglottos*	Resident	Terrestrial			O
35	Red-billed Streamertail	*Trochilus polytmus*	Endemic	Terrestrial			R
36	Royal tern	*Sterna maxima*	Resident	Coastal	R		
37	Ruddy Turnstone	*Arenaria interpes*	Resident	Coastal	O		
38	Sad Flycatcher	*Myiarchus barbirostris*	Endemic	Terrestrial			R
39	Semipalmated Plover	*Charadrius semipalmatus*	Resident / Migrant	Coastal	O	R	
40	Smooth-Billed Ani	*Crotophaga ani*	Resident	Terrestrial		O	O
41	Snowy Egret	*Egretta thula*	Resident / Migrant	Wetland	R	R	
42	Tricoloured Heron	*Egretta tricolor*	Resident / Migrant	Wetland	R	R	
43	Turkey Vulture	*Carthartes aura*	Resident	Terrestrial			O
44	Vervain Hummingbird	*Mellisuga minima*	Resident	Terrestrial		R	O
45	White-chinned Thrush	*Turdus aurantius*	Endemic	Terrestrial			R
46	White-Collared Swift	*Streptoprocne zonaris*	Resident	Terrestrial			R
47	Yellow Warbler	*Dendroica petechia*	Resident	Wetland		F	R
48	Yellow-Crowned Night Heron	*Nycticorax violaceus*	Resident	Wetland	R	R	
49	Yellow-faced Grassquit	*Tiaris olivacea*	Resident	Terrestrial			F

	Proper Name	*Scientific Name*	Status	Habitat	Coast	Wetland	Woodland
50	Yellow-Shouldered Grassquit	*Loxipasser anoxanthus*	Endemic	Terrestrial			O
51	Zenaida Dove	*Zenaida aurita*	Resident	Terrestrial			O

Herpetology

Sample sites were selected throughout the project area to cover the main habitat types. The selected areas were actively searched throughout the day, and specimens were identified or pictures taken for further study if necessary. This also included the capture of some specimens for closer examination - these were placed in glass bottles or catchment containers, but were subsequently returned to the habitat. Night surveys were carried out mainly to identify the frogs when they become vocal.

Amphibians

Only three amphibians were recorded on the property (see **Table 5.9**): 1) *Eleutherodactylus johnstonei* 2) *Eleutherodactylus pantone; and* 3) *Rhinella marina.* The *Eleutherodactylus* species observed are not endemics and are usually found in highly disturbed areas. Only a few bromeliads were observed in the woodland area of the property. A large number of the amphibians found in Jamaica are found exclusively in bromeliads.

Herps		**DAFOR SCALE**
Rhinella marina	Amphibian	R
Eleutherodactylus johnstonei	Amphibian	A
Eleutherodactylus pantoni	Amphibian	O
Anolis garmani	Reptile	O
Anolis grahami grahami	Reptile	F
Anolis lineatopus neckeri	Reptile	O
Anolis Sagrei	Reptile	A
Aristelliger praesignis	Reptile	F
Sphaerodactylus argus henriquesi	Reptile	O
Trachemys terrapin	Reptile	R

Table 5.9. Amphibians and Reptiles recorded the assessment.

Reptiles

Seven reptiles were identified during the study (see **Table 5.10**). The most abundant reptile in the study area was *Anolis sagrei* (**Figure 15.3**).

Figure 1.15. Cuban Anole *Anolis sagrei*, observed on a post on the coast.

Crocodile

The crocodile survey was conducted on foot during day and night. The day activity entailed walking along the coast of the project area and also the ponds in close proximity to the project area to note crocodile presence/ activity such as tail drag, foot prints, basking areas, and nesting areas.

In general, crocodiles are more difficult to detect in the day than at night because of their secretive habits. The night survey relies on the use of the spotlights to detect the reflective eyes of the crocodiles. It is the most popular method used to estimate crocodile numbers in an area.

The coastal survey involved the main natural pond and two man-made ponds over two days. No crocodiles were encountered on the coast or observed in the two man-made ponds. Members of the community however, mentioned that they have encountered crocodiles in the artificial ponds.

Approximately 5 crocodiles were encountered in the natural pond. Tree crocodiles were seen in the pond in the day and 5 during the night assessment (see **Figure 5.16**).

Figure 5.16. Crocodile observed swimming in the large natural pond.

All the crocodiles encountered were adults. Additionally, potential nesting sites were observed around the natural pond. However, due to the number of crab holes and mounds in the area, it is

difficult to identify the nesting areas used by the crocodiles. An old crocodile trap was seen at the pond, suggesting that the animals were once removed from the area.

Crocodiles are very mobile animals and they will move from one wetland to another. According to staff member of the hotel and the local fishermen, crocodiles have been seen basking on beach and also at the groyne, in close proximity to the main project area.

Fresh Water Turtles

The fresh water turtle, *Trachemys terrapin,* was reported by the fishermen and crab catchers to be present in the large natural pond. However, none were encountered during the survey.

Sea Turtles

According to the staff and community members in the area, sea turtles regularly nest on the beach, including the beach to the west of the groyne of the proposed development (Turtle Beach).

In 2016, a total of 18 nests were recorded of which 10 were lost due to natural predation (from mongoose, ants) and the passage of Hurricane Matthew. From the 2016 nesting period (observation from April to December) 950 hatchlings were released.

No turtle tracks were observed on the beach during the surveys; however, it should be noted that the walkthrough of the area was conducted outside of the peak turtle nesting season which is usually between March and June.

Hawksbill Turtles

Hawksbill Turtles (*Eretmochelys imbricata*) are ranked internationally as 'Critically Endangered' (IUCN), and in Jamaica, they are protected under the Wild Life Protection Act. It is a criminal offence to hunt, kill or have any part of the turtle, including eggs, in one's possession. Despite the endangered designation and legal protection, the illegal harvesting of hawksbill turtles and their eggs continues to be one of the major threats facing these marine animals. In addition to illegal harvesting, hawksbill turtles in Jamaica are further threatened by natural and introduced predators (e.g., dogs, wild pigs, and mongoose), degradation of the marine environment (pollution), marine

debris (plastics and fishing nets), and especially by loss of nesting habitat due to coastal development.

Butterflies

The butterfly species encountered during the walkthrough of the property were noted using the appropriate butterfly keys. No specimens were collected during the assessment. However pictures were taken of species that could not be identified in the field.

Fourteen butterfly species from 7 families were identified during the study (see **Table 5.10**). Of the 14 species 3 were endemic. None of the species are of any special conservation needs.

FAMILY	**GENUS & SPECIES**	**COMMON NAME**	**DAFOR RATINGS**	**COMMENTS**
Hesperiidae	*Pyrgus oileus*	Syrichtus	O	Occurs in southern U.S., Mexico, Costa Rica and Isles of the West Indies
Nymphalidae	*Anartia jatrophae jamaicensis*	The Jamaican White Peacock	D	Endemic subspecies, common in Jamaica
Nymphalidae	*Phyciodes frisia*	Cuban Crescent Spot	R	
Nymphalidae	*Mestra dorcas*	Dorcas	O	Endemic to Jamaica, widespread.
Nymphalidae	*Siproeta stelenes stelenes*	The Antillean Malachite	R	
Pieridae	*Phoebis sennae sennae*	The Cloudless Sulphur	O	Occurs throughout the West Indies

FAMILY	GENUS & SPECIES	COMMON NAME	DAFOR RATINGS	COMMENTS
Pieridae	*Ascia monuste*	Antillean Great white	O	Common throughout West Indies
Heliconiidae	**Heliconius charitonius simulator*	The Zebra	O	Endemic subspecies; from Montserrat to Andros Island, Bahamas
Heliconiidae	*Dione vanilla vanillae*		O	Widespread in West Indies
Heliconiidae	*Dryas iulia delia*	Julia	F	Widespread, West Indies & America
Papilionidae	*Papilio andraemon*	Cuban Swallowtail	O	Introduced, Cuba, Bahamas and Florida
Lycaenidae	*Hemiargus hanno*	Hanno Blue	O	Widespread, West Indies & America
Lycaenidae	*Leptotes cassius theonus*	The Cassius Blue	O	Endemic , widely distributed throughout Jamaica
Arctiidae	*Empyreuma anassa*		R	Jamaican endemic, widespread

Table 5.10. The butterfly species observed during the assessment of the area.

5.2.3.5 Other fauna observed

Crustaceans

Several crabs and their holes were seen in the mangrove wetland. There were approximately 6 holes/m^2. Community members were observed catching crabs in the wetland (see **Figure 5.17**).

Figure 5.17. Crab man Dennis observed catching crab in the wetland (Lat -18.114458, Lon -77.990984).

Mammals

Goats and mongoose were seen on the property during the survey.

5.2.3.6 Ecological Carrying Capacity and Limiting Factors

Whitehouse Beach

This section of beach falls within the Whitehouse Fish Sanctuary and is a known nesting site for hawksbill turtles. Sandals South Coast Resort (formerly Sandals Whitehouse) has been actively supporting and promoting turtle conservation initiatives. Working closely with the Whitehouse Sanctuary and the Bluefield's Fishermen Friendly Society, Sandals has created a Hawksbill Turtle Farm at their resort[2]. Since 2013, Sandals, along with WH Sanctuary staff, Bluefield's Bay Friendly Fishermen's Society (BFFS) and volunteers, have played an instrumental role in protecting hawksbill turtle nests and ensuring that thousands of hatchlings make their way to ocean each year.

[2] http://jamaica-gleaner.com/gleaner/20140616/news/news3.html

For the purpose of this analysis 'Whitehouse Beach' refers to the 2.4 km stretch of sandy beach (**Figure 5.19**) which includes the ~0.8 km Sandals South Coast Resort tourist beach, highlighted in Red, a natural ~1 km beach to the west of the resort highlighted in green and a small beach (~0.5 km) to the east of the resort highlighted orange.

The turtle nesting data for Whitehouse beach were provided by different sources (**Table 5.11**) and include partial data from 2011, 2013 for the turtle farm, and more detailed data for 2014, 2015 and 2016 nesting seasons.

Source	Beach name	Year	# Nests	# Attempts	# Nest lost	# Nests moved	# Trash	# Eggs	# Hatchlings	Success Rate (%)
BBFFS	Whitehouse	2011	5	-	-	-	-	-	-	-
Sandals	Sandals Turtle Farm	2013		-	-	-	-	-	478	-
BBFFS	Whitehouse	2014	19	-	-	3	804	-	756	94
Whitehouse Sanctuary	Whitehouse	2015	29	9	-	3	1123	-	1066	95
Whitehouse Sanctuary	Whitehouse	2016	18	-	10	-	-	-	950	-
	Averagae # nests		22							
BBFFS	Farm Beach	2011	20	-	-	-	-	-	1019	-
BBFFS	Farm Beach	2012	21	-	-	-	-	-	-	-
BBFFS	Farm Beach	2013	71	-	-	-	-	-	-	-
BBFFS	Farm Beach	2014	64		-	-	4547	-	3783	83
BBFFS	Farm Beach	2015	43	25	-	-	2678	-	2184	82
BBFFS	Farm Beach	2016	51	60	-	-	3227	-	2154	67
	Averagae # nests		45							

Table 5.11 Hawksbill turtle nesting data for Whitehouse and Farm beach areas. Data were provided by Bluefield's Bay Fishermen's Friendly Society

The 2014 and 2015 nesting seasons recorded the highest nesting activity with 19 and 29 nests respectively (**Table 5.11**). The hatchling success, measured as number of hatchlings vs. trash numbers recorded, were 94% and 95% respectively. In 2015, three of the nests (total of 468 eggs) were relocated as they were deemed to be too close to the shore line. Of these, 129 hatched and were released. In 2016, there were 18 recorded nests, of which 10 were lost due to mongoose predation, ants, and the passage of Hurricane Matthew. Despite the loss of some nests, the number of hatchlings that survived (950) were comparable to previous two years.

It is important to note that for 2016, nests were only reported on the natural part of the beach (Error! Reference source not found.**17**-Turtle beach in GREEN), to the west of the security post. Nests were spread out along this part of the beach, with no apparent clustering.

Figure 5.19. Whitehouse Beach is a 2.4 km stretch of sandy beach which includes the Sandals South Coast Resort tourist beach area (~0.8 km RED), a natural beach to the west of the resort where most of the turtle nesting occurs (~1 km in GREEN), and a small beach area (~0.5 km ORANGE) to the east of the resort.

Farm Beach

Farm beach (**Figure 5.20**) is a small beach located approximately 2 km west of the Whitehouse beach. This beach was used as a reference site because of its relatively untouched state and its proximity to the Whitehouse beach. Despite the relatively small area (0.31 ha), the number of nests on the beach ranged from 20 to 71, with an average number of 45 nests per year, over a five-year period (**Table 5.11**). The number of hatchlings were two to three-fold higher than the number of hatchlings reported for Whitehouse beach. The success rate for the hatchlings (# hatchlings vs. # trash) was 83% and 82% for 2014 and 2015 respectively, but dropped to 67% in 2016, presumably due to Hurricane Matthew.

Figure 5.20. Farm beach located 2k west of Whitehouse beach remains unimpacted by coastal development and supports anywhere from 20-71 nests per year.

5.2.3.7 Carrying Capacity

The highest number of turtle nests (71) reported for Farm beach since 2011, was used to estimate a nest density of 0.023 nests/m^2, or 1 nest per 44m^2 (~6.6m x 6.6m area) (**Table 5.12**). The estimated nest area (i.e. 44 m^2) was subsequently used to estimate the carrying capacity of the entire 5.1 ha of Whitehouse beach. By assuming conditions were equivalent to those at Farm beach (i.e., minimal impact, no development, similar turtle population dynamics), and using availability of nesting habitat, while excluding habitat suitability and other nest selection criteria, it is estimated that the 2.4 km stretch of the pre-development Whitehouse beach could have supported up to 1161 hawksbill turtle nests annually. Using these same assumptions, it can be estimated that the section of the Whitehouse turtle beach that remains in its natural state today, could support up to 559 turtle nests. While it is an accepted fact that the marine turtle populations today represent a fraction (an estimated 3-7%) of their pre-exploitation levels (Jackson et al. 1997), it is important to note that the current nesting density at Whitehouse beach is low and represents <1% of the expected nesting density that could be supported at Whitehouse turtle beach at full capacity.

Based on the comparison to Farm beach, the number of turtle nests reported for Whitehouse turtle beach since 2011 are well below carrying capacity. As such, it can be concluded that other factors, including the impact of the resort, the modification of the beach due to the installation of groynes and in-water structures (i.e., habitat alteration), and the aquatic and terrestrial activities (i.e, trampling, noise, light, debris) are affecting the quality of the habitat and deterring females from returning to their beach. Available information indicates that since the Sandals resort was constructed, 39% of the available nesting space on Whitehouse beach has been permanently altered and is no longer used (regularly, if at all) as a turtle nesting ground. An additional 13% of the beach on the east end of Whitehouse beach has been rendered less than suitable for nesting due to nearby sand mining and high foot traffic. Overall, availability of nesting space has been reduced by 52% since the inception of the resort, and the remaining 48% of the habitat is under considerable stress from increased traffic and debris. It is anticipated that the present impact would be exacerbated by the proposed overwater bungalow development.

The life history of hawksbill turtles, especially the time it takes for them to reach sexual maturity is such that juvenile and mature turtles require high annual survivorship and a long breeding life in order to maintain a stable and reproductively viable population. As such, activities that discourage a female turtle from returning to its nesting site can impact the local population in the short-term, and introduce uncertainty for its future. Once a nesting population is extirpated (loss of all eggs and adults) from a nesting beach, it is highly unlikely that it will recover. It is therefore, extremely important to ensure proper population monitoring and adequate habitat protection to support ongoing turtle nesting and recruitment in the Whitehouse Sanctuary area.

Beach Name	Area (ha)	% Total beach area	Max # nests	Min # nests	Average # nests	Max Density of nests /m²	Area per nesting turtle (ha)	Area per nesting turtle (m2)	Estimated Carrying Capacity (# nest)
Farm Beach Refererence site	0.31	100	71	21	45	0.023	0.004	44	
WH_Turtle Beach	2.44	48	29	18	22				**559**
WH_Tourist Beach	1.96	39							
WH_Eastern Beach	0.67	13							
WH_Total Beach Area	5.07	100							**1161**

Table 5.12. Hawksbill carrying capacity analysis for Whitehouse beach based on habitat availability alone, using nest density (#/m^2), and nest area from a nearby reference site (i.e., Farm Beach).

Risks Associated with the Overwater Structures

The risks posed by the proposed development to the existing nesting hawksbill population and their nesting habitat, will be associated with the operational and construction phases.

During the Construction Phase : Various barges and equipment required for the construction of overwater bungalows have already been placed into the water, over seagrass beds, immediately adjacent to the turtle nesting beach area (western edge of property) (**Figure 21**). Given that April is the beginning of the nesting season, the presence of this equipment, along with the noise during operation of the equipment and the increased traffic on the beach, has the potential to deter returning hawksbill turtles from entering the area and coming up onto the beach to nest. Any debris left on the beach can become an obstacle to a nesting turtle while exiting or returning to the water.

During the Operational Phase: The installation of overwater structures represents a permanent alteration of the habitat which may act to deter female turtles from returning to nest on the Whitehouse beach. In addition to habit alteration and degradation, increased noise and lights from the overwater structures, and increased number of visitors walking along the turtle nesting area, all represent increased threat to the nesting turtles, and consequently, to the long-term success and survival of the Whitehouse hawksbill turtle population.

Figure 5.21. Barges placed into the water for the construction of overwater bungalows.

Other considerations:

During the site surveys at Sandals South Coast Resort conducted in February 2016, there were numerous mongoose sitings (**Figure 5.22**). Mongoose are a confirmed threat to the turtle nests. As such, implementing a trapping strategy aimed at reducing the mongoose population in the vicinity of the Whitehouse beach would reduce, at least in part, the predation risk to the nests along this stretch of the beach.

Figure 5.22. The mongoose population at Whitehouse beach pose a threat to turtle

5.2.2 Coastal Dynamics/Oceanography

5.2.2.1 Baseline Study of Specific Site Development

Introduction

The study area is located along the southwest coast of Jamaica, facing south toward the Caribbean Sea (**Figure 5.23**). The protruding Sandals Whitehouse resort is fairly well protected by a shallow barrier reef about 300 m seaward of the headland. The barrier reef is typically 0.3 m to 0.5 m deep with an approximately 30 m wide gap (**Figure 5.24**). The headland and the curved adjacent shoreline is likely controlled by the wave diffraction around the barrier reef.

This portion of the coastal dynamics study examines the nearshore processes at the Sandals Whitehouse site. Oceanographic conditions, particularly offshore wave conditions, are analysed based on computed waves using the US NOAA WAVEWATCH III model. Nearshore wave conditions are investigated using the CMS-WAVE model developed by the US Army Corps of Engineers. Nearshore sediment processes are examined based on the modeled wave conditions and analysis of the present state of the beach. Impacts by historical tropical storms and hurricane over the past 100 years are analysed based on US NOAA's National Hurricane Center database. This portion of the report is organised such that the above topics are discussed in individual sections respectively.

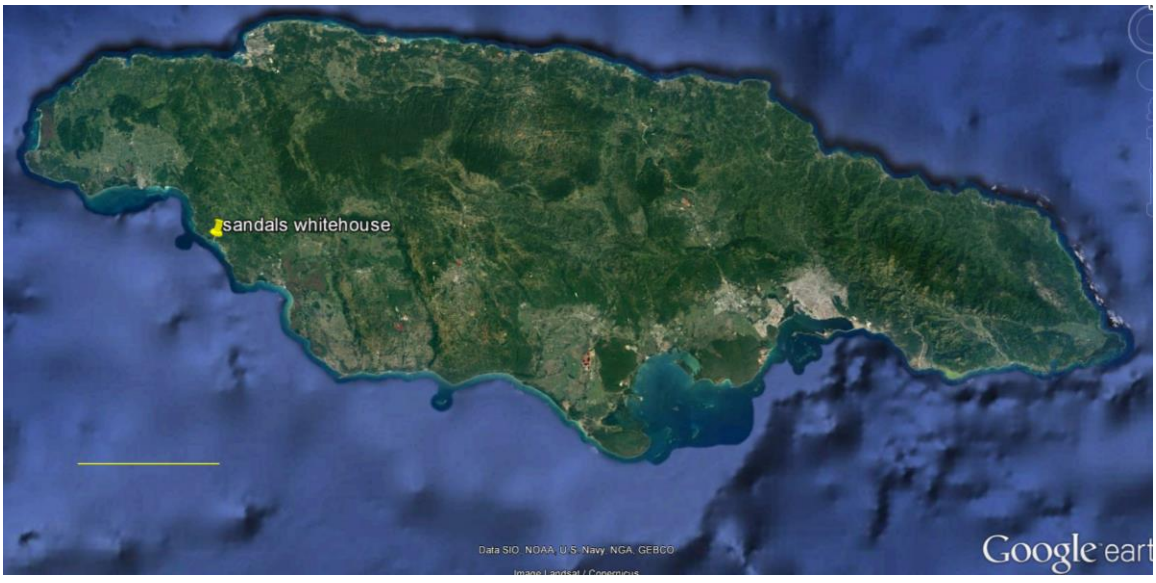


Figure 5.23. The Sandals Whitehouse study site, facing south toward the Caribbean Sea.

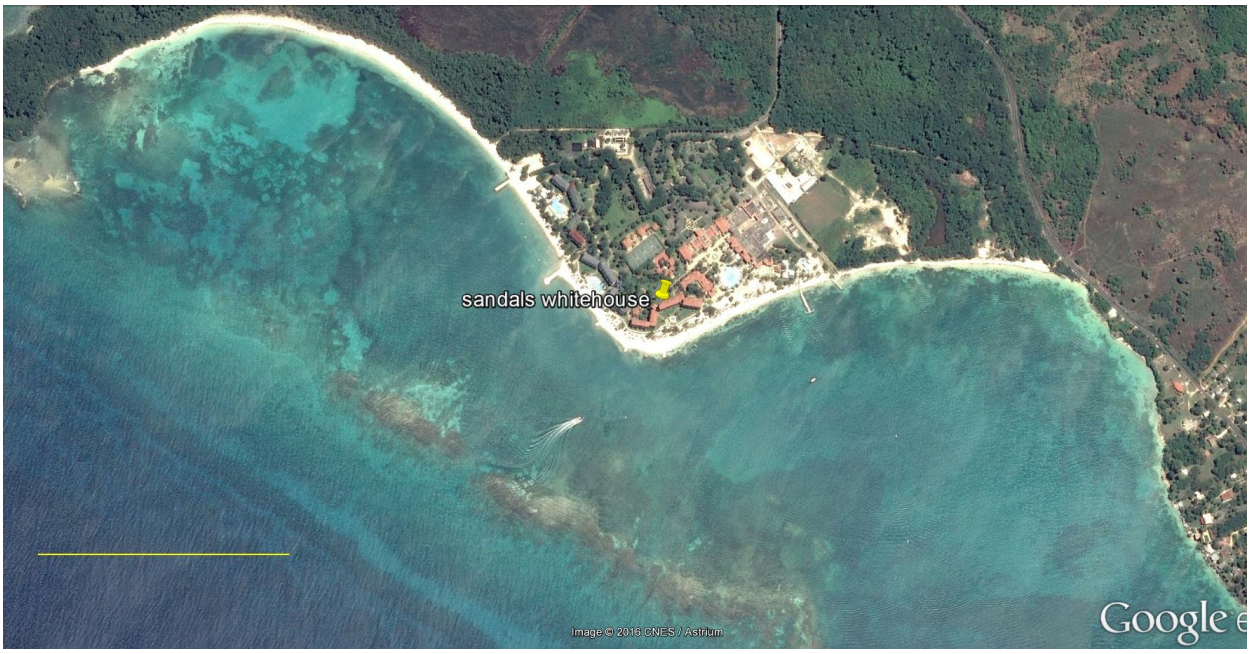


Figure 5.24. The Sandals Whitehouse study site. A shallow barrier reef extends along the study area at about 300 m offshore. Yellow line scale = 500 m.

5.2.2.2 Oceanographic Conditions Offshore the Sandals Whitehouse Study Site

No long-term wave measurements are available in the greater study area. Reasonably accurate wave information can be obtained from US NOAA's WAVEWATCH III numerical model. WAVEWATCH III computes wave conditions based on meteorological measurements. In this study, the wave conditions computed from WAVEWATCH III are extracted from a numerical station approximately 8 km south-southwest of the Sandals Whitehouse study area in deep water. The location of the WAVEWATCH III station is shown in **Figure 5.25**. This is the closest wave station to the study area.

Figure 5.25. The WAVEWATCH III numerical station located about 8 km south-southeast of the Sandals Whitehouse study area.

Computed wave conditions by the WAVEWATCH III model from the beginning of 2005 to the end of 2016, or 12 years, were extracted. Statistical analysis of these relatively long term wave conditions was conducted and is summarised in **Table 5.25** and illustrated in **Figures 5.26** through **Figure 5.2.10**. The waves were partitioned into 16 incident wave angle brackets at 22.5 degrees each bracket. The average significant wave height and average peak wave period within each wave-angle bracket were calculated. The storm conditions are represented by the average of the top 2% and top 1% highest waves within a wave-angle bracket. This statistical wave information provides an overview of the wave conditions at the study site and is discussed herein. The statistical wave conditions are also used as the input offshore wave conditions for the numerical wave modeling discussed in the following sections.

The wave conditions at the shoreline along the Sandals Whitehouse site is significantly controlled by the shallow barrier reef about 300 m from the protruding headland (**Figure 5.2.2**). Here, the offshore wave conditions as computed by WAVEWATCH III are discussed. It is worth emphasising that the nearshore wave conditions are significantly different from the offshore ones. The nearshore wave conditions are computed using the CMS-Wave model and are discussed in the following section.

Table 5.13. Statistical wave conditions calculated from the 12-year wave data obtained from the WAVEWATRCH III model. The station location is shown in Figure 5.25.

		% occurrence	Average Sig. H	Average Wave Period	Top 2% Sig H	Top 2% Wave Period	Top 1% Sig H	Top 1% Wave Period
Direction			m	S	M	s	m	S
N	348.75-11.249	0.16	0.21	4.62	0.64	8.27	0.64	8.27
NNE	11.25-33.749	0.17	0.31	4.17	0.76	3.21	0.76	3.21
NE	33.75-56.249	0.17	0.35	4.22	1.02	2.64	1.02	2.64
ENE	56.25-78.749	0.12	0.23	4.68	0.53	2.88	0.53	2.88
E	78.75-101.249	0.16	0.16	6.09	0.85	2.55	0.85	2.55
ESE	101.25-123.749	5.90	0.15	6.79	0.42	7.78	0.48	7.91
SE	123.75-146.249	82.11	0.46	7.73	1.05	9.71	1.13	9.72
SSE	146.25-168.749	3.04	0.41	5.02	1.50	7.83	1.70	7.98
S	168.75-191.249	1.69	0.48	5.09	2.52	7.49	2.66	7.69
SSW	191.25-213.749	0.85	0.48	4.93	2.00	7.39	2.24	6.89
SW	213.75-236.249	0.78	0.70	5.17	3.84	8.63	3.97	8.88

WSW	236.25-258.749	0.43	0.54	5.82	2.01	7.49	2.03	7.52
W	258.75-281.249	0.89	0.58	6.87	1.75	8.02	1.80	7.80
WNW	281.25-303.749	2.27	0.41	6.96	1.17	8.77	1.23	9.15
NW	303.75-326.249	0.94	0.25	6.76	0.37	7.17	0.41	7.00
NNW	326.25-348.749	0.32	0.17	5.95	0.57	5.16	0.62	2.49

Sig. H – Significant Wave Height; S - Seconds, m - meters

The southeast incident wave is by far the most dominant, occurring over 82% of the time with an average significant wave height of 0.46 m and average peak wave period of 7.73 s (**Table 5.25**, **Figures 5.26** through **Figure 5.28**). The average of the top 2% highest waves has a significant wave height of 1.05 m with an average peak period of 9.71 s (**Figures 5.29 and Figure 5.30**). For the top 1% highest waves, the average significant wave height is 1.13 m with an average peak wave period of 9.72 s, just slightly greater than the average top 2% of the highest waves (**Figure 5.31** and **Figure 5.32**). The dominant easterly approaching waves are controlled by the trade winds in the tropical area.

The second most frequent incident waves are from the ESE direction, at 5.9% of the time (**Table 5.25**). However, the ESE incident waves are relatively low with an average wave height of 0.15 m and an average peak wave period of 6.79 s (**Figure 5.23** and **Figure 5.27**). The average of the top 2% and top 1% highest waves is also relatively low, at 0.42 m and 0.48 m, respectively (**Figure 5.29** through **Figure 5.32**). The landmass and the protruding shoreline to the east of the greater study area, shelter the easterly approaching waves significantly (**Figure 5.24**), resulting in the overall low offshore wave conditions at the Sandals Whitehouse site (**Table 5.25**).

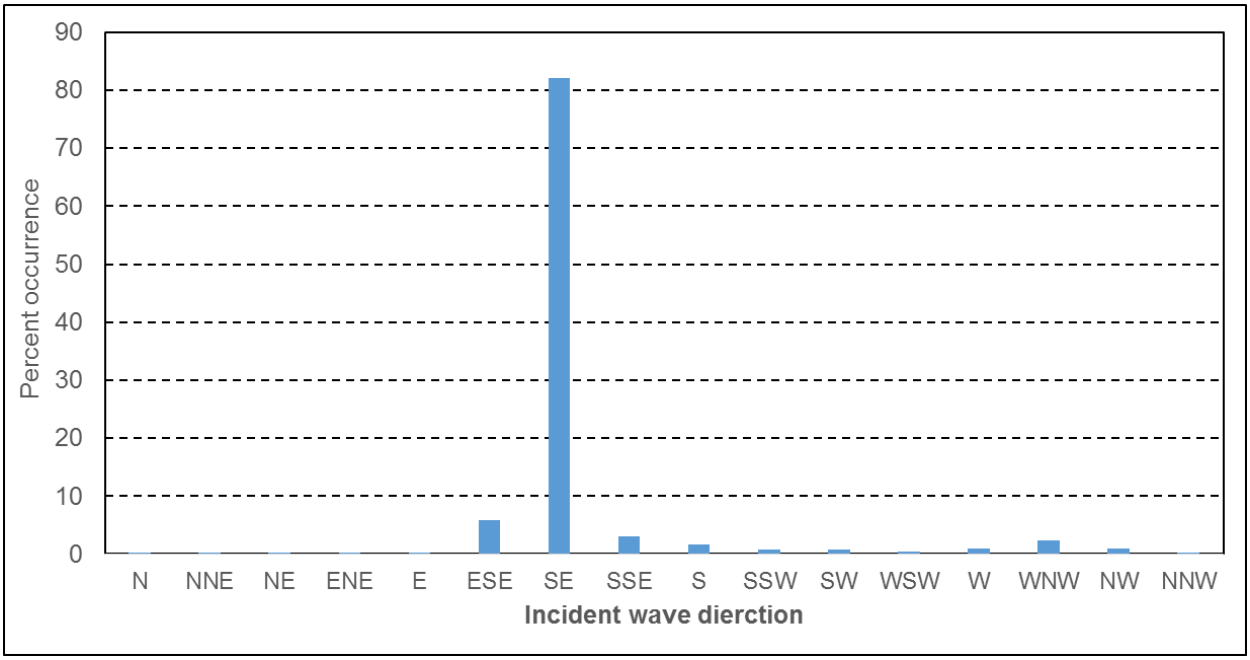


Figure Figures 5.26. Frequency of occurrence of waves approaching from different directions.

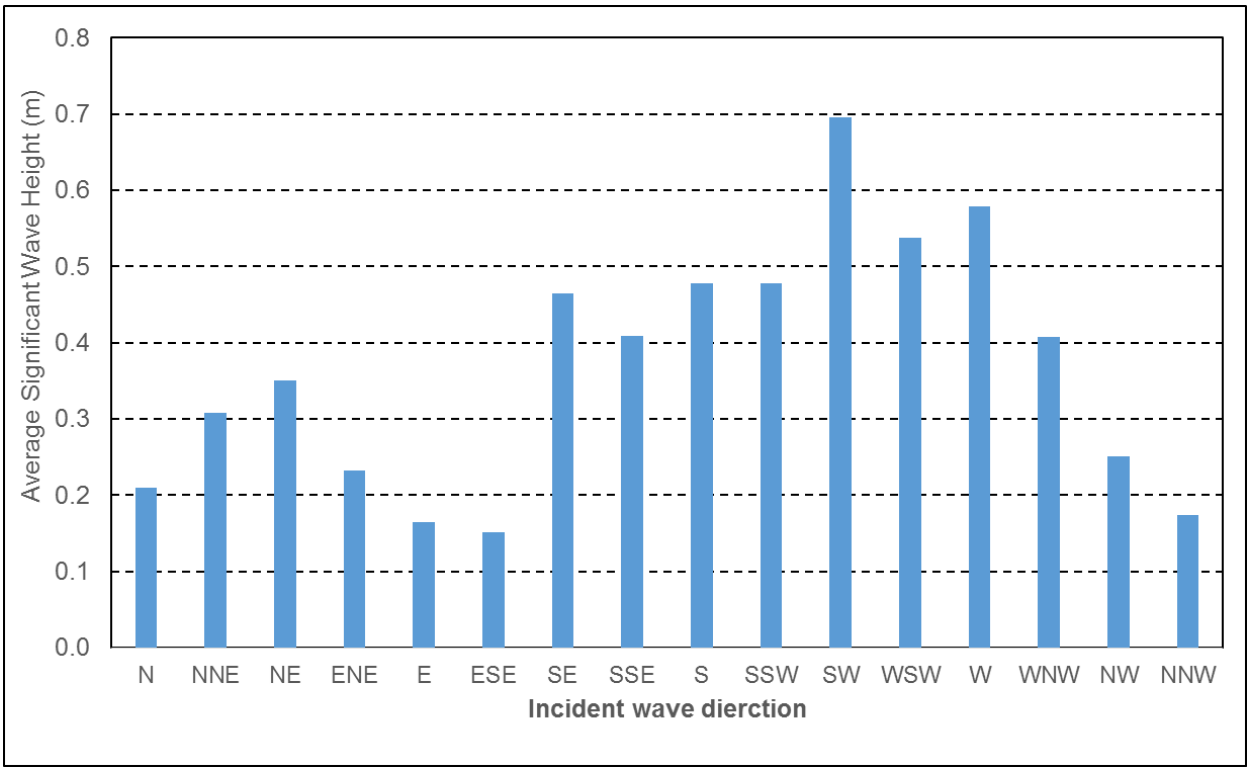


Figure 5.27. Average significant wave height waves approaching from different directions.

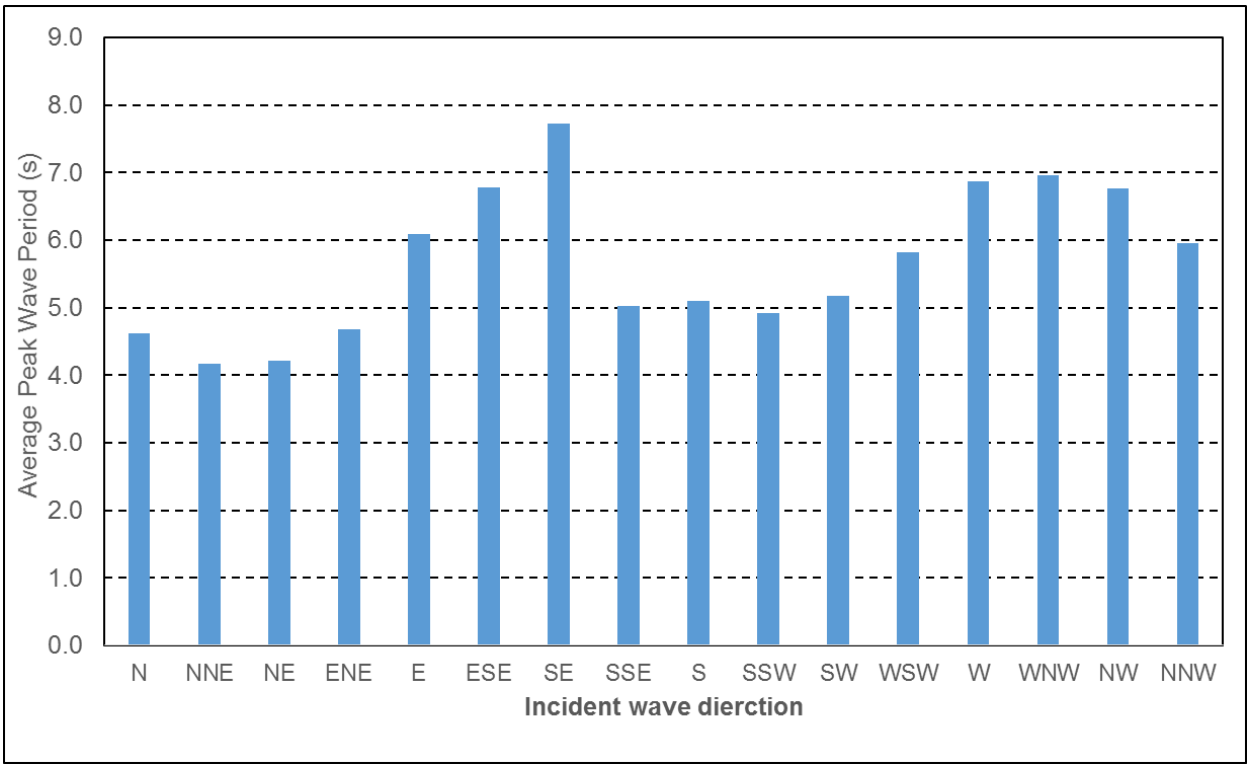


Figure 5.28. Average peak wave period waves approaching from different directions.

