SOUTH ABACO: HOTEL, MARINA AND RESIDENCES

ENVIRONMENTAL IMPACT ASSESSMENT

Submitted to:
The Department of Environmental Planning and Protection Charlotte House, Charlotte & Shirley Streets, Nassau, The Bahamas.

Submitted by:
Caribbean Coastal Services Ltd.
Lot 57, Airport Industrial Park | P. O. Box CB-11524 Nassau, The Bahamas.

On behalf of:
Tyrsoz Family Holdings Ltd.
South Abaco, Bahamas

4 November 2020

Table of Contents

1 Executive Summary

The South Abaco: Hotel, Marina and Residences aim to provide a secluded and low-density atmosphere for guests, inclusive of an ultra-luxurious hotel, residential areas, 18-hole golf course, marina and other amenities at Lantern Head (LH) and South West Point (SW Point) on the island of Great Abaco. This Environmental Impact Assessment (EIA) describes the biological, physical and socio-economic impacts associated with the development of the overall project. Moreover, potential environmental impacts associated with the development were identified and discussed, as well as the scale of impact on the surrounding communities. Mitigation measures for potential adverse environmental impacts during construction and operation were proposed and discussed to elucidate best environmental practices for the project.

The developments at LH and SW Point will have some moderate to significant impacts onsite and potentially on the immediate environments surrounding the properties. However, mitigation strategies will lessen the overall environmental impacts of the project allowing the full socio-economic benefits of the project to be realized by South Abaco residents and stakeholders. The LH project activities which have the potential to cause adverse impacts include impacts to terrestrial habitats and bird populations due to land clearing during the creation of the golf course and upland infrastructure. Other potential moderate impacts from the LH project activities include impacts to water quality and hydrology due to excavation for golf course ponds and course maintenance. Mitigation against water quality impacts include the installation of an impermeable liner beneath golf course ponds. In addition, the use of organic fertilizers will reduce potential adverse impacts to water quality from golf course irrigation. The removal of terrestrial habitats will be mitigated through the preservation of habitat corridors, replanting with natives, and transplanting of rare endemic or endangered species elsewhere on the property. Planning for land clearing outside of Abaco Parrot breeding season can minimize the potential for negative impacts on nests. It is important to note that most reported nesting sites are located well north of both properties.

The marina excavation at SW Point will have the potential to alter subsurface hydrology and water quality in the immediate areas of the marina basin. Removal of terrestrial habitats will also have an adverse impact on terrestrial habits within the marina basin footprint, and the associated terrestrial fauna and flora utilizing these habitats. The construction and operations of the marina has the potential to moderately impact marine resources within the immediate areas of the project. The use of concrete curtain walls during marina construction will lessen the likelihood of saltwater intrusion into possible freshwater aquifers on site. The removal of terrestrial habitats will be mitigated through the preservation of habitat corridors, replanting with natives, and transplanting of rare, endemic or endangered species elsewhere on the property. Planning for land clearing outside of Abaco Parrot breeding season can minimize the potential for negative impacts on nests. Striving for Blue Flag marina certification, public education initiatives will be used as a tool to aid in the decrease of the marina's impacts on the surrounding marine environments. This will assist with the decrease of potential marine pollution, overfishing and collisions with marine mammals and sea turtles.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Several scenarios were modeled in a flushing analysis provided in the SW Point Flushing Analysis. The most likely scenarios (case 3 & 4) discussed in the report considers typical wind conditions in the basin. These scenarios showed the basin would meet United States Environmental Protection Act (EPA) standards for localized spill, under tidal and wind forcing.

The anticipated significant socioeconomic benefit of this project is much needed among the South Abaco stakeholders. Despite the potential adverse impacts associated with construction and operation of the development at LH and SW Point, the overall design of the project and Developer's commitment to a low density, low impact residential community will allow for effective mitigation strategies to be employed during construction and operations phases of the project. Effective mitigation strategies have the potential to lessen and even eradicate adverse environmental impacts due to project activities.

Recommendations on best practices and industry standard operations will be provided in the Environmental Management Plan (EMP) for the Project.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

2 Introduction and Objectives

2.1 Objective of the Environmental Impact Assessment (EIA)

The Project aims to provide a secluded and low-density atmosphere for guests, inclusive of an ultra-luxurious hotel, residential areas, 18-hole golf course, marina and other amenities at Lantern Head (LH) and South West Point (SW Point) on the island of Great Abaco. The objective of this EIA is to describe the biological, physical and socio-economic impacts associated with the development of the South Abaco: Hotel Marina and Residences (hereinafter referred to as the "Project"). Moreover, the objective is to identify potential environmental impacts associated with the development, as well as the scale of impact on the surrounding communities. Proposed mitigation measures for possible adverse environmental impacts during development will be discussed to ensure guidance of best environmental practices.

2.2 Scope of the EIA

The scope of the EIA for the developments at Lantern Head and South West Point in South Abaco, The Bahamas, includes biological and physical assessments of the marine and terrestrial environment within and surrounding both properties. Socio-economic impacts were considered for the South Abaco communities. Additionally, this EIA aims to share goals of environmentally responsible practices during the development, which respects the cultural significance and pristine nature of South Abaco.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

3 Geographical Setting

3.1 Location of Site

The island of Abaco is the second largest island in Commonwealth of The Bahamas with approximately 2,300 square miles of land and is located in the Northern region of the country. Abaco is comprised of various islands and cays which includes the main island of Great Abaco, Little Abaco, Moore's Island, Elbow Cay, Castaway Cay, Green Turtle Cay, Great Guana Cay, Walker's Cay, etc. These islands and cays cover approximately 130 square miles of Bahamian waters. Known for its crystal-clear waters and bountiful fishing opportunities, travelers make the Abaco islands their yearly vacation destination.

The sites of the Project are located in the southern district of the island of Great Abaco known as South Abaco. These sites include two properties, Lantern Head and South West Point. Lantern Head lies to the northeast of South West Point, which lies at the southernmost point of Great Abaco. The nearest inhabited settlements and communities to these properties are Sands Cove, Sandy Point and Crossing Rocks.

Lantern Head (25° 52' 59" N, 77° 11' 30" W) is in excess a 654-acre site that is located 45 miles south of the capital city of Great Abaco, Marsh Harbour, and borders the Abaco National Park. The site contains approximately 12,000 feet of shoreline with elevations that top 100 feet. The town of Sandy Point is approximately 20 miles to the northwest of Lantern Head. A functional 4,500- foot airstrip is located near the Sandy Point settlement, where it is able to support incoming and outgoing travel of small aircrafts. The Marsh Harbour International Airport is located approximately 49 miles north of the site.

The South West Point (25° 50' 56" N, 77° 12' 48" W) site includes 505 acres, 7,000 feet of shoreline and has an elevation of 80 ft. It is situated approximately 4 miles to the southwest of the Lantern Head site and is served by an unpaved roadway taking approximately five minutes to navigate.

3.2 Site Description

Lantern Head Site Description

The LH project site, totaling 696.16 acres, is located an estimated 12 miles south of the Great Abaco Highway in South Abaco.

The original property size was 654 acres. in agreement with the Bahamian government two parcels were added to the site which includes approximately 182.66 acres of what is known as the 'Northern Extension' and approximately 34 acres of coastal land for a total of 217 acres of extension.

The consideration for the 217 acres extension includes an agreed cash amount and Developer granting to the government 174.50 acres of land located in the north western boundary of the site which abuts the southern boundary of the protected Abaco National Park, managed by the Bahamas

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

National Trust (See Appendix A – Lantern Head Survey Map: Tracks A & B Totaling 174.50 exchange). Given its proximity to the Abaco National Park It is the intention that this 174.50-acre parcel will extend the Abaco National Park's boundaries.

The terrestrial landscape of Lantern Head is a mixture of coppice and pine forest with access to the south eastern coast of Great Abaco. Most of its vegetation consists of coppice forest with pine forest dominating the western most areas of the property. The coastal coppice forest beyond the ridge at Lantern Head exhibits stunted growth due to the strong coastal winds which has shaped the vegetation into a dwarf, dense version of the coppice forest protected by the main ridge on the property. Its coastal environment consists of a sandy beach, rocky intertidal zone and cliffs that face the Atlantic Ocean.

South West Point Site Description

South West Point is a 505-acre site located approximately 14.5 miles from the Great Abaco Highway in South Abaco. Site boundaries extend approximately 1 mile from the northern boundary (25° 51' 28" N, 77° 12' 28" W) to the southern boundary, which lies at the southern-most tip of the island of Great Abaco. The Developer is granted two additional pieces of land adjacent to the existing property. This includes the 15-acre southern coastal property that mirrors the original property boundary, as well as the 30-acre south eastern terrestrial property. South West Point consists of both interior and coastal coppice, and mostly rocky shorelines with cliff features that overlook the Atlantic from the southern end of Great Abaco.

3.3 Areas of Influence

The immediate terrestrial and marine habitats of the Lantern Head and South West Point sites will be influenced by the development for the South Abaco: Hotel, Marina and Residences. The Project will impact the physical, biological and socioeconomic environment. The alteration of some pine forest, coppice forest, coastal area and marine environment is necessary to complete the design of the development. The design includes a full golf course, marina, residential areas, back of house facilities, the Sandy Point airstrip renovation, the modification of the Lighthouse and Soldier Roads, as well as the Hole in the Wall Lighthouse refurbishment. With regards to Lantern Head, areas of influence include pine forest, coppice forest and coastal habitats. Areas of influence at South West Point include the terrestrial, marine and near shore beach environment. This development would also impact the terrestrial habitat within the footprint of the existing Hole in the Wall Lighthouse, the Sandy Point airstrip and the aforementioned roads leading from Great Abaco Highway to both properties and The Lighthouse. Furthermore, the area of influence spans from the development sites to the surrounding communities in South Abaco. Due to their proximity, the existing communities will experience socio- economic impact due to the provision of financial opportunity.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

4 Existing Land Use and Ownership

Apart from the Abaco National Park, the properties surrounding Lantern Head and South West Point are a combination of crown and private Land. Presently, both Lantern Head and South West Point are uninhabited. The mixed pine and coppice forest at Lantern Head provide adventurous trails for hunting and hiking, as locals and visitors may partake in these activities. Its proximity to the Abaco National Park further encourages recreational use of the land. This property also has access to the coast, which provides locals and visitors with a variety of recreational activities such as fishing, boating, swimming, snorkeling and scuba diving opportunities. Its coastal environment provides an unobstructed view of the deep blue waters of the Atlantic. Lantern Head is the closest of the two properties to the significant Hole in the Wall Lighthouse. This historic property is open with unrestricted access to the grounds surrounding the lighthouse. The rich coppice forest within the South West Point parcel provides an opportunity to hike through its unmarked territory and to access the coastal environment of the southernmost point of Great Abaco. This property provides similar recreational opportunities as Lantern Head but rarely accessed by locals or visitors due to the lack of foot paths.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

5 Project Description

The development of the Project encompasses two properties, Lantern Head and South West Point. Both properties were preferred due to their elevation and topography. Thus, providing the framework for potential to complete a dream destination in South Abaco. Both developments are expected to be completed and fully operational by January 2026.

Part of this project includes the renovation of the Sandy Point airfield which will operate as a port of entry into South Abaco by providing swift and efficient access to the developments at both locations. The goal of developing the Sandy Point Airport is to increase private, non-commercial, international and domestic flights into South Abaco. The Developer will extend the existing asphalt airstrip by an additional 2,500 ft. to create a fully operational take-off and landing airport, instrument certified for international aviation standards. Construction of a 2,500 sq. ft. airport terminal building, airplane parking area, lighting and fueling station are included in the renovation of this airfield. Thus, becoming a regulated port of entry by making provisions for The Bahamas government to regulate flights with stationed Bahamas Customs and Immigration personnel.

The project includes the restoration of the culturally significant Hole in The Wall Lighthouse, which lies about 1.09 miles to the south east of the Lantern Head parcel's boundary. This restoration focuses on refurbishing the historic South Abaco lighthouse to its former glory. The lighthouse is operational, however interior and exterior refurbishment is necessary. In addition, the historical restoration of the surrounding support buildings will allow these structures to function as quasi-museums to showcase the rich and fascinating history of South Abaco and the Lighthouse. Refurbishment of these buildings would be completed under the direction and partnership of the Antiquities, Monuments and Museums Corporation (AMMC) and in accordance with the Bahamas National Trust (BNT).

For ease of access to the development, the access road known as the Lighthouse Road will be upgraded to the Ministry of Public Works (MoW) road standards and will include civil infrastructural works such as land grading, paving, striping, lighting, signage and drainage. This road improvement will modernize approximately 15.5 miles of road with a width of 30 ft. to fit the existing right-of-way, which includes Lighthouse and Solider Roads, as well as the access road to the beach from the junction at both Lighthouse and Solider Roads as detailed in Section 9.12.

5.1 Lantern Head Project Description

The master plan for Lantern Head includes a full size 18 hole golf course (Figure 1), a club house inclusive of 4 tennis courts, the development of a 50-room luxury hotel inclusive of spa, gym, pool, bar, beach club, casual and upscale restaurant (Figures 2 & 3). These amenities are supported by a Back of House (BOH) /utilities facility and employee housing. The Developer intends to create an

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

approximately 300' jetty structure which is designed to protect the existing beach feature; thus, creating a swimming cove for bathers and more space for cabanas. Furthermore, the master plan for Lantern Head intends to provide various residential home lots throughout the site. Approximately 75-residential home lots inclusive of hilltop and waterfront are major features for this development.

Golf Course at Lantern Head

The master plan for Lantern Head includes the development of a full sized 18-hole golf course which will take advantage of the natural vistas and features of the site. The 18-hole championship golf course is a key amenity for this project. Like the entirety of this project the course is designed, constructed and will be maintained by top-level professionals. The design plan for the golf course includes a predominantly links style course that will take advantage of the natural vistas and features of the site. The complete Lantern Head Gold Course supplementary information is included in Appendix B.

Clearing

Clearing for the golf course will be focused on the areas required for development of fairways, cart paths, water bodies and construction access. Special attention will be paid to specimen vegetation and unique geologic formations which will be identified by qualified personnel and avoided or mitigated accordingly. A nursery area for long term site landscape maintenance is part of the development plan. Any specimen trees and vegetation that is impacted by the course clearing will be transplanted to the nursery area for remediation back into the native areas between fairways as the course construction progresses or otherwise will be planted back in coordination with the Bahamas National Trust in the "nature preserve" area which the project is transferring to the BNT.

Materials

The natural ground material at Lantern Head is mostly made of very porous coral limestone with little high-quality topsoil. Fill from the marina excavation at Southwest Point will be used to augment the natural grades within the course. Topsoil needs for the course will be developed to the greatest extent possible from soils available on Lantern Head and Southwest Point with nutrient and blend augmentation to meet the needs of the golf course. If more material than is available from the two project sites is required, soils from elsewhere on Abaco will be acquired and similarly augmented to meet the ultimate requirements of the course. The design of the golf course turf areas uses geofabric underlayment to contain soils and irrigation flows to the design areas. The soils cross section of turf areas will maintain proper percolation for natural aquifer recharge while inhibiting fertilizers and herbicides from running off into on- site water bodies, the ocean or leaching into the aquifer. Tees and greens are designed with underdrains to provide the very best control of fertilizer and herbicide leachate and reuse as these turfs are the only areas of the course that have more stringent requirements for nutrient augmentation and weed control.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Course Coverage

Environmental stewardship is a flagship component of this entire project, as it is for the golf course. Conservation of water and environmentally sensitive course maintenance methods and materials are key to the design and operation of the course. Clearing and reshaping of the natural environment is reduced with the links style design. Fairway coverage is 39% of the overall 217 acres of golf course area. In areas between fairways where the native vegetation can be enhanced with resort quality landscaping, it will remain and there the cart paths will be the only impact to the native condition. Not all the fairway area will necessarily be 100% turf covered. As the design for construction is finalized, some areas may be left more native within the links design. So, this 39% fairway area represents a nominal maximum of the course to be converted to turf.

Irrigation

The irrigation needs of the golf course and related landscaping are estimated annually at 4 acre-feet per turf acre or landscaped acre. With an average annual rainfall of just shy of 4 acre-feet the irrigation needs of landscaping will be relegated to the dry months. The turf will require regular irrigation. Salt/brackish and gray water will be the water source for the fairway irrigation. Graywater and the engineered water bodies that are part of the rainwater collection system of the site will be used for irrigation of tees, greens and enhanced landscaping on the course.

Turf and Related Irrigation Considerations

All turf areas of the course use controlled coverage sprinkler irrigation with all designed landscape areas irrigated with drip or concentrated disbursement for maximum irrigation efficiency and minimum water use. Fairway turf will be Seashore Paspalum which is a variety specifically developed for coastal golf course applications. This turf offers the advantage of very high salt tolerance, while also providing the playing characteristics desired in golf turf. After it is established, Seashore Paspalum can be maintained with pure sea water which provides unique water conservation options. Sea water assists in the control of weeds and minimizes the need for herbicide use. The combined features of this turf grass help to achieve a level of environmental stewardship that is befitting this resort golf course.

Tee boxes and greens turf will be Bermuda grass hybrids. This turf is elemental to the world- famous Augusta National Country Club among other notable courses and provides the caliber of playing surface expected in a world class resort. Bermuda grass is excellent warm weather turf that has minimum irrigation needs, is fast growing, and quick to recover from injury. Environmentally responsible organic fertilizers tailored to Bermuda grass have been developed over the last 40+ years, fungicide application is seldom justified.

Bunkers and sand traps throughout the course all use coarse grain native sands.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Water Features

The golf course will have water features that are integral to the design of the golf course and the entire resort. In addition to being beautifully sculpted landscape amenities, these water bodies will be used as rainwater collection reservoirs to store rain collected by structures on the overall site for domestic and irrigation water needs of the course and resort. The course design contains 22 acres of water feature. These water bodies will be engineered and fully lined to maximize water capture and reuse.

Figure 1. Lantern Head Golf Corse design.

Area	Acres	% Coverage
Fairways	84	39%
- Tees & Greens *	7	3%
- Bunkers *	2	1%
Water Bodies	22	10%
Non-fairway area	111	51%
Total Golf Course	217	
* Included in fairway area		

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

5.2 South West Point Project Description

The master plan for South West Point includes the development of an approximately 130-acre marina (inclusive of a 1 mile flushing canal), a marina village, 100-room limited service hotel, 20 room fishing lodge, approximately seventy-five (75) 1-acre residential lots, the "life-style" village, artists village and a small water park. The marina is designed to be a 136-slip super yacht marina ranging from 150 ft. to 660 ft., with protective jetty structures extending approximately 300 ft. from shore along each side of the entrance canal. An estimated 30,000 tons of boulders from Grand Bahama would be used for the jetty structures at South West Point and the break water at Lantern Head. The proposed marina has a depth -15ft MLLW for the main basin, and -10ft MLLW for the flushing channel. These marina slips will serve as a mixture of rental and sale usage. The concrete floating docks at the marina will include modern waste removal, electrical connection outlets and fuel. No docks will be allowed to be built on the coastline and the Developer incorporated a setback of the properties from the coastline to avoid such docks being built on any of the residential lots located on the coast line. Approximately 44 of the residential lots will be situated inside the marina and along the canal. Each of those 44 lots will include an individual 100' boat slip. Approximately 18- residential home lots will be located along the ocean front in the south and west portion of the parcel. An estimated 13- residential home lots are designed to be developed on the hilltop at the back of the marina for spectacular views of the Atlantic Ocean. The "life-style" village will occupy the eastern area of the parcel; inclusive of the granted 30-acre south eastern extension. This residential village would consist of about 120 small lots complete with 1,500 ft. – 3,500 ft. houses and a small 20-room fishing lodge. The development of this village envisages it to be branded by a well-known celebrity as a "lifestyle" village.

A 'Marina Village' is incorporated in the marina design to serve as the focal point and entertainment hub for visitors. This design is inclusive of facilities such as a club for yacht's crew with amenities such as a lounge, gym and laundry services. Retail stores, yacht charter office, fishing charter office, fishing guide office, restaurant, bar and a small casino and nightclub is also incorporated in the concept of this Marina Village. The proposed development of a port of entry in South Abaco would provide an avenue for the establishment of The Bahamas Customs and Immigration Office to facilitate the necessary Bahamian border control. The Developer will rent office and retail spaces to locals, rent- free, for the first few years of the Project.

As a part of community outreach, the South West Point development also includes the development of a small waterpark, basic triage medical facility, and an artist village. Designs for this small waterpark consists of an estimated 10 acres; inclusive of various pools including a Lay-Z River styled pool. The artist's village would consist of approximately 20 small units rented out to local Bahamian artists at zero rent. The concept of the artist village aims to cultivate authentic Bahamian art and cultural expression and providing an avenue for local artists to exhibit and sell locally made products. The medical development would be designed to facilitate guests of the Project as well as locals, while providing an alternative source for medical aid within South Abaco. Table 1 shows the mass balance for each component of the project.

Table 1. Project Mass Balance Estimates.

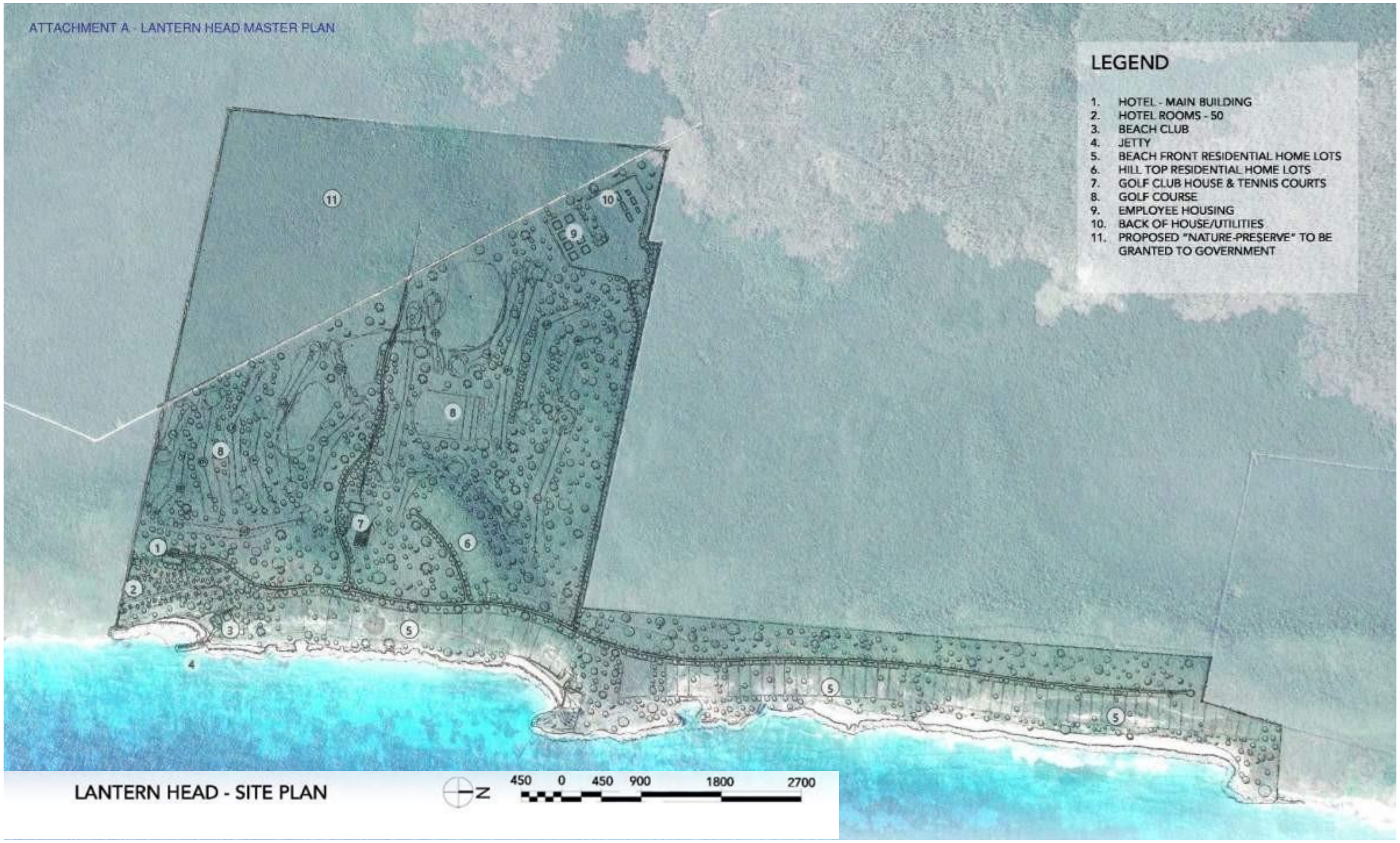
Primary Project Elements	Fill (cu ft)	Fill Acre Feet
Lantern Head	57,431,950	1,318
Airport Improvements	1,857,500	43
South West Point	175,904,795	4,138
Lighthouse Improvements	29,700	1
Total Fill	235,223,945	5,500
Marina (sf)	4,356,000	
Above SL (ft)	30	
Below SL (ft)	25	
	239,580,000	
Cuttings (cu ft)	239,580,000	5,500
Balance (cu ft)	0	0

**Considerations are inclusive of the road improvements for usage of the fill balance from these developments.*

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

5.3 Lantern Head Master Plan

Figure 2. Lantern Head Master Plan



Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

5.4 South West Point Master Plan

Figure 3. South Point Master Plan.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

6 Lantern Head Land Use

The terrestrial areas of the Lantern Head property have no ongoing residential, commercial or industrial operations. Historical uses of the property include residential/living quarters and sisal farming. Infrastructural ruins and naturalized plantings of sisal are remnants of past land uses for the Lantern Head property (Figure 4). The vegetated areas of the interior coppice are utilized as White Crowned Pigeon hunting grounds by local hunters, as evidence by spent shotgun shells and hunting platforms erected in the coppice forest (Figure 5).

Figure 4. Ruins located at Lantern Head

Figure 5. Shotgun shells and debris located along the pathway at lantern Head.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

7 South West Point Land Use

The terrestrial areas of the South West Point property have no ongoing residential, commercial or industrial operations. Broadleaf coppice forests and nearby ephemeral wetlands serve as hunting grounds for local hunters seeking White Crowned Pigeons and Wild Hogs. Spent shotgun shells and litter were observed on the property along Soldier Road, and well-worn trails traverse the forests. Two areas utilized as hunting blinds were observed in the broadleaf coppice south of Soldier Road. Hunting trails and blinds were characteristically littered with spent shells, aluminum cans and plastic debris (Figure 6).

Figure 6. Shotgun shells and aluminum can debris located along pathways at South West Pont.

Off-site and adjacent to the north-west boundary of the South West Point property exists the remnants of the old Alexandria settlement. Historical documentation on the settlement of Alexandria is limited to anecdotal stories of its past use as a pineapple and sisal farm, as well as a receiving area for supplies during construction of the Hole in the Wall Lighthouse. The remnants of old walls, buildings, and rock ovens can be seen scattered throughout the adjacent property. Limited relict infrastructure was observed on the South West Point property in areas along the shared boundary to the old settlement (Figure 7). Old walls were observed along Solider Road and within the coppice interior to the south of the property (Figures 8 – 9).

Figure 7. Yellow shaded area represents the observed extent of historical infrastructure and rock walls at South West Point.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 8. Rock wall infrastructure within the coppice interior at South West Point.

Figure 9. Rock wall infrastructure within the coppice interior at South West Point.

8 Alternatives

8.1 Alternative Plans

Lantern Head Alternative Plans

The property at LH was chosen for its stunning views and high elevations. The original property design included a higher density of development, incorporating the areas of the property west of the Lighthouse Road. To lessen overall footprint of the project, approximately 174.5 acres of intact coppice forest will be preserved and donated to the Bahamas National Trust (BNT) as an addition to the Abaco National Park system. No alternative was considered without the golf course element for the LH development, as this feature is central to the marketability of the development as a luxury residential community.

South West Point Alternative Plans

Considerations were given for alternate locations of the marina based on availability of suitable land parcels in South Abaco. The South West Point property was chosen due to its leeward orientation, proximity to deeper waters and its distance from the Cross Harbour marine protected area to the north of the property. Originally, additional parcels of land were to be included in the overall design of SW Point, with these areas slated for high economic impact residential home lots along the western shoreline of the property. However, terrestrial surveys have confirmed the presence of ruins from the old settlement of Alexandria located on these additional parcels.

As a result, and in spite of the significant financial impact, the Developer determined not to include these additional parcels in the SW Point development in order to avoid any potential disruption to the cultural and historical heritage of these resources.

The SW Point Marina is a critical component to the economic projections for both developments at SW Point and LH. The super yacht marina will not only provide and economic stimulus to South Abaco, but also the Northern Bahamas.

8.2 "No Action" Alternative

The no action alternative for a project describes the scenario where the proposed project is not implemented, and the resulting impacts on the current environment. Most areas of South Abaco are undeveloped, natural areas with healthy and intact terrestrial and marine habitats, supporting a wide diversity of species. The ecosystem services provided by these undisturbed areas would continue to support local recreational and subsistence activities such as fishing, hunting and bird watching.

The proposed development at LH and SW Point aims to maximize the economic benefits of such a project while minimizing environmental impacts where possible. The potential economic benefits for residents of South Abaco and the wider Bahamas would not be realized if the project does not occur. The total investment for the project totals approximately $600 million USD, with direct and indirect employments opportunities. Additionally, offshoots of local entrepreneurial opportunities, potential partnerships with some local non-government organizations and stakeholders, improvements to the Lighthouse and Solider Roads, refurbishment of the Hole in the Wall Lighthouse, creation of beach access and the renovation and upgrading of Sandy Point Airstrip are all beneficial impacts of this project on its surrounding environment. An Economic Impact Assessment carried out by CBRE has indicated the project will have a financial impact of $2 billion injected into the economy over a 10-year period.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

9 Physical and Biological Baseline

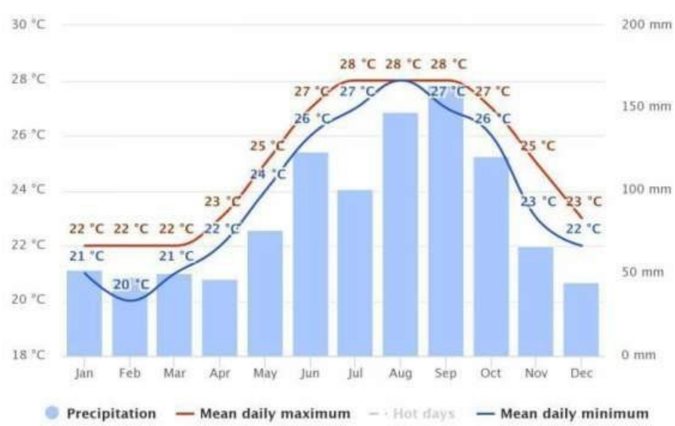
9.1 Climate

Situated in the sub-tropical zone, The Bahamas experiences yearly warm to hot temperatures. Climate varies in The Bahamas due to its latitudinal extent (450 miles from North to South). As a result, temperature variations are notable from the northern islands to the southern islands. Islands in the north such as Abaco are considerably cooler in winter months such as January and February in comparison to the southern islands, which are drier in the summer months. Abaco average daily winter temperature is 68°F and its average daily summer temperature is 90°F. Average rainfall in Abaco consists of 8" of rainfall in the rainy month (June-November) (Figure 10). Average wind direction over Abaco moves easterly with wind speeds of 10-15 knots. South Abaco weather readings for both sites were recorded using a Kestrel Weather Meter (Figures 11 & 12) (Tables 2 & 3).

The climate of The Bahamas is influenced by global wind and ocean currents. Masses of warm and cold air are brought to the islands by global wind currents throughout the year. The Northeast Trade winds originate near the warm areas of the equator over Africa, and blow warm, moist air eastwards towards The Bahamas through most of the year. The Prevailing Westerlies, originating in the nearby North American continent, have more of an influence on the northern islands of The Bahamas. These winds may bring rain and storms originating in the Gulf of Mexico, but mostly bring masses of cold air to the northern islands during the winter months.

The insular nature of the Bahama Islands allows its climate to be influenced by ocean currents. The North Atlantic Gyre represents a synchrony of various ocean currents involved in the global thermo- halocline cycle. The North Equatorial Current flows eastward from the coast of Africa along the equator towards South America. The encounter with South America and the Antilles splits the current into the Gulf Stream and Antillean current, the former passing west of the Caribbean islands into the Gulf of Mexico and the latter passing along the eastern boundary of the Bahama Islands. The Gulf Stream warms considerably in the Gulf of Mexico and flows northward along the east coast of Florida as the Florida Strait towards its final destination in the colder waters off Greenland. The overall effect of these currents produces relatively warm oceans, with average sea surface temperature for The Bahamas ranging between 74°F in February and 85°F in August.

Figure 10. Average temperatures and rainfall in Abaco, The Bahamas.



Source: meteoblue.com

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 2. Lantern Head climate readings.

Lantern Head Climate Readings - February 14, 2019		
Humidity Ratio	g/kg	14.0425
Relative Humidity	%	81.85
Dew Point	Â°C	19.325
Density Altitude	m	334.25
Relative Air Density	%	96.8
Station Pressure	mb	1015.475
Psychro Wet Bulb Temperature	Â°C	20.35
Air Speed	mps	4.95
Temperature	Â°C	22.55
Air Density	kg/m^3	1.186
Evaporation Rate	kg/m^2/h	0.03
Barometric Pressure	mb	1015.45
Wind Chill	Â°C	22.55
Heat Stress Index	Â°C	23.45
Delta-T	Â°C	2.2
Air Flow	m^3/s	0.475

Figure 11. Kestrel recording weather data at Lantern Head site.

Table 3. South West Point Climate Readings.

South West Point Climate Readings - February 16, 2019		
Humidity Ratio	g/kg	14.9975
Relative Humidity	%	75.7
Dew Point	Â°C	20.35
Density Altitude	m	422.5
Relative Air Density	%	95.975

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Station Pressure	mb	1015.45
Psychro Wet Bulb Temperature	Â°C	21.75
Air Speed	mps	3.35
Temperature	Â°C	24.95
Air Density	kg/m^3	1.17575
Evaporation Rate	kg/m^2/h	0
Barometric Pressure	mb	1015.425
Wind Chill	Â°C	24.9
Heat Stress Index	Â°C	26.025
Delta-T	Â°C	3.2
Air Flow	m^3/s	0.325

Figure 12. Kestrel recording weather data at the South West Point site.

**Site specific Metocean data is provided in the attached Coastal Engineering Analysis in AppendixC.*

9.2 Geography

The islands of the Abaco archipelago are the easternmost emergent tops of the shallow water carbonate platform known as the Little Bahama Bank. The Bahama Islands were formed through cycles of sediment deposition and exposure of this platform, coinciding with the Ice Ages and fluctuations of sea level. The main island of Great Abaco, like many other islands along the eastern edges of the Bahama Banks, has a rolling landscape of high ridges and low rock lands, with wetlands occupying areas falling below sea level in the rock lands.

These land features are especially pronounced along the eastern shorelines of South Abaco. In coastal areas devoid of protection from offshore islands, most beaches feature high Holocene sandy dunes interspersed with rocky cliff faces. The rolling landscape continues landward over Pleistocene ridges, some of which reaching up to 100 ft. ASL. These rock ridges run parallel to the coastline and are typically forested by broadleaf coppices and drought/salt tolerant coastal species. The underlying substrate exhibits signs of erosion and weathering typical of the Bahamian karst landscape, including loose boulders, dogtooth limestone, plate rocks, sink holes, banana holes and pit caves. In coastal areas where the rock ridge land

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

meets the sea, flank margin caves and subterranean caverns are typical in this landscape.

The low-lying rock land being the ridges of South Abaco are forested by extensive hectares of the Bahama

Pine, and are typically flat areas with exposed, weathered pitted limestone. Low lying areas in the rocklands form freshwater wetland or marshlands or in some cases blue holes. The figures on the following pages show land features at the project site.

Figure 13.Eroding Holocene dune ridge.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 14. Solution holes in coppice forests of LH ridgeland.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 15. Coastland with sandy dunes and exposed Holocene and Pleistocene rock.

Figure 16. Coastland with sandy dunes and exposed Holocene rock boulders.

Figure 17. Dog toothed limestone along rocky shore at LH.

Figure 18.Eroded Pleistocene cliff at LH.

Figure 19. Rocky shore at LH.

Figure 20.Rocky shore at LH.

Figure 21. Freshwater wetland in rocklands at SW Point.

Figure 22. Tidal wetland in coppice of SW Point.

Marine Geography

The coastal areas of LH and SW Point are both in close proximity to the deep waters of the Northeast Providence Channel, one of the deep subaquatic canyons which make up the submerged 'mountain ranges' of The Bahamas. The Tongue of the Ocean is one of the deepest underwater canyons on the planet, with depths reaching down to 2,000m at its deepest, and the current configuration of islands of The Bahamas represent the exposed tops of this aquatic mountain range. Strong ocean current pas through these underwater canyons, progressively eroding away at the canyon, transporting sediments throughout these valleys. The following figures show the bathymetric map of the site.

Figure 23. Bathymetry map of northeast and northwest providence channel.

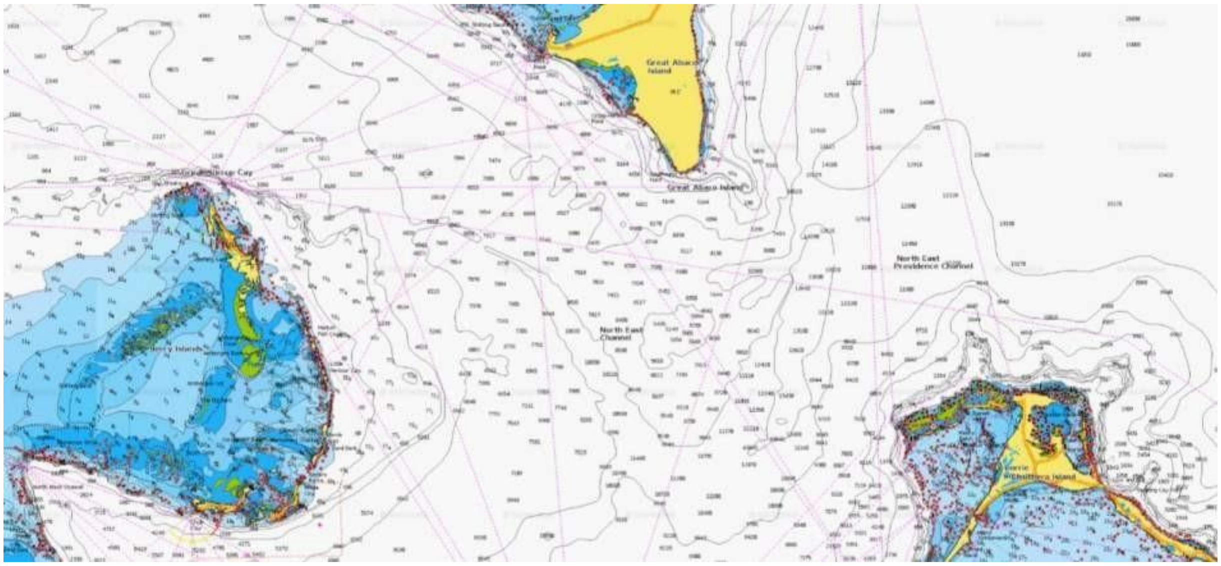


Figure 24. Bathymetry map of South Abaco near SW Point and Hole in the Wall.

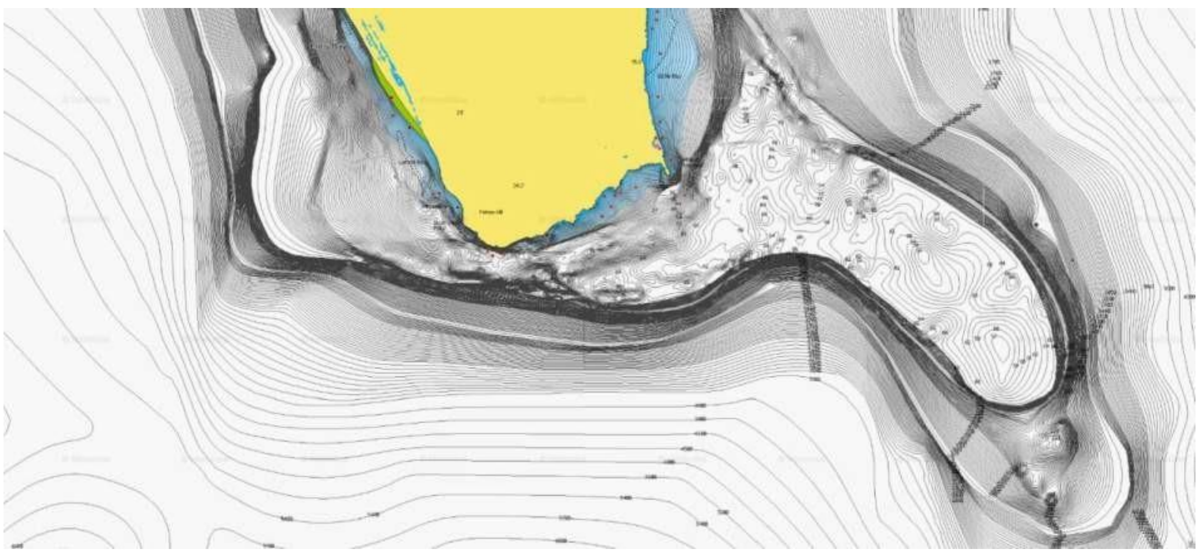


Figure 25. Aerial image of offshore areas near SW Point.

Figure 26. Aerial image of near shore drop-off into the NE Providence Channel by SW Point.

9.3 Coastal Processes

Numerical simulations were carried out on the proposed South West Point Marina development using DHI's MIKE21 FM model. The model was constructed using a combination of collected field data and other

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

available existing data. Model results were compared with EPA guidelines for new marina design that recommend a minimum 90% flushing reduction in the basin within 24 hours.

Several scenarios were modeled in a flushing analysis provided in the South West Point Flushing Analysis. The most likely scenarios (case 3 & 4) discussed in the report considers typical wind conditions in the basin. This scenario showed the basin would meet EPA standards for localized spill, under tidal and wind forcing.

The following considerations were noted:

- If a contaminant is applied over the entire basin (from the surface to the basin floor) then it is unlikely that the concentration of the substance within the basin area will reduce by 90% over a 24-hour period. However, this situation is extremely unlikely to occur and a point-source release of contaminant (such as a fuel spill) is a more likely scenario.

- If a corner of the basin is contaminated, the EPA criteria can be met. Moreover, the results also suggest that the typical regional wind generally improves basin flushing. It is likely that this effect is underestimated in the model and more mixing will occur in prototype as a result of wind induced current shear in the water column.

It should be noted that the model is limited in its application and ability to replicate the true physical mixing and flushing processes. However, the results found during this investigation are conservative in nature. Therefore, the basin will flush more readily than the model demonstrates. This is especially true for the "no wind" cases that were tested since the addition of wind will promote vertical circulation and increase the flushing potential.

Some additional comments relating to the marina are as follows.

- If further flushing is required, a pump system could be installed in the flushing channel to increase its flushing capability. The width of the entrance channel can also be increased to allow more flow into the basin such that the basin would flush better;

- Besides minimizing environmental impacts, the facility layout should consider capacity (including surrounding development and long-term planning), aspects related to dredging (initial, maintenance and disposal, etc.), level of protection offered to vessels and infrastructure, and overall safety.

See South West Point Flushing Analysis Report in Appendix D.

9.4 Hurricanes

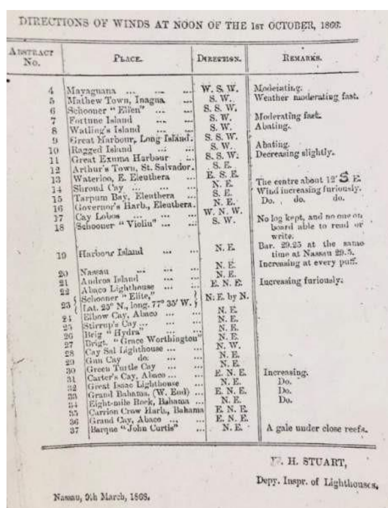
The Bahamas experiences hurricane activity throughout the months of June to November. On average The Bahamas experiences tropical storms and hurricanes every two years. Hurricanes occur due to low pressure systems mixed with the warm waters of the Atlantic Ocean, of which The Bahamas is situated.

The last major hurricane to impact Abaco was Hurricane Dorian in 2019. It made land fall on September 1, 2019 as a category 5 storm with an estimated 185 mph sustained wind speed and storm surge greater than 18 ft. This record storm was stationed over the northern Bahamas for approximately 40 hours[1]. This storm essentially impacted the entire Bahamas as it made its way from the southern-most island of Inagua to the north affecting islands such as Grand Bahama and Abaco.

Abaco is one the three Bahamian islands ranked in the top ten most effected cities, islands and countries in the North American Basin[2] . Records reflect hurricane activity within Abaco in the mid 1800's (Figure 27). There were several destructive hurricanes that affected the island of Abaco from the year 1785 – 2017. A notable storm was the great hurricane of 1926. The Bahamas experienced two hurricanes and one tropical storm during this hurricane season, as it was extremely active. Abaco was majorly affected by the events of this storm, as locals experienced devastation throughout the island due to severe storm surges and intense wind speeds. This great storm destroyed boats, homes and infrastructure in Great Abaco. Its cays experienced immense damages due to intense wave activity. Flood waters averaged above 4'. It was reported that many Abaco residents succumbed to hurricane affects. Recent hurricane activities directly or indirectly affecting Abaco are listed in Table 4.

To help mitigate hurricane impacts due to storm surges and wind speed, the Developer will build in accordance with the Bahamas Building Code and raise the building of the development at least 30 ft above sea level. Further details of building structure and hurricane safety will be outlined in the EMP for this development.

Figure 27. List of hurricane activity in The Bahamas in the 1860's.[3]



DIRECTIONS OF WINDS AT NOON OF THE 1ST OCTOBER, 1866.

Abstract No.	Place.	Direction.	Remarks.
4	Mayaguana	W. S. W.	Moderating.
5	Mathew Town, Inagua ...	S. W.	Weather moderating fast.
6	Schooner "Ellen"	S. S. W.	
7	Fortune Island	S. W.	Moderating fast.
8	Watling's Island	S. W.	Abating.
9	Great Harbour, Long Island.	S. S. W.	
10	Ragged Island	S. W.	Abating.
11	Great Exuma Harbour ...	S. S. W.	Decreasing slightly.
12	Arthur's Town, St. Salvador.	S. E.	
13	Waterloo, E. Eleuthera ...	E. S. E.	The centre about 12' S E.
14	Shroud Cay	N. E.	Wind increasing furiously.
15	Tarpum Bay, Eleuthera ...	S. E.	Do. do. do.
16	Governor's Harb., Eleuthera.	N. E.	
17	Cay Lobos	W. N. W.	No log kept, and no one on board able to read or write.
18	Schooner "Violin"	S. W.	
19	Harbour Island	N. E.	Bar. 29.25 at the same time at Nassau 29.5.
20	Nassau	N. E.	Increasing at every puff.
21	Andros Island	N. E.	Increasing furiously.
22	Abaco Lighthouse	E. N. E.	
23	Schooner "Elite," Lat. 23° N., long. 77° 35' W.	N. E. by N.	
24	Elbow Cay, Abaco	N. E.	
25	Stirrup's Cay	N. E.	
26	Brig "Hydra"	N. E.	
27	Brigt. "Grace Worthington"	N. E.	
28	Cay Sal Lighthouse	N. W.	
29	Gun Cay do.	N. E.	
30	Green Turtle Cay	N. E.	
31	Carter's Cay, Abaco	E. N. E.	Increasing.
32	Great Isaac Lighthouse ...	N. E.	Do.
33	Grand Bahama, (W. End) ...	E. N. E.	Do.
34	Eight-mile Rock, Bahama ...	N. E.	Do.
35	Carrion Crow Harb., Bahama	E. N. E.	
36	Grand Cay, Abaco	E. N. E.	
37	Barque "John Curtis" ...	N. E.	A gale under close reefs.

[illegible]. H. STUART,
Depy. Inspr. of Lighthouses.

Nassau, 9th March, 1866.

---

[1] https://www.weather.gov/ilm/Dorian

[2] Neely, W. (2009). The great Bahamian hurricanes of 1926. P. 98.

[3] Government of The Bahamas. (1866). Report on The Bahamas hurricanes.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 4. Recent Hurricane History of Abaco.

Year	Event	Storm
1995	Erin	1
1996	Bertha	2
1999	Floyd	4
1999	Dennis	2
2004	Francis	2
2004	Jeanne	3
2005	Franklin	Tropical
2005	Katrina	Tropical
2007	Noel	1
2008	Hanna	Tropical
2011	Irene	3
2012	Sandy	2
2016	Matthew	4
2017	Irma	4
2019	**Dorian**	5

9.5 Air and Noise Quality

Air quality and noise levels were not measured as part of this assessment. The remote location of the Lantern Head and South West Point properties and consistent ocean winds result in good air quality at these locations. There are no industrial of commercial operations in proximity to the properties, and land- based sources of emissions are restricted to forest fires, which are part of the natural pineland ecology. Impacts to air quality from pineland fires are more likely at the Lantern Head property, as it borders the southern extent of the pine forests of the Abaco National Park.

Dust storms are known to traverse the Atlantic and settle on the islands of The Bahamas and can temporarily lower air quality in the South Abaco area during the summer months. No consistent sources of noise exist near to the Lantern Head and South West Point properties. Transient noise is created by passing aircraft and boats, however the natural sounds of the coastal waves, ocean winds, and terrestrial fauna dominate soundscape of the area.

9.6 Botanical Survey

Methodology

Botanical surveys were conducted at Lantern Head, South West Point, The Sandy Point Airstrip and along the entrance road to determine vegetation types, structure and diversity. Walking relevé surveys were conducted to generate comprehensive botanical lists for the sites and to delineate terrestrial habitat and

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

their transition zones. Plots were established at random points throughout the Lantern Head and South West Point sites to determine dominant species for vegetation types via measures of abundance calculated using DBH (in cm), frequency and cover class. Botanical ID's were assigned to specific epithet where possible in the field, and desktop studies conducted to confirm flora identity using The Flora of the Bahama Archipelago (1979) and The Catalogue of Seed Plants of the West Indies (2012) (Tables 5 & 6). Updated nomenclature was assigned according to the most recent APGIV (2016) publication. Classifications of vegetation types were assigned according to the International Classification of Ecological Communities' Guide to Caribbean Vegetation Types (Areces-Mallea et al., 1999)[4].

Table 5. Lantern Head Botanical Species List.

Family	Genus	Species	Common Name	Habitat[5]
Asteraceae	*Ambrosia*	*hispida*	Bay Geranium	SD/CS
Myrtaceae	*Amyris*	*elemifera*	White Torch	CP/CC
Rubiaceae	*Antirhea*	*myrtifolia*		PW
Primulaceae	*Ardisia*	*escallanioides*	Marlberry	PW/CP
Asteraceae	*Borrichia*	*arborescens*	Sea Ox Eye Daisy	CS/SD
Boraginaceae	*Bourreria*	*succulenta*	Strong Back	CP
Burseraceae	*Bursera*	*simaruba*	Gum Elemi	CP/CC
Malphigiceae	*Byrsonima*	*lucida*	Locust Berry	PW
Fabaceae	*Caesalpinia*	*bonduc*	Nicker bean	PW/CS
Fabaceae	*Caesalpinia*	*bahamensis*	Bahama Brasiletto	PW/CP
Boraginaceae	*Cakile*	*lanceolata*	Sea Rocket	SD
Fabaceae	*Canavalia*	*rosea*	Beach Pea	CS
Canellaceae	*Canella*	*winteriiana*	Cinnamon Bark	CP
Rubiaceae	*Casasia*	*clusiifolia*	Seven Year Apple	CS
Fabaceae	*Cassia*	*lucayanum*		PW
Lauraceae	*Cassytha*	*filiformis*	Love Vine	PW/CP/CC/CS
Casuarinaceae	*Casuarina*	*equisetifolia*	Australian Pine	SD
Orchidaceae	*Cattleyopsis*	*lindenii*		PW
Rubiaceae	*Chiococca*	*parviflora*	Pineland Snowberry	PW
Asteraceae	*Chromoleana*	*lucayana*		SD/CS
Polygonaceae	*Coccoloba*	*tenuifolia*	Bahama Pigeon Plum	PW/CC/CP/CS

[4] Acevedo-Rodríguez, P., & Strong, M. T. (2007). Flora of the West Indies. *National Museum of Natural History, The Smithsonian Institution, Washington, DC. Published in the Internet: http://persoon. si. edu/antilles/westindies/index. htm*.
[5] CP – Broadleaf Coppice; PW – Pine Woodland; SD -Sandy/Dune Community; CS-Coastal Shrubland; CC-Coastal Coppice; red-invasive; yellow – protected; green - endemic

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Polygonaceae	*Coccoloba*	*sp.*		PW
Polygonaceae	*Coccoloba*	*uvifera*	Sea Grape	CS
Arecaceae	*Coccothrinax*	*argentata*	Silver Thatch Palm	PW/CC/CS
Combretaceae	*Conocarpus*	*erectus*	Buttonwood	CS/SD
Cyperaceae	*Dicromena*	*floridanum*		PW
Euphorbiaceae	*Drypetes*	*laterifolia*	Guiana Plum	PW/CP/CC/CS
Orchidaceae	*Encyclia*	*altissima*		PW/CP
Orchidaceae	*Encyclia*	*fehlingii*		PW/CP
Rubiaceae	*Erithalis*	*fruticosa*	Black Torch	PW/CC/CS/CP
Rubiaceae	*Ernodea*	*littoralis*	Golden Creeper	PW/CP
Erythroxylacea	*Erythroxylum*	*rotundifolium*	Rat Wood	PW/CP
Myrtaceae	*Eugenia*	*axillaris*	Stopper	CS
Euphorbiaceae	*Euphorbia*	*mesembrianthemif*	Coast Spurge	CS/SD
Asteraceae	*Gochnatia*	*ilicifolia*	Candle Wood	CP
Nyctaginaceae	*Guapira*	*obtusata*	Broad Leaf Blolly	PW/CP/CS
Nyctaginaceae	*Guapira*	*discolor*	Narrow Leaf Blolly	CC/CS/CP
Asteraceae	*Gundlachia*	*corymbosa*	Horse bush	CS
Euphorbiaceae	*Hippomane*	*mancinella*	Manchineel	CS
Liliaceae	*Hymenocallis*	*arenicola*	Spider Lily	CS/SD
Sapindaceae	*Hypelate*	*trifoliata*	White Iron Wood	PW/CP
Convolvulacea	*Ipomoea*	*pes-capraea*	Railroad Vine	SD
Convolvulacea	*Ipomoea*	*violaceae*	Moon Vine	CS
Convolvulacea	*Jacquemontia*	*havanensis*		PW/CC
Primulaceae	*Jacquinia*	*keyensis*	Joewood	PW/CS
Crasslusaceae	*Juniperus*	*barbadensis*	White Cedar	PW
Verbenaceae	*Lantana*	*involucrata*	White Sage	PW/CC/CS
Anacardiaceae	*Metopium*	*toxiferum*	Poison Wood	PW/CP/CC/CS
Cactaceae	*Opuntia*	*stricta*		SD
Passifloraceae	*Passiflora*	*bahamensis*		PW
Passifloraceae	*Passiflora*	*cupraea*	Devil's Pumpkin	CP
Apocynaceae	*Pentalinon*	*luteum*	Wild Allamanda	CS
Cactaceae	*Pilocereus*	*polygonus*	Millspaugh's Dildo	CC/CS
Pinaceae	*Pinus*	*caribeaum*	Abaco Pine	PW/CP
Myrtaceae	*Psidium*	*longipes*	Wild Guava	PW/CP
Rubiaceae	*Psychotria*	*nervosa*	Wild Coffee	CP
Rubiaceae	*Rachicallis*	*americana*	Sand Fly Bush	CS
Rhamnaceae	*Reynosia*	*septentrionali*	Darling Plum	PW/CC/CP
Arecaceae	*Sabal*	*palmetto*	Sabal Palm	SD
Asteraceae	*Salmea*	*petrobioides*	Shanks	SD/CS

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Euphorbiaceae	*Savia*	*bahamensis*	Maiden Bush	PW/CP
Goodeniaceae	*Scaevola*	*taccada*	Hawaiian Lettuce	SD
Goodeniaceae	*Scaevola*	*plumieri*	Inkberry	SD
Sapotaceae	*Sideroxylon*	*salicifolium*	Willow Bustic	PW/CP
Sapotaceae	*Sideroxylon*	*americanum*	Wild Saffron	CS/CP
Sapotaceae	*Sideroxylon*	*foetidssimum*	Mastic Tree	CP
Simaroubaceae	*Simarouba*	*glauca*	Paradise Tree	CP
Smilacaceae	*Smilax*	*havanensis*	Razor Vine	PW/CC/CS
Rubiaceae	*Strumpfia*	*maritima*	Mosquito Bush	CS
Surianaceae	*Suriana*	*maritima*	Bay Cedar	CS/SD
Meliaceae	*Swietenia*	*mahagoni*	Caribbean Mahogany	PW/CP
Bignoniaceae	*Tabebuia*	*bahamensis*	Five Finger	PW/CP
Melastomacea	*Tetrazygia*	*bicolor*		PW
Sapindaceae	*Thouinia*	*discolor*	Naked-wood	PW/CP
Bromeliaceae	*Tillandsia*	*fasciculata*		PW/CP
Bromeliaceae	*Tillandsia*	*utriculata*	Wild Big Pine	PW/CP
Boraginaceae	*Tournafortia*	*gnaphalodes*	Bay Lavender	SD
Boraginaceae	*Tournafortia*	*volubilis*	Soldier Vine	CP
Poaceae	*Uniola*	*paniculata*	Sea Oats	SD
Fabaceae	*Vachellia*	*choriophylla*	Cinnecord	PW/CP/CS

Lantern Head Botanical Survey - Mixed *Pinus caribea var. bahamensis – Metopium toxiferum* Forest

Vegetation west of the Lighthouse Road resembles coastal coppice by its structure and assemblage of species however, is far removed from the direct influences of the coastal environment. The transition from pine woodland to broad leaved coppice occurs in this area with the occurrence of solitary individuals of *Pinus caribea var. bahamensis* becoming less and less the further south the habitat is located.

In the areas devoid of Pinus, *Metopium toxiferum* represent the dominant tree species in the canopy, sharing the upper strata of the forest with *Guapira obtusata*, *Swietenia mahagoni*, *Savia bahamensis, Reynosia septentrionalis, Thouinia discolor, Sideroxylon salicifolium, Erithalis fruticosa, Coccothrinax argentata, Jacquinia keyensis, Tabebuia bahamensis, Caesalpinia bonduc, Juniperus barabadensis, Psidium longipes, Tetrazygia bicolor, Hypelate trifoliata, Ardisia escallanoides, Coccoloba tenuifolia, Drypetes laterfifolia* and *Vachellia choriopyhlla* (Figures 28 & 29).

Understory shrubs in the Mixed *Pinus caribea var. bahamensis – Metopium toxiferum* Forest include *Ernodea littoalis, Cassytha filiformis, Encyclia altissima, Tillandsia fasiculata, Passaflora bahamensis, Smilax havanensis, Byrsonima lucida, Lantana involucrata, Chiococca parviflora, Jacquemontia havanensis* and *Cassia lucayanum*.

Figure 28. Lantern Head botanical density pie chart.

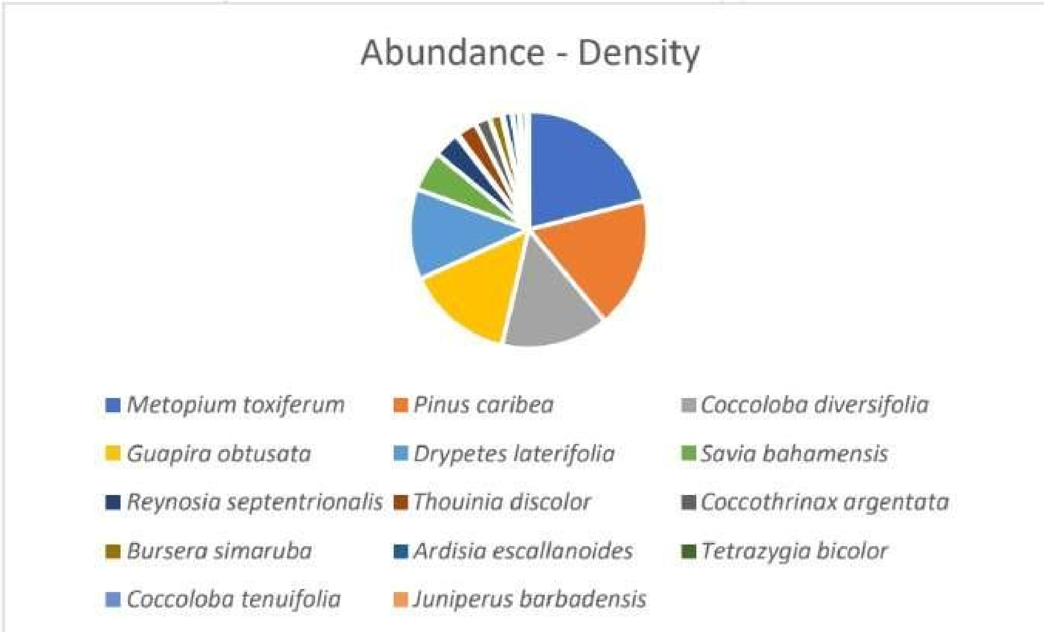
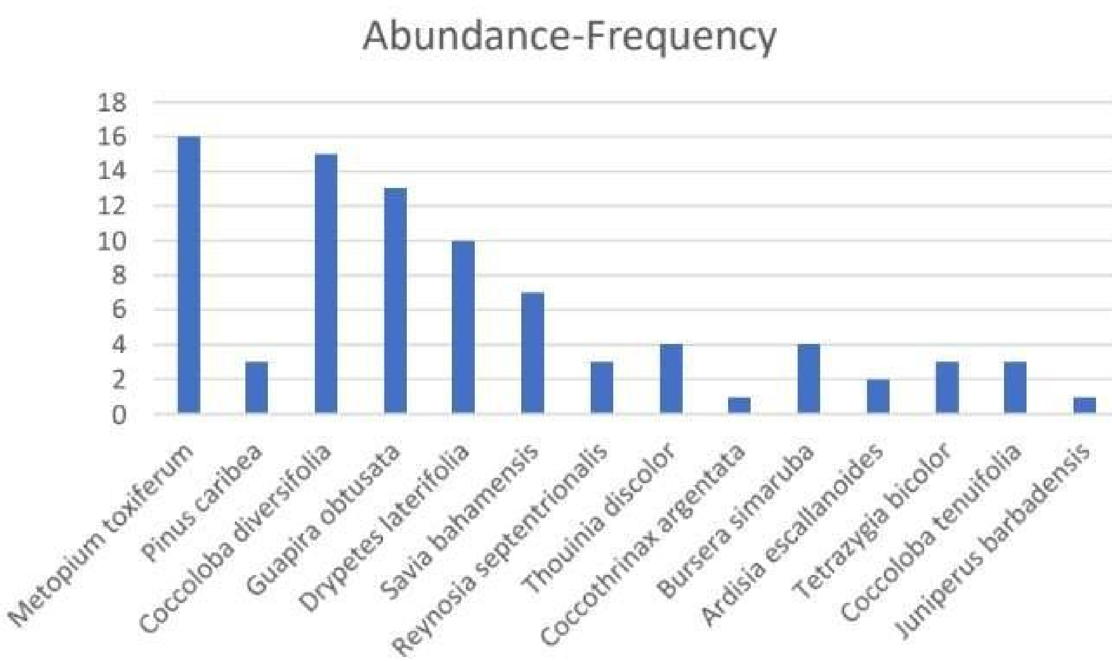


Figure 29. Lantern Head botanical frequency bar chart.



Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 30. Donated coppice vegetation west of Lighthouse Road (highlighted green).

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 31. View from NW corner, south into property.

Figure 32. View from SW corner, east into property.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 33. View from SW corner, north into property.

Figure 34. Metopium toxiferum dominated coppice forest.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 35. Metopium toxiferum dominated coppice forest.

Figure 36. Metopium toxiferum dominated coppice forest.

Figure 37. Juniperus barbadensis

Mixed *Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata* Broadleaf Evergreen Forest The understory of this formation includes *Antirhea mytifolia, Thouinia discolor, Erithalis fruticose, Savia bahamensis, Psidium longipes, Vachellia choriophylla, Jacquinia keyensis, Psychotria nervosa, Encyclia altissima, Encyclia fehlingii, Cattleyopsis lindenii, Tillandsia fasciculata, Tillandsia utriculata, Ernodea littoralis* and *Smilax havanensis*.

Figure 38. Abundance Measure for Mixed Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata Broadleaf Evergreen Forest.

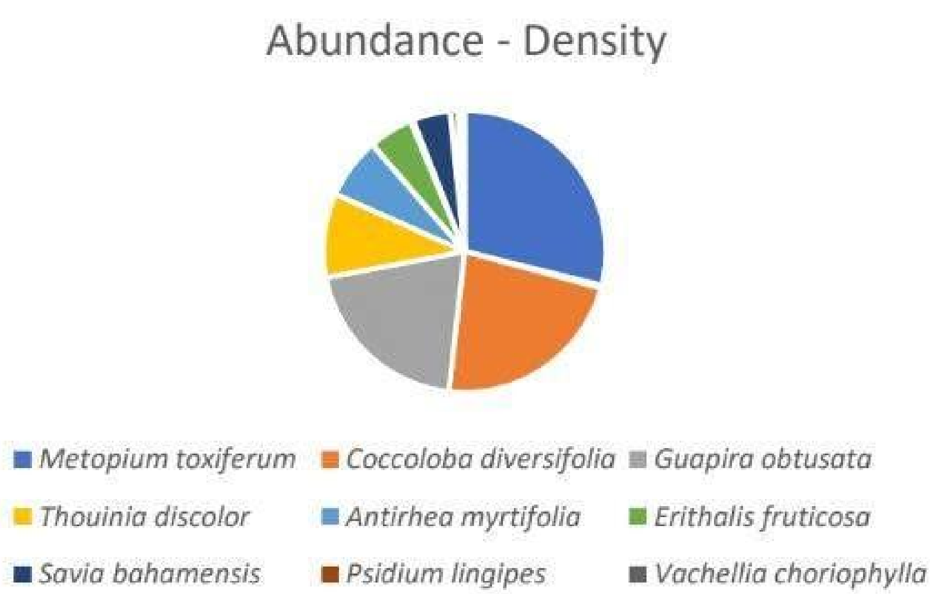


Figure 39. Abundance Measure Mixed Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata Broadleaf Evergreen Forest.

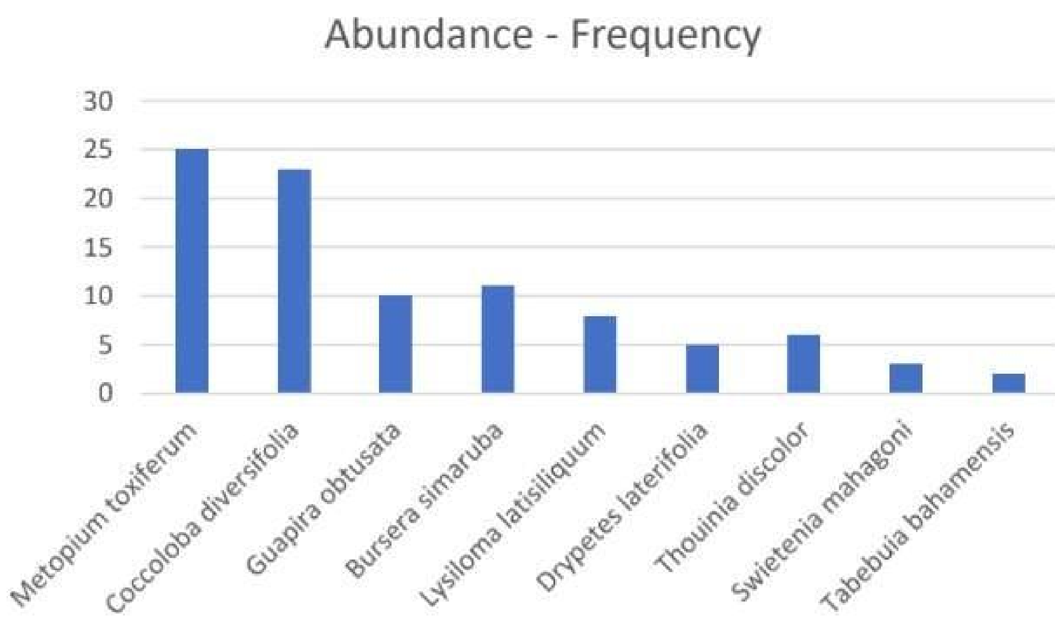


Figure 40. Mixed Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata Broadleaf Forest.

Figure 41. Mixed Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata Broadleaf Forest.

Figure 42. Mixed Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata Broadleaf Forest.

Figure 43. Mixed Metopium toxiferum – Coccoloba diversifolia – Guapira obtusata Broadleaf Forest.

Figure 44. Terrestrial Encyclia rufa and Encyclia altissima orchids in understory.

Figure 45. Leafy substrate on forest floor.

Figure 46. Lantern Head vegetation on property to be developed (yellow).

Stunted *Drypetes laterifolia – Coccoloba diversifolia* Broadleaf Forest

Atop the ridges of Lantern Head, where the ocean winds and salt spray are consistently shaping the landscape, the broadleaf coppice which stood 5-6 meters tall in the lee of the ridge is now stunted vegetation, reaching no higher than 1-2m tall. The vegetation in this formation is mutli- stemmed, with many horizontal branches and uniform crowns. These stunted forests are dominated by Drypetes laterifolia and *Coccoloba diversifolia*, and includes *Metopium toxiferum, Savia bahamensis, Sideroxylon americanum* and *Cassytha filiformis*.

Figure 47. Species abundance measure of Stunted Drypetes laterifolia – Coccoloba diversifolia Broadleaf Forest.

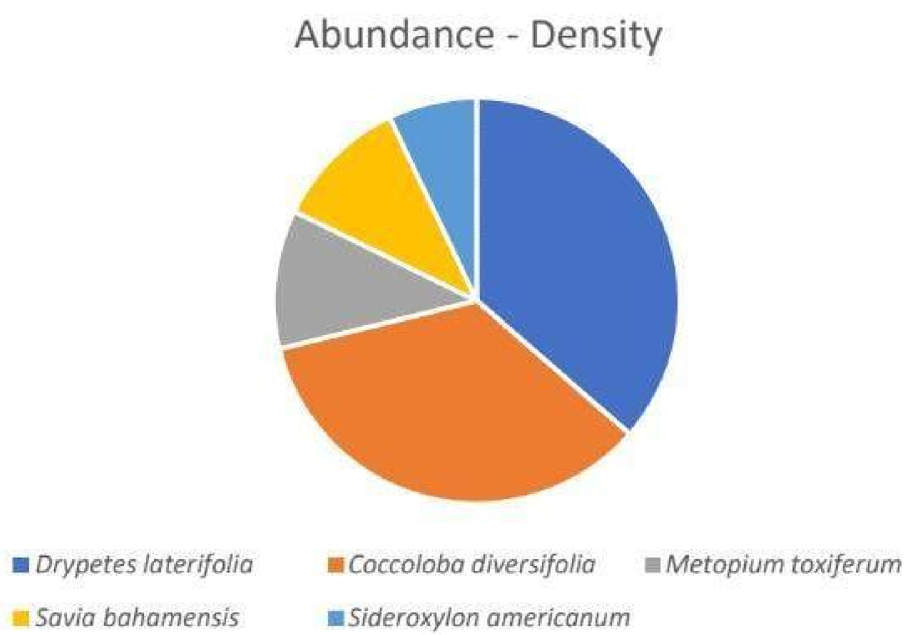


Figure 48. Stunted Drypetes laterifolia – Coccoloba diversifolia Broadlead Forest.

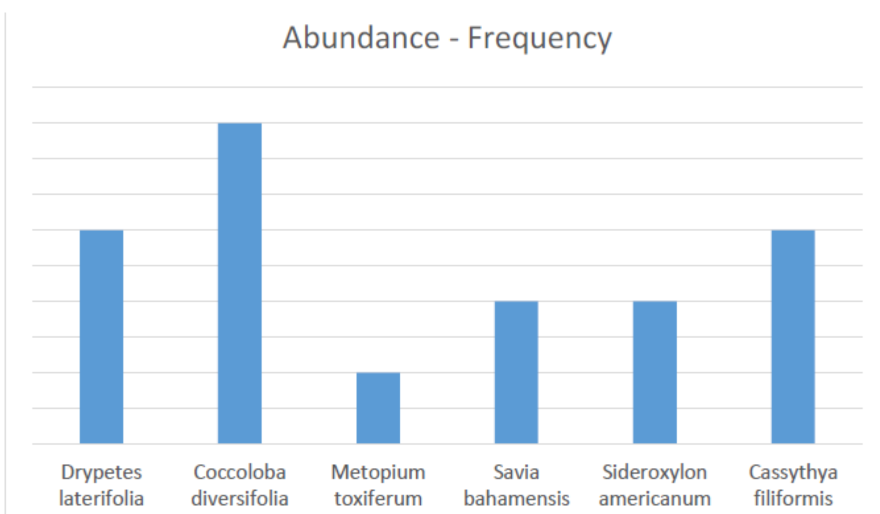


Figure 49. Stunted Drypetes laterifolia – Coccoloba diversifolia Broadleaf Forest.

Figure 50. Stunted Drypetes laterifolia – Coccoloba diversifolia Broadleaf Forest.

Figure 51. Stunted Drypetes laterifolia – Coccoloba diversifolia Broadleaf Forest.

Interior *Coccoloba diversifolia – Bursera simaruba* Broadleaf Forest

Established in the lee of the high ridges on the Lantern Head property is healthy, well intact interior broadleaf coppice forest. Removed from the direct influence of ocean forces, the vegetation in these forests can reach up to 5-6m, forming a closed canopy with shady understories. The leaf litter is thick in these habitats, collecting in the pitted landscape created by emergent karst limestone formations, boulders and rocks. Pit caves are common throughout this habitat, with depth averaging 2-3m in the low Rocklands, and depths observed up to 4-5m in the higher elevations up on the ridges of the property.

Dominant in these interior broadleaf forests are *Coccoloba diversifolia*, *Bursera simaruba* and *Metopium toxiferum* forming most of the canopy, with other species such as *Hypelate trifoliata, Sideroxylon foedtidissimum, Swietenia mahagoni, Simarouba glauca, Thouinia discolor, Canella winteriiana, Tabebuia bahamensis, Erithalis fruticosa, Guapira discolor, Bourreria succulenta, Sideroxylon americanum, Vachellia choriophylla, Reynosia septentrionalis* and *Passiflora cupraea*.

Figure 52. Species abundance measure of Interior Coccoloba diversifolia – Bursera simaruba Broadleaf Forest.

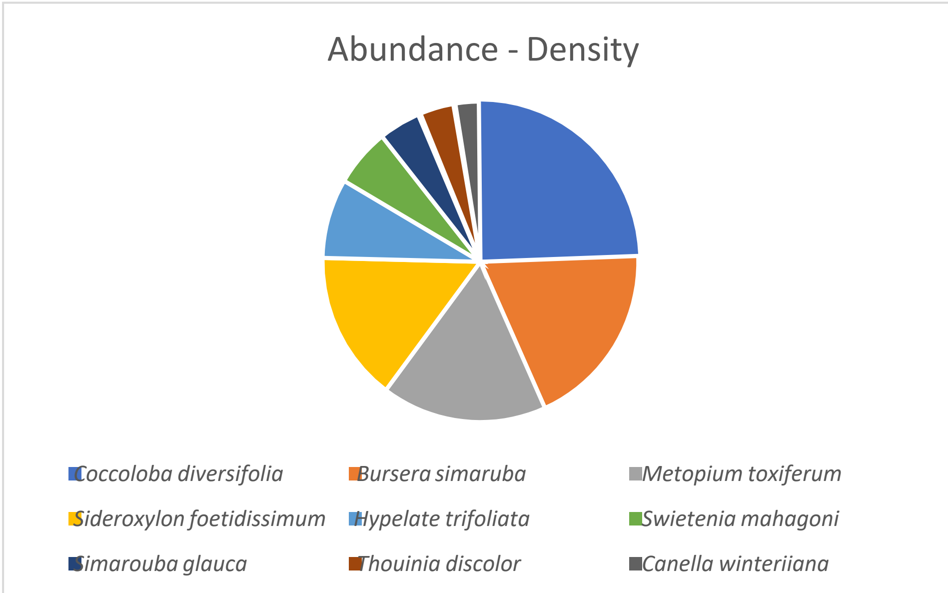


Figure 53. Species frequency measure for the Interior Coccoloba diversifolia – Bursera simaruba Broadleaf Forest.

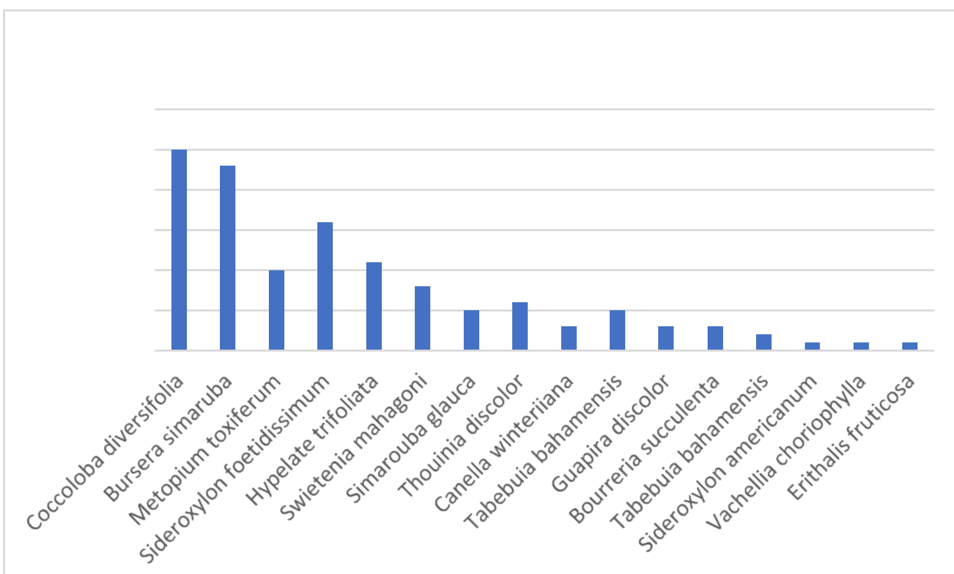


Figure 54. Interior Coccoloba diversifolia – Bursera simaruba Broadleaf Forest.

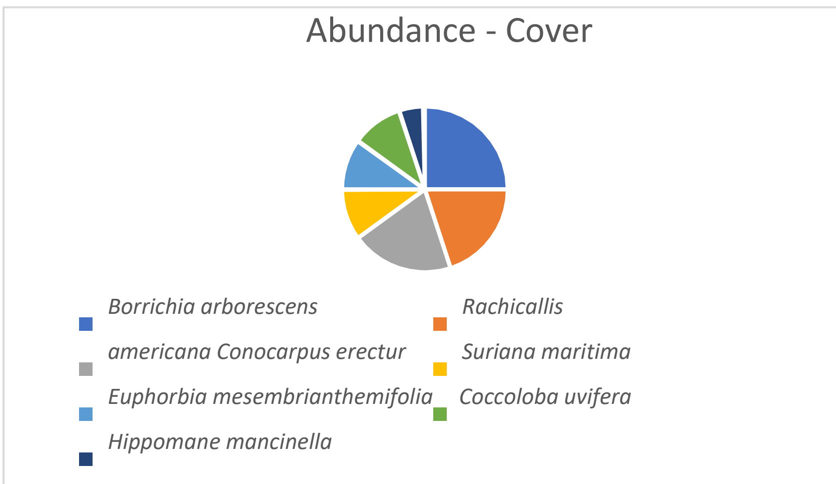
Figure 55. Interior Coccoloba diversifolia – Bursera simaruba Broadleaf Forest.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Borrichia arborescens – Rachicallis Americana – Conocarpus erectus Dwarf Coastal Shrubland

Along the windward face of the high ridges on Lantern Head, as the habitat transitions closer to the cliff face, the vegetation becomes more stunted as the ocean's influence on plant structure becomes more evident. In these areas, pitted limestone rock is exposed among sandy substrate, with the stunted vegetation clambering across the landscape. The plants in this habitat are salt and drought tolerant, semi- succulent species. Dominant in these areas are *Borrichia arborescens*, Rachicallis Americana, and *Conocaprus erectus*, with Suriana maritima, *Euphorbia mesembrianthemifolia*, *Coccoloba uvifera*, *Hippomane mancinella* and *Hymenocallis arenicola*. Sporadic individuals of the cactus *Pilocerues polygonus* occur throughout this coastal landscape.

Figure 56. Species cover estimates for the Borrichia arborescens – Rachicallis Americana – Conocarpus erectus Dwarf Coastal Shrubland.



Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 57. Frequency measure for the Borrichia arborescens – Rachicallis Americana – Conocarpus erectus Dwarf Coastal Shrubland.

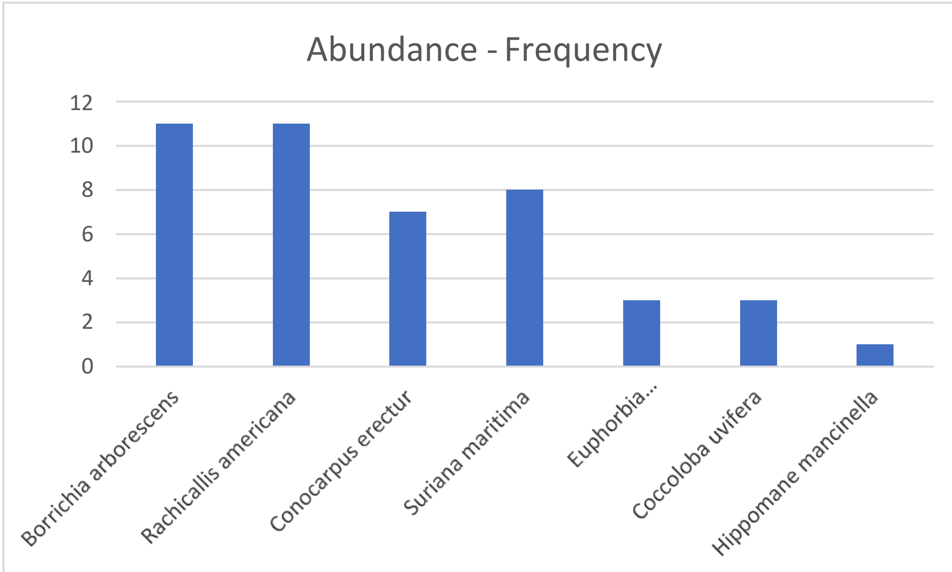


Figure 58. Borrichia arborescens – Rachicallis Americana – Conocarpus erectus Dwarf Coastal Shrubland.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 59. Borrichia arborescens – Rachicallis Americana – Conocarpus erectus Dwarf Coastal Shrubland.

Figure 60. Borrichia arborescens – Rachicallis Americana – Conocarpus erectus Dwarf Coastal Shrubland.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 61. Coastal shrublands at LH.

Figure 62. Zamia sp. in coastal shrubland at LH.

Figure 63. Cliff vegetation at LH.

Sandy/Dune Community*: Scaevola taccada-Tournefortia gnaphalodes* intertidal coastal shrubland

Within the intertidal sandy habitat along the Lantern Head eastern shoreline are populations of the invasive *Scaevola taccada* and *Tournefortia gnaphalodes* established within the splash zone. These areas are subject to direct inundation and splashing from sea water and help to stabilize the shifting sands in this dynamic environment. It is common for small, non-woody species to have established themselves in close proximity to the salt tolerant shrubs, as the stable sands allow colonization of this harsh environment. Other species growing in this habitat include *Suriana maritima, Uniola paniculata, Cakile lanceolata*, *Sesuvium portulacastrum* and *Ipomoea pes-caprae.*

Figure 64. Sandy/Dune Community: Scaevola taccada-Tournefortia gnaphalodes intertidal coastal shrubland.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

<u>*Uniola paniculata – Hymenocallis arenicola Association*</u>

Above the high-water mark, the drier areas of the sandy dune community are comprised of an extensive coastal grassland dominated by *Uniola paniculata* and *Hymenocallis arenicola*. The grassland is a densely vegetated, with plant heights reaching 1m. Growing within the thick Sea Oats grassland are *Hyemnocallis arenicola, Optunia stricta, Borrichia arborescencs, Scaevola plumieri, Suriana maritima, Salmea petrobioides, Ambrosia hispida, Chromolaena lucayanum, Ipomoea pes caprae* and *Casasia clusiifolia*.

Figure 65. Uniola paniculata – Hymenocallis arenicola Association.

<u>Coastal Shrubland – transition from coastal shrubland to stunted broadleaf coppice forest.</u>

Gundlachia corymbosa, Eugenia axillaris, Erithalis fruticosa, Sideroxylon americana, Cassytha filiformis, Lantana involucrate, Drypetes laterifolia, Coccoloba uvifera, Salmea petrobioides, Metopium toxiferum, Jacquinia keyensis, Smilax havanensis, Coccothrinax argentata and *Guapira obtusata*

Figure 66. Coastal shrubland at LH.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 67. Coastal Shrubland at LH.

Coastal Ridgeland vegetation

Stunted coastal shrubland established on rocky ridge less than 200m from shore. Ridgeland habitat is continuous and parallel to coastline. Dominated by *Coccoloba diversifolia* and *Drypetes laterifolia*, also included on this rocky habitat is *Coccothrinax argentata, Pilocereus polygonus, Conocarpus erectus, Ambrosia hispida, Chromolaena lucayanum* and *Hymenocallis arenicola*.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 68. Coastal Ridgeland vegetation at LH.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 69. Coastal ridgeland vegetation at LH.

Figure 70.Agave sisiliana growing in coastal shrubland at LH.

South West Point

Table 6. South West Point Botanical Species List.

Family	Genus	Species	Common Name	Habitat
Agavaceae	*Agave*	*sisiliana*	Sisal	CS
Asteraceae	*Ambrosia*	*hispida*	Bay Geranium	RS
Myrtaceae	*Amyris*	*elemifera*	White Torch	CP
Primulaceae	*Ardisia*	*escallanioides*	Marlberry	CP
Euphorbiaceae	*Ateramnus*	*lucidus*	Crabwood	CP
Asteraceae	*Borrichia*	*arborescens*	Sea Ox Eye Daisy	CS
Boraginaceae	*Bourreria*	*succulenta*	Strong Back	CP
Burseraceae	*Bursera*	*simaruba*	Gum Elemi	CP/CC/CS
Canellaceae	*Canella*	*winteriiana*	Cinnamon Bark	CS/CP
Orchidaceae	*Cattleyopsis*	*lindenii*		CP
Rubiaceae	*Chiococca*	*alba*	Snowberry	CP
Asteraceae	*Chromoleana*	*lucayana*		RS
Vitacaea	*Cissus*	*tuberculata*	Warty Cissus	RS
Polygonaceae	*Coccoloba*	*diversifolia*	Pigeon Plum	CP/CC/CS
Polygonaceae	*Coccoloba*	*uvifera*	Sea Grape	CS
Combretaceae	*Conocarpus*	*erectus*	Buttonwood	CS
Poaceae	*Eragrostis*	*elliotii*		CS
Rubiaceae	*Erithalis*	*fruticosa*	Black Torch	RS
Erythoxylaceae	*Erythroxylum*	*rotundifolium*	Rat Wood	CP
Myrtaceae	*Eugenia*	*foetida*	Stopper	CP/CS
Myrtaceae	*Eugenia*	*axillaris*	Stopper	CS/CP
Euphorbiaceae	*Euphorbia*	*mesembrianthemifolium*	Coast Spurge	CS/RS
Moraceae	*Ficus*	*citrifolia*	Wild Fig	CS
Cyperaceae	*Fimbristylis*	*cymosa*	Hurricane Grass	CS
Nyctaginaceae	*Guapira*	*discolor*	Narrow Leaf Blolly	CC/CS
Euphorbiaceae	*Hippomane*	*mancinella*	Manchineel	CP
Poaceae	*Lasciasus*	*divaricata*		CP
Fabaceae	*Leuceana*	*leucocephala*	Jumbey	CP/CS
Anacardiaceae	*Metopium*	*toxiferum*	Poison Wood	CS/CC
Myrtaceae	*Myrcianthes*	*fragrans*	Naked Wood	CP
Lauraceae	*Ocotea*	*coriacea*	Lancewood	CP
Cactaceae	*Opuntia*	*stricta*		CS

Apocynaceae	*Pentalinon*	*luteum*	Wild Allamanda	RS
Rubiaceae	*Phialanthus*	*myrtilloides*	Candlewood	CP
Simaroubaceae	*Picramnia*	*pentandra*	Snake Root	CP
Cactaceae	*Pilocereus*	*polygonus*	Millspaugh's Dildo	RS
Myrtaceae	*Psidium*	*longipes*	Wild Guava	CP

Rubiaceae	*Rachicallis*	*americana*	Sand Fly Bush	RS
Asteraceae	*Salmea*	*petrobioides*	Shanks	CS
Goodeniaceae	*Scaevola*	*taccada*	Hawaiian Lettuce	CS
Sapotaceae	*Sideroxylon*	*foetidssimum*	Mastic Tree	CP
Smilacaceae	*Smilax*	*havanensis*	Razor Vine	RS
Fabaceae	*Sophora*	*tomentosa*	Sea Pod Necklace	CS
Surianaceae	*Suriana*	*maritima*	Bay Cedar	CS
Boraginaceae	*Tournafortia*	*gnaphalodes*	Bay Lavendar	CS
Fabaceae	*Vachellia*	*choriophylla*	Cinnecord	CP
Rutaceae	*Zanthoxylum*	*fagara*	Wild Lime	CP
Rutaceae	*Zanthoxylum*	*flavum*	Yellow Wood	CP
Euphorbiaceae	*Drypetes*	*laterifolia*	Guiana Plum	CP
Euphorbiaceae	*Savia*	*bahamensis*	Maiden Bush	CP
Bromeliaceae	*Tillandsia*	*fasciculata*		
Euphorbiaceae	*Croton*	*eluteria*	Cascarilla	CP
Sapindaceae	*Thouinia*	*discolor*	Naked-wood	CP
Orchidaceae	*Encyclia*	*altissima*		CP
Meliaceae	*Swietenia*	*mahagoni*	Caribbean Mahogany	CP
Bromeliaceae	*Tillandsia*	*utriculata*	Wild Big Pine	CP
Primulaceae	*Jacquinia*	*keyensis*	Joewood	CS
Fabaceae	*Caesalpinia*	*bonduc*	Nicker bean	
Fabaceae	*Pithecellobium*	*keyense*	Ram's Horn	CP
Rhamnaceae	*Krugiodendron*	*ferreum*	Iron Wood	CP
Celastraceae	*Maytenus*	*buxifolia*	Box Leaved Maytenus	CP
Rubiaceae	*Randia*	*aculeata*	Boxwood	CP
Combretaceae	*Bucida*	*buceras*	Black Olive	CP

The western shoreline at South West Point is an area devoid of sandy dunes, but instead its dunes are comprised of flat, plate like rock rubble, mounded into dunes by wave action parallel to the coastline. It is behind these rocky runes that sandy substrate settles, favoring

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

establishment of hardy, salt tolerant coastal species within 10-20m of the shoreline. This vegetation is a coastal scrubland which transitions to a taller shrubland once further removed from the coastline.

The immediate colonizers of the rock dunes include *Tournefortia gnaphalodes* and *Coccolona uvifera,* with the diversity of species expanding in the sandier substrate to include *Conocarpus erectus, Opuntia stricta, Ficus citrifolia, Coccoloba divsersifolia, Agave sisiliana, Leuceana leucocephala, Suriana maritima, Borrichia arborescens, Eugenia axillaris, Eugenia foetida, Scaevola taccada, Euphorbia memebrianthemifolia* and *Metopium toxiferum*.

Figure 71. Rocky dunes at SW Point.

Figure 72. Rocky dunes at SW Point.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 73.Rocky dunes at SW.

Figure 74. Coastal shrubland at SW.

<u>Rocky Shore Habitat- *Rachicallis americana xeric* shrubland</u>

This open, exposed ironshore limestone sits approximately 2m ASL and is within 10m of the shoreline. This habitat is devoid of any significant substrate, with small amount of sand accumulating in pockets of the rock. The hardy *Rachicallis americana* dominates this habitat as the only plant species.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 75. Rachicallis americana xeric shrubland.

<u>*Tournefortia gnaphalodes-Borrichia arboerscens-Ambrosia hispida* coastal shrubland</u>

Some areas being the rocky shore habitat have accumulated wide areas of sandy substrate, creating a flat habitat which is periodically inundated by sea water during rough weather. The three species, Tournefortia gnaphalodes, Borrichia arborescens and Ambrosia hispida dominate this habitat, creating a silver mosaic amongst the succulent foliage. Also colonizing this habitat are *Rachicallis americana, Euphorbia mesembrianthemifolia, Cissus tuberculatus, Chromolaena lucayanum, Pentalinon luteum, Pilocerous polygonous, Smilax havanenis* and *Erithalis fruticosa*.

This type of coastal shrubland exists in pockets along the western and southern shores of the property at SW Point.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 76. Tournefortia gnaphalodes-Borrichia arboerscens-Ambrosia hispida coastal shrubland.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 77. Tournefortia gnaphalodes-Borrichia arboerscens-Ambrosia hispida coastal shrubland.

Interior Broadleaf Coppice Forest- *Bursera simaruba-Coccoloba diversifolia-Metopium toxiferum Broadleaf Evergreen Forest*

The forests to the interior of the SW Point property are a mature broadleaf coppice, with canopies ranging from 3-8 meters throughout the habitat. The substrate is a thick layer of dark humus overlaid by leaf litter. Exposed limestone rocks and boulders were evident in most areas, with other karst limestone formations obscured by leaf litter. Concave and fissure like depressions were common in this habitat, with one fissure like depression connecting to an interior tidal wetland located in the midst of the coppice forest, 300m from the shoreline.

Large *Bursera simaruba*, *Metopium toxiferum* and *Coccoloba diversifolia* dominated the canopy in this habitat, also including *Ficus citrifolia, Ardisia escallandoides, Eugenia axilaris, Amyris elemifera, Guapira discolor, Phialanthus myrtylloides, Smilax havanensis, Sideroxylon foetidissimum, Psychotria nervosa, Swietenia mahagoni, Jacquinia keyensis, Ocotea coriacea, Bourreria succulenta, Myrcianthes fragrans, Krugiodendron ferreum* and *Erythroxylum rotundifolium.*

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 78. Bursera simaruba-Coccoloba diversifolia-Metopium toxiferum Broadleaf Evergreen Forest.

Figure 79. Bursera simaruba-Coccoloba diversifolia-Metopium toxiferum Broadleaf Evergreen Forest.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 80. Bursera simaruba-Coccoloba diversifolia-Metopium toxiferum Broadleaf Evergreen Forest.

Figure 81.Bursera simaruba-Coccoloba diversifolia-Metopium toxiferum Broadleaf Evergreen Forest.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 82. Large Bursera simaruba (left) and Metopium toxiferum (right) in broadleaf forest at SW Point.

Figure 83. Large Swietenia mahagoni (left) and Sideroxylon foetidissimum (right) in broadleaf forest at SW Point.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 84. Large Pilocerous polygonous in broadleaf coppice at SW Point.

As the interior broadleaf coppice habitat transitions closer to the coastal areas, the vegetation become stunted and shrubby, forming dense communities almost impossible to pass. These multibranched interlocking individuals are shaped by the wind and slat from the ocean's forces. This coppice shrubland is a mixed assemblage of species, including *Coccoloba diversifolia, Eugenia axillaris, Coccoloba uvifera, Erithalis fruticosa, Maytenus buxifolia, Ficus aurea, Bursera simaruba, Phialanthus myrtlloides, Maytenus phyllanthoides, Lantana involucrate, Smilax havanensis, Amyris elemifera* and *Ardisia escallanoides.*

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 85.Stunted coastal coppice at SW.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 86. Stunted Coastal coppice at SW.

Figure 87. Pedialanthus bahamensis in coastal shrubland at SW Point.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Interior Tidal Wetland

Located approximately 300m from shore in the midst of the interior coppice forest is a tidal wetland with healthy population of aquatic algae colonizing the subaquatic environments, and healthy coppice along its edges. The wetland is connected to a fissure-like crack underlying the thick leaf litter to the east and west of this wetland feature. Observations were made at low tide, with the saturated height tide line evident along the rocky margins of the wetland. The long filamentous algae in the wetland were trailing to the west, as is drawn in that direction during the low tide outflow of water towards the coastline. The exposed muck contains marine gastropods and showed signs of heavy traffic by wild hogs. Scarlett dragonflies were observed skimming the wetland, with Thick Billed Vireos foraging in the vegetation around the wetland, and a Louisiana Water thrush observed foraging along the ponds edge in the mucky substrate.

The aquatic plants growing within the wetland are *Ruppia maritima*, a salt tolerant wetland species, and *Neomeris annulata* and *Cladophora sp*., both macro algae species.

On the fringes of the wetland were coppice forest species including *Pithecellobium keyense, Acacia choriophylla, Swietenia mahagoni, Metopium toxiferum, Jacquinia keyensis, Coccoloba diversifolia, Guapira discolor* and *Pilocerus polygonus*.

Figure 88. Tidal wetland in broadleaf forest at SW Point.

Figure 89. Satellite image depicting location of tidal wetland at SW Point.

Figure 90. Tidal wetland in broadleaf forest at SW Point.

Figure 91. Tidal wetland, at low tide, in broadleaf forest at SW Point.

Figure 92. Tidal wetland, at low tide, in broadleaf forest at SW Point.

Figure 93. Subterranean fissures at western end of tidal wetland in broadleaf forests at SW Point.

Figure 94. Evidence of tidal fluctuations in wetland at SW Point.

Figure 95. Macro algae Cladophora sp.

Figure 96. Ruppia maritima in aquatic environment of tidal wetland at SW Point.

Figure 97. Neomeris annulata and Ruppia maritima in aquatic environment of tidal wetland at SW Point.

Table 7. Sandy Point Airstrip Species List.

Family	Genus	Species	Common Name	Habitat
Pinaceae	*Pinus*	*caribeaum*	Abaco Pine	PW
Arecaceae	*Coccothrinax*	*argentata*	Silver Thatch Palm	PW
Rubiaceae	*Ernodea*	*littoralis*	Golden Creeper	PW
Rubiaceae	*Chiococca*	*parviflora*	Pineland Snowberry	PW
Verbenaceae	*Lantana*	*involucrata*	White Sage	PW
Cyperaceae	*Dicromena*	*floridanum*		PW
Malvaceae	*Corchorus*	*hirsutus*	Wooly Bugger	PW
Passifloraceae	*Turnera*	*ulmifolia*	Bahama Buttercup	PW
Boragincaeae	*Cordia*	*bahamensis*	Cat's Tongue	PW
Malvaceae	*Waltheria*	*bahamensis*	Bahama Waltheria	PW/GL
Asteraceae	*Gundlachia*	*corymbosa*	Horse bush	PW
Burseraceae	*Bursera*	*simaruba*	Gum Elemi	PW
Cannabacaeae	*Trema*	*lamarckianum*	Pain in back	PW
Polygonaceae	*Coccoloba*	*uvifera*	Sea Grape	PW
Bignoniaceae	*Tabebuia*	*bahamensis*	Five Finger	PW
Apocynaceae	*Angadenia*	*berteroi*	Pineland Golden Trumpet	PW/GL
Anacardiaceae	*Metopium*	*toxiferum*	Poison Wood	PW
Scrophulariaceae	*Stemodia*	*maritima*	Obeah Bush	PW/GL
Sapindaceae	*Thouinia*	*discolor*	Naked-wood	PW
Dennstaedtiaceae	*Pteridium*	*aquilinum*	Southern Bracken	PW
Fabaceae	*Vachellia*	*choriophylla*	Cinnecord	PW
Sapotaceae	*Sideroxylon*	*salicifolium*	Willow Bustic	PW
Malphigiceae	*Byrsonima*	*lucida*	Locust Berry	PW
Lauraceae	*Cassytha*	*filiformis*	Love Vine	PW
Polygonaceae	*Coccoloba*	*diversifolia*	Pigeon Plum	PW
Sapindaceae	*Exothea*	*paniculata*	Butterbough	PW
Celastraceae	*Crossopetalum*	*rhacoma*	Poison Cherry	PW
Fabaceae	*Stylosanthes*	*hamada*	Pencil Flower	GL
Verbenaceae	*Stachytarpheta*	*jamaicensis*	Blue Flower	GL
Passifloraceae	*Passiflora*	*bahamensis*		PW/GL
Rubiaceae	*Borreria*	*laevis*	Buttonweeed	GL
Linaceae	*Linum*	*bahamense*		GL

Convolvulaceae	*Ipomoea*	*violacea*	GL

Figure 98. Pine woodland east of runway at Sandy Point Airstrip.

Figure 99. Pine woodland east of runway at Sandy Point Airstrip.

Figure 100. Sabal palm in Pine woodland east of Sandy Point Airstrip.