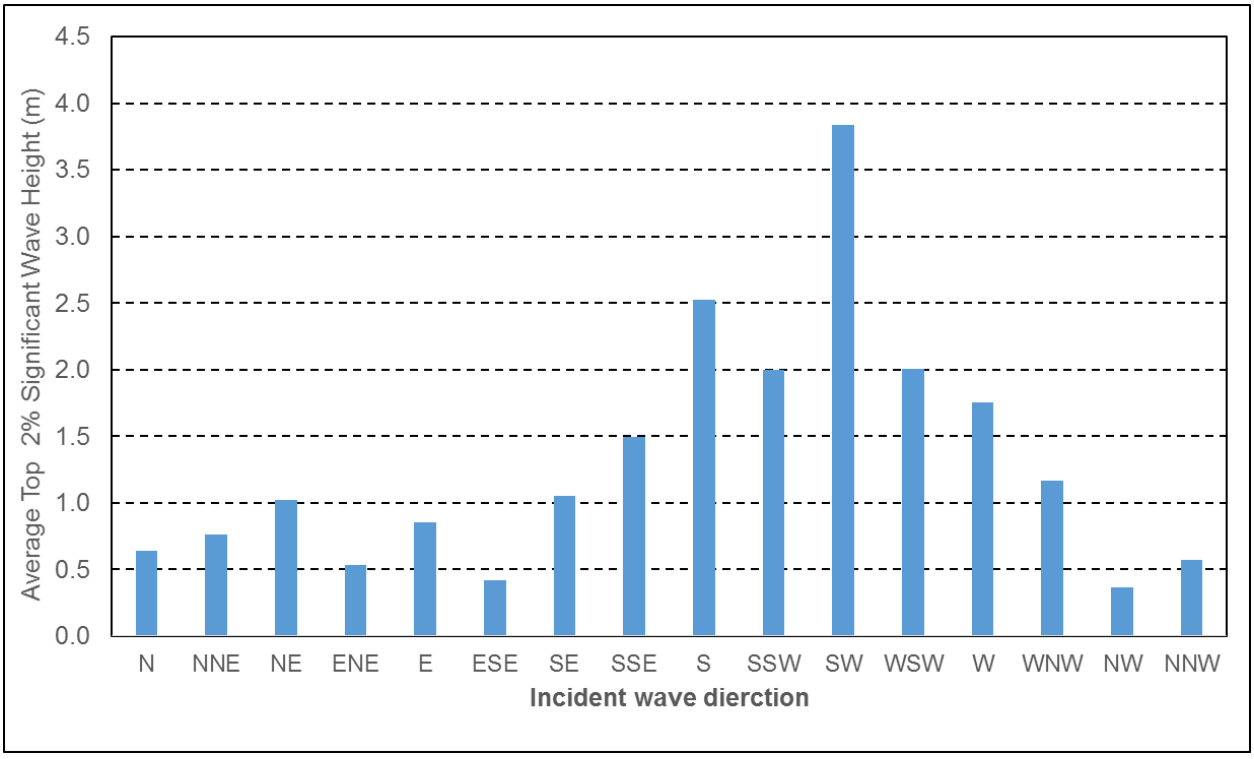


Figure 5.29. Average significant wave height of top 2% highest waves approaching from different directions.

The third most frequent incident waves are from SSE, occurring at 3.04%, with an average significant wave height of 0.41 m with a peak wave period of 5.02 s (**Figure 5.27** and **Figure 5.28**). The average of the top 2% and top 1% highest waves is quite energetic, at 1.50 m and 1.70 m, respectively (**Figure 5.29** through **Figure 5.32**). These much higher storm waves, compared to the more easterly approaching waves are due to the reduced sheltering of the land to the north and east.

The fourth most frequent incident waves are from the south, occurring at 1.69%, with an average significant wave height of 0.48 m and a peak wave period of 5.09 s (**Figure 5.27** and **Figure 5.28**). The average of the top 2% and top 1% highest waves is very energetic, at 2.52 m and 2.66 m, respectively with average peak wave period of 7.49s and 7.69 s, respectively (**Figure 5.29** through **Figure 5.32**). Again, these much higher storm waves, compared to the more easterly approaching waves are due to the reduced sheltering of the land to the north and east.

The most energetic waves come from the SW direction (**Table 5.25**), with the average significant wave height of 0.70 m and average peak wave period of 5.17 s (**Figure 5.27** and **Figure 5.28**). The SW wave occurs only about 0.78% of the time (**Table 5.25** and **Figure 5.26**). **Although the frequency of occurrence is not high, it is still very significant.** Storm waves from the SW are very energetic due to the open Caribbean Sea in that direction. The average of the top 2% and top 1% highest waves is the most energetic for the greater study area, at 3.84 m and 3.97 m, respectively with average peak wave period of 8.63 s and 8.66 s, respectively (**Figure 5.29** through **Figure 5.32**). The design of the over water accommodation and shore protection measures should carefully consider the energetic SW incident wave. It is worth noting again that the waves described above waves are offshore conditions, the nearshore wave height should be significantly reduced by the nearshore barrier reef.

In summary, the easterly approaching waves occur well over 90% of the time. The protruding landmass to the east of the study area provides substantial sheltering to the waves approaching from the east (**Figure 5.23** and **Figure 5.25**). This explains the overall low average as well as storm wave height of the easterly approaching waves. The northerly approaching waves are directed offshore and should not have significant influence on shoreline processes. The southwesterly approaching waves are not blocked by any landmass and arrive at the shoreline directly from the open Caribbean Sea. This explains the relatively high wave coming from this

direction. Although they are not very frequent, occurring about 3% of the time, they should have the most significant influence on the shoreline processes and should be carefully considered in any coastal engineering design.

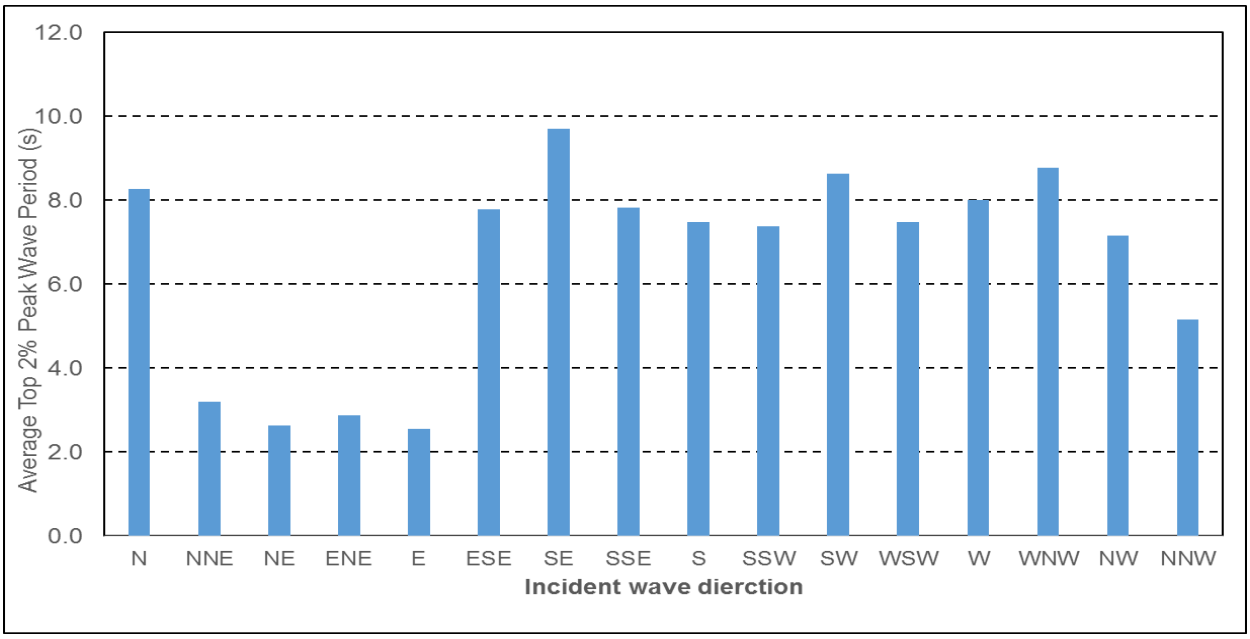


Figure 5.30. Average peak wave period of top 2% highest waves approaching from different directions

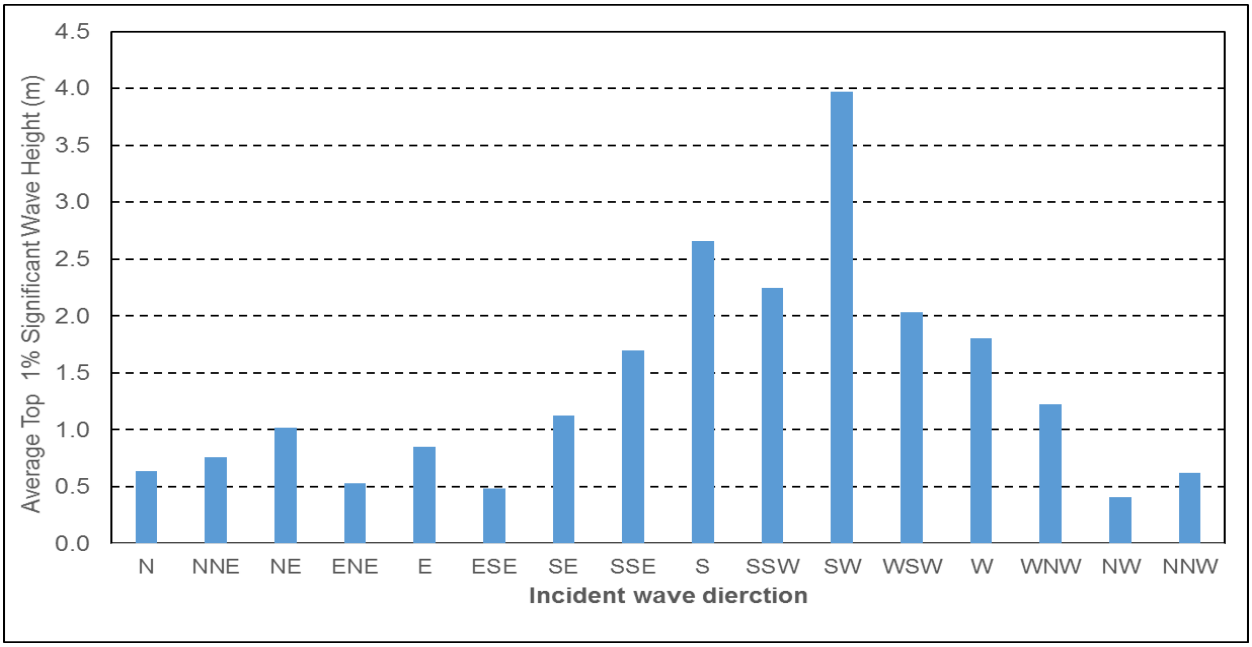


Figure 5.31. Average significant wave height of top 1% highest waves approaching from different directions

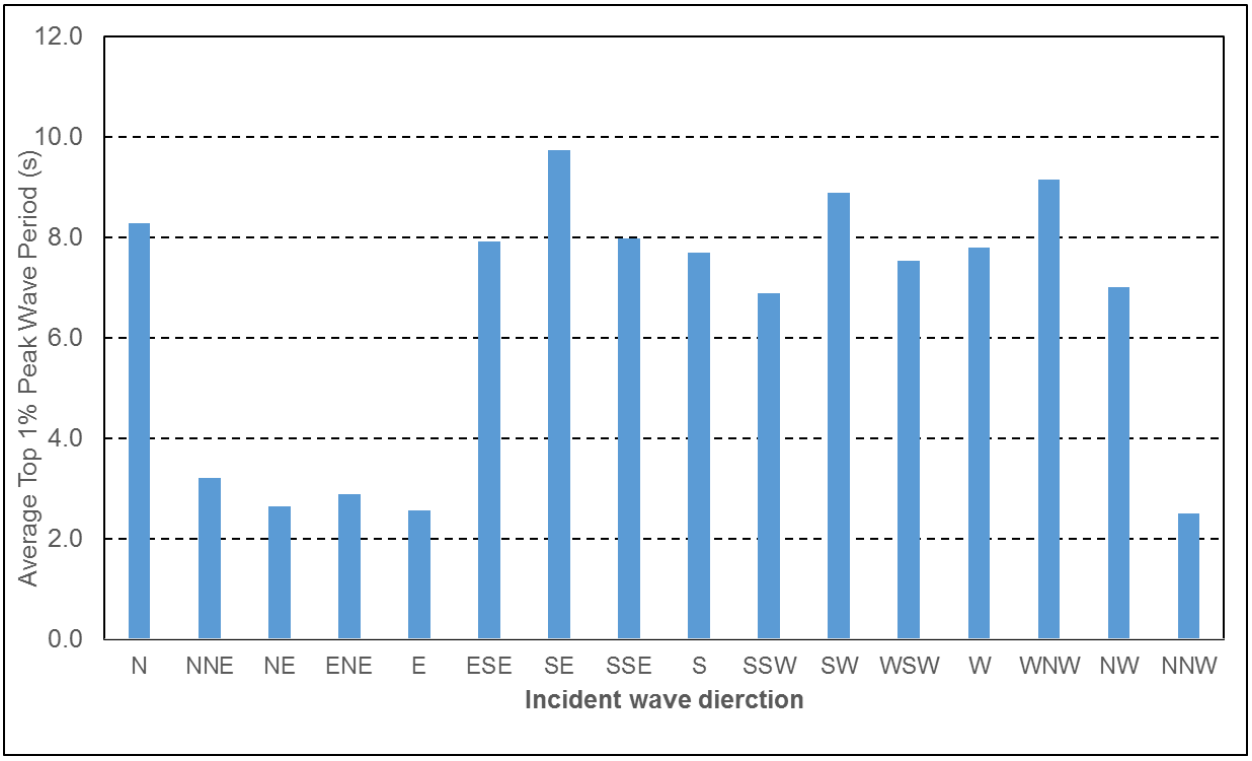


Figure 5.32. Average peak wave period of top 1% highest waves approaching from different directions

Figure 5.33. Most frequently occurring incident wave directions.

Nearshore Wave Conditions Computed by the Cms-Wave Model

The wave fields in the project area were investigated using the numerical CMS-Wave model (http://cirp.usace.army.mil/wiki/CMS-Wave). The CMS-Wave is developed by the U.S. Army Corps of Engineers. It is a steady-state, half-plane, two-dimensional spectral transformation model using a finite-difference, forward-marching implicit scheme. Wave refraction, shoaling, reflection, diffraction, and breaking are computed. This makes the CMS-Wave an ideal model to investigate the project area with complicated bathymetry and highly oblique incident wave angle. The CMS-Wave model can use measured directional wave spectral or generate directional wave spectrum using statistical wave parameters such as significant wave height, wave period, and incident wave angle, spectral peak, and directional spreading. Recently, wave setup and runup have been added. For this study, statistical wave conditions derived from the 12-year WAVEWATCH of III data, as summarised in **Table 5.25** and **Figure 5.26** through *Arenaria interpes*, were used as the input to the CMS-Wave. JONSWAP type wave spectra were generated based on statistical wave height and wave period (**Table 5.25**).

Wave propagation pattern in the nearshore area is significantly influenced by nearshore bathymetry. The detailed nearshore bathymetry extending to approximately 1 km offshore at water depth of more than 20 m were surveyed by this study to ensure that accurate and up-to-date bathymetry is used in the wave modeling. **Figure 5.34** illustrates the nearshore bathymetry obtained by this study. Overall the nearshore bathymetry is quite complicated offshore the Sandals Whitehouse study area.

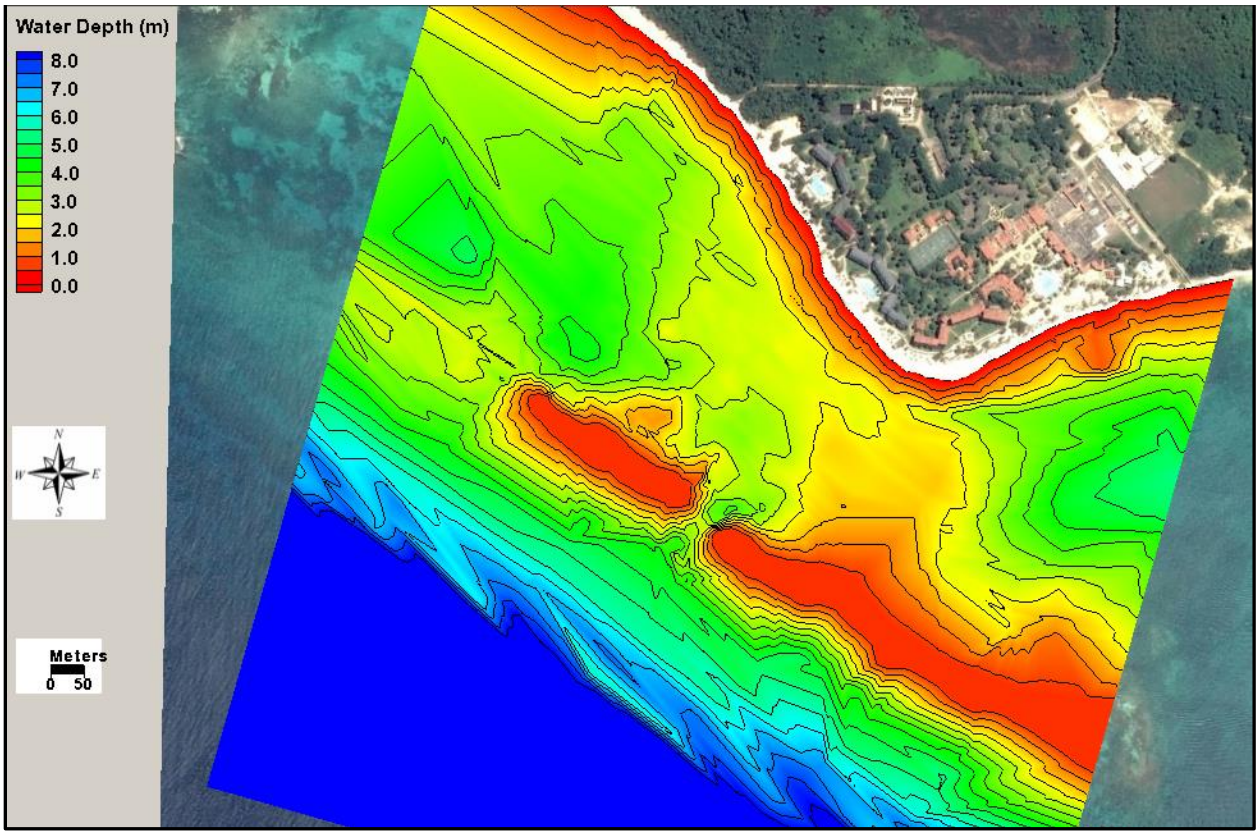


Figure 5.34. Nearshore bathymetry at Sandals Whitehouse study site. To better illustrate water depth variation in the nearshore, depth greater than 8 m is shown as solid blue. The depth is referred to mean sea level.

A nearshore reef with a crest of 0.3 to 0.5 m below mean sea level extends along the study area. This barrier reef is approximately 300 m seaward of the Sandals Whitehouse headland. The shallow water over the barrier reef induces significant wave breaking and subsequently reduces wave height substantially landward of the reef. A 30-m gap exist in the barrier reef (**Figure 5.34**). The gap is located to the west of the Sandals Whitehouse headland. The water depth between the headland and the barrier reef is considerably shallower than that adjacent areas, typically less than 2 m versus over 4 m. This bathymetry characteristics have significant influence on nearshore wave field, as discussed in the following.

Figure **5.34** through **Figure 5.43** illustrate the nearshore wave field as modeled by the CMS-WAVE. Statistical wave conditions as summarised in **Table 5.25** were used as the input offshore wave to the model. The average wave and the top 2% wave representing energetic storm

conditions were modeled. The top 1% wave conditions are rather similar to the top 2% waves and should yield similar modeling results.

The ESE incident wave occurs relatively frequently at 5.9% of the time (**Table 5.25**), second to the most frequent SE incident wave. Due to the sheltering of the landmass (**Figure 5.24**), the ESE waves have low wave height, with average significant wave height of 0.15 m and average top 2% wave height of 0.42 m. The ESE approaching wave is significantly refracted as it propagates onshore (**Figure 5.35**). Due to the low wave height in addition to further dissipation by the barrier reef, nearshore wave height under ESE incident wave is rather low. Therefore, ESE approaching wave should not play a significant role in the nearshore beach processes and should not constitute a major consideration for the shore protection design.

As noted before, the SE approaching wave occurring 82.1% of the time (**Table 5.25**), is by far the most frequent incident wave. The SE wave propagates roughly parallel to the shoreline orientation in the greater study area (**Figure 5.25**). The average significant wave height is 0.46 m and average top 2% wave height is 1.05 m. Similar to the ESE wave, the SE approaching wave is also significantly refracted as it propagate onshore (**Figure 5.36**). Based on the CMS-WAVE modeling, the wave height in the nearshore area landward of the barrier reef is less than 0.3 m under average conditions. Under storm conditions, the nearshore wave height is typically less than 0.4 m due to the protection of the barrier reef. It is worth noting that the modeling effect here did not consider elevated water level due to storm surge. The nearshore wave height would be greater

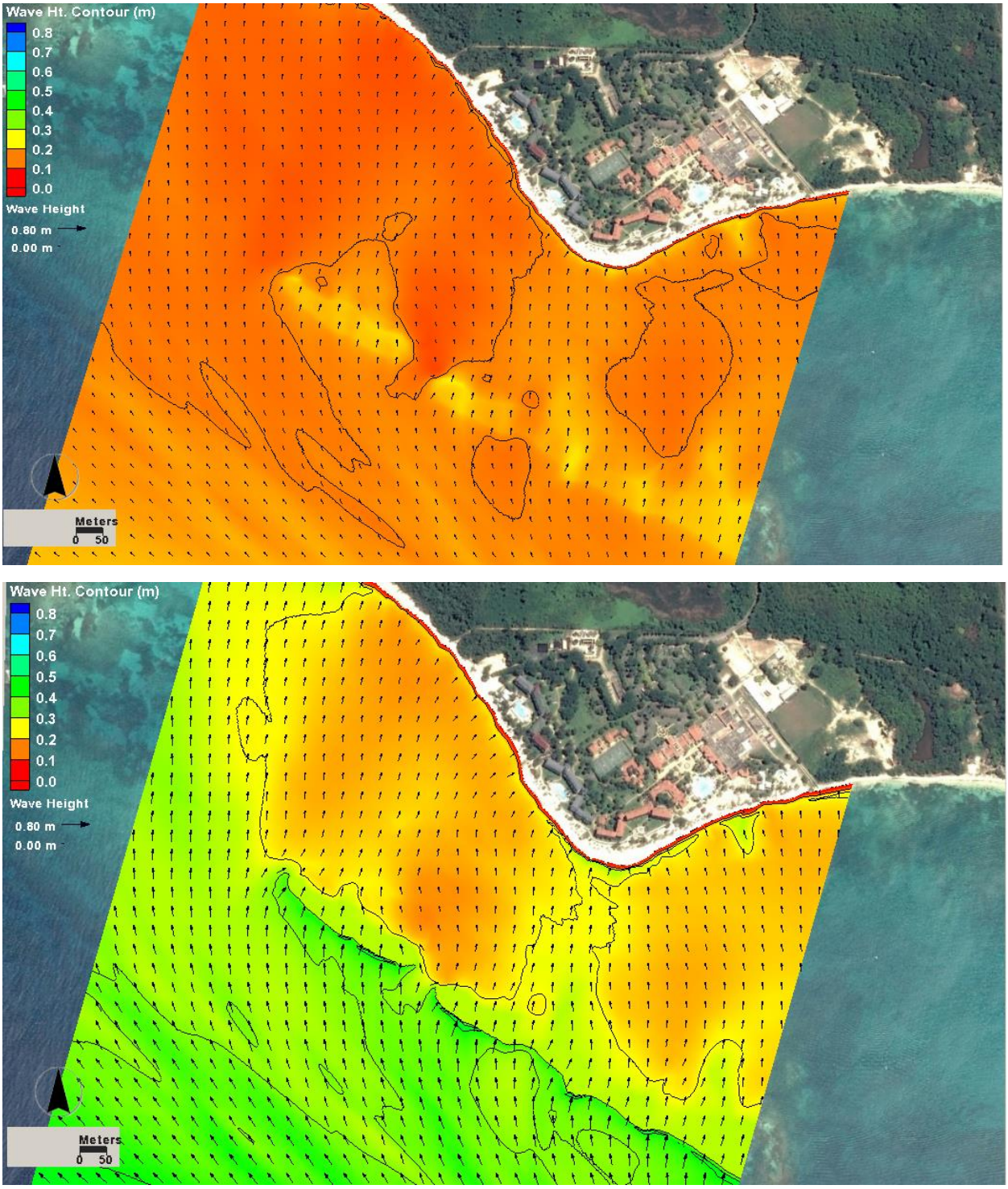


Figure 5.35. Modeled wave field for the ESE (112.5 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.15 m and a peak wave period of 6.79 s. Lower panel: average of top 2% high wave with a significant wave height of 0.42 m and a peak wave period of 7.78 s.

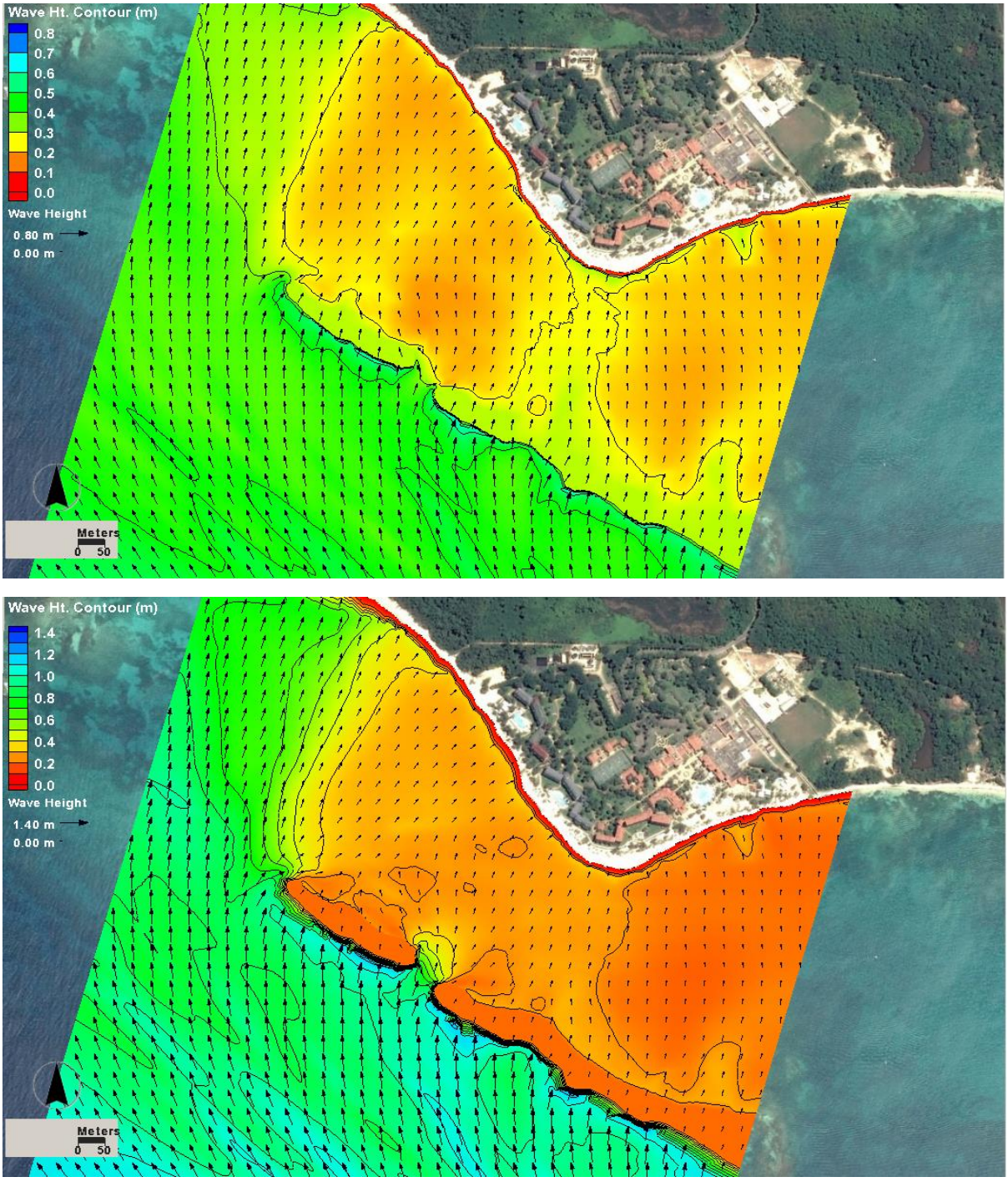


Figure 5.36. Modeled wave field for the SE (135 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.46 m and a peak wave period of 7.73 s. Lower panel: average of top 2% high wave with a significant wave height of 1.05 m and a peak wave period of 9.71 s. if storm surge occurs. Owing to the generally oblique wave incidence, limited wave transmission occurs at the gap of the barrier reef (**Figure 5.36**). Due to the very frequent

occurrence of the SE incident wave, it is expected to play a significant role in the nearshore beach processes and should be a major consideration for the shore protection design.

The SSE incident wave occurs relatively frequently at 3.0% of the time (**Table 5.25**), third behind the SE and ESE incident waves discussed above. Similarly to the SE wave, the SSE wave still propagates roughly parallel to the shoreline orientation in the greater study area (**Figure 5.25**). The average significant wave height is 0.41 m and average top 2% wave height is 1.50 m. Similar to the SE wave, the SSE approaching wave is also significantly refracted as it propagate onshore (**Figure 5.37**). Based on the CMS-WAVE modeling, the wave height in the nearshore area landward of the barrier reef is less than 0.3 m under average conditions. Under storm conditions, the nearshore wave height is typically less than 0.4 m due to the protection of the barrier reef. It is worth noting that the modeling effect here did not consider elevated water level due to storm surge. The nearshore wave height would be greater if storm surge occurs. Compared to the SE wave, increased wave transmission occurs at the gap of the barrier reef particularly under storm conditions, resulting in slightly higher wave in the vicinity of the gap (Figure). Overall, the SSE incident wave behaves rather similarly as compared to the SE wave.

The S incident wave does not occur frequently, at 1.7% of the time (**Table 5.25**). Compared to the southeasterly approaching waves, the S approaching wave is considerably less influenced by the adjacent landmass (**Figure 5.25**). This is reflected in the much higher storm wave at 2.52 m for the average of top 2% wave and 2.66 m for the top 1% wave. The average significant wave height is 0.48 m, which is similar to the southeasterly approaching waves. The refraction of the S approaching wave is not as severe as the southeasterly approaching waves as discussed earlier. Based on the CMS-WAVE modeling, the wave height in the nearshore area landward of the barrier reef is less than 0.3 m under average conditions (**Figure 5.38**). Under storm conditions, the nearshore wave height is typically less than 0.4 m due to the protection of the barrier reef. It is worth noting that the modeling effect here did not consider elevated water level due to storm surge. The nearshore wave height would be greater if storm surge occurs. Compared to the southeasterly approaching waves, increased wave transmission occurs at the gap of the barrier reef particularly under storm conditions, resulting in modestly higher wave of up to 0.6 m in a greater area near the

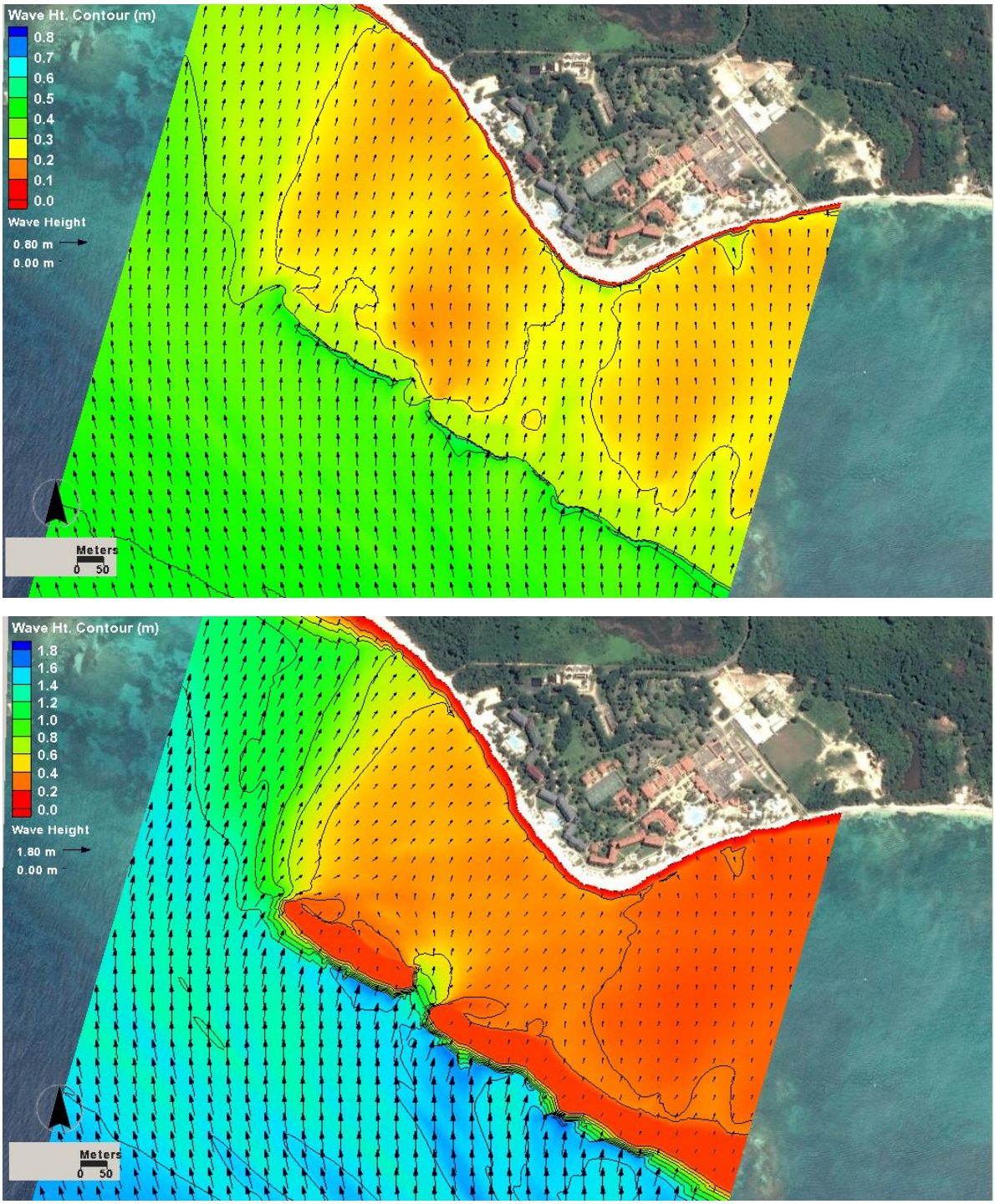


Figure 5.37. Modeled wave field for the SSE (157.5 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.41 m and a peak wave period of 5.02 s. Lower panel: average of top 2% high wave with a significant wave height of 1.50 m and a peak wave period of 7.83 s.

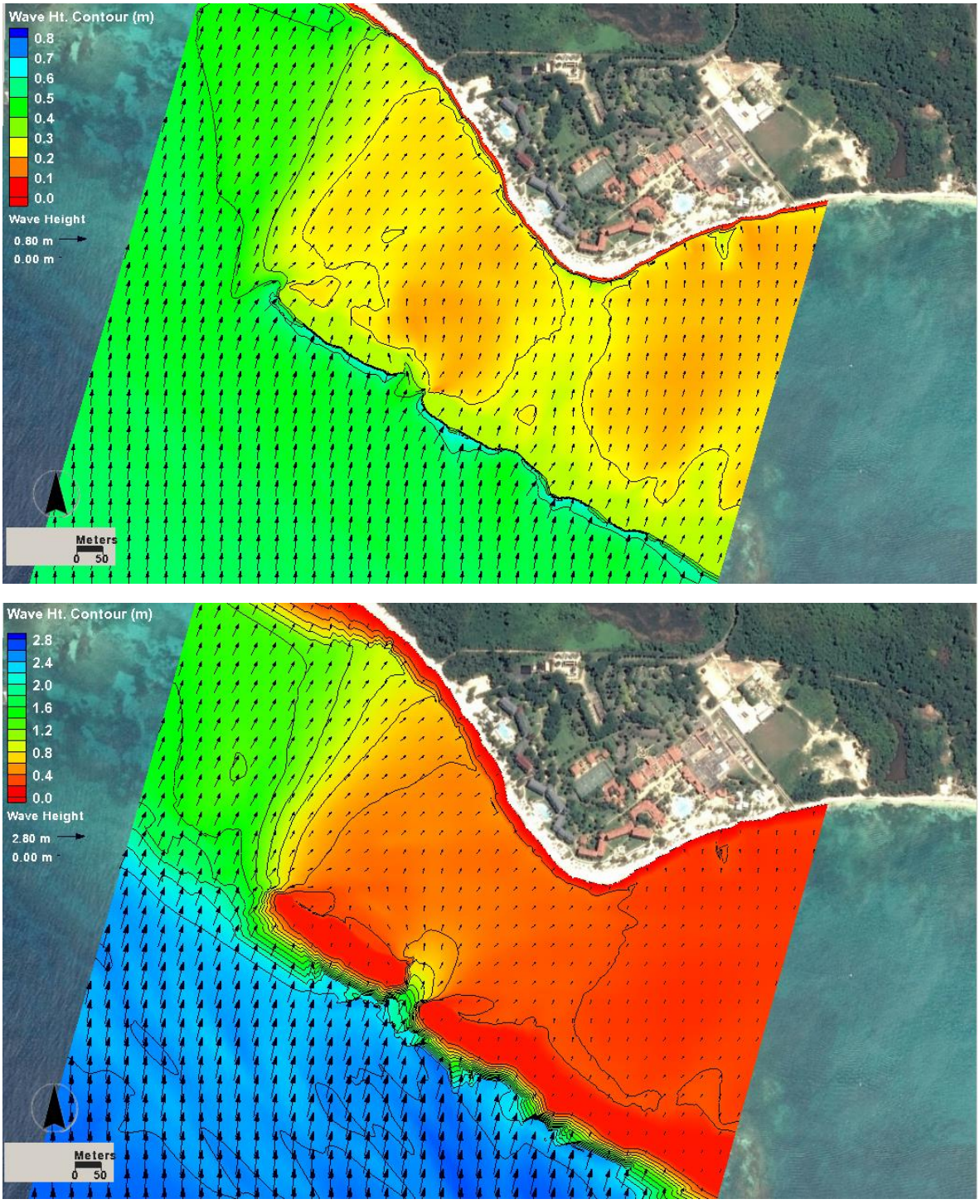


Figure 5.38. Modeled wave field for the S (180 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.48 m and a peak wave period of 5.09 s. Lower panel: average of top 2% high wave with a significant wave height of 2.52 m and a peak wave period of 7.49 s.

gap (**Figure 5.38**). Another noticeable difference in the nearshore wave field under the S incident wave, as compared to the southeasterly wave, is the considerable wave diffraction around the west end of the barrier reef. This wave diffraction resulted in higher wave along the western flank of the Sandals Whitehouse shoreline. The S approaching wave should be a major consideration for the shore protection design.

The SSW incident wave does not occur frequently, at 0.9% of the time (**Table 5.25**). The average significant wave height is 0.48 m, which is similar to the S approaching waves. The storm wave height is lower than the S wave. The SSW wave approaches perpendicular to the barrier reef. Based on the CMS-WAVE modeling, the wave height in the nearshore area landward of the barrier reef is mostly less than 0.3 m under average conditions (**Figure 5.39**). Under storm conditions, the nearshore wave height can be up to 0.7 m. This is considerably higher than the cases discussed earlier. The wave dissipation by the barrier reef is less efficient for perpendicular incident waves as compared to the oblique incident waves. Furthermore, more wave energy is transmitted through the gap and diffracted around the western end, which also contributes to the higher nearshore wave. This wave diffraction around the western end of the barrier reef results in higher wave along the western flank of the Sandals Whitehouse shoreline. The SSW approaching wave should be a major consideration for the shore protection design.