Figure 101. Mixed coppice understory in Pine woodland east of the runway at Sandy Point Airstrip.

Figure 102. Lawn vegetation adjacent to runway at Sandy Point Airstrip.

Figure 103. Stachytarpheta jamaicense, Stylosanthes hamada and Waltheria bahamensis growing on lawn near airstrip.

Figure 104. Lawn vegetation west of the runway at Sandy Point Airstrip.

Figure 105. Lawn vegetation west of the runway at Sandy Point Airstrip.

Hole in the Wall Lighthouse

The lighthouse superstructure appears to be in sound structural condition. However, the interior auxiliary structures, such as the stairwell, are in a state of disrepair. The salt air environment has caused the steel structures to corrode extensively. The concrete landings have also been damaged as a result of the corrosion and expansion of the steel elements. As it stands, the stairs inside the lighthouse are unsafe, and must be repaired/replaced should access be re-opened.

Considerable rusting could be seen on the steel structure of the lantern room. However, due to the unsafe staircase, the outer deck could not be accessed. It is likely that the steel structure of the lantern room itself could be refurbished/refinished, however, it may be required to replace the steel railings and decking.

In conjunction, the auxiliary buildings around the lighthouse must all be refurbished. The wood flooring in many of the buildings is decayed, and thus poses a health and safety risk. The roofs of the structures need replacement, as the wooden structural members have weathered and decayed over the years. The architecture and aesthetics of any renovations must be considered carefully and thoroughly, to preserve the archaeological/historical integrity of the entire historical site.

Anecdotal evidence suggests the presence of mercury exists at the Hole in the Wall lighthouse site. However, during the site assessment by CCS, there was no observation of warning signage for mercury or other hazardous waste. A sign was observed warning visitors on the main entrance of the Hole in the Wall Lighthouse (Figure 106).

Figure 106. Signage on the entrance at Hole in the Wall Lighthouse.

The Department of Transport and Aviation referred CCS to Antiquities Monuments Museums Corporation (AMMC). CCS was informed by Dr. Grace Turner, AMMC Archaeologist, that the Hole in the Wall Lighthouse was closed due to its poor structural integrity and no mention of mercury or other hazardous waste was noted. She further explained that it would be a safety hazard to remain open in its current state.

According to Dr. Turner, in order to restore the Lighthouse, a letter must be written to the Director of AMMC requesting permission to do so. The letter should include the following information.

a) An introduction of the agency requesting permission to restore the Lighthouse;
b) The reason the agency would like to restore the Lighthouse; and
c) A description of the structural repairs proposed.

Figure 107. Aerial image of Hole in the Wall Lighthouse and accessory structures.

Figure 108. Aerial image of Hole in the Wall Lighthouse and accessory structures.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 109. Aerial image of Hole in the Wall Lighthouse.

Figure 110. Ground view of Hole in the Wall Lighthouse, solar panel supports at top of image.

Figure 111. Ground view of Hole in the Wall Lighthouse footing.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 112. Ground view of Hole in the Wall Lighthouse footing.

Figure 113. Interior view of Hole in The Wall Lighthouse steel staircase.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 114. Hole in the Wall Lighthouse interior staircase supports showing signs of rust.

Figure 115. Hole in the Wall lighthouse staircase leading to basement.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 116. Stair supports in Hole in the Wall Lighthouse showing signs of rust.

Figure 117. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 118. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Figure 119. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 120. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Figure 121. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 122. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 123. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 124. Accessory structures at Hole in the Wall Lighthouse in disrepair.

Figure 125. Trig station at Hole in the Wall Lighthouse.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Accessory structures at Hole in the Wall Lighthouse in disrepair.

Figure 126. Lantern Head vegetation map.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 127. South West Point vegetation map.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

<u>Invasive Fauna - Wild Hogs</u>

The terrestrial areas of both LH and SW Point both show signs of extensive wild hog activity throughout the properties. Evidence of wild hog movement, foraging, feeding and wallowing can be readily observed along high tides marks in sandy intertidal zones where it appears the hogs dig for buried crabs, in coastal shrublands where crabs, tuberous roots, cacti and agave all serve as food sources, in the broadleaf forests where they create well-worn paths and uproots saplings and remove tree bark during scratching, and within the freshwater wetland where they source water and wallow during the hotter periods of the day. The impacts of wild hogs are significant in the South Abaco areas, with the broadleaf interior forested areas generally lacking dense understories due to constant movement and foraging by wild hogs. No lands crabs were observed during terrestrial fieldworkon both sites.

The presence of wild hogs in these areas will continue to threaten the health of the forests of South Abaco, as well as the faunal diversity in sensitive areas where Abaco Parrots nest in the ground. No close encounters with wild hogs were experienced during terrestrial fieldwork, as fieldwork was conducted during daylight hours when wild hog activity tends to slow. Encroachment on wild hog resting/nesting areas were met with defensive posturing and grunts by the animals.

Figure 128. Wild Hog pathways at LH in coastal shrubland.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 129. Wild hog prints in muddy substrate of tidal wetland at SW Point.

Figure 130. Evidence of wild hog feeding on Pilocerous polygonous in the coastal shrubland at SW Point.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 131. Wild hog scat in the broadleaf forests at SW.

9.7 Avian Assessment

Bird counts were conducted on January 30-31 and May 22-23, 2019. All bird observations were recorded by species and habitat type, as well as a count of observed individuals. Stop and count observations were performed in the morning and evening on fieldwork days indicated, in coastal and interior vegetated areas, for 10 minutes at a time. Bird species, habitats and counts were records during these stop and count observations.

Table 8. South West Point Avian Species List.

South West				
Family	**Species**	**Common Name**	**Habitat**	**Observations**
Parulidae	*Setophaga americana*	Northern Parula	CS	2
Tyrannidae	*Tyrannus dominicensis*	Grey Kingbird	CS	10
Picidae	*Melanerpes superciliaris*	West Indian Woodpecker	CP	6
Cathartidae	*Cathartes aura*	Turkey Vulture	CS	25
Haematopodidae	*Haematopus palliatus*	American Oystercatcher	RS	9
Scolopacidae	*Limnodromus griseus*	Short Billed Dowitcher	RS	3
Fregatidae	*Fregata magnificens*	Frigate Bird		6
Hirundinidae	*Tachycineta cyaneoviridis*	Bahama Swallow	CS	33
Psittaculidae	*Amazona leucocephala bahamensis*	Abaco Parrot	CP	4

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Polioptilidae	*Polioptila caerulea*	Blue Grey Gnatcatcher	CS	2
Parulidae	*Setophaga ruticilla*	American Redstart	CP	1
Parulidae	*Parkesia motacilla*	Louisiana Waterthrush	CS	1
Vireonidae	*Vireo crassirostris*	Thick Billed Vireo	CP	5

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 9. Lantern Head Avian Species List.

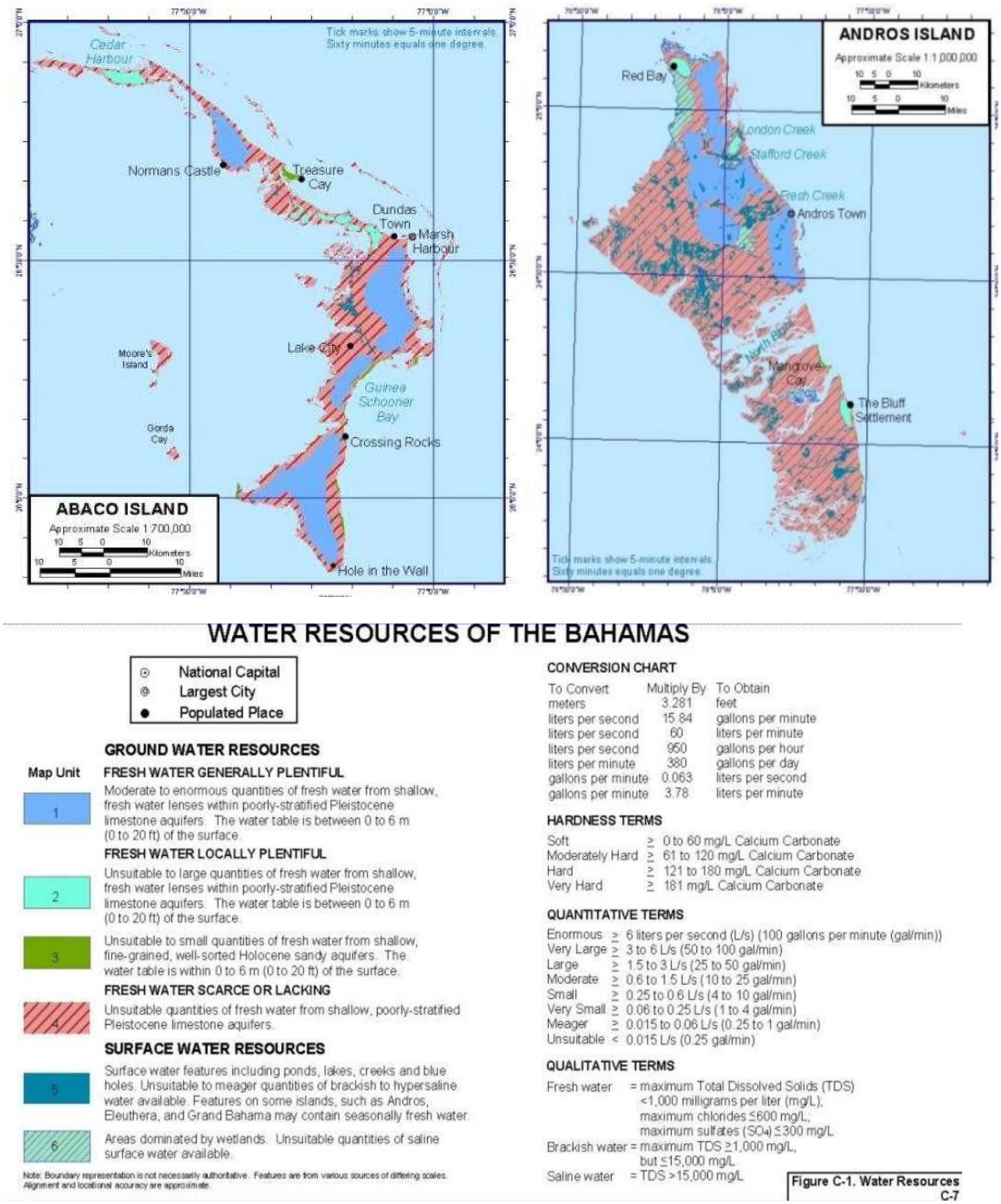
Lantern Head				
Family	**Species**	**Common Name**	**Habitat**	**Observations**
Columbidae	*Zenaida aurita*	Zenaida Dove	PW/CP	2
Vireonidae	*Vireo crassirostris*	Thick Billed Vireo	CP	4
Tyrannidae	*Tyrannus dominicensis*	Northern Mockingbird	PW/CP	12
Spindalidae	*Spindalis zena*	Western Spindalis	PW	5
Parulidae	*Setophaga ruticilla*	American Redstart	CP	3
Polioptilidae	*Polioptila caerulea*	Blue Grey Gnatcatcher	CS	3
Tyrannidae	*Myiarchus sagrae*	La Sagra's Flycatcher	RS	3
Picidae	*Melanerpes superciliaris*	West Indian Woodpecker	PW/CP	3
Fregatidae	*Fregata magnificens*	Frigate Bird		2
Falconidae	*Falco sparverius*	American Kestrel	CS	1
Thraupidae	*Coereba flaveola*	Bananaquit	CP	6
Charadriidae	*Charadrius vociferus*	Killdeer	CS	15
Cathartidae	*Cathartes aura*	Turkey Vulture		10
Psittaculidae	*Amazona leucocephala bahamensis*	Abaco Parrot	CP	6

9.8 Fresh Water Assessment

South Abaco is known for its extensive freshwater lens. The US Army Corps of Engineers states that the area between Crossing Rocks and Hole in the Wall contains a thick (12 – 18 m) and extensive freshwater lens that may produce yields greater than 2.5 L/s (40 gpm) (US Army Corps of Engineers, 2004[6]). A map within this report indicates that the project sites within Lantern Head and South West Point may lie outside of the vast freshwater lens in South Abaco (Figure 132). The water resource map of Andros is also shown in this figure for comparison of the size of the fresh water lens. It is possible that the parcels may be positioned in an area scarce of freshwater resources as they are near the coast of South Abaco.

[6] US Army Corps of Engineers. (2004). Water resources assessment of The Bahamas.

Figure 132. Water resource maps for Abaco and Andros (Source: US Army Corps of Engineers, 2004).



9.9 Marine Assessment

Methodology

Benthic surveys were conducted during high tide on May 21st, 2019 between the hours of 12:30pm and 3:00pm at South West Point; as well as May 22nd, 2019 between the hours of 12:30pm and 1:30pm at Lantern Head. Marine surveys were completed along the coastal and subaquatic habitats at Lantern Head and South West Point.

Investigations at South West Point were conducted at three (3) areas of interest, as illustrated in Figure 136. Roving surveys were completed with the use of snorkel and scuba equipment to assess marine species and benthic habitats. These survey areas were accessed by boat and were performed moving in an eastern direction parallel and perpendicular to the coastline, along the southern most coastal habitat of Great Abaco. Within each area of interest, approximately 1 mile of benthic assessment was completed.

The Lantern Head coastal and benthic survey consists of one (1) area of interest known as 'Lantern Head Beach'; as shown in Figure 155. This survey area was executed by walking along the southern beach at Lantern Head and snorkeling approximately 1 mile of the immediate survey area; parallel and perpendicular to the coastline.

The purpose of this marine investigation was to record the presence and abundance of marine flora and fauna; also, to assess benthic bottom types and coverage. Fish species observed were recorded using the following abundance categories: single, few (2-10) and many (10+). General observations were made for the entire survey area, while marine flora and fauna species observed were recorded. Photos were taken periodically throughout the survey to assist with defining habitat types and species discovered in each marine habitat.

South West Point Marine Habitat

The marine and coastal habitats at South West Point are categorized by the rocky intertidal zone, patch reef, sandy bottom, hard bottom and beach zone ecosystems. Table 10 below includes lists of common and scientific names, as well as habitat identification on all observed species at three (3) areas of interest.

The marine habitat at the 'Entrance' survey area is dominated by hard bottom features. Various patch reef systems were observed throughout the extent of the survey area. This marine habitat contains various coral and algae species such as *Stegastes leucostictus, Halichoeres bivittatus, Lutjanus synagris, Penicillus capitatus, Gorgonia flabellum and Acropora palmata.*

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 133. Aerial image of proposed marina entrance channel at SW Point.

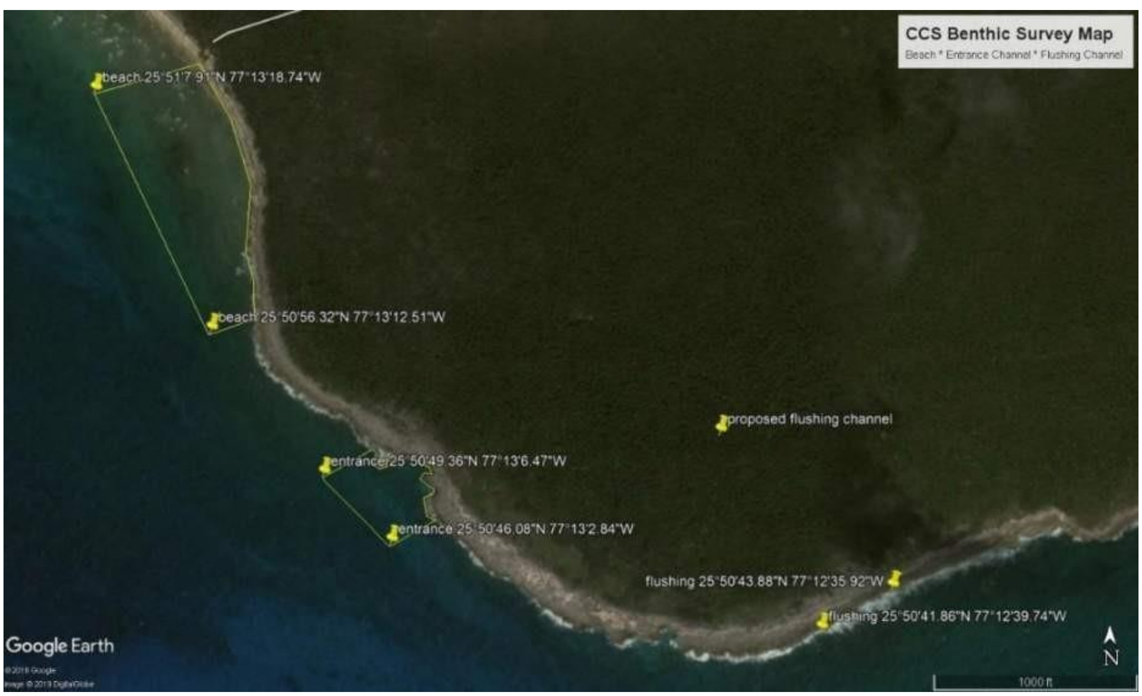
The 'Beach' habitat consists of shallow water and hard bottom habitat. There is little sand along the beach face. However, this area has an abundance of calcium carbonate features inclusive of shell and rock deposits. Various species of marine algae covers the hard-bottom surface. Some of these species include *Acetabularia crenulate, Penicillus capitatus, Padina boergesenii, and Dictyota sp.* Shipwreck debris is present within the survey area. A considerable size of metal protrudes from the subaquatic environment. Pieces of the shipwreck's debris were widely distributed throughout this hard-bottom habitat, with various marine algae and coral attached. Thus, providing an artificially favorable coral habitat for marine species aiding in coral and algal growth.

Figure 134. Aerial image of surrounding benthic areas at SW Point.

Figure 135. Aerial image of Alexandria shipwreck near SW Point.

The 'Flushing' survey area is made up of both sandy bottom and hard bottom habitat with several subaquatic boulders present. Sparse amounts of diverse marine algae are positioned among the hard bottom and boulders. Some of these species include *Padina jamaicensis, Dictyota sp.,* and *Penicillus capitatus.* This habitat host groups of juvenile fish species. However, this survey area displays little ecological biodiversity as these marine species were scarce.

Figure 136. South West Point Benthic Survey Area.



Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 10. South West Point Marine Species List (A-D)

A. Marine Algae Species List

Common Name	Scientific Name	Habitat
White Mermaid's Wineglass	*Acetabularia crenulata*	Hard Bottom
Leafy Rolled-Blade	*Padina boergesenii*	Patch Reef/ Hard Bottom
Blister Saucer Leaf Algae	*Turbinaria turbinata*	Patch Reef
Tubular Thicket Algae	*Galaxaura sp.*	Patch Reef
Bristle Ball Algae	*Penicillus capitatus*	Sandy Bottom/ Hard Bottom
White Scroll Algae	*Padina jamaicensis*	Patch Reef
Mermaid Fan	*Udotea sp.*	Patch Reef
Spiny Seaweed	*Acanthophora spicifera*	Sandy Bottom
Y Branched Algae	*Dictyota sp.*	Artificial Reef / Patch Reef

B. Coral Species List

Common Name	Scientific Name	Habitat
Venus Sea Fan	*Gorgonia flabellum*	Hard Bottom
Bent Sea Rod	*Plexaurella flexuosa*	Hard Bottom
Mustard Hill Coral	*Porites astreoides*	Artificial Reef / Patch Reef
Symmetrical Brain Coral	*Diploria strigosa*	Artificial Reef / Patch Reef
Knobby Brain Coral	*Diploria clivosa*	Patch Reef
Elkhorn Coral	*Acropora palmata*	Patch Reef
Shelf Knob Rod	*Eunicea succinea*	Patch Reef
Black Sea Rod	*Plexaurella homomalla*	Patch Reef
Grooved Brain Coral	*Diploria labyrinthiformis*	Patch Reef
Massive Starlet Coral	*Siderastrea siderea*	Patch Reef
Blade Fire Coral	*Millepora complanata*	Patch Reef

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

C. Marine Vertebrate Species List

Common Name	Scientific Name	Abundances	Habitat
Queen Triggerfish	*Balistes vetula*	Single	Hard Bottom
Red Hind Grouper	*Epinephelus guttatus*	Single	Patch Reef
Slippery Dick	*Halichoeres bivittatus*	Many	Patch Reef
Longspine Squirrel Fish	*Holocentrus rufus*	Single	Artificial Reef
Yellow Tail Snapper	*Ocyurus chrysurus*	Many	Patch Reef
Beaugregory (Juvenile)	*Stegastes leucostictus*	Few	Patch Reef
Ocean Surgeonfish	*Acanthurus bahianus*	Few	Patch Reef
Blue Tang	*Acanthurus coeruleus*	Few	Patch Reef
Doctor Fish	*Acanthurus chirurgus*	Few	Patch Reef
Yellowtail Damsel (Juvenile)	*Microspathodon chrysurus*	Few	Patch Reef
Sergeant Major	*Abudefduf saxatilis*	Many	Artificial Reef / Patch Reef
Bluehead Wrasse	*Thalassoma bifasciatum*	Few	Patch Reef
Spanish Hogfish	*Bodianus rufus*	Few	Patch Reef
Great Barracuda	*Sphyraena barracuda*	Few	Sandy Bottom
Blue Striped Grunt	*Haemulon sciurus*	Many	Patch Reef
French Grunt	*Haemulon flavolineatum*	Many	Patch Reef
French Angelfish	*Pomacanthus paru*	Single	Artificial Reef
Schoolmaster	*Lutjanus apodus*	Few	Artificial Reef
Yellowtail Parrotfish	*Sparisoma rubripinne*	Few	Artificial Reef
Silver Porgy	*Diplodus argenteus*	Few	Patch Reef / Artificial Reef
White Margate	*Haemulon album*	Few	Artificial Reef
Lane Snapper	*Lutjanus synagris*	Few	Patch Reef
Yellow Jack	*Carangoides bartholomaei*	Few	Artificial Reef
Banded Butterflyfish	*Chaetodon striatus*	Few	Artificial Reef
Queen Parrotfish (juvenile)	*Scarus vetula*	Few	Artificial Reef
Glassy Sweeper	*Pempheris schomburgkii*	Many	Artificial Reef

D. Marine Invertebrate Species List

Common Name	Scientific Name	Habitat
Rock Boring Urchin	*Echinometra lucunter*	Hard Bottom
Coral Encrusting Sponge	*Cliona caribbaea*	Patch Reef
Flamingo Tongue	*Cyphoma gibbosum*	Patch Reef
Long Spined Urchin	*Diadema antillarum*	Hard Bottom
Brown Variable Sponge	*Cliona varians*	Patch Reef
Orange Sieve Encrusting Sponge	*Diplastrella megastellata*	Patch Reef

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figures 137-146: Observed at the 'Entrance' area ofinterest.

Figure 137. Elkhorn Coral.

Figure 138. Benthic cover of Venus Fan Coral.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 139. Queen Triggerfish.

Figure 140. Black Sea Rod.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 141. Brown Variable Sponge.

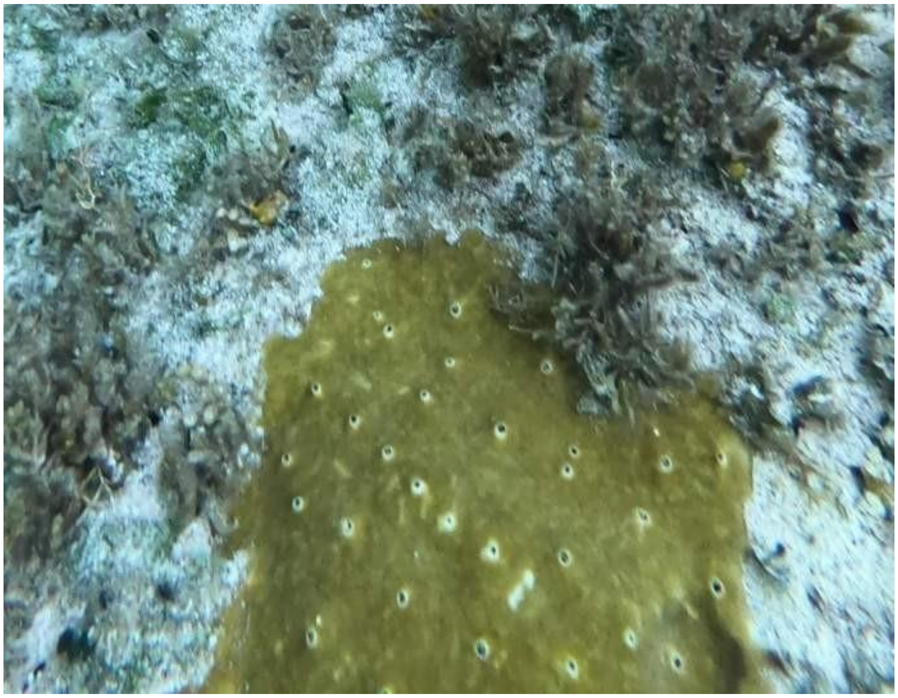


Figure 142. Symmetrical Brain Coral.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 143. Leafy Rolled Blade Algae surrounded by Tubular Thicket and Blister Saucer Algae.

Figure 144. Developing Blade Fire Coral.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 145. Yellow Tail Snapper, Spanish Hogfish and Ocean Surgeonfish surrounding a patch reef habit.

Figure 146. Massive Starlet Coral with Y-Branched Algae attached.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 147. 'Flushing' area of interest display of hard bottom subaquatic boulders with sparse algae

Figures 148-154: Observed at the 'Beach' area of interest.

Figure 148. Limestone deposit shoreline void of sandy habitat.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 149. Exposed shipwreck debris.

Figure 150. Shoal of fish species inclusive of Sergeant Major, Yellow Tail Snapper, Blue Striped Grunt and White Margate.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 151. Blue Tang, Sergeant Major and French Grunt.

Figure 152. Submerged shipwreck debris with developing marine algae.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Figure 153. Developing Mustard Hill and Knobby Brain Coral attached to shipwreck debris.

Figure 154. Yellowtail Jack.

Lantern Head Marine Habitat

The coastal habitat at Lantern Head is characterized by the rocky intertidal zone, beach zone and sandy bottom. Table 11 includes lists of common and scientific names, as well as habitat notes for all the species that were observed and identified. The rocky intertidal zone is located along the beach face and is comprised of karst formations known as Ironshore or Dog-Toothed Limestone, which encompass the western area of the Lantern Head Beach. This karst formation is elevated at approximately 40 ft. above the beach face and located in the supralittoral zone; where it would become submerged during severe storm activities. The low tide zone consists of jagged limestone formations that form various intertidal pools. Several species of mollusks were observed during this survey; inclusive of *Nerita peloronta, Nerita tessellate, Cenchritis muricatus,* and *Arcanthopleura granulate.*

The subaquatic survey area consists of both sandy and hard bottom habitat. Large submerged boulders were observed throughout the sandy bottom, along with separate slabs of hard bottom dispersed in arbitrary locations. Marine algae were an abundant species observed within this habitat; some of these species include *Neomeris annulate, Penicillus capitatus, Thalassia testudinum and Sargassum fluitans.* Pieces of deceased Turtle Grass (*Thalassia testudinum*) were observed floating throughout the survey area. However, no sea grass beds were observed. Large amounts of deceased Sargassum Sea Weed (*Sargassum fluitans*) were observed accumulating along the entire beach face. Lantern Head Beach displays intense wave energy which resulted in high turbidity and limited visibility during the snorkel survey.

Figure 155. Lantern Head Benthic Survey Area.

Marine Species List

Table 11. Lantern Head Marine Species List.

Common Name	Scientific Name	Habitat
Sargassum Seaweed	*Sargassum fluitans*	Sandy Bottom
Bleeding Tooth Nerite	*Nerita peloronta*	Rocky Shore
Checkered Nerite	*Nerita tessellata*	Rocky Shore
Fuzzy Chiton	*Arcanthopleura granulata*	Rocky Shore
Sergeant Major	*Abudefduf saxatilis*	Sandy Bottom
Beaded Periwinkle	*Cenchritis muricatus*	Rocky Shore
Checkered Periwinkle	*Littorina scutulata*	Rocky Shore
Slender Periwinkle	*Echinolittorina angustior*	Rocky Shore
Fuzzy Tip	*Neomeris annulata*	Hard Bottom
Bristle Ball Algae	*Penicillus capitatus*	Hard Bottom
Turtle Grass	*Thalassia testudinum*	Sandy Bottom

Figure 156. Fuzzy Chiton imbedded in the rocky intertidal zone.

Figure 157. Beeded Periwinkle, Checkered and Bleeding Tooth Nerites attached to the limestone rock in the rocky intertidal zone.

Figure 158. Hard Bottom habitat within a highly turbid marine environment.

Figure 159. Floating Sargassum Seaweed with subaquatic boulders.

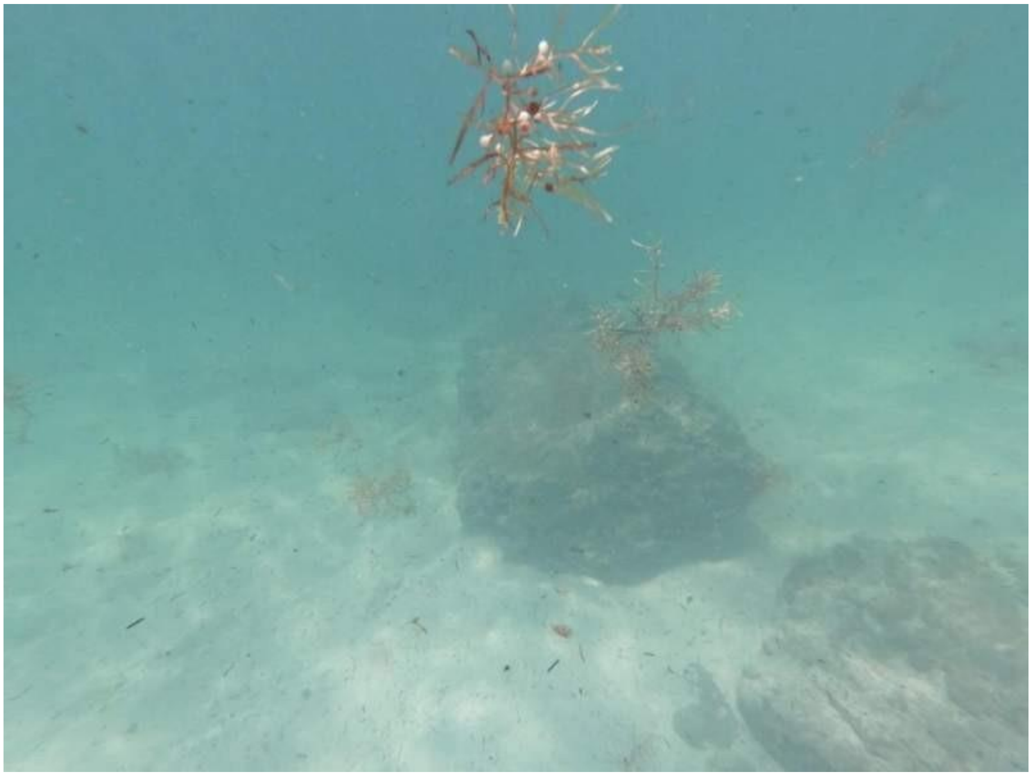


Figure 160. Elevated Ironshore within the rocky intertidal zone.

Figure 161. Low tide rocky intertidal zone with jagged karst formation.

Figure 162. Extent of Lantern Head Beach from an elevated northern view.

Caves & Blue Holes

No caves or blue holes were discovered within the immediate aquatic survey areas of South West Point and Lantern Head. However, various cave features were observed along the southern coastline of South West Point as seen in Figure 163. Flank-margin cave structures are formed horizontally when fresh water dissolves the limestone near the coast.

Figure 163. South West Point flank-margin cave.

Discussion

Endangered / Protected Species & Species of Economic Importance

Referencing the International Union for Conservation of Nature (IUCN) Red List of Threatened Species[7], threatened or endangered species observed during the survey include the Elkhorn Coral (*Acropora palmata*). This species is listed as critically endangered due to a common disease known as White-Band Disease among other detrimental diseases (Aronson et al., 2008). Additionally, major threats to this coral species are the effects of climate change on the marine ecosystems, such as coral bleaching and increased storm activity. Coral bleaching occurs as a result of the ocean's absorption of surplus amounts of carbon dioxide (CO_2); which decreases the ocean's pH and contributes to ocean acidification. Thus, forming carbonic acid (H_2CO_3) which compromises the development of calcium carbonate in corals; leaving coral species vulnerable to environmental factors. Notably, the Venus Sea Fan (*Gorgonia flabellum)* was observed in abundance on all patch reef systems and accompanied by various species of fish at different developmental stages within the survey area. The abundance of this soft coral species supports healthy ecological biodiversity due to its ability to provide habitation for various marine species. The composition of soft coral species is more resilient to abiotic stressors which also aids in increased biodiversity.

---

[7] Aronson, R., Bruckner, A., Moore, J., Precht, B. & E. Weil 2008. *Acropora palmata*. *The IUCN Red List of Threatened Species* 2008: http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133006A3536699.en.

No Bonefish (*Albula vulpes*) were observed within the survey areas. Bonefish are a commercially important fish species for locals because they provide substantial income for fishermen and tour guides. The IUCN[8] lists this species as near threated due to threats of unsustainable fishing practices and habitat loss (Adams et al., 2012). The absence in Bonefish observations at this site maybe due to the time of year of which the survey was conducted, as they spawn in deeper waters between November and December. Cross Harbour National Park plays a significant role in Bonefish aggregation as this species uses the shallow waters of this site to migrate toward deeper waters for spawning. Due to its proximity to Cross Harbour National Park, it is possible the connectivity of the two sites are vital for Bonefish spawning migration.

The Nassau Grouper *(Epinephelus striatus*) is another commercially important marine species for South Abaco locals as well as the wider Bahamas. South Abaco locals suggest that the waters in this area are home to this species. During the site survey, there were no observations of this fish species. Evidence suggests that Nassau Grouper spawning exits east of Hole in The Wall within the deeper waters of South Abaco. Nassau Grouper Spawning occurs from December to the end of February. According to the IUCN[9], this species is considered critically engendered due to overfishing (Sadovy et al., 2018).

Invasive Species

There were no marine invasive species observed within the South West Point and Lantern Head survey areas.

Habitat Utilization

Patch Reef systems within the 'Entrance' were extremely active as fish were observed feeding and using this habitat for shelter. Both juvenile and adult fish species utilized the various widespread patch reef systems, which proved to be a vital ecological habitat in supporting biodiversity.

A multitude of fish species were identified among the artificial reef system supplied by the shipwreck at the 'Beach'. These fish exhibited shoaling and competitive behavior as some were viewed swimming in unison among various fish species, while others displayed aggressive behavior with other fish. Mustard Hill Coral (*Porites astreoides*) and Knobby Brain Coral (*Diploria clivosa*) were the few coral species attached to the shipwreck remains; as seen in Figure 153. These metal fragments demonstrate advantageous use for the development of reef building coral reef structures by hosting hard coral structures such as *Diploria*. Overtime, this promising growth behavior could provide a resilient habitat for various marine species; therefore, supporting biodiversity.

The habitat within the 'Flushing' survey area habitat host groups of juvenile fish species. However, this survey area displays little ecological biodiversity as these marine species were scarce.

---

[8] *Adams, A., Guindon, K., Horodysky, A., MacDonald, T., McBride, R., Shenker, J. & Ward, R. 2012. Albula vulpes. The IUCN Red List of Threatened Species 2012: . http://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T194303A2310733.en.*

[9] *Sadovy, Y., Aguilar-Perera, A. & Sosa-Cordero, E. 2018. Epinephelus striatus. The IUCN Red List of Threatened Species 2018: http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T7862A46909843.en.*

Species within the Lantern Head rocky intertidal zone habitat thrive due to their adaptation to harsh marine environments inclusive of harsh temperatures and lack of constant water supply. Various mollusks were observed attached to the limestone features. This attachment would allow these species to conserve water and nutrients in tidal pools during extreme low tide events.

The high turbidity at Lantern Head Beach effects the reproduction rate of coral and marine algae, which are heavily dependent on sunlight for growth. The lack of biodiversity observed within the survey area may be a result of harsh environmental conditions for marine flora and fauna within this ecosystem.

Human Influence

Both South West Point and Lantern Head exhibit no evidence of human influence due to the lack of pollution observed within both marine and coastal environments. However, it is possible that locals frequent the marine habitat near the coast of South West Point due to the presence of a fishing vessel several nautical miles north of this area.

There are two national parks located within the vicinity of the proposed development sites; Abaco National Park and Cross Harbour National Park. These national parks were created to protect natural resources of economic and ecological importance.

Cross Harbour National Park (CHNP) was established in 2015 by the government of The Bahamas and encompasses 15,181.9 acres of marine and wetland habitat. This creative effort was brought on by the 2008 Caribbean Challenge Initiative, which consists on protecting 20% of the country's marine and near shore environments. CHNP is a wetland ecosystem that provides habitat for various commercially important species. Most importantly, studies show that Bonefish use the area as a breeding ground, as it is the most popular breeding ground for this species. Spawning aggregations travel from these flats to deeper waters to reproduce. Thus, labeling this shallow water habitat vital due to historical reproduction migration. Queen Conch and Nurse Sharks also utilize this habitat for breeding purposes. Various fish species from initial to terminal stages have been noted within this park. Therefore, the park establishes itself as a habitat of great importance to Bahamian marine ecological biodiversity. The cultural significance of this park is significant. Locals use the shallow waters for subsistence and commercial fishing, ecotourism profits and recreational activities.

The Abaco National Park (ANP) was established by the Bahamas National Trust in 1994. This park encompasses 21,027.1 acres, of which 5,000 acres of pine forest is protected. This vast protected area was created to protect vital natural resources and preserve forest biodiversity such as Bahamian Pine *(Pinus caribaea var. bahamensis*), aquafers and the endemic Abaco Parrot (*Amazona lecocephala bahamensis*).

An extensive tract of Mixed Broadleaf Coppice is protected in the Abaco National Park. The habitat/ecosystem is important for many reasons, including its historical value to The Bahamas and the biodiversity it supports. The Park also protects an extensive tract of Bahamian Pine. No other National Park protects such a large tract of this species and the ecosystem it supports. The area is known as a breeding ground for the White-crowned Pigeon, the most popular game bird of the Bahamas. The ANP also protects critical feeding and breeding habitat for the endemic Abaco Parrot. Conservation of this area is vital to the species and promotes the stability of its population in the northern Bahamas. One of the main reasons for the establishment of the Abaco National Park was to protect the northern habitat of this endangered species. Unique among New World Parrots, these birds are subterranean nester, nesting in naturally created limestone cavities on the ground of the pine forest.

Figure 164. Map of Cross Harbour National Park and Abaco National Park.

9.10 Socio-Economic Aspect

The developments at Lantern Head and South West Point in South Abaco provide various socio-economic benefits for the surrounding communities, as well as the island of Great Abaco. Economic impact has been measured based on data from similar hotels in the Caribbean region. These measurements generate revenue and expense estimates based on five years of hotel operation. Economic impact estimated values are measured by factors such as output, earning and employment in relation to direct, indirect and induced effects.

Lantern Head – Hotel

The proposed luxury hotel development at Lantern Head, Abaco is expected to have substantial economic benefit to Abaco by generating in 2026 an estimated $74,688,000 of economic impact for the community (Table 12). Economic impact for the first ten years reflects an estimated total of $1,051,967,000 based on output and wages totals.

Table 12. Estimated annual operating results for Lantern Head Hotel.

Summary of Estimated Annual Operating Results				
Year	Total Revenue	Economic Impact		
		Output	Wages	Total (Rounded)
2024	$42,160,125	$52,240,216	$22,447,390	$74,688,000
2025	$49,587,636	61,443,574	26,402,033	87,846,000
2026	$55,140,882	68,324,550	29,358,758	97,683,000
2027	$58,740,444	72,784,734	31,275,280	104,060,000
2028	$60,012,865	74,361,379	31,952,757	106,314,000
2029	$61,815,022	76,594,415	32,912,283	109,507,000
2030	$63,667,498	78,889,800	33,898,599	112,788,000
2031	$65,577,591	81,256,578	34,915,594	116,172,000
2032	$67,545,804	83,695,373	35,963,533	119,659,000
2033	$69,572,655	86,206,825	37,042,693	123,250,000
Total	**$593,820,521**	**$735,797,442**	**$316,168,919**	**$1,051,967,000**

Source: CBRE Hotels

Rates of value added tax (VAT) are applied which is the standard rate of 12.0 percent. Table 13 contains the VAT tax totals for the ten-year estimate of resort operation. The hotel at Lantern Head is projected to generate valuable VAT revenue for the government of The Bahamas. Thus, contributing to the country's gross domestic product (GDP). Please note that the following terminology as it relates to Table 13: RR – Room Revenue, F&B – Food and Beverage, OOD – Other operated Departments, ROI – Rentals and Other Income.

Table 13. Estimated Lantern Head hotel tax totals for ten-year operational period.

Summary of Estimated Annual Lodging and Sales Tax					
Year	*VAT* 12% of RR	*VAT* 12% of F&B	*VAT* 12% of OOD	*VAT* 12% of ROI	*Total Tax*
2024	$2,991,994	$1,046,920	$992,109	$28,192	$5,059,215
2025	3,809,995	1,118,909	988,568	33,044	5,950,516
2026	4,472,451	1,185,390	921,956	37,109	6,616,906
2027	4,921,445	1,232,727	855,343	39,338	7,048,853
2028	5,033,426	1,257,641	870,352	40,125	7,201,544
2029	5,184,641	1,295,371	896,462	41,329	7,417,803
2030	5,339,944	1,334,232	923,356	42,569	7,640,100
2031	5,500,150	1,374,259	951,057	43,846	7,869,311
2032	5,665,261	1,415,486	979,588	45,161	8,105,496
2033	5,835,276	1,457,951	1,008,976	46,516	8,348,719
Total	**$48,754,583**	**$12,718,886**	**$9,387,766**	**$397,228**	**$71,258,463**

Source: CBRE Hotels

South West Point – Marina

The proposed marina development at South West Point, Abaco is expected to have substantial economic benefit to Abaco by generating in 2026 an estimated $21,252,000 of economic impact for the community (Table 14). Economic impact for the first ten years reflects an estimated total of $321,976,000 based on output and wages totals.

Table 14. Estimated annual operating results for South West Point Marina.

Summary of Estimated Annual Operating Results				
Fiscal Year	Total Revenue	*Economic Impact* Output	Wages	Total (Rounded)
2024	$15,741,811	$18,580,526	$2,671,974	$21,252,000
2025	$18,650,412	22,013,633	3,165,672	25,179,000
2026	$21,138,406	24,950,286	3,587,978	28,538,000
2027	$23,817,871	28,112,938	4,042,783	32,156,000
2028	$24,532,407	28,956,326	4,164,067	33,120,000
2029	$25,268,380	29,825,016	4,288,989	34,114,000
2030	$26,026,431	30,719,767	4,417,659	35,137,000
2031	$26,954,662	31,815,385	4,575,214	36,391,000
2032	$27,763,302	32,769,847	4,712,471	37,482,000
2033	$28,596,201	33,752,942	4,853,845	38,607,000
Total	**$238,489,884**	**$281,496,666**	**$40,480,652**	**$321,976,000**

Source: CBRE Hotels

Due to the development of the South Abaco marina, projections estimate to generate $28,564,100 in tax revenue over a ten-year period. Please note that the following terminology as it relates to Table 15: SR – Slip Revenue, OI – Other Income.

Table 15. Estimated Marina tax totals for ten-year operational period.

Summary of Estimated Annual Sales Tax			
Fiscal Year	VAT 12% of SR	VAT 12% of OI	Total VAT
2024	$1,512,250	$376,768	$1,889,017
2025	1,814,700	423,350	2,238,049
2026	2,064,221	472,388	2,536,609
2027	2,334,157	523,987	2,858,145
2028	2,404,182	539,707	2,943,889
2029	2,476,308	555,898	3,032,206
2030	2,550,597	572,575	3,123,172
2031	2,627,115	589,752	3,216,867
2032	2,705,928	607,445	3,313,373
2033	2,787,106	625,668	3,412,774
Total	**$23,276,564**	**$5,287,536**	**$28,564,100**

Source: CBRE Hotels

South West Point - Hotels

The proposed development of a 75-room luxury hotel and a 100-room extended stay hotel at South West Point, Abaco is expected to have substantial economic benefit to Abaco by generating in 2026 an estimated $49,796,000 of economic impact for the community (Table 16). Economic impact for the first ten years reflects an estimated total of $570,851,000 based on output and wages totals.

Table 16. Estimated total annual revenue.

Summary of Estimated Annual Operating Results				
Fiscal Year	Total Revenue	*Economic Impact*		
		Output	Wages	Total (Rounded)
2024	$28,949,063	$34,826,925	$14,968,653	$49,796,000
2025	$29,817,534	35,871,733	15,417,712	51,289,000
2026	$30,712,060	36,947,885	15,880,244	52,828,000
2027	$31,633,422	38,056,322	16,356,651	54,413,000
2028	$32,582,425	39,198,011	16,847,350	56,045,000
2029	$33,559,898	40,373,952	17,352,771	57,727,000
2030	$34,566,695	41,585,170	17,873,354	59,459,000
2031	$35,603,695	42,832,725	18,409,555	61,242,000
2032	$36,671,806	44,117,707	18,961,841	63,080,000
2033	$37,771,960	45,441,238	19,530,696	64,972,000
Total	**$331,868,559**	**$399,251,670**	**$171,598,826**	**$570,851,000**

Source: CBRE Hotels

The development of the South Abaco hotel is estimated to generate $39,824,227 in tax revenue over a ten-year period. Please note that the following terminology as it relates to Table 17: RR – Room Revenue, OI – Other Income.

Table 17.Estimated hotel estimate sales and lodging tax revenue.

Summary of Estimated Annual Lodging and Sales Tax			
Fiscal Year	*VAT*	*VAT*	*Total Tax*
	12% of RR	12% of OI	
2024	$2,792,250	$681,638	$3,473,888
2025	2,876,018	702,087	3,578,104
2026	2,962,298	723,149	3,685,447
2027	3,051,167	744,844	3,796,011
2028	3,142,702	767,189	3,909,891
2029	3,236,983	790,205	4,027,188
2030	3,334,093	813,911	4,148,003
2031	3,434,115	838,328	4,272,443
2032	3,537,139	863,478	4,400,617
2033	3,643,253	889,382	4,532,635
Total	**$32,010,017**	**$7,814,210**	**$39,824,227**

Source: CBRE Hotels

The renovation and operation of the Sandy Point Airport is estimated to generate significant revenue and provide additional economic benefits such as the creation of jobs, airport landing fees and fuel sales. Furthermore, casino development would garner supplementary economic benefits and government taxes. The complete Economic Impact Analysis done by CBRE Hotels is included in Appendix E.

Total Operational Employment

It is estimated that the entire project when fully developed and stabilized will generate about 600 full time permanent jobs. This of course will have a very large and beneficial effect on Abaco.

9.11 Cultural Resources

South Abaco is rooted in Bahamian history as some of the first settlers landed on its shores in the 1500's. These settlers were American loyalists, loyal to the British crown, that traveled from Florida to The Bahamas. Later, New England and New York Irish settlers came to Abaco by way of former Virginia governor Dunmore. Abaco's bountiful natural resources such as wood, fresh water, soil, whales and its resilience to storms encouraged settlers to colonize this island (Durrel, 1972)[10]. Governor Dunmore wrote of the abundance of whales in an attempt to entice whalers to settle in Abaco as this was a lucrative industry. Furthermore, in 1708 literature made mention of the presence of ambergris in Abaco (Durrel, 1972). However, due to lack of abundant fertile ground and harsh weather conditions, long term agriculture became almost impossible. From 1795 to 1803, crops like sisal were not flourishing due to thin soil and its exposure to extreme sunlight (Dodge, 1983)[11].

The name 'Hole in the Wall' originates from the geological formation of extended rock from the coast of South Abaco. Early maps illustrate Hole in the Wall as a settlement which shows its significance to the island of Great Abaco (Figure 165). This unique rock formation exhibits an opening between two once connected pieces of rock/land mass, which allows the unforgiving waters of the Atlantic to flow through. Hole in the Wall lighthouse was the first lighthouse on the island of Abaco. It was built in 1836 by the British Imperial Lighthouse Service. The original operation of the lighthouse consisted of lighting the kerosene mantel while turning the Fresnel lens by weight and cable. Lighthouse operation became fully automated in 1995. The establishment of the lighthouse was due to the growing ship wrecking industry.

U.S. ships frequently and unintentionally made its way to Hole in the Wall, aiming for the Gulf of Mexico, which made way for wrecking as an industry. Wrecking became popular due to failed agricultural yields. To effectively end this practice, the lighthouse was erected to serve as a warning of impending rock formations and potential ship damage as it's light marks the entrance of the northeast New Providence Channel.

Hole in the Wall lighthouse is located 55 miles south from community of Marsh Harbour. Currently, the

[10] Durrel, Z. (1972). The innocent island: Abaco in the Bahamas.
[11] Dodge, S. (1983). Abaco, the history of an out island and its cays.

lighthouse is functional. However, the lighthouse and its surrounding buildings are dilapidated. The buildings surrounding the lighthouse were built as homes for the lighthouse keepers to live and work. Presently, this historic lighthouse is government property and is open and available for all to view and explore.

Figure 165. Early 17th century map of Abaco with a depiction of a settlement at South Abaco at Hole Rock (Hole in the Wall).

Figure 166. Aerial Image of SW Point ruins.

9.12 Transportation

The Great Abaco Highway serves as the major thoroughfare across the island of Abaco and is the only access route to the Hole in the Wall Lighthouse, also leading to Lantern Head and Southwest Point. The Lighthouse Road is approximately 13 miles long from the junction at the highway to Solider Road at the southern tip of the island. Solider Road is also a 2.5 mile unpaved road, with overgrown sides and rugged, rocky terrain, providing access to both SW Point and Hole in the Wall Lighthouse.

The Developer, as part of the external project activities for the LH and SW Point project, will improve the road system leading from the Great Abaco Highway, past LH and down to Hole in the Wall Lighthouse, and to the SW Point property. Additionally, the Developer will reopen a 20' wide public thoroughfare to a beach south of the junction at Soldier and Lighthouse Roads (Figure 167). The South West Point survey plan illustrating the public access road is included in Appendix F . The road improvement would include modern infrastructure to provide safe and easy access to both properties from the Great Abaco Highway, which currently services transportation from Marsh Harbour to Sandy Point. To help facilitate this road development, the Developer intends to use the excavated fill from the development of the marina, as shown in Section 5.2 Table 1, to expand the width (30 ft. in width) of the road to allow for two lane single carriage for motor vehicle transportation. The total distance of the combined roads are an estimated 15.5 miles south of the Great Abaco Highway.

Figure 167. Proposed road improvements of Lighthouse and Soldier Roads from the Great Abaco Highway to SW Point and Hole in the Wall Lighthouse.

The nearest airstrip to the project site is the Sandy Point airstrip located approximately 14 miles northwest of the properties. The airstrip is not actively managed or maintained and is not operational for commercial or private access. No marina or docking facility exists near the Lantern Head and SW Point properties, only the dysfunctional Ferry Dock near Rocky Point, and the private and public docks located in the settlement of Sandy Point. As described in Section 5 above Developer will extend and improve this airstrip.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

9.13 Utilities Description

9.13.1 Energy

The Developer has committed to producing 30% of the Project's energy demand from solar energy as economically feasible. It is expected that solar power will be able to provide some of the power needs for both the Lantern Head and South West Point sites. The use of a solar electric power will allow for surplus power generation that shall be tied to the Project's power distribution grid. The design standard for the development will be to use solar water heating as the primary hot water system. This technology is well developed and further reduces the load that water heating puts on the energy system for the development. Solar water heating will be able to produce all the needs for any residence within the developments and can meet most of the needs for the commercial needs in the hotels and retail establishments planned.

It is expected that solar power will be able to provide some of the power needs for both sites. The use of solar electric power will allow for surplus power generation that shall be tied to the Project's power distribution grid. This is a sustainable method of solar generated electricity is uniquely possible with a private development such as this. The implementation of solar technology promotes good environmental practice and the preservation of the natural beauty of South Abaco. The development will also utilize appropriate design standards that would reduce energy needs of the development. Standards for insulation, day light utilization, LED only lighting requirement, occupancy sensing for lighting and environmental controls, and solar design loading standards are just a few of the advanced standards that will be applied to every aspect of this development.

However, the main support of electric power for each site will be a conventional diesel generator-based power system. The generator facility will be storm hardened housing multiple generating units for redundancy, maintainability and provide the ability to update and improve as the needs of each site grow. The size of the generation at each site will start small but is expected to grow to approximately 4 MW for Lantern Head and 8 MW for South West Point. Diesel tankage will be established at the generation facilities as required and supplied via tanker deliveries at the South West Point marina. The primary distribution will be underground high voltage to point-of-use transformers where it will be converted to useable voltage levels. Conventional power metering will be utilized to charge users for the power they consume.

The hotel, restaurant, retail and marina facilities are anticipated to require a substantial amount of laundry support. Commercial laundries are heavy power and water consumers. The development will establish commercial laundries as needed utilizing self-contained recycling commercial laundry systems to minimize utility and water demand. These systems will be augmented as necessary with solar electric and water heating capacity.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

The back of house locations of each site will have parking pads and connection points for primary liquid propane tankers so that propane gas can be distributed around the site via an underground piping system. Tankers will be rotated through the sites as needed and supplied by ocean barge through the SW Point marina. The primary use for propane gas will be both commercial and residential cooking but will also be available for decorative use (fireplaces and torches) and could also be used for supplemental heating of water. Gas use will be metered at each connection point of use.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 18. Electrical demands for developments ate South West Point.

South West Point – Electricity Demands				
Amenity	**Number of Units**	**Size**	**Acreage**	**Electrical load KVA**
Super-Yacht Marina (136 Slips)	(23) 300 ft - 600ft. slips (23) 200 ft. slips (40) 175ft. slips (50) 150ft. slips	30 ft. - 75 ft.(width of each slip)	110 ac. (inclusive ofcanal/ flushing channel)	**2,900**
Marina Port of Entry Customs Office	1	1,000 sf.		**9**
Marina Village with commercial stores (marina store, fishing guide's office, fishing charter office, yacht charter, repair services, fishing & scuba shops), full-service restaurant and bar.		45,000 sf.		**400**
Limited service hotel	100 rooms	50,000 sf.	1 ac.	**375**
Canal/ Marina residential lots (each inclusive of 100 ft. boat slip)	44 units(each inclusive of 100ft. Boatslip)	≤ 20,000 sf.(each home will be built at the owner's choice. But not to exceed 20,000 sf.)	1 ac. each	**4,400**
Ocean front residential lots	18 units	≤ 20,000 sf. (each home will be built at the owner's choice. But not to exceed 20,000 sf.)	1 ac. each	**1,900**

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Hilltop residential lots	13 units	≤ 20,000 sf. (each home will be built at the owner's choice. But not to exceed 20,000 sf.)	1 ac. each	**1,400**
Residence " Lifestyle" Village	120 units	average 2,500 sf. each	125 ac. (total acreage)	**1,800**
Small Fishing Lodge (Included within the Residence Village development area)	20 room	25,000 sf.	(Included in the total residence village above)	**200**
Small Casino	I unit	7,500 sf. - 10,000 sf.		**125**
Small Water Park (inclusive of approximately, Lay-Z River, toddler pool, slides, and kids pool)			8-10 ac. Total space	**100**
Artists Village	20 small homes	1,000 sf. each	1 ac. each	**300**
Medical Facility	I unit	4,000 sf.		**55**
			South West Point sub-total	**13,964**

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 19.Electrical Demands for developments at LH.

Lantern Head (Hotel, Golf Course, Club House & Residential Lots) - Electricity Demands				
Amenity	**Number of Units**	**Size**	**Acreage**	**Electrical load KVA**
Golf Course (full size)	18 Hole		~ 250 ac.	**150**
Beach Club (outdoor pool, pool slides, water sports, food and beverage service)		5,000 sf.		**95**
Club House (inclusive of Pro-shop, locker rooms, club food outlet, driving range, golf cart maintenance and 4 tennis courts)		11,000 sf.		**140**
2-story Luxury Hotel (main building inclusive of lobby, small meeting room, spa, gym, pool, restaurants bar, beach club, casual and upscale restaurant)	50 stand-alone units	30,000 sf. (Main Hotel) 1,000 sf. X 50 (Stand Alone Units)		**650**
Hilltop Home Lots	10	≤ 20,000 sf. (each home will be built at the owner's choice. But not to exceed20,000 sf.)	1 ac. each	**1300**

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Waterfront Home Lots	10	≤ 20,000 sf. (each home will be built at the owner's choice, but not to exceed 20,00 sf.)	2 ac. each	**1,100**
Waterfront Home Lots	55	≤ 20,000 sf. (each home will be built at the owner's choice, but not to exceed 20,00 sf.)	1 ac. each	**5,200**
			Lantern Head sub-total	**8,635**

Table 20. SWP and LH Electrical Load Summary

Electrical Load Summary	
Phase	Estimated total demand load (kVA)
South West Point sub-total	13,964
Lantern Head sub-total	8,635
South Abaco Infrastructure Improvements	125
Total demand load (KVA)	**22,724**

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 21.Lantern Head – Potable and irrigation water demands.

Residential Demand							
Master Plan Item No.	**Unit Type**	**No. of Units**	**No. of Persons**	**Demand Per Person (GPD)**	**Average Daily Demand [ADD] (GPD)**		
	Hilltop Home Lots	10	4	125	5,000	Unit count from DLUST Assumed No. Persons based on stand alone home	
	Waterfront Home Lots (2 acre lots)	10	4	125	5,000	Same as Above	
	Waterfront Home Lots (1 acre lots)	55	4	125	27,500	Same as Above	
Total					**37,500**		

Commercial Demand				
Master Plan Item No.	**Unit Type**	**Building Area (sq. ft.)**	**Demand Per Bldg. Area (GPD)**	**Average Daily Demand [ADD] (GPD)**
	Club house	10,000.00	0.125	1,250
	50-room Luxury Hotel	30,000.00	0.125	3,750
	Beach Club	5,000.00	0.125	625
Total				**5,625**

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Irrigation Demand						
Master Plan Item No.	**Unit Type**	**Area (sq ft)**	**Demand Per Sq. Ft. (GPD)**	**Average Daily Demand [ADD] (GPD)**		
	Golf Course			500,000	Assumed based on typical Golf Course irrigation usage	
	Site Landscape Irrigation	2,962,080	0.06	177,724.80		
Total				**677,724.80**		

Potable Water Demand Summary					
Item #	**Boat Length (ft.)**	**Average Daily Demand [ADD] (GPD)**			
1	Residential	37,500			
2	Commercial	5,625			
3	Irrigation	677,725			
Total		**720,850**			
Maximum Daily Demand (MDD) = 1.6 X ADD =			1,153,359.68	GPD	
MDD converted to GPM = MDD/(24 hr X60 min per hr) =				800.94	GPM
Potable water minimum flow =		801	GPM flow		
Fire water minimum flow = 1,000 GPM					

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 22. Lantern Head Sew Flow.

Residential Demand							
Master Plan Item No.	**Unit Type**	**No. of Units**	**No. of Persons**	**Demand Per Person (GPD)**	**Average Daily Demand [ADF] (GPD)**		
	Hilltop Home Lots	10	4	125	5,000	Unit count from DLUST Assumed No. Persons based on stand alone home	
	Waterfront Home Lots (2 acre lots)	10	4	125	5,000	Same as Above	
	Waterfront Home Lots (1 acre lots)	55	4	125	27,500	Same as Above	
Total					**37,500**		

Commercial Demand				
Master Plan Item No.	**Unit Type**	**Building Area (sq ft)**	**Demand Per Bldg. Area (GPD)**	**Average Daily Demand [ADF] (GPD)**
	Club house	11,000	0.125	1,375
	50-room luxury Hotel	30,000	0.125	3,750
	Beach Club	5,000	0.125	625
Total				**5,750**

Sewer Flow Summary				
Item #	**Boat Length (ft.)**	**Average Daily Demand [ADF] (GPD)**		
1	Residential	37,500		
2	Commercial	5,750		
Total		**43,250**		
Design Flow (2 X ADF)			**86,500**	
GPM (Design Flow /[24 hours X 60 Min.]) =			**60.07**	**GPM**

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 23. Potable and irrigation water demand for South West Point.

Residential Demand							
Master Plan Item No.	**Unit Type**	**No. of Units**	**No. of Persons**	**Demand Per Person (GPD)**	**Average Daily Demand [ADD] (GPD)**		
	Artists Village	20	4	75	6,000	Unit count from DLUST Assumed No. Persons based on stand alone home	
	Waterfront Home	18	4	125	9,000	Same as Above	
	Canal Home	44	4	125	22,000	Same as Above	
	Resident "Lifestyle" Village	120	4	125	60,000	Same as Above	
Total					**97,000**		

Commercial Demand				
Master Plan Item No.	**Unit Type**	**Building Area (sq ft)**	**Demand Per Bldg. Area (GPD)**	**Average Daily Demand [ADD] (GPD)**
	Small Casino	7,500	0.125	938
	Medical Facility	4,000	0.125	500
Total				**1,438**

Master Plan Item No.	Unit Type	No. of Units	No. of Persons	Demand Per Person (GPD)	Average Daily Demand [ADD] (GPD)		
	Marina Customs Office (sq. ft.)	1,000	0	0.125	125.00	Unit count from DLUST Assumed No. Persons	
	Marina Village Stores (sq. ft.)	45,000	0	0.125	5625.00	Same as above	
	Limited Service Hotel (rooms)	100	2	50	10,000	Rough Estimate	
	Water Park				150,000	Rough Estimate	
Total					**167,188**		

Marina Demand						
Item #	**Boat Length (ft.) assumed**	**No. of Boats**	**Daily Demand Per Boat (GPD)**	**Average Daily Demand [ADD] (GPD)**		
1	90	50	750	37,500		
2	115	40	1,000	40,000		
3	140	23	1,500	34,500		
4	440	23	3,000	69,000		
Total				**181,000**		
Note: boat size and quantities are assumed based on the information provided in the DLUST.						

Irrigation Demand				
Master Plan Item No.	**Unit Type**			**Average Daily Demand [ADD] (GPD)**
	Site Landscape Irrigation	4,791,600.00	0.06	**287,496.00**
Total				**287,496.00**

Potable Water Demand Summary					
Item #	**Boat Length (ft.)**	**Average Daily Demand [ADD] (GPD)**			
1	Residential	97,000			
2	Commercial	167,188			
3	Marina	181,000			
4	Irrigation	**287,496**			
Total		**445,188**			
Maximum Daily Demand (MDD) = 1.6 X ADD =			712,300.00	GPD	
MDD converted to GPM = MDD/(24 hr X60 min per hr) =				494.65	GPM
Potable water minimum flow =		495	GPM flow		
Fire water minimum flow = 1,000 GPM					

Table 24. SWP Sewer Demands

Residential Demand							
Master Plan Item No.	**Unit Type**	**No. of Units**	**No. of Persons**	**Demand Per Person (GPD)**	**Average Daily Demand [ADF] (GPD)**		
	Artists Village	20	4	75	6,000	Unit count from DLUST Assumed No. Persons based on stand alone home	
	Waterfront Home	18	4	125	9,000	Same as Above	
	Canal Home	44	4	125	22,000	Same as Above	
	Residence "Lifestyle" Village	120	4	125	60,000	same as Above	
Total					**97,000**		
Design Flow (2 X ADD)					**194,000**		
GPM (Design Flow /[24 hours X 60 Min.]) = (176000 GPD/[24 hr X 60 min]) =					**135**	**GPM**	

Commercial Demand						
Master Plan Item No.	**Unit Type**	**Building Area (sq ft)**	**Demand Per Bldg. Area (GPD)**	**Average Daily Demand [ADF] (GPD)**		
	Small Casino	7,500	0.125	938		
	Medical Facility	4,000	0.125	500		
Total				**1,438**		
Design Flow (2 X ADD)				**5,750**		
GPM (Design Flow /[24 hours X 60 Min.]) = (5750 GPD/[24 hr X 60 min]) =					**4**	**GPM**

Master Plan Item No.	Unit Type	No. of Units	No. of Persons	Demand Per Person (GPD)	Average Daily Demand [ADF] (GPD)		
	Marina Customs Office (sq. ft.)	1000	0	0.125	125	Unit count from DLUST Assumed No. Persons	
	Marina Village Stores (sq. ft.)	45000	0	0.125	5,625	Same as above	
	Limited Service Hotel	100	2	50	10,000	Rough Estimate	
	Water Park				150,000	Rough Estimate	
Total					**171,500**		
Design Flow (2 X ADD)					**343,000**		
GPM (Design Flow /[24 hours X 60 Min.]) =					**238**		

Marina Demand						
Item #	**Boat Length (ft.)**	**No. of Boats**	**Daily Demand Per Boat (GPD)**	**Average Daily Demand [ADF] (GPD)**		
1	90	50	750	37,500		
2	115	40	1,000	40,000		
3	140	23	1,500	34,500		
4	420	23	3,000	69,000		
Total				**181,000**		
Design Flow (2 X ADD)				**362,000**		
GPM (Design Flow /[24 hours X 60 Min.]) =				**251**		
Note: boat size and quantities are based on the information provided in the DLUST.						

Sewer Flow Summary				
Item #	**Boat Length (ft.)**	**Average Daily Demand [ADF] (GPD)**		
1	Residential	194,000		
2	Commercial	343,000		
3	Marina	362,000		
Total		**899,000**		
GPM (Design Flow /[24 hours X 60 Min.])=			**624.31**	**GPM**

Table 25. Sandy Point Airport and Hole in the Wall water demand.

Commercial Demand				
Master	**Unit Type**	**Building Area (sq. ft.)**	**Demand Per Bldg.**	**Average Daily Demand**
	Sandy Point Airport Terminal	2,500	0.125	**312.50**
	Hole in the Wall supporting Building	2,500	0.125	**312.50**
Total				**625**

9.13.2 Potable Water

The primary water system for each site will be developed based on a rainwater collection and storage system. All primary structures in each development will be required to be designed to collect rainwater and connect to the rainwater collection system on the site. The collection system will deliver water to a series of reservoirs and holding systems. The collected rainwater will be processed as needed in a central plant into a primary distribution tank for distribution via a piping system to all points of use on each site. Although rainwater is designed to be the primary source of potable water for the project, the use of groundwater wells and the development of a reverse osmosis plant will be considered as a supplement to water needs. Well systems will be used to supplement the storage locations of the rainwater-based water system simplifying overall design implication. All potable water systems will be designed to provide fire protection flow rates around the development, and water use will be metered at all points of use to allow for demand charging. All the water system technologies mentioned are developed and improving technologies.

9.13.3 Sewer

All sewerage will be collected by a centralized collection system for each site and processed in a properly sized central plant(s) per site. Each connection point will be metered so that charges to maintain the sewer plants can be levied based on actual sewerage production. These plants will be designed to produce potable water but will initially be expected to only produce product water sufficient to be used for irrigation. The lush landscaping plans for the developments are expected to create a need for supplemental irrigation even though native planting will be the primary focus of the landscape designs. The ability for the sewer plants to produce both irrigation and potable water is a fundamental part of the redundant design strategy being used for the infrastructure of the development.

9.13.4 Irrigation Water

Irrigation is necessary for both properties as they require fresh water for residential and golf course landscaping. To avoid unnecessary water usage, the landscape design for The Project will focus on incorporating native species whenever possible. However, the golf course would require supplemental irrigation. The irrigation needs of the golf course and related landscaping are estimated annually at 4 acre-feet per turf acre or landscaped acre. With an average annual rainfall of just shy of 4 acre-feet the irrigation needs of landscaping will be relegated to the dry months. Only grey water will be used for this purpose.

The use of an aquifer well may be used as an alternative source of water irrigation for the both properties depending on the demand. Irrigation pipe systems will be installed throughout the development sites at all practical points of connection for optimal use. This irrigation system will be metered at each point to monitor and conserve water use.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

9.13.5 Solid Waste System

During the construction phase, the South Abaco landfill will be used for solid waste storage. The material can be sorted before transportation to divide recyclable waste from non-recyclable waste materials. Recyclable waste will be stored at the South Abaco landfill until suitable facilities are constructed by the Developer. The waste will be self-contained, and that the Developer is open to improving the landfill to accommodate waste generated from the developments during the construction phase. The Developer is willing to work with local government to determine current gaps in the management of the existing landfall and to provide adequate assistance in improving this facility. In its current state, the local landfill is not regularly managed, increases the risk of wildfires in the area, and is a potential source of contamination of the nearby protected Cross Harbor National Park.

Final waste estimates have not been calculated as final designs and quantities of construction material yet to be completed. An US EPA formula for calculation of solid waste is presented below:

$$C_w = M \times W_c$$

where C_w = total amount of construction waste generated; M = estimated materials to be consumed; W_c = percentage of material discarded during new construction

Estimated percentages of construction material discarded during construction projects are presented below:

Table 26.Estimated % of construction waste.

Material	Percent Discarded
Concrete	3%
Wood Products	5%
Drywall and Plasters	10%
Steel	0%
Brick and Clay Tile	4%
Asphalt Shingles	10%
Asphalt Concrete	0%

Source: DelPico (2004) and Thomas (1991)

The design strategy is to establish a single back of house location for solid waste collection and management. A solid waste collection method will be designed for the overall development to separate and collect organic waste, recyclable waste, and non-recyclable waste. The organic waste will be composted in a purpose designed back of house facility. The composting byproducts will be used for fertilizer at the nursery facility and throughout landscaping around the development. Recyclable wastes will be collated at the facility and compacted for transport to suitable facilities. Heavy solid wastes will similarly be transported to proper facilities for disposal. The development will require very regular supply of goods which is anticipated to be primarily from the US via ocean freighter or barge. This supply system could be used, on its way back, if necessary, to transport and dispose of solid waste in proper waste disposal sites in the USA, if desirable. This will be determined as the operational details of the development are established during the design phase.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

9.13.6 HVAC Systems

The heating, ventilation and air condition (HVAC) systems in the development are to utilize high performance advanced heat pump systems such as those manufactured by Mitsubishi, Sanyo, LG, Trane and Carrier. These systems are main stream allowing a more sustainable maintenance approach than a highly specialized custom central plant. As their name implies, these systems can heat as well as cool thus eliminating the need for special systems to concentrate on the occasional space heating need. These systems will also be required to connect to hot water systems to maximize the energy capture within the

structure whenever possible. The design standard for the development will be to use solar water heating as the primary hot water system. This technology is well developed and further reduces the load that water heating puts on the energy system for the development. Solar water heating is able to produce all the needs for any residence within the developments and can meet most of the needs for the commercial needs in the hotels and retail establishments planned. Connecting HVAC systems into the hot water system will augment solar capability. Any unmet water heating need will be met with propane on demand systems whenever practical to reduce the peak load design requirements for the development's electrical grid.

9.13.7 Pool Heating

As the development of The Project promotes its establishment as a luxury resort, pool heating is an amenity that upholds the standards of upscale recreational pool use. Direct solar energy will be sourced to heat the resort's pool amenities. Although, the sun provides ample solar energy, alternative pool heating systems are necessary for less than ideal weather conditions as a continued heating source. Energy efficient advanced pool heat pump systems will be installed for public resort pools. However, residential homes will be required to only use solar heating if owners deem pool heating is necessary.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

10 Environmental Laws, National Environmental Policies and International Conventions

10.1 Relevant Governmental and Non-Governmental Agencies

The relevant regulatory bodies having jurisdiction relating to environmental protection in The Bahamas and their mandate, laws, regulations and policies:

10.1.1 Ministry of Public Works

The Ministry of Public Works maintains the physical infrastructure and natural environment of The Bahamas.

Department of Public Works

The Department of Public Works maintains public infrastructure inclusive of government buildings, roads, docks, bridges and cemeteries.

Department of Physical Planning

The Department of Physical Planning manages town, physical, country and land use planning, zoning, private roads and subdivisions for New Providence and the Family Islands.

Department of Lands and Surveys

This department is responsible for planning, mapping and monitoring of crown land (i.e. where beaches begin and end, high water marks etc.).

Conservation and Protection of the Physical Landscape of The Bahamas Act, 1997 (Ch. 260)

"An Act to make provision for the conservation and protection of the physical landscape of The Bahamas",

- where, section 3 speaks to excavation and harvesting of protected trees.

Town Planning Act, 1961 (Ch. 255)

"An Act relating to town planning",

- where, section 5 speaks to prescribed restricted areas and forbidding building activities.
- where, section 7 speaks to committee sanctioned development activities.

Planning and Subdivision Act, 2010

"An Act to combine, consolidate and revise the law related to town planning and law relating to the development of subdivisions and to provide for matters connected thereto",

- where, section 3 speaks to the purpose of this Act which includes:
    - to provide planning for a controlled development system led by policy, land use designations and zoning;
    - the prevention of indiscriminate division and development of land;
    - to ensure the efficient and orderly provision of infrastructure and services to the built environment;
    - promoting sustainable development in a healthy natural environment;
    - to maintain and improve the quality of the physical and natural environment;
    - to protect and conserve the natural and cultural heritage of The Bahamas;

- to provide for planning processes that are fair by making them open, accessible, timely and efficient;
- to recognize the decision-making authority and accountability of the Government in land use planning; and
- to plan for the development and maintenance of safe and viable communities.

Coast Protection Act, 1968 (Ch. 204)

"An Act to make provision for the protection of the coast against erosion and encroachment by the sea and for purposes connected therewith",

- where, section 8 speaks to approval for coastal protection work.
- where, section 9 speaks to the excavation of materials that compose of the seashore.

10.1.2 Water and Sewerage Corporation

The Water and Sewerage Corporation is entrusted with managing, maintaining, distributing and developing the water resources of The Bahamas.

Water and Sewerage Corporation Act, 1976 (Ch. 196)

"An Act to establish a Water and Sewerage Corporation for the grant and control of water rights, the protection of water resources, regulating the extraction, use and supply of water, the disposal of sewage and for connected purposes",

- where, section 3 speaks to government control of the production, extraction and use of water in the public interest.

10.1.3 Ministry of Environment & Housing

The Ministry of Environment and Housing serves to protect, conserve and manage the environment of The Bahamas. This ministry focuses on environmental control, solid waste management, public sanitation and the beautification of public areas such as parks and beaches.

Department of Environmental Planning and Protection (DEPP)

DEPP manages environmental agreements and evaluates environmental impact assessments (EIA) and environmental management plans (EMP) for development projects within The Bahamas. The BEST Commission was subsumed by the Department of Environmental Planning and Protection.

Department of Environmental Health

The Department of Environmental Health manages the disposal of all wastes and management of environmental pollution (on land or in water). This department also promotes planning and approves various measures designed to ensure wise use of the environment.

Environmental Health Services (Collection and Disposal of Waste) Regulations, 2004 (Ch. 232)

"These Regulations may be cited as the Environmental Health Services (Collection and Disposal of Waste) Regulations, 2004",

- where, section 3 speaks to the provision of waste collection service.
- where, section 5 speaks to commercial waste.

Environmental Health Service Act, 1987 (Ch. 232)

"An Act to promote the conservation and maintenance of the environment in the interest of health, for proper sanitation in matters of food and drinks and generally, for the provision and control of services, activities and other matters connected therewith or incidental thereto",

- where, section 12 speaks to solid and liquid waste treatment in accordance with government regulations.
- Where, section 14 speaks to government notification of emissions or discharge, etc. of contaminant pollutants.

Marine Mammal Protection Act, 2005 (Ch. 244A)

"An Act to make provision for the protection of marine mammals",

- where, section 4 speaks to the prohibition of harassing, etc. of a marine mammal.

Forestry Act, 2010

"An act to provide the conservation and control of forests and for matters related thereto"

- where, section 7 speaks to the declaration of protected forests.
- where, section 10 speaks to the declaration of protected trees.

Wild Bird Protection Act, 1952 (Ch. 249)

"An Act to make provision for the protection of wild birds",

- where, section 4 speaks to the killing or capture of wild birds during closed season.

Wild Animals Protection Act, 1968 (Ch. 248)

"An Act to make provision for the control of the taking and export of wild animals",

- where, section 3 speaks to taking of capture of wild animals.

10.1.4Office of the Prime Minister

The Office of the Prime Minister coordinates ministries, government and parliamentary business.

National Emergency Management Agency

The National Emergency Management Agency (NEMA) aims to reduce life and property loss in the event of a natural disaster.

Disaster Preparedness and Response Act, 2006 (Ch. 34A)

"An Act to provide for a more effective organization of the mitigation of, preparedness for, response to and recovery from emergencies and disasters."

- Contains parts regarding Director of the National Emergency Management Agency; Advisory Committee, policy review and plan; emergency operation centers and shelters; obligations of other public officers; specifically, vulnerable areas; disaster alerts and emergencies; and miscellaneous entries.

Antiquities, Monuments and Museum Corporation

This quasi-governmental organization protects, preserves, and promotes the archaeology and historic cultural resources of The Bahamas.

Antiquities, Monuments and Museum Act, 1998 (Ch. 51)

"An Act to provide for the preservation, conservation, restoration, documentation, study and presentation of sites and objects of historical, anthropological, archaeological and paleontological interest, to establish a National Museum, and for matters ancillary thereto or connected therewith",

- where, section 3 speaks to the declaration of a monument by reason of its historical, anthropological, archaeological or paleontological significance.

The Bahamas National Trust

The Bahamas National Trust is a legislated non-government organization charged with developing and managing the Bahamas National Park Systems.

Bahamas National Trust Act, 1959 (Ch. 391)

"An Act to incorporate and confer powers upon The Bahamas National Trust for Places of Historic Interest or Natural Beauty".

10.2 International Conventions of Relevance

The relevant international treaties, conventions and agreements to which The Bahamas is a signatory and their competent authorities are as follows:

Ramsar

• "The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world."

Barbados Programme of Action

• Established by the UN General Assembly 25 April to 6 May 1994, the Barbados Programme of Action reaffirms principles and commitments to sustainable development as embodied in Agenda 21 and translated these into specific policies, actions and measures to be taken at the national, regional and international levels.

Stockholm Convention Persistent Organic Pollutants

• "As set out in Article 1, the objective of the Stockholm Convention is to protect human health and the environment from persistent organic pollutants."

Commission on Sustainable Development

• "The United Nations Commission on Sustainable Development (CSD) was established by the UN General Assembly in December 1992 to ensure effective follow-up of United Nations Conference on Government Departments and Local Non-Governmental Organizations Environment and Development (UNCED), also known as the Earth Summit."

Kyoto Protocol

• The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets.
• The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005.

International Convention for the Prevention of Pollution from Ships (MARPOL)

• MARPOL Convention was adopted on November 2nd, 1973 and is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.
• This Convention focuses on regulations that prevent and minimize accidental and routine operation pollution.

11 Environmental Impact Analysis

11.1 Methodology

The impact analysis is a critical component of the EIA process as it evaluates the potential impacts resulting from the interaction between project related activities and the surrounding environment during construction and operations Phases of the Project. Impacts are described as changes brought about to the surrounding environment as a result of project related activities. The surrounding environment for this EIA is inclusive of the physical, biological and socioeconomic environment within the Project's area of influence. Environmental aspects considered in this analysis are listed in the table below.

Table 27. Environmental impact analysis aspects.

Environmental	
Physical	Hydrology & Hydrogeology
	Air Quality
	Noise
Coastal Processes	Erosion & Sedimentation
	Beach
Biological	Terrestrial Habitats
	Marine Habitats
	Birds
	Terrestrial Flora
	Marine Mammals
	Marine Resources
So-Econ	Neighboring Communities
	Relocation
	Traffic
	Economic
Cultural	Archaeological, Historic & Paleontological Resources
	Hunting
	Fishing

Project related activities during construction and operations have the potential to impact the surrounding environment, and the nature of these impacts can be Adverse or Positive and Direct or Indirect. Negative impacts are activities which result in an adverse change or degradation from the environmental baseline, while positive impacts result in a beneficial change or improvement to the environmental aspect under consideration. Direct impacts result from the direct interaction between Project related activities and the surrounding environment, while indirect impacts consequences of the Project implementation on the surrounding environment on a larger time and distance scale.

Cumulative impacts are the compounding effects of Project related activities when combined with past, current or future actions related to this or another Project in the nearby environment. Cumulative impacts represent the interaction of impacting factors originating from different sources with the same host environment. The result is typically an exacerbation of the impact on the environmental aspect and is considered in this assessment.

Significance in this assessment is a determination of the degree of importance assigned to an environmental impact resulting from project related activities. An impact's significance is evaluated in terms of its magnitude and likelihood. Magnitude is a function of the impact's extent, whether restricted on site to the immediate project area, locally within a 10-mile radius, regionally to include the island of Abaco and the Northern Bahamas and Nationally to include the extent of The Bahama Archipelago.

The duration of the impact relates to the temporal scale which is required for changes in the host environment to return to baseline conditions or undetectable levels. Temporary impacts persist for a short duration and occur occasionally and/or intermittently. Short Term Impacts are expected to persist for the duration of the project activities related to the construction phase of the Project. Long Term impacts extend beyond the duration of the construction period and exist throughout the life of the project. Permanent impacts persist far beyond the life of the project and are irreversible changes to the host environment due to project related activities.

The intensity of an impact can be considered as Negligible, Low, Medium or High. A Negligible impact is one which has no detectable change on the host environment. A low intensity impact does not affect the host environment in such a manner to alter natural flows and processes. Medium intensity impacts alter the natural flows and process of the host environment while allowing the flows and process to retain their natural functions. High intensity impacts alter natural flows and processes to the extent where natural functions are totally inhibited for a temporary or permanent period of time.

The likelihood of an impact is a rating which evaluates the likely potential for an impact to occur, with typical rating categories being unlikely to occur, likely to occur under most conditions, and definitely will occur.

11.2 Land Use Impacts

No commercial or ongoing developmental infrastructure exists within the footprint the proposed developments at Lantern Head and SW Point. Past activities within this area consist of logging, and farming of sisal and pineapple. Currently, no farming is practiced within the area, as it is unoccupied and used by locals for recreational purposes. Evidence of hunting platforms and spent shotgun shells indicate the presence of this recreational activity. Hunting in the immediate areas of the development may be prohibited for safety purposes. However, hunting is permitted in other natural areas in South Abaco, including the BNT's Abaco National Park.

Approximately 327 acres of land will be impacted directly or indirectly by the proposed Lantern Head development; inclusive of the Full-Sized 18-hole Golf Course, BOH Facility, Employee Housing, Hotel, Residential Lots, Beach and Golf Club. The design of this proposed development also encompasses the creation of road infrastructure and pathways necessary to access available amenities. This impact will affect the terrestrial and marine environment within the immediate and surrounding area of the development.

Approximately 358 acres of land will be impacted by the proposed SW Point development; inclusive of the Marina, Entrance & Flushing Channel, one (1) Hotel, Marina Village, Residential Lots, Artists Village, Small Water Park, and BOH Facility. The design of this proposed development also encompasses the creation of cart and pedestrian pathways necessary to access available amenities. Direct and indirect impacts of the biological and physical environment will arise as a result of development within this area.

11.3 Aesthetic Impact

The properties at Lantern Head and SW Point are both undeveloped, natural areas with inherent beauty in the landscape and wildlife present onsite.

The primary visual features of the proposed development at Lantern Head are the stunning ocean views and the 18-hole golf course. Its residential lots are designed to encourage community development, while the hotel displays opulent features. The layout captures the availability of natural light and south east winds. Golf course landscape and features increase the beauty of the proposed development due to its greenery, water features and contours. The aesthetics of this development will mesh with the natural environment, creating a seamless transition from nature to luxury. Beach creation along the southern Lantern Head beach would amplify the beauty of this beach zone while adding appeal to guests.

The SW Point project design emphasizes the beauty of the marine and terrestrial environment, with the marina as its focal point. Residential lots take advantage of the elevated coastal ocean views and its fresh ocean breezes. The overall layout of the project is aesthetically pleasing, as the design thrives to create a thriving and vibrant community which encourages the development and exhibition of Bahamian culture. Due to its remote location, the development cannot be seen from the surrounding communities as it is obstructed by miles of pine and coppice forest. The existing shipwreck along the south western shoreline serves as an unpleasant view because rests in the middle of the beach zone.

11.4 Impacts to the Physical Environment

11.4.1 Erosion and Sediment Impact

Lantern Head Erosion and Sediment Impact

The presence of the proposed jetty structure should not increase erosion down drift due to its position, as it is not trapping sediment. This jetty is intended to act as a barrier from wave intensity for bathers. Its design is not intended to be installed perpendicular to the beach. Thus, its presence would not create adverse effects to the beach or shoreline along the northern end of the southern Lantern Head beach where it is proposed to be placed. This jetty is intended to act as a barrier from wave intensity for bathers. The effects of the jetty located at the Lantern Head southern beach are minor as the proposed jetty will be an extension of an existing iron shore projection, which has depressed wave action and supported accretion to form the current beach onsite. Its impact on erosion and sedimentation is minor and should not impact the process of natural beach erosion.

Land clearing associated with upland construction and the development of a full-sized 18-hole golf course can increase the potential for erosion of exposed topsoil and sedimentation into aquatic resources. This activity can adversely impact water resources due to sediment contamination, also removing soil nutrients and biota supporting the ecology of the terrestrial habitats. It is unlikely, that the development of the golf course would directly impact the marine environment due to its elevation and distance from the coastline. However, due to the limestone geography of The Bahamas, it is possible that indirect leaching is likely to occur through underground caverns and other subterranean features leading to the marine environment.

Land clearing on the coastal facing ridges will increase the potential for erosion of loose sediment into the marine environment via surface run-off. Appropriate erosion control and other environmental mitigation strategies must be practiced avoiding negative impacts of erosion and sedimentation during the construction phase of the project. Minor negative impacts may occur but will be localized and temporary.

South West Point Erosion and Sediment Impact

Upland clearing activity can increase the rate of erosion and sedimentation, which has the potential to negatively impact water resources within the onsite areas of the project. During heavy rain and flooding events, loose sediment can enter the marina basin via surface run-off, increasing turbidity in the near shore areas of the project.

The excavation of the marina basin will expose the limestone walls to the erosive forces of wave action once the marina plug has been opened. Gradual erosion can weaken the integrity of the rock supporting the upland structures along the immediate boundaries of the marina.

Excavation will occur during the creation of the marina basin and dredging of the entrance channel. This activity can potentially impact water quality in near shore environment by increasing turbidity. The effects of high turbidity include light restrictions for marine flora (primary producers), diminish recreational and aesthetic value. Short term exposure to high turbidity conditions will have minor impact on coral species, however some are more susceptible to prolonged exposure. Corals can survive high turbidity ranges from several days (sensitive species) to at least 5- 6 weeks (tolerant species). Increased sedimentation has the potential to cause smothering and burial of coral polyps, tissue necrosis and population explosions of bacteria in coral mucus (Erftemeijer et al., 2012[12]). High turbidity within this marine environment could potentially decrease aesthetic value of the immediate of surrounding marine environment.

The jetties along the boundary of the marina entry canal at South West Point will temporarily increase turbidity when the boulders are placed on the seabed. Placing the boulders on the seabed will also negatively impact the marine life on the benthos.

The anticipated long term impacts of installing a groyne at the South West Point is continued beach accretion at the sites.

Impacts resulting from sedimentation during marina construction will have minor negative and short term impacts to water quality and biological resources in the immediate environment of the marina basin.

11.4.2 Beach Impact

Lantern Head Beach Impact

The effects of the jetty located at the Lantern Head southern beach are minor as the proposed jetty will be an extension of an existing iron shore projection, which has depressed wave action and supported accretion to form the current beach onsite. The extension of the beach face which provide bathers the opportunity to enjoy recreational swimming while protecting the beach zone from intense wave activity. Furthermore, protecting the foreshore from high energy erosion effects.

Beachfront and Oceanfront residences are positioned behind the primary dune system and will not remove the dune during construction of these structures.

South West Point Beach Impact

The coastal areas of the South West Point property are devoid of sandy beaches, with only a rocky rubble beach along the northwestern shoreline of the property. The development will create a sandy beach area to replace the existing hard bottom and stony foreshore environment; which is located along the north western coastline. To accomplish this, it is proposed a groin structure be constructed within the foreshore area of the beach, which will support accretion of sand in these areas, and retain sand used in the beach creation. Overtime, the presence of these large boulders or metal structures create uplift accretion which aid in trapping sand and other sediment along the foreshore of the beach. The beach creation will enhance the aesthetics of the current rocky rubble beach for the residents and guests at SW Point. As marine resources in these immediate areas are scarce, minor negative impacts are expected with the local areas of the project. Potential adverse impacts on adjacent beaches are likely in severe storms due to down drift erosion of sand used in the beach creation.

11.4.3 Hydrological Impact

Lantern Head Hydrological Impact

[12] Erftemeijer, P. L. A., Riegl, B., Hoeksema, B. W and Todd, P. A. (2012). Environmental impacts of dredging and other sediment disturbance on corals: A review. *Marine Pollution Bulletin.* 64*,* (9): 1737-1765.

Moderate adverse hydrological impacts may arise at Lantern Head from the creation of the golf course and the development infrastructure. Excavation of golf course ponds may temporarily decrease surface water quality and disrupt the natural flow of underground hydrological resources. Excavation of trenches has the potential to alter surface water flow from the high ridgelands into the rocklands and coastal areas. Additionally, concrete slabs and asphalt roadways become impermeable and reduces ground water recharge into the onsite aquifers. The low-density nature of the development will reduce the potential for adverse hydrological impacts due to reduced groundwater recharge. A storm management plan for the Project will be developed before any construction activities commence and will outline plans for diverting storm water runoff into the golf course ponds and natural wetlands surrounding the property.

The use of Reverse Osmosis may be necessary to supply potable water to the proposed development, however harvested rainwater, and recycled grey water will also be utilized to supplement water demands. Although fresh water resources have been described as generally plentiful in the south Abaco areas, mitigations measures must be taken to prevent saltwater intrusion of freshwater aquifers via extraction by RO plants for the development.

South West Point Hydrological Impact

Major adverse impacts to the hydrology of South West Point are considered due to the excavation of the marina basin. Direct impacts from the introduction of salt water into a terrestrial basin increases the potential of salt water intrusion into potential onsite freshwater aquifers. The existence of the tidal wetland and subterranean fissures within the footprint of the marina basin indicates that excavation of this area will alter the onsite hydrology as it relates to subsurface water flow and tidal fluctuations. The installation of concrete curtain walls during the marina construction will decrease the potential of salt water impact on the inland terrestrial habitats.

11.4.4 Air Quality Impact

Lantern Head Air Quality Impact

The proposed development would generate minor adverse impacts to air quality in the immediate and surrounding environments at Lantern Head. During construction, emissions from construction vehicles and equipment, as well as emissions and dust from project activities will temporarily lower local air quality in the immediate areas of the development. It is expected that impacts to air quality from these activities are short term and will last the duration of construction phase.

Major sources of emission during the operations phase of the Lantern Head Project will be fossil fuel powered equipment and machinery onsite. Diesel generators can reduce local air quality during operation, which are expected to be minor negative impacts lasting the duration of the project lifetime.

Studies suggest that the net annual oxygen production by urban forests ranges from 1,100 tons to 94,800 tons, with regards to rate of oxygen inhalation (Nowak et al., 2007)[13]. The forest habitat at Lantern Head is significantly larger than that of an urban forest. Therefore, it is understood that this area potentially provides vast amounts of oxygen and is a vital component in a clean air quality. Furthermore, the creation of fossil fuel emissions during construction and operational phases moderately threaten the air quality if environmental monitoring is left unmanaged. No burning will be conducted on the property during land clearing. Overall, air quality impacts

[13] Nowak, D. J., Hoehn, R., and Crane, D. E. (2007). Oxygen production by urban trees in the Unites States. *Arboriculture & Urban Forestry. 33* (3): 220-226.

within the footprint of the Lantern Head development site are minor due to the constant winds from the eastern coastline over the Atlantic Ocean. Once the development is in operation, minimal impacts to the air quality will result from power generator emissions, as the Developer intends to follow best environmental practices.

South West Point Air Quality Impact

Construction phases of the marina would produce minor negative impacts to the air quality of the immediate construction zone due to the temporary nature of these activities. Suspended particulate matter (SPM) is created during upland clearing and stock pile activities; which is potentially the main source of air emissions. Additionally, fossil fuel emission from construction vehicles and machinery would alter air quality and compromise its existing pristine nature. Thus, impacting native and endemic bird habitats and behavior. Avian responses to air pollution include respiratory distress and illness, increased detoxification effort, elevated stress levels, immunosuppression, behavioral changes, and impaired reproductive success which result in reduced population density, species diversity, and species richness in bird communities (Sanderfoot et al., 2017)[14]. No burning will be conducted on the property during land clearing, which could possibly exasperate air pollution. The magnitude of impact depends on weather conditions such as prevailing winds, wind speed and precipitation. South east prevailing winds are dominant most of the year in South Abaco, however, the wind direction typically shifts to north and north west in the winter months. It is unlikely that the surrounding communities would be affected by air pollutants due to their distant location from the localized impacts within the construction site. Therefore, reducing the high risk of public health issues that arise as a result of poor air quality.

Minor adverse impacts of air pollution are expected to occur during marina operations. These pollutants include fossil fuel emissions from volatile fuel storage, energy utilities, boat repairs, boat and vehicle exhaust. Boat repair emissions could have minor effects on the air quality due to activities such as sanding and paint spraying activities. Widespread effects of these emissions are unlikely. However, the SPM produced could impact the surrounding marine and upland environments, as this matter would inevitably land on the marine or land surface. Boat and vehicle exhaust are not expected to have adverse effects to the air quality once proper management and maintenance practices are performed. Routine boat and vehicle maintenance would reduce excess fossil fuel emissions. Also, volatile fuel storage units and fueling stations are not expected to have significant influence on the air quality when following marina environmental standards. The presence of a diesel-powered stationary generator and fuel storage located at South West Point would emit fossil fuels. Diesel exhaust contains a mix of toxic substances and is classified as a known human carcinogen. Increased use for electricity generation will also increase the exposure to harmful emissions (World Health Organization, 2012)[15]. However, its effects would be minimal once it is properly contained and managed.

11.4.5 Noise Impact

Lantern Head and SW Point Noise Impacts

Contributing factors to the potential noise impacts associated with the construction phase of the proposed

[14] Sanderfoot, O. V. and Holloway, T. (2017). Air pollution impacts on avian species via inhalation exposure and associated outcomes. *Environmental Research Letters.* 12: 3-16.

[15] World Health Organization – International Agency for Research on Cancer. IARC: Diesel Engine Exhaust Carcinogenic (Press Release No. 213). June 12, 2012. Available at http://press.iarc.fr/pr213_E.pdf.

development includes the use of construction vehicles and equipment as well as noise emanating from project activities during construction. Noise associated with the construction phases of the Lantern Head development would be considered minimal, due to its temporary operation and should not rise to increased levels that are detrimental to human health. Due to its remote location, the noise produced should not affect surrounding stakeholder communities.

Increased levels of noise however, can potentially have a moderately negative impact on birds within the surrounding area. Thus, affecting native and endemic bird species such as the Bahama Parrot (*Amazona leucocephala bahamensis*) within this environment. This impact affects the behavior, biodiversity and population of bird species located in the coppice and pine forest ecosystem, as they tend to avoid areas of disturbance when noise levels exceed 45-57 db. (Bottalico et al., 2015)[16]. Bahama Parrots communicate with loud high-pitched sounds and rely on auditory stimuli to detect their environment. Adaptation changes in their communication behavior, such as increased vocalization, occur as an effect of increased noise activity which masks the bird vocalizations within their surroundings. Therefore, exposing them to predation and increasing their rate of energy excretion.

During fully operational phases of the development, increase vehicle and energy generation infrastructure would act as contributing factors to increased noise availability. The use of golf carts would be used as a source of transportation to access amenities and service facilities throughout the property. Thus, eliminating the congestion and noise pollution associated with vehicular traffic and emitting lower sound frequencies than a fully automated vehicle.

According to the American National Standards Institute, on site construction noise levels should not be prolonged and exceed 85 dB. (Zitzman, 2018)[17]. The Developer intends to work within environmental standards which alleviates potential noise impacts on stakeholders and native fauna.

[16] Bottalico, P., Spoglianti, D., Bertetti, A. C., and Falossi, M. (2015). Effect of noise generated by construction sites on birds. Retrieved from
<https://www.researchgate.net/publication/277589185_Effect_of_Noise_Generated_by_Construction_Sites_on_Birds>

[17] Zitzman, L. (2018). How loud is construction site noise. Retrieved from <https://blog.ansi.org/2018/10/how-loud-is- construction-site-noise/#gref>. *American National Standards Institute.*

11.5 Biological Impacts

11.5.1 Habitat Fragmentation

<u>Lantern Head - Golf Course Creation</u>

Figure 168. . Lantern Head golf course habitat impact.

Table 28.Lantern Head habitat use for the creation of the golf course.

Habitat	Existing Area Onsite (acres)	Habitat to be Impacted by Golf Course	% removed	Area remaining
Mixed Pine Woodland - Coppice	115	61.7	54%	53.3
Broadleaf Coppice	403	156	38.70%	247
Coastal Shrubland	124	0	0	124
Rocky Shore	13	0	0	13
Sandy/Dune	7	0		7

Table 29. Lantern Head habitat use for the creation of residential lots.

Habitat	Remaining Area	Area to be impacted by upland development	% removed total	total area remaining
Mixed Pine Woodland-Coppice	53.3	0	54%	53.3
Broadleaf Coppice	247	190	86%	57
Coastal Shrubland	124	90	73%	34
Rocky Shore	13	2	15%	11
Sandy/Dune	7	1	14%	6

SW Point Marina Creation

Figure 169. South West Point habitat impact.

Table 30. South West Point habitat loss during marina construction.

Habitat	Existing Onsite (acres)	Habitat area to be impacted by Marina Creation (acres)	% removed	Area Remaining
Broadleaf Coppice	443	97.8	23%	**345.2**
Coastal Shrubland	30	2.96	14.4%	**27.04**
Rocky Shore	16.4	2.17	17.5%	**14.23**
Hard Bottom – Patch Reef		**1.21**		

Table 31. South West Point habitat loss during upland construction.

Habitat	Existing Onsite – After Marina Construction (acres)	Habitat area to be impacted by Upland Construction (acres)	% removed	Area Remaining
Broadleaf Coppice	345.2	320	93.00%	**25.2**
Coastal Shrubland	27.04	22	82.00%	**5.04**
Rocky Shore	**14.23**	**10**	**70.00%**	**4.23**

11.5.2 Habitat Loss and Degradation Impacts

Significant habitat loss at the Lantern Head property will be caused through land clearing for the creation of the golf course. The golf course creation will require removal of approximately 62 acres of Mixed Pine-Coppice habitat and approximately 184 acres of broadleaf coppice forest. Upland construction at Lantern Head will require removal of 20 acres of broadleaf coppice and 55 acres of coastal shrublands.

The marina creation at SW Point will result in significant habitat loss in the terrestrial habitats on the property. Land clearing and excavation will require removal of approximately 98 acres of broadleaf coppice, 2.96 acres of coastal shrubland, 2.17 acres of rocky shoreline and 1.21 acres of patch reef habitat for the entrance and flushing channels. Upland construction at SW Point will require removal of 47.3% acres of broadleaf coppice, 2.3 acres of coastal shrubland and 1 acre of rocky shoreline.

Approximately 810,000 cu. ft. of material will be dredged from the entrance channel, the remainder will be excavated from the inland marina basin. The material will be stored in strategically located stockpile areas near to future lots and roadways, construction pads and earth works on SW Point and Lantern Head. Excess material from the marina excavation will be trucked to Lantern Head and stored in areas slated for construction of the golf course. Excavation material will also be utilized at the Sandy Point airport to raise the level of the site, and for improvements at the South Abaco landfill. This fill will also be used in developments of the road improvement. All excavated and dredged material will be properly stored away from bodies of water and utilized during construction of the development. No spoils will enter the marine environment once excavated/dredged.

Figure 170. Proposed material stockpile areas at SW Point are located in sections 11,12, 15,17,18,20, 22 & 23.

Figure 171. Proposed stockpile areas at Lantern Head.

11.5.3 Impacts on Special Ecological Features and Biodiversity

The vegetation in these habitats serve as feeding as breeding grounds for terrestrial organisms including the endemic Abaco Parrot and Bahama Swallow, as well as other rare, endemic or protected species of Bahamian birds. Removal of nesting habitats during breeding season can have population level impacts for bird species utilizing the forested habitats on both properties.

Land clearing for construction and road laying will fragment terrestrial habitats and can impose edge effect on these healthy forest habitats. Disturbances in the forest structure alters resource availability for forest species and increases the potential for introduction of invasive species in cleared areas.

The removal of this habitat will also directly impact populations of coppice forest species in these areas, inclusive of the endemic *Thouinia discolor*, protected *Swietenia mahagoni* and *Pinus caribea var. bahamensis*, and rare orchid and bromeliad species. Mitigation against removal of forest habitats can include the intentional preservation of habitat corridors throughout the property, use of native trees in landscaping, and the transplanting of rare, endemic and protected species where feasible.

At Southwest Point, the marina creation will require excavation of the tidal wetland located within the broadleaf coppice. The hydrological connectivity and distance from the coastline make this wetland a unique feature to this property not commonly observed in the surrounding areas of South Abaco.