The SW incident wave does not occur frequently, at 0.8% of the time (**Table 5.25**). However, the SW wave, which approaches the coastline from the open Caribbean Sea, is the most energetic, with the average significant wave height of 0.70 m and average top 2% and 1% wave height of 3.84 m and 3.97 m, respectively. The SW wave is significantly higher than waves from all the other directions under both average and storm conditions. Based on the CMS-WAVE modeling, the wave height in the nearshore area landward of the barrier reef is mostly less than 0.4 m under average conditions (**Figure 5.39**). Under storm conditions, the nearshore wave height can be up to 0.8 m. This is considerably higher than the cases discussed earlier. Similar to the SSW wave, the wave dissipation by the barrier reef is less efficient for perpendicular incident waves compared to the oblique incident waves. Furthermore, more wave energy is transmitted through the gap and diffracted around the western end, which also contributes to the higher nearshore wave. This wave diffraction around the western end of the barrier reef results in high wave of more than 1 m along the western flank of the Sandals Whitehouse shoreline. The SW approaching wave, although

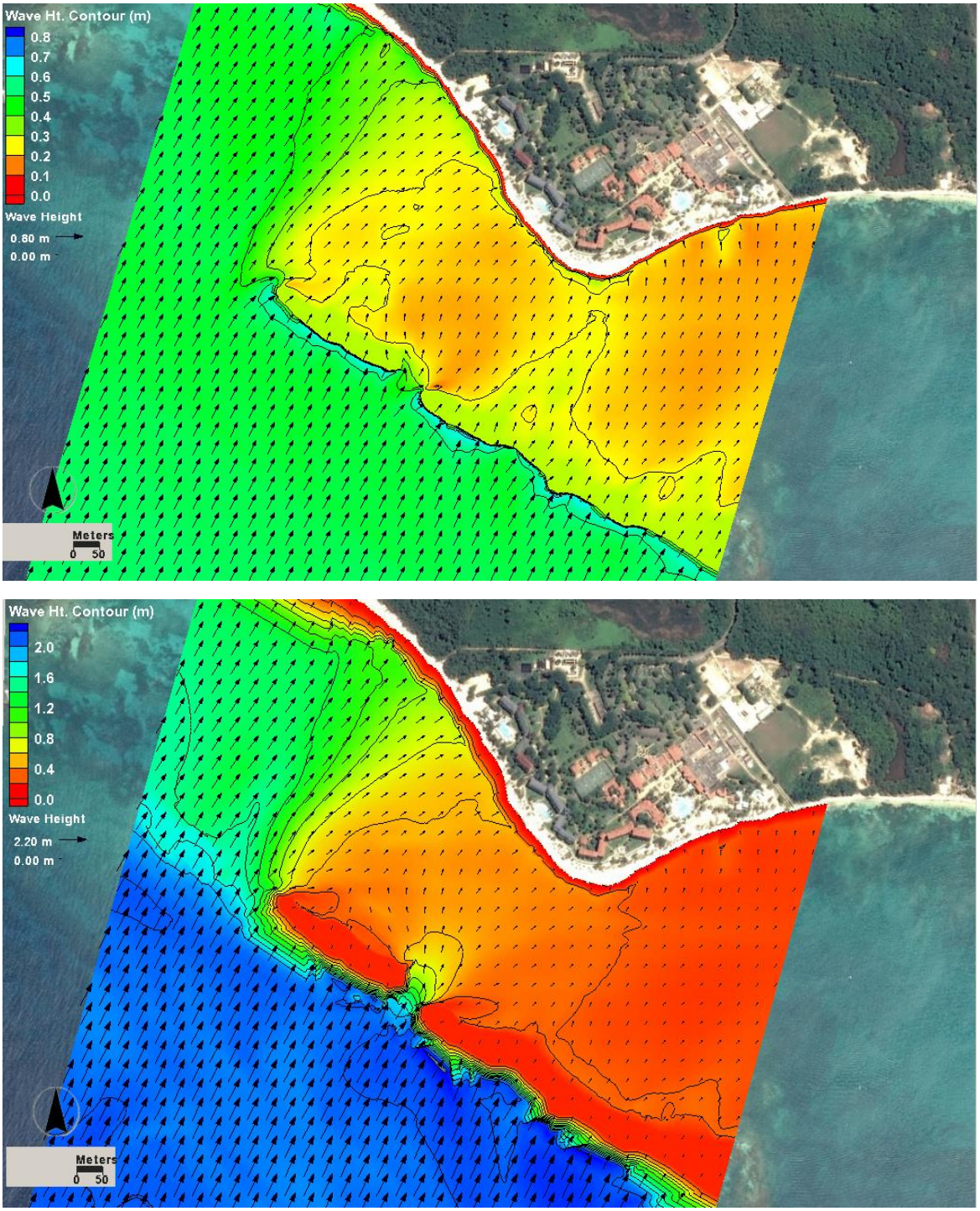


Figure 5.39. Modeled wave field for the SSW (202.5 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.48 m and a peak wave period of 4.93 s. Lower panel: average of top 2% high wave with a significant wave height of 2.00 m and a peak wave period of 7.39 s.

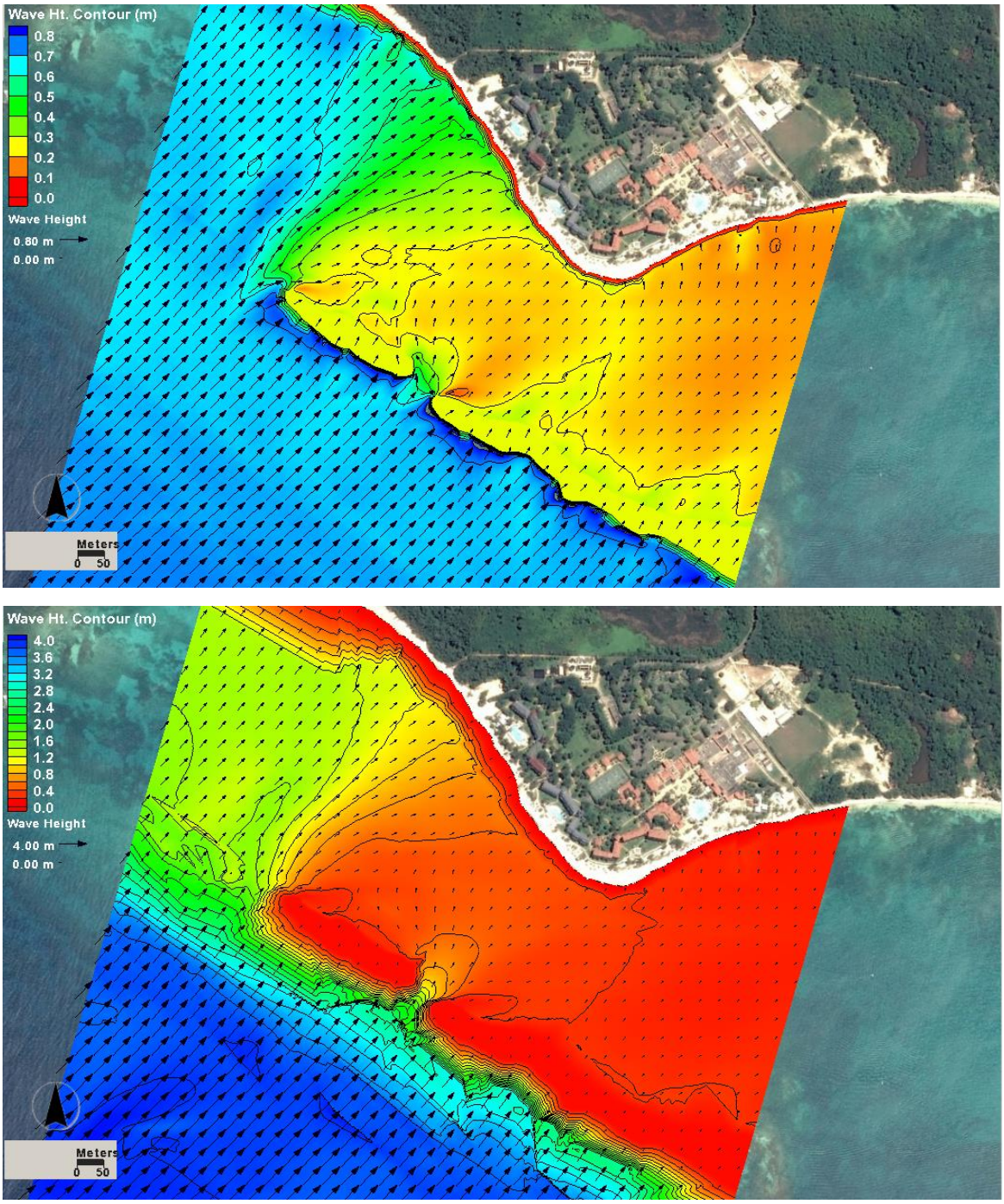


Figure 5.40. Modeled wave field for the SW (225 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.70 m and a peak wave period of 6.17 s. Lower panel: average of top 2% high wave with a significant wave height of 3.84 m and a peak wave period of 8.63 s.

rather rare, should be the most important consideration for the shore protection design because of its height and the wave diffraction around the western end of the barrier reef. Based on the results of the wave modeling, it is not recommended that the over-the-water housing unit be constructed along the western flank of the Sandals Whitehouse headland. The headland provides substantial wave sheltering for the high wave from the SW, resulting in significant difference in the level of wave energy along the western and eastern flank of the headland.

The WSW and W incident waves at rare, occurring at 0.4% and 0.9% 0.8% of the time, respectively (**Table 5.25**). Because the study area is located in the tropical trade wind zone, westerly wind forcing is rare and associated with abnormal weather conditions. The significance of the westerly approaching waves to the Sandals Whitehouse study site is the wave propagation through the gap between the barrier reef and the mainland and diffraction around the western tip of the barrier reef. This results in relatively energetic wave along the western flank of the headland, particularly under storm conditions (**Figure 5.41** and **Figure 5.42**). The eastern flank of the headland is protected by the protruding headland and therefore, the wave height there is significantly smaller than that along the western flank. Furthermore, due to the orientation of the gap, more wave energy propagates through the gap for the westerly approaching waves than for the easterly approaching waves. This results in moderately higher wave landward of the barrier reef.

WNW approaching wave is the most frequent westerly approaching wave, occurring at 2.27% of the time. Similar to the waves discussed above, the significance of the WNW wave to the Sandals Whitehouse shoreline is the considerable wave energy along the western flank of the headland. In contrast, the eastern flank of the headland is much calmer due to the sheltering of the headland.

In summary, based on wave modeling results, under existing conditions, the Sandals Whitehouse shoreline is quite well protected against the dominant southeasterly approaching waves by the nearshore barrier reef. However, although the southwesterly approaching waves are not the dominant wave, they do occur at about 3% of the time and are therefore significant. More importantly, the southwesterly approaching waves are not obstructed by landmass and therefore have high storm waves. The southwesterly approaching waves arrive at the western flank of the Sandals Whitehouse headland largely un-obstructed by the barrier reef and therefore, can result in quite energetic conditions.

Based on the wave modeling results, the top 2% wave can generate wave height of well over 1 m along the shoreline of the western flank of the headland (**Figure 5.39** through **Figure 5.43**). Based on the statistical analysis of a 12-year wave record conducted by this study, the frequency of occurrence of the top 2% waves approaching from the S-W quadrant (including S, SSW, SW, WSW, and W approaching angles) is 0.093%, or 0.34 day per year or 8.2 hours per year. Although very rare, this generates significant risk for any over-the-water structures along the western flank. In contrary, the protruding headland, as well as the barrier reef, protects the eastern flank of the headland from these rare energetic waves. In addition, the barrier reef protects both the eastern flank and the western flank from the dominant wave approaching from the S-E quadrant. Therefore, over-the-water structures along the eastern flank are at much lower risk, as compared to structures along the western flank.

Based on the wave analyses and numerical modeling, it is recommended that the proposed over-the-water structures be constructed along the eastern flank of the Sandals Whitehouse headland. Additional wave protection using artificial reefs is necessary if the structures are to be constructed along the western flank. Finally, the present wave modeling as discussed above did not consider waves that can be generated by local wind. However, given the fact that the fetch of the eastern flank for the eastern approaching wind is mostly less than 1.5 km, waves generated by local wind should not be a significant factor.

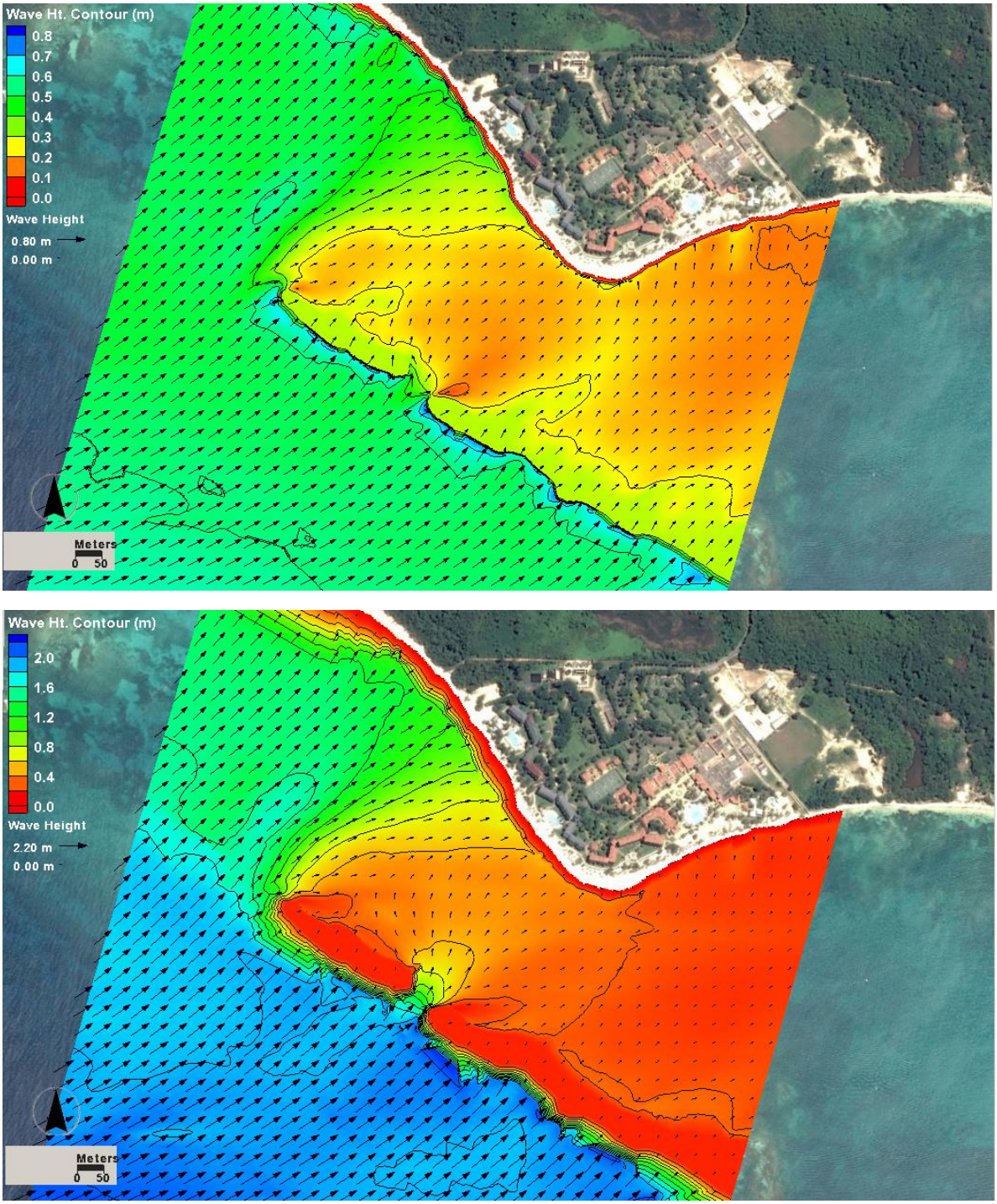


Figure 5.41. Modeled wave field for the WSW (247.5 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.54 m and a peak wave period of 5.82 s. Lower panel: average of top 2% high wave with a significant wave height of 2.01 m and a peak wave period of 7.49 s.

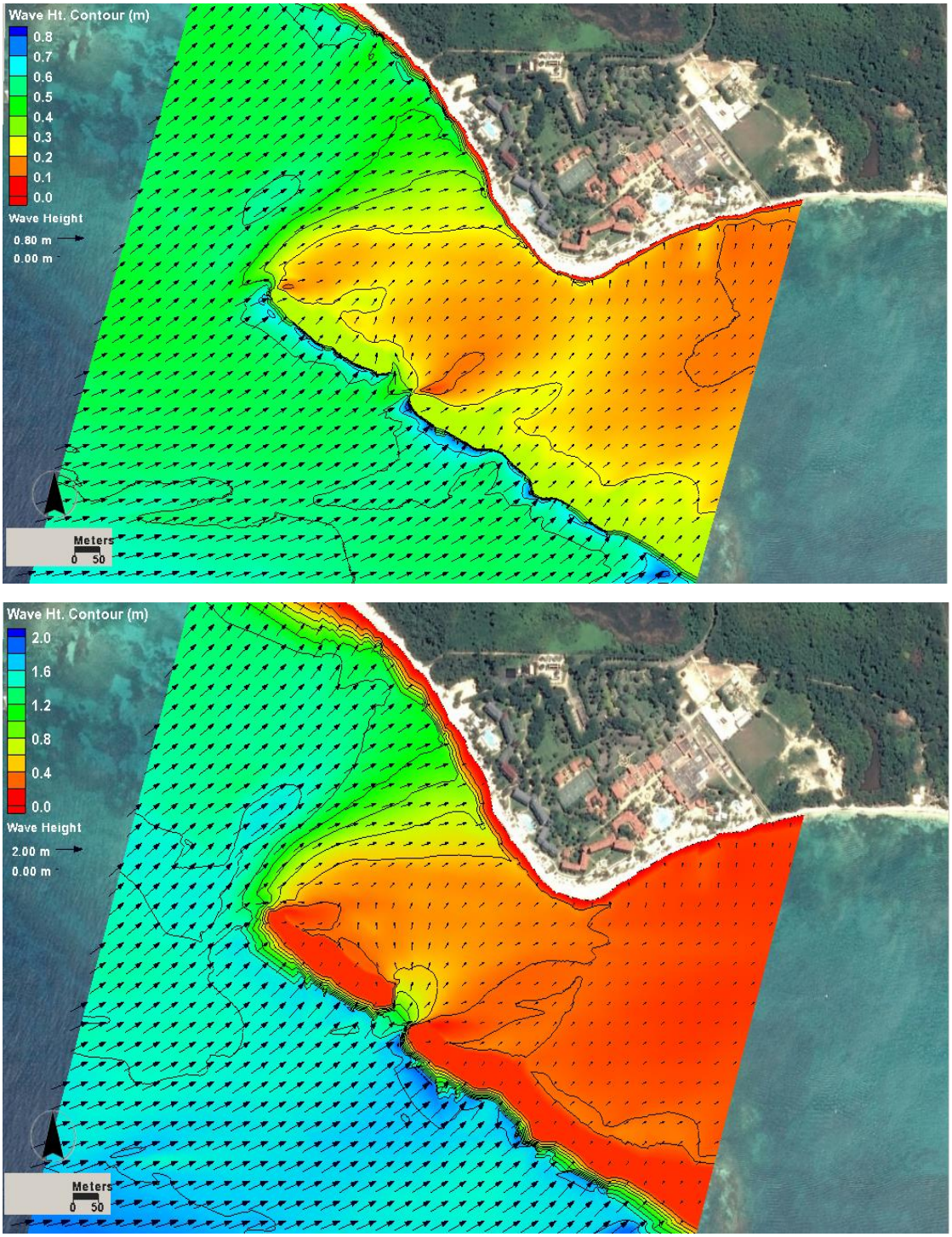


Figure 5.2.42. Modeled wave field for the W (270 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.58 m and a peak wave period of 6.87 s. Lower panel: average of top 2% high wave with a significant wave height of 1.75 m and a peak wave period of 8.02 s.

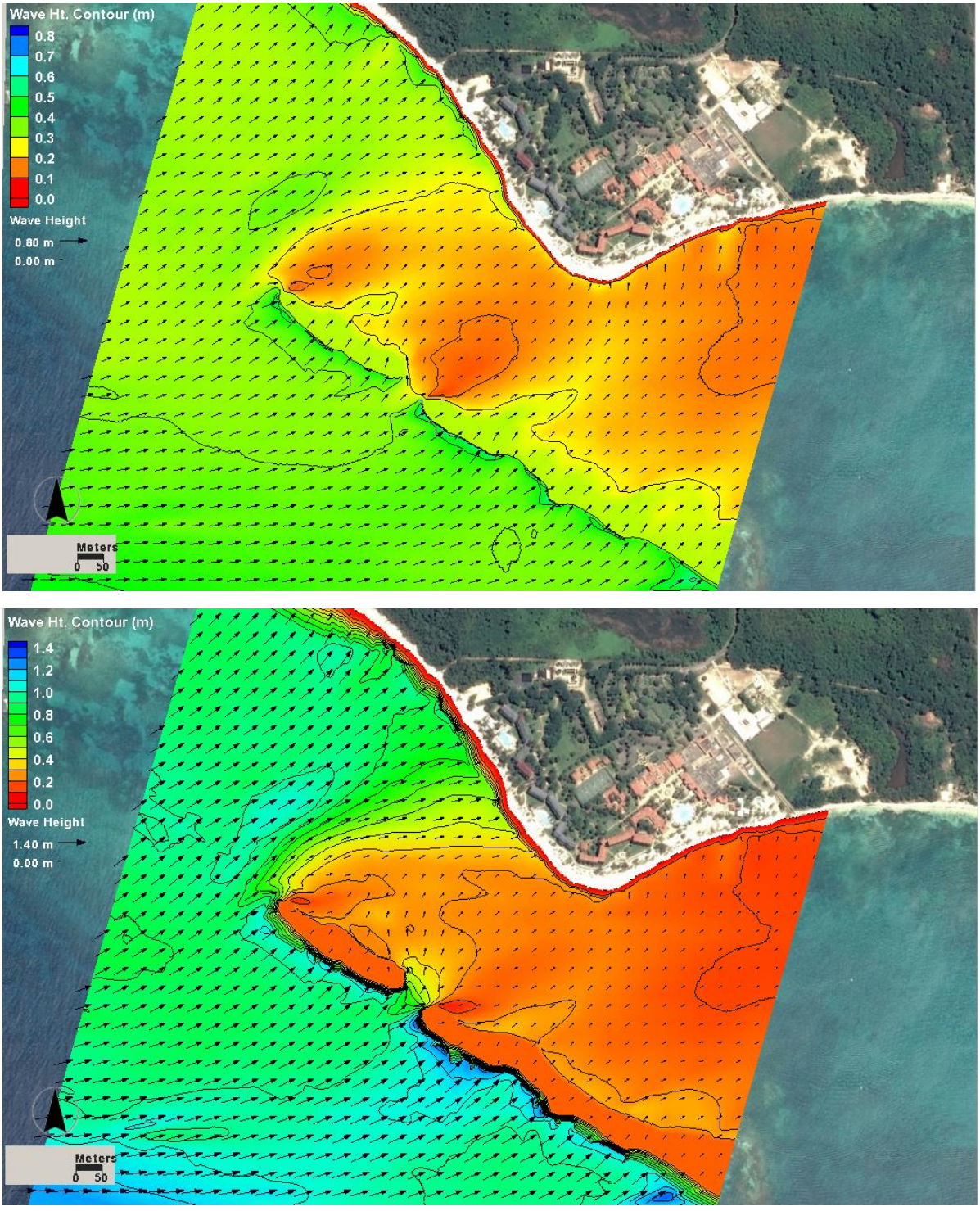


Figure 5.43. Modeled wave field for the WNW (292.5 degrees) incident wave. Upper panel: average wave condition with a significant wave height of 0.41 m and a peak wave period of 6.96 s. Lower panel: average of top 2% high wave with a significant wave height of 1.17 m and a peak wave period of 8.77 s.

5.2.2.3 Nearshore Sediment Transport Pattern and Beach Morphology

Due to the predominantly calm conditions along the Sandals Whitehouse shoreline, as discussed above, nearshore sediment transport induced by ocean waves propagated from the Caribbean Sea should not be very active within the Sandals Whitehouse study site. Field observations, as well as the morphological characteristics of the current beach, suggest that sediment transport by locally wind generated choppy waves can play a significant role on nearshore sediment transport. In the following, Google Earth photos are utilised to explain two main mechanisms of sediment transport at the study site shoreline.

Wave diffraction around the barrier reef is likely responsible for the regional scale sediment transport at the headland, as illustrated in **Figure 5.44**. This aerial photo was taken under an energetic southerly approaching wave condition. The barrier reef significantly reduced the wave height landward and along most of the Sandals Whitehouse shoreline, as apparent from the aerial photo. The wave diffraction around the ends of the barrier reef resulted in higher and oblique incident wave along the shoreline both to the east and west of the headland. This wave diffraction induced sediment transport gradient and leads to a sediment transport convergence at the headland, and subsequently the wider beach at the headland, as compared to the beaches along the two flanks of the headland. It is worth noting here that the wave propagation pattern illustrated by **Figure 5.44** match qualitatively with the modeled wave field under SSE incident wave (**Figure 5.37**). In summary, wave converging at the headland due to the diffraction around the ends of the barrier reef explains the wider beach at the tip of the headland.

Figure 5.44. Waves converging at the headland due to the diffraction around the ends of the barrier reef results in the wider beach at the tip of the headland.

Several groins were constructed around the Sandals Whitehouse headland, as can be seen on a recent aerial photo shown in **Figure 5.45**. Sand accumulation along the east side of the groin and erosion along the west side is apparent, especially at the long groin to the west of the headland. This offset pattern, although not very significant at the shorter groins, suggests a westward longshore sand transport, which is likely driven by the persistent easterly trade wind generated waves near the shoreline. The relatively small offset indicates that the net rate of sediment transport is not large. As a matter of fact, when comparing the Google Earth photos for the last 10 years since the site was developed, the shoreline at the Sandals Whitehouse site has been relatively stable.

Figure 5.45. Groins around the Sandals Whitehouse headland, note the sand accumulation along the east side of the groin and erosion along the west side.

5.2.2.4 IMPACT OF TROPICAL STORMS AND HURRICANES

A total of ten tropical storms and hurricanes passed within 60 km of the Sandals Whitehouse study site over the past 100 years (**Figure 5.46**). This suggests that the study area is not very prone to storm impact, as compare to 21 storms passing within 60 km of Miami, Florida USA for the same period. This may be related to the fact that the study site is located at a low latitude where tropical storm development is initiated but not fully developed.

Perhaps the most significant storm that impacted the study area was an unnamed storm in 1933 (**Figure 5.46**). This storm moved from south to north and made landfall just to the west of the Sandals Whitehouse site. It was a category 2 hurricane when passing through the study site which at the time, was not developed. No information on the impact of the 1933 hurricane on the study site was available.

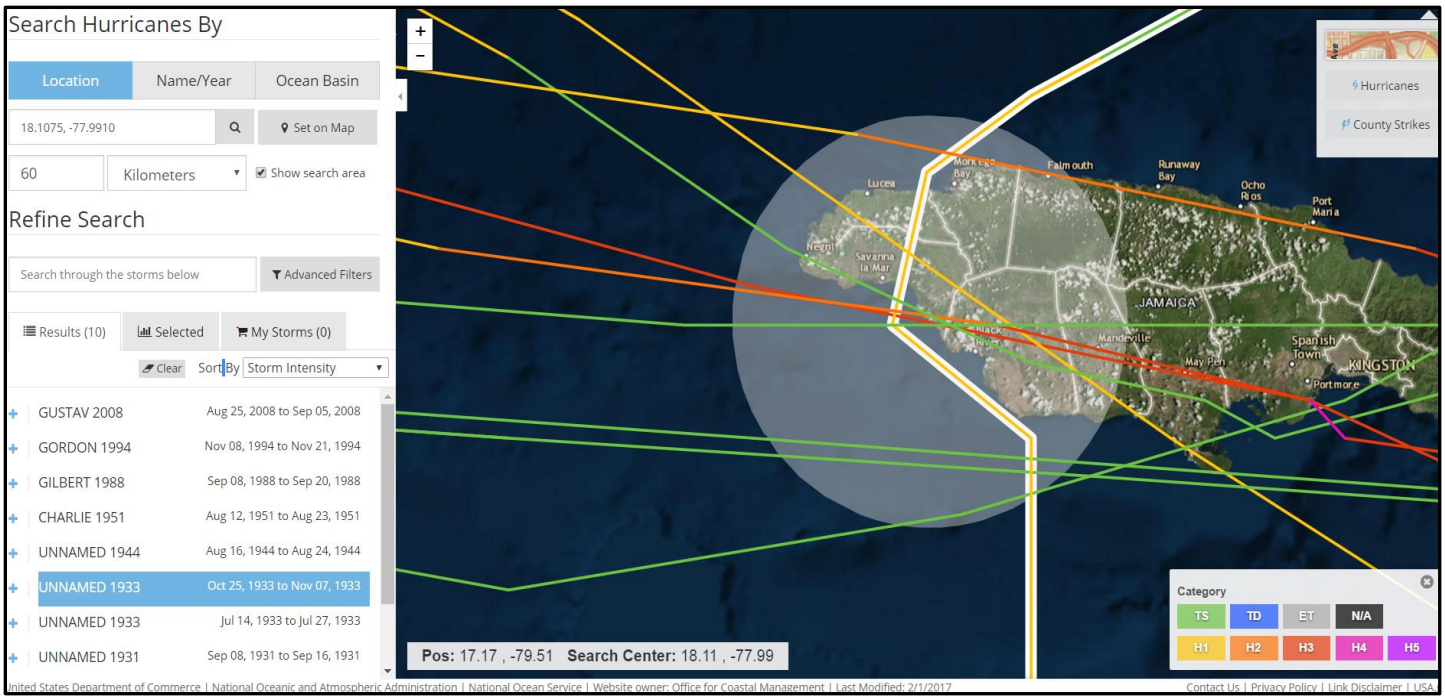


Figure 5.46. Track of an unnamed hurricane when it passed through the study area in 1933. It was a category 1 hurricane at that time moving from south to north and made landfall just to the west of the study area.

Another significant hurricane that passed through the study site was Hurricane Charlie in 1951 (**Figure 5.47**). This was a category 2 hurricane moving from east to west. It moved off land just to the west of the study site which was not developed at the time. At that time, the area was not developed. There was no record or literature for the impact of Hurricane Charlie on the study site.

The study area was impacted by Hurricane Gilbert in 1988 (**Figure 5.48**). This was a category 3 hurricane moving from east to west along a very similar track as that of Hurricane Charlie. It moved off land just to the west of the study site, which at the time was not developed. Damage to the general area was noted by a local stakeholder who related that "….. the property which houses the New Hope Primary and Junior High School in Whitehouse has been severely affected and needs to be addressed with urgency". (http://jamaica-gleaner.com/gleaner/20130727/western/western2.html). The press report indicated that the landscape in Culloden and Whitehouse and sections of Belmont had changed drastically. Erosion in the vicinity of the New Hope Primary and Junior High School, Whitehouse is reported

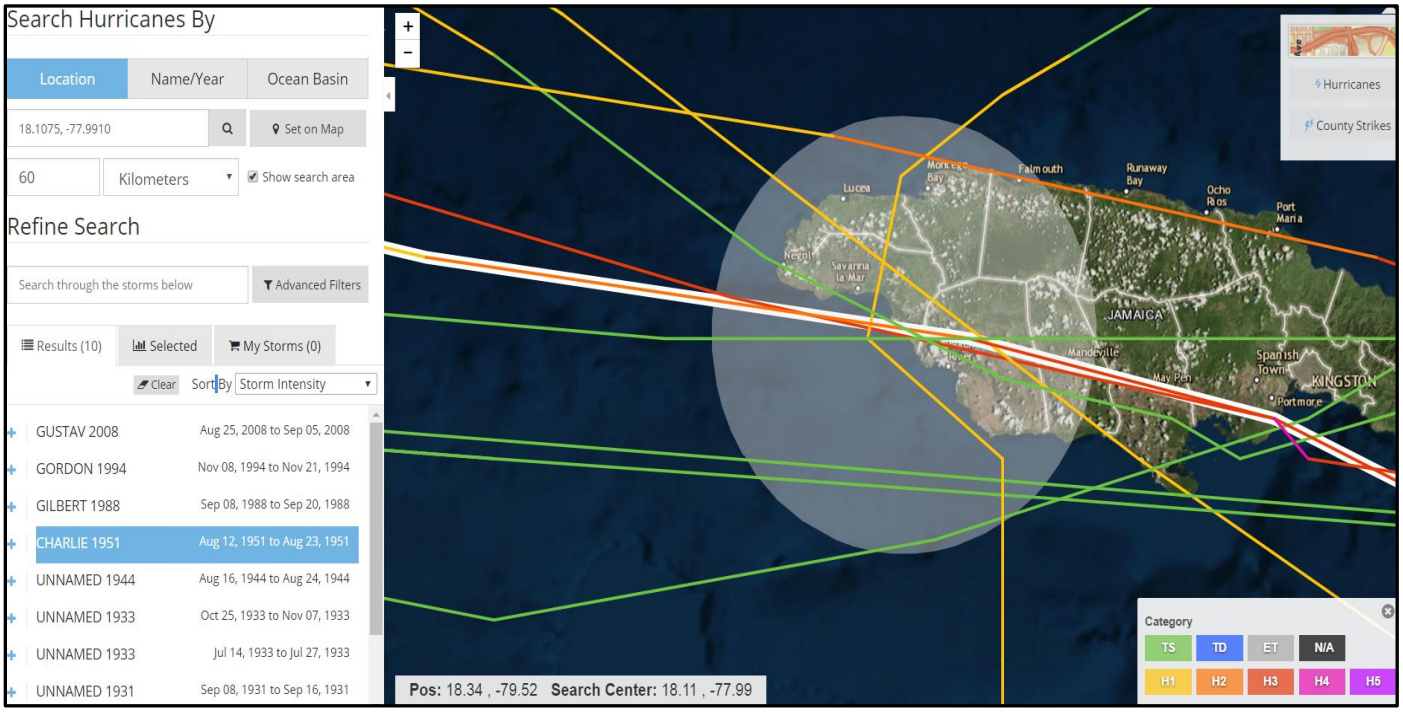


Figure 5.47. Track of Hurricane Charlie when it passed through the study area in 1951. It was a category 2 hurricane at that time moving from east to west.

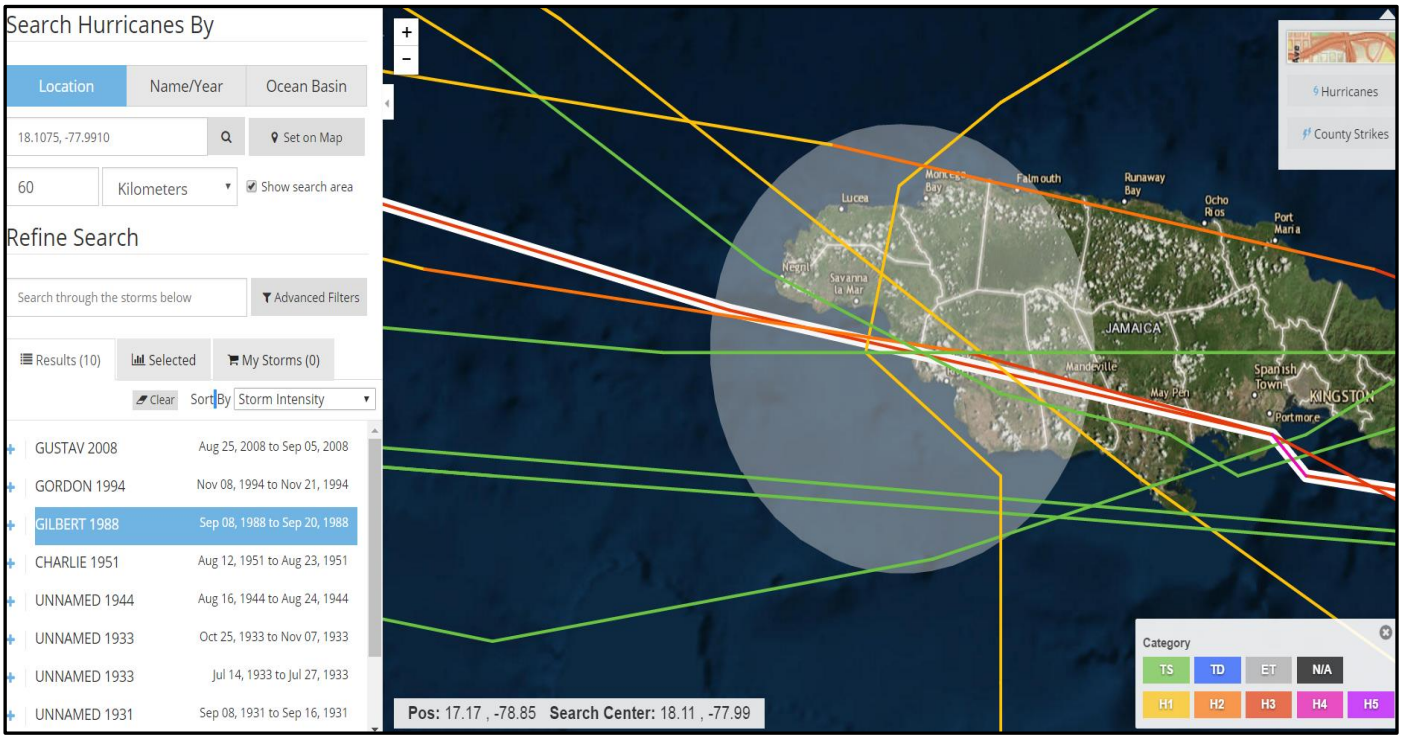


Figure 5.48. Track of Hurricane Gilbert when it passed through the study area in 1988. It was a category 3 hurricane at that time moving from east to west.

The most recent tropical storm that passed through the study site was Hurricane Gustav in 2008 (**Figure 5.49**). Gustav was a tropical storm when it moved pass the Sandals Whitehouse area, moving from east to west like most of the tropical storms. It moved off land to the west of the study site. At that time, the Sandals Whitehouse resort was developed. Comparing the Google Earth photo of 2005 and that of February 2009 shortly after the passage of the storm, no significant storm impact and beach changes can be identified. This indicates that Tropical Storm Gustav did not have significant impact to the resort as well as to the beach. This is likely due to the fact that the storm was relatively weak at the time, moving quite fast from east to west, a track that is not effective in generating high storm waves and surge.