11.5.4 Marine Resource Impacts

Lantern Head Marine Resource Impacts

The development at Lantern Head has the potential to impose moderate adverse impacts upon the marine resources along the eastern coast of south Abaco, due to the position of the amenities along this coastline. Furthermore, land clearing associated with upland construction and the development of a full-sized 18-hole golf course can increase the potential for erosion of exposed topsoil and sedimentation into aquatic resources.

The presence of these amenities creates the potential to generate hazardous, sewage and solid waste pollution, which can possibly enter the nearby marine ecosystem, negatively impacting the water quality and marine resources. Eutrophication occurs due to the high nutrient levels introduced as a result of nutrient pollution run-off. Added nutrients increase pH levels, lowers dissolved oxygen, affects the energy movement throughout trophic levels, affects public health and creates an overall toxic marine environment for organism. When water quality is affected, this impacts the marine resources and stakeholders that rely on them. Commercially important fish associated with available toxins due to poor water quality can cause public health issues. Bioaccumulation of toxins in fish tissue can be ingested by locals reliant on this source of protein.

Lantern Head beach would amplify the beauty of this beach zone while adding appeal to guests. Moreover, the presence of a jetty structure could positively affect the marine resources within this environment. Jetties have the potential to become artificial habitats due to algae and coral growth. This growth encourages an increase in marine fauna populations due to food availability by primary producers which support various trophic levels within this marine ecosystem.

South West Point Marine Resource Impacts

The South West Point project design emphasizes the beauty of the marine and terrestrial environment, with the marina as its focal point. The dredging required at SW Point is not extensive, as it will be limited only to the entrance channel, extending from shore to a depth of 25ft. The selection of SW Point for the marina location was guided by the site’s proximity to deep water, i.e. 25ft depth, at approximately 100ft offshore. Impacts to corals will be mitigated through transplanting species were possible and impacts due to turbidity will be temporary and short term.

Large scale land clearing is an unavoidable impact of the project, however commitments such as the donation of 174.5 acres of forested land to the government, monetary donations to the BNT for management of the donated forest and towards the Abaco National Park, and strategic partnerships with BNT to salvage terrestrial species prior to land clearing will assist in mitigating against the overall impact of land clearing activity on the ecology of SW Point and Lantern Head.

The construction of the marina at SW Point would have moderate environmental impact on the marine resources within this area and its surrounding environments. This is due to the removal of habitat in the entrance and flushing channels and the potential to adversely impact water quality. Patch reef systems supporting various fish species and endangered coral were observed in the immediate areas of the flushing and entrance channels. The dredging activities would remove this habitat and impact local ecosystems and biodiversity. However, this impact would be localized to the dredged channels, and transplanting of coral species is a mitigation measure that can be employed prior to dredging. Noise created during dredging activity will be temporary and have minor negative impacts on marine resources.

Water quality would be temporarily impacted during dredging activity as turbidity will increase within the immediate areas. When sediment is disturbed, and turbidity increases, it reduces light availability for primary producing organisms and their consumers. Turbidity silt curtains should be used to contain the disrupted sediments that were agitated during dredging activities.

Other sources of pollution during the construction stage include discharges from marine and land-based construction equipment and land based run-off from dredge spoils. Discharges of grey or black water, petroleum-based products, solvents and other hazardous chemicals during construction has the potential to alter chemistry in the immediate areas of the marina basin, adversely impacting marine resource utilizing these habitats. Accumulated marine impacts for the development include possible pollution that may affect the existing water quality at both Lantern Head and South West Point. These moderate to adverse impacts may result from construction activities such as dredging, and exaction works.

The operations phase of the marina will have moderate adverse impacts to marine resources in the immediate areas of the marina. Routine operations such as boat fueling, washing, repair and maintenance can introduce pollutants into the marine environment of the SW Point Marina, eventually entering the open ocean habitats and impacting marine habitats and organisms. Increased boat traffic can potentially negatively impact turbidity in shallow areas through engine kick up, increase ambient noise levels in the immediate marine environment, and increase the risk of collisions with large marine mammals and turtles known to inhabit the deeper water off the coast of South Abaco. Added fishing pressures are also expected on marine resources in the South Abaco areas as boaters practice recreational and sport fishing.

11.5.5 Wildlife Impacts

Lantern Head South West Impacts

The clearing of forest vegetation impacts bird ecosystems and their population within this affected area. This can negatively affect the Abaco Parrot population as they nest below ground. Therefore, removing habitat, nesting areas and possibly reducing the population of an endemic species. The Developer has committed to incorporating vegetation within the landscape of the development to offset this environmental impact. For instance, plants such as Coco Plum support the White Crowned Pigeon. Therefore, providing a source of food for this species within the footprint of the development. It is recommended that construction phases should with regards to excavation and land clearing, should not occur during nesting season of these bird species. Additionally, creating intentional natural corridors will allow consistent habitat passage for wildlife.

South West Point Wildlife Impacts

Development of the marina would directly impact the forest area due to the removal of forest vegetation and terrestrial habitats. Therefore, negatively affecting populations of native and endemic bird species. This activity has similar effects on the Abaco Parrot within this area as it does at Lantern Head; impacting nesting and feeding grounds. Other endemic and native wildlife affected are the Bahama Swallow and White Crowned Pigeon. The White Crown Pigeon have been seen in groups of 20-30 at morning and dusk within this area. It is possible that this population may decrease and will travel in search nearby suitable habitats. Mitigation measures for the continued preservation of these bird species should include allowing coastal vegetation to remain in areas where it is not necessary to be removed. While also adding native vegetation to be incorporated within the design of the landscape.

11.6 Fire and Hurricane Risks

Hurricane activity is common in the Atlantic Hurricane Belt, and the LH and SW Point properties in South Abaco both exhibit sign of past hurricane activity. Coastal vegetation at both sites are stunted and bent away from the prevailing easterly winds. Storm surge impacts are evident at both sites, with large sea-borne boulders and rocks transported well above the high tide mark and primary dune system. The powerful erosive forces of wave action have eroded the Pleistocene limestone on the cliffs and rocky shores of Lantern Head, as well as the extensive rocky shorelines of the SW Point property. Storms surges and over wash have carved the sandy dune landscape at LH, with mangrove wetland becoming established in the saturated depressions being the primary dune system.

Anecdotal accounts from South Abaco residents recall severe hurricanes of the past which have destroyed settlements along the eastern shore of South Abaco and caused severe flooding in low lying areas of the Sandy Point settlement. The location of this development along the coastline leaves it susceptible to harsh wind and wave activity during hurricane season presenting a risk of property damage and safety of guests and residents. The SW Point property, with its lower elevations and large marina basin, will be at a greater risk for impact due to storm surges during hurricanes and storms.

The fragmentation of terrestrial habitats, introduction of electrical and motorized equipment, flammable materials and humans will increase the chances of fire on the LH and SW Point properties. The proximity of Lantern Head to the pine forests of the Abaco National Park leaves it susceptible to fire impacts stemming from this fire ecology habitat. The property at SW Point is further removed from pineland vegetation and is at a lesser risk of impact from wildfires. Wildfires in the South Abaco area will temporarily lower air quality and can have moderate to severe long-term impacts on coppice forest habitats. Establishment of fire boundaries around both properties and implementation of a strict fire emergency protocols will reduce the risks of fire to the surrounding environments of South Abaco.

11.7 Solid Waste & Hazardous Waste Impacts

Improper disposal of solid and hazardous waste can have moderate negative impacts on terrestrial and marine habitats, water and air quality, and marine resources for both the LH and SW Point properties. The coastal nature of the properties lends itself to the potential for releases of solid or hazardous waste into the marine environments, especially during coastal construction and marina creations. Land clearing will produce organic waste which can be used as compost for landscape plantings on the properties. Construction debris in the form of wood, plastics, metals, solvents and other materials are common on construction sites, and can degrade land based and marine habitats if not properly disposed of. The impacts of plastics on the marine environment are well documented. Accumulated solid waste may also increase the risk of fire on these properties.

The local landfill is unable to support large amounts of solid waste stemming from the proposed developments at Lantern Head and SW Point and would require upgrades to the landfill or the use of recycling, composting and an onsite incinerator to reduce amounts of waste deposited at the Sandy Point landfill.

11.8 Water and Wastewater Impacts

<u>Lantern Head Water and Wastewater Impacts</u>

The residential demand for potable water at LH is approximately 38,000 GPD, commercial demands 6,000 GPD and irrigation demand 680,000 GPD and averaging at approximately 241,000 GPD.

Wastewater estimate for the LH property are approximately 38,000 GPD for residential units and approximately 6,000 GPD for commercial units, totaling approximately 44,000 GPD on average and with a design flow capacity of approximately 87,000 GPD.

<u>South West Point Water and Wastewater Impacts</u>

The residential demand for potable water at SW Point is 97,000 GPD, commercial demands of approximately 168,000 GPD, Marina demand of 181,000 GPD and irrigation of approximately 288,000 GPD. The potable water summary for SW Point is 445,188 GPD on average.

Wastewater estimate for the SW Point property are 194,000 GPD for residential units, 343,000 GPD for commercial demands, and 362,000 GPD for marina demands, totaling 899,000 GPD.

11.9 Socio Economic Impacts

<u>Sandy Point Airstrip</u>

Extending the Sandy Point airstrip and developing a fixed based operation terminal suitable for international standard, provides economic and safety benefits within the south Abaco community. The existing airstrip is not properly managed, hazardous to human health in the event of an emergency and unregulated. With the provisions of an airport terminal, the government of The Bahamas can better regulate port of entry. This will be achieved by constructing a facility capable of operating as a point of entry into south Abaco. The renovation of the Sandy Point Airstrip will create job opportunities for

Abaconians to effectively operate this facility. Furthermore, the extension of the airstrip allows provisions for safe landing and take-off for larger international aircrafts. Thus, increasing the safety of passengers and crew and encouraging visitation. This added feature provides an opportunity for tourism growth and economic development within Great Abaco. The proposed development would impact the existing pine forest and wetland directly, due to the extension of the airstrip, fixed based operation and terminal facility. Flooding is possible due to the southern extension of the runway as it sits directly between a wetland.

Hole in the Wall Restoration

The refurbishment of this major historic feature is beneficial to the south Abaco community by essentially recreating a piece of history. Restoring the lighthouse and its surrounding buildings provides an economic opportunity to generate revenue from visitors and for locals to be enriched in Bahamian culture and history. This economic benefit would essentially trickle into the south Abaco community and effect the island of Great Abaco. During restoration, minimal impact is expected due to the pre-existing design of the buildings. The Developer intends to work in cohesion with AMMC and BNT to ensure that responsible environmentally responsible practices are followed, and that the restoration is authentic and respectfully represents this time in Bahamian culture.

Direct Economic Benefits

Construction and operations at both properties will provide direct economic benefits to local workers and other Bahamians involves with the project. Opportunities exist for local entrepreneurs to engage residents and guests of the LH and SW Point properties with local art and crafts, recreational tours and excursions, local dining experiences and taxi services.

The luxury hotel at Lantern Head provides substantial economic benefit to Abaco by generating an estimated $74,688,000 of operational revenue in 2026 into the community. Operational revenue for the first ten years reflects an estimated total of $1,051,967,000 based on output and wages totals. Due to the development of the South Abaco marina, projections estimate to generate $28,564,100 in tax revenue over a ten-year period. The development of the proposed 75-room Full-Service hotel and 100-room Extended Stay hotel collectively is estimated to generate $49,796,000 in operational revenue in the year 2014. Total revenue over a ten-year period of operations is $570,851,000. Estimated employment to support both hotels requires 200 staff.

12 Tables of Issues of Environmental Concern

Table 32. South West Point–Potential Impact Matrix.

South West Point - Potential Impact Matrix																				
		Aspect																		
Project Component	Impacting Factor	Physical			Coastal Processes		Biological						Socio-Economic				Cultural			
		Hydrology & Hydrogeology	Air Quality	Noise	Erosion & Sedimentation	Beach	Terrestrial Habitats	Marine Habitats	Birds	Terrestrial Flora	Marine Mammals	Marine Resources	Neighboring	Relocation	Traffic	Economic	Archaeological, Historic & Paleontological	Hunting	Fishing
Construction																				
Marina Creation	Land Clearing	*	*	*	*		*		*	*							*	*	
	Excavation	*	*	*	*												*		
	Entrance Channel Dredging			*	*	*		*			*	*			*				*
	Flushing Channel			*	*	*		*			*	*			*				*
	Marina Opening	*		*	*	*		*			*	*			*				*
	Spoil Stockpiling	*			*		*			*									
Upland Construction	Land Clearing		*	*	*		*		*	*								*	
	Solid Waste		*				*	*	*	*	*	*						*	
	Liquid & Hazardous	*	*					*		*	*	*						*	
	Discharges	*	*				*	*		*	*	*						*	
	Noise		*						*									*	
	Emissions		*						*									*	
	Infrastructure Installation															*			
Operations																			
Marina	**Accidental**																		
	Oil Spills	*	*					*			*	*	*						*
	Sewage	*	*					*			*	*	*						*
	Fuel Spill	*	*					*			*	*	*						*
	Surface Runoff	*			*			*			*	*	*						*
	Routine																		
	Boat Wash &	*	*	*				*			*	*	*						*
	Fuel Dock	*	*					*			*	*	*						*
	Boat Traffic	*	*	*	*			*			*	*	*		*	*			*
Resort & Marina Village	**Routine**																		
	Solid Waste		*				*	*	*	*	*	*						*	
	Liquid & Hazardous Waste	*	*					*		*	*	*						*	
	Noise		*						*		*							*	
	Emissions		*						*									*	
	Retail, Resort, Restaurants												*			*			*

Table 33. South West Point Impact Significant Matrix.

South West Point - Impact Significance Matrix																			
		Aspect																	
Project Component	Impacting Factor	Physical			Coastal Processes		Biological						Socio-Econ				Cultural		
		Hydrology & Hydrogeology	Air Quality	Noise	Erosion & Sedimentation	Beach	Terrestrial Habitats	Marine Habitats	Birds	Terrestrial Flora	Marine Mammals	Marine Resources	Neighboring	Relocation	Traffic	Economic	Archaeological, Historic & Paleontological	Hunting	Fishing
Construction																			
Marina Creation	Land Clearing																		
	Excavation																		
	Entrance Channel Dredging																		
	Flushing Channel Dredging																		
	Marina Opening																		
	Spoil Stockpiling																		
Upland Construction	Land Clearing																		
	Solid Waste																		
	Liquid & Hazardous Waste																		
	Discharges																		

	Noise																		
	Emissions																		
	Infrastructure																		
Operations																			
Marina	**Accidental**																		
	Oil Spills																		
	Sewage Discharge																		
	Fuel Spill																		
	Surface Runoff																		
	Routine																		
	Boat Wash & Repair																		
	Fuel Dock																		
	Boat Traffic																		
Resort & Marina Village	**Routine**																		
	Solid Waste																		
	Liquid & Hazardous Waste																		
	Noise																		
	Emissions																		
	Retail, Resort, Restaurants																		

Table 34. Lantern Head Impact Potential Matrix.

Lantern Head - Impact Potential Matrix																			
		Aspect																	
Project Component	Impacting Factor	Physical			Coastal Processes		Biological						Socio-Economic				Cultural		
		Hydrology & Hydrogeology	Air Quality	Noise	Erosion & Sedimentation	Beach	Terrestrial	Marine Habitats	Birds	Terrestrial Flora	Marine Mammals	Marine Resources	Neighboring	Relocation	Traffic	Economic	Archaeological, Historic & Paleontological	Hunting	Fishing
Construction																			
18-Hole Golf Course	Land Clearing	*	*	*	*		*		*	*	*	*					*	*	
	Solid Waste		*				*	*	*	*	*	*							
	Liquid & Hazardous Waste	*	*				*	*		*	*	*							
	Discharges	*			*		*	*		*	*	*							
	Noise		*	*					*										
	Emissions		*						*										
	Infrastructure Installation	*			*		*	*				*			*	*			*
Golf Club House	Land Clearing	*	*	*	*		*		*	*									
	Solid Waste		*				*		*	*	*								
	Liquid & Hazardous Waste	*	*				*	*		*									
	Discharges	*			*		*	*		*		*							
	Noise		*	*					*										
	Emissions		*						*										
	Infrastructure Installation	*			*		*	*		*					*				
Beach Club	Land Clearing	*				*	*	*	*	*									
	Solid Waste		*			*	*	*		*									
	Liquid & Hazardous Waste					*	*	*		*									
	Discharges					*	*	*		*									
	Noise								*										
	Emissions					*	*	*	*										
	Infrastructure Installation					*	*	*		*					*				
Residential Lots	Land Clearing	*			*														
	Solid Waste																		
	Liquid & Hazardous Waste																		
	Discharges																		
	Noise																		
	Emissions																		
	Infrastructure Installation														*				
Luxury Hotel	Land Clearing		*						*										
	Solid Waste					*													
	Liquid & Hazardous Waste																		
	Discharges					*													
	Noise			*															
	Emissions																		
	Infrastructure Installation															*			
Operations																			
	Routine																		
	Solid Waste		*				*	*		*	*	*				*		*	*
	Discharges	*	*				*	*		*	*	*						*	*

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

Table 35. External Project Improvement Matrix.

External Project Improvements																			
Project Component	**Impacting Factor**	**Physical**			**Coastal Processes**		**Biological**						**Socio-Econ**				**Cultural**		
		Hydrology & Hydrogeology	Air Quality	Noise	Erosion & Sedimentation	Beach	Terrestrial	Marine Habitats	Birds	Terrestrial Flora	Marine Mammals	Marine Resources	Neighboring	Relocation	Traffic	Economic	Archaeological, Historic & Paleontological	Hunting	Fishing
Road Improvements & Construction	Queen's Highway to Soldier Road, SW Point and Hole in the Wall			*			*		*	*			*		*	*			
	Man Camp			*									*	*		*			
	Staff Housing			*									*	*		*			
	Hole in the Wall Refurbishment			*						*			*			*	*		
	Sandy Point Airport Improvements			*			*		*	*			*		*	*			

Table 36. Lantern Head Impact Significance.

Lantern Head-Impact Significance																				
		Aspect																		
Project Component	Impacting Factor	Physical			Coastal Processes		Biological						Socio-Econ				Cultural			
		Hydrology &	Air Quality	Noise	Erosion & Sedimentation	Beach	Terrestrial Habitats	Marine Habitats	Birds	Terrestrial Flora	Marine Mammals	Marine Resources	Neighboring	Relocation	Traffic	Economic	Archaeological, Historic & Paleontological	Hunting	Fishing	
Construction																				
Upland Construction	Land Clearing																			
	Solid Waste																			
	Liquid & Hazardous Waste																			
	Discharges																			
	Noise																			
	Emissions																			
	Infrastructure Installation																			
Operations																				
Resort	Routine																			
	Solid Waste																			
	Liquid & Hazardous Waste																			
	Noise																			
	Emissions																			

	Retail, Resort, Restaurants																		
External Project Improvements																			
Road Improvements & Construction	Queen's Highway to Soldier Road, SW Point and Hole in the Wall																		
	Man Camp Staff																		
	Housing Hole in																		
	the Wall Refurbishment																		
	Sandy Point Airport Improvements																		

Caribbean Coastal Services Ltd.
P.O. Box CB-11524, Nassau, Bahamas | Tel (242) 327-5348 | Fax (242) 327-4981
www.CaribbeanCoastal.com | info@CaribbeanCoastal.com

13 Environmental Management

13.1 Draft Environmental Management Plan TOR

- Environmental Management Plan
  - Purpose, Scope and Content
  - Geographic Location
  - Project Description
  - Master Plan
  - Potential Environmental Impacts
  - Potential Accidents/Malfunctions
  - Environmental Regulatory Bodies and Standards
  - Planned Mitigation Measures
  - Response Measures to Accidents/Malfunctions
  - Monitoring Program
  - Implementation of Monitoring Program
  - Best Management Practices -Marina Creation, Beach Creation, Land Clearing

The EMP ToR will be re-submitted as a separate document which outlines the terrestrial and marine mitigation measures inclusive of the golf course, marina, coral, and other upland development designs. This document will also include sections on accidents, malfunctions, employee training, fire, flood, as well as health and safety management.

14 Public Consultation

Public consultation meetings were carried out in Abaco by the Developer on April 9, 2019 and December 12, 2019. The first meeting held on April 9 in Marsh Harbour was solely dedicated to engage with local environmental stakeholder groups, in which the Project details were presented to the environmental groups by the Developer and issues of environmental concern werevoiced by the environmental groups. Developer has taken these issues very seriously and as a result the Project has changed somewhat to accommodate concerns raised by the environmental groups (as an example the SW site originally included some of the footprint of the Alexandria settlement. Developer choose to give up on that area and move the project site so that it will not involve Alexandria at all). All these issues are addressed in this report. Another meeting held on April 9th was in Sandy Point. This meeting presented the project to local stakeholders in the neighboring communities near to Lantern Head and South West Point. The meeting was attended by businessmen from all over Abaco, local government officials, and other residents of South Abaco. The project was met with excitement and enthusiasm by all attendance estimated at about 500 people. At the request of Bahamian government another meeting was held on December 12th. That meeting was hosted in the Sandy Point community with stakeholders, local environmentalists, DEPP officers and Bahamas Investment Authority (BIA) representatives in attendance. During this meeting, the Project once again was embraced with enthusiasm by virtually all attendees, many of whom expressed their interest in work on the Project commencing urgently. Participants in the meeting expressed their desire for job and business opportunities as well as general excitement for modern development in their nearby community. The strong and continuing support for this Project from local stakeholders is evidenced by the two letters of support that were sent by the local government, which are included in Appendix G.

15 Recommendations and Mitigation Strategies

15.1 Methodology

The following recommendations and mitigation strategies are a combination of best management practices used in previous experiences on similar developments. In accordance with these practices, a full- time environmental monitor will be on site during construction to ensure mitigation measures outlined in the Environmental Management Plan are always adhered to during development. Following construction, these practices should be taken on by a resident Environmental Manager. These practices include capitalizing on environmental windows (opportune times outside of breeding, spawning, nesting and/or migrating seasons) for valued ecosystem components (birds, marine mammals, bonefish, etc.), as much as reasonably practicable, in an effort to limit disturbances to the natural environment during construction and operational activities.

15.2 Land Use Mitigation

The Developer supports the cultural tradition of hunting in designated areas of South Abaco such as the Abaco National Park or other undeveloped areas which will not prove a safety risk to guests and infrastructure.

Excavation activities for the marina at SW Point will be carried out on land, with minor dredging activity at the entrance and flushing channels. The respective ocean depths at the channels allow for minimal dredging to occur during marina creation.

Special considerations were given to minimize land clearing to the extent possible. This includes the revision and comparison of satellite imagery with the proposed site plan for the area. The baseline data was compiled in a habitat map and also overplayed with the site plan as shown in Section 11.4

The cut and grind land clearing method will be used initially on both properties. During this process protected trees will be identified and flagged by the environmental monitor of the site. Forest underbrush and small plants will be removed to clear a path for larger equipment. The pushover method will then be used to clear larger areas of land. Flagged trees will be avoided where possible. If it is determined by the Environmental Manger that a protected tree should be removed to further the development of the property, the Department of Forestry and DEPP will be notified. The protected tree will be relocated if possible. Furthermore, $1mill will be donated to BNT for the development of a conceptual plan for the Abaco National Park and further forest development. Also, $350k will be donated to BNT to improve the 174.50 acres ceded to the government as part of the land swap in LH.

15.3 Mitigation for Impacts to the Physical Environment

Sediment created during dredging will be contained with turbidity curtains. The Environmental Management Plan will include a dredge and turbidity monitoring plans to outline the details of the dredging activities, and related impacts mitigation and environmental oversight. In particular, the dredging extents, equipment, methodology, material handling and stockpile management, safety and environmental protection measures, responsible personnel, as well as turbidity monitoring and reporting protocols.

Noise created during dredging is broadband (below 1kHz) and is not likely to cause damage to marine mammal auditory systems. Masking, behavioral changes and changes in prey availability are temporary impacts that may occur in the immediate areas of the dredging activity.

The implementation of concrete curtain walls during construction of the SW Point marina, will decreases the potential of the salt water intrusion of the onsite freshwater aquifers. The concrete interface between the marina and the aquifer prevents salt water from entering directly into the upper freshwater lens, but instead diffuses into the denser salt water below the base of the concrete curtain wall of the marina.

15.4 Biological Mitigation

The development at Lantern Head is designed to be a low-density development, maintaining as much of the natural forest as possible. Any land clearing exercise will be prefaced with an inspection for Bahama Parrot nesting sites in the ground and will be scheduled to commence within acceptable environmental windows (outside of parrot nesting season). The coppice forests on Lantern Head and SW Point serve as feeding grounds for the Abaco Parrot and other resident birds, and approximately 174.5 acres of coppice forest will be donated to the BNT for conservation and management. Habitat preservation at SW Point will aim to maintain feeding grounds for the Bahama Swallow which are known to frequent the area. If removal of pine trees is required, it will be done in coordination with the Forestry Department and BNT.

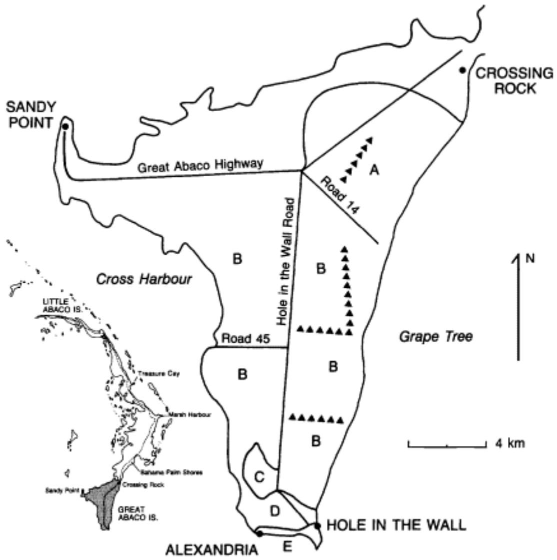
15.4.1 Avian and Terrestrial Mitigation

During road improvements and land clearing activities, the Developer will incorporate most of the recommendations provided by Caroline Stahala, leading Abaco Parrot researcher, into the EMP for the proposed project. These include:

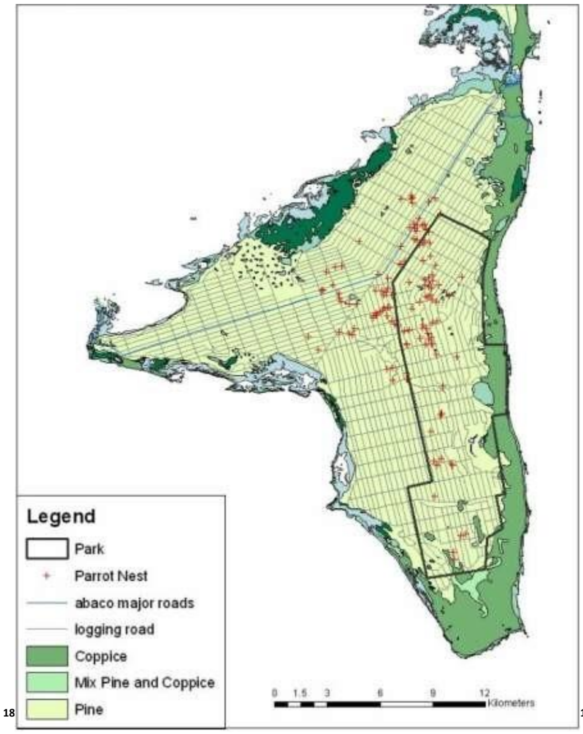
- Surveying for parrot nests and foraging area immediately before any road construction is undertaken.
- As much as possible ensure that all vegetative coppice/hardwood buffer currently existing will remain along park boundary.
- Efforts to leave any hardwood tree over 4cm in diameter, where possible.
- Efforts to design a contiguous hardwood corridor/habitat on the Lantern Head site to provide foraging trees for parrots during the nonbreeding season.
- Efforts to leave some native forest intact wherever possible.

Previous studies on Bahama Parrot nesting sites in South Abaco have indicated that the vast majority of nests were located north of the Lantern Head and SW Point properties (Figure 172), with little to no nesting reported in the vicinity of the sites. The locations of recorded nests suggest a lower likelihood of encountering active nests on the two properties during construction activities. Table 37 below lists protected species observed within the project areas.

Figure 172. Bahama Parrot nesting sites in South Abaco (Source: Stahala, 2007).



[18]



[19]

The proposed development presents the opportunity to work along with the BNT and bird researchers to encourage the residents and guests to utilize the National Park, as well as contribute to park management and citizen science initiatives.

The key seasons for the umbrella species as outlined in Table 37 below will be considered during construction and operational activity . As construction efforts proceed during these periods, pre-clearance surveys of the site will be conducted prior to road clearing and other pre-construction activities in an effort to identify potential nesting areas of the protected avian species. Site works will commence once the 'all clear' is given during this monitoring period. Extra precautions in association with those established by Stahala will be executed during known breeding seasons.

The development at Lantern Head is designed to be a low-density development, maintaining some of the natural forest wherever possible. Any land clearing exercise will be prefaced with an inspection for Bahama Parrot nesting sites in the ground.

The coppice forests on Lantern Head and SW Point serve as feeding grounds for the Bahama Parrot and other resident birds, and 174.5 acres of coppice forest will be donated to the Bahamas National Trust (BNT) for conservation and management. Habitat preservation at SW Point will aim to maintain feeding grounds for the

---

[18] Gnam, R and Burchsted, A. (1991). Population estimates for the Bahama parrot on Abaco island, Bahamas. *Journal of Field Ornithology. 62 (1),* 139-146.

[19] Stahla, C. (2007). Effects of Abaco national park rd 49 & 50 clearing on the Abaco Parrot.

Bahama Swallow which are known to frequent the area. Also, the White Crown Pigeon has been observed in groups of 20-30 at morning and dusk within the SW Point area.

Table 37. Key Periods for Umbrella Species (Avian and Flora) observed on site visits. LH - Lantern Head, SW - South West Point, SPA-Sandy Point Airstrip.

Avian Species						
Common Name	*Breeding Season*	*Migration*	*Diet*	*Status*	*Site*	*Notes*
Bahama Parrot	March to September	Resident	Wild Guava, Poison Wood berries, Pigeon Berry, Gumbo Limbo Fruit, Bahamian Pine seeds.	Protected	LH, SW	Nest in the Pine forests but forage in the coppice forests.
White Crown Pigeon[20]	March to August / September	Resident	Pigeon Plum, Gum Elemi Mastic Blolly	Near Threatened IUCN, regulated in the Bahamas via hunting season.	LH, SW	During the winter months most of Florida's White Crowned Pigeon population migrates to The Bahamas.
Bahama Swallow[21]	Mid-March to July	Resident but in Winter Months to other islands in The Bahamas	Small flying insects.	Near Threatened (Collar et. al. 1992).	SW	
Kirtland Warbler	Not in The Bahamas	Winter Migrant	Insects, pine needles and berries.	Near Threatened	Not Seen	This species was not observed during various site visits. However, its presence is known in The Bahamas. Therefore, it is considered in the mitigation efforts.

Flora Species Associated with Avian Habitat and Food Source				
Common Name	*Scientific Name*	*Site*	*Status*	*Season*
Narrow Leaf Blolly	*Guapira discolor*	LH, SW	Protected	Throughout the year

[20] https://bnt.bs/birds/white-crowned-pigeon/

[21] https://www.birdscaribbean.org/2017/05/bahama-swallows-in-the-pine-islands-report-from-the-field/

Candlewood	*Gochnatia ilicifolia*	LH	Protected	December to July
White Cedar	*Juniperus barbadensis*	LH	Protected	January to September
Caribbean Mahogany (Madeira)	*Swietenia mahagoni*	LH, SW	Protected	May to August
Passion Flower	*Passiflora bahamensis*	LH,SPA	Endemic	Throughout the year
Naked Wood	*Thouinia discolor*	LH, SW	Endemic	Throughout the year
Bahamian Pine	*Pinus caribaea var. bahamensis*	LH, SPA	Protected	Throughout the year
Sea Oats	*Uniola paniculata*	LH	Protected	July to August

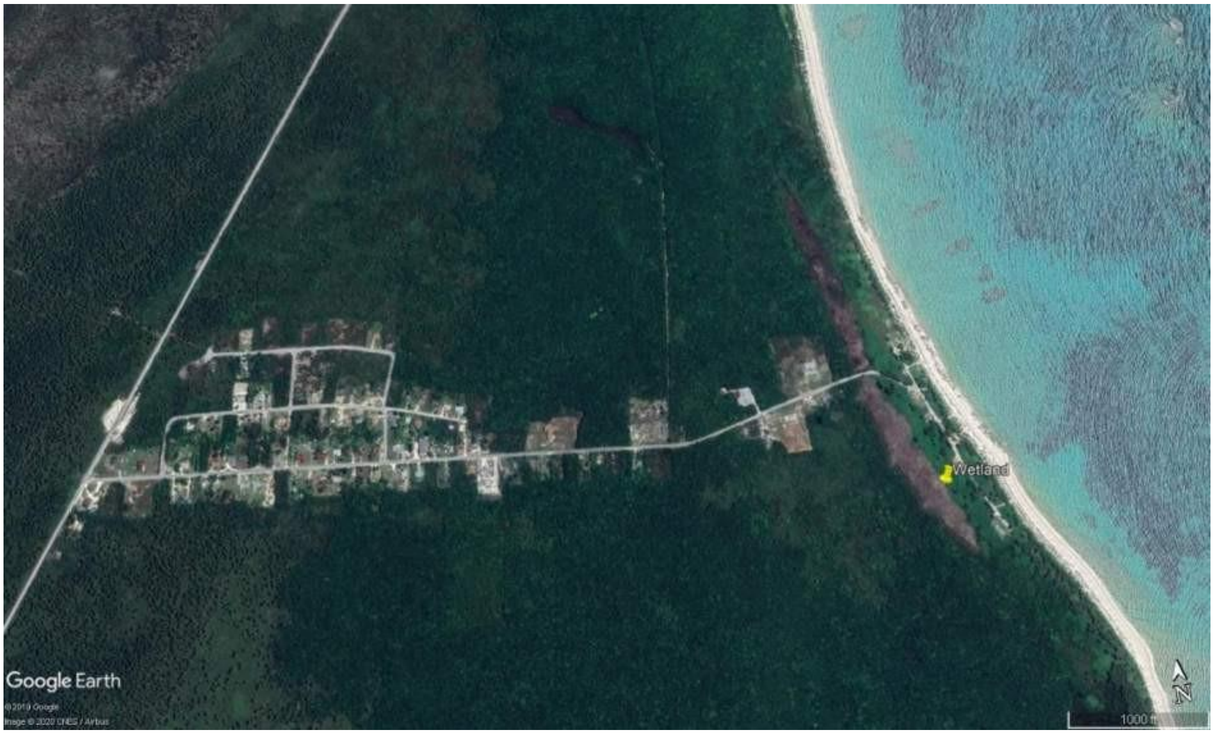
During the cut and grind phase of the land clearing, the endemic Naked-Wood and Passion Flower/Passion Vine will be transplanted to a temporary on site nursery. The Developer anticipates using the endemics in the landscaping of the property wherever possible and will rely on the nursery as an initial source for the plants. Additional efforts to preserve the native vegetation will also be made by including important fruiting plants that resident birds feed on as shown in Table 37.

Furthermore, due to extensive acreage of Lantern Head and SW Point, there is ample propagative material that can be sourced from within and surrounding both properties to be utilized for onsite nursery programs and landscaping. This conservation effort provides an opportunity to for the Developer work closely with the neighboring BNT to help preserve these protected and endemic species.

Wetland Mitigation

The approximately 0.12-acre wetland habitat located within the marina footprint at South West Point, will be directly impacted during creation of the marina. Mitigation efforts for this impact may include the restoration of an extensive ~12 acre freshwater habitat within the Crossing Rocks community or conservation of an existing ~0.56 acre freshwater wetland within the rocklands of the South West Point parcel boundaries. The existing freshwater wetland within Crossing Rocks is occupied by invasive Cattails (*Typha domingensis*). Anecdotal evidence indicates that prior to the growth of this invasive species, this area was populated with various bird species. Restoration efforts of this habitat would provide an essential habitat for nearby and migratory avian species known to inhabit South Abaco.

Figure 173. Proposed wetland for restorative mitigation in Crossing Rocks, South Abaco (Google Earth).



15.4.2 Invasive Species Management

Proper staff training and identification of the mentioned invasive species will be priority in establishing an invasive species removal plan for the development. Once identified, the entire root ball will be removed as these species can return if the root system is not eradicated. Careful application of herbicide on cut surfaces of removed individuals can assist in preventing regrowth from the roots.

15.4.3 Marine Resource Mitigation

Excavation

The proposed location of the marina is currently landward of the current high-water mark and would require excavation as opposed to dredging. As a result, the anticipated methodology for the marina creation would include mechanical excavation through the use of heavy machinery such as excavators, loaders and dump trucks. This method is cost and time-efficient, it also reduces the impacts of noise pollution on the surrounding marine environment. Additionally, land-based excavation is more precise, and its impacts will be confined to the immediate point of excavation. The heavy equipment used in the excavation will follow a pre-cleared pathway to the marina site. Prior to land clearing of the marina area, efforts to salvage protected species and other species of interest will be conducted (e.g. cacti, orchids, bromeliads, agaves, endemics). Salvaged species can be utilized on-site for future landscaping activities.

Turbidity

To mitigate against increased turbidity along the coast from the excavation, the mouth of the marina will remain closed until the construction of the marina concrete walls are completed. The sediment will have time to settle in the marina area before the channel is open to prevent sediment from moving beyond the marina along the coast.

Coral Relocation

Relocating the channel entrance was considered. However, moving further north of the area indicated below (Figure 174) for the channel entrance would increase the direct impact to other species of coral that are growing further north. Moving the channel entrance further south will lead to removing a large proportion of hard bottom habitat, which could be suitable habitat for coral recruitment. The area currently proposed for the entrance is sandy bottom. There were no endangered or protected species observed in the area, which means constructing the channel entrance in the area shown in the Figure 174 is the best available option for the project as it results in minimal impact.

There were two standing Elkhorn corals observed in the described survey area related to the channel entrance. The figure below shows the two corals and the surrounding environment in the survey area. In the immediate vicinity of the channel, no corals were observed as shown in Figure 174 that shows the survey area, the Elkhorn coral location and the location of the channel entrance. The benthos in the entrance channel area was sandy bottom and dominated by gorgonians as shown in the supporting figures below (Figures 175-178). The Project intends to relocate the Elkhorn coral observed at the site as Elkhorn coral lends itself well to relocation. Coral relocation specialists will be identified to support this activity. Another factor considered in the relocation of the coral is that they are growing in individual colonies, which makes harvesting and relocation of corals easier than relocating a thicket of Acropora.

Figure 174. South West Point marina entrance depicting extent of benthic survey (red), proposed width of entrance channel (white) and area where Elkhorn coral was observed (yellow).

Figure 175. Elkhorn coral colony north of proposed entrance channel.

Figure 176. Second Elkhorn colony, north of proposed entrance channel.

Figure 177. Benthos north of proposed entrance channel, two colonies of Elkhorn observed in area.

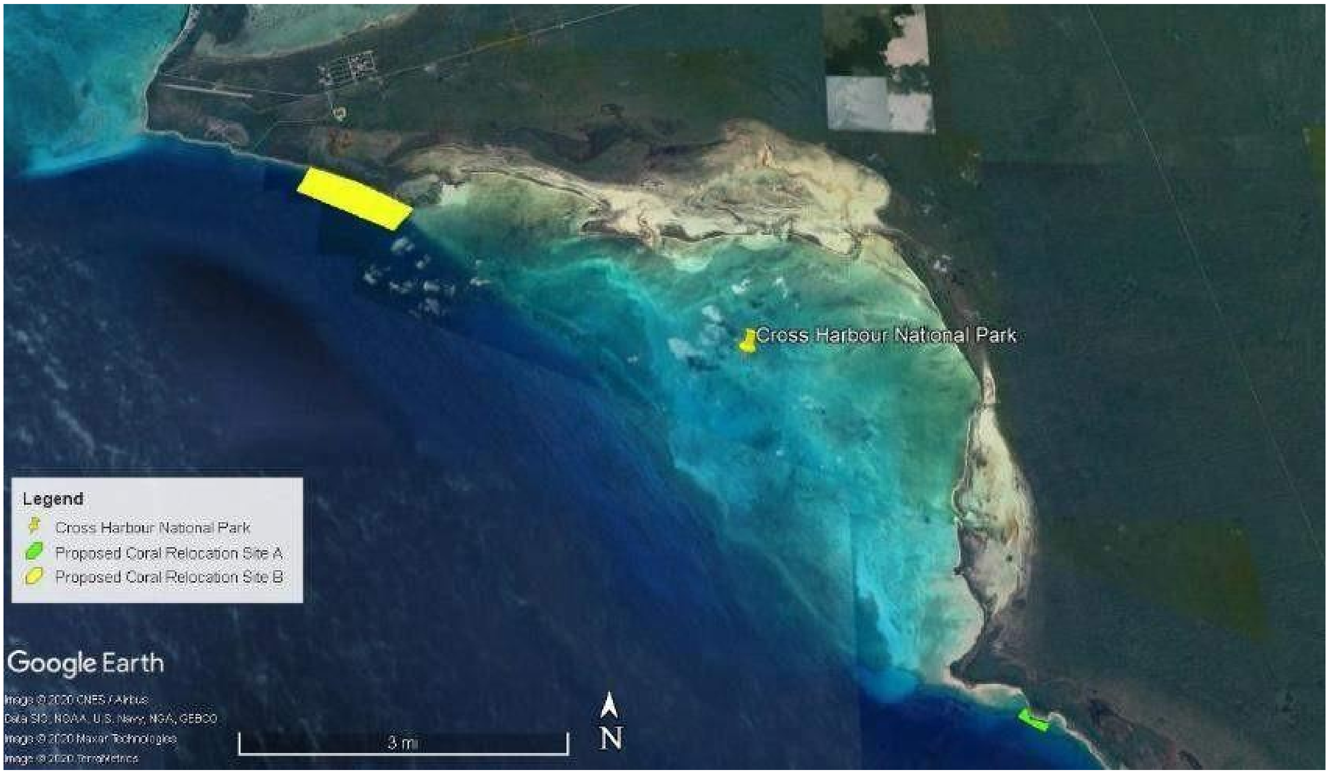
Figure 178. Benthos within footprint of proposed marina entrance.

Two proposed coral relocation sites are shown in Figure 179. The sites are near the boundary of the Cross Harbour National Park (Figure 180), in areas conducive Elkhorn coral growth. The final relocation site selection will be guided by DEPP and based on several factors:

1. The site should have suitable environmental requirements for corals.
2. It should be outside the construction area of impact.
3. Corals at the relocation site should be healthy and shown no signs of disease. Corals showing symptoms of diseases will not be relocated. In the event that a coral disease is identified at the relocation site or at the area of impact site, DEPP will be notified.

Figure 179. Proposed coral relocation sites distance from point of origin.

Figure 180. Proposed coral relocation sites in proximity to the Cross Harbor National Park.



In addition to relocating the Elkhorn coral, all reef building stony corals larger than 10 cm in diameter will be removed from the seafloor. Individual corals will be removed by hammer and chisel to effectively remove the limestone coral skeleton from its point of attachment and leaving the living tissue of the coral unharmed. Corals removed will be collected and kept underwater in mesh bags, basket or other containers that allow water to flow through until the time that they will be relocated. At that time all corals collected will be brought to the surface and put in coolers on a surface support vessel for immediate transport to a nearby site.

Marine Mammals and Dredging

Collisions between marine mammals and the dredger are not anticipated due to the slow speeds in which it operates. As part of the mitigation efforts to be outlined in our EMP, marine mammal spotters can be positioned where dredging activity is taking place to ensure the area is free from marine mammals during work hours. The seabed dredging activity is a minor portion of the marina construction, the majority of which will consist of excavation activities on land.

The project can incorporate whale watching platforms/kiosks along the eastern and southern shoreline of South Abaco to allow use by researchers/recreationists. Educational and interpretive signage can be installed to educate visitors of the natural resources of South Abaco.

To decrease the likelihood of impacts on marine mammals and the Cross Harbor National Park, Developer will include in the EMP that during operations there is an effort to inform marine vessels destined for the marina at SW Point about suggested routes and speeds for entering the marina (see Figure 181 below). Developer is committed to apply for Blue Flag certification for the marina, as this will lessen potential environmental impacts.

Figure 181. Example of signage that can be used to alert boaters to remain cautious of marine mammals.

Fishery Resources

The use of environmental windows can be employed during dredging activities to minimize potential impacts to bonefish and grouper species. As mentioned in Section 9.9, "evidence suggests that Nassau Grouper spawning exits east of Hole in The Wall within the deeper waters of South Abaco", which is out of the direct area of impact caused by the development for the SW Point Marina. Furthermore, various commercial fish species from initial to terminal stages have been noted in the Cross Harbour National Park, which is approximately 7 miles west of the proposed SW Point marina. The existence of this marine protected area aids in the reproduction and conservation of important commercial species that service various commercial and subsistence fishermen, as well as the existing ecotourism developments within South Abaco. The presence of this established marine protected area provides essential ecosystem services for the South Abaco community. Eventually, these species will develop and travel from this site into various areas which support the local community.

With regards to fishery resource management in South Abaco, the Developer will work along with the Department of Marine Resources and the Bahamas National Trust. The development presents an opportunity to work along with such agencies to improve day to day management of these resources to prevent depletion and exploitation by residents and foreigners alike.

15.5 Fire and Hurricane Risks

The proximity of the Lantern Head development to the southern extent of the Abaco National Park's pine forests creates the risk of natural fires impacting the Lantern head property. Pinelands are a fire ecology, with fires being an essential component to the health and succession of the pine forests. The property at Southwest Point is further removed from the fire prone pinelands, and features mostly broadleaf coppice habitat, which due to its pitted limestone and moist humus, tends to resist the spread of fire from pinelands.

The introduction of humans, infrastructure, equipment and flammable chemicals into the natural environments of Lantern Head and South West Point increases the risk of human induced fires on both properties. In addition to educating guests and resident on the importance for fire prevention, both properties shall cut and maintain a 20 ft. fire boundary between the development and surrounding properties natural habitats. The Developer will ensure fire prevention and controls are in place to minimize risk of damage to surrounding environments in both LH and SWP.

With regards to hurricane activity, the natural site topography provides opportunities to build many of the structures well above the foreseeable levels of storm surge resulting in improved ability to withstand hurricanes. All utility cables and pipes will be underground and thus should be able to continue to function post hurricane. The leeward location of SW Point is favorable. Furthermore, the Developer intends to follow the Bahamas Building Code which is designed to withstand hurricane force winds.

15.6 Solid Waste & Hazardous Waste Mitigation

The solid and hazardous waste generated from the operations phases of the Project are not fully outlined as these preliminary estimates are not finalized. However, the Project intends to enhance the local landfill near the Sandy Point airstrip to facilitate solid waste during construction and operations phases. Recycling will be utilized at all stages of the project to reduce the volume of waste deposited at the landfill. The organic waste will be composted to create soil for use in landscaping on the property, while recyclable plastic and metals will be separated and deposited at the appropriate processing facility for recycling.

All excavated and dredged material will be properly stored away from bodies of water and utilized during construction of the development. No spoils will enter the marine environment once excavated/dredged.

15.7 Water and Wastewater Mitigation

Lantern Head Golf Course

Mitigation measures for the potential fresh water resources during Lantern Head development include best environmental practices such as placing an impermeable membrane beneath the proposed golf course during development.

The proposed golf course has the potential to materially impact ground and coastal waters of South Abaco. However, mitigation measures will be used during construction and operations to limit the impacts to water quality. Primarily, no ground water will be used for irrigation of the golf course, only recycled grey water. The golf course will be designed with an impermeable membrane beneath the soil, grass and ponds which will collect and redirect all irrigation water used on the golf course to storage tanks for re-use in irrigation activities on the golf course. Environmentally friendly fertilizers and chemicals will be utilized during golf course maintenance, and regular water quality monitoring will be conducted during golf course operations.

Wastewater will be directed to a centralized plant for processing and only greywater will be used for irrigation. Recycling of grey water will reduce water demands for the development. No ground water will be used for irrigation on either property.

Conceptually, native vegetation will be included in the landscape of the golf course design where possible. Native vegetation is adapted to the arid environment and will require less water to maintain. This will also help with mitigation efforts because protected plants and species would remain intact to the extent possible and reduce habitat fragmentation.

South West Point Marina

The installation of concrete curtain walls during the marina construction at South West Point will decrease the permeability of saltwater introduction to this fresh water terrestrial habitat. The use of curtain walls during marina construction, combined with the hydrostatic pressure of the freshwater lens on the walls of the marina, will minimize saltwater intrusion into the aquifer. As stated previously , commitment to achieving Blue Flag certification for the marina will ensure environmental best practices are carried out during marina operations, preventing possible contamination of the freshwater aquifer surrounding the marina.

The implementation of concrete curtain walls during construction of the South West Point marina will decrease the potential of the saltwater intrusion of the onsite freshwater aquifers. The development will affect an estimated 0.1% of the Abaco fresh water lens which extends from Norman's Castle to Hole in the Wall. This calculation is based on the marina's footprint (an estimate 100 acres) and the estimated acreage of the Abaco fresh water lens (an estimated 89,936 acres). The estimated 100 acres of the 89,936 results in a 0.1% loss due to the scale of the marina compared to the size of the fresh water reservoir is identified. Furthermore, these calculations were based on estimates from an overlay image of Abaco from The U.S. Army Corp's of Engineers' 2004 Water Resources Assessment of the Bahamas (Figure 182 & 183). These figures are conservative estimates in observing the approximate location of the marina to the fresh water lens. The marina appears to be outside of the fresh water lens boundary. However, the estimates of the marina have included excess acreage to account for possible fresh water aquifers in the area.

Figure 182. Abaco Water Resource Map overlay which indicates that the marina lies just outside of the estimated fresh water reservoir.

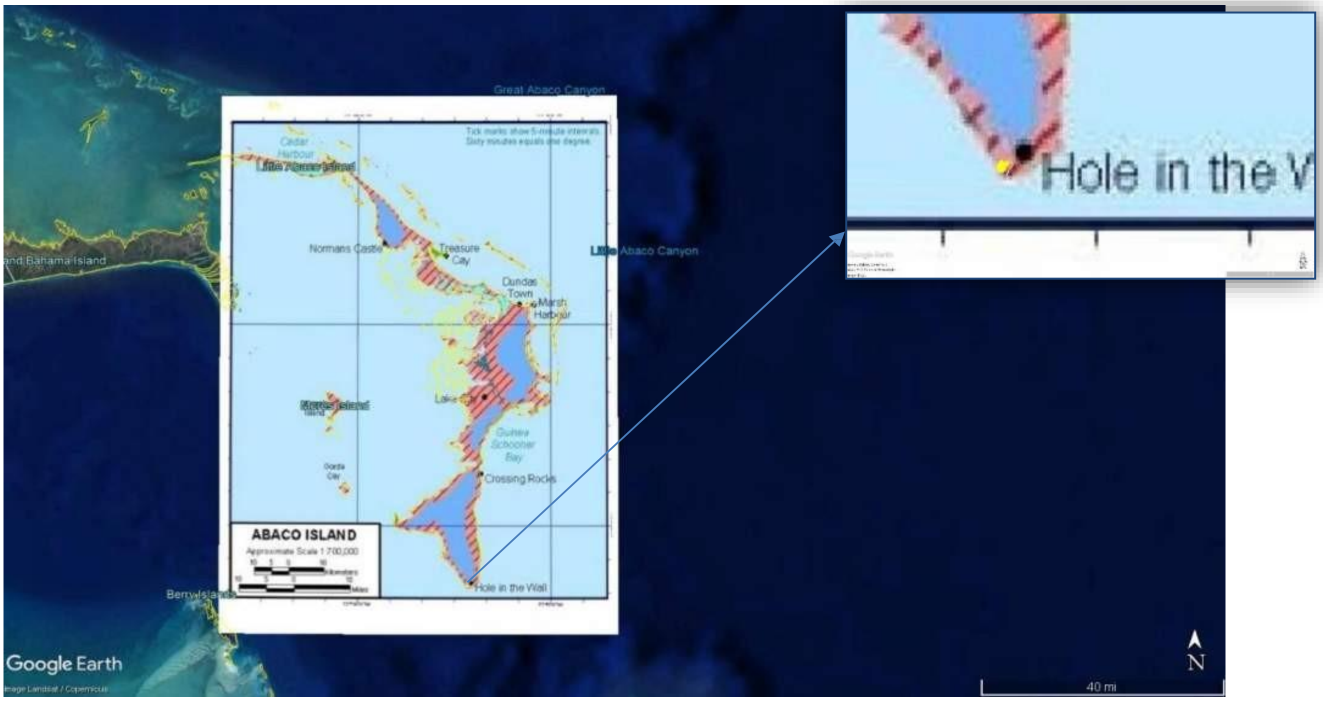


Figure 183. Area of the marina in relation to the fresh water reservoir shown in figure 182.

The concrete interface between the marina and the aquifer prevents saltwater from entering directly into the upper freshwater lens but instead diffuses into the denser saltwater below the base of the concrete curtain wall of the marina. For example, concrete curtain walls can act as an impermeable layer to prevent the adverse impacts associated with saltwater intrusion on the freshwater lens during development.

The most effective way to limit the extent of this physical disturbance is through the use of a physical, very-low permeable or completely impermeable barrier. The proposed marina has a depth -15ft MLLW for the main basin, and -10ft MLLW for the flushing channel. Due to these geometric parameters of the proposed marina, soil retention will be necessary. There are two acceptable ways to achieve the required soil retention. Vertical bulkhead and boulder revetment.

The Developer intends to use the vertical bulkhead method for the majority of the marina covering the entire perimeter of the marina. Vertical bulkhead wall requires less area of high-value land for the retention of the upland area. This land can therefore be used for high-end commercial, recreational and residential development, which is critical for the economic model of any development project.

The revetment boulder methodology will be used along the flushing channel.

In the case of the vertical bulkhead, the structure itself will perform as an impermeable physical barrier to prevent saltwater intrusion inland. Figure 184 illustrates this concept. In the case of boulder revetment, it is possible to install a cutoff wall landward of the crest of the revetment to mitigate saltwater intrusion. Cut-off walls are used to limit groundwater seepage into an excavation. The wall is formed by the construction of a very low permeability barrier around the perimeter of the proposed excavation. The cut- off wall proposed is non-structural, comprised of a cement-bentonite mixture. Bentonite to comprise between 10% - 20% of Bentonite Concrete mixture. The final design is to be confirmed based on in-situ soil characteristics. Bentonite is an inert, natural clay material. This method provides a very cost effective, low impact approach to stop fresh groundwater flow and subsequent loss into the marina basin. Figure 185 illustrates this concept.

Figure 184. Conceptual Bulkhead Section.

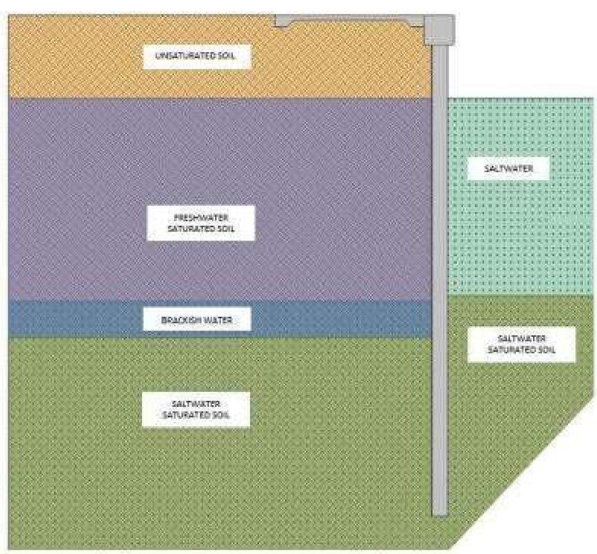
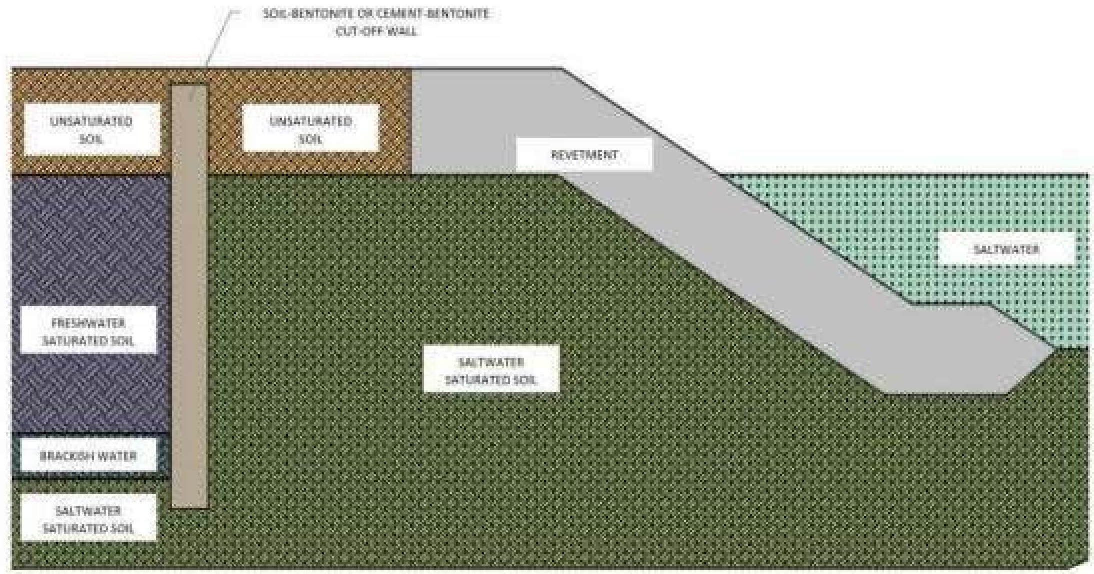


Figure 185. Conceptual Revetment Section.



Construction phasing also plays a critical role in the mitigation of saltwater intrusion inland. Due to its size, the excavation of the marina basin can take considerable time to complete. It is vital that saltwater intrusion mitigation measures be but in place, temporarily, permanently, or a combination of both, prior to extensive excavation.

This approach also has potential to yield cost savings in the excavation of the marina basin and construction of the bulkhead. Excavation of a dry basin can be orders of magnitude more economical than seaborne dredging activities and can yield a higher quality end result. This is also the case with construction in a dry basin. Preventing water intrusion into the basin makes it considerably easier and therefore more economical to keep dry, as water is prohibited from seeping through the cut faces. Therefore, preventing saltwater intrusion is both necessary from an environmental protection perspective and in the interest of the Developer.

The proposed phasing strategy for the main basin is outlined below, with accompanying Figure 185:

1. Basin construction/excavation to commence at the landward-most extents.
2. As much bulkhead construction as possible will be conducted prior to excavation.
3. Predetermined segments of excavation will be enclosed in a perimeter of soil-bentonite or cement-bentonite slurry cut-off wall and bulkhead.
4. Dewatering will then be conducted as necessary, and in accordance with best management practices.
5. Bulkhead will be exposed, and the outer face aesthetically finished as required.
6. The segment will then progress as required, repeating steps 1-5. Bentonite slurry from demolished cut-off walls should be recycled and re-used.
7. As the last phase of excavation, the entrance channel will then be excavated, allowing the basin to flood.
8. The walls of the entrance channel will then be constructed as necessary.

The flushing channel will be phased similarly, with works commencing at the landward most extent, and finalizing with the excavation opening the channel up to the sea. The Saltwater Intrusion Mitigation Report is included in Appendix H.

Figure 186. Conceptual Basin Excavation Phasing (Red – Impermeable Bulkhead; Dashed Line – Temporary Cut-off Wall).

Another threat to fresh water supplies is storm surge and the resultant saltwater ponding. Storm surge from tropical cyclones can flood upland areas. Without considerable run-off, standing seawater can seep through porous soil and infiltrate fresh groundwater reservoirs. The proposed inland marina potentially increases the exposure to storm surge. To address this, the deck elevation has been designed to be +7ft above MSL. Additionally, the hard surface immediately around the marina will encourage drainage and shedding of saltwater back into the marina once seawater surfaces have receded, and therefore reduce ponding.

The proposed perimeter road presents a good opportunity to organically integrate drainage separation into the overall design, with the intent of allowing clean rainwater to be drained through the permeable soil to replenish the possible freshwater lens below ground. The elevation of this roadway will be determined based on the potential water levels associated with the 100-year storm event. The land between the perimeter road and the marina will be designed to flow into a catchment system, filtered as per best management practices and returned to the sea. The area of land landward of the perimeter road will be allowed to flow through a filtration system and be drained through the soil. A cut-off wall is proposed to be installed at the road location to mitigate saltwater intrusion upland through groundwater flow. This cut-off wall can be substantially shallower in depth than the marina bulkhead, as the net drainage design will limit seawater ponding, and subsequently the seawater head at the perimeter road location.

This approach creates two clearly defined zones for the marina development site with respect to storm surge; Localized Storm Surge Management Zones and Storm Surge Exclusion Zones. Within the Local Storm Surge Management Zone, proposed designs will be required to manage extreme storm surge levels on a local level, i.e. seawalls, flood barriers, high finish floor elevations, etc. Within the Storm Surge Exclusion Zone, proposed designs should still consider the possibility of extreme flooding events but can do so less extremely than in the Localized Storm Surge Management Zones.

**Please note that all areas with potential to introduce pollutants to ground water, such as back of house areas, parking lots and roadways, will be specially and thoroughly designed. A preliminary conceptual sketch can be seen below in Figure 187.*

Figure 187. Storm Surge Management Plan (Blue Arrows – Net Rainwater drainage direction; Yellow Arrows – Net Seawater and Rainwater drainage direction; Orange – Perimeter Road; Purple – Special Drainage Design Areas, Hatched Area – Localized Storm Surge Management Zone).

The Environmental Management Plan will include a Marina Creation Monitoring Plan to outline the details of the dredging and excavation activities and related impact mitigation and environmental oversight. In particular, the dredging extents, equipment, methodology, material handling and stockpile management, safety and environmental protection measures, responsible personnel, as well as monitoring and reporting protocols. Wells installed at various points on the site can be utilized to monitor potential changes to the freshwater resources on site.

16 Conclusion

The proposed developments at Lantern Head and South West Point will have some moderate to severe impacts onsite and potentially on the immediate environments surrounding the properties. Mitigation strategies will be employed, where possible, to lessen the overall environmental impacts of the project, allowing the full socioeconomic benefits of the project to be realized by South Abaco residents and stakeholders.

Lantern Head Project activities which have the potential to cause severe impacts include impacts to terrestrial habitats and bird populations due to land clearing during the creation of the golf course and upland infrastructure. Other potential moderate adverse impacts from Lantern Head project activities include impacts to water quality and hydrology due to excavation or golf courses ponds and course maintenance. The removal of terrestrial habitats will be mitigated through the preservation of habitat corridors, replanting with natives, and transplanting of rare endemic or endangered species elsewhere on the property.

The marina excavation at SW Point will have the potential to alter subsurface hydrology and water quality in the immediate areas of the marina basin. Removal of terrestrial habitats will also adversely impact terrestrial habits within the marina basin footprint, and the associate wildlife utilizing these habitats. The construction and operations of the marina has the potential to moderately impact marine resources in the immediate areas of the project. The use of concrete curtain walls during marina construction will limit the potential of saltwater intrusion into potential freshwater aquifers on site. The removal of terrestrial habitats will be mitigated through the preservation of habitat corridors, replanting with natives, and transplanting of rare endemic or endangered species elsewhere on the property. Striving for Blue Flag marina certification, as well as public education initiatives can assist to decrease the impacts of marinas on the surrounding marine environments, inclusive of decreasing the potential of marine pollution, overfishing and collisions with marine mammals and sea turtles.

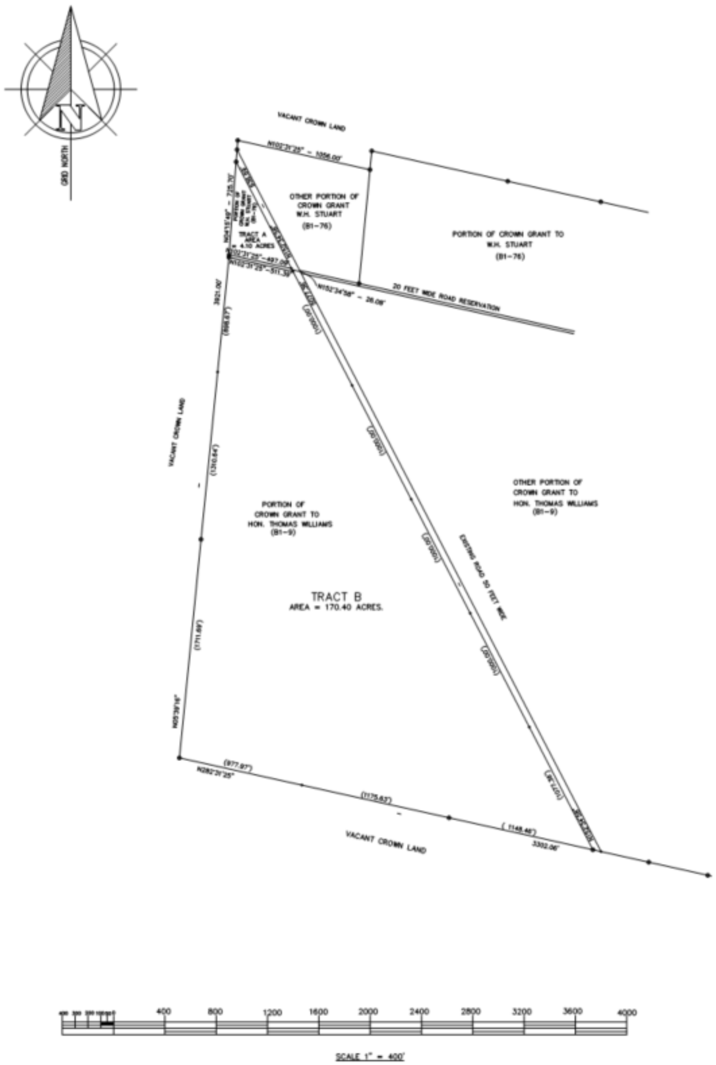
Furthermore, several scenarios were modeled in a flushing analysis provided in the South West Point Flushing Analysis. The most likely scenarios (case 3 & 4) discussed in the report considers typical wind conditions in the basin. This scenario showed the basin would meet EPA standards for localized spill, under tidal and wind forcing.

The socioeconomic benefits of this project are much needed amongst the locals and stakeholders of South Abaco. Despite the potential adverse impacts associated with construction and operation of the developments at LH and SW Point, the overall design of the project and Developer's commitment to a low density, low impact residential community will allow for effective mitigation strategies to be employed during construction and operations phases of the project. Effective mitigation strategies have the potential to lessen and even eradicate environmental impacts due to project activities. Recommendations on best practices and industry standard operations will be provided in the Environmental Management Plan for the Project.

17 Appendices

APPENDIX A – Lantern Head Survey Map: Tracks A & B Totaling 174.50-Acre Exchange.

Attachment B – Lantern Head Survey Map (Tracks A & B Totaling 174.50 Acres)



NOTE:

REFERENCE WAS MADE TO CROWN GRANT NUMBER B1-9, B1-11, AND B1-76,

REFERENCE WAS MADE TO CHEE-A-TOW AND COMPANY LIMITED PLAN DATED JUNE 1996

GRID CONNECTION WAS MADE TO A 53 AND A 54

ALL BEARINGS ARE GRID, ALL DISTANCES ARE TRUE.

LEGEND:

DENOTES BOUNDARY MARKERS FOUND ●
DENOTES BOUNDARY MARKERS SET ○
DENOTES BOUNDARY MARKERS COMPUTED ●

RECORDED IN THE DEPARTMENT OF LANDS AND SURVEYS IN ACCORDANCE WITH SECTION 3 OF THE LAND SURVEYORS ACT 1975 AS PLAN NO . ABACO. THIS DAY OF 2019.

SURVEYOR GENERAL

SURVEYOR'S CERTIFICATE

I, DALE J.S. GRANT, A SURVEYOR REGISTERED AND LICENSED IN THE BAHAMAS, HEREBY CERTIFY THAT THIS PLAN HAS BEEN THIS PLAN HAS BEEN MADE FROM SURVEYS EXECUTED BY ME, OR UNDER MY PERSONAL SUPERVISION, THAT BOTH THE PLAN AND SURVEY ARE CORRECT, AND HAVE BEEN MADE IN ACCORDANCE WITH THE LAND SURVEYORS ACT, 1975, AND THE LAND SURVEYORS REGULATIONS, 1975, MADE THEREUNDER

DALE J.S. GRANT LIC. NO. 060

CHECKED BY

APPROVED BY

DLS FILE NO.

DESCRIPTION

SURVEY PLAN
SHOWING
TRACTS A AND B TOTALLING 174.50 ACRES BEING PORTIONS OF CROWN GRANTS B1-9 AND B1-76
SITUATE
APPROXIMATELY 7,000 NORTH OF SOLDIER ROAD AND WEST OF A 50 FEET EXISTING ROAD
IN THE ISLAND OF
ABACO – BAHAMAS
SURVEY AT THE INSTANCE OF TYRZOS FAMILY HOLDINGS

A T A METRICS

WINDSOR BUSINESS PARK
WINDSOR FIELD ROAD
NASSAU – BAHAMAS
PHONE (242)-424-9334
email: info@atametrics.com
www.atametrics.com

JOB NAME: SOUTH ABACO RESORT	DRAWN BY: DG	CHECKED BY: ER
	SCALE: 1" = 400'	
LOCATION: LANTERN HEAD	DATE: 2019-02-28	
SURVEYED BY: DALE GRANT	JOB NUMBER: A1901002	SHEET No. 1

APPENDIX B –Lantern Head Golf Course.

Lantern Head
Golf Course

Introduction
The 18-hole championship golf course is a key amenity for this project. Like the entirety of this project the course is designed, constructed and will be maintained by top-level professionals. The design plan for the golf course included herein illustrates a predominantly links style course that will take advantage of the natural vistas and features of the site.

Clearing
Clearing for the golf course will be focused on the areas required for development of fairways, cart paths, water bodies and construction access. Special attention will be paid to specimen vegetation and unique geologic formations which will be identified by qualified personnel and avoided or mitigated accordingly. A nursery area for long term site landscape maintenance is part of the development plan. Any specimen trees and vegetation that is impacted by the course clearing will be transplanted to the nursery area for remediation back into the native areas between fairways as the course construction progresses or otherwise will be planted back in coordination with the Bahamas National Trust in the "nature preserve" area which the project is transferring to the BNT.

Materials
The natural ground material at Lantern Head is mostly made of very porous coral limestone with little high-quality topsoil. Fill from the marina excavation at Southwest Point will be used to augment the natural grades within the course. Topsoil needs for the course will be developed to the greatest extent possible from soils available on Lantern Head and Southwest Point with nutrient and blend augmentation to meet the needs of the golf course. If more material than is available from the two project sites is required, soils from elsewhere on Abaco will be acquired and similarly augmented to meet the ultimate requirements of the course. The design of the golf course turf areas uses geofabric underlayment to contain soils and irrigation flows to the design areas. The soils cross section of turf areas will maintain proper percolation for natural aquifer recharge while inhibiting fertilizers and herbicides from running off into on-site water bodies, the ocean or leaching into the aquifer. Tees and greens are designed with underdrains to provide the very best control of fertilizer and herbicide leachate and reuse as

Area	Acres	% Coverage
Fairways	84	39%
- Tees & Greens *	7	3%
- Bunkers *	2	1%
Water Bodies	22	10%
Non-fairway area	111	51%
Total Golf Course	217	
* Included in fairway area		

these turfs are the only areas of the course that have more stringent requirements for nutrient augmentation and weed control.

Course Coverage

Environmental stewardship is a flagship component of this entire project, as it is for the golf course. Conservation of water and environmentally sensitive course maintenance methods and materials are key to the design and operation of the course. Clearing and reshaping of the natural environment is reduced with the links style design. Fairway coverage is 39% of the overall 217 acres of golf course area. In areas between fairways where the native vegetation can be enhanced with resort quality landscaping, it will remain and there the cart paths will be the only impact to the native condition. Not all the fairway area will necessarily be 100% turf covered. As the design for construction is finalized, some areas may be left more native within the links design. So, this 39% fairway area represents a nominal maximum of the course to be converted to turf.

Irrigation

The irrigation needs of the golf course and related landscaping are estimated annually at 4 acre-feet per turf acre or landscaped acre. With an average annual rainfall of just shy of 4 acre-feet the irrigation needs of landscaping will be relegated to the dry months. The turf will require regular irrigation. Salt/brackish and gray water will be the water source for the fairway irrigation. Graywater and the engineered water bodies that are part of the rainwater collection system of the site will be used for irrigation of tees, greens and enhanced landscaping on the course.

Turf and Related Irrigation Considerations

All turf areas of the course use controlled coverage sprinkler irrigation with all designed landscape areas irrigated with drip or concentrated disbursement for maximum irrigation efficiency and minimum water use. Fairway turf will be seashore paspalum which is a variety specifically developed for coastal golf course applications. This turf offers the advantage of very high salt tolerance, while also providing the playing characteristics desired in golf turf. After it is established, seashore paspalum can be maintained with pure sea water which provides unique water conservation options. Sea water assists in the control of weeds and minimizes the need for herbicide use. The combined features of this turf grass help to achieve a level of environmental stewardship that is befitting this resort golf course.

Tee boxes and greens turf will be Bermuda grass hybrids. This turf is elemental to the world-famous Augusta National Country Club among other notable courses and provides the caliber of playing surface expected in a world class resort. Bermuda grass is excellent warm weather turf that has minimum irrigation needs, is fast growing, and quick to recover from injury. Environmentally responsible organic fertilizers tailored to Bermuda grass have been developed over the last 40+ years. And fungicide application is seldom justified.

Bunkers and sand traps throughout the course all use coarse grain native sands.

Water Features

The golf course will have water features that are integral to the design of the golf course and the entire resort. In addition to being beautifully sculpted landscape amenities, these water bodies will be used as rainwater collection reservoirs to store rain collected by structures on the overall site for domestic and irrigation water needs of the course and resort. The course design contains 22 acres of water feature. These water bodies will be engineered and fully lined to maximize water capture and reuse.

APPENDIX C– Coastal Engineering Analysis.

Caribbean Coastal Services

COASTAL ENGINEERING ANALYSES

PROPOSED SOUTH WEST POINT MARINA

SOUTH ABACO, THE BAHAMAS

Prepared for: Tyrsoz Family Holdings

July 30, 2019

Table of Contents

1 INTRODUCTION

Caribbean Coastal Services Ltd. (CCS) was contracted to conduct a study of metocean conditions has been completed for Lantern Head and the South West Point (SW Point) of South Abaco, located on the island of Great Abaco, The Bahamas.

The purpose of this study was to define metocean conditions as required to support the planning and design of the proposed developments at Lantern Head and a marina at Southwest Point. This study included the following activities:

- Extraction of metocean data offshore for South Abaco from a thirty-year Atlantic Ocean wave hindcast;
- Analysis of historical measured wind data near the site;
- Analysis of the site to determine the magnitude and frequency of conditions related to hurricanes;
- Simulation of historical hurricanes and calibration the model using NOAA data and previous results to obtain storm surge and hurricane wave conditions using the model results;
- Set up a nearshore wave transformation model using the MIKE21 spectral wave module;
- Set up a nearshore hydrodynamic model using the MIKE21 flexible mesh module;
- Definition of operational and extreme wave conditions at the project site;
- Definition of extreme water levels (storm surge) and wave heights (hurricane waves) at the project site;
- Assessment of wave mitigation effects by the proposed breakwater at Lantern Head;
- Assessment of wave agitation levels within the proposed marina.

This report summarizes the methodologies and results of each of the above listed tasks. If not specifically noted, this report uses the International System of Units (SI) for all results.

2 AVAILABLE DATA

2.1 Tidal Benchmarks

Typical tidal benchmark values for the region are listed as follows:

Table 2.1 Tidal Benchmarks near the Proposed Project Sites

Tide Levels	Tide Level (m-MSL)
Mean Higher High Water (MHHW)	0.48
Mean High Water (MHW)	0.39
Mean Sea Level (MSL)	0.00
Mean Low Water (MLW)	-0.40
Mean Lower Low Water (MLW)	-0.41

2.2 Hurricane History

The Bahamas is frequently affected by hurricanes. An analysis of historical hurricanes (Figure 2-1) was recently completed by accounting for all hurricanes passing within a 200 nautical miles radius from 1859 to 2017, therefore providing a suitable dataset for a preliminary assessment of the frequency of occurrence and magnitude of hurricane events impacting South Abaco. There have been 115 hurricanes passing South Abaco, one hurricane in every 1.4 years on average. The hurricane season typically lasts from June to November, causing heavy rainfall and coastal flooding. Hurricane Andrew, a Category 5 hurricane occurred in 1992, had the strongest wind speed of 160 mph. The most recent catastrophic hurricane is Hurricane Matthew in 2016, which caused 8-ft storm surge in southwest coast of Nassau and Grand Bahama. Figure 2-2 presents the logarithmic exceedance curve of hurricane wind speed for the 115 historical hurricanes. The 50-year hurricane wind speed is 75 knots (38.55 m/s), and will be used for the modelling of nearshore hurricane wave transformation.

The historical hurricane wind data will be used for storm surge and hurricane wave modelling in this study. Particularly, major hurricanes from 1979 to 2017 will be simulated using HURDAT2 (NOAA) hurricane track data since the hurricane data are more reliable during this time frame due to the launches of meteorological satellites in 1970s. Details of these major hurricanes are presented in Table 2.2.

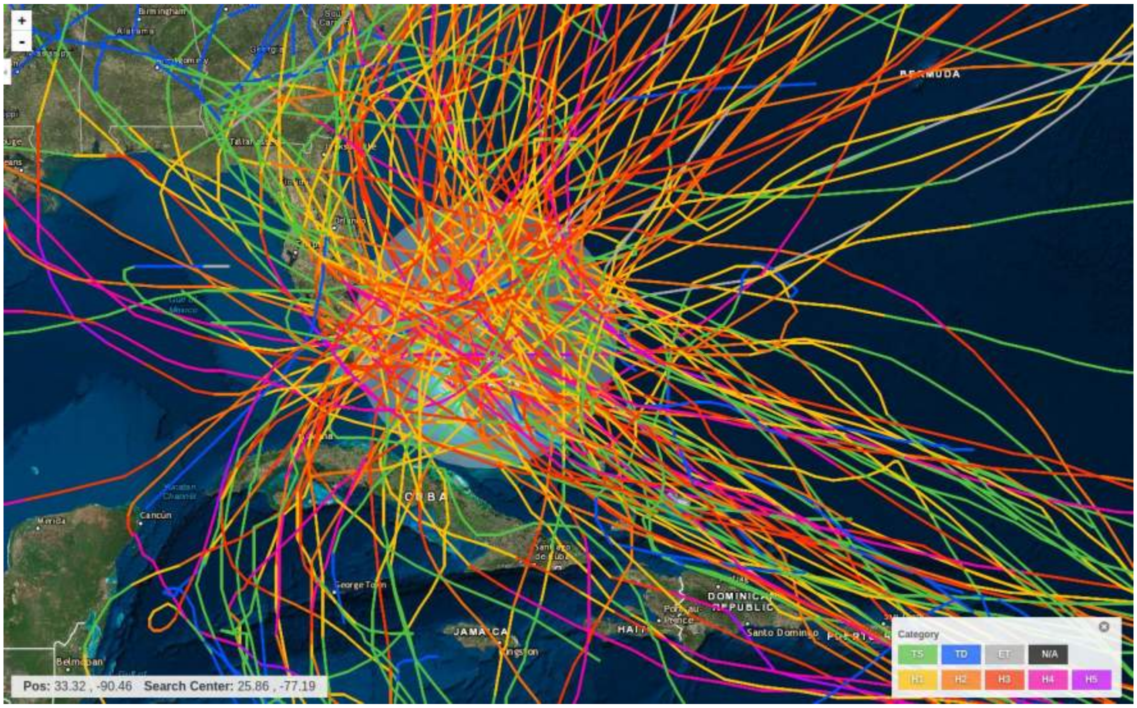


Figure 2-1 Historical Hurricane Passing with 200 nmi of the project sites (1859-2017) (Source: https://coast.noaa.gov/hurricanes/).

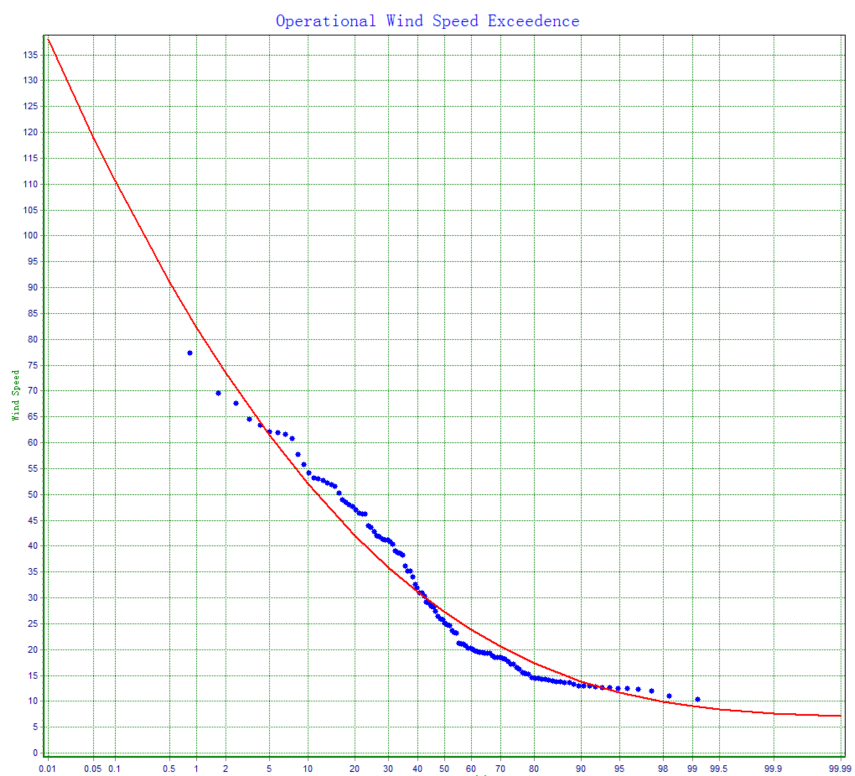


Figure 2-2 Logarithmic Exceedance Curve for Hurricane Wind Speed

Table 2.2 Details of Historical Hurricane Passing with 200 nmi of the project site (1979-2017)

Name	Year	Pressure (milibars)	Max Sustainable Wind (knots)	Category	Duration (Days)
DAVID	1979	976	80	H1	15
GERT	1981	993	80	H1	9
FLOYD	1987	994	50	H1	6
HUGO	1989	950	100	H3	15
ANDREW	1992	923	140	H5	13
ERIN	1995	980	75	H1	7
BERTHA	1996	966	80	H1	13
FRAN	1996	952	105	H3	19
LILI	1996	970	90	H2	16
DENNIS	1999	976	75	H1	16
FLOYD	1999	930	110	H3	13
IRENE	1999	985	65	H1	8
MICHELLE	2001	980	75	H1	9
FRANCES	2004	960	90	H2	17
JEANNE	2004	957	100	H3	17
KATRINA	2005	1000	45	TS	9
WILMA	2005	955	105	H3	12
NOEL	2007	981	70	H1	14
IRENE	2011	950	90	H2	10
SANDY	2012	968	70	H1	11
JOAQUIN	2015	942	110	H3	20
MATTHEW	2016	952	110	H3	13

2.3 Local Wind

The Bahamas is dominated by easterly trade wind all year round. The wind direction is mainly northeasterly from October to April and southeasterly from May to September. The nearest wind station is located at the Nassau International Airport (77.47W, 25.04N), which is maintained by the Department of Meteorology and provides fifteen-years (2003-2017) hourly measured wind data. No elevation adjustment was applied to the wind data, as wind measurements were assumed to be recorded 10 m above land, with the station itself lying 4.9 m above sea level. These wind data are presented in Figure 2-3 as a wind rose and Figure 2-4 as a logarithmic exceedance curve. Note that wind speed data corresponding to hurricane have been removed based on hurricane events duration documented in Section 2.2. A total number of 114053 wind speed records were used for producing the wind rose and logarithmic exceedance curve plots. Annual and weekly wind speed limits are corresponding to the 0.013% (15 / 114053) and 0.68% (15 x 52 / 114053) exceedance, 14.7 m/s and 9.8 m/s, respectively. These two values were used for the modelling of locally generated waves.

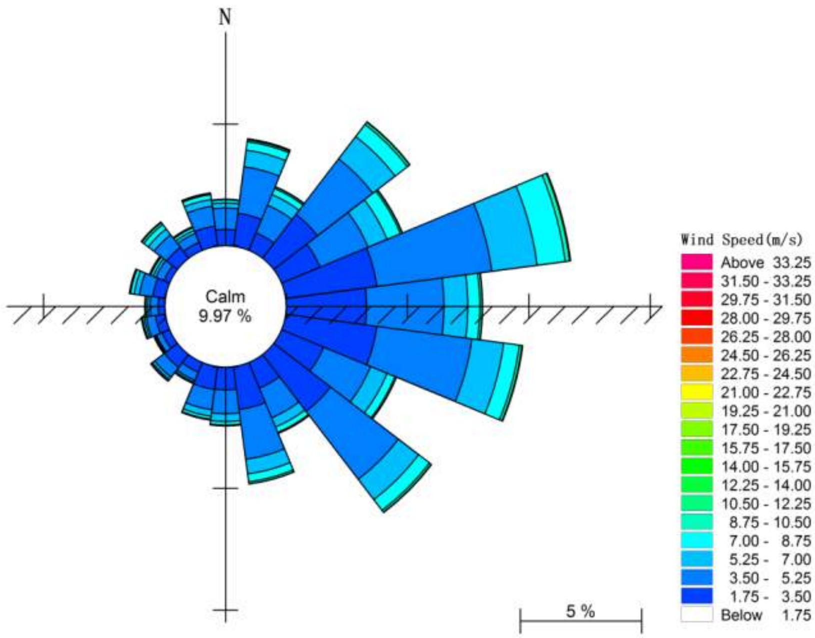


Figure 2-3 Local Wind Rose (Hourly NOAA Measured Data from 2003 to 2017)

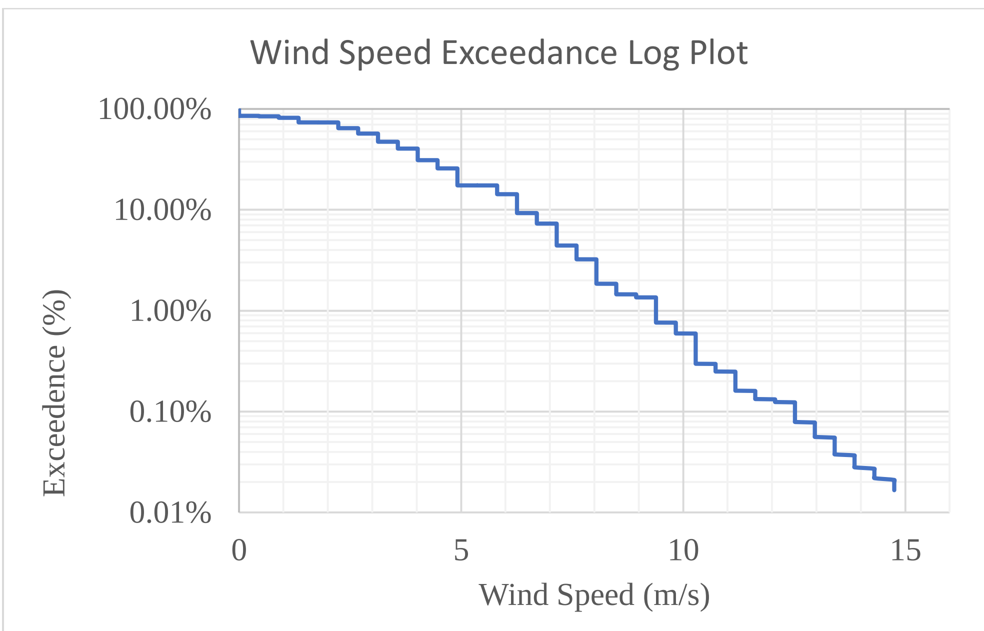


Figure 2-4 Logarithmic Exceedance Curve for Local Wind Speed (NOAA Measured Data)

2.4 Offshore Wave Climate

In order to determine the operational wave conditions at the project site, the 30-yr offshore wave hindcast results were extracted from the WAVEWATCH III 30-yr Hindcast Phase 2 study (http://polar.ncep.noaa.gov/waves/hindcasts/nopp-phase2.php). The model grid uses 10 minutes spacing and simulates wave generation and propagation over Gulf of Mexico and Northwest Atlantic Ocean (Figure 2-5). The hindcast was from 01/01/1979 to 12/31/2009. The model provides an estimate of the wave conditions every three hours. An example of the wave height distribution from the 30-year hindcast are presented in Figure 2-6. The wave conditions for the MIKE21 model were extracted from a grid point in deep water, approximately 35 km east of South Abaco (Figure 2-6).

Validation of the WAVEWATCH III model was completed through comparisons with NOAA Wave Buoy 41047, which is located 350 nautical miles ENE of Nassau (Figure 2-7). This was chosen due to its distance from islands and shoals. An example of a wave time series comparison is shown in Figure 2-8, while a statistical comparison of the wave conditions is shown in Figure 2-9. This figure is a Quantile-Quantile (QQ) plot, which shows a comparison of wave height exceedance for the two data sets, for concurrent data samples. A QQ plot that lies close to the 1:1 line indicates that the two data sets would have essentially equal wave height exceedance statistics. This would indicate a good statistical fit between the hindcast and the measurements. The lower half of the plot shows the matching data points that also cluster close to the 1:1 line. From the hindcast, data and model results are in good agreement.

Figure 2-10 shows the wave rose for offshore waves. It can be seen that offshore waves in this region are generally limited to directions between 45º and 180º; these waves are associated with the prevailing NE trade winds, as well as swell waves generated by storms in the North Atlantic.

Figure 2-11 presents a logarithmic exceedance curve for the offshore significant wave height. Like the wind speed data, offshore wave data corresponding to hurricane have also been removed based on hurricane events. A total number of 89131 wind speed records were used for generating the wind rose and logarithmic exceedance curve plots. The annual and weekly wind speed limits are corresponding to the 0.09% (30 / 89131) and 1.75% (30 x 52 / 89131) exceedance, 2.8 m and 2.5 m, respectively. These two values as offshore significant wave heights (Hs) were used as boundary conditions for modelling the propagation of swells into the nearshore region.

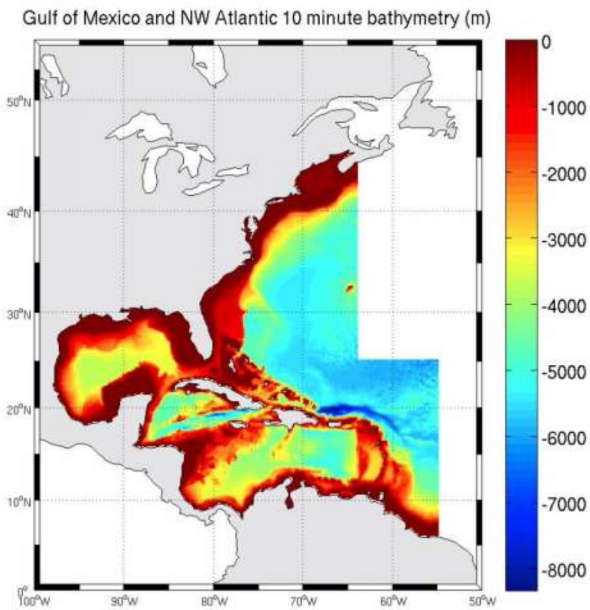


Figure 2-5 Model Mesh Domain and Bathymetry.

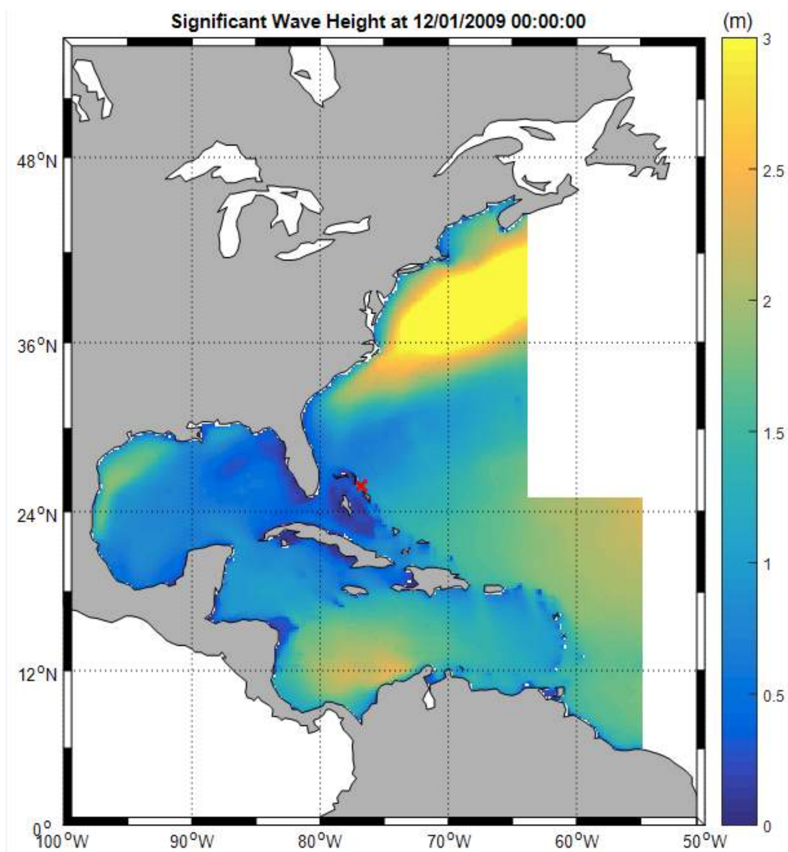


Figure 2-6 An example of hindcast significant wave height distribution. Red cross shows the location where the offshore wave conditions were extracted (-76.83°E, 25.83°N).

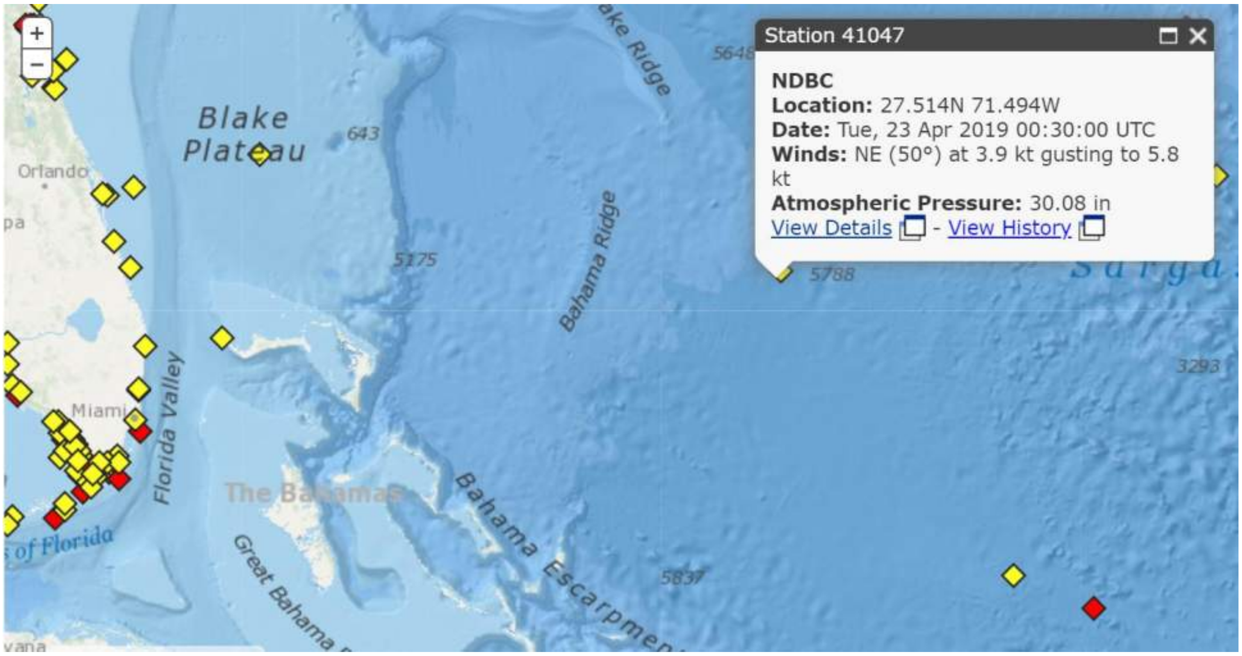


Figure 2-7 NOAA Wave Buoy 41047.

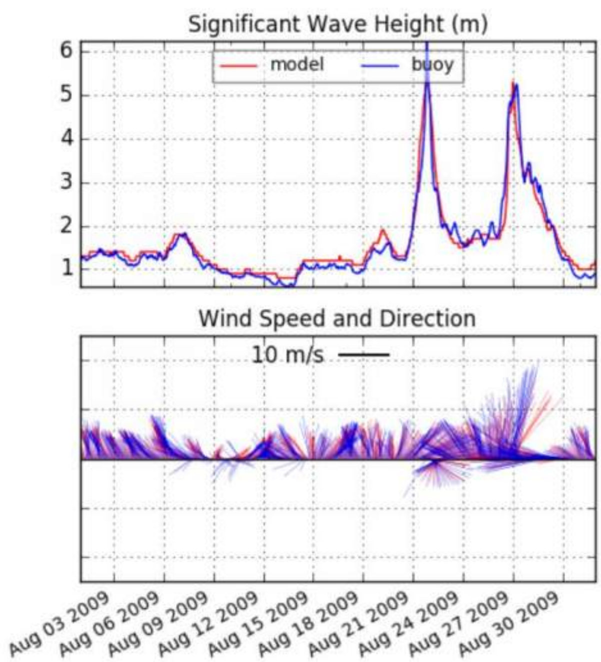


Figure 2-8 Wave and Wind Time Series Comparisons During August 2009.

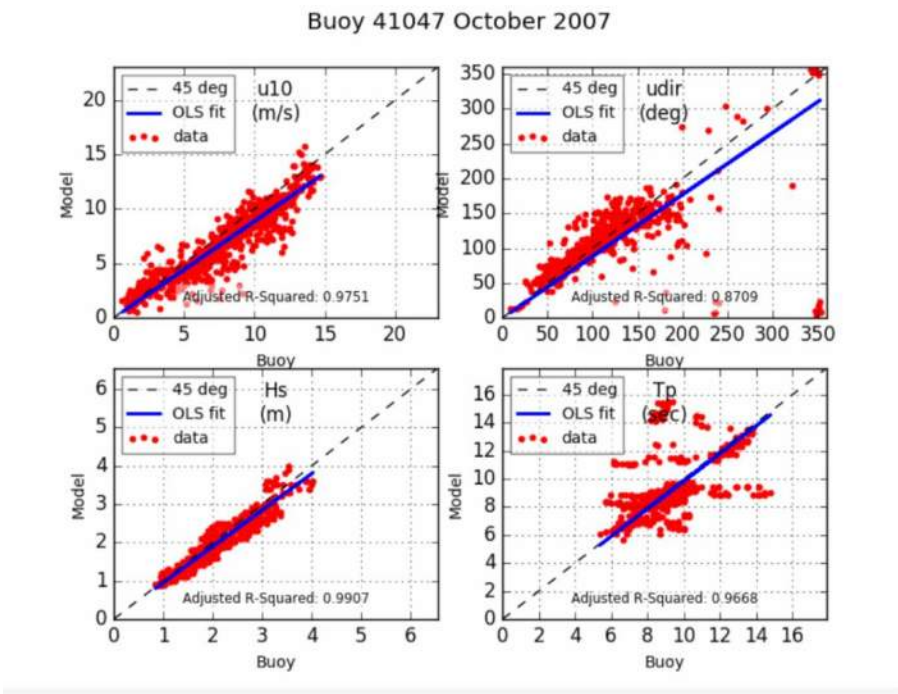


Figure 2-9 QQ Plot of Wind and Wave Statistics During Hurricane Noel, 2007. u10: Wind Speed; udir: Wind Direction; Hs: Significant Wave Height; Tp: Peak Period.

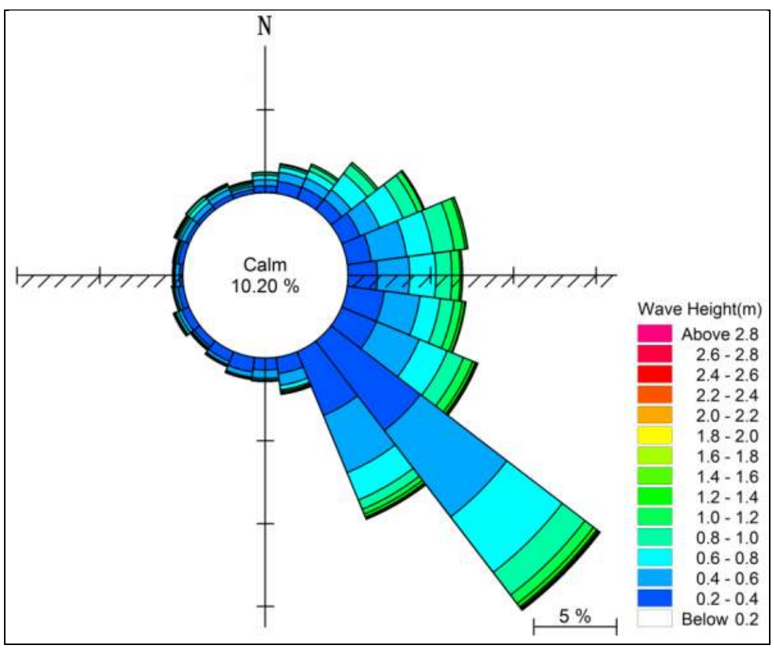


Figure 2-10 Offshore Wave Rose (Jan 1979 to Dec 2009, from deepwater).