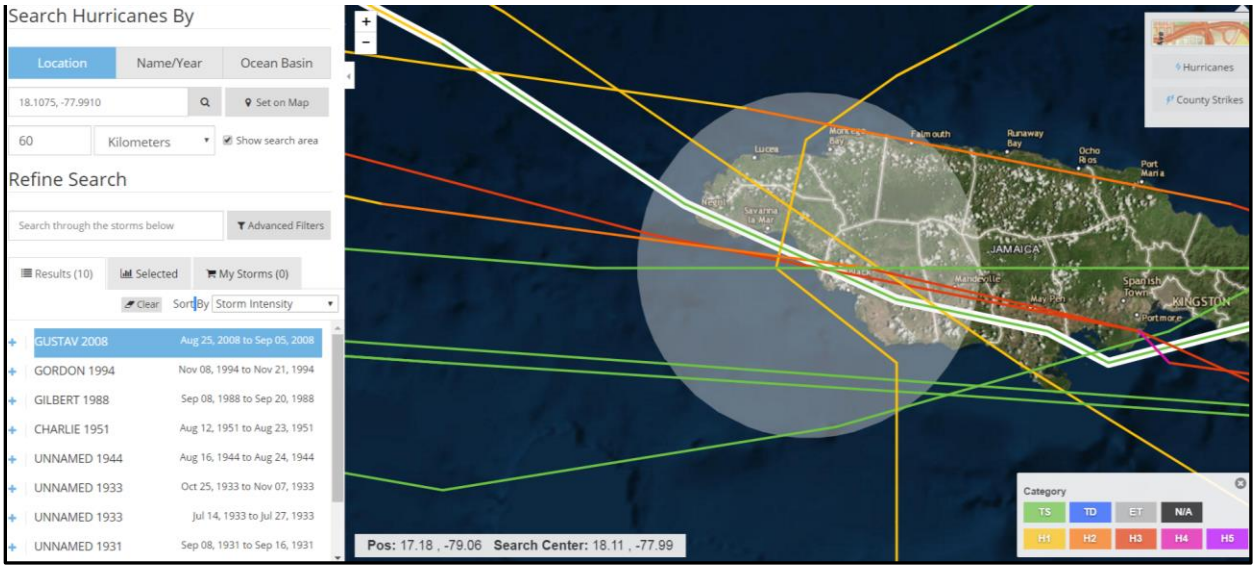


Figure 5.49. Track of Hurricane Gustav when it passed through the study area. It was a tropical storm at that time moving from east to west.

5.2.3 Water Quality

Water quality data are presented in **Table 5.14**.

Dissolved oxygen (DO) levels were in the range of 2.32mg/l to 6.14. The lowest DO was determined for the pond just west of the Property while at SWH 2T (the northernmost site), DO was highest. For the marine sites DO ranged from a low of 4.05 mg/L to a high of 6.14 mg/L. The lowest DO in the marine environment (4.45 mg/l) was determined east of the Gazebo at the bottom of the water column (SWH4B). In proximity to the proposed overwater suites DO was 4.67mg/l at the surface (SWH3T) and 4.54mg/l at the bottom of the water column (SWH3B). Over the reef, DO was 4.8 mg/l at the surface (SWH1T) and 4.7 mg/l at the bottom of the water column (SWH1B).

The highest DO deficit calculated for the marine sites (32.78%) was for SWH3T, at the water surface. The Pond had the highest DO deficit overall (71.07%). On the other hand the lowest recorded DO deficit was at the surface of the water at SWH2 (6.97%).

The **Biological Oxygen Demand** (**BOD**) according to the laboratory results were at a minimum of 4.6 mg/l (SWH1) and a maximum of 7.2 mg/l at SWH2. For all other sites the BOD ranged from 5.3 mg/l to 5.8 mg/l.

Salinity (**SAL**) ranged from a low of 5.5ppt in the pond to a high of 32.8 ppt at SWH2 and SWH4 at the surface and bottom of the water column. The lowest recorded salinity in the marine environment (31.7ppt) was over the reef at the surface (SWH1), where at the bottom of the water column salinity was 31.9ppt.

pH showed little variation being in the range 7.75 to 7.96. The highest pH was to the east of the Gazebo (SWH4), while the reef (SWH1) had the lowest pH.

Temperature in the marine environment was in a narrow range of 27 – 27.3^{0}C. The lowest temperature (24 ^{0}C) was recorded in the pond (SWHP).

Turbidity (TURB) measurements were recorded at a high of 3 NTU at the bottom of the water column to the east of the Gazebo (SWH4B). Turbidity was negligible for SWH1, which was located in proximity to the reef and also at the base of the water column at the site located the

shortest distance from the Overwater site (SWH3B). Site 2 and 4 recorded different measurements for turbidity at the surface and at the base of the water column.

Nitrate levels recorded were between 0 mg/L – 0.02 mg/L. Sites 4 and 4A were duplicates with results yielding 0.02 mg/L and <0.01 mg/L respectively. The lowest measurement of nitrates was near the Gazebo (SWH 3). On the other hand the highest nitrate level which was 0.02 mg/L was found at two sites: at the reef (SWH1) as shown in **Figure 5.50** and to the east of the Gazebo (SWH4).

Phosphate was undetected at a test detection limit of 0.05 ppm for all locations.

TSS levels were mostly low and did not reveal a quantity via chemical analysis. Sites 2 and 3 experienced levels of TSS which were detected not quantifiable (dnq), while Site 1 had the highest amount of total suspended solids at 8.5 mg/L.

Figure 5.50 Showing Reef

Time	Sample ID & Description			Location		Depth (m)	SAL	Turb (NTU)	DO (mg/l)	DO sat (mg/l)	DO def (mg/l)	DO defecit %	pH	Temp (°C)	TSS (mg/L)	NO3 (mg/L)	OPO4 (mg/L)	FC (MPN/ 100ml)	BOD (mg/L)	Oil and Grease (mg/L)
				N18°	W 77°															
8:29	SWH1	T	at the reef	6.297	59.657	3.11	31.7	0	4.8	6.66	1.86	27.93	7.75	27.1	8.5	0.02	<0.05	< 1.8	4.6	dnq
		B					31.9	0	4.7	6.65	1.95	29.32		27.1						
8:52	SWH 2	T	Northernmost site	6.624	59.819	2.99	32.8	2	6.14	6.6	0.46	6.97	7.88	27.3	dnq	0.01	<0.05	< 1.8	7.2	dnq
		B					32.8	2	6.07	6.6	0.53	8.03		27.3						
9:11	SWH3	T	Close Proximity to Gazebo	6.483	59.589	2.19	32.7	2	4.45	6.62	2.17	32.78	7.9	27.1	dnq	< 0.01	<0.05	2	5.5	11.5
		B					32.7	1	4.54	6.63	2.09	31.52		27.0						
9:38	SWH4	T	Located to the east of the Gazebo	6.374	59.216	4.57	32.8	2	5.44	6.6	1.16	17.58	7.96	27.3	5.22	0.02	<0.05	2	5.8	dnq
		B					32.8	3	5.49	6.61	1.12	16.94		27.2						
	SWH4A		Located to the east of the Gazebo			4.57									nd	< 0.01	<0.05	1.8	5.3	dnq
10:20	SWHP						5.5		2.32	8.02	5.7	71.07		24.9						
11:05	Pier (W)												7.87							
			NEPA Standard:						4.8				8.0 - 8.4			0.007 - 0.014	0.001 - 0.003	<2 - 13	0.0 - 1.16	
				MAX:		4.57	32.80	3.00	6.14	6.66	2.17	32.78	7.96	28.90	8.50	0.02		2.00		
				MIN:		2.19	31.70	0.00	4.45	6.60	0.46	6.97	7.75	27.00	5.22					
				AVG:		**3.22**	**32.56**	**1.44**	**5.18**	**6.62**	**1.42**	**21.38**	**7.87**	**27.37**	**6.86**					

T = top of water B = bottom of water

dnq = detected not quantifiable

nd = not detected

Table 5.14 Results of Water Quality Analysis

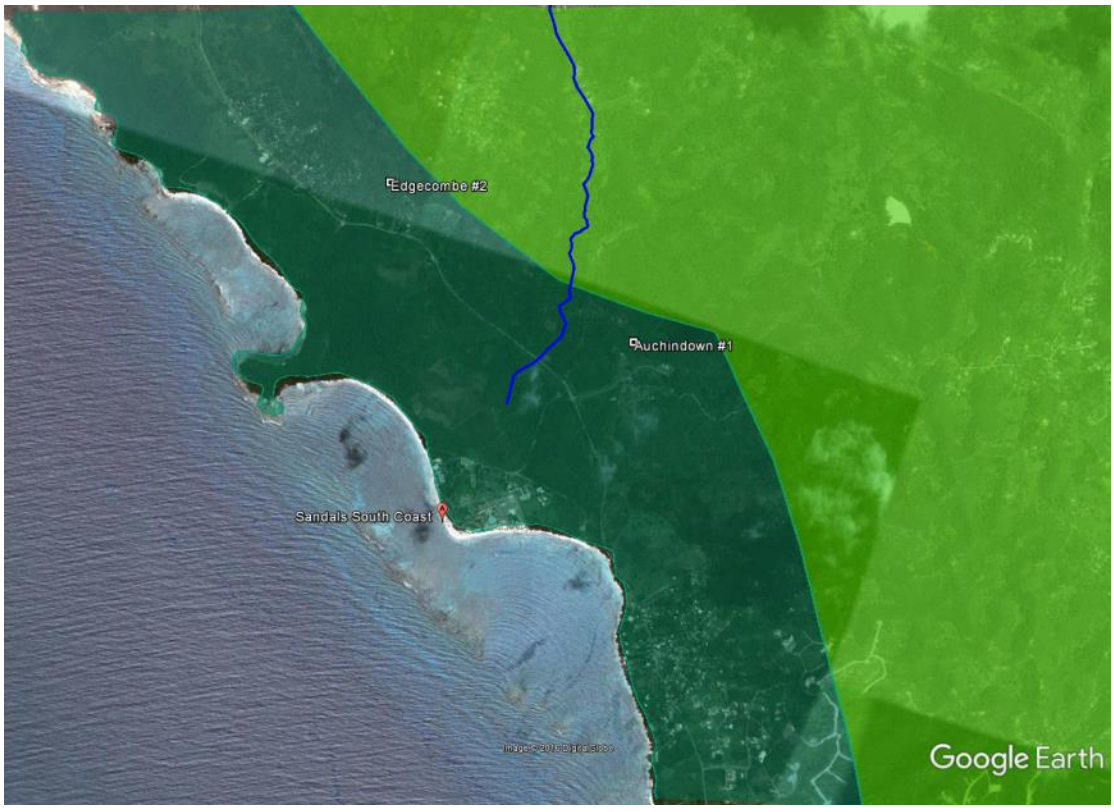
Site 4 A had concentrations of TSS that were not detected while the duplicate, Site 4 had a higher concentration of 5.22 mg/L.

Oil and Grease concentration at a majority of sites were low and were detected but not quantifiable by chemical analysis. Site 3 which is located in close proximity to the Gazebo experienced the highest concentration of oil and grease at 11.5 mg/L.

Faecal Coliform was tested as being at an undetected test detection limit of 1.8 MPN/100ml at SWH1 and SWH2 a high of 2MPN/100ml at SWH3 and SWH4.

5.2.4 Hydrogeology and Natural Hazards

The site is located on the Coastal Aquiclude **Figure 5.51** shows the site location and the water resources within 1 km of the site.



Map 5.51 - Hydrogeology and hydrologic features within 1000m of the site. Coastal Aquiclude (dark green); Limestone Aquifer (light green)

Robins River, located within the Deans Valley River Watershed, is noted to the north of the site. Robins River discharges to a depression north of the site before final flowing to the sea. The river does not impact the site. There are onsite drainage locations that take authorized stormwater runoff to the sea.

Two groundwater wells, Auchindown #1 and Edgecombe #2 are over 1km from the site.

No faults are noted on the geological map. The limestone is described as Gibraltar -Bonnygate White Limestone. The site is underlain by coral reef limestones covered by wave and wind-blown sands.

The site's land use is dsignated Swamp Forest with Secondary Forest and Fields to the north.

5.2.4.1 Hazards

Earthquake and Tsunami: Seismic hazard of any representative point in Jamaica depends on the proximity of that point to the nearest seismogenic sources. In Jamaica the Plantain-Garden Fault in eastern Jamaica is the most likely source of intense earthquakes above 6.0 magnitude in Jamaica.

Figure 5.52 below presents the relative contribution in terms of exceedance rates for each of the anticipated faults sources and for the city of Kingston. Based on the graph for a return period of 500 years, a probable maximum ground acceleration on bedrock (like limestone) would be of the order of 190 gals.

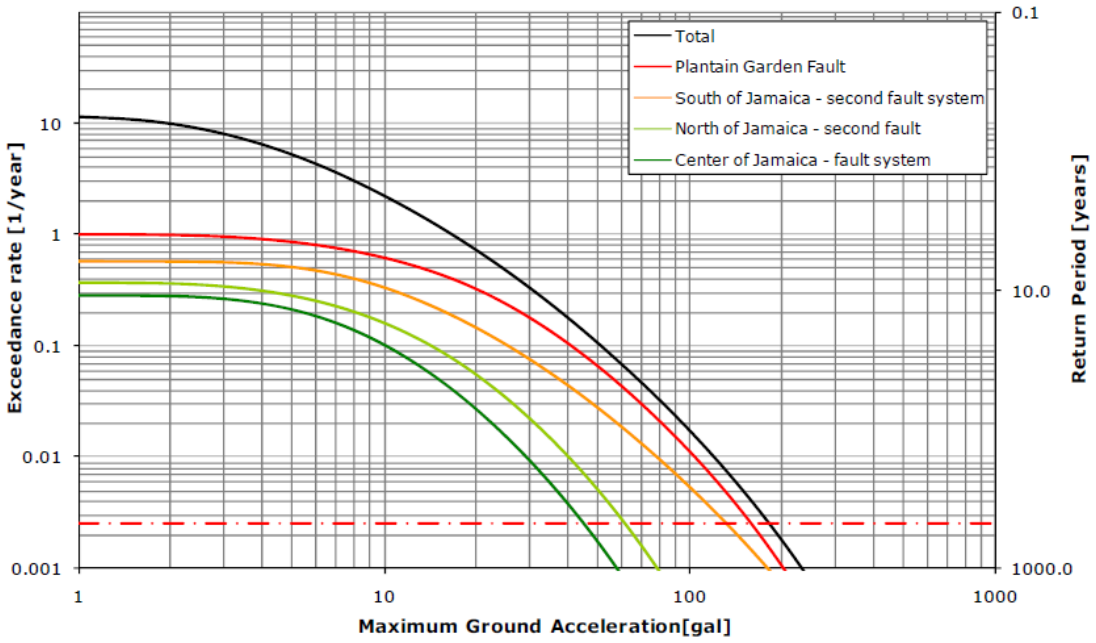


Figure 5.52 - Exceedance rates of maximum acceleration for Kingston

Based on all the four fault systems/sources and the total hazard caused by each system in **Figure 5.53** it can be shown that the Plantain Garden Fault and the South Coast Fault systems together account for about 99% of Jamaica's seismic hazard.

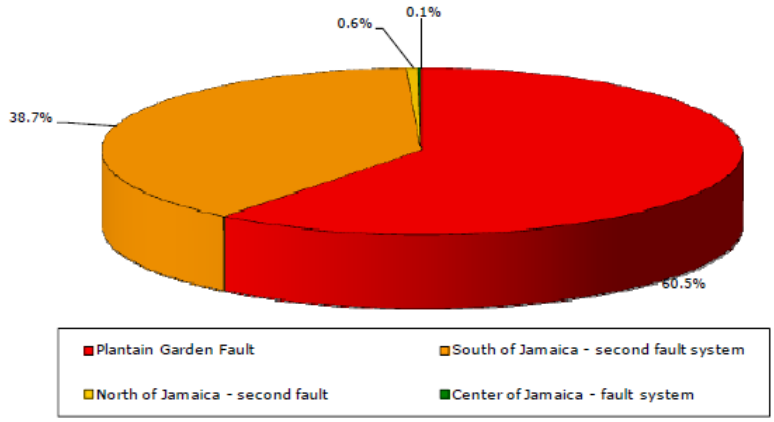


Figure 5.53 - Percentage of occurrence of events on the four fault systems in Kingston based on a 500 yr. return period

Scientific research since 2010 has indicated that the lack of surface rupture of the Enriquillo-Plantain Garden Fault in Haiti (which is linked to the fault in Jamaica) along with other geological

and seismologic evidence confirm to geoscientists that the Enriquillo-Plantain Garden fault remains a significant seismic hazard.

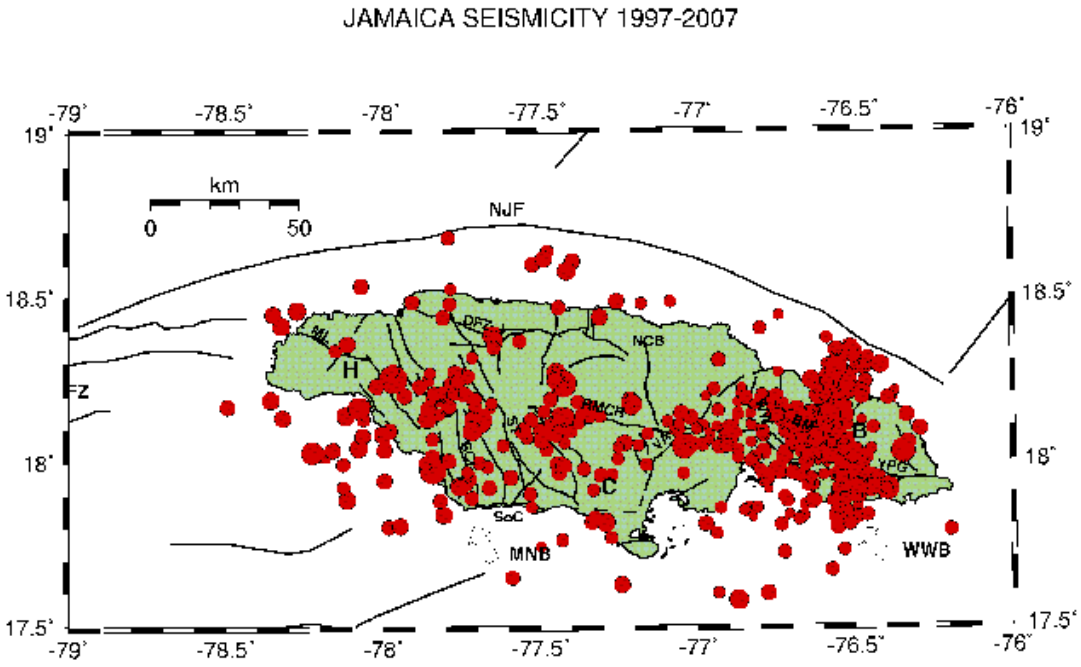


Figure 2.54 The seismic events across Jamaica between 1997 and 2007.

Most of the seismic activity occurs in the eastern section of Jamaica (**Map 5.20).**

Table 5.15 The Average Return Frequency of Earthquakes based on magnitude

MAGNITUDE	RETURN PERIOD (Yrs)
4.0	1.1
5.0	8.7
5.4	20
6.0	70
7.0	611

Tsunami hazards are inextricably linked to earthquakes and submarine landslides triggered by earthquakes. In Jamaica, the tsunamis that have been recorded have been in and around Kingston

Table 5.16). Lander et al, in 2002, documented all the tsunamis in Jamaica and ascribed a 1 in 160yr return period based on the available data.

RECORDED TSUNAMIS IN JAMAICA BETWEEN 1688 AND 1907		
1688	March 01	Earthquakes felt. No report of the tsunami reaching shore. Ship at sea was destroyed by wave.
1692	June 07	Earthquake with estimated magnitude of 7.5 caused portions of Port Royal to sink killing 2000 souls. Reported that the sea withdrew 274m and a 1.8m wave came to shore. Sea withdrawal at Yallahs was also noted.
1812	November 11	Earthquake agitated the sea in Annotto Bay causing a ship to lose its anchor. No report of wave reaching the shore.
1852	July 17	No earthquake reported, however, a ship 113km from Jamaica was affected by turbulent sea and simultaneous agitation in the harbour at Santiago de Cuba. There was no report of tsunami reaching shore
1907	January 14	Earthquake with estimated magnitude of 6.5 affect Kingston with 1000 souls lost. Seiches (osscilating waves in water) of 2.5m reported in Kingston Harbour. Waves up to 2.5m affected the north coast from Buff Bay to St Anns Bay. Sea receded 93m at Annotto Bay and 69m at Ocho Rios.

Table 5.16 The Recorded Tsunamis in Jamaica.

Based on the evidence there is an earthquake hazard that is likely in Jamaica in the future. The tsunami risk associated with any large magnitude earthquake, which may be of the type seen in the Pacific region recently, is considered to be low when compared to the Pacific. In the records, there are no reports of anyone being killed by a tsunami.

5.2.4.2 Hurricane Hazard

Despite the frequency of hurricanes being perceived as very high, the frequency of occurrence in Jamaica is low, particularly catastrophic events. The historic trajectories for Jamaica are presented in **Figure 5.55**.

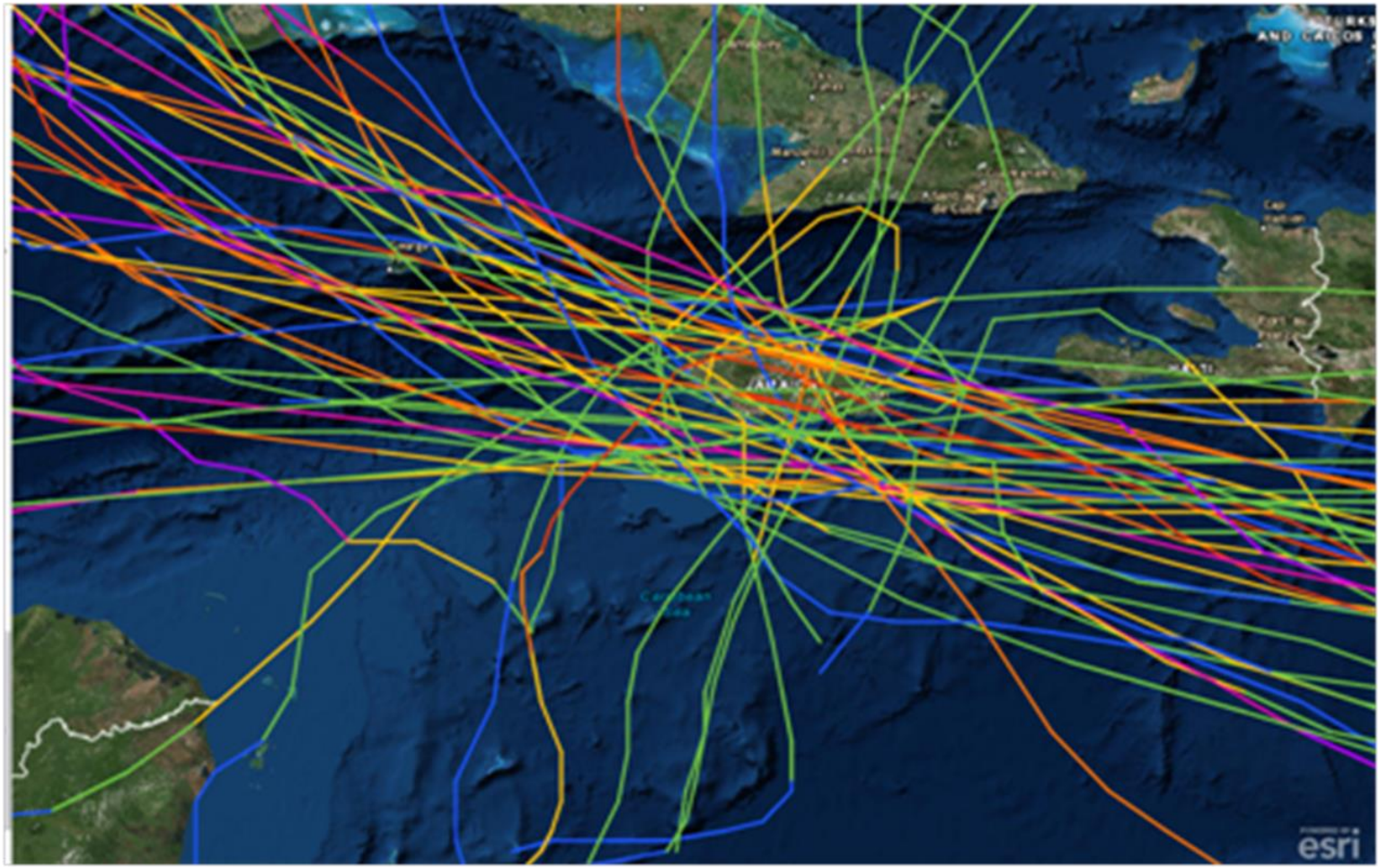


Figure: 5.55 Hurricane trajectories across Jamaica from 1854 to present. 54 storms are mapped courtesy of the NOAA archive

An evaluation of hurricane hazard for the entire island was done by the IDB in 2009 based on the trajectory of the historical hurricanes. The **Figure 5.56** shows the maximum wind velocity maps for different return periods.

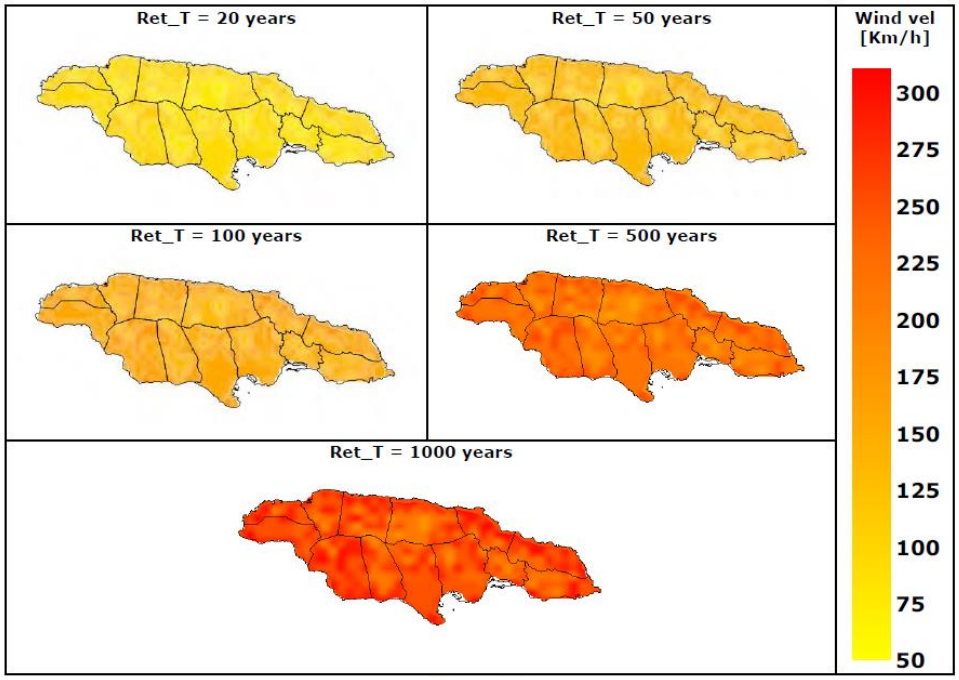


Figure 5.56 Maximum wind velocity maps (km/h) for diifferent return periods

Vulnerability to wind action depends on factors such as:

- Building structural system
- Shape of the structure, % of openings and other geometric characteristics
- Roof systems, angle and fastening systems of the roof to the main structure.

5.2.4.3 Landslides

The site is located in bedrock and on fairly flat land and as such landslip risk is negligible.

5.2.4.4 Storm water runoff

The proposed site will be located over the Caribbean Sea. As such the pre-development and post-development runoff will be nil.

It is required that any rainfall that may interact with potentially deleterious substances should not be allowed to discharge to the sea without pre-treatment.

End of Description of Environment

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6.0 SOCIO ECONOMIC ANALYSIS OF WESTMORELAND PARISH

6.1 Geography

Sandals South Coast Jamaica (SSGJ) is located on the South Coast of Jamaica in the Parish of Westmoreland. The Parish is located on the South-Western coast of the Island and is bordered by the Parish of Hanover to the North, the parishes of St. James and St. Elizabeth to the East and the Caribbean Sea to the South and West. Westmoreland is the 7th largest of the 14 parishes in Jamaica, occupying an area of 789.54 km². According to the Social Development Commission (SDC), Westmoreland is made up of 5 Developmental Areas and 83 communities. SSCJ is located in the Whitehouse development area between the townships of Whitehouse and Bluefields.

Development Areas	Number of Communities
Savanna-La-Mar	32
Grange Hill	11
Whitehouse	10
Darliston	22
Negril	8
Total	**83**

Table 6:1. Westmoreland Development Area. Source: Westmoreland Parish Profile 2013.

6.2 Population of Westmoreland

The population of Jamaica in 2015 was 2,728,900 with Westmoreland accounting for 5.3% of the nation's population, with a 145,800 living in the parish. While the population of Westmoreland grew by 0.38% per annum between 2001 and 2011 based on the census report of 2011, the population percentage as a portion of Jamaica's has been reducing, representing 6.2% in 1970, 5.5% in 1982 and 5.4% in 1991. This indicates a net migration from the parish. The population of Whitehouse and Bluefields according to the 2011 census are 4211 and 2978 respectively. Whitehouse shares the same gender breakdown as the parish with 51% male and 49 % female, while Bluefields has 50% of male and female each.

The age cohorts of the population show that 29% of the population of the Parish and Whitehouse Township are below the age of 15, while it is 30% for Bluefields Township. The youth population percentage for the Parish, Whitehouse and Bluefields are 19%, 20%, and 21% respectively, while the total dependent population for the parish and both townships are 37%.

Population Age Distribution %			
Age Cohorts	**Parish**	**Whitehouse**	**Bluefields**
0-4	9.2%	9.8%	9.5%
5-9	9.9%	10.1%	10.3%
10-14	9.6%	9.3%	10.1%
15-19	9.9%	9.6%	11.3%
20-24	8.9%	10.4%	9.3%
25-29	8.3%	8.5%	8.4%
30-34	6.4%	6.1%	7.2%
35-39	6.3%	5.5%	6.1%
40-44	5.8%	5.5%	6.0%
45-49	5.3%	5.0%	4.7%
50-54	5.2%	5.1%	4.8%
55-59	3.6%	3.6%	3.2%
60-64	3.0%	3.1%	2.4%
65+	8.6%	8.4%	6.8%

Table 6:2. Population cohort

6.3 Employment

According to the Planning Institute of Jamaica, the labour force of Jamaica in 2015 was 1,316,000 with men comprising 54.6% of the labour force and women 45.4%. Unemployment was 13.5% for men and 17.8% for women. The SDC analysis of the labour force in the parish estimate a labour force of 84,482 persons, comprising 51.6 % males and 48.4% female. This survey revealed that at least 70% of household in the parish has at least one or two members employed, while 24% of

household had no person employ (See Figure 2, showing Occupational Distribution of Household Heads).

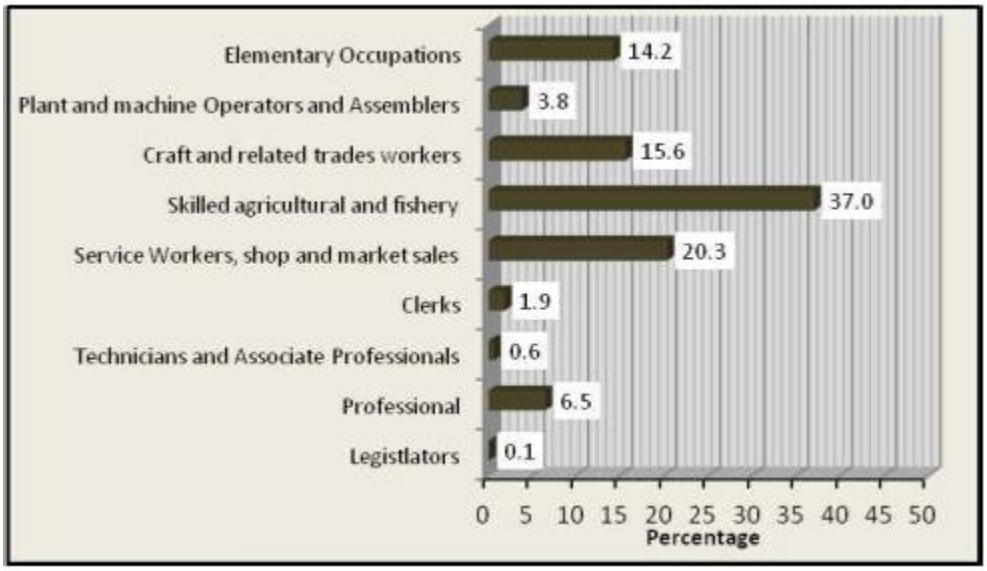


Figure 6:1. Percentage of Employment by Sector. Source: SDC

According to the SDC, the main source of employment in the parish is Agriculture which represents the highest employment in Whitehouse, Grange Hill and Darliston Development areas. Agriculture includes sugar cane, bananas, cash and tree crops, cattle-rearing, small stock rearing, and fishing.

At the end of 2015, 7.7% of persons were employed in hotel and restaurant service industry across the Jamaica. In 2014, tourism and restaurant represented 7.1% of the workforce, which shows a steady growth in tourism employment. Female made up 61.3% of the workforce in the industry.

The main tourism-related employment in the parish is in Negril which comprise the overwhelming majority of the accommodation rooms in the parish. SSCJ is the only large-scale tourism accommodation in the Whitehouse area.

Fishing is one of the main economic activities of Whitehouse/Bluefields area, proving the livelihood of numerous fisherfolks in the area.

6.4 Housing

According to the 2011 census there were 49,222 dwelling units and 47,265 housing units in the parish, Whitehouse and Bluefields had 1383 and 979 dwelling units and 1322 and 941 housing

units respectively. In the parish, 78% of the dwellings were self-owned, 11% rent-free and 10 % rented. Fifty-six percent (56%) of the housing was constructed with wood and 32% was constructed with concrete and blocks and 96% were separate detached housing units. The roofs were mainly constructed with metal sheeting (81%) and to a lesser extent concrete slab (14%). Bathrooms are not available in 15% of the dwellings.

Most of the housing stock in the parish comprised of 2 rooms (27.5 %), with 3 rooms and 1 room representing 22.7% and 19.9% respectively, with the average household size in the Parish of 3.5. According to the 2008 Housing Quality Index (HQI), the quality of the housing units in Westmoreland was one of the lowest at 63.2%, well below the country average of 71.4%. The HQI is based on indoor taps, electricity supplied, exclusive use of water closets, exclusive use of kitchen and one person per habitable room.

6.5 Education

There were 252 educational institutions in the parish in 2012 according to Ministry of Education and Early Childhood Commission, 2012-13. This comprised of 159 private basic infant schools, 68 public government schools, and 25 independent schools. The school age population of the parish is 19.4%, with Whitehouse and Bluefields having 19.4% and 20.4% of their population being of school age.

The functional literacy level of the parish is 72.5% which is below the national average for 2015 which is 78.3%. Based on the 2011 census, 1.2% of the persons above school age in Westmoreland had no schooling, which represents the highest in the country, with the country average being 0.5%. On the opposite spectrum, 2.2% and 4.2% of the population above school age has attained university and other tertiary education respectively. These percentages represent the lowest on both counts of all the parishes, the country average for university and other tertiary education is 6.1% and 6.7% respectively.

6.6 Health Facilities

Westmoreland is part of the Western Regional Health Authority (WRHA) that also serves the parishes of Hanover, St. James and Trelawny. The WRHA compromised of 4 hospital and 82

health centres located throughout the parishes. The Parish of Westmoreland has one Public General Hospital located in the parish capital and 21 health centres.

Parish	Hospital	Type	Bed Complement	Occupancy Rate 2013/2014	Major operating rooms (#)
St James	Cornwall Regional Hospital (CRH)	A	417	87.8%	4
Westmoreland	Savanna la Mar Hospital (SPGH)	B	164	102.9%	2
Trelawny	Falmouth Public General Hospital (FPGH)	C	111	107%	2
Hanover	Noel Holmes Hospital	C	38	63.4%	0

Table 6:3. Hospital Beds in Western Region. Source: Western Regional Health Authority, 2015

There are four (4) health centres within the Whitehouse Development area. Bluefields, Beeston Springs and New Works all have Type 1 health centres which provide the following services;

- Prenatal Care
- Postnatal Care
- Family Planning
- Immunization
- Home Visit
- Home delivery

Whitehouse Township has a Type 3 Health Centre that provides all the services of the Type 1 Health facility along with the additional services,

- Curative Services
- Mental Health Services
- Family Counselling
- Nutritional Counselling
- Dental Health Services

Figure 6:2. Health Facilities in Western Region. (Source: Western Regional Health Authority, 2015)

The parish has two (2) public pharmacies that are both located in the parish capital. According to the Pharmacy Council of Jamaica website, there are 20 registered private pharmacies in the Parish, 9 of which are located in Savannah-le-Mar. Based on the website and observation, there are only 2 registered pharmacies within the Whitehouse Development area, one in Whitehouse Township and another was observed on travels to Bog.

Persons employ will be able to access private care through insurance once permanent with the company.

6.7 Potable Water

Westmorland has 22 water supply facilities that serve the parish that comes from 16 springs, 4 wells, and 2 rivers. The main sources of surface water within the parish are from Roaring River, Venture River, Cabarita and Sweet River. The installed capacity of the parish is 8 mgd, with Roaring River (3 mgd) and Bulstrode (2 mgd) Water Supply Systems being the major systems in the parish. Other significant water supply systems in the parish are Bluefields, Williamsfield, Carawina and Cave systems. The Bluefields systems supply, Bluefields and Whitehouse and the areas around the project site.

Based on the 2011 census, 79% of households of the parish received their water from a public source while 21 % came from a private source. Forty-five percent (45%) of households received water piped to their dwelling compare to 58% nationally, with 24% having access to water piped to their yard and another 17% utilizing catchment. In Whitehouse Township, 45% of households received water piped to their dwellings, while 13% has water piped to their yard and 21% receive water via Catchment. In Bluefieds the percentage of persons receiving water piped to their dwellings, yard and from catchments are 40%, 21%, and 13% respectively, with 19% of households receiving water from spring or river.

This project will not affect water source.

6.8 Wastewater Disposal

There are five (5) public Wastewater Treatment Plants (WWTPs) in Westmoreland, with a daily designed capacity of over 18.1 million litres per day. Two of the Sewage Plants are located in the capital of Savannah-La-Mar and the majority are associated with housing development. The Negril treatment plant is the largest and caters for all establish within its catchment. There is no public WWTP in the Whitehouse area where the project is located. SSCJ has its own private WWTP that is licensed to operate by NEPA.

Name	Designed Capacity (Million Litres per Day)	Daily Capacity (Million Litres per Day)	Name of Operator
Llandilo Housing Scheme Sewage System	0.6	0.43	National Water Commission
Llandilo Sewage Treatment Plant	0.9	0.61	National Water Commission
Shrewsbury Treatment Plant	0.7	0.5	National Water Commission
Negril Sewerage System	15.9	5	National Water Commission
Meylersfield Housing Scheme Sewage System	-	-	National Housing Trust

Table 6:4. WWTP in Westmoreland (Source: SDC)

6.9 Toilet Facilities

Water closet was the most prominent type of toilet facility used in the parish representing for 54% of household use, with 41% of household using pit latrines. Comparatively, the country average is 73% of household using water closets and 24% using pit latrines.

6.10 Garbage Collection

The National Solid Waste Management Authority conducts garbage collection within the parish. According to SDC collection in the parish comprised of 8 trucks with the townships of Savannah-la-Mar and Negril being cleaned daily, while the remaining areas in the parish receive monthly picked up. Garbage is currently disposed at the Retirement Landfill in St. James. The Executive Director of the (NSWMA) Audley Grant announced the acquisition of land at George's Plain, Westmoreland on 2nd March 2017 (Jamaica Observer).

There is conflicting information regarding household garbage disposal in the parish, with the SDC reporting that 68.1% of households burn their garbage, while 23% are picked up for disposal. The 2011 census on the other hand 47.1% of the households received regularly collection, another 10% irregularly collection and 38.1% burn their garbage.

6.11 Fire Service

The Westmoreland Fire Division is served by two (2) Fire Stations located at Redground, Negril and Darling Street in Savannah-La-Mar. These Fire Stations are served by one (1) Fire tender each. The Darling Street Fire Station is the nearest to SSCJ, 29.9 Km and at least 38 minutes away. River Fire Station located at Black River, St. Elizabeth is actually the closest fire station to the SSCJ. It is located 21.6 km and 24 minutes away from the property.

There were 512 serious fire calls in the Parish in 2015, representing 4.4% of the fire calls countrywide. Between the four-year period of 2012 and 2015, there was an average of 509 serious fire calls per year.

6.12 Transportation

Westmoreland has approximately 348 km of main road network, 713 km of parochial road network and 63 km of farm roads. Highway. One of the main Class A roads, Highway A2 runs from Negril through Savanna-la-Mar passing Sandals South Coast Jamaica going through Whitehouse on its way through St. Elizabeth.

Type of Road	Number of Roads	Length (Km)	Condition
Class A	4	79.85	2 Good; 2 Fair
Class B	5	49.19	1 Good; 3 Fair; 1 Poor
Class C	28	218.83	1 Good; 21 Fair; 6 Poor

Source: National Works Agency, Westmoreland (2015)

Table 6:5. Road Network Type. Source: SDC

The main source of transportation in the parish is buses that do the inter-parish transfer (e.g. to Hanover, St. James), routes taxis, private vehicles, and motorcycles taxis. "The Parish is served by approximately 888 route taxis operating on 67 approved Transport Authority taxi routes. One hundred and fifty-three rural stage carriages which operate on 33 routes also form part of the public transportation system in Westmoreland" (Transport Authority, 2014 qtd in SDC). The main source of transportation for the Whitehouse Development area is route taxis, private motor vehicles and walking. The passage of Highway A2 in front of the hotel makes it very accessible to employees throughout the parish. Most guests arrived via Sangster International Airport from Montego Bay via Highway B8, which is in need of repair.

6.13 Air Service

The only air service in Negril is the Negril Aerodrome that is located 7 km from North from Negril Point.

6.14 Lighting

Electricity is the major power source of lighting for the parish, with 90% of households receiving lighting through this mean. This is below the country average of 92%, but rank higher than rank higher than 7 other parishes. 7% of household use kerosene for lighting.

6.15 Telecommunication

The 2011 census survey indicated that 79% of persons in the parish had cellular phones. According to the Office of Utility Regulations in 2015, the cellular penetration in Jamaica was 115.2% of the population. This would indicate that cellular usage in the Parish would be around or close to 100%.

The penetration of fixed line across the country has been on the decrease, moving from 12.8% in 2006 to 9.28% in 2015. Conversely, internet broadband penetration has risen exponentially from 2.8% in 2006 to 61.3% in 2015 across the country. We expect both trends to replicate across Westmoreland.

6.16 Financial Services

Savannah-La-Mar is the banking capital of the parish with (5) five of the (7) registered commercial banks having a branch in the town.

- National Commercial Bank (NCB)
- Sagicor Bank
- Bank of Nova Scotia
- CIBC First Caribbean,
- Jamaica National Bank

In addition, NCB and Bank of Nova Scotia have branches in Negril. There is no commercial Bank in Whitehouse. There are 36 Automatic Banking Machines across the parish.

Communities and Workers of Jamaica Cooperative Credit Union Limited has four branches across Westmoreland located in

- Savannah-La-Mar
- Negril
- Whitehouse
- Grange Hill

While, JTA Cooperative Credit Union and Victoria Mutual Building Society also have branches in parish capital. The National People's Co-operative Bank of Jamaica Limited (NPCB), a national bank that serve the interest of rural agricultural development has three branches in the parish in;

- Grange Hill
- Bethel Town
- Darliston

6.17 Crime

There was 431 serious crime reported in Westmoreland in 2015, representing 5.7% of category 1 crime in the country. Murder represented 25.8% of the crime reported and shooting represented 23.2%, both of which were over-represented in the country comparison with 9.2% and 9.3% respectively. Westmoreland had the 5th highest murder rate by parish and the 7th highest based on parish population. The percentage of category 1 crime that was solved in 2015 was 39.1%, which is lower than the country average of 41.4%.

Westmoreland Crime Statistics comparing with crime in Jamaica				
Crime Category	**Parish Actual**	**Country Actual**	**Parish %**	**Parish % of Country**
Murder	111	1207	25.8%	9.2%
Shooting	100	1070	23.2%	9.3%
Rape	41	596	9.5%	6.9%
Aggravated Assault	31	597	7.2%	5.2%
Robbery	68	1909	15.8%	3.6%
Break-in	66	1801	15.3%	3.7%
Larceny	14	336	3.2%	4.2%
Total	431	7516		5.7%

Table 6:6. Crime Statistics. Source: Planning Institute of Jamaica

In 2013, 9.3% of the 140 crime reported against tourist occurred in Westmoreland. Crime in the Whitehouse and Bluefields areas are reportedly very low, compare across the parish. Both Bluefields and Whitehouse are serviced by a Police Station each. There are 15 officers stationed at Whitehouse and 20 officers at Bluefields, with 8 of those officers servicing in the Marine Division. Each station has one motor vehicle and Bluefields has a boat, powered by an 86-horsepower engine. A visit to the stations revealed that domestic crimes were most prominent in these two localities.

6.18 Governance in Westmoreland

The parish has three constituency representatives in the Jamaican Parliament and 14 Parish Council Divisions. The Member of Parliament of the constituency, Councillor of the Division and 8 other councillors were part of the stakeholder consultation process.

Constituency	Member of Parliament	Parish Council Division	Councillor
Westmoreland Western	Wykeham McNeil	Negril	
		Sheffield	Garfield James
		Little London	Ian Myles
		Grange Hill	
		Friendship	Kevin Murray
Westmoreland Central	Dwayne Vaz	Frome	
		Savanna-La-Mar	
		Savanna-la-Mar North	Devon Thomas
		Petersfield	George Wright
		Cornwall Mountain	Donette Foster
Westmoreland Eastern	Luther Buchanan	Whitehouse	Valdence Gifford
		Darliston	Jerome Bacchas
		Leamington	Cebert McFarlane
		Bethel Town	

Table 6:7. Governance in the Parish

6.19 Land Use

Both current and proposed development order have the project area to be used for Marine Sanctuary. As such, this project will in no way change the use of the area in any way, since no fishing will be permitted in the area. Actually, the stakeholders has recommended the expansion of the present sanctuary.

The project is located along the licensed beached of SSCJ. The only recreational activities that appears to be taking place within the water where the project is located is the occasional watersports craft from the hotel wondering across the area. There was no observation of local personnel within the project location and it doesn't forms part of a channel. Further, stakeholder consultation with Fisherfolks in the area hasn't indicate that the area is use for any purpose by their members.

7.0 PUBLIC PARTICIPATION

NEPA's term of reference required that the public be consulted about the project concept and their full views on the project be reflected in this technical paper.

7.1 Methodology

Considering the type and scale of project that is being undertaken, we choose to identify stakeholders that would be most affected by the project and would have a vested interest through their proximity to the project location and resource use along with and their community influence through participation in community development process. Stakeholders were placed in to the following group

- Social
- Community
- Political
- Regulatory

7.2 Stakeholder Map

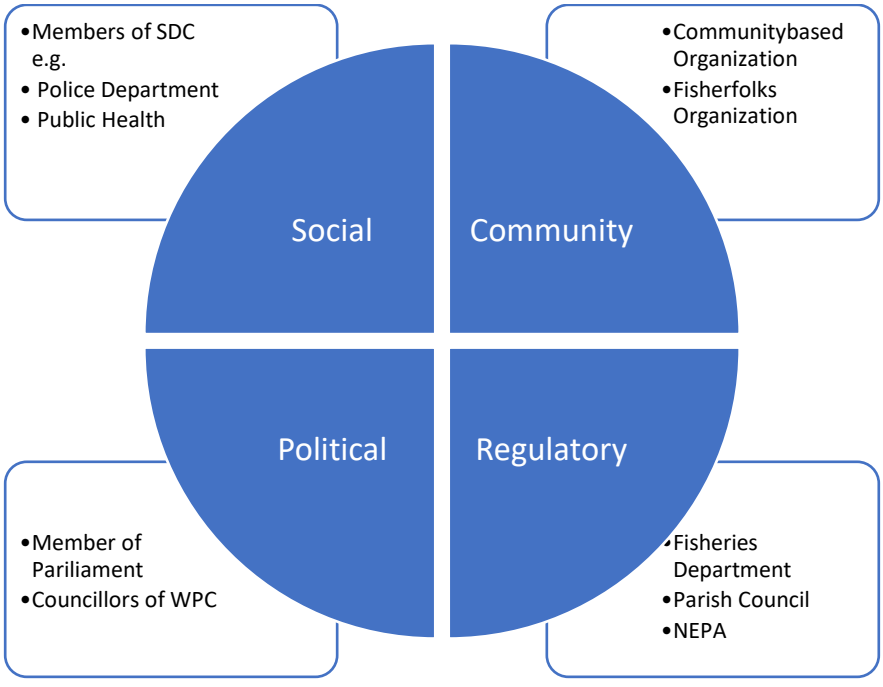


Figure 7:1- Stakeholder Map

7. 2 Presentation to Stakeholders

A standard Microsoft PowerPoint presentation was made by Dexter Cummings at each of the stakeholders' consultation. The outline of the presentation was as follows (see presentation slide attached in **Appendix 6**)

- Overview of Sandals Royal Caribbean Overwater Room Project
- SSCJ Project Location within SWFCA
- SSCJ Project Concept and Footprint
- Sea Floor of Project Site
- Building foundation - Pile structure & Pile driving Operation
- Utilities
- Structure Construction
- Mitigation Measures
- Operation of Rooms

At the end of the presentation we opened the floor for questions, suggestions and comments.

7.4 Parish Stakeholders

The Social Development Commission (SDC) has divided the parish of Westmoreland into 5 Developmental areas based on "a cluster of communities based on geographic, economic, and social boundaries locally defined" (See table 6:1). The SDC has the mission to "facilitate the empowerment of citizens in communities, enabling their participation in an integrated, equitable, sustainable National Development Process". To this end the SDC work within the parish to strengthened and streamline community-based organizations (CBO) to "enable citizen participation in the management of Jamaica's development processes".

Each Community within the parish has a Community Development Committee (CDC) that is comprised on representative of all CBOs within that community. These CDCs have elected members to represent the communities at the Development Area Committee (DAC). Each Developmental Area has a DAC which comprised of executive members from each CDC within that DAC.

The Whitehouse DAC is comprised on 10 CDCs, one for each of the community that makes up the Whitehouse Development Area, namely

- Beeston Spring
- Bog
- Whitehouse
- Bluefields
- Cave
- Kentucky
- New Works
- Petersville
- Mearnfville-Auldayr
- Kilmarnock

7.5 Stakeholder Consultation

7.5.1 Whitehouse CDC

SSCJ is located within Whitehouse CDC. We presented the Project at a meeting of the Whitehouse CDC on 6th February at the Whitehouse Community Centre. This meeting was chaired by Mrs. Ivette Ferguson of the SDC and there were 18 persons in attendance from the following organisations that make up the Whitehouse CDC.

- Culloden Infant
- Whitehouse Marine Sanctuary
- Social Development Commission
- Church of Jesus Christ Whitehouse
- Western Strikers Cricket Club
- Refuge Temple Culloden
- Whitehouse CDC
- Whitehouse DAC

After the presentation, one question was asked:

- Would Sandals employ persons from the local communities?

Vilma Smith (Environment Health and Safety Manager at SSCJ) informed the audient that Sandals policy is to employ at least 60% of the persons from the surrounding communities and this would result would indeed result in increased employment in the surrounding communities. Dexter Cummings informed the group that the 17 suites that were built at Sandals Royal Caribbean resulted in about 90 additional permanent employees at the hotel, as well as over 100 persons, were employed during construction.

7.5.2 Whitehouse DAC

The Whitehouse DAC had their meeting on 15th February 2017 at the Bog Infant School in Bog, Westmoreland. The meeting was chaired by Mr. Hugh Rodney, the Chairman for the DAC. Mr. Rodney had invited us to make the presentation to his membership. There were 30 persons present at the meeting representing the following CDCs,

- Beeston Spring
- Bog
- Cave
- Kentucky
- New Works
- Petersville

The following questions and comment were raised by participants.

- Sandals provide training to lots of young persons, but a lot of the persons do not receive jobs with the company.

It was explained to the audience that Sandals Resorts has a 6 weeks HTP programme that provide training to mostly persons with no experience in the hotel industry, providing practical training in departments throughout the hotel. The Trainees are certified after the training and some are employed by the company where vacancies exist. Many of the trainees are able to use the certification to gain job within the industry, due to the high standard of training imparted.

- A participant commented that when he was younger the coastline had more prominent mangrove ecosystem and expressed concern this development would affect this ecosystem

that forms a protective barrier. He also questioned the degree of impact that can result from the project.

The audience was reminded that this project wouldn't affect any mangroves ecosystems and wherever such projects may affect an ecosystem, NEPA has a no net loss guideline that would require the developer to provide remediation as Sandals would have done with a similar project at Sandals Royal Caribbean. We reinforce that it's the company every intention to take the precaution identified to mitigate against potential impacts, since it is in Sandals, NEPA and the wider community interest for us to minimize potential impacts. To this degree, it was explained to the gathering that NEPA's actively monitor the project during and after construction through physical inspection, along with independent reports of remediation for prolong period of 3-5 years in some instances.

Fig 7. 2. Public Presentation to Whitehouse DAC

- Another participant commented that with Jamaica's beautiful landscape he would like to more eco-tourist that would be beneficial to the environment.

We acknowledge that this niche tourism can be further enhanced and Island Routes, one of our sister companies is leading the way in this regard.

- A question was asked about what was the possible impact of the pile foundation on the seafloor.

We informed the group that no dredging of the sea floor is associated with this project. The 184 piles would occupy a miniscule 0.002% of the sea floor of the Sanctuary, i.e. approximately 53.8 m^2. We believe that the small foraging area lost to the fishes and other marine lifeforms will be compensated in efforts to improve the fish resources in the sanctuary.

7.5.3 Whitehouse Parish Council Representative

Mr. Valdence Gifford is the representative of the Whitehouse area on the Westmoreland Parish Council. We met at SSCJ on 16th February 2017. The project was presented to him and we did a site visit. He asked for further clarification about our waste management plan and sewage plan. The details of those plans were explained to him and the mitigation measures we would have in place during construction and operation the Overwater Rooms.

7.5.4 Westmoreland Eastern Parliamentary Representative

SSCJ is within the political constituency of Westmoreland Eastern district that is represented by Member of Parliament (MP) Luther Buchanan. The project was presented to MP Buchanan on 27th February 2017 and he was given a tour of the site and shown how the project will be executed. He asked about the possibility of local employment for members of the constituency during construction. Assurance was given that the main contractor is expected to source labour from the surrounding communities.

7.5.5 Whitehouse Fisherfolks

We meet with the Whitehouse Fisherfolks organization on 31st January 2017 at 9:30 a.m. in the Conference Room at SSCJ. This meeting was arranged by the Whitehouse Fish Sanctuary, whose representatives were among the sixteen (16) persons present.

The following were discussed after the presentation.

Mr. Honeyghan (President) commented that the mitigation plan as presented was good. Mr. Broomfield (Fisheries Officer), enquire about the biomass increase from the Sanctuary and was told by Mr. Hernould (Sandals Foundation, Environmental Officer) that the biomass increased by 33% in 2015 and they are awaiting the latest report from the ongoing study conducted.

Mr. Honyeghan proposed that the Sanctuary be extended east towards Black River. A participant asked what would happen to the fishers who use the area. Mr. Anthony Gordon stated that he once fished in the area and concluded that it would be better since currently persons are able to catch more fishes outside the SWFCA than within that area because it is overfished. Mr. Broomfield said only about 5 scull fishers currently fish within that area and he was supportive of the proposed extension. He further stated that the proposed increase would result in more biomass increase and this is been realized with personnel in Savanna-la-Mar asking for a Special Fisheries Conservation Area as well. The general consensus of the participants was that the SWFCA should be extended. We informed the group that we would be supportive of this extension and would agree to be a partner in the process.

Mr. Broomfield asked if NEPA supports Fishing Aggregating Devices (FADS) suggested that some can be placed outside the sanctuary. He explained that FADs attract fishes, resulting in increased catch. This idea was supported by Mr. Honeyghan, who said this was being done in other Caribbean Islands.

One of the participants suggested that Sandals give to fisherfolks functional lifejackets that are no longer used by guests due to discoloration etc. A commitment was made for this to be done. Mr. Bromfield suggested that Casitas can be placed within the sanctuary to be a protective habitat for lobster. He also suggested setting up a marine exhibit that can be accessed by school children from the Western Parishes to be educated about the marine environment. Fish condos were also proposed to be placed within the sanctuary. The possibility of conducting tours within the sanctuary was also discussed.

Mr. Honeyghan asked about Sandals buying fish from the local Fisherfolks. We explained that the main challenge with arranging such purchases was that any hotel the magnitude of Sandals has to enter into a contract with a supplier to provide an established quantity and quality of product at an agreed price. I shared my experience in the industry across Barbados, St. Lucia and Jamaica; in

that fisherfolks were generally unwilling or unable to make such commitment, instead fisherfolks generally sell their catch to the highest bidder especially during period of scarcity.

7.5.6 Bluefields Bay Fishermen Friendly Society (BBFFS)

We meet with the Society on the 17th February 2017, at the Society's office at Belmont Bay. We presented the project to 7 members who attended the meeting.

The following questions and comments were raised after the meeting

A participant commented on the lack of adequate linkage between the hotel and fisherfolks in relations to fisherfolks taking guest out to sea to fish, even in cases where the boats are licensed and insured.

Concerns were raised about guest throwing garbage into the sea during the occupation of the rooms. We explained that all our guests go through an orientation upon checking that includes the importance of preserving the environment. Our mitigation plan requires that our staff to remove all refuge from the rooms and place into our waste management system and our security team that use Jet-ski will remove any floating object within the area. We haven't experience the issue of guest throwing garbage into the sea at Sandals Royal Caribbean. It was pointed out that in front of the hotel is at time littered with garbage and it was felt that the hotel can do a better job of having same clean to project a better image.

It was brought to our attention that a pond to the East of the property consists of crocodiles that have been known from time to time to escape into the sea. We assured the group that we will assess the situation and mitigate appropriately. The group stated that turtle usually lay eggs on the beach to the West of the project and we commit to use turtle appropriate lighting to mitigate against any potential impact. The group supported the placement of FADs outside the sanctuary.

They asked if Sandals can provide certified dive training for some of their members that would allow them to develop their diving skills and provide opportunities to improve income. We agreed to provide this training.

7.5.7 Fisheries Department

We had a telephone discussion with the Director of Fisheries, Mr. Gerald Kong on 21st September 2016 informing him of our application to NEPA for the construction of the Overwater Rooms. We discussed our general approach to have a positive impact on the Special Fisheries Conservation Area (SFCA) and our intention to have consultation with the fisherfolks in the area and marine biologists for recommendations on how we can enhance the SFCA. On 22nd September 2016, we forward our Project Brief to Mr. Kong that outlined mitigation measures that would be employed during construction.

An assessment of the area was conducted by Marine Biologist Dr. Dayne Buddo in September 2016, who made a number of recommendations on possible enhancement of the SFCA (**Appendix 7**). This assessment was shared with the Director of Fisheries on 18th January 2017. We meet with the Director of Fisheries and the Sandals Foundation at the Sandals Foundation Office in Kingston on 3rd February 2017. We had wide-ranging discussions on what can be done to enhance the SFCA and our stakeholder engagement process. The Director of Fisheries shared his ideas on possible enhancement measures but concluded that he would be willing to support stakeholders and other professional recommendations once these recommendations would benefit the SFCA (**Appendix 8 – No objection letter**). Sandals Foundation committed to continued long term management of the Sanctuary (**see Appendix 9**)

7.5.8 Governmental & Non-Governmental Organisation (NGO)

Mr. Ron Daley the Regional Manager of the SDC Western Region organized a meeting with the some of the governmental and NGOs that partners SDC in the Parish. Twenty-four (24) persons attended the consultation that was held at SSCJ conference room. The following organizations were represented.

- Westmoreland Public Health Ministry of Health
- Jamaica Constabulary Force
- Ministry of Labour and Social Security
- Citzen Security Justice Programme
- National Council of Drug Abuse

- Women's Centre of Jamaican Foundation
- National Youth Service
- Moesha Wallace Foundation of Restorative Justice
- Office of Children Registry
- Ministry of Justice, Victim Services Division
- Child Development Agency
- Department of Correction Services, Westmoreland Probation Office
- Social Development Commission

The following questions were asked

- What percentage of labour will be sourced locally?

The group was informed that Tank-Weld would be doing the pile operation, which requires specialized labour and as such Tank-Weld usually brings in their employees to on such projects. The building contractor on the under hand is expected to hire a substantial amount of local labour as was the case in Montego Bay.

- A member of the group who also is a nearby resident expressed concern about the loud noise that was heard when the hotel was constructed years ago. She wanted to know how we plan to manage such noise.

It was explained that we are not using the traditional hammer for our pile driving exercise that was used during the hotel construction. We are instead using a hydraulic vibrating hammer to drive the pile on this project. We shared our experience from the SRC Overwater project in Montego Bay, where noise wasn't an impact factor even to our guests within100 metres of the pile driving operation or for the neighbouring hotel. As such we didn't anticipate any impact from noise to guest, staff or surrounding residence from the pile driving operation.

- What preparation do we have in place for hurricane during construction?

It was explained that once a hurricane is approaching the Island and the project location is within the cone of impact, we are required to put our hurricane plan into action. This consist of battening down all structures and material that will be subject to the vagary of the winds and potential storm

surge. What items that cannot be battened down or sufficiently covered are removed to a safe location.

Fig: 7.3. Government and NGO Public Consultation Meeting

- What security measures are going to be in place during construction and operation?

It was explained that during construction all equipment and material on land will be within the fenced boundary of the property that is currently secured by Hawkeye. During construction, there will be adequate turtle approve lighting and additional security along the beach to ensure construction materials and equipment are safe. While we couldn't provide intimate details of operational security for obvious reason to the group, we informed them that our Director of Security Mr. James Forbes has incorporated a plan at Sandals Royal Caribbean that comprised of 24-hour security, cameras, jet-ski patrols and critical points manned by security personnel. We are certain that the same measures will be employed at SSCJ.

7.5.9 Whitehouse Fisherfolks (Vendors)

This meeting was arranged through the President of the Whitehouse Fisherfolks Society Mr. Honeyghan. We circulate posters at the Whitehouse Fish Market.

The following questions and comments were received

- One persons asked about access to the area.

We informed the group that while the area is not within a channel and although there may be boat traffic in the vicinity, our Security personnel will be very vigilant to incept if needed to protect our guests and structures

- Another individual asked how will the project benefit the community.

We pointed out that during construction and operation of the project many of part and permanent jobs will be created that the members of the community have access to gain. Further we will be taken actions to enhance the fisheries within the sanctuary.

A comment was made that Sandals doesn't buy fish from the fisherfolks at Whitehouse

We explained that the main challenge with arranging such purchases was that any hotel the magnitude of Sandals has to enter into a contract with a supplier to provide an established quantity and quality of product at an agreed price. I shared my experience in the industry across Barbados, St. Lucia and Jamaica, is that fishermen were generally unwilling or unable to make such commitment, instead fisherfolks generally sell their catch to the highest bidder. Some vendors indicate that current fish supply is just sufficient for the community and any purchases from Sandals can create a shortage, resulting in higher prices for residents.

Further, the fishfolks were advised it best to approach a venture such as selling fish catch to large hotel by doing it through their organization whereby they can each agree to supply a percentage of their catch at a contracted price, giving them the flexibility to sell the remainder to the local market.

7.5.10 Parish Council Civic & Community Affairs Committee

This is a statutory meeting of the Parish Council was held on the 2nd March 2017 at the Parish Council and was attended by 14 persons included 8 elected Councillors. The group was receptive to the presentation and stated that they will give our application for building permission due consideration.

7.5.11 Parish Council Technical Committee

We presented the plan to the management team of the Parish Council. The following persons were present

- Secretary Manager
- Planning Manager
- Building Superintendent
- Building Officer

As a result of this presentation and questions raised, everyone except the Secretary Manager went to Sandals Royal Caribbean Overwater Rooms in Montego Bay on 21st March 2017 for a site visit to get a better appreciation of the project.

(See **Appendix 10** for sign-in sheets for Stakeholder Meetings)

8. IMPACT IDENTIFICATION AND ANALYSIS

8.1 Introduction

Sandals South Coast Jamaica Overwater Structure project will potentially create a variety of positive and negative impacts during construction and operation phases. This section will seek to identify the potential impacts and severity of such impacts that affect the following environment,

- Physical
- Biological
- Natural Hazards
- Socio-Economic

8.2 Environmental Impacts

The level of environmental impact indicates the extent to which harm can be done to the environment by a particular activity. It doesn't address the likelihood of harm occurring. Table 7: 1 below identify the criteria used to determine the risk level for environmental impact on this project.

Risk Level	**Risk Level Criteria**
No Impact	This indicates that there will be no harm to the environment
Minor Impact	Pollution that can cause some harm to the environment over a short period of time (days to weeks)
Moderate Impact	Pollution or damage that can cause limited harm to the environment over the medium term and can be repetitive and may require clean-up (Months, during construction period)
Major Impact	Pollution and damage that cause considerable harm to the environment for an extensive period of time that may need extensive clean-up efforts or irreversible damage (Years, well after operation)

Table 8:1 Criteria use to determine risk level for environmental impact

8.3 Significance of Environmental Impacts

Not all environmental impacts are significant. Significant impacts are impacts that require environmental mitigation measures to reduce anticipated harm or loss to the environment. The following criteria will be used to determine the significance of an impact.

- Legislative or regulatory requirement
- The frequency of the event
- Would the impact caused permanent, irreversible or serious damage to the environment
- Would the impact create a nuisance to neighbour, guest or employees

An impact has to meet at least 2 of the above criteria to be determined as potentially significant. There need to be mitigation measures in place for all significant impacts.

8.4 Duration of Impact

The duration of the impact is an indication of the length of time the occurrence would affect the environment. (See table 7.2 below).

Risk Level	**Risk Level Criteria**
None	Very short term, within one day
Short Term	Less than one month
Medium Term	During the construction phase of the project
Long Term	Extend beyond the construction period and into the operation phase of the project

Table 8:2 Criteria use to determine duration of environmental impact

8.5 Probability of the Impact occurring

The probability of an environmental impact occurring varies. The higher the probability of an impact occurring the most likely a mitigation measure needs to be developed to reduce its occurrence and effects. Table 7.3 below shows the criteria used to determine the probability of an impact occurring.

Risk Level	Risk Level Criteria
Extremely Low	This impact is highly unlikely to occur.
Low	This impact while most likely improbable, a possibility exist that it can occur.
Moderate	While this impact rarely occur, there is a possibility that it will occur
High	This impact usually occur and is extremely likely to occur because of the project

Table 8:3 Criteria use to determine probability of environmental impact occurring

8.6 Direct, Indirect Impact and Cumulative Impacts

Direct Impacts are impacts that occur because of activities that are undertaken by the project. There is generally a cause-effect relationship. Indirect Impacts, on the other hand, are impacts which are not as a result of direct project activities. This impact is referred to as secondary impact and is closely related to the project and in many cases can have more far-reaching consequence than direct impacts. Cumulative impacts occurred when the incremental impact from the project is combined with cumulative effects of other past, present, and reasonably foreseeable future projects.

8.7 Environmental Impact Risk Assessment

The factors described in through Section 7:2 to 7:6 are used to analyze the environmental risk that the project pose. Table 7.4 ranks the risk level.

Criteria	Risk Level	Rank
Impact	No Impact Minor Impact Moderate Impact Major Impact	1 2 3 4
Significant of Impact	Not Significant Potentially Significant	1 2
During of Impact	None Short Term Medium Term Long Term	1 2 3 4
Direct or Indirect Impact	Direct Impact Indirect Impact Cumulative	1 2 3
Probability of Occurrence	Extremely Low – highly unlikely Low – improbable but possible Moderate – Rarely Occur High – Extremely Likely	1 2 3 4
Project Phase	Pile Driving Construction Operation	1 2 3

Table 8.4: Ranking of Environmental Risk Level

8.8 Project Impact Risk Assessment Analysis

Project Impact Risk Assessment Analysis						
Environmental Issue	**Project Phase**	**Project Impact**				
		Impact	**Significant**	**Duration**	**Direct or Indirect**	**Probability**
Physical Environment						
Noise	Piling driving	2	1	1	1	2
	Construction	2	2	2	1	4
	Operation	2	1	1	1	2
Sewage	Construction	2	2	3	1	2
	Operation	3	2	4	1	1
Air Quality	Construction	2	1	2	2	4
Oil Spill	Construction	3	2	2	1	2
	Operation	3	2	2	1	1
Solid Waste	Construction	3	2	3	1	3
	Operation	3	2	4	1	3
Chemical	Construction	2	2	2	1	3
	Operation	3	2	4	1	2
Potable Water	Construction	2	1	2	2	1
	Operation	2	1	4	2	1
Water Quality	Construction	3	2	2	1	2
	Operation	2	2	3	1	2
Turbidity	Construction	2	1	2	1	2
	Operation	1	1	1	1	1
Biological Environment						
Seagrass	Construction	2	1	4	1	4
	Operation	3	1	4	2	3
Turtle nesting	Construction	3	2	3	2	3
	Operation	3	2	4	2	3
Crocodile	Construction	2	1	3	1	1
	Operation	3	2	4	2	2
Benthic fauna	Construction	3	1	2	3	2
	Operation	1	1	1	1	1
Fishes	Construction	2	1	3	1	2
	Operation	1	1	3	2	4
Fish Sanctuary	Construction	2	1	2	2	3
	Operation (Beneficial)	3	2	4	2	4
Natural Hazards						
Hurricane	Operation	4	2	4	2	3
Earthquake	Operation	3	2	4	1	2
Tsunamis	Operation	4	2	4	1	2
Social-economic Environment						
Crime	Construction	3	2	3	3	2
	Operation	4	2	4	3	2
Traffic/Transportation	Construction	2	1	2	2	2
	Operation	1	1	1	1	2
Recreation	Construction	2	1	3	1	2
	Operation	2	1	1	1	1
Employment	Construction (Beneficial)	3	2	2	3	4
	Operation (Beneficial)	3	2	4	2	4
Health & Safety						
Fire	Construction	2	1	2	3	2

Project Impact Risk Assessment Analysis						
Environmental Issue	**Project Phase**	**Project Impact**				
		Impact	**Significant**	**Duration**	**Direct or Indirect**	**Probability**
	Operation	3	2	4	1	2
Construction Activities	Construction	4	2	3	2	3

9.0 MITIGATION OF POTENTIAL IMPACTS

This section provides details of the potential impacts that were identified in the previous section and suggested ways that these impacts should be mitigated against. Mitigation is actions taken to reduce any harm a potential impact can have on the environment.

9.1 Physical Environment

Environmental Issue	Potential Impact	Mitigation
Noise	Construction *Pile Driving Operation* - Concern was raised during the stakeholder consultation process that this can be a cause of significant concern. We anticipate the impact from this operation to be none existence to low because of the pile driving methodology that will be used. The project is using a vibrating hydraulic hammer to drive the pile instead of the traditional pile driving hammer that usually generates a considerable amount of noise that extends beyond the project area.	No mitigation measure is recommended.
	Building – Potential noise can be generated by drilling, hammering, sawing, the use of power tools and engines (Crawler Crane) etc. Noise, generated by use of these equipment, is not expected to travel outside of the project area. Workers using the tools will be most susceptible to any impact.	Workers using power tools should wear ear muff
	Noise is not expected to be an issue during the operational phase of the project.	No mitigation measure is recommended.
Sewage	Construction The worksite will have just over 100 workers during construction and lack of adequate toilet facilities for sewage generate on the worksite and lack of adequate disposal can result in cumulative an impact to the environment.	Adequate toilet facilities will be built for the workers on the job site and be piped to the lift station which will be subsequently pumped to the property Wastewater Treatment Plant.
	Operation The occupancy of the 12 rooms is expected to generate 23.3 m^3 of sewage daily. Should	The sewage system pipelines should be routed below the

Environmental Issue	Potential Impact	Mitigation
	there be breach or breakage on the sewage line, this can result in the sewage going directly into the sea or along the coastal environment. Sewage pollution can directly harm flora and fauna and indirectly harm humans, which can result in a major significant impact.	boardwalk. The boardwalk and area below the rooms should be designed in a manner to protect the PVC pipes from an accidental hit from any errant objects that may cause damage to the pipelines. Further, a monthly inspection should be undertaken and recorded by the property to ensure the integrity of the pipelines is maintained. Inspections should also be conducted and recorded after the occurrence of any natural hazards such as Tropical Storms, Hurricanes, Earthquakes, etc that affected the project area.
Air Quality	*Combustion Emission* The operation of heavy-duty equipment such as crawler cranes & trucks can result in minor increase in combustion emission that will contribute to greenhouse gases. *Dust* Dust can be generated by trucks and equipment traversing the worksite, as well as during construction activities such as sawing, grinding, sanding and mixing cement. Dusk generated by these activities can be inhaled by workers or go into their eyes, impacting their health.	Equipment needs to be in good working condition to reduce emission and ignition turned off when not in use Trucks traversing to the worksite should be covered. Workmen using tools that generate dust such as cutting and grinding should wear appropriate goggles and dusk mask.
Oil Spill	<u>Construction</u> *Coastal* There will be equipment within the project worksite that requires refueling. Fuel storage and refueling can result in spills that can	Storage container should be placed within a containment bund to restrict spill fuel.

Environmental Issue	Potential Impact	Mitigation
	impact both the marine and coastal environment. *Marine* There will be a crawler crane on the pontoon at sea that will be used to drive the pile that would need to be refueled during the project. Three motorized vessels would also be in used. Spill in the marine environment can be of major significance	Spill kits of sand or sawdust should be kept on site to be employed to clean up any accidental spills and same be disposed of adequately The pontoon will have a fuel storage tank to store the fuel to refuel the crane and vessels. This storage tank also should be within a containment bund to trap any fuel spillage. Spill kits of sand or sawdust need to be kept on the pontoon as well to clean up any spillage and be disputed adequately An Obstacle barrier should encircle the project site throughout construction that would trap any fuel within the project area that can be skimmed off the water in the event of a spill.
Solid Waste	<u>Construction</u> *Terrestrial & Coastal* Construction will generate solid waste within the staging area. Solid waste generated will include cardboard, food boxes, wood, steel, foam, plastic etc. The failure to store and disposed of solid waste properly will result in pollution impact to the environment. *Marine* Construction over the sea will result in debris falling into the water from time to time. This would result in pollution to the seafloor and coastal environment.	The construction site needs to have bins for workers to place food waste. A skip should be provided for other construction waste An obstacle barrier needs to encircle the project to capture any floating debris within the project site. The debris should then be taken up by boat and returned to land to be placed into the Skip.