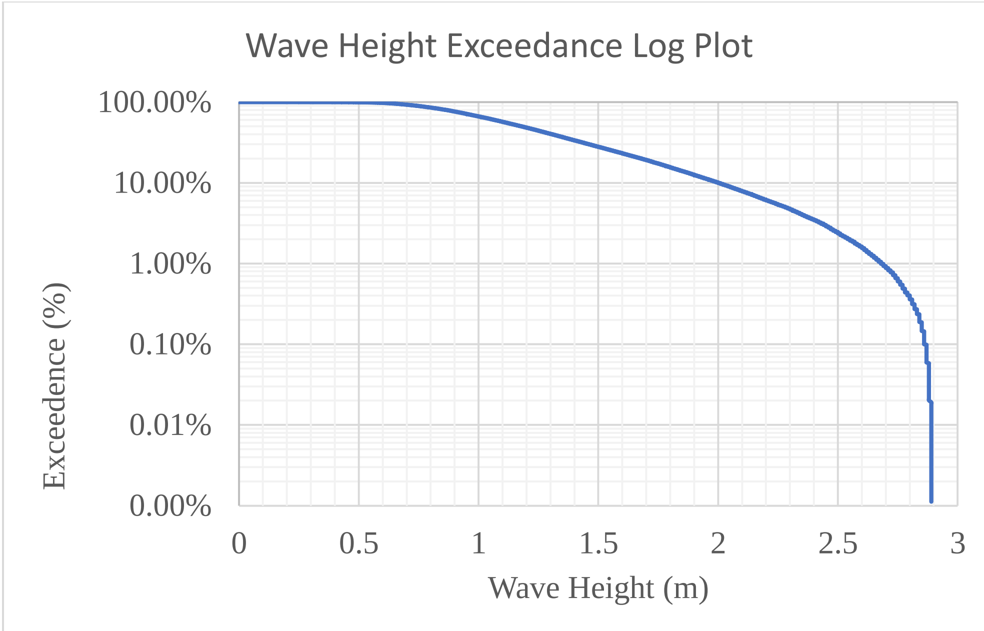


Figure 2-11 Logarithmic Exceedance Curve for Offshore Significant Wave Height

2.5 Bathymetric Data and Structure Layout

Bathymetric data used in the model study include satellite derived bathymetry, nautical chart data, and Etopo2 data (NOAA). Satellite derived bathymetric data was collected in the immediate vicinity of proposed project; while navigational chart data was used for intermediate water depth. NOAA's Etopo2 data was utilized for deep water.

The proposed marina basin is to be cut inland from the sea and will be accessed by an 8.1-m deep entrance channel. The basin will be approximately 530 m wide by 650 m long (for a total area of approximately 344,500 m²) and would have a depth of 5 m. A flushing channel has also been proposed with a depth of 1.8 m. The jetties at the entrance channel and man-made island in the marina will have elevations of +2.4 m-MSL and +1.8 m-MSL, respectively. For the proposed breakwater, the water depth near the beach is set to be -2 m-MSL. The breakwater will be 92 m long with a crest elevation of +2.5 m-MSL and a crest width of 3.2 m.

3 OPERATIONAL CONDITION MODELLING

3.1 Hydrodynamics Modelling

MIKE 21 Flexible Mesh hydrodynamic model (M21FM) was used to simulate the hydrodynamics near the proposed project sites. The M21FM model uses a mesh of triangles to represent the bathymetry in the area, and can use larger elements in less critical areas, and increased resolution where it is required. Figure 3-1 shows the computational domain. The mesh covers the shoreline of South Abaco and its neighboring area and stretches 1685 km seaward. The element size varies from 29000 m at the offshore region to 6 m at the project locations. This feature allows the modeler to both have the desired high resolution at areas of interest and cover large areas while limiting the number of elements and run times. The model inputs include a bathymetric mesh and tidal hydrographs (calibration) at the eastern offshore boundary. The mesh contains bathymetry interpolated from the nautical chart for the nearshore and open ocean regions of the Bahamas. Satellite bathymetric data has also been incorporated to the model bathymetry.

The hydrodynamic model was validated using tidal data from May to June 2019. Tide amplitude was observed to be about 0.5 m over the deployment period. As shown in Figure 3-2, the simulated tidal surface elevations match well with the measured data.

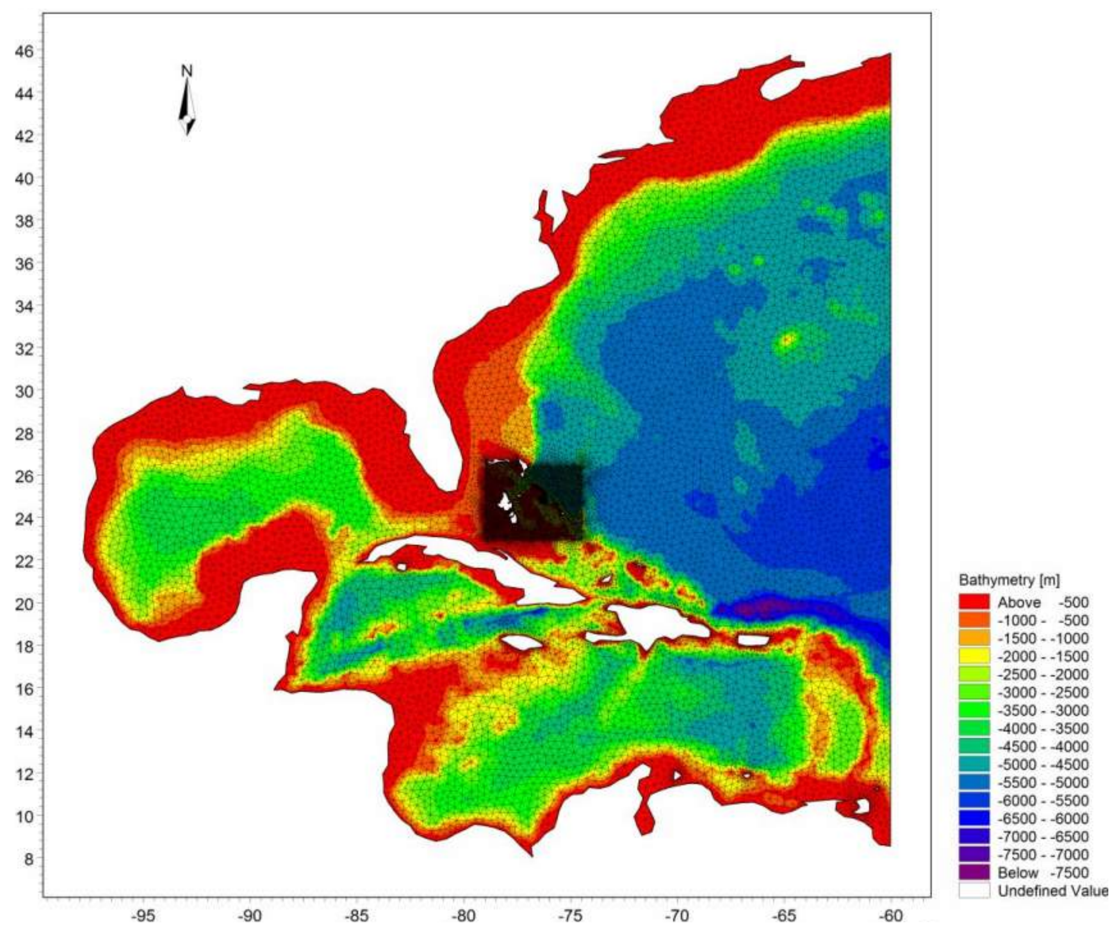


Figure 3-1 Hydrodynamics Modelling Mesh and Bathymetry

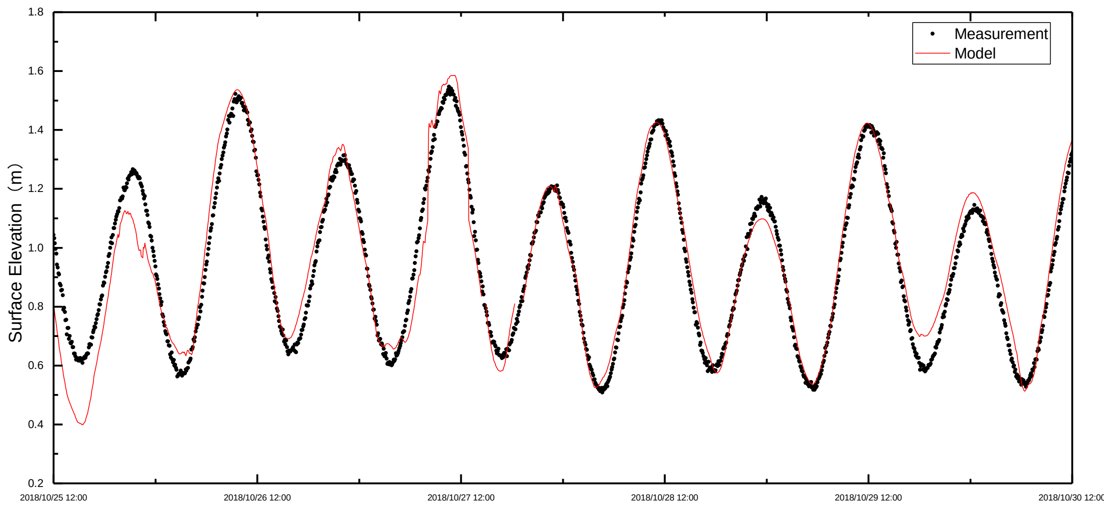
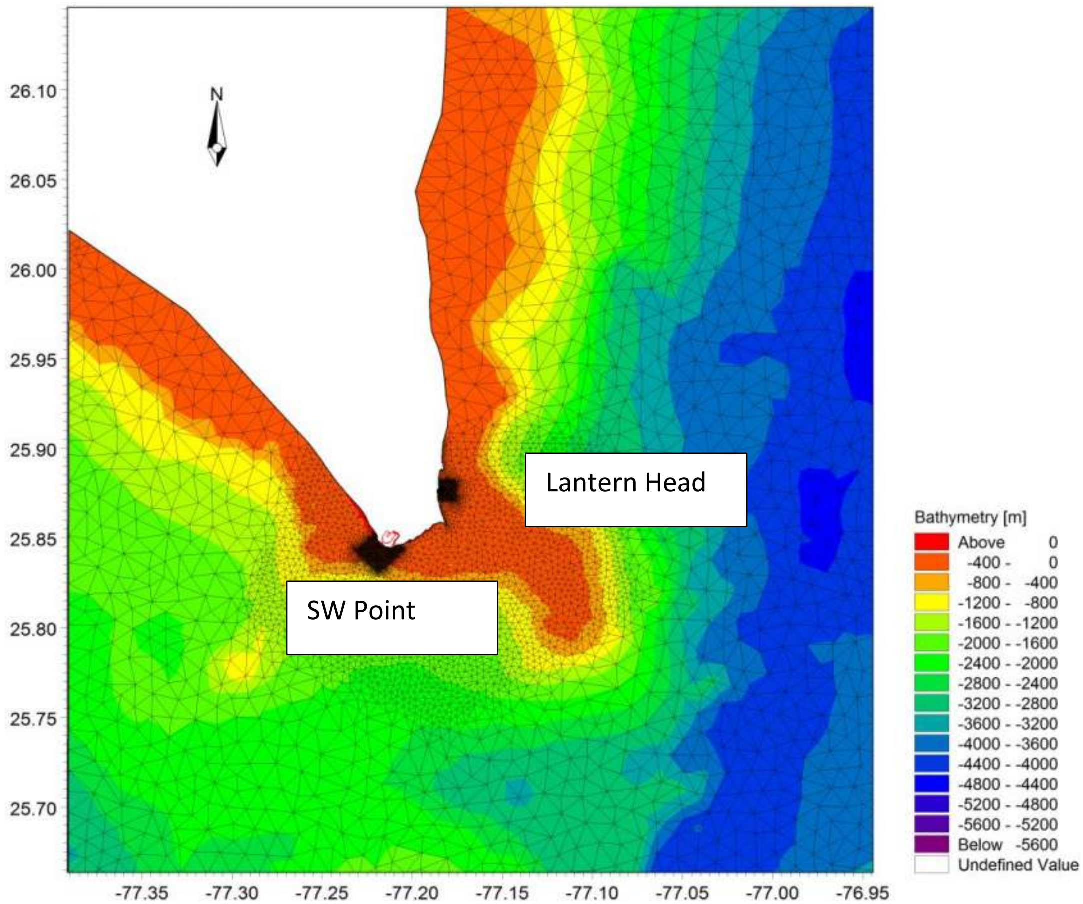


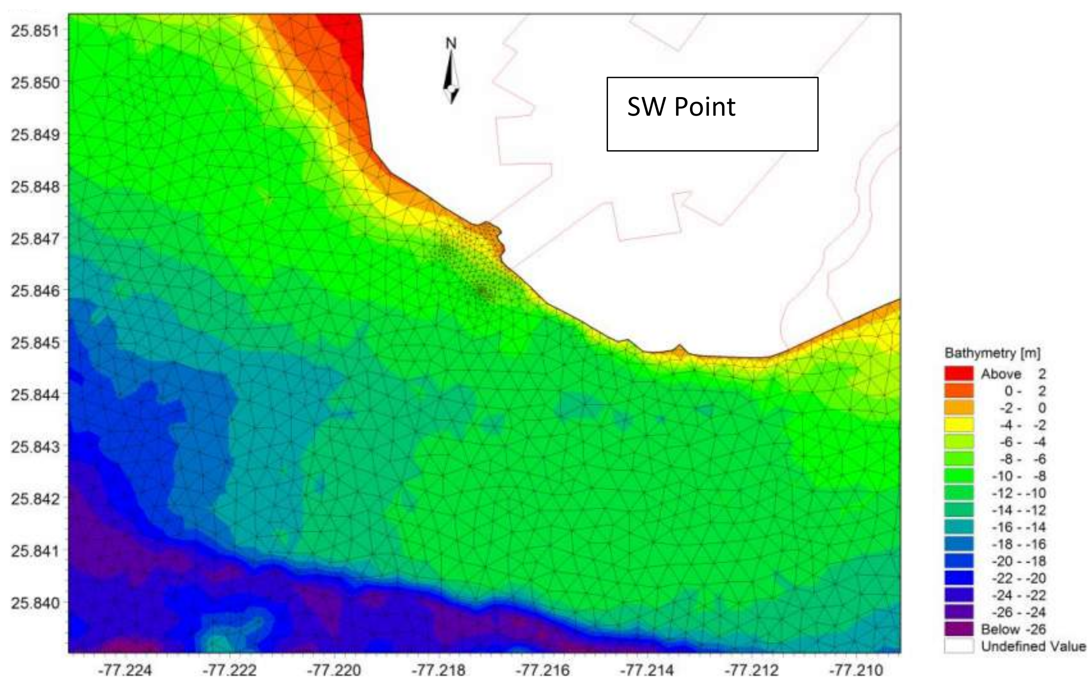
Figure 3-2 Modeled and Measured Water Surface Elevation

3.2 Wave Modelling

Nearshore wave transformations were completed using the MIKE 21 Spectral Wave model (M21SW), which simulates breaking, refraction, shoaling, diffraction, and various other wave processes. The model can be forced by water levels, deep-water wave conditions, or wind forcing over the computational domain (Figure 3-3). The model uses a flexible mesh approach to represent the bathymetry, and several different meshes were generated to represent different regions. The bathymetry was constructed using nautical chart combined with satellite bathymetric data and water-depth data. Simulations were conservatively conducted for the MHHW condition (+0.48 m-msl). The wave model will be used for swell and wind waves modelling, and the results will be used to investigate the wave mitigation effects of the proposed breakwater and the wave agitation effects in the proposed marina. Bed friction was turned off in all model simulations to ensure conservative estimates of wave propagation across the shallow waters.



Lantern Head
SW Point
Bathymetry [m]
Above 0
-400 - 0
-800 - -400
-1200 - -800
-1600 - -1200
-2000 - -1600
-2400 - -2000
-2800 - -2400
-3200 - -2800
-3600 - -3200
-4000 - -3600
-4400 - -4000
-4800 - -4400
-5200 - -4800
-5600 - -5200
Below -5600
Undefined Value
N



SW Point
N
Bathymetry [m]
Above 2
0 - 2
-2 - 0
-4 - -2
-6 - -4
-8 - -6
-10 - -8
-12 - -10
-14 - -12
-16 - -14
-18 - -16
-20 - -18
-22 - -20
-24 - -22
-26 - -24
Below -26
Undefined Value

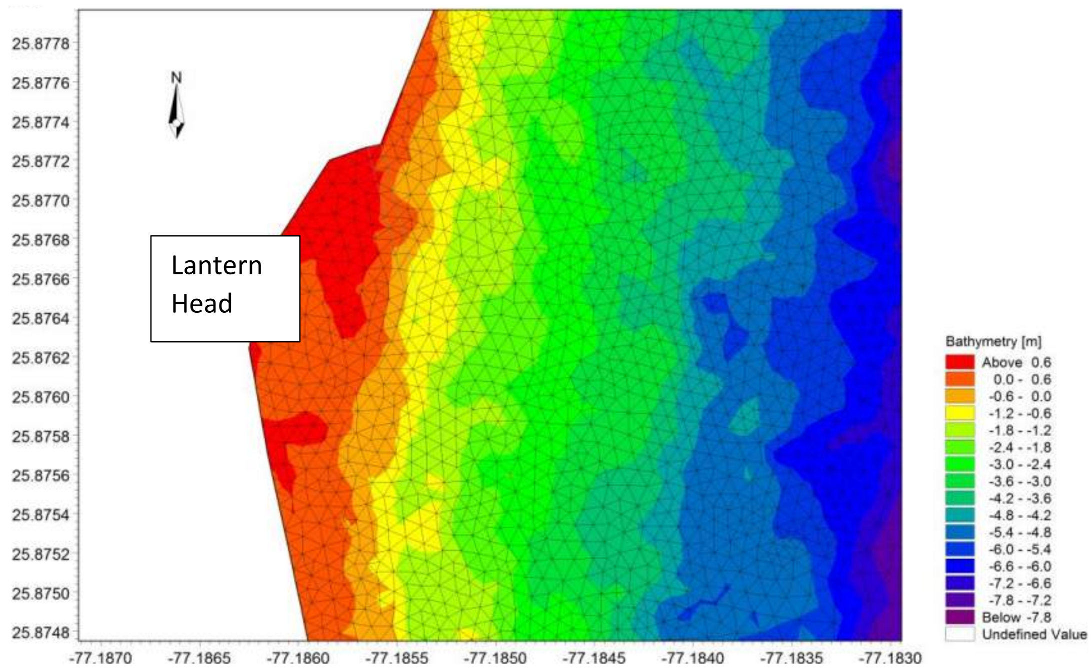


Figure 3-3 Nearshore Wave Modelling Mesh Domain and Bathymetry. Top: Whole Computational Domain; Middle: SW Point; Bottom: Lantern Head.

3.2.1 Swells

The model was run with the weekly and annual significant wave height (Hs = 2.5m and 2.8 m) input at the offshore boundary shown in Section 2.4 from three principal directions, 90º, 135º, and 180º. These directions correspond to the east, southeast, and south directions of the operational wave climate and provide a conservative prediction as to whether offshore waves contribute to operational wave conditions at the project site. The corresponding peak wave period for these simulations was Tp = 9.7 seconds (25% exceedance). Wave heights at the project sites (Figure 3-4) for the weekly and annual events are presented numerically in

Table 3.1. Wave height distributions for the annual events are shown graphically in Figure 3-5 through Figure 3-7. Swell waves reach their maximum at Lantern Head when offshore waves propagate from the east; while they are the largest at SW Point with southerly incoming waves.

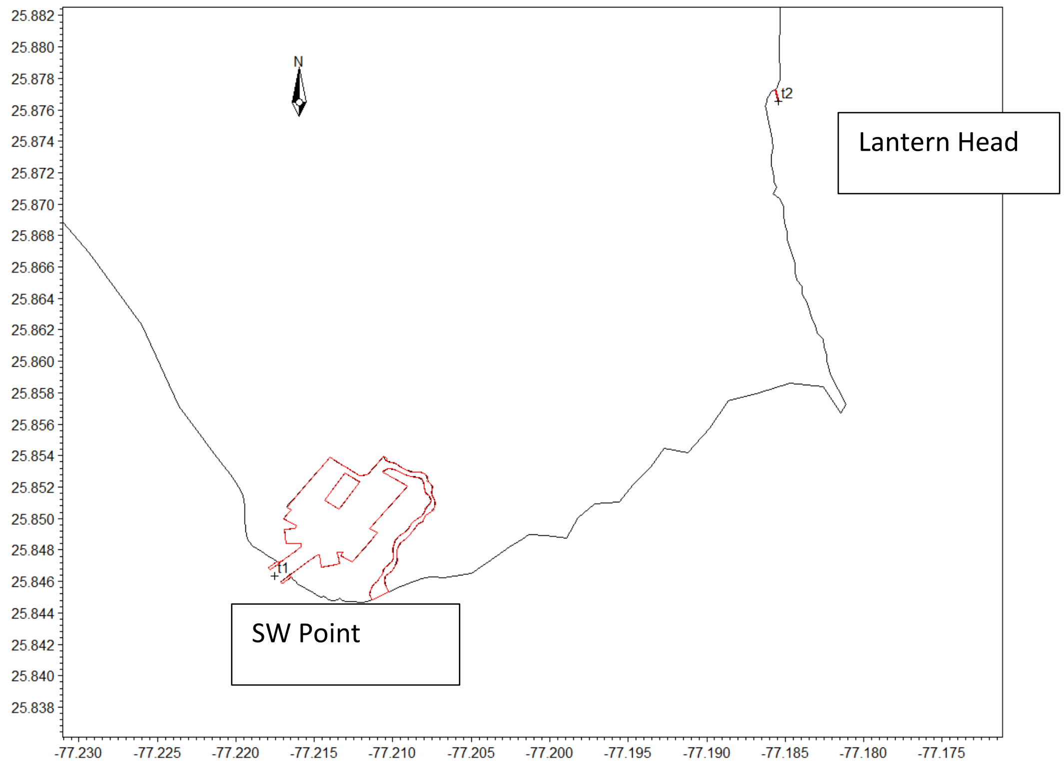


Figure 3-4 Wave Heights Extraction Locations.

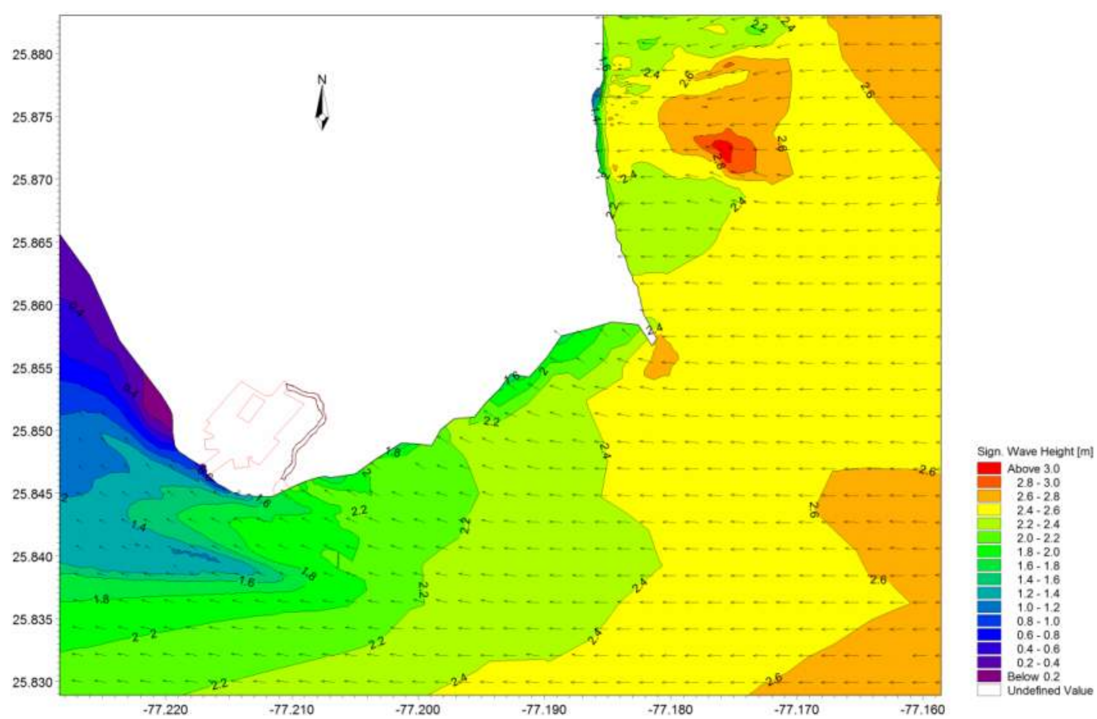


Figure 3-5 MIKE21 SW Output for Hs=2.8m, Tp=9.7s and MWD=90°

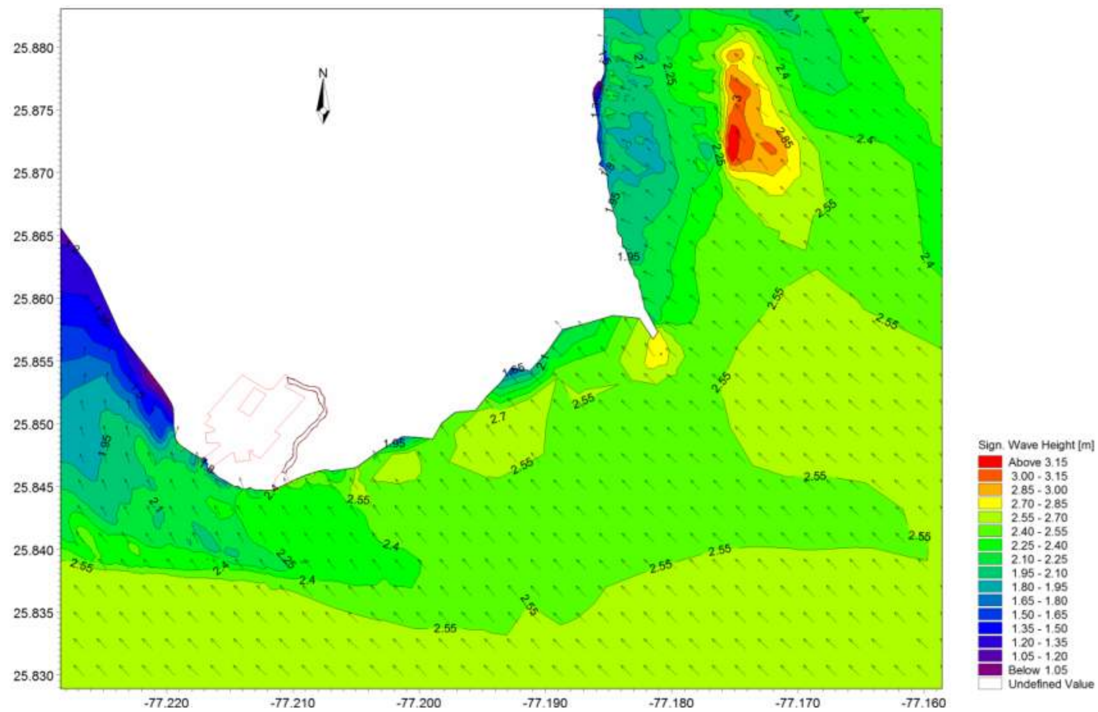


Figure 3-6 MIKE21 SW Output for Hs=2.8m, Tp=9.7s and MWD=135°

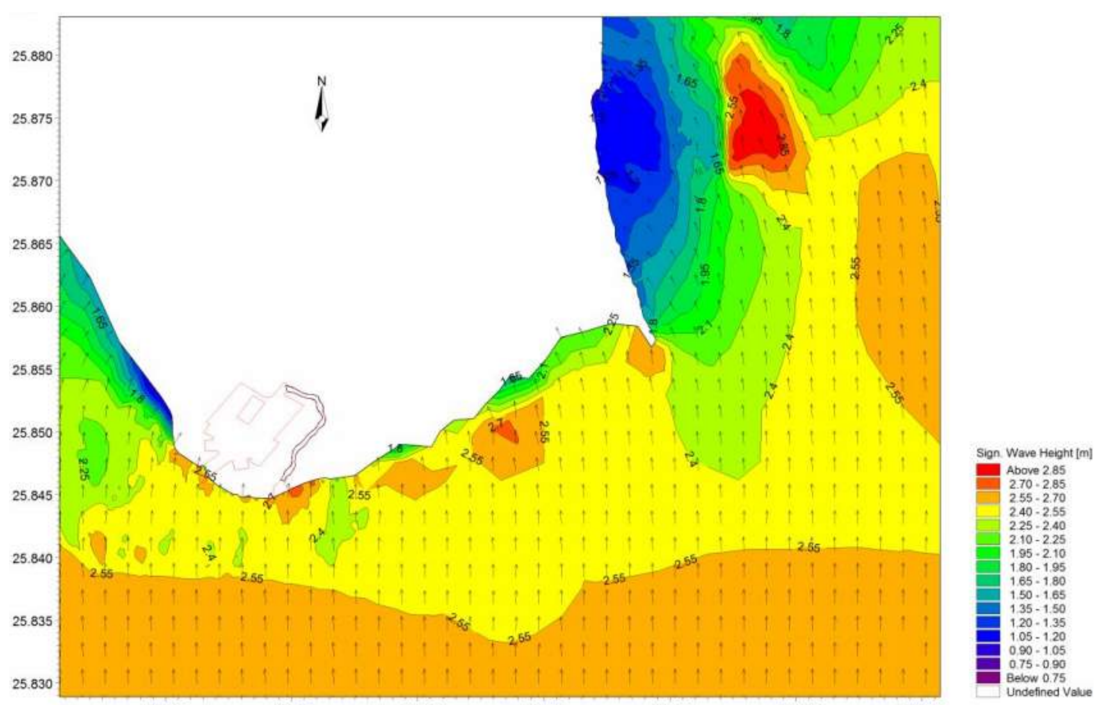


Figure 3-7 MIKE21 SW Output for Hs=2.8m, Tp=9.7s and MWD=180°

Table 3.1 MIKE21 SW Results for Offshore Waves Propagating into Project Sites

Runs	Waves			SW Point	Lantern Head
	Dir (°)	Hs (m)	Tp (s)	Hs (m)	Hs (m)
SWELL01	90	2.5	9.7	1.02	2.03
SWELL02	135	2.5	9.7	1.86	1.90
SWELL03	180	2.5	9.7	2.24	1.19
SWELL04	90	2.8	9.7	1.17	2.07
SWELL05	135	2.8	9.7	2.09	1.98
SWELL06	180	2.8	9.7	2.48	1.26

4.2.1 Locally Generated Waves

To determine the locally generated wave climate associated with operational winds, the MIKE21 SW model was once again employed. Constant wind speeds of 9.8 and 14.7 m/s (as presented in Section 2.3) corresponding to the weekly and annual events were blowing across the domain from three directions as follows: 90º (easterly winds), 145º (southeasterly winds), and 180º (less frequent but direct attack to SW Point). The wave height distributions for the weekly events are shown in Figure 3-8 through Figure 3-10. The resulting wave heights at the project sites are presented in Table 3.2 with the wave height extraction locations shown in Figure 3-4.

From Table 3.2 the wind direction has a significant impact on the waves at the sites. Locally generated waves are 0.78 m and 1.52 m for the weekly and annual events under easterly wind condition at Lantern Head. The waves can reach 0.81 m and 1.58 m for the weekly and annual events under southerly wind condition at SW Point.

The operational wave condition modeling shows that swells dominate the wave climate at the two proposed project sites, because the lack of barrier islands near the sites which would have protected the sites from the attack of offshore waves. The operational wave conditions will be used to study wave mitigation effects of the proposed breakwater and wave agitation effects of the proposed marina.

Table 3.2 MIKE21 SW Results for Locally Generated Waves at the Project Sites

Runs	Waves		SW Point	Lantern Head
	Dir (°)	Speed (m/s)	Hs (m)	Hs (m)
WW01	90	9.8	0.43	0.78
WW02	135	9.8	0.76	0.75
WW03	180	9.8	0.81	0.51
WW04	90	14.7	0.81	1.52
WW05	135	14.7	1.47	1.46
WW06	180	14.7	1.58	0.96

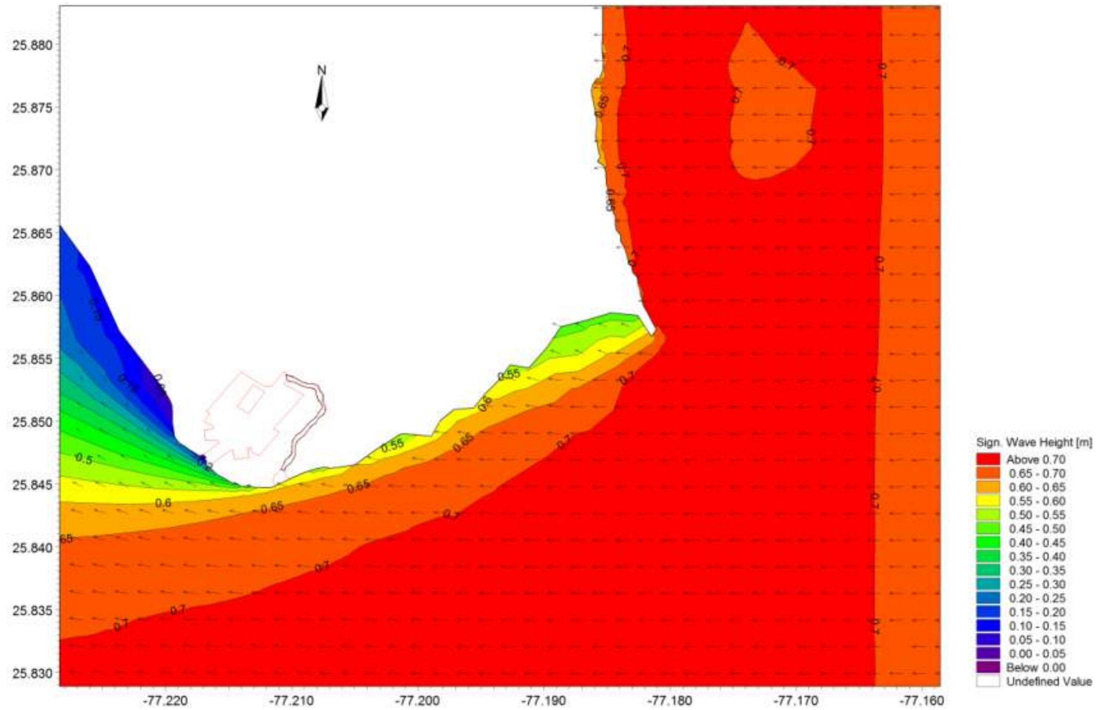


Figure 3-8 MIKE21 SW Output for Wind Speed of 9.8 m/s and Direction of 90°

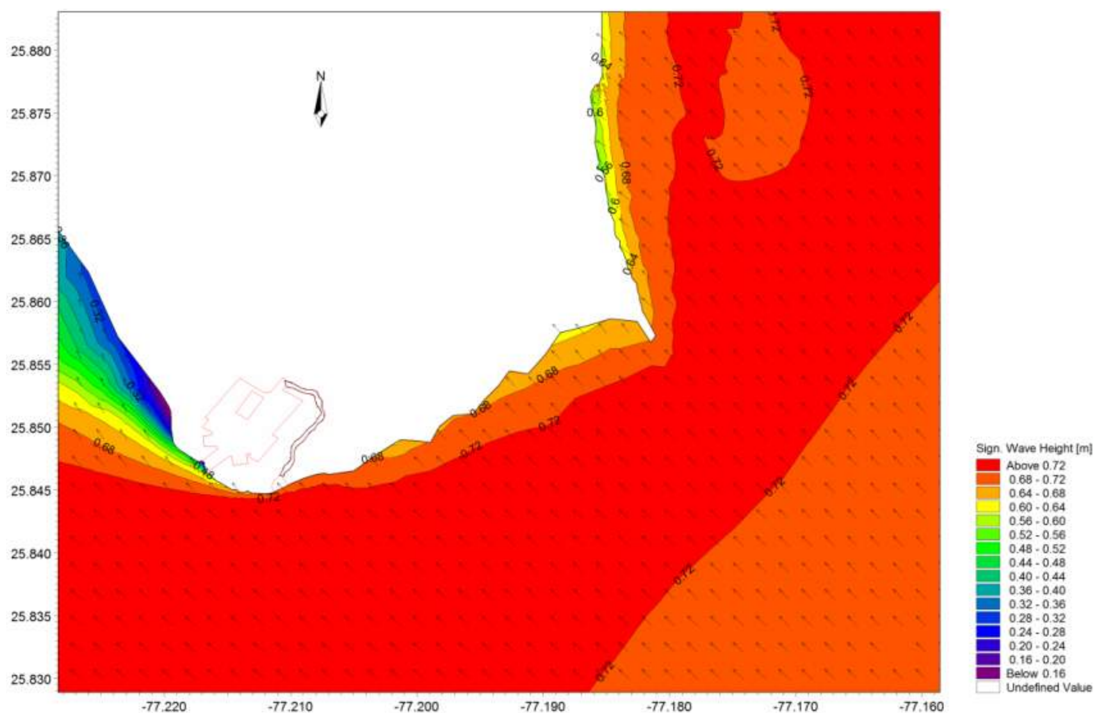


Figure 3-9 MIKE21 SW Output for Wind Speed of 9.8 m/s and Direction of 135°

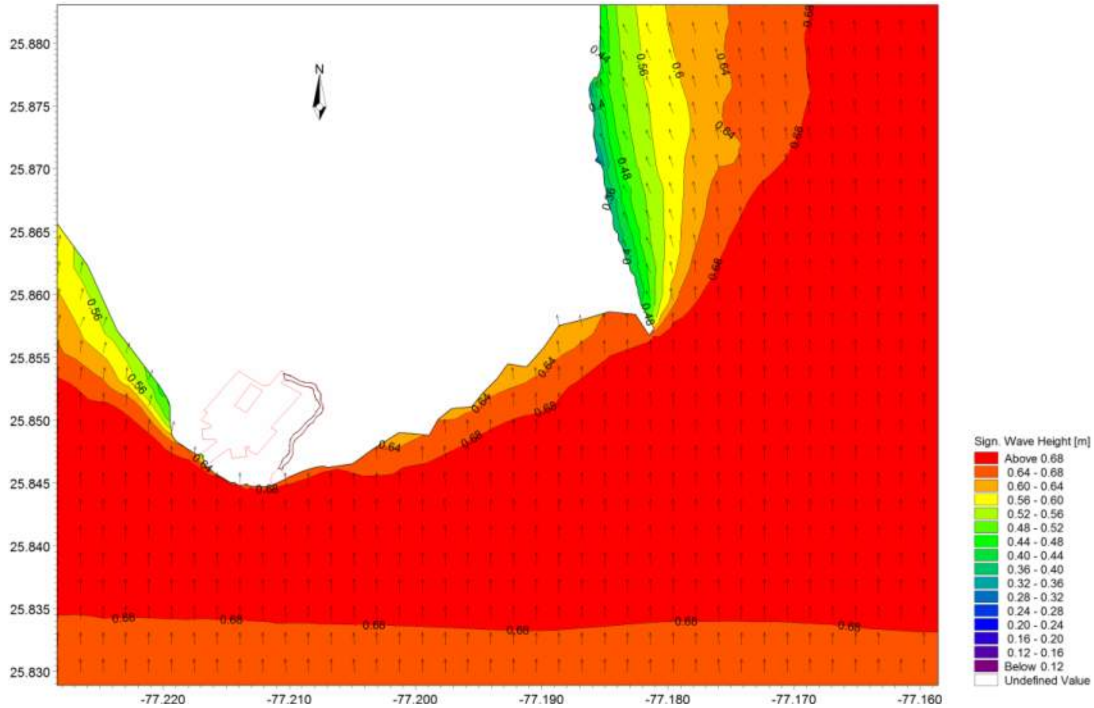


Figure 3-10 MIKE21 SW Output for Wind Speed of 9.8 m/s and Direction of 180°

4 EXTREME CONDITIONS DURING HURRICANES

4.1 Storm Surges

The M21FM model was also used to assess surges resulting from hurricanes and involved the simulation of both pressure setup (due to the low pressure in the center of the storm) and wind setup. Storm surge simulations in M21FM included 22 historical hurricanes passing within 200 nmi of the project sites from 1979-2017 as shown in Section 2.2.

The best track data for these 22 storms were used for storm surge modelling, and an estimate of the surges at both project sites was determined for each historical storm. The simulated storm surge elevation was compared with recorded data by NOAA for selected hurricanes. For example, model results for Hurricane Matthew show that the surge elevation in the area of northwest Nassau is 2.6 m, consistent with the NOAA hurricane report. As such, the model was considered accurate.

An extreme value analysis was then conducted to estimate the storm surge elevations at the project sites by return period. The logarithmic exceedance curves for storm surge at the project sites are shown in Figure 4-1 through Figure 4-2. From this analysis, the 50-year storm surge elevations at Southwest Point and Lantern Head are 3.83 m and 3.28 m, respectively. This estimate does not include wave setup or long-term sea level rise.

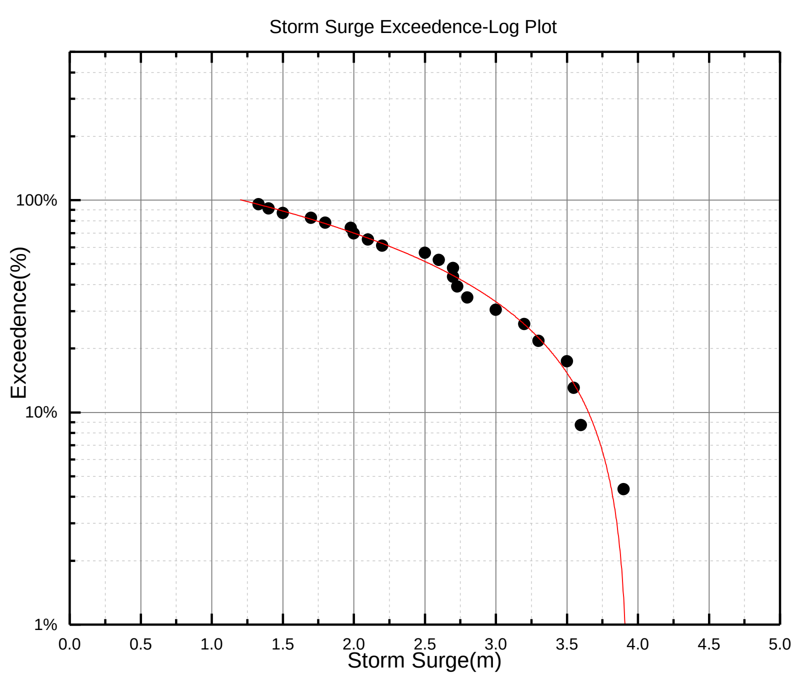


Figure 4-1 Logarithmic Exceedance Curve for Storm Surge Elevation at Southwest Point

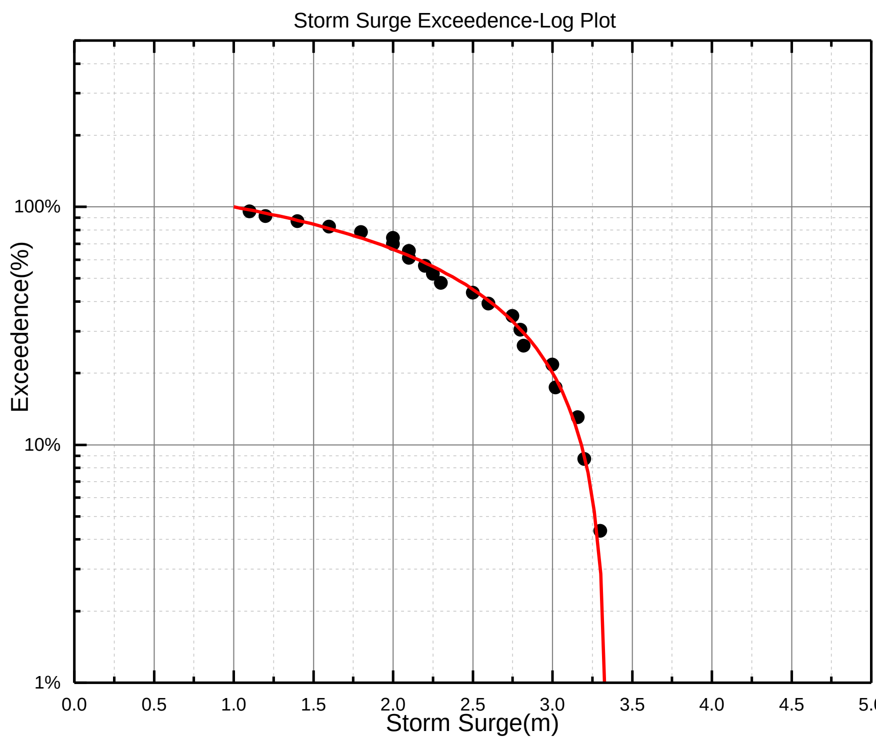


Figure 4-2 Logarithmic Exceedance Curve for Storm Surge Elevation at Lantern Head

4.2 Hurricane Waves

4.2.1 Deepwater Waves

The magnitude of hurricane waves caused by the passage of a hurricane depends on the location of the storm track relative to the point of interest, and the size, intensity and speed of the hurricane. The key variables of interest are the storm track, the minimum central pressure (which is strongly correlated to the maximum wind speed), the radius to maximum winds and the forward tracking speed. Same as the storm surge modelling, 22 major historical hurricanes passing the project sites from 1979 to 2017 (Section 2.2) were simulated to obtain the deep-water hurricane wave height. The same mesh for storm surge modelling was used for hurricane wave simulation.

The deep-water wave heights at two locations, (-77.20°E, 25.61°N) for Southwest Point and (-76.91°E, 25.94°N) for Lantern Head, were then selected as the boundary conditions for nearshore wave transformations at the two project sites. The waves will undergo significant shallow water wave effects as they propagate to Lantern Head and Southwest Point in South Abaco. The numerical values of these wave heights are shown in Table 4.1; while the logarithmic exceedance curves for deep-water hurricane waves are shown in Figure 4-3 through Figure 4-4. The 50-year deep-water hurricane wave heights are 14.6m and 15.5m for Southwest Point and Lantern Head, respectively. These wave heights together with the 50-year wind speed (Section 2.2) and storm surge elevation (Section 4.1) will be used for the modelling of nearshore hurricane wave transformation.

Table 4.1 MIKE21 SW Results for Deepwater Hurricane Waves 35km Southeast of South Abaco

Storm Name/Date	Southwest Point			Lantern Head		
	Peak Hso(m)	Tp(s)	MWD(deg)	Peak Hso(m)	Tp(s)	MWD(deg)
DAVID/1979	6.8	8.3	106	7.6	8.8	135
GERT/1981	5.3	7.3	286	6.2	8	305
FLOYD/1987	4.1	6.6	226	4.9	7.7	268
HUGO/1989	6.3	9.9	49	6.7	10.7	60
ANDREW/1992	14.2	16.1	47	15.3	16.9	66
ERIN/1995	6.7	8.1	15	8.1	10.2	359
BERTHA/1996	7.1	8.2	68	8.8	9.8	86
FRAN/1996	7.6	8.9	35	9.2	10.6	52
LILI/1996	5.9	7.7	301	7.1	9	8
DENNIS/1999	7.4	8.6	265	8	9.8	281
FLOYD/1999	10.2	10.9	256	10.8	12.2	267
IRENE/1999	4.9	6	182	6	7.2	201
MICHELLE/2001	6.1	7.5	347	7.9	9.3	11
Table 4.2 Continued						
FRANCES/2004	7.7	9.1	326	8.6	10	359
JEANNE/2004	3.7	5.2	8	4.6	7.3	35
KATRINA/2005	4.1	6.3	193	3.9	6.8	221
WILMA/2005	6.5	8.7	75	6.9	9.3	87
NOEL/2007	6.6	8.4	22	7.5	10	60
IRENE/2011	8.2	9.7	91	8.9	10.6	105
SANDY/2012	7.4	8.5	347	9.4	11.2	98
JOAQUIN/2015	10.5	11.8	355	12.2	13.6	358
MATTHEW/2016	12.8	14.8	98	13.5	15.5	114

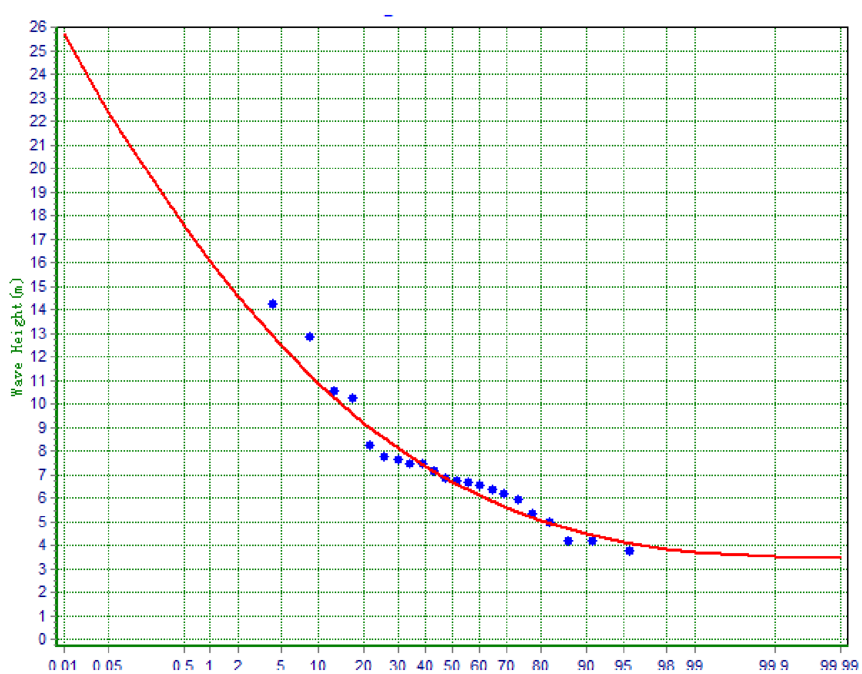


Figure 4-3 Logarithmic Exceedance Curve for Deepwater Wave Height for Southwest Point

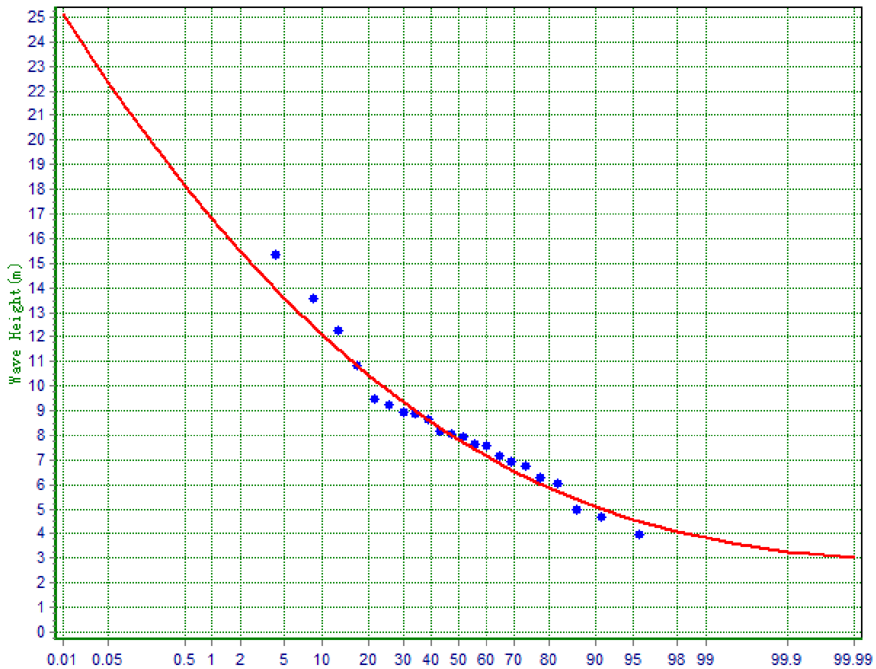


Figure 4-4 Logarithmic Exceedance Curve for Deepwater Wave Height for Lantern Head

4.2.2 Nearshore Wave Transformation

The 50-year nearshore hurricane wave heights at the proposed project sites were also simulated using the MIKE 21 Spectral Wave model (M21SW) with the same mesh for swell and wind waves modelling (Section 2.3 and Section 2.4). The 50-year storm surge height (conservatively using 3.83 m) combined with the MHHW (+0.48 m-msl) form the water level for modelling. The deep-water wave heights developed in the previous section were specified at the model boundary. The 50-year hurricane wind (38.55 m/s) was also included. The deep-water and wind were set to come from E, SE, and S to produce the worse-case scenario. The wave height distributions for the three cases are shown in Figure 4-5 through Figure 4-7. The numerical results are shown in Table 4.3. The easterly condition produces the greatest wave at Lantern Head (4.73 m) while the southerly condition results in the largest wave (7.30 m) at Southwest Point. These are the 50-year hurricane wave heights for the proposed project sites.