Environmental Issue	Potential Impact	Mitigation
		Divers should periodically dive the project site to salvage any debris that sunk within the project site and place same in skip.
	<u>Operation</u> Solid waste will be generated within the rooms, e.g. food waste, bottle, paper etc. It is possible that guest from time to time that the occasional solid waste may enter the marine environment through the carelessness of guests that shouldn't result in any significant impact.	Guest should be oriented about the importance of maintaining a pristine environment upon check-in to reduce the possibility of littering the marine environment. Sandals team members should remove solid waste that accumulates within the rooms daily All solid waste removed from the site and property should be taken to the Retirement Landfill in St. James for adequate disposal
Chemicals	<u>Construction</u> *Marine* During construction, the project will be using lacquer and Rust Grip to be applied to wood and steel respectively. These chemicals can cause minor short-term impact to the environment should spill occur.	During the application of chemical to surfaces, the chemical container should be placed on cardboard, cloth or within a bund container to reduce possibility of spill. Workers need to wear appropriate nose and face protection. Rust Grip should be applied ex-situ where possibility of spill will not enter marine environment
	<u>Operations</u> Chemicals will be used to clean the rooms during hotel operation. Improper disposal	Only non-phosphate biodegradable chemicals

Environmental Issue	Potential Impact	Mitigation
	and spillage during usage can result in minor to moderate significant impact to the environment.	should be used as stipulate by Planning Guideline – Overwater Structures 01/2016 All chemicals should be properly stored, dispensed and have spill kit available to address any spill.
Potable Water	<u>Construction & Operation</u> Water will be used during construction and be supplied to the rooms on a permanent basis during operation. The additional water used by the property will not have any notable impact on current supply within the parish	Water saving faucets and devices should be installed. Water leak audits should be done monthly to ensure this natural resource is not waste
Water Quality	*Marine* During construction, any pollutants such as oil, chemicals etc and any activity that disturb the seafloor resulting in increased turbidity can result in change of water quality that can have impact on the environment <u>Operation</u> During operation water quality can be affected by cleaning chemicals used to clean the rooms	Measures should be taken to mitigate against pollutants entering the marine environment (as detailed above). Monthly water quality analysis should be conducted during construction to ensure the water quality has not deteriorated. A three-year water quality monitoring plan should be implemented.
Storage	Improper storage of chemicals and materials such as cement, gravel etc can seep into the environment after heavy rains	Materials that can affect the environment needs to be properly stored

9.2 Biological Environment

Environmental Issue	Potential Impact	Mitigation
Seagrass	Construction The seafloor of the project area is covered by seagrass. The H-Pile foundation would result in the irreversible loss of approximately 53.2 m^2 of seagrass. The anchoring of boats and barge have some minimum effects on seagrass Operation The overwater structure will result in shading over the marine environment resulting in the reduction of the sunlight to the seagrass on the seafloor. Reduction of sunlight is known to have an effect on seagrass, albeit no study has been conducted in Jamaica on the effects of Overwater structures with an average height of 7 feet above mean sea level and its impact on seagrass	Measures should be implemented benefit the fish sanctuary to compensate for this loss. The structure will be constructed at a height of 7 feet above sea level to reduce the effects of shading. Sandals is in discussions with the University of the West Indies to collaborate in a study on the effects of the overwater structure on the seagrass. This study will monitor the project site for 3 years. The understanding gained from such study will be able to guide planning guidelines for future projects
Turtle Nesting	Construction and Operation The beach to the west of the project site is a Hawksbill turtle nesting site. The lights introduce to the project site is a potential impact to the turtle hatchlings causing possible disorientation. Construction noise may impact adult turtle using the area within and nearest to project site.	The project should only use turtle approve external lighting to minimize the impact on turtle hatchlings Sandals should continue to support the Sandals Foundation initiatives to monitor and record turtle nesting activities Sandals should continue to educate guests and staff about turtle nesting and their significance to the

Environmental Issue	Potential Impact	Mitigation
		environment. (See **Appendix 10**)
Crocodile	<u>Construction & Operation</u> Crocodile is a protected species under the Wildlife Act and they occupy a habitat to the East of the area site. It has been reported that during heaving rains when the pond may overflow in the sea or from time to time they may crawl across the beach into the sea. While there has been no incident to date where anyone has been attacked by a crocodile, any such attack can result in moderate to major impact social impact. Bathers using Watersports beach closest to the natural pond with the crocodiles is much more at risk than occupants of the overwater rooms that are approximately 1.4 km away from the pond.	The property should consider putting a wire mesh fence that would allow the free flushing between the pond and the sea during periods of flooding but would actively block crocodiles from exiting the pond to enter the sea
Fish Sanctuary	<u>Construction</u> Vibration and noise from pile driving exercise may have minor insignificant impact on benthic marine organism and fishes within project area <u>Operation</u> The shading provided by the overwater structures should result in the beneficial impact of fishes within the project area.	No mitigation measures are recommended. The following should be done to provide beneficial impact to the sanctuary. a. Build and installed an agreed number of Fish Condos within the Sanctuary b. Build and installed an agreed number Casitas (Lobster habitat) c. Explore the possibility through the Sandals Foundation to partner with the Fisherfolks organization to expand the SWFCA

9.3 Natural/Manmade Hazards

Environmental Issue	Potential Impact	Mitigation
Hurricane	Construction The project will be constructed during part of the hurricane season and would be susceptible to storm surge and heavy winds from hurricane and tropical storm. This can result in the loss of material and damage to equipment, as well as construction material littering the seafloor and coastline. Operation Only 10 hurricanes have passed within 60 km of the project site in the last 100 years, and based on IDB study the area is within 50-year return for Category 2 storms. Impacts from Categories 1 to 3 hurricanes can result in structural damage, damage to roof, utility and other infrastructure, resulting in debris entering the marine environment. Catastrophic category 4 and 5 hurricanes may generate storm surge that can threaten the building.	Contractors need to have a hurricane preparedness plan that would include the securing of material and equipment during approaching storm. The structure should be designed to withstand a Category 3 hurricane as per IBC Code. The building structure should be designed at a floor height of at least 6 feet above sea level The hotel needs to have a hurricane plan that considers evacuating the rooms for tropical storm events. The plan should include the removal and safe storage of any equipment and material that can impacted by the hurricane especially outside of the buildings.
Earthquake	Earthquake can result in structural damage to building rendering it unsafe for use.	The structure will be designed to withstand earthquake with the piles being driven into the bedrock of the sea.
Tsunami	Tsunami can cause storm surge that can generate high waves, causing damage to structures in its path	The building structure should be designed at a floor height of at least 6 feet above sea level
Fire	Terrestrial/Social Should the structure be affected by fire resulting in total or partial of loss of the structure, this would result in moderate impact to the environment due to smoke and remaining debris as well as moderate impact	Construction material should be fire resistance. An adequate fire plan should be installed, including of

Environmental Issue	Potential Impact	Mitigation
	to community due to permanent or temporary loss of job	Smoke detectors, call points, strobe lights, fire extinguishers and Fire training for staff. Structure should be insured, including salvaging operation A JA$25 Million bond is lodged with NEPA that can be used for such salvage operation in the event Sandals doesn't complete same.

9.4 Socio-Economic Environment

Environmental Issue	Potential Impact	Mitigation
Traffic	Terrestrial Materials and Equipment will be transported to the work site via Highway A2. The frequency of the arrival of material will have no impact on the traffic. Guest arriving for the additional 12 rooms will not have any additional impact traffic as well. Marine The main contractor has three motorized boats on the worksite, along with a pontoon. There is no anticipated impact from the activities of these vessels on the traffic on the sea. The project site doesn't form part of the channel and the visibility is excellent.	No mitigation measure is recommended.
Crime	Social This structure will be away from the cluster of the property and will be more vulnerable to approaches from the sea. Any breaches of the security can be a major social and marketing impact	Security measures has to be employed using a combination of Jet-ski, security cameras and personals to cover structures for 24 hours
Recreation	The project site is located off the beach in front of the SSCJ hotel. Currently, the only recreation that occurs within this area is the occasional Sandals guests that may wonder in the zone with a kayak or wind surf. The project area is located with the SWFCA and fishing is prohibited within the area, therefore there will be no impact to utilization of fisheries resources.	Save for security measures that will be applied for safety of the guest, no additional mitigation measure is recommended
Employment	Both the construction and operational phases would result in local employment that would directly benefit the employees and indirectly benefit the local communities	Efforts should be made to employ persons from within the surrounding communities

9.5 Health & Safety

Environmental Issue	Potential Impact	Mitigation
Crawler Crane	Crawler crane will be used to build the pile foundation. This would involve materials moving overhead, requiring lots of coordination within the workforce. Accident can occur resulting in injury to human	The crane should be well maintained The wire used to lift and any rope or wire used should be of industry standard and should be periodically checked to ensure its integrity is good Helmets and appropriate safety shoes should be worn once overhead construction activities is taking place.
Construction Activities	Workers will be using equipment and tools that can impact their safety or another colleague safety	Appropriate safety measures should be taken such as the use of personal protective equipment (helmet, ear muff & plugs, goggles, safety shoes)
Marine Activities	The construction will be undertaken over approximately 9 feet of water. As such workers can accidentally fall into the water resulting in drowning	Contractor should employ at least 2 life guards and have life rings and rope at varying points on the structure

10.0 ENVIRONMENTAL MONITORING PLAN

The main objectives of this Environmental Monitoring Plan are

- To minimize the effects of the construction and operation of the project on the Physical, Biological and Socio-economic environment.
- To comply with the regulatory and legislative requirement

Monitoring	Frequency & Report	Responsible Parties
Sewage		
Construction		
Workers toilet facilities need to be kept clean	Facilities should be cleaned daily	Contractors
The integrity of installed sewer pipelines with regards to leaks and functionality.	Pressure test the sewer system prior to its commission to ensure there are no leaks and it is functioning as designed.	Contractor and verified by Sandals Project Manager
Operation		
Maintain integrity of the sewer pipelines	Conduct monthly visual checks of the pipelines while system is being flushed	Maintenance Department
Flushing the sewer pipelines	The manholes should be checked and clean if necessary weekly	
Maintenance of the sewer system	The lift station should be checked daily as part of the Maintenance Department log	
In preparation for an approaching tropical weather system (Tropical storms, Hurricanes)	The system should be fully flushed after the evacuation of the rooms to ensure no sewage is within the sewer system.	Maintenance Department
After the passage of a tropical weather system and natural hazard such as Tsunami, earthquake etc.	Visual inspection should be done to ensure the integrity of the system is intact, including the pipelines and infrastructure (brackets and hangers that secure the pipelines.	Projects Department
	The system should be pressure test by flushing and fully inspect for leaks	Projects Department

Monitoring	Frequency & Report	Responsible Parties
Air Quality		
Construction Motorized equipment is in good working condition, not emitting additional pollutant.	Visual inspection of motorized equipment should be done while operating to ensure they are not emitting additional air pollutant (black smoke from exhaust) and corrective action taken.	Contractors
Oil Spill		
Construction Fuel bond on pontoon needs to be checked daily to ensure there is no fuel leakage	Daily visual inspection	Contractor
Spill kits of sand or sawdust be kept on construction site and Pontoon	Daily visual inspection	Contractor Contractor
Obstacle barrier encircle the project site is unbroken and servicing its purpose	Daily visual inspection	Contractors
Refueling should be done on hardstand or on material that wouldn't absorb into the environment	Daily visual inspection. Clean-up any spill on land and disposed the refuge at special disposal facilities at Retirement Land	Contractor
	Any marine spillage must be reported to NEPA and clean-up activities start as soon as possible as directed by NEPA	Sandals EHS Department
Waste Management		
Construction At least two (2) 100-gallon garbage bins need to be on project site and one (1) garbage bin on the pontoon for non-construction waste. Non-construction general waste should be removed when the bin is full or every 3 days and be taken to the compactor.	Daily visual inspection. Removal of waste should be logged by security.	Contractors

Monitoring	Frequency & Report	Responsible Parties
One (1) skip needs to be placed on the project site or alternatively an area designated for construction waste. This waste area needs to be kept in an orderly manner, with no overflowing waste Construction waste removes when skip or designated area is full.	Daily visual inspection Removal of waste should be logged by security.	Contractors
Hazardous waste has to be stored separately	Daily visual inspection	Contractors
Obstacle barrier is always encircling the project marine site	Daily visual inspection	Contractors
Remove any debris that fell into the sea and placed in disposal bins or skip	Floating debris should be removed daily. Weekly diving should be done to remove any debris on the seafloor.	Contractors
Solid waste must be disposed to Retirement Landfill in St. James.	Reputable waste management company must be hired to transfer solid water or contractor should show receipt/invoice from Landfill for receiving waste	Contractor, EHS Department
Operation Removal solid waste that accumulates within the rooms daily and placed in compactor	This should be done daily.	Butlers and Room Attendants
Solid waste that accidentally falls into the sea should be removed	Floating debris should be removed whenever seen Monthly dive sessions should be done to check for any waste	Security & Watersports Watersports
Chemical		
Construction Rust Grip should generally be applied on land	Daily visual observation	Contractor

Monitoring	Frequency & Report	Responsible Parties
Paint, lacquers, and varnishes, when applied on structure must be in bund containers or rest on material that will absorb spill such as cloth, cardboard etc	Daily visual observation	Contractor
Chemicals need to be stored properly, in well-ventilated area, away from ignition source, and its original container	Daily visual observation	Contractor
Operation Material Safety Data Sheet of every chemical used to clean room should be checked to approve chemical prior to usage to ensure it is phosphate free.	Chemical approval form should be documented before any chemical is introduced. Check Housekeeping cleaning carts monthly	EHS Department
Water Quality		
Construction & Operation The following parameters should be monitored ✓ pH ✓ Dissolved oxygen ✓ Turbidity ✓ BOD ✓ Salinity ✓ Faecal Coliform ✓ Nitrates ✓ Organo Phosphates ✓ Temperature	***Construction*** Once monthly ***Operation*** Three-year monitoring plan Year 1- Quarterly Year 2 – Biannually Year 3 – Biannually These tests should be conducted by an independent laboratory and results submitted to NEPA	EHS Department
Marine Sanctuary		
Possible partnership with the University of West Indies to monitor the impact of the structure's shading on seagrass.	Biannual reports for three years submitted by the University to Sandals and NEPA	Projects Department
Install Fish Condos and Casitas within sanctuary	Annual Reports of their effects over the next 3 years	Projects Department

Monitoring	Frequency & Report	Responsible Parties
Health and Safety		
Construction		
Put safety precaution in place for workers operating over the water. This can include a combination of Lifeguards, Life Ring, Staff count at end of day, Life jackets etc.	Daily inspection of workers on worksite	Contractor
Workers need to be outfitted with the appropriate Personal Protective Equipment such as safety boots, helmets, noise mufflers, eye protection, safety vest, gloves etc.	Daily inspection of workers on worksite	Contractor
Stocked First Aid Kit needs to be available on site	First Aid kit needs to be re-stocked weekly. Weekly report of the number of persons injured should be presented to Sandals Project Manager and any serious injury should be reported immediately.	Contractor
Worksite should be tidy and well organized, eliminating hazards to make a safe environment for staff. This includes removing trip and fall hazard, electrical hazard, ensuring equipment is working properly.	Daily inspection of worksite	Contractor
Relevant safety signs are in place on worksite	Daily inspection of worksite	Contractor

11.0 IDENTIFICATION OF ALTERNATIVES

The main use of the area at the moment is for occasional recreational activities by guests from the hotel who may kayak and windsurf in the area. The occasional local boats will also traverse the area from time to time. It is currently illegal to fish in the area.

11.1 No Alternative

This option would leave the project site and the surrounding environment in its present condition.

11.1.1 Positives of No Alternative

- All of the potential impacts that can occur from the project would no longer apply
- There will continue to be unimpeded access to the area by members of the public traversing the waterway.
- The view of the coastline will be unobstructed.

11.1.2 Negatives of No Alternatives

- Loss of investment to the economy, resulting in loss revenue and jobs
- Loss of employment opportunities for local residence
- Loss of the opportunity to investigate the true impact of overwater shade on seagrass

11.2 Proposed Project

The proposal as proposed would represent a substantial investment on the South Coast, introducing a new clientele to the Jamaican tourism market resulting in substantial increase in revenue gained that would benefit the economy.

Positives of Proposed Project

- The project will benefit the socio-economic environment of the local communities through the provision of substantial employment during construction and application.
- Improvements to the Fisheries Conservation Area and better understanding of the ecological environment
- This project will in no way stop the current use of the water surrounding the project site.

Negatives of the Proposed Project

- Loss of miniscule amount of seagrass to accommodate pile foundation

12.0 LIST OF REFERENCES

Adams, C.D. (1972). Flowering plants of Jamaica. University of the West Indies Press. Kingston, Jamaica.

American Public Health Association (1998). Standard Methods for the Examination of Water and Wastewater 20th Edition.

Bibby C., M. Jones, S. Marsden. (1998). Expedition field Technique. Bird Surveys. Royal Geographical Study. London.

Downer, Audrey, and Robert Sutton. Birds of Jamaica. Cambridge: Cambridge University Press, 1990.

Garraway, E, and A J Bailey. (2005). Butterflies of Jamaica.

Holland, A.F.; Gainey, C.; & Denise M. Sanger. (2004). Cumulative Impacts of Dock Shading on Spartina alterniflora in South Carolina Estuaries. Environmental Management, 33 (5), 741-748.

http://www.jamaicaobserver.com/news/Land-acquired-in-Westmoreland-for-waste-transfer-station

http://www.wrha.gov.jm/content/WRHA_Westmoreland.html

Jamaica Observer (2014). Sandals Whitehouse steps up turtle preservation efforts. http://www.jamaicaobserver.com/environment/Sandals-Whitehouse-steps-up-turtle-preservation-efforts_16933734 [Accessed 4 April 2017]

Jamaica Survey of Living Conditions, Parish Report 2008, The Planning Institute of Jamaica & the Statistical Institute of Jamaica, 2013.

Kearney, V., Segal, Y., & M.W. Lefor (1983). The Effects of Docks on Salt March Vegetation. The Connecticut State Department of Environmental Protection, Water Resources Unit, Hartford, Ct.

National Water Commission. (2011). Westmoreland Water Supply Plan. Kingston: National Water Commission.

NEPA, Draft Jamaica National Ambient Water Standard for Marine Water, 2009

NOAA NCCOS OCRM. (2005). Managment of Small Docks and Piers. Environmental Impacts and Issues. Environmental Impacts of Docks. National Oceanic and Atmospheric Administration National Centers for Coastal Ocean Science and the Office of Ocean and Coastal Resource Management.

Parker, T. (2003). Manual of Dendrology Jamaica. Forestry Department. Jamaica.

Pharmacy Council of Jamaica, 2017. http://www.pcoj.org/regPharmacies/RegPharmacies.htm

Planning Institute of Jamaica, 2014. Economic and Social Survey Jamaica 2013, Planning Institute of Jamaica, Kingston.

Planning Institute of Jamaica, 2016. Economic and Social Survey Jamaica 2015, Planning Institute of Jamaica, Kingston.

Population and Housing Census 2011 Jamaica, Age & Sex Volume 2, The Statistical Institute of Jamaica, Kingston, 2013.

Population and Housing Census 2011 Jamaica, Economic Activities Volume 8, The Statitiscal Institute of Jamaica, Kingston, 2013.

Population and Housing Census 2011 Jamaica, Housing Volume 10, Part C (2), The Statistical Institute of Jamaica, Kingston, 2013.

Population and Housing Census 2011 Jamaica, Housing Volume 10, Part C (3), The Statistical Institute of Jamaica, Kingston, 2013.

Population and Housing Census 2011 Jamaica, Housing Volume 10, Part C (1), The Statistical Institute of Jamaica, Kingston, 2013.

Population and Housing Census 2011 Jamaica, Housing Volume 10, Part A (2), The Statistical Institute of Jamaica, Kingston, 2013.

Population and Housing Census 2011 Jamaica, Housing Volume 10, Part A (1), The Statistical Institute of Jamaica, Kingston, 2013.

Raffaele, J. A Guide to the Birds of the West Indies. Princeton University Press, (1998).

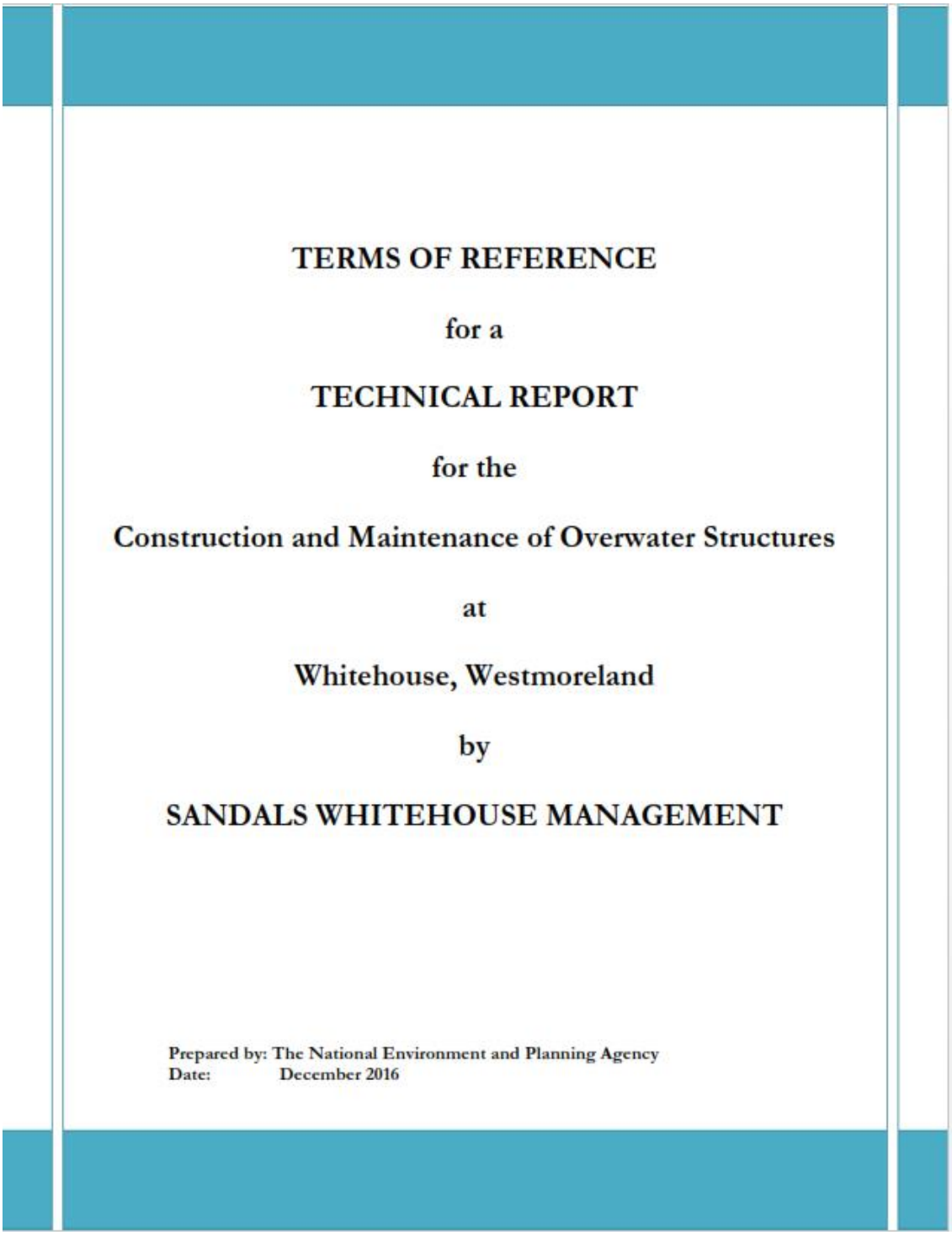
Tong, S.L., et al Goh, S.H., Abdulah, A. Rani, Tahir, N.M. & Wang, C.W. Asean Marine Water Quality Criteria for Oil And Grease, 1999

Western Regional Health Authority, 2015: AUDIT REPORT: High Risk Clinical Areas at Large Hospitals and Parish Health Centres

Wunderle, J M. (1994) “Census methods for Caribbean land birds.” Gen. Tech, 1994: S0-98.

13.0 APPENDICES

Appendix 1 NEPA's Terms of Reference



TERMS OF REFERENCE

for a

TECHNICAL REPORT

for the

Construction and Maintenance of Overwater Structures

at

Whitehouse, Westmoreland

by

SANDALS WHITEHOUSE MANAGEMENT

Prepared by: The National Environment and Planning Agency
Date: December 2016

Technical Report for the Construction and Maintenance of Overwater Structures at Sandals Whitehouse

The Technical Report should include but not be limited to the following:

1) Executive Summary
2) Introduction
3) Policy, Legislation and Regulatory Consideration
4) Project Description
5) Description of the Environment
6) Public Participation
7) Impact Identification and Analysis
8) Mitigation
9) Environmental Monitoring Plan
10) Identification of Alternatives
11) Conclusion and Recommendations
12) List of References
13) Appendices

1) EXECUTIVE SUMMARY

Provide a brief statement on the context of the technical report to include purpose and objective. The executive summary should provide a summary of the main findings of the report, including but not limited to main impacts and mitigation measures, analyses and conclusions.

2) INTRODUCTION

The introduction should provide a background and seek to explain the need for and the context of the project and the technical report. It should also provide the delineation and justification of the boundary of the study area, general methodology, assumptions and constraints of the study. The study area shall include at least the area within a 1km radius of the boundaries of the proposed

3) POLICY, LEGISLATION AND REGULATORY CONSIDERATION

This section should provide details of the pertinent regulations, standards, policies and legislations governing environmental quality, safety and health, cultural significant finds, protection of sensitive areas, protection of endangered species, tourism enterprises, siting and land use control at the local and national levels. The examination of the legislation should include at a minimum the Natural Resources Conservation Authority Act 1991, Natural Resources Conservation Regulations 1996, amended 2015, Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, Beach Control Act, Wild Life Protection Act, Town and Country Planning Act, Planning Guidelines – Overwater Structures, and the Fishing Industry Act and **all** appropriate international convention/protocol/treaty where applicable. Describe traditional land use and advise of any prescriptive rights including public access rights.

4) PROJECT DESCRIPTION

This section should provide a comprehensive description of the overall project concept and specify the different components. It should include the following:

- History and background of the project
- A location map at a scale of 1:12,500 (or an appropriate scale)
- Site maps illustrating areas to be impacted and areas to be preserved in their existing state.
- A master site layout plan showing the various components and design elements of the proposed development
- Detailed description of the project, project objectives and phases (where applicable), including all applicable timelines for the various aspects of the project (from pre to post development). The description should also provide details of the design concept, design components, material(s) to be used, total number, size, and types of guest rooms/suites; boardwalk or means of access to the rooms; design height of structures above sea level; and supporting services such as administrative, "back-of-house" facilities and amenities to serve the proposed development such as pools, restaurants, chapel etc. This should be supported by the use of maps, diagrams and other visual aids where appropriate.
- Detailed description of all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to seagrass and/or coral relocation and shading; collection, transfer, and disposal of waste (solid waste and sewage); provision of potable water and electricity; and dredging.
- Details of the methods and equipment to be employed to undertake each aspect of the project including coral/seagrass relocation, dredging, transportation of material, disposal of spoils (if applicable), storage of material, installation of pylons, construction of units, installation of required infrastructure and secondary activities such as refueling of vessels, proposed location(s) for equipment storage (staging area) and establishment of a site office.
- Details of any required decommissioning of the works and/or facilities.

5) DESCRIPTION OF THE ENVIRONMENT

A survey of the proposed development site should be conducted and this information will form the basis upon which impacts of the project will be assessed. The following aspects should be described in this section:

Physical Environment

This section should provide a complete description of the study area including geographical boundaries and methodologies used for the collection of baseline data. The description should include the following aspects of the environment:

Water Quality

i. Baseline water quality should include study areas and associated environs and control sites. These should be accurately mapped and a spatial comparison of the data should be done in order to determine any possible source(s) of pollutants (*the data should be geo-referenced*).

ii. Water quality should include but not be limited to the following parameters:
    a) Turbidity
    b) nutrients (nitrates and phosphates)
    c) Faecal Coliform

d) BOD
e) oil and grease

iii. Results from the water quality sampling should be compared to local and international water quality standards.
iv. Historical data should be used for comparisons where possible.

Hydrodynamics

i. Existing and proposed final bathymetry and/or elevation profiles of the site including areas to be dredged, reclaimed or used as temporary storage.
ii. Baseline sediment transport and circulation patterns.

Biological Environment

Description of habitats, existing vegetation, flora and fauna surveys inclusive of a species list; commentary on the ecological health, function and value in the project area, threats and conservation significance. This should include:

Coastal/Terrestrial Assessment

i. Benthic surveys should be conducted with emphasis placed on those areas (seafloor) which will be impacted by the proposed development.
ii. Coastal surveys should be conducted in order to describe the plant and animal community present within the project/impact areas - including temporary staging, equipment and material storage areas. The ecosystems and habitats identified within the impact areas should be described and mapped. This should include but not be limited to the seagrass beds, corals and other ecologically important habitats and or species.
iii. A species list should be generated with special emphasis on those species considered rare, threatened, endangered, endemic, protected, invasive and economically or nationally important. Identification and description of the different ecosystem types and structure including species dominance, species dependence, habitats/niche specificity, community structure and diversity, possible biological loss or habitat fragmentation ought to be considered. The assessment must be done according to internationally (scientific) acceptable standards and the provision of photographic inventory is preferred.
iv. Any crocodile, turtle or bird nests observed in or around the project area should be recorded and mapped. This should be supported by information including but not limited to the following; existing crocodile and sea turtle nesting sites and seasons and habitat usage by migratory species

Carrying Capacity

The ecological carrying capacity of the site should be assessed

Natural Hazards

A risk assessment of the development in relation to the following must be undertaken

i. Tropical Storms, Hurricanes, Tsunamis
ii. Natural hazard risk assessment should take in account climate change projections.

Socio-economic Environment

Demography, regional setting, location assessment and current and potential land-use patterns (of neighbouring properties); description of existing infrastructure such as wastewater, roads and

transportation, electricity, water, telecommunications, and health facilities. There should also be an assessment of the present and proposed uses of the site and surrounding areas. Effects on socio-economic status such as changes to public access and recreational use, impacts on existing and potential economic activities, public perception, contribution of development to national economy and development of surrounding communities.

A socio-economic survey/public consultation to determine public perception of the project concept (both negative and positive) should also be completed. The methodology for conducting the survey should be included in the Technical Report.

6) PUBLIC PARTICIPATION

This section should detail the results public perception surveys conducted. It should summarize the issues identified during the public participation process and how these have been addressed or incorporated in the technical report.

It should describe the public participation methods, timing, type of information provided and collected from public and stakeholder target groups. The sampling methodology employed must be appropriate for the population size and distribution, and must be weighted towards the communities/interest groups in closest proximity to the proposed development. The instrument used to collect the information must be included in the appendix. Stakeholder meetings should also be held to inform the public of the proposed development and the possible impacts and gauge the feeling/response of the public toward the development.

Public Meeting(s) should be held in accordance with the Guidelines for Conducting Public Presentation at a time and location signed off by the National Environment and Planning Agency (NEPA).

7) IMPACT IDENTIFICATION AND ANALYSIS

The major potential environmental, health and safety impacts of the project should be identified. This section shall seek to distinguish between levels of impact, significance of impact (a ranking from major to minor/significant to insignificant should be developed), positive and negative impacts, duration of impacts (long term or short term or immediate), direct and indirect and impacts, reversible or irreversible impacts, long term and immediate impacts and identify avoidable impacts.

Cumulative impacts should also be evaluated taking into account previous developments and any proposed development immediately adjacent to the subject development The major concerns surrounding environmental, health, and safety issues should be noted and their relative importance to the design and implementation of the project indicated. All impacts should be listed, ranked and assessed, preferably in a single table.

The impacts to be assessed should include but not be limited to the following:

<u>Physical Environment</u>

- Impacts of construction activities such as dredging, relocation of seagrass and corals, shading of seagrass engineering requirements, disposal of spoils
- Impacts of potential spills (such as oil and chemical spills)
- Impacts on water quality (during construction and operation)
- Noise
- Operation and maintenance – provision and demand requirements of potable water and electricity, waste disposal, sewage treatment and disposal, communication and other utility requirements
- Impacts on aesthetics and landscape

Biological Environment

This should include an assessment of the direct and indirect impacts of the project on the ecology of the marine and terrestrial environment with emphasis being placed on rare, endemic, threatened, protected, endangered, invasive, and economically important species found. This should include habitat loss and fragmentation, loss of species and natural features, and the impact of noise and vibration on fauna.

Natural Hazards

Potential impact of natural hazards including tropical storms, hurricanes and tsunamis

Socio-economic Environment

This should include effects on socio-economic status including changes in resource use, public access and recreational use; impacts on existing and potential economic activities; public perception; and the contribution of development to the national economy and development of surrounding communities.

8) MITIGATION

This section should provide practical solutions for avoiding, reducing and compensating (eg. restoration or rehabilitation) for any identified impacts, including the proposed timeline for the implementation of these mitigation measures. Full details of the methods proposed to be employed in the implementation of these measures should be provided, including details on the materials and location. Where appropriate, maps and diagrams should be used to illustrate areas where mitigation measures are proposed to be implemented.

9) ENVIRONMENTAL MONITORING PLAN

The draft Environmental Monitoring Plan should detail:

i. The locations selected for monitoring
ii. The mitigation measures to be implemented and the parameters which will be monitored for each activity
iii. The proposed methodology to be employed for the monitoring of the various parameters
iii. The frequency of the monitoring
iv. The proposed format that the monitoring reports should take
v. The frequency of the submission of the monitoring reports
vi. The responsible parties for the monitoring

vii. Details for special monitoring of sea turtles, birds and crocodiles during and after the proposed works

10) IDENTIFICATION OF ALTERNATIVES

This section should examine and detail alternatives to the project or aspects of the project including the no-action alternative. This examination should incorporate previous uses and the history of the overall area in which the development is proposed. A rationale for the selection of the preferred project alternative should be provided.

11) CONCLUSION AND RECOMMENDATIONS

12) LIST OF REFERENCES

13) APPENDICES

The appendices should include but not be limited to the following documents:

i. Reference documents
ii. Photographs/ maps
iii. Data Tables
iv. Glossary of Technical Terms used
v. Final Terms of Reference
vi. Profile of the project proponent and implementing organization
vii. Composition of the consulting team, team that undertook the study/assessment, including name, qualification and roles of team members
viii. Notes of Public Consultation sessions
ix. Instruments used in community surveys

Appendix 2: Letters from National Land Agency

NATIONAL LAND AGENCY
20 North Street, Kingston, Jamaica
Tel: (876) 750-5263/946-5263 • Fax (876) 948-9382
Website: www.nla.gov.jm

Ref. No.: SH/385

October 6, 2016

Mr. Dexter Cumming
Environmental Health & Safety Manager
Sandals Royal Caribbean
P.O. Box 167
Mahoe Bay
Montego Bay, St. James

Dear Mr. Cummings,

Re: Application to Lease –
Lands part of Ackendown, Whitehouse, Westmoreland

Yours of October 5, 2016 refers.

The Commissioner of Lands (COL) is minded to grant a lease of 0.98 acres of the seafloor to Sandals Royal Caribbean to construct twelve (12) overwater rooms, two (2) ancillary rooms, all connected to a boardwalk leading from a groyne at Sandals Whitehouse, Westmoreland.

This is however, subject to National Environment and Planning Agency (NEPA) granting the necessary environmental licence and permit which is needed to ground the submission to the Land Divestment Advisory Committee and thereafter for the Honourable Minister's approval.

Please see attached letter dated October 6, 2016 which was forwarded to NEPA in support of your application for the licence and permit.

.....

Donovan Hayden
Director, Estate Management
for Commissioner of Lands

Appendix 3: Wastewater Treatment Plant Capacity Analysis

McDONALD GROUP INTERNATIONAL, INC. CA-7580
GEORGE J. McDONALD, P.E.
WATER, WASTEWATER & ENVIRONMENTAL ENGINEERING
9030 S. BRITTANY PATH INVERNESS FLORIDA 34452
TOLL FREE US NATIONWIDE: (877) 593-2364
FAX (888)523-0884 VOICE (352) 637-1652
E-MAIL: gmcdonald@mcdonaldgroup.com
WEB SITE: www.mcdonaldgroup.com

September 15, 2016

Lerone Henry
Engineering
Sandals Resorts International
1231 – 1232 Providence Drive,
Ironshore Industrial Estate
Montego Bay, St. James, Jamaica W.I

Subject **Sandals Whitehouse: Wastewater Plant Capacity Assessment**
Available Capacity to Accept 12 Additional Rooms

Dear Mr. Henry;

Thank you for call and information sent regarding the capacity of the wastewater treatment plant at the Sandals Whitehouse resort to accept an additional 12 rooms.

Rated Capacity of Existing Treatment Plant

The rated capacity of the existing treatment plant is documented in the report, *Process Evaluation Report for Sandals Whitehouse Wastewater Treatment and Reclamation Plant, Westmoreland Parish, Jamaica W.I.* dated March 31, 2014.

Quoting from the report, "..Sandals Whitehouse is an "all-inclusive" resort. The original plant was designed to accommodate an 336 rooms, catering to couples only. The original design basis used a value of 375 gpd/room or 1.4 cubic meter per room per day. The plant was intended to be operable over a range of flow, which on average should be about 126,000 gallons per day or 477 cubic meters per day. Generally, it is not advisable to design a plant to be operated at 100% of design, some reasonable operational buffer is desired and which may also provide some residual capacity for future minor additions or increases, and so the plant nominal design capacity was intended to be 0.150 MGD or 568 cubic meters per day. "

In other words, the plant was built with a nominal average rated or design capacity of 150,000 gallons per day or 568 cubic meters per day flow. Actual flow was expected to average 126,000 gpd, with the difference between nominal design capacity flow and actual flow being intended to accommodate possible variations in flow and minor service area additions, such as contemplated in this letter.

Current Flow, Flow Per Room, and Capacity Utilized

You supplied metered influent flow and room occupancy data for the past year. This helps to establish what the percentage of rated capacity utilized is at present, which in turn indicates the capacity that is available for minor service area addition.

PROFESSIONAL ENGINEERS REGISTRATION BOARD
PE/01/0591
Stephan R. Rampole
JAMAICA

The historical record of room occupancy, water and metered wastewater influent flow in 2015 and 2016 is as follows:

Month	Year	Occupancy total	City Water consumption total	Sewage Influent Meter Readings
		Occupied rooms	litres	Litres
August	2015	4267	15830045	12461000
September	2015	5859	19154736	10696000
October	2015	8510	25107280	15021000
November	2015	8705	23646000	14838000
December	2015	8319	24628155	14615000
January	2015	8803	24351000	15054000
February	2016	10302	17811070	14372000
March	2016	9169	23237057	14430000
April	2016	8501	23324560	13756000
May	2016	7242	23562465	17136000
June	2016	6707	23970705	23257000
July	2016	7265	20080534	24352000

Analysis of this data indicates the following:

Total Occupied Room- days over one year	93649
Annual Average Occupied Rooms per Day	257
Total Flow, Liters this year	189988000
Annual Average Flow, Liters Per Day	520515
Annual Average Flow, Gallons Per Day	137520
Avg Flow Per Room, Liters per day	2029
Avg Flow Per Room, gallons per day	536

The analysis indicates the existing treatment plant is operating below rated capacity, or at 92% of its nominal capacity. The plant is presently processing 137,520 gallons per day or 520,515 liters per day on an annual average basis. With an annual average room occupancy of 257 units, flow per unit is 536 gallons per day or 2,029 liters per day. This is an aggregate measure of all uses per room, and is inclusive of not only direct guest use but also kitchens, laundry, maintenance work. The value of 536 gpd per room is higher than expected but probably reflects intensive renovation work and renovation work staff reported in progress.

Projected Wastewater Flow With the Addition of 12 Rooms

Future projected annual average flow can be estimated on the basis of multiplying the number of new rooms times the historic average flow per room and adding that to the current established annual average flow:

Rooms to Be Added	12
Expected Flow from New Rooms, gpd	6432
Expected Flow from New Rooms, Liters/day	24345
Expected Total Plant AADF, gpd	143952
Expected Total Plant AADF, Lit/day	544860
Expected Total Plant AADF, M^3/day	545

The plant nominal design capacity was intended to be 0.150 MGD or 568 cubic meters per day, on annual average basis; future projected flow with the addition of 12 rooms shows a future flow rate of 0.144 MGD or 545 M^3/day. Plant is therefore expected to continue to operate below its nominal design capacity with the addition of these rooms

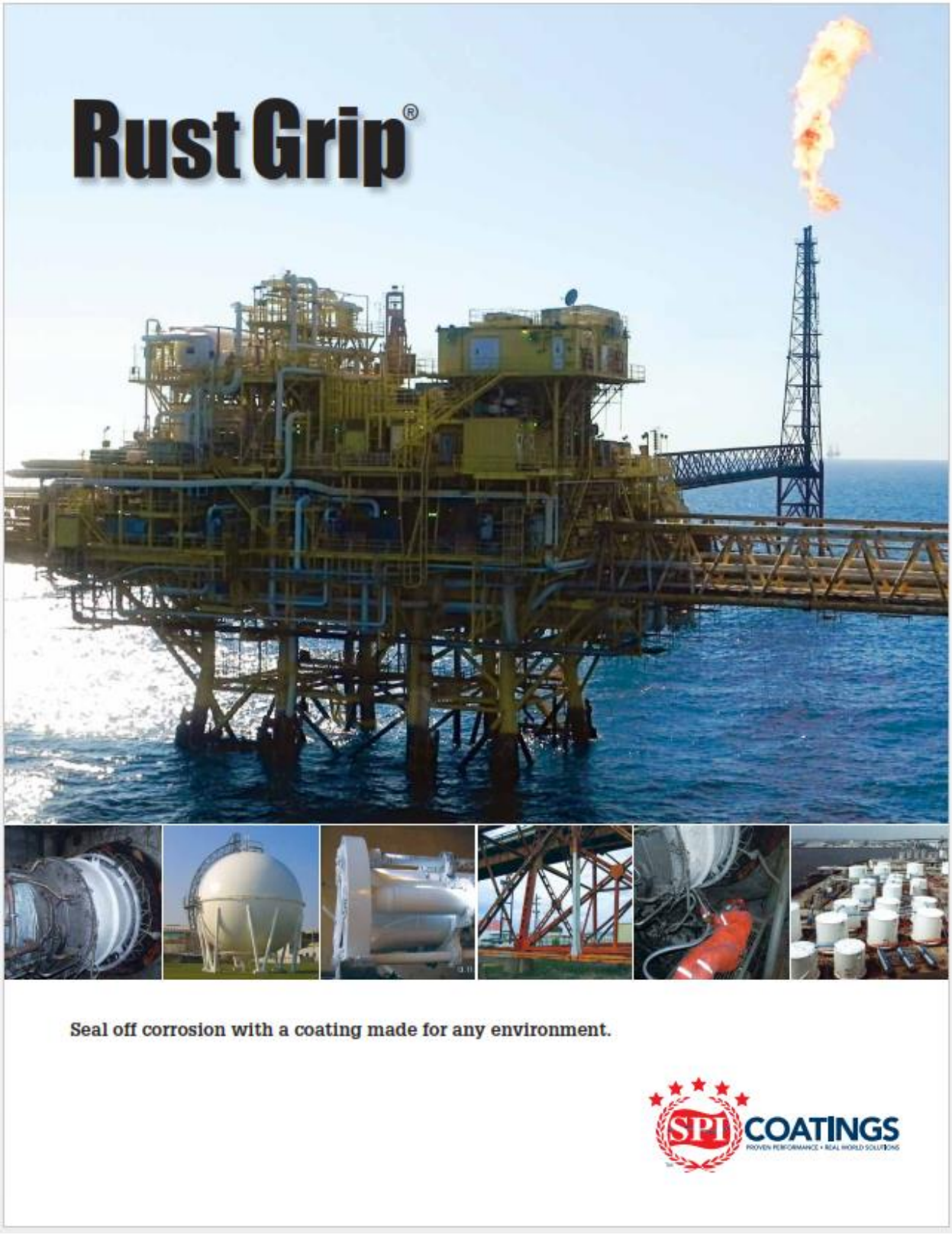
I trust this information is helpful, please contact me if you have any questions.

Sincerely,
MCDONALD GROUP INTERNATIONAL, Inc.

George J. McDonald, P.E.
GJM/gm

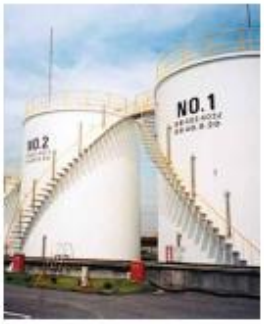
PROFESSIONAL ENGINEERS REGISTRATION BOARD
PE/01/0591
Stephen R. Rampaie
JAMAICA

Appendix 4: Rust Grip



Rust Grip®

One-Coat Encapsulation.



THE COST OF CORROSION.

The total direct cost of corrosion to U.S. structures, machinery and other items was determined to be $279 billion per year, which is 3.2 % of the then U.S. gross domestic product (GDP).

Indirect cost to the user (society costs) are conservatively estimated to be equal to the direct costs.

United States GDP

- *Direct cost of corrosion to U.S. Structures*
- *United States Gross Domestic Product*

U.S. Department of Labor Statistics. 2010 census.

Corrosion control is a given challenge for many industries with systems exposed to extreme weather and moisture. With Rust Grip,® you can stop the progression of rust and corrosion like never before. Within one hour of application, Rust Grip® begins to cure by pulling moisture from the air and microscopically swelling into the individual pores of the surface as it hardens. This process seals against any possibility of outside air, moisture, or minerals attacking the surface and causing further corrosion. Rust Grip® also encapsulates toxic elements such as lead-based paint, asbestos and other biohazardous materials. The success of Rust Grip® in a variety of environments can be seen everywhere from chemical fields, oil fields, oil rigs and numerous hazardous areas. This widespread use is just one more way that SPI remains an obvious and trusted choice to solve real world problems and conditions.

Superior Products International II, Inc.

spicoatings.com

RUST GRIP® VS. TRADITIONAL METHODS.

Rust Grip® is tested to encapsulate rust, lead-based paint, asbestos and biohazardous materials.

The one-coat application process behind Rust Grip® makes it an efficient and adaptable solution for companies.

RUST GRIP®

Rust Grip® is easy to apply and stops the progression of rust and corrosion while protecting the surface far longer than conventional surface gluing and industrial grade rust inhibitors. Traditional methods of corrosion protection have remained unchanged for the past 50 years. These methods require sandblasting, primer preparation and multiple application coats. Rust Grip® only requires minimal preparation and no white sand blasting of the surface.

After one application, it can penetrate deep into and seal the surface, blocking corrosion quickly and effectively.

Rust Grip® requires minimal preparation and no white sand blasting of the surface.

TRADITIONAL METHODS

Corrosion prevention and protection for the past 50 years has yielded inefficiencies for industries that depend on critical infrastructure. With many of these methods, limited success is achieved because most corrosion coatings are "glue-on-to-surface." This process doesn't allow for corrosion to be controlled in the pores of applied surfaces and won't protect against mold and mildew among other environmental toxins

Rust Grip® penetrates deep into the pores of and seals the surface from further corrosion.

	Traditional Methods	RUST GRIP®
Installation	Requires lengthy sandblasting.	Minimal surface preparation.
Application	Involves multiple coats.	Paint directly on rust and firmly bonded paint.
Moisture Prevention	Limited protection from mold and mildew.	Stops water vapor transmission through electro-chemical freezing.
Longevity	Shorter lifetime endurance.	Penetrates deep into pores of surfaces.
Corrosion	Not effective at blocking long-term degradation.	Adds strength to weakened surfaces.
Repair and Maintenance	Requires continual repair or complete overhaul.	Reduced surface preparation and efficient application yields cost savings.

spicoatings.com

RUST GRIP® IN ACTION.

Rust Grip® is used all over the world to help industries in need of innovative corrosion control solutions. Its ability to be applied to metal, concrete and even wood makes it effective for quick application and labor savings. See how the industries represented here have made simple improvements with Rust Grip® that continues to make all the difference.

Storage Tank

Separation Vessels

Pipelines

Bridges

Metal Roofs

Ship Hull

Ship Deck

Ballast Tank

Marine

Offshore Drilling Rig

Drill Pipe Risers

Concrete

Corrosion Under Insulation

Hoover Dam Bridge

Superior Products International II, Inc.

spicoatings.com

PROVEN PROTECTION EFFICIENCY.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

Salt Fog Spray Test

- Passed 15,000 hours

500 hour scribe test

- Perfect score of 10 at only 150 microns DFT
- No bubbles or undercutting along the scribe

MICHIGAN CITY, INDIANA – BLUE CHIP CASINO

- Bare, rusted 1-year-old steel was used on boat before application.
- Boat was entirely coated with Rust Grip®
- No white metal blast was required before coating and all corrosion issues were solved.

VINTON LOUISIANA BRIDGE

- Coated with Rust Grip® in April 1996 for testing in salt air, warm and highly humid environment.
- Other competing corrosion coatings failed.
- Has maintained high performance since original application in 1996.

NIGERIA OFFSHORE APPLICATIONS

- Years of exposure to saltwater, salt spray, sun, abrasion and extreme temperatures caused excessive deterioration of original coating.
- Two coats of Rust Grip® were applied in addition to Moist Metal Grip and Enamo Grip.
- Piping used for offshore drilling operations was completely restored.

US ARMY CORPS OF ENGINEERS

- Most consistent performer.
- Exceeded adhesion requirements.
- Outperformed all other coatings.
- Only '3 in 1' coating solution to pass rust evaluation requirement.

LOUISIANA DEPARTMENT OF TRANSPORTATION

Leg on the Mississippi 190 Baton Rouge railroad/ passenger car bridge was coated with Rust Grip® "without any prep" in 2003 and inspected in 2010 by NACE III engineering group finding no corrosion and no bleed through, and rechecked in 2013 confirming no corrosion development. From this performance, the QPL (Qualified Product Listing) for Rust Grip® was issued."

INDUSTRY COMPLIANT AND TRUSTED

- USDA
- LEED® Compliant
- DNV (Det Norske Veritas)
- Louisiana Department of Transportation
- Mississippi Department of Transportation
- IMO (International Marine Organization)
- ABS (American Bureau of Shipping)
- U.S. Coast Guard
- Tennessee Department of Transportation
- University of Kentucky
- Masdar
- FM Approved

Top Companies using Rust Grip®

- Halliburton
- Eni S.p.A.
- Pemex Oil
- Saipem S.p.A.
- Chevron Corp.
- Saudi Aramco Oil
- Gazprom Oil
- Shell Global
- ExxonMobil
- Rowan Companies, Inc.
- Drydocks World
- Ecopetrol
- Mubarak Marine

Rust Grip® experiences no loss in performance over its 15-20 year life expectancy in the harshest environments.

Rust Grip® creates an unsurpassed protective surface that's been proven through on-site evaluations and real-world applications.

Superior Products International II, Inc.

SUPERIOR PRODUCTS INTERNATIONAL PRESENCE

Asia	Europe	Middle East	South America	Central America	Africa	Australasia	North America
Japan	Italy	Saudi Arabia	Venezuela	Mexico	Egypt	Australia	Mexico
China	Germany	UAE	Colombia	Panama	Nigeria	New Zealand	Canada
Taiwan	France	Oman	Brazil	Puerto Rico	Tanzania		U.S.A.
Korea	Belgium		Argentina		South Africa		
Malaysia	Netherlands		Chile		Angola		
Singapore	Turkey						
Indonesia	Greece						
India	Spain						
	Russia						
	Ukraine						

PROTECTING INDUSTRIES WITH PREMIUM COATINGS.

Industries cannot rely on temporary efficiency when delivering their products and systems. That's why SPI Coatings work for numerous corporations and individuals. Our coatings were made to save you money because of their innovative performance and long-term durability. With an international presence in a wide diversity of markets, SPI brings industries peace of mind when it comes to combating weather and corrosion. As energy costs become more complex, SPI Coatings continue to push the boundaries of effectivness and efficiency. SPI offers a system of products refined from remarkably conclusive data and forged under the most rigorous conditions.

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

Superior Products International II, Inc.
sales@spicoatings.com
spicoatings.com

Appendix 5: Greenheart Specification

GREENHEART

Family: LAURACEAE (angiosperm)
Scientific name(s): Chlorocardium rodiaei
Ocotea rodiaei (synonymous)
Commercial restriction: no commercial restriction
Note: In Surinam, the name GROENHART is also used for IPE squared timber and square edged boards.

WOOD DESCRIPTION

Color: yellow brown
Sapwood: clearly demarcated
Texture: fine
Grain: straight
Interlocked grain: absent

LOG DESCRIPTION

Diameter: from 80 to 100 cm
Thickness of sapwood:
Floats: no
Log durability: good

Note: Very thick sapwood, heartwood yellow brown to dark olive brown, with sometimes irregular darker veins.

PHYSICAL PROPERTIES

MECHANICAL AND ACOUSTIC PROPERTIES

Physical and mechanical properties are based on mature heartwood specimens. These properties can vary greatly depending on origin and growth conditions.

	Mean	Std dev.
Specific gravity *:	0,97	
Monnin hardness *:	19,8	
Coeff. of volumetric shrinkage:	0,36 %	
Total tangential shrinkage (TS):	8,2 %	
Total radial shrinkage (RS):	7,5 %	
TS/RS ratio:	1,1	
Fiber saturation point:	40 %	

Stability: moderately stable to poorly stable

	Mean	Std dev.
Crushing strength *:	98 MPa	
Static bending strength *:	217 MPa	
Modulus of elasticity *:	30400 MPa	

(*: at 12% moisture content, with 1 MPa = 1 N/mm²)

Musical quality factor: 160,5 measured at 2931 Hz

NATURAL DURABILITY AND TREATABILITY

Fungi and termite resistance refers to end-uses under temperate climate. Except for special comments on sapwood, natural durability is based on mature heartwood. Sapwood must always be considered as non-durable against wood degrading agents.
E.N. = Euro Norm

Funghi (according to E.N. standards): class 1 - very durable
Dry wood borers: durable - sapwood demarcated (risk limited to sapwood)
Termites (according to E.N. standards): class D - durable
Treatability (according to E.N. standards): class 4 - not permeable
Use class ensured by natural durability: class 4 - in ground or fresh water contact
Species covering the use class 5: Yes
Note: This species is listed in the European standard NF EN 350-2.
This species naturally covers the use class 5 (end-uses in marine environment or in brackish water) due to its high specific gravity and hardness.
According to the European standard NF EN 335, performance length might be modified by the intensity of end-use exposition.

REQUIREMENT OF A PRESERVATIVE TREATMENT

Against dry wood borer attacks: does not require any preservative treatment
In case of risk of temporary humidification: does not require any preservative treatment
In case of risk of permanent humidification: does not require any preservative treatment

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GREENHEART

DRYING

Drying rate: slow
Risk of distortion: slight risk
Risk of casehardening: no
Risk of checking: slight risk
Risk of collapse: no

Possible drying schedule: 5

M.C. (%)	Temperature (°C) dry-bulb	wet-bulb	Air humidity (%)
30	42	41	94
25	42	39	82
20	48	43	74
15	48	43	74

This schedule is given for information only and is applicable to thickness lower or equal to 38 mm.
It must be used in compliance with the code of practice.
For thickness from 38 to 75 mm, the air relative humidity should be increased by 5 % at each step.
For thickness over 75 mm, a 10 % increase should be considered.

SAWING AND MACHINING

Blunting effect: fairly high
Sawteeth recommended: stellite-tipped
Cutting tools: tungsten carbide
Peeling: not recommended or without interest
Slicing: not recommended or without interest
Note: Sawdust may cause allergies.

ASSEMBLING

Nailing / screwing: good but pre-boring necessary
Gluing: correct
Note: Gluing must be done with care (very dense wood).

COMMERCIAL GRADING

Appearance grading for sawn timbers: According to NHLA grading rules (January 2007)
Possible grading: FAS, Select, Common 1, Common 2, Common 3

FIRE SAFETY

Conventional French grading: Thickness > 14 mm : M.3 (moderately inflammable)
Thickness < 14 mm : M.4 (easily inflammable)

Euroclasses grading: D s2 d0
Default grading for solid wood, according to requirements of European standard EN 14081-1 annex C (April 2009). It concerns structural graded timber in vertical uses with mean density upper 0.35 and thickness upper 22 mm.

END-USES

Hydraulic works (seawater)
Ship building
Bridges (parts in contact with water or ground)
Heavy carpentry
Sleepers
Poles
Hydraulic works (fresh water)
Cooperage
Bridges (parts not in contact with water or ground)
Industrial or heavy flooring
Turned goods

Note: Although not very used in France, GREENHEART is one of the most suitable species for end-uses in marine environment. Species resistant to acids. GREENHEART is also used for billiard cue.

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Appendix 6 – Slides of Presentation made at Public Consultation

4/6/2017

Sandals South Coast Jamaica Overwater Rooms

Presented
By
Dexter Cummings

OWR at SRC

Sandals Royal Caribbean

- 17 OWS
- Boardwalk (1233 Ft)
- 354 Pylons

Project Location

1

Project Location

Project as SSGJ

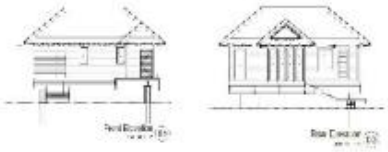
- 12 Rooms (700ft²)
- 2 Ancillary Room
- 186 Piles
- 623 ft boardwalk

Sandals South Coast

Project Footprint Impact

- Size of SFCA – 3,166,466 m² 782.45 acres.
- Project Area 3964 m² (0.98 acres) – 0.1% of sanctuary
- Pile Foot print 53.8 m² – 0.00002% of sea floor

Room Elevation View



SRC Project

SRC Project

SRC Project

Sea Floor of Project Area

- Seagrass beds

- 2 Main Species
  - (90% turtle grass)
  - (10% Manatee grass)
- No Coral

WORK PLAN

Pile Structure

Pile Driving

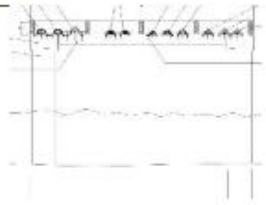
- 3.5 Tons
- Vibrating Hammer
- Hydraulics

Pile Driving Process

Pile Protection

Pouring of Concrete

Utilities



Utilities

Potential Environmental Impacts - Construction

Mitigation

Noise

- Operation Crane
- Driving Pile
- Our Experience
- Mitigation

Water Quality

- Turbidity
- Monthly test

Water Quality Results

Construction Debris

- Debris in water
- Garbage Bin
- Obstacle Barrier
- Dive

Obstacle Barrier

Sea Floor

- No Dredging
- Piles

Protection of Sea Floor

Protection of Sea Floor

Oil Spill

- Refuel Crane
- Spill Kit
- Barrier

During Construction

Potential Impacts during Operation

Environmental Management System

Sewage

- Gravity feed
- Lift station
- Sewage plant

Waste Management

- Cans
- Bottles
- Paper
- Return to Mainland via boardwalk
- Place in compactor/recycle are
- Disposed appropriately

Refuge Removal

Chemicals

- Clean room
- Biodegradable
- Proper Storage
- Dispensing system
- Appropriate use and disposal
- Zero disposal in sea

Hurricane

- Structure design (Category 3 Hurricane)
- Storm Surge (7 feet)
- Wind Damage
- Hurricane Plan

Discussion and suggestions

Appendix 7: Rapid Survey

SANDALS WHITEHOUSE EUROPEAN VILLAGE & SPA

12 WATER BUNGALOWS

ECOLOGICAL OPINION ON SITE LOCATION

AND PROJECT ELEMENTS

DAYNE BUDDO PhD

MARINE ECOLOGIST

September 29, 2016

Purpose of Opinion and Approach:

On the request of Sandals Resorts International, a rapid review of the project and the proposed site was conducted. This is by no means an in-depth study of the project area, but forms the basis for discussions going forward with the stakeholders involved and regulators responsible for the environment. This was particularly important since the project will have a footprint within the Sandals Whitehouse Special Fishery Conservation Area (SFCA), otherwise known as the Whitehouse Fish Sanctuary. This opinion also proposes several measures that may be considered to minimize impacts. It also suggests possible ways to enhance the ecological function and performance of the Sanctuary at the actual project site, and well as the Sanctuary as a whole.

Project documents were reviewed which was followed by a site visit on September 22nd, 2016. A camera was deployed within the seagrass area of the footprint and left undisturbed for 1 hour on September 18th, 2016. The footage was then reviewed to identify and enumerate the fish seen. A snorkel of the site was also carried out during the site visit.

Observations:

1. The overall project footprint within the Sanctuary is estimated at 3964m^2 (0.125% of Sanctuary) while the actual footprint of the pylons to support the structures is 53.7m^2 (0.002% of the Sanctuary)[1]

2. The depth of the water at this site is approximately 3m.

3. The footprint of the Bungalows will cover a seagrass bed. This is a healthy and well-established seagrass bed consisting of mainly *Thalassia testudinum* (80-90% cover) and *Syringodium filiforme* (10% cover). Macroalgae is minimal and comprised mainly *Halimeda sp.*

4. Animals observed on the visit include:

    a. *Diadema antillarum* (Long-spine Black Sea Urchin)
    b. *Lytechinus variegatus* (Green Sea Urchin)
    c. *Oreaster reticulatus* (Cushion sea star)
    d. Juvenile fish of the species:
        i. *Sparisoma aurofrenatum* (Red-band Parrotfish)
        ii. *Sparisoma atomarium* (Greenblotch parrotfish)
        iii. *Haemulon aurolineatum* (Tomtate Grunt); > 100 seen from the video footage

5. The seagrass blades were colonized by epibiota and bite marks (Mean = 8 bite marks/blade) suggest that this area is used for foraging by fish and other animals.

6. The site was turbid, and it appears that this is influenced by run-off from the nearby mangrove area, as well as suspension of the fine sediments on the seafloor. There also seems to be some amount of run-off of fine sediments from the groyne. The site visit occurred shortly after a rain shower.

[1] Project Brief – Sandals Whitehouse European Village & Spa, 12 Water Bungalows

Measures for Consideration:

Pre-Construction Phase:

1. ***Establish baseline environmental conditions*** at the Site to ensure that these conditions remain unchanged pre- and post construction within reason. These include:
    a. % cover of seagrass, blade length and shoot density immediately within the footprint, as well as adjacent areas
    b. macrofauna within the area (fish and invertebrates)
    c. Physicochemical parameters including but not limited to light, temperature, salinity, dissolved oxygen and turbidity. Dataloggers and sediment traps should be installed as soon as possible to get a profile established before construction.

2. ***Install Silt Screens around the footprint***, as close as possible to the construction site, especially where the pylons will be installed. This would minimize smothering of the seagrass close to the pylon installation points.

3. ***Conduct a detailed briefing for the construction team*** as to the sensitivity of the area and the importance of using the best practices to minimize collateral damage of the seagrass beds.

4. ***Install temporary moorings*** for the barge to eliminate the need for anchoring indiscriminately that may damage the seagrass beds adjacent to the construction site.

Construction Phase:

1. As the actual diameter of the pylons and PVC casing is relatively small, it may not be suitable to relocate the entire seagrass bed within the footprint. This may cause more damage to the seagrass beds versus the holes for the pylons. It is recommended that ***due care of the seagrass beds*** that are being affected be employed to ensure best survivability, especially immediately surrounding the pylons.

2. ***Monitoring of physicochemical environmental parameters*** outlined in Pre-Construction Phase (1c) above should be done.

3. The seagrass beds immediately around and within the project footprint at the end of each day should be checked; ***any significant sediment that may have***

smothered the seagrass should be removed. This could be as simple as wafting water to remove the sediment from the seagrass to using a low-pressure pump to remove excess sediments. This would encourage survival of the seagrass during construction.

4. ***Check the silts screens*** each day to ensure that there is no breach.

5. At the end of construction, ***remove any debris***

Post-Construction/Operational Phase:

1. ***Install a LED lighting system*** that will reduce the shading effect of the Bungalows. This would essentially aim to replace the function of the sun during the daytime and provide lighting for the seagrass. These lights should emit enough lumens to be comparable to the light regime identified during the pre-construction baseline. At night, these lights should be turned off which would simulate the natural conditions and not disturb the circadian rhythms of the organisms underneath and in close proximity of the Bungalows. To reduce the carbon footprint and emphasize the green approach, a solar system could be installed to run these lights. The ***seagrass areas underneath and surrounding the Bungalows should be monitored*** to measure seagrass health to compare and manage any effects of the Project on the natural ecosystem.

2. ***Install a series of habitats*** on the pylons. These habitats would be simple designs, comprising small PVC pipes of various diameters, arranged horizontally and attached on the PVC casings for the pylons. This would increase the habitat space for lobsters, fish, crabs, eels and other creatures. This would serve to offset the loss of habitat offered by the seagrass where the pylons would exist, and would even increase the physical habitat space currently available (though different in nature). ***These "new" habitats should be monitored*** to document the animals that colonize. The PVC casings can also be abraded to create a rough texture to promote colonization of algae and animals, creating food and space.

3. ***Explore the expansion of the existing Sanctuary***. The Sanctuary could be expanded to increase the amount of area that is being protected. This increase should be substantial, but within the current capacity of the management to provide the requisite monitoring and enforcement. Consideration should be given to expansion from shore seawards, inclusion of mangrove areas, expansion along the coast (especially towards Bluefields SFCA and possibly linking the two closely associated Sanctuaries). This would require an assessment by the team, stakeholder consultations and submission to the Fisheries Division for legal modification. The expansion of the SFCA would

increase the benefit to the fisheries in the area, especially the seaward expansion, as deeper reef areas would now be protected. These deeper reef areas would add areas to protect commercially important species such as snappers and groupers, increasing the performance of the SFCA and the increase in fish stocks outside the SFCA. ***An ongoing Monitoring Programme should be implemented*** to include live coral cover, fish populations, water quality, fish larvae and mangrove and seagrass health. This should be designed to compare the inner and outer areas of the SFCA.

4. ***Enhancement of the Guests' Experience***. The guests that will stay in these Bungalows should know and appreciate that they are staying in a very special area that is protected and managed by the Sandals Foundation, for the benefit of the local fishers and by extension the country. These initiatives may have the added benefit of increasing the support of the Foundation, as guests would increase their appreciation of the conservation work being done by the Foundation. Several initiatives can be explored and implemented, at low or no cost, which include:

    a. ***Have a special orientation*** for these guests to increase their appreciation of staying in a fish sanctuary. This should include the purpose, the work being done by the SFCA Management Team, and things they should not do (for eg. Throw anything in the water - including feeding the fish). This could be in the form of a 5-min video that is shown by the Sanctuary Manager or EHS Manager.

    b. ***Naming the Bungalows***. The bungalows could be named after marine species that are being protected in the Sanctuary, or named for the various Sanctuaries in Jamaica. This could also be enhanced by using photographs or paintings in the Bungalows to depict actual images of these species from the Sanctuary in which the guests are staying.

    c. ***Install an underwater camera system*** that feeds into the Bungalows. One underwater camera can be installed to focus on an area of active marine life underneath the Bungalows (eg. Home for lobsters or an eel, or area where fish tend to feed). The live video feed can then be shown on a special channel on the television in the Bungalows. This feature ("Fish Watch') would add a unique dimension and emphasize that these guests are staying in a fish sanctuary. The camera can be moved periodically to change the point of interest.

    d. ***Offer a diving/snorkeling option*** exclusively for the guests of the Bungalows. This diving experience would involve going underwater with the Sanctuary Team to monitor the reef, counting fish, tending to

a coral nursery, removing lionfish, among other things. This would give these divers an additional interest point to observe and even participate. A "Diving with a Scientist Programme" could be included where these guests would dive with a Marine Biologist who may be working in the Sanctuary at that particular time.

e. ***Dedicate a coral fragment*** to the Guests. The guests can adopt a coral fragment and they would get the opportunity of naming this fragment. This model has worked in the East Portland SFCA, and persons who adopt the coral would pay $50/year to maintain the coral in the nursery. They would get photo updates on the growth of their coral.

Overall Likely Benefits of Project to the SFCA:

1. The expansion of the SFCA will have a direct benefit to the fisheries in the area. Protecting more fish and lobster breeding areas may have a direct spill-over effect for the nearby fishing areas. Notwithstanding the physical increase in area, inclusion of deeper reef areas as well as the mangroves may have a muliplier effect in increasing fish stocks. The monitoring programme will guide management of the SFCA in a dynamic manner, to ensure that decisions are taken on the best information.

2. The installation of coral nurseries within the SFCA will serve to enhance the recovery of live coral cover on the reefs during the outplanting stage. With the likely increase in support and awareness from guests staying at the Bungalows, the reef restoration work would have a greater chance of success. Restoration of the shallow reef areas in the SFCA will also allow for coordinated snorkelling activities, that can be lead by fishers from the area. Fishers should also be trained and fully incorporated into the establishment and maintenance of the coral nurseries and outplant sites.

3. The public awareness about the Whitehouse SFCA and SFCAs nationally may help to improve support from private sector interests and guests. With the guests in these Bungalows given the opportunity to interact with the managers and scientists (and fishers) working with the SFCA, it would serve to increase appreciation and support for the value fo the SFCA.

Appendix 8: No objection letter from Fisheries Department

MINISTRY OF INDUSTRY, COMMERCE, AGRICULTURE & FISHERIES
FISHERIES DIVISION, 2c NEWPORT EAST, KINGSTON 15, JAMAICA

Tel: (876) 923-8811-3; Fax: (876) 937-6726
fisheries_jamaica@live.com

PLEASE QUOTE
REFERENCE NO.

April 3, 2017

Mr. Peter Knight
Chief Executive Officer
National Environmental & Planning Agency
10-11 Caledonia Avenue
Kingston 5

Dear Mr. Knight,

Re: Construction of Overwater Rooms within the Sandals Whitehouse Special Fisheries Conservation Area (SW SFCA)

I write regarding the subject at caption. Please be advised that the Fisheries Division has had discussions with the Sandals Resorts regarding their plan to construct twelve (12) overwater rooms within the Sandals Whitehouse Special Fisheries Conservation Area (SW SFCA).

Based on our review of the project concept, construction methodology, and recommended mitigation measures, it is believed that with strict adherence to guidelines set by NEPA coupled with extensive consultation with fishers, the project could be implemented with minimal impact on the SW SFCA.

We therefore offer no objection to the project, under the strict proviso that:

1. The project is executed in a manner that will ensure that all safeguards are identified and implemented with minimal impact to the SW SFCA;

2. Sandal Resorts commit to a suitable mechanism that will ensure that the development contribute to the sustainable development and management of fisheries in the area. Such support may be facilitated through initiatives such as direct funding to enhance the management of SW SFCA and /or any other SFCA.

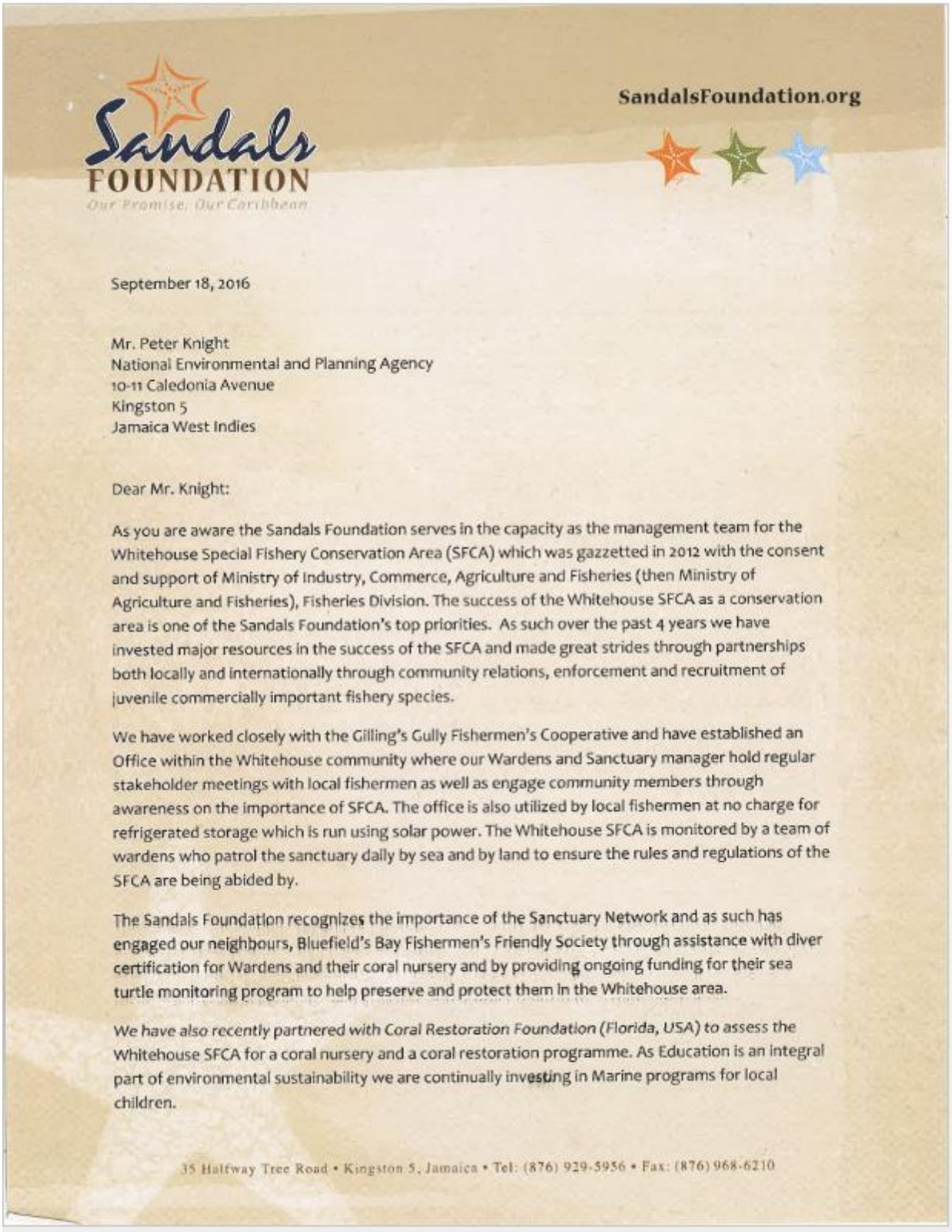
Yours sincerely,

G. Andre' Kong

G. Andre' Kong
Director of Fisheries

c. Lt. Cdr.(Ret'd) Paul Wright, CEO, Fisheries Division
Dexter Cummings, Environmental Manager, Sandals Resorts International

Appendix 9: Sandals Foundation Commitment Letter



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September 18, 2016

Mr. Peter Knight
National Environmental and Planning Agency
10-11 Caledonia Avenue
Kingston 5
Jamaica West Indies

Dear Mr. Knight:

As you are aware the Sandals Foundation serves in the capacity as the management team for the Whitehouse Special Fishery Conservation Area (SFCA) which was gazzetted in 2012 with the consent and support of Ministry of Industry, Commerce, Agriculture and Fisheries (then Ministry of Agriculture and Fisheries), Fisheries Division. The success of the Whitehouse SFCA as a conservation area is one of the Sandals Foundation's top priorities. As such over the past 4 years we have invested major resources in the success of the SFCA and made great strides through partnerships both locally and internationally through community relations, enforcement and recruitment of juvenile commercially important fishery species.

We have worked closely with the Gilling's Gully Fishermen's Cooperative and have established an Office within the Whitehouse community where our Wardens and Sanctuary manager hold regular stakeholder meetings with local fishermen as well as engage community members through awareness on the importance of SFCA. The office is also utilized by local fishermen at no charge for refrigerated storage which is run using solar power. The Whitehouse SFCA is monitored by a team of wardens who patrol the sanctuary daily by sea and by land to ensure the rules and regulations of the SFCA are being abided by.

The Sandals Foundation recognizes the importance of the Sanctuary Network and as such has engaged our neighbours, Bluefield's Bay Fishermen's Friendly Society through assistance with diver certification for Wardens and their coral nursery and by providing ongoing funding for their sea turtle monitoring program to help preserve and protect them in the Whitehouse area.

We have also recently partnered with Coral Restoration Foundation (Florida, USA) to assess the Whitehouse SFCA for a coral nursery and a coral restoration programme. As Education is an integral part of environmental sustainability we are continually investing in Marine programs for local children.

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We have just recently completed a yearlong "Save our Seas School Program" in Partnership with the Guy Harvey Ocean Foundation and Carib Save and have implemented ongoing "Reef Keepers Environmental Clubs" in a number of Whitehouse schools. We have also partnered with the University of the West Indies to control the lionfish in and around the SFCA, which has shown much success.

From present feedback from our Wardens, local fishermen and divers there is a noticeable difference in numbers of juvenile fish within sanctuary. In 2015 an initial Baseline Study was done by your office. We are presently awaiting results of the 2016 NEPA study for comparison data. We are confident it will indicate some significant areas of improvement.

At this time Sandals Resorts International is looking to enhance the tourism product of our island by providing new types of accommodation. This involves the construction of over the water suites within the Whitehouse SFCA. According to the project design, wide scale removal of seagrass in the project area would not be necessary since pylons will be used and the structures raised above the water. In addition, the depth of the water and proposed height of the suites over the water would reduce shading of the seagrass beds. Through studies we understand that these suites could be potential fish habitats. Based on "What attracts juvenile coral reef fish to mangroves: habitat complexity or shade" structural complexity of habitat as well as the degree of shade, are both equally and separately important factors in recruitment of types of reef fish. The construction of over the water suites could potentially provide areas of shade as well as relatively complex structures for fish to congregate.

We are aware that any construction within the Sanctuary will have some impact on the surrounding environment. The integrity of the Sanctuary and the investment the Sandals Foundation has made to date in this protected region are our first priority. The Sandals Foundation is prepared to work alongside the Ministry of Industry, Commerce, Agriculture and Fisheries, and Sandals Resorts International to ensure we continue to protect as much of the coast line possible through a proposed expansion of the existing area of the SFCA up to five times the amount of area that is impacted.

We are also prepared to implant additional artificial structures to act as breeding grounds for juvenile fish to offset any displaced ecological services that the affected seagrass currently provides.

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These areas would have close ongoing monitoring during and after construction by Consultant Marine Biologists and our Warden team to minimize any impact that may occur. We are committed to continue to do all we can to ensure the success of this sanctuary and are open to engage in further discussions on the matter with your team.

Yours truly,

Heidi Clarke (Mrs.)
DIRECTOR OF PROGRAMS

Cocheret de la Morinière, E., Nagelkerken, I., van der Meij, H. et al. Marine Biology (2004) 144: 139. doi:10.1007/s00227-003-1167-8

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Appendix 10. Public Participation Sign-in Sheets (Contact numbers were block out)

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA
Overwater Suites Rooms – Whitehouse Fisherfolks

Date of Event: 20th February 2017 **Time:** 10:00 a.m.

Location: Whitehouse Community Centre

Please sign as a record of your attendance.

NAME	ORGANIZATION	SIGNATURE	PHONE #
Raphael Taylor			
Annie Lair			
Tanesha Parkman			
Donna Salmon			
Bernett Brown			
Walter Grant			
Rhoan Taylor			
Wayne Brown			
Winston Murray			

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Whitehouse Community Development Corporation

Date of Event: 7th February 2017 **Time: 6:30 p.m.**

Location: Whitehouse Community Centre

Please sign as a record of your attendance.

NAME	Organization	SIGNATURE
XAVIER HOWDEN	WHITEHOUSE MARINE SANCTUARY	
Ainsworth Quest	Whitehouse Marine Sanctuary	
Terrell Powell	Whitehouse Marine Sanctuary	
Niquoe Gayle	Whitehouse Marine Sanctuary	
Kishroy Brown	Marine Santuary	K. Brown
Aston Miller	" "	A.A. Miller
DANE ANTHONY EDWARDS	WHITEHOUSE. P.O. WESTMORELAND	MR. MR. K. DANE, A.B. BROWN
Diego Salmon	Marine Sanctuary	
HOWARD BROMFIELD	CHURCH OF JESUS CHRIST. Whitehouse	
Donetta Grant	Culloden Infant Whitehouse	
Lorna Bernard	Culloden Infant Whitehouse P.O.	
Milton Salmon	WH. C D C	
RICARDO GORDON	WESTERN STRIKERS CRICKET CLUB	
Katherine Reynolds	Refuge Temple Culloden	
Gilroy Reynolds	/ / /	
Yvette Ferguson	S.D.C	
Gilroy Reynolds	Refuge Temple Culloden	4

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Whitehouse Community Development Corporation

Date of Event: 7th February 2017 **Time: 6:30 p.m.**

Location: Whitehouse Community Centre

Please sign as a record of your attendance.

NAME	Organization	SIGNATURE
Raphael Williams	N/Town CDC	Raphael Williams
Hugh Rodney	W.H.D.A.C.	

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Fisher folks Focus Group Meeting

Date of Event: 31st January 2017 **Time: 9:30 a.m.**

Location: Sandals South Coast Jamaica

Please sign as a record of your attendance.

NAME	Organization	SIGNATURE
Jonathan Hunnibell	Sandals Foundation	
Leni Mane	SSC Projects	
Diego Salmon	Whitehouse Marine Sanc.	
Kenrell Porter		
Milton Salmon		
Shamir Blair		S Blair
J'M Davis		
Jordan Powell		
Prince DAVIS		DAVIS
ANTHONY GORDON		GORDON
NOEL SAMUELS		
Ricardo Bromfield		R. Bromfield
Tarna Salmon		T. Salmon
XAVIER HOWDEN	Whitehouse marine Sanctuary	
Howard Bromfield	FISHERIES DIVISION	

Secretary GGFASS:

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Whitehouse Development Area – Community Development Committee

Date of Event: 15th February 2017 **Time: 5:00 p.m.**

Location: Bog Community Centre

Please sign as a record of your attendance.

NAME	ORGANIZATION	SIGNATURE	PHONE #
ANDRE DALEY	BOG CDC		
Douglas Blair	Bog CDC		
Pamela Linton	New Works CDC		
Charmaine Samuels	New Works C.D.C.		
Kathleene Robinson	New Works CDC		
Rosalie Porter	Petersville C.D.C.		
SYLVIA LEWIS	Petersville CDC		
Angella Campbell	Petersville CDC		
Laurel Ewart	Mount CDC		
Thelma Foote	Kentucky CDC		
Robert Satchwell	Bog CD C.		
Ralph Forest	Bog CDC	RF	
Idyn Blake	Bog CDC		
Brentee Blair	Bog CDC		
CARROL Graham	BOG C.D.C		

R

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Bluefields Bay Fishermen Friendly Society

Date of Event: 14th February 2017 **Time: 10:00 p.m.**

Location: Bluefields Bay

Please sign as a record of your attendance.

NAME	ORGANIZATION	SIGNATURE	PHONE #
R Ewart	Kentucky CDC	Ewart	5062148
Ryland Smith	Bay C/d C	R Smith	
Ethelda Satchwell	Bay CDC	Satchwell	
Dannett Johnson	Kentucky CDC		
Lascelles Jones	Beeston CDC		
ASST GAGE	Beeston Spring CDC	Asst Gage	
Koretta Young	Kentucky CDC	Kyoung	
Beverly Hibbert	Kentucky C.D.C	B. Hibbert	
Penny Richardson	Cave Mountain CDC	P. Richardson	
Osmond Basham	Beeston Spring C.D.C		
Rowan Foster	Kentucky CDC	R Foster	

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Bluefields Bay Fishermen Friendly Society

Date of Event: 17th February 2017 **Time: 2:00 p.m.**

Location: Belmont Fishing Bay

Please sign as a record of your attendance.

NAME	ORGANIZATION	SIGNATURE	PHONE #
Roydel Walker	Bluefields Bay FS		
Emsley Graham	Bluefields Bay		
Kawaine McIntyre	Bluefields Bay		
Chad Myrie	Bluefields Bay		
Livingston Thompson	Bluefields Bay		
Nigel Powell	Bluefields Bay		
Glenroy Stewart	Bluefields Bay		

Sandals
RESORTS INTERNATIONAL

SANDALS SOUTH COAST JAMAICA

Overwater Suites Rooms – Westmoreland Parish Council

Civic and Community Affairs Meeting

Date of Event: 2nd t March 2017 **Time:** 10:00 a.m.

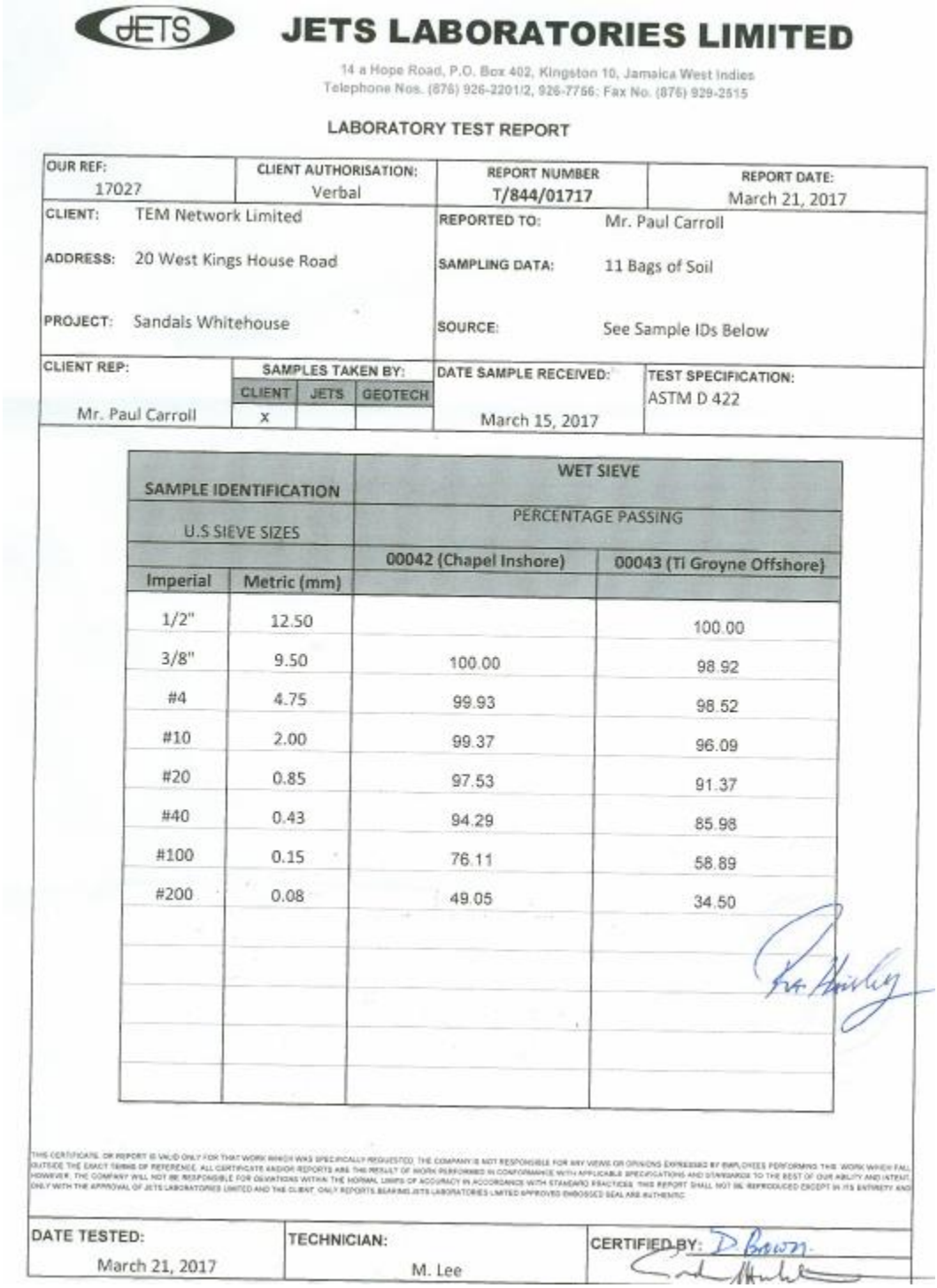
Location: Westmoreland Parish Council

Please sign as a record of your attendance.

NAME	ORGANIZATION	SIGNATURE	PHONE #
GARFIELD TANKS	Councillor Sheffield Division		
George Wright	Councillor Peters Field Division		
RUDOLPH UBY	W.M.C CLLR RUDOLPH UBY		
Jawnette Foster	CLLR Cornwall MTN		
Kevin Murray	Councilor (Friendship Div)		
Ian Myles	Councillor Little London Division		
Clement McFarlane	Councillor Cleamington	C'm McFarlane	
JEROME BACCHAS	COUNCILLOR DARLISTON		
Devon Thomas	C/H		
ORVILLE MURDOCK	WESTMORELAND MUNICIPAL CORPORATION. ROAD AND WORKS DEPARTMENT	Murdock	
SONIA GLAZE	✓		
Rowan Stephens	WestMoreland Health Department, PHI		
Rohan Griffiths	J.F.B		
Coretta Spence	JCDC		

Appendix 11: Sandals Turtle Trek Signage

Appendix 12: Laboratory Results



JETS LABORATORIES LIMITED

14 a Hope Road, P.O. Box 402, Kingston 10, Jamaica West Indies
Telephone Nos. (876) 926-2201/2, 926-7756; Fax No. (876) 929-2515

LABORATORY TEST REPORT

OUR REF:	CLIENT AUTHORISATION:	REPORT NUMBER	REPORT DATE:
17027	Verbal	T/844/01717	March 21, 2017

CLIENT:	TEM Network Limited	REPORTED TO:	Mr. Paul Carroll
ADDRESS:	20 West Kings House Road	SAMPLING DATA:	11 Bags of Soil
PROJECT:	Sandals Whitehouse	SOURCE:	See Sample IDs Below

CLIENT REP:	SAMPLES TAKEN BY:			DATE SAMPLE RECEIVED:	TEST SPECIFICATION:
	CLIENT	JETS	GEOTECH		ASTM D 422
Mr. Paul Carroll	x			March 15, 2017	

SAMPLE IDENTIFICATION		WET SIEVE	
U.S SIEVE SIZES		PERCENTAGE PASSING	
		00042 (Chapel Inshore)	00043 (Ti Groyne Offshore)
Imperial	Metric (mm)		
1/2"	12.50		100.00
3/8"	9.50	100.00	98.92
#4	4.75	99.93	98.52
#10	2.00	99.37	96.09
#20	0.85	97.53	91.37
#40	0.43	94.29	85.98
#100	0.15	76.11	58.89
#200	0.08	49.05	34.50

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DATE TESTED:	TECHNICIAN:	CERTIFIED BY:
March 21, 2017	M. Lee	D Brown

JETS LABORATORIES LIMITED

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LABORATORY TEST REPORT

OUR REF:	CLIENT AUTHORISATION:	REPORT NUMBER	REPORT DATE:
17027	Verbal	T/844/01717	March 21, 2017

CLIENT: TEM Network Limited	REPORTED TO: Mr. Paul Carroll
ADDRESS:	SAMPLING DATA: 11 Bags of Soil
PROJECT: Sandals Whitehouse	SOURCE: See Sample IDs Below

CLIENT REP:	SAMPLES TAKEN BY:			DATE SAMPLE RECEIVED:	TEST SPECIFICATION:
	CLIENT	JETS	GEOTECH		ASTM D 422
Mr. Paul Carroll	x			March 15, 2017	

SAMPLE IDENTIFICATION		WET SIEVE	
U.S SIEVE SIZES		PERCENTAGE PASSING	
		00044 (TO Offshore)	00045 (Nathan Offshore Beach)
Imperial	Metric (mm)		
1/2"	12.50		
3/8"	9.50		
#4	4.75	100.00	
#10	2.00	97.99	
#20	0.85	95.64	100.00
#40	0.43	94.13	99.65
#100	0.15	66.44	82.06
#200	0.08	34.23	19.09

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DATE TESTED:	TECHNICIAN:	CERTIFIED BY:
March 21, 2017	M. Lee	D. Brown.

JETS LABORATORIES LIMITED

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Telephone Nos. (876) 926-2201/2, 926-7756; Fax No. (876) 929-2515

LABORATORY TEST REPORT

OUR REF:	CLIENT AUTHORISATION:	REPORT NUMBER	REPORT DATE:
17027	Verbal	T/844/01717	March 21, 2017

CLIENT:	TEM Network Limited	REPORTED TO:	Mr. Paul Carroll
ADDRESS:		SAMPLING DATA:	11 Bags of Soil
PROJECT:	Sandals Whitehouse	SOURCE:	See Sample IDs Below

CLIENT REP:	SAMPLES TAKEN BY:			DATE SAMPLE RECEIVED:	TEST SPECIFICATION:
	CLIENT	JETS	GEOTECH		ASTM D 422
Mr. Paul Carroll	x			March 15, 2017	

SAMPLE IDENTIFICATION		WET SIEVE	
U.S SIEVE SIZES		PERCENTAGE PASSING	
		00046 (Nathan Inshore Beach)	00047 (TI-W Inshore)
Imperial	Metric (mm)		
1/2"	12.50		100.00
3/8"	9.50	100.00	99.02
#4	4.75	99.65	98.12
#10	2.00	95.56	94.11
#20	0.85	91.82	78.97
#40	0.43	88.94	49.80
#100	0.15	78.69	16.08
#200	0.08	58.29	4.62

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DATE TESTED:	TECHNICIAN:	CERTIFIED BY:
March 21, 2017	M. Lee	D Brown

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LABORATORY TEST REPORT

OUR REF:	CLIENT AUTHORISATION:	REPORT NUMBER	REPORT DATE:
17027	Verbal	T/844/01717	March 21, 2017

CLIENT:	TEM Network Limited	REPORTED TO:	Mr. Paul Carroll
ADDRESS:		SAMPLING DATA:	11 Bags of Soil
PROJECT:	Sandals Whitehouse	SOURCE:	See Sample IDs Below

CLIENT REP:	SAMPLES TAKEN BY:			DATE SAMPLE RECEIVED:	TEST SPECIFICATION:
	CLIENT	JETS	GEOTECH		ASTM D 422
Mr. Paul Carroll	x			March 15, 2017	

SAMPLE IDENTIFICATION		WET SIEVE	
U.S SIEVE SIZES		PERCENTAGE PASSING	
		00048 (French Beach)	00049 (TI-E Inshore)
Imperial	Metric (mm)		
1/2"	12.50	100.00	
3/8"	9.50	99.18	100.00
#4	4.75	98.27	99.72
#10	2.00	91.43	99.72
#20	0.85	75.86	99.31
#40	0.43	62.03	95.22
#100	0.15	35.58	19.34
#200	0.08	23.31	2.01

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DATE TESTED:	TECHNICIAN:	CERTIFIED BY:
March 21, 2017	M. Lee	D. Brown

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CLIENT: TEM Network Limited	REPORTED TO: Mr. Paul Carroll
ADDRESS:	SAMPLING DATA: 11 Bags of Soil
PROJECT: Sandals Whitehouse	SOURCE: See Sample IDs Below

CLIENT REP:	SAMPLES TAKEN BY:			DATE SAMPLE RECEIVED:	TEST SPECIFICATION:
	CLIENT	JETS	GEOTECH		ASTM D 422
Mr. Paul Carroll	x			March 15, 2017	

SAMPLE IDENTIFICATION		WET SIEVE	
U.S SIEVE SIZES		PERCENTAGE PASSING	
		00050 (French Beach Inshore)	00051 (Chapel Offshore)
Imperial	Metric (mm)		
1/2"	12.50	100.00	
3/8"	9.50	96.73	100.00
#4	4.75	94.01	99.90
#10	2.00	91.01	98.50
#20	0.85	86.86	94.60
#40	0.43	76.11	87.60
#100	0.15	26.48	68.90
#200	0.08	14.77	50.30

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DATE TESTED:	TECHNICIAN:	CERTIFIED BY:
March 21, 2017	M. Lee	D. Brown

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CLIENT REP:	SAMPLES TAKEN BY:			DATE SAMPLE RECEIVED:	TEST SPECIFICATION:
	CLIENT	JETS	GEOTECH		ASTM D 422
Mr. Paul Carroll	x			March 15, 2017	

SAMPLE IDENTIFICATION		WET SIEVE	
U.S SIEVE SIZES		PERCENTAGE PASSING	
		00052 (TO-E Inshore)	
Imperial	Metric (mm)		
1/2"	12.50		
3/8"	9.50		
#4	4.75		
#10	2.00	100.00	
#20	0.85	98.61	
#40	0.43	85.41	
#100	0.15	20.43	
#200	0.08	1.77	

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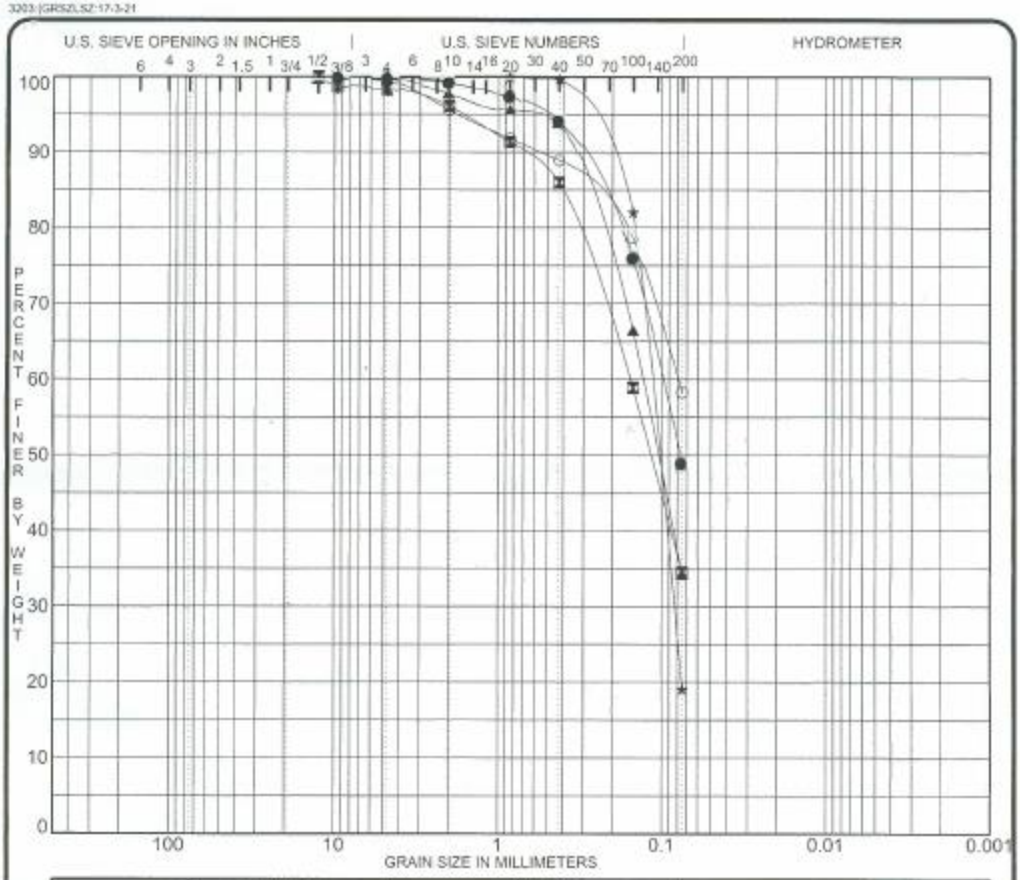
DATE TESTED:	TECHNICIAN:	CERTIFIED BY: D. Brown
March 21, 2017	M. Lee	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	00042	0.0							
⧗	00043	0.0							
▲	00044	0.0							
★	00045	0.0							
○	00046	0.0							

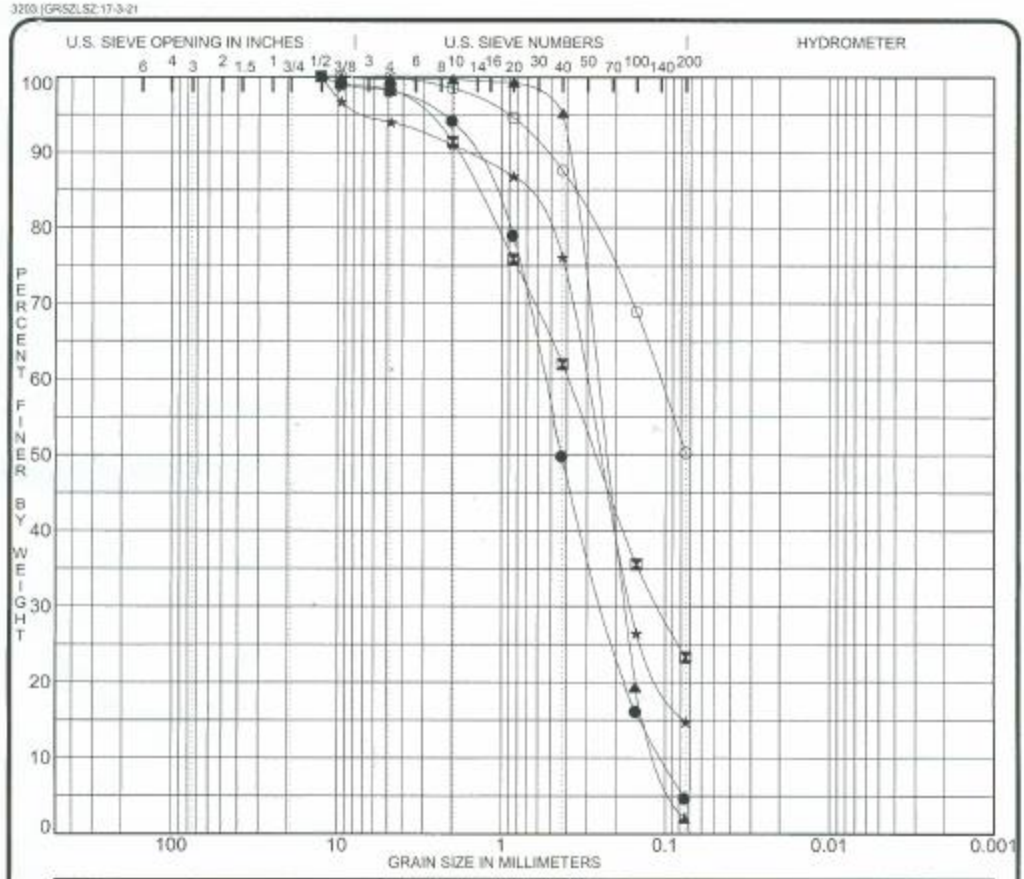
	Specimen Identification		D50	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	00042	0.0	0.08	0.10			0.1	50.9	49.0	
⧗	00043	0.0	0.12	0.16			1.5	64.0	34.5	
▲	00044	0.0	0.11	0.13			0.0	65.8	34.2	
★	00045	0.0	0.11	0.12	0.085		0.0	80.9	19.1	
○	00046	0.0		0.08			0.3	41.4	58.3	

PROJECT Sandals Whitehouse - JOB NO. 17027
DATE 17-3-21

GRADATION CURVES
JETS Laboratories Ltd.
Kingston

(a)

3203 [GRSZLSZ:17-3-21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	00047	0.0	POORLY GRADED SAND SP					0.95	5.2
⊠	00048	0.0							
▲	00049	0.0	POORLY GRADED SAND SP					1.11	2.5
★	00050	0.0							
○	00051	0.0							

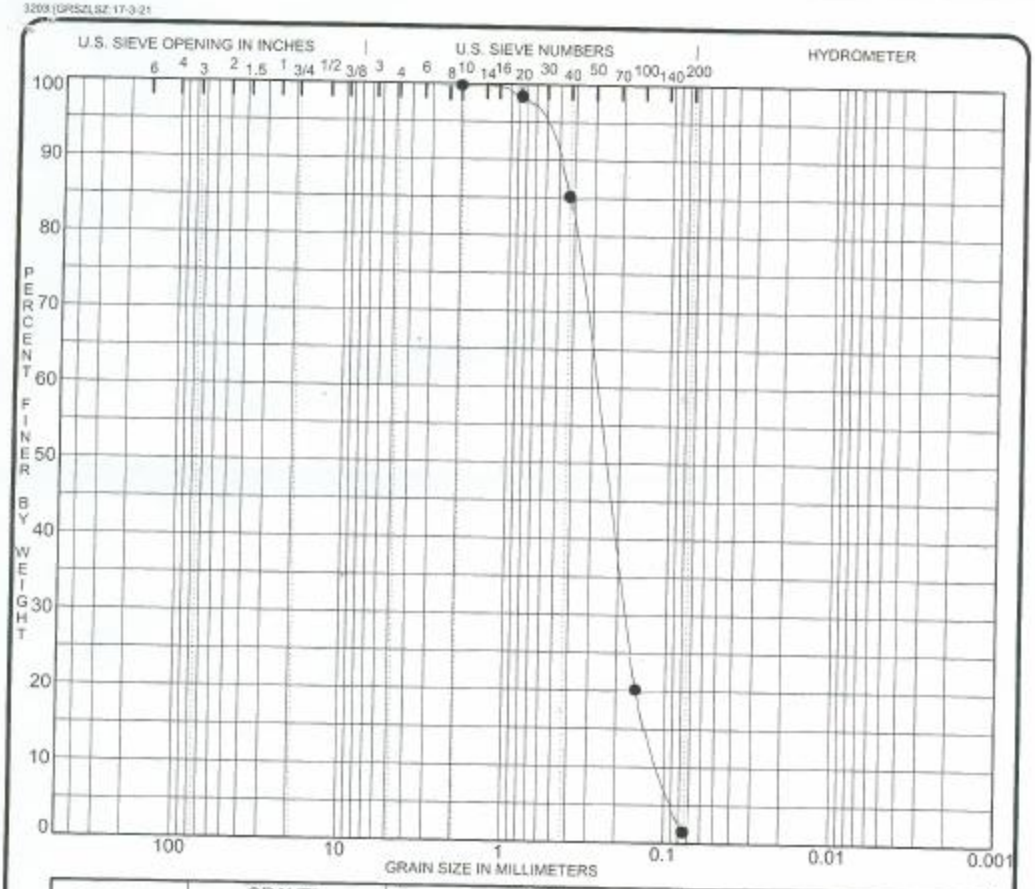
	Specimen Identification		D50	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	00047	0.0	0.43	0.54	0.231	0.1038	1.9	93.5	4.6	
⊠	00048	0.0	0.26	0.39	0.109		1.7	75.0	23.3	
▲	00049	0.0	0.23	0.26	0.174	0.1032	0.3	97.7	2.0	
★	00050	0.0	0.25	0.30	0.161		6.0	79.2	14.8	
○	00051	0.0		0.11			0.1	49.6	50.3	

PROJECT Sandals Whitehouse - JOB NO. 17027
DATE 17-3-21

GRADATION CURVES
JETS Laboratories Ltd.
Kingston

(b)

3203 [GRSZLSZ 17-3-21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	00052	0.0	POORLY GRADED SAND SP					1.06	2.8

	Specimen Identification		D50	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	00052	0.0	0.24	0.28	0.175	0.1018	0.0	98.2	1.8	

PROJECT Sandals Whitehouse -

JOB NO. 17027
DATE 17-3-21

GRADATION CURVES

JETS Laboratories Ltd.
Kingston

(c)

BUREAU OF STANDARDS JAMAICA
6 Winchester Road, P.O. Box 113, Kingston 10, Jamaica W.I.
Tel: (876) 926-3140, Fax: (876) 929-4736 Email: info@bsj.org.jm, Website: http://www.bsj.org.jm

TEST REPORT
No. TESR 26/2017/1039

This report is a correct record of the measurements and observations made. The report is intended for the private information of those for whom the work was done and not be used in whole or in part in any other way except with the written approval of the director of Standards. Misuse may lead to the penalties provided under the Standards Act, 1968. The Bureau accepts no responsibility for any loss or damage which may be sustained as a result of the use or reliance upon this report.

Customer Name :	Technological & Environmental Management Network	**Reference:**	CM-M/Misc 9131
Address:	20 West Kings House Road, Kingston 10	**Date Received:**	2017-02-16
Manufacturer:		**Date Tested:**	2017-02-16
Product:	Five (5) samples Sea Water	**Serial No. / ID No.:**	See table below
Test Method:	*Standard Methods for the Examination of Water and Wastewater – APHA, 22nd edition, Section 9221*	**Specification(s):**	
Ambient Conditions:		**Test Uncertainty:**	
Standard(s) Used:		**Traceability:**	

RESULTS

Lab. No.	Code	MPN/Faecal Coliform/mL
1039 A	Sample Date: 16/2/17 8:29 Station ID: 2	< 1.8
1039 B	Sample Date: 16/2/17 8:52 Station ID: SWH 4B	1.8
1039 C	Sample Date: 16/2/17 9:11 Station ID: SWH 3	2.0
1039 D	Sample Date: 16/2/17 9:13 Station ID: 1	< 1.8
1039 E	Sample Date: 16/2/17 9:54 Station ID: SWH 4	2.0

BUREAU OF STANDARDS 08 MAR 2017 MICROBIOLOGY

END OF REPORT

Circulation: Technological & Environmental Management Network Microbiology	**Remarks:**	**Prepared by:** **Signature:** **Name:** Kimone Campbell **Post:** Analyst **Date:** 2017-03-08	**Approved by:** **Signature:** **Name:** Karen Miller **Post:** Team Leader **Date:** 2017-03-08

BUREAU OF STANDARDS JAMAICA

6 Winchester Road, P.O. 113, Kingston 10, Jamaica
Tel: (876) 926-3140-5; Fax: (876) 929-4736
Website: http://www.bsj.org.jm Email: info@bsj.org.jm

TEST REPORT
No. TESR 25/2017/1038

This report is a correct record of the measurements and observations made. The report is intended for the private information of those for whom the work was done and not be used in whole or in part in any other way except with the written approval of the director of Standards. Misuse may lead to the penalties provided under the Standards Act, 1968. The Bureau accepts no responsibility for any loss or damage which may be sustained as a result of the use or reliance upon this report.

Customer Name	Technological and Environmental Management Network Limited	**Reference:**	ISC-C/WATER 1480
Address:	20 West Kings House Road Kingston 10	**Date Received:**	2017 February 16
Manufacturer:	N/A	**Date Tested:**	2017 March 07 - 09
Product:	Sea water - five (5) samples	**Serial No. / ID No.:**	N/A
Test Method:	See below	**Specification(s):**	N/A
Ambient Conditions:	Temperature: 23.8. - 25.2°C Relative Humidity: 50 - 60%	**Test Uncertainty:**	N/A
Standard(s) Used:	N/A	**Traceability:**	N/A

Test Methods:

1. Oil and Grease: EPA Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry.

2. Total Suspended Solids: Standard Methods for the Examination of Water and Wastewater (2005) - 21st Edition - 2540 D Total Suspended Solids Dried at 103 - 105°C.

BUREAU OF STANDARDS JAMAICA
09 MAR 2017
CHEMISTRY DEPARTMENT

REPORT CONTINUED ON PAGE TWO (2)

Circulation:	**Remarks:**	**Prepared by:**	**Approved by:**
Technological and Environmental Management Network Limited Chemistry Department		**Signature:**	**Signature:**
		Name: Mr. Ruel Freemantle	**Name:** for Mr. Dwyte Bremmer
		Post: Analyst	**Post:** Team Leader
File		**Date:** 2017 March 09	**Date:** 2017 March 09

Sample Identification	Oil and Grease (mg/L)	Total Suspended Solids (mg/L)
#1SWH: 2/16/2017 8:36	dnq	8.50
#2SWH: 2/16/2017 8:52	dnq	dnq
#3SWH: 2/16/2017 9:11	11.5	dnq
#4SWH: 2/16/2017 9:38	dnq	5.22
#4ASWH: 2/16/2017 9:38	dnq	nd

Limits of Detection (LOD) and Limits of Quantification (LOQ)

	Oil and Grease (mg/L)†	Total Suspended Solids (mg/L)‡
LOD	5.00	2.4
LOQ	10.0	4.8

Note:
1. † MDL traceable to reported test method.
2. ‡MDL traceable to Method 208D. Total Non-filterable Residue Dried at 103 - 105 C (Total Suspended Matter) in Standard Methods for the Examination of Water and Wastewater, 14th Edition.

END OF REPORT

National Public Health Laboratory

Environmental Health and Entomology

24 Slipe Pen Road

LABORATORY REPORT 14/03/2017 11:33

SAMPLE 1
KSA Health Department

Collection 16/02/2017 08:29
Lab No JEH0007222
Received 16/02/2017 14:47

Referred by PUBLIC HEALTH INSPECTOR

KSA Health Department
1A Caledonia Crescent
Kingston5

Tests ordered EHLSI,P8SEA

SAMPLING INFORMATION, EHLSI		Flags	RefInterval

Sample Information
Sampling Officer ..... Samira Bowden
Parish ..... Kingston & St Andrew
Sampling Location ..... Sample 1
Sample Type ..... Beach
Relinquished By ..... Paul Cerrall
Entered by Kerry-Ann Shaw-Walke 16/02/17 20:05
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24

BEACH, P8SEA		Flags	RefInterval
Analysis			
Nitrate-Nitrogen	0.02 mg N/L	L	0.20 - 1.70

Entered by Tara Wallace 27/02/17 11:09
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24

--- End of Laboratory Report ---

National Public Health Laboratory

Environmental Health and Entomology 24 Slipe Pen Road

LABORATORY REPORT 14/03/2017 11:33

SAMPLE 2
KSA Health Department

Collection 16/02/2017 08:52
Lab No JEH0007223
Received 16/02/2017 14:47

Referred by PUBLIC HEALTH INSPECTOR

KSA Health Department
1A Caledonia Crescent
Kingston5

Tests ordered EHLSI,P8SEA

SAMPLING INFORMATION, EHLSI	Flags	RefInterval

Sample Information
Sampling Officer ..... Samira Bowden
Parish ..... Kingston & St Andrew
Sampling Location ..... Sample 2
Sample Type ..... Beach
Relinquished By ..... Paul Cerrall
Entered by Kerry-Ann Shaw-Walke 16/02/17 20:07
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24

BEACH, P8SEA		Flags	RefInterval
Analysis			
Nitrate-Nitrogen	0.01 mg N/L	L	0.20 - 1.70

Entered by Tara Wallace 27/02/17 11:24
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24

--- End of Laboratory Report ---

National Public Health Laboratory

Environmental Health and Entomology 24 Slipe Pen Road

LABORATORY REPORT 14/03/2017 11:31

SAMPLE 3
KSA Health Department

Collection 16/02/2017 09:11
Lab No JEH0007224
Received 16/02/2017 14:47

Referred by PUBLIC HEALTH INSPECTOR

KSA Health Department
1A Caledonia Crescent
Kingston5

Tests ordered EHLSI,P8SEA

SAMPLING INFORMATION, EHLSI	Flags	RefInterval

Sample Information
- Sampling Officer ..... Samira Bowden
- Parish ..... Kingston & St Andrew
- Sampling Location ..... Sample 3
- Sample Type ..... Beach
- Relinquished By ..... Paul Cerrall
- Entered by Kerry-Ann Shaw-Walke 16/02/17 20:07
- Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24

BEACH, P8SEA	Flags	RefInterval
Analysis		
Nitrate-Nitrogen	< 0.01 mg N/L L	0.20 - 1.70

Entered by Tara Wallace 27/02/17 11:24
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24

--- End of Laboratory Report ---

National Public Health Laboratory

Environmental Health and Entomology 24 Slipe Pen Road

LABORATORY REPORT 14/03/2017 11:31

SAMPLE 4
KSA Health Department

Collection 16/02/2017 09:38
Lab No JEH0007225
Received 16/02/2017 14:47

Referred by PUBLIC HEALTH INSPECTOR

KSA Health Department
1A Caledonia Crescent
Kingston5

Tests ordered EHLSI,P8SEA

SAMPLING INFORMATION, EHLSI		Flags	RefInterval
Sample Information			
Sampling Officer	Samira Bowden		
Parish	Kingston & St Andrew		
Sampling Location	Sample 4		
Sample Type	Beach		
Relinquished By	Paul Cerrall		
Entered by Kerry-Ann Shaw-Walke 16/02/17 20:08			
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24			

BEACH, P8SEA		Flags	RefInterval
Analysis			
Nitrate-Nitrogen	0.02 mg N/L	L	0.20 - 1.70
Entered by Tara Wallace 27/02/17 11:24			
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:24			

--- End of Laboratory Report ---

National Public Health Laboratory

Environmental Health and Entomology 21 Slipe Pen Road

LABORATORY REPORT 14/03/2017 11:29

SAMPLE 4A
KSA Health Department

Collection 16/02/2017 09:54
Lab No JEH0007226
Received 16/02/2017 14:47

Referred by PUBLIC HEALTH INSPECTOR

KSA Health Department
1A Caledonia Crescent
Kingston5

Tests ordered EHLSI,P8SEA

SAMPLING INFORMATION, EHLSI	Flags	RefInterval

Sample Information
- Sampling Officer ..... Samira Bowden
- Parish ..... Kingston & St Andrew
- Sampling Location ..... Sample 4A
- Sample Type ..... Beach
- Relinquished By ..... Paul Cerrall
- Entered by Kerry-Ann Shaw-Walke 16/02/17 20:09
- Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:25

BEACH, P8SEA		Flags	RefInterval
Analysis			
Nitrate-Nitrogen	< 0.01 mg N/L	L	0.20 - 1.70

Entered by Tara Wallace 27/02/17 11:25
Authorised by Valbert Porter (Environmental Engineer) 14/03/17 11:25

--- End of Laboratory Report ---

SCIENTIFIC RESEARCH COUNCIL
(An Agency of the Ministry of Science, Energy & Technology)
P.O. Box 350, Hope Gardens, Kingston 6, Jamaica
Telephone: (876) 927-1771-4, 977-2190-1

ISO 17025 ACCREDITED LABORATORY

ANALYTICAL SERVICES DEPARTMENT
Report Sheet

Reference #: A14331

Customer's Name: TEM Network
Address: 20 West Kings House Road
# of samples submitted: 3
Type(s) of sample: Sea Water & Brackish Water

Samples collected by: Paul Carroll
Date of sampling: 2016/08/24
Date of receipt of samples: 2016/08/25 @ 8:52 am
Condition of sample on arrival: On Ice

RESULTS OF ANALYSIS

Method	Parameter	Date of Analysis	SWH1	SWH2	SWH3	SWH4	SWH4A
HACH Method 8048	Phosphate mg/L	2017/02/17	<0.05	<0.05	<0.05	<0.05	<0.05
HACH Method 8043	BOD mg/L	2017/02/17	4.6	7.2	5.5	5.8	5.3

HACH: HACH Water Analysis Handbook, 5th Edition.

Certified by

Signature: A. Latore
(Laboratory Analyst)

Name: Janell Latore

Date: 2017/03/28

Approved by

Signature:
(Technical Manager)

Name: EUSTACE SMITH

Date: 2017/03/28

Results relate to the sample received as identified. Validity & applicability of the results will be dependent on whether suitable sampling procedures were adhered to. This report shall not be reproduced except in its entirety and only with the approval of the client and the SRC. SRC accepts no responsibility for any loss or damage that may occur as a result of the use of this report.

Appendix 13 – Project Team

Dexter Cummings, MSc	Project Manager
	Socio-Economic Assessment & Public Participation
	Project Impacts & Mitigation
Paul Carroll, MSc	Water Quality
Peter Gayle, MPhil	Ecology
Pierre Diaz, BSc	Coastal Dynamics/Oceanography
Brian Richardson, MSc	Natural Hazard Risk Assessment
Bernadette Charpentier, MPhil	Ecology
Wesley Jackson, BSc	Technical Service Coordination/Research
Samira Bowden, BSc	Research
David Goldson, ME, PE	Structural Engineer
Bruce Lopez, leed ap	Architecture
Lloyd Thomas, PE	MEP