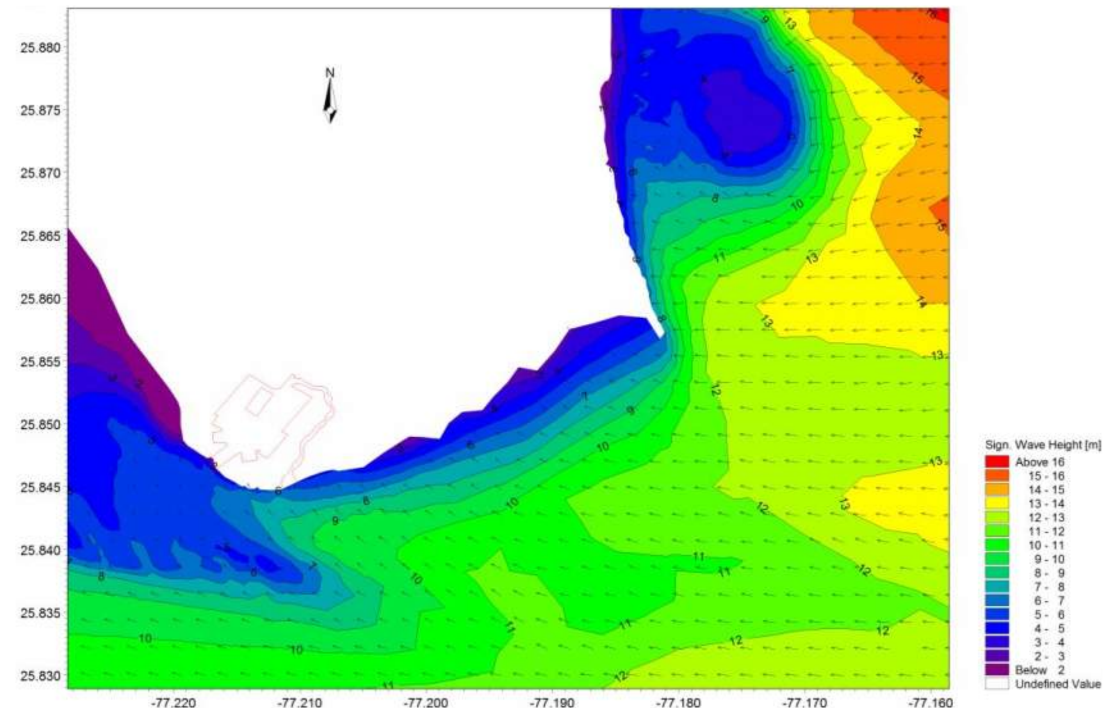


Figure 4-5 MIKE21 SW Output for Wave and Wind Direction of 90°

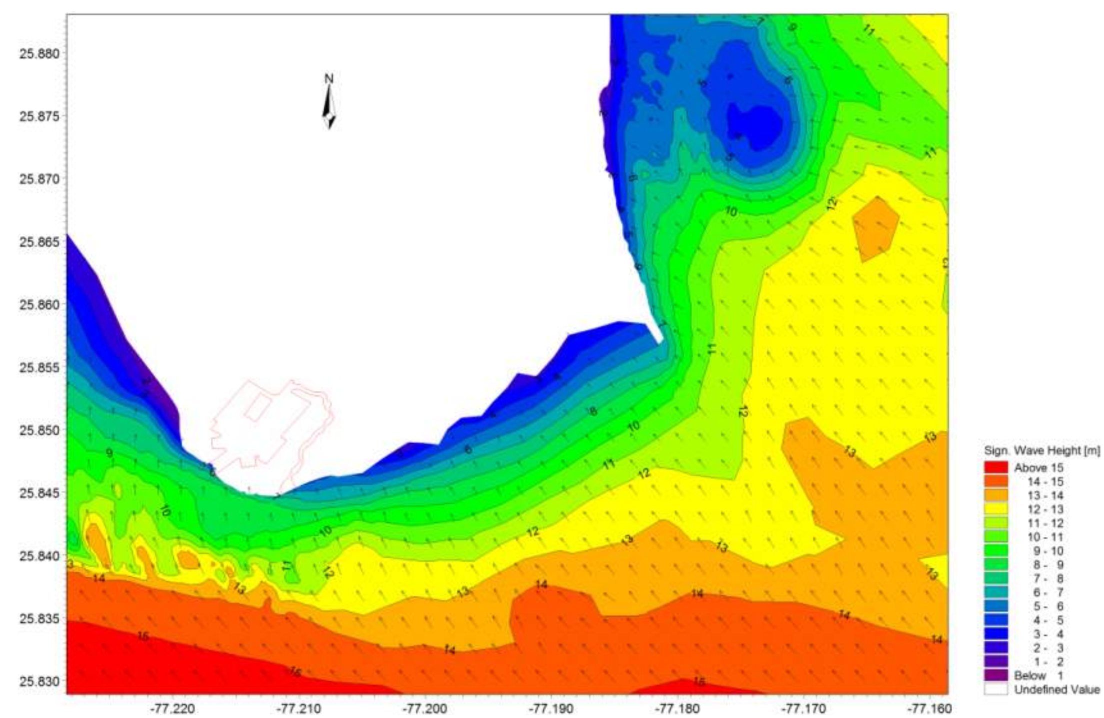


Figure 4-6 MIKE21 SW Output for Wave and Wind Direction of 135°

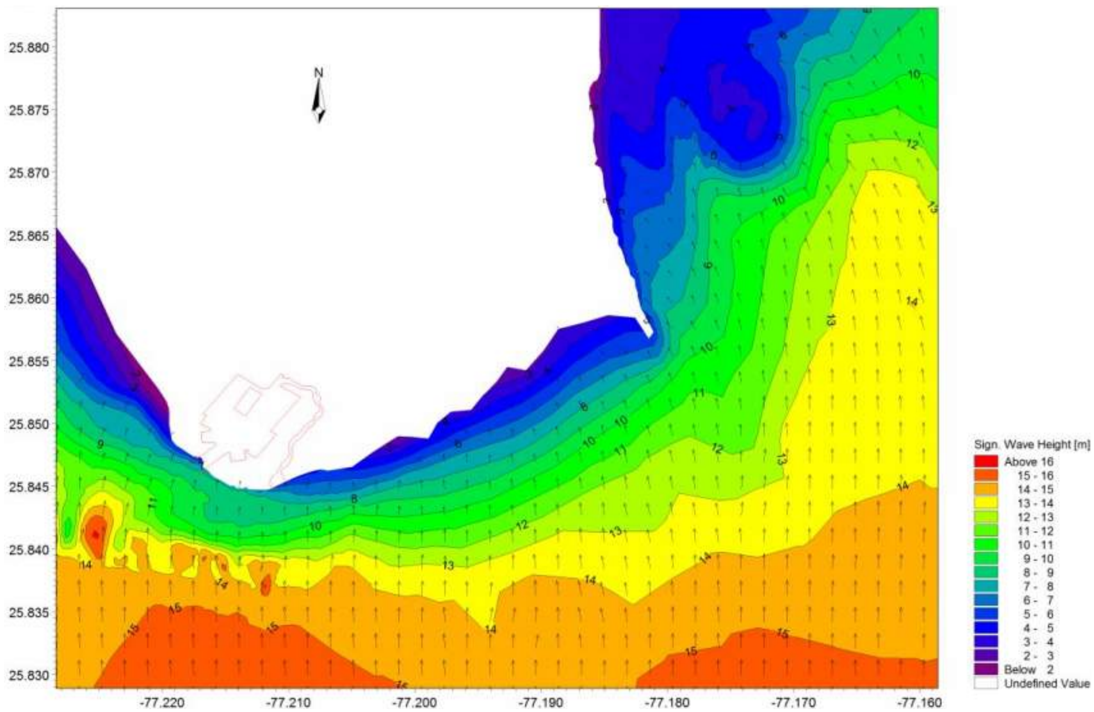


Figure 4-7 MIKE21 SW Output for Wave and Wind Direction of 180°

Table 4.3 MIKE21 SW Results for the 50-Year Hurricane Waves at the Project Sites

Runs	Waves	SW Point	Lantern Head
	Dir (°)	Hs (m)	Hs (m)
HW01	90	5.30	4.73
HW02	135	7.08	4.71
HW03	180	7.30	4.58

5 WAVE MITIGATION OF THE PROPOSED BREAKWATER AT LANTERN HEAD

Numerical model simulations were conducted to assess the reduction in wave height due to the placement of a breakwater as per the preliminary layout provided (Figure 5-1). The previously described MIKE21 SW model was used with the mesh altered such that the proposed breakwater was resolved in the mesh. A layout of the proposed breakwater is shown in Figure 5-1.

Based on the previous experience of using MIKE21 SW as a preliminary tool for assessing diffraction and wave mitigation around breakwaters, it was decided that the MIKE21 SW model would provide a sufficiently accurate tool in assessing wave height near the breakwater.

The proposed breakwater is intended to reduce waves near the beach for swimmers. Therefore, only the operational conditions are considered, and the wave mitigation study at the site is focused on operational wave conditions. It was previously shown that swells dominate wind waves at the project site. As such, the weekly (2.5 m) and annual events (2.8 m) are chosen to provide the deep-water wave heights. As the project site is located at the east shoreline of South Abaco facing east, the numerical model was run for waves propagating from two directions: east (90°) and southeast (135°).

Data were extracted at a point near the breakwater (t1) as shown in Figure 5-1. The wave heights at this location are presented in Table 5.1. Selective contour plots showing diffraction around the breakwater are shown from Figure 5-2 through Figure 5-5.

Note that the conceptual layout would not be as efficient in protecting the beach when waves arrive from south due to the direction of the breakwater. However, southerly waves are less frequency and milder than easterly and southeasterly waves as shown in Section 2.4. Table 5.1 shows that the proposed breakwater reduces wave heights by over 50% when waves arriving from the east and southeast. Therefore, the breakwater is considered effective and efficient in mitigating waves near the beach.

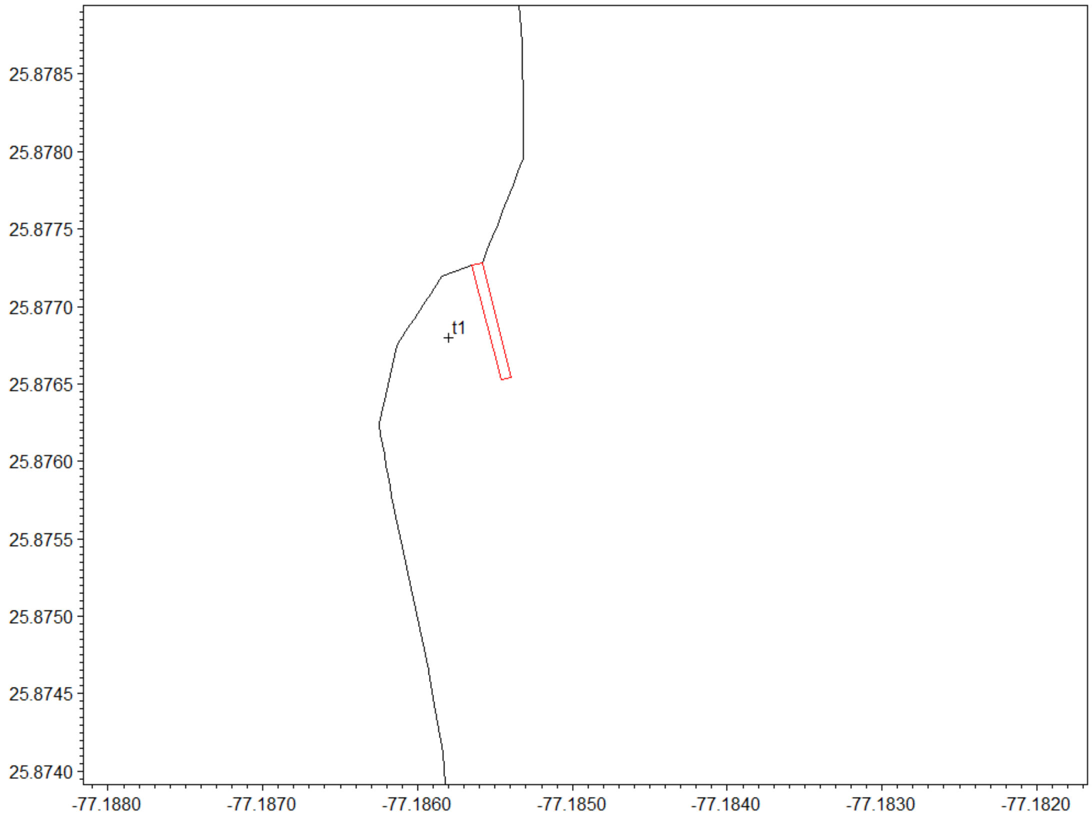


Figure 5-1 Preliminary Conceptual Breakwater Layout. t1: Data Extraction Location. Red: Proposed Breakwater

Table 5.1 Comparison of Wave Heights near the Proposed Breakwater（-77.19°E, 25.88°N）

Runs	Waves			Existing	Proposed
	Dir (°)	Hs (m)	Tp (s)	Hs (m)	Hs (m)
EXT01	90	2.5	9.7	1.07	0.33
EXT02	135	2.5	9.7	1.04	0.46
PRP01	90	2.8	9.7	1.1	0.34
PRP02	135	2.8	9.7	1.09	0.48

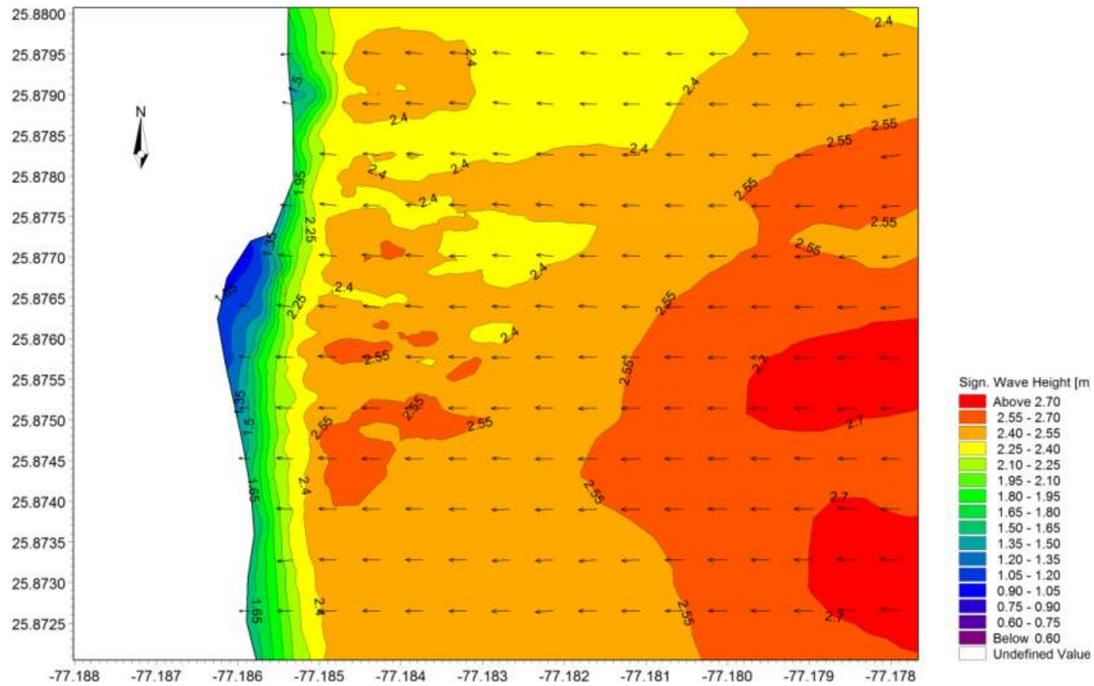


Figure 5-2 MIKE21 SW Output for Hs=2.8 m, MWD=90°(Existing)

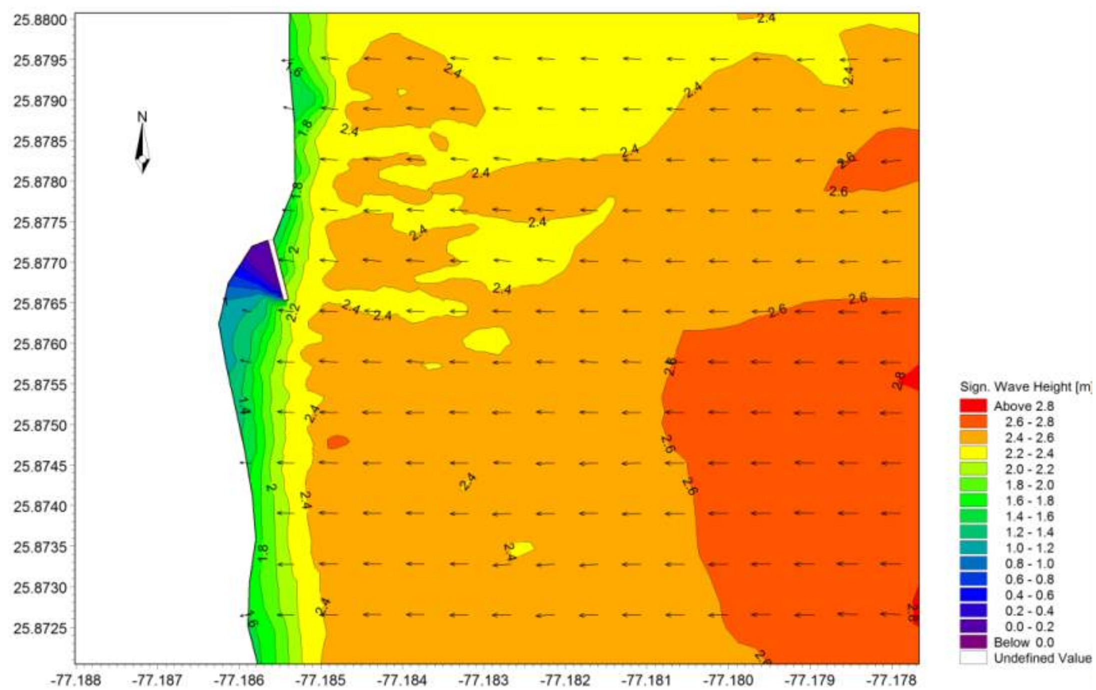


Figure 5-3 MIKE21 SW Output for Hs=2.8 m, MWD=90°(Proposed)

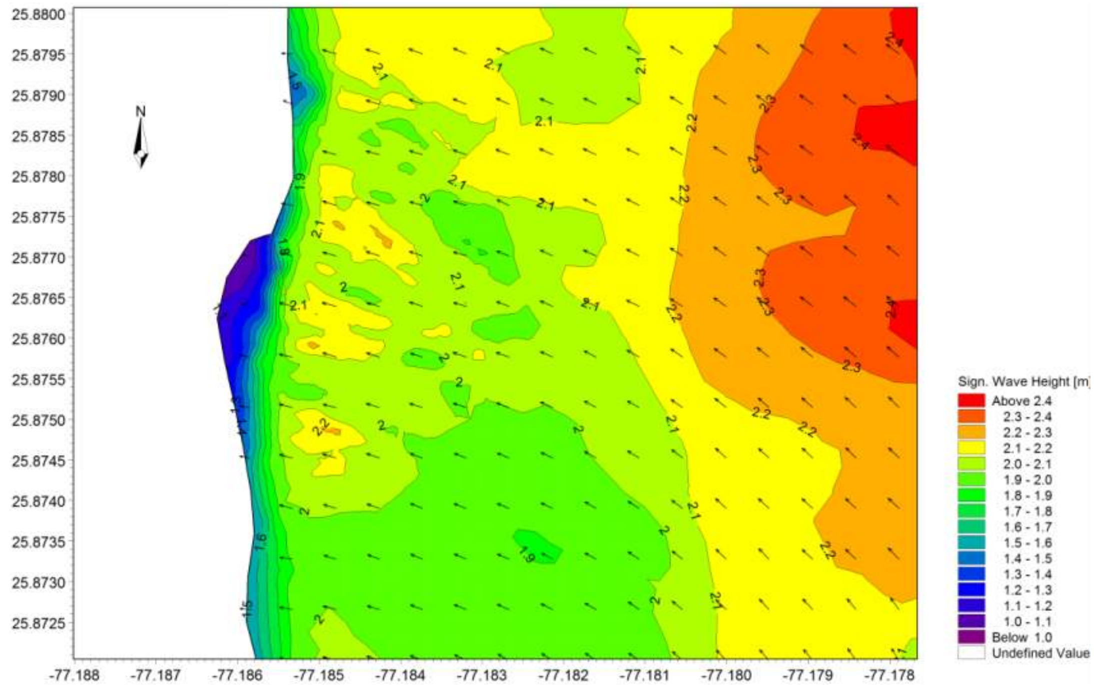


Figure 5-4 MIKE21 SW Output for Hs=2.8 m, MWD=135°(Existing)

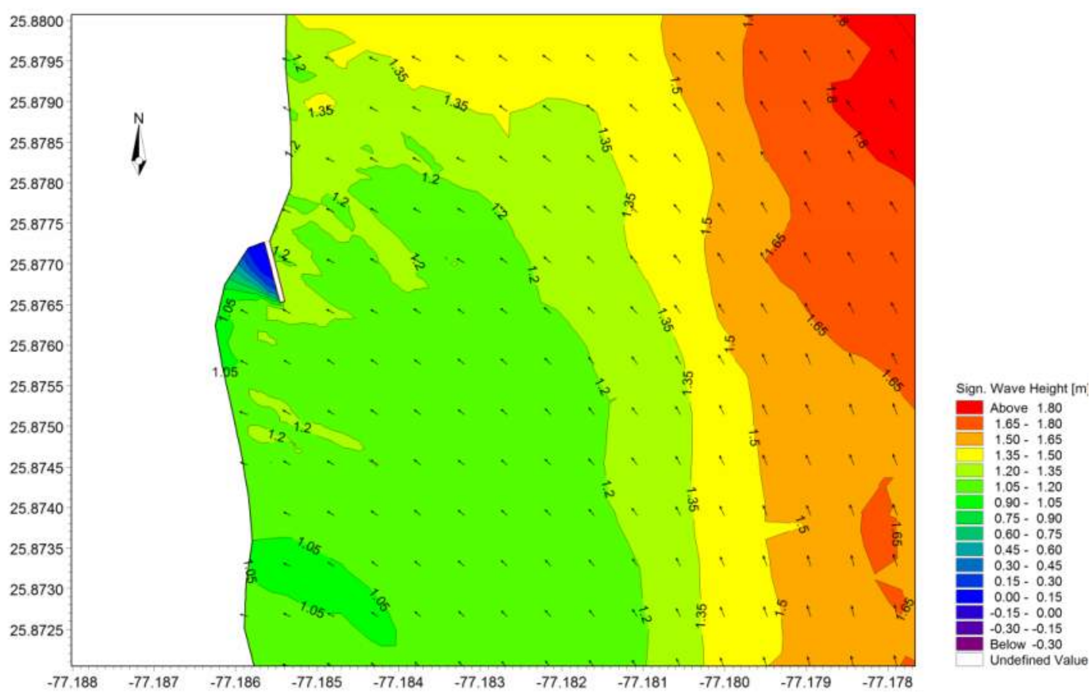


Figure 5-5 MIKE21 SW Output for Hs=2.8 m, MWD=135°(Proposed)

6 WAVE AGITATION IN THE PROPOSED MARINA AT SOUTHWEST POINT

Numerical model simulations were conducted to assess the wave agitation in the proposed marina as per the preliminary layout provided. The Boussinesq wave model, MIKE21 BW, was used to model waves in the area of the proposed marina as it is generally used for marina wave agitation studies. A portion of the model domain encompassing the proposed marina is shown in Figure 6-1.

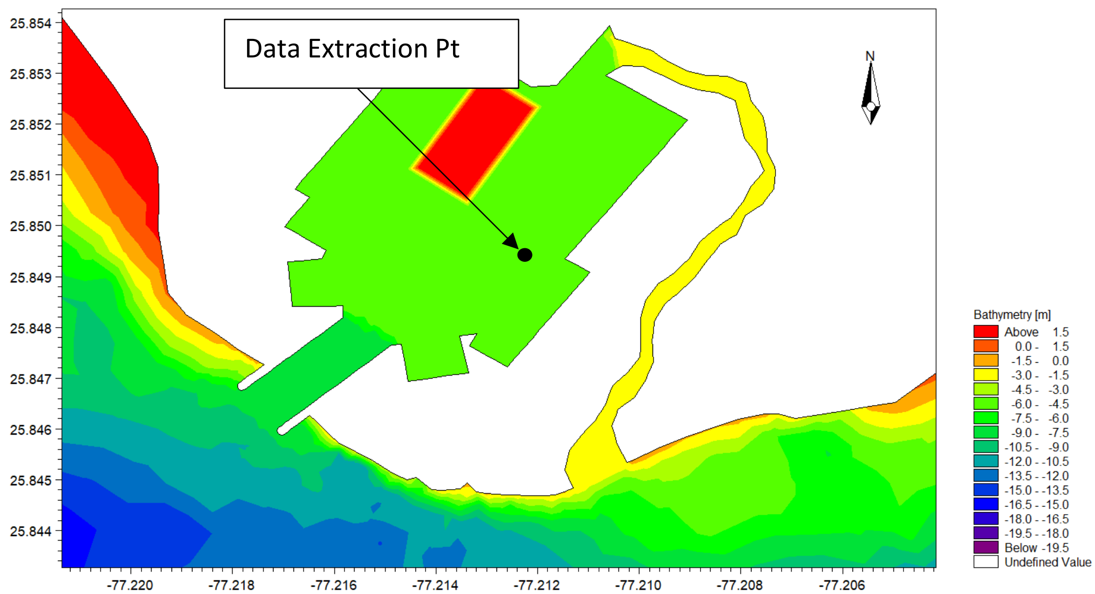


Figure 6-1 Mike21 BW model domain bathymetry of the proposed marina (mesh resolution: 3m)

It was previously shown that the wave condition at the marina entrance is dominated by swell. It was also determined that wave agitation in the marina should conform to the weekly and annual limits specified in ASCE (2012) for "excellent" conditions. As such, swell wave conditions corresponding to weekly and annual return periods were determined from Section 0.03.2.1 and used for the BW model.

The numerical model was run for the estimated weekly and annual swells propagating from the south (greatest wave heights) and southeast (most frequent wave direction). Data was extracted at a central location within the marina, representing the approximate average level of wave agitation within the marina. The location of the extraction point is shown in Figure 6-1, while the results at this location are presented in Table 6.1. Contour plots showing two examples of agitation levels within the marina are shown from Figure 6-2 through Figure 6-3.

Table 6.1 shows that for both the weekly and annual events, the suggested agitation criterion is exceeded. In order to decrease wave agitation level in the marina, extensions to the north and south jetties could be considered. In addition, an overlap of the north and south jetties would reduce wave agitation in the marina.

Table 6.1 Numerical Model Results for Wave Agitation in the Marina, Compared to Limiting Criteria for "Excellent" Conditions Developed from ASCE Guidelines

Return Period	Dir (°)	Hs-Marina (cm)	ASCE Criteria (cm)
Weekly	180	43.0	6.0
Annual	180	48.0	11.5
Weekly	135	32.0	6.0
Annual	135	36.0	11.5

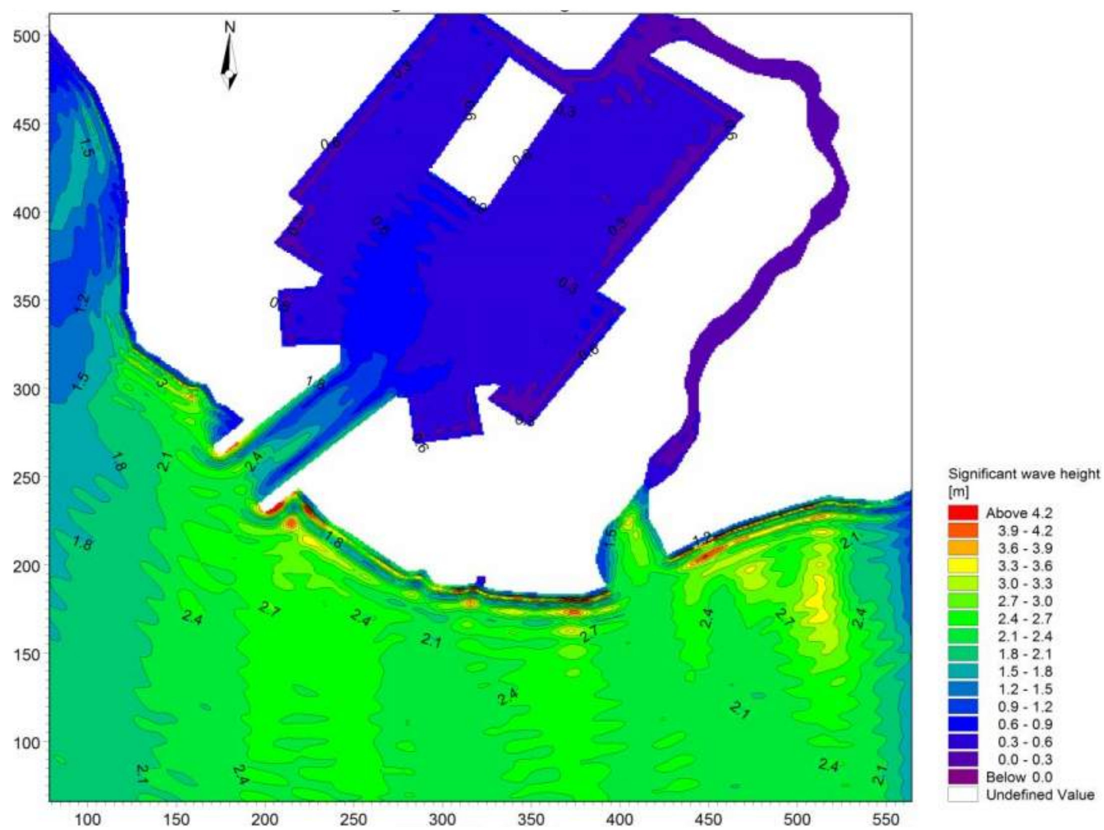


Figure 6-2 Numerical Model Results Showing Wave Agitation with Annual Waves Coming from South (180°)

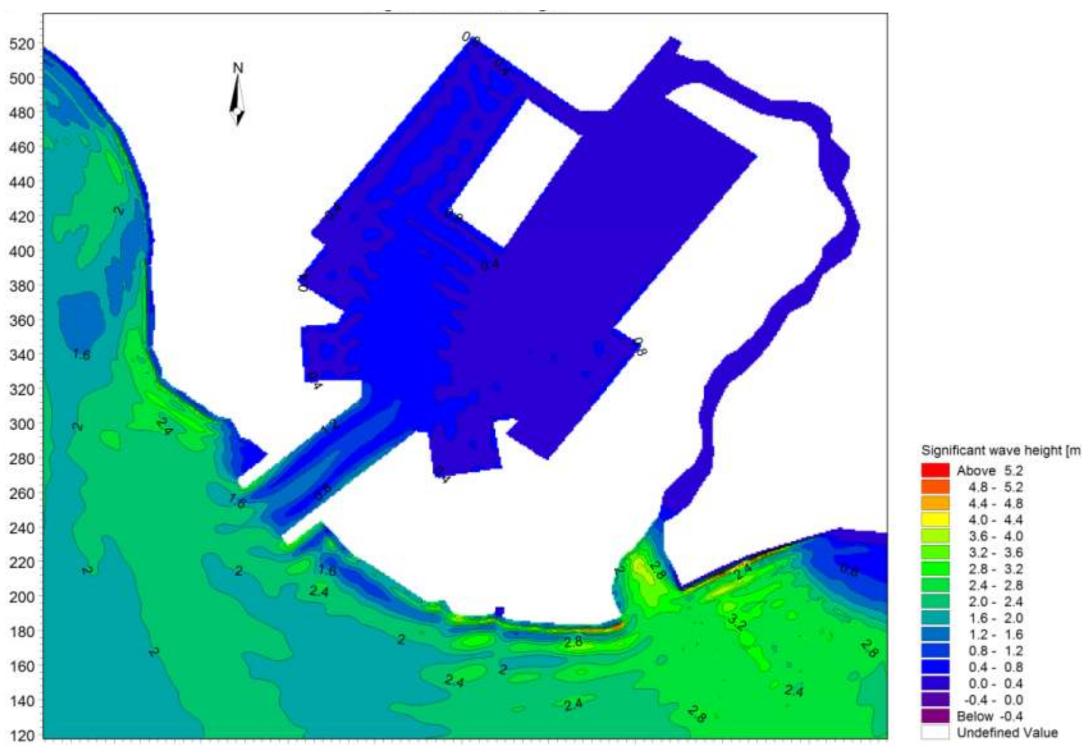


Figure 6-3 Numerical Model Results Showing Wave Agitation with Annual Waves Coming from Southeast (135°)

APPENDIX D– Flushing Analysis.

FLUSHING ANALYSIS

PROPOSED SOUTH WEST POINT MARINA

SOUTH ABACO, THE BAHAMAS

Prepared for: Tyrsoz Family Holdings

July 30, 2019

Table of Contents

1 INTRODUCTION

Caribbean Coastal Services Ltd. (CCS) was contracted to conduct a flushing analysis for the proposed New South West Point Marina (Figure 1-1). The intention of this analysis is to investigate the flushing performance of the proposed facility in the case of accidental spills within the confines of the proposed marina, as well as to ensure that the facility does not experience stagnation, which could be harmful to fish and other marine species which may migrate to the marina basin.

Figure 1-1 Location Map of the Proposed New South West Point Marina, Abaco, Bahamas.

The proposed marina basin is to be cut inland from the sea and will be accessed by an 8.1-m deep entrance channel. The basin will be approximately 530 m wide by 650 m long (for a total area of approximately 344,500 m^2) and would have a depth of 5 m. A flushing channel has also been proposed with a depth of 1.8 m. The proposed jetties at the entrance channel and man-made island in the marina will have elevations of +2.4 m-MSL and +1.8 m-MSL, respectively.

CCS led field investigation, data collection, and modelling exercises, including a comprehensive desktop site investigation to supplement the modelling. The goal of the modelling was to investigate the flushing capacity of the marina under operational (i.e., day-to-day) conditions. Modelling was undertaken using DHI's MIKE21 FM numerical model to simulate the tracer contamination in the basin and its dispersion patterns. Several cases were tested to check the sensitivity of the tracer behavior to variables such as tracer placement and prevailing wind conditions.

CCS deployed a tide gauge over a one-month period starting June 4, 2019. In addition to the tide elevation data, CCS obtained satellite derived bathymetric data. These data were vital in setting up and verifying the model.

Table 1.1 Tidal Benchmarks near the Proposed Project Sites

Tide Levels	Tide Level (m-MSL)
Mean Higher High Water (MHHW)	0.48
Mean High Water (MHW)	0.39
Mean Sea Level (MSL)	0.00
Mean Low Water (MLW)	-0.40
Mean Lower Low Water (MLW)	-0.41

2 MARINA FLUSHING PERFORMANCE CRITERIA

The modeling results were compared to published criteria by the United States Environmental Protection Agency (EPA) and Bahamas Environmental Science and Technology (BEST) Commission. Hydrodynamic modeling is recommended by BEST as part of the design of new marinas. However, they do not specify the design or extent of these investigations.

Pertinent guidance and supporting information relating the design and approval of new marinas is found below, as extracted from http://water.epa.gov/polwaste/nps/czara/ch5-2a.cfm:

- The EPA management measure is intended to be applied by States to new and expanding marinas;
- Maintaining water quality within a marina basin depends primarily on flushing as determined by water circulation within the basin (Tsinker, 1992);
- The objective of the marina siting and design management measures is to ensure that marinas and ancillary structures do not cause direct or indirect adverse water quality impacts or endanger fish, shellfish, and wildlife habitat both during and following marina construction;
- Circulation and flushing play important roles in the distribution and dilution of potential contaminants;
- In areas where tidal ranges do not exceed 1 meter, as in the southeastern United States, a flushing reduction (the amount of a conservative substance that is flushed from the basin) of 90 percent over a 24-hour period has been recommended.

3 GENERAL SITE OBSERVATIONS

The site is located on the southwestern shoreline of Abaco Island. There is a steep rock face at the shoreline, extending from approximately 5-7 ft above sea level to approximately 3-5 ft below sea level. The seabed then slopes gradually towards the southwest, to a depth of over 30 ft about 240m offshore.

Winds during the summer months are predominantly from the E or SE. In the winter months, when cold fronts arrive, the wind blows predominantly out of the NW - NE.

4 MODEL SETUP

The grid was set up using the satellite bathymetric data obtained by CCS and supplemented with data extracted from nautical charts. The proposed basin, entrance channel and flushing channel depths were used to create the bathymetry within the model domain. The model domain extended approximately 10 km offshore from the basin location. Figure 4-1 shows an overview of the model domain and MIKE21 mesh; while Figure 4-2 presents the model mesh of the proposed marina including the proposed entrance channel, marina configuration, manmade island, and flushing channel.

The model was primarily driven by a combination of tidal and wind forcings. Calibration of the model was carried out to reproduce the neap tide elevations. The neap tide produces the smallest current velocities in the harbor and therefore yields a conservative assessment of the marina flushing time. Representative tidal amplitudes were in the range of 0.5 m and local (tidal) currents were at the order of 0.05 to 0.1 m/s oscillating in line with the shoreline orientation. Figure 4-3 shows the time series of the tidal water level which was used as the offshore boundary condition. The hydrodynamic model was first run for 12 hours to initiate the tidal currents before introducing the tracer. Each simulation lasted for 4 days using 1-minute time steps.

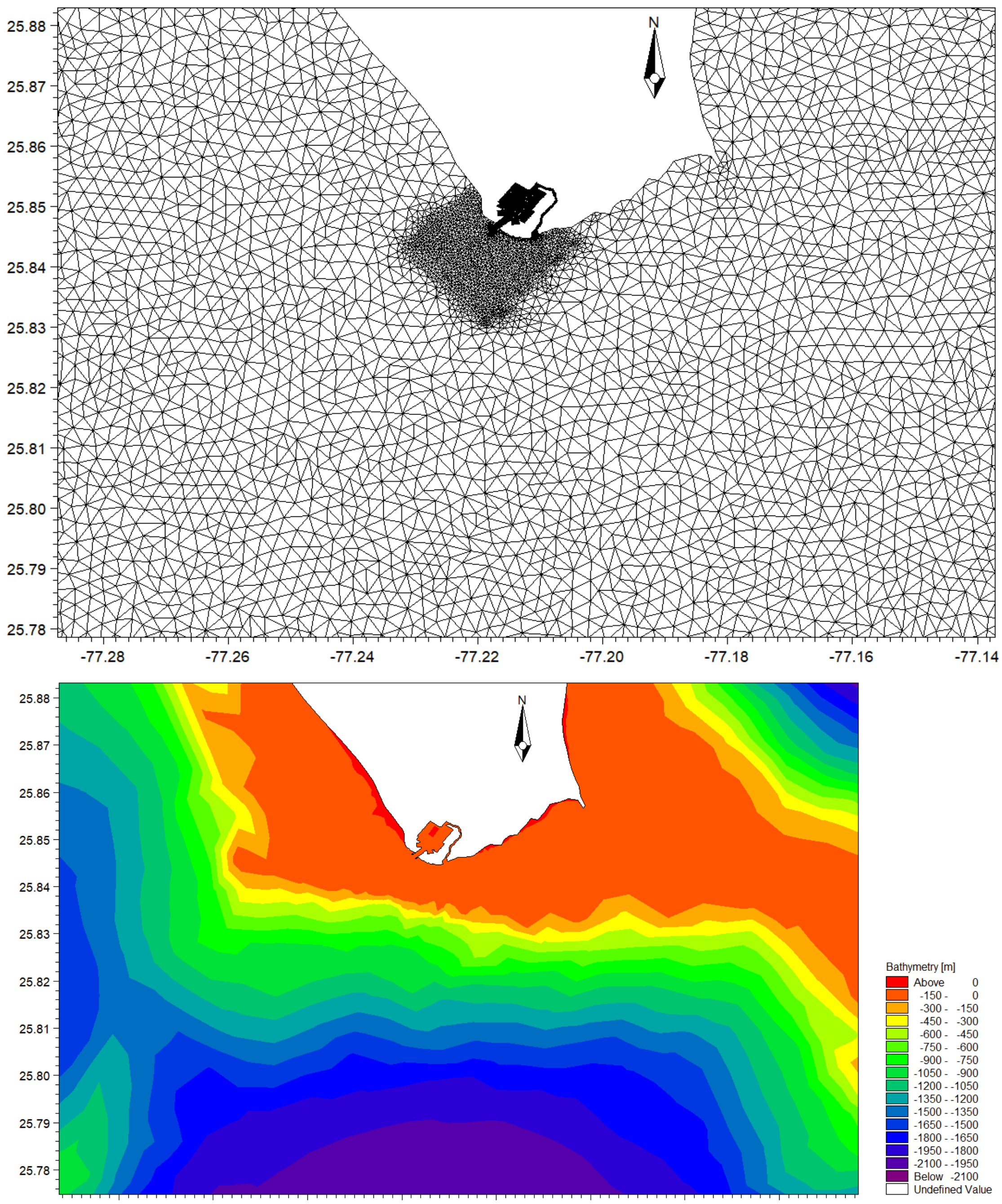


Figure 4-1 Mike21 FM model mesh (top) and bathymetry (bottom).

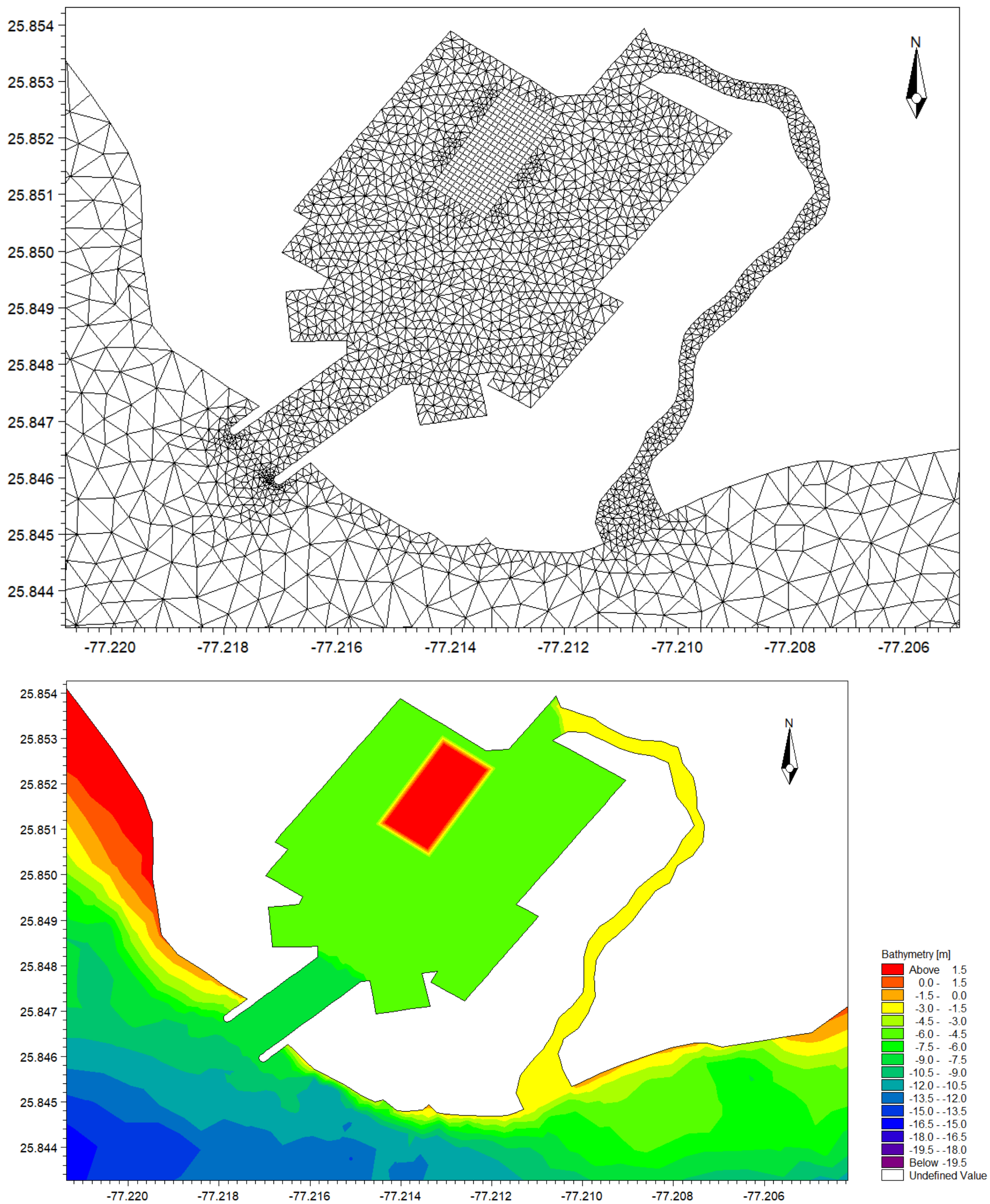


Figure 4-2 Mike21 FM model mesh (top) and bathymetry (bottom) of the proposed marina.

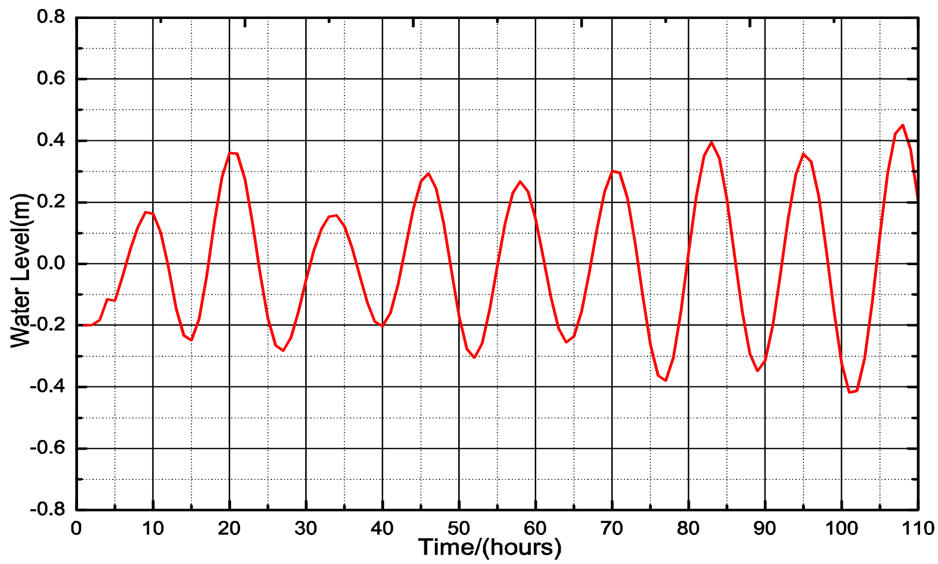


Figure 4-3 Time series of the tidal water level (m-msl) which drives the Mike21 FM model.

5 TEST CONDITIONS

Various test conditions were simulated in the model to compare to a 'base case' condition that involved filling the entire basin with an initial tracer concentration of 100 mg/L and without wind. The location of the tracer was varied, and typical winds (derived from Nassau Airport data) were applied to investigate the effect on basin flushing and contaminant dispersion. Although the location and extent of the tracer was varied throughout the test program, the initial concentration was 100 mg/L in all the simulations. The following test conditions were investigated in the MIKE21 FM model:

Table 5.1 Model Tests Settings

Case	Tracer location	Wind conditions	
		Speed (m/s)	Direction (deg)
Base Case	Full basin	-	-
Case 2	Full basin	4.2	130
Case 3	SW Corner	-	-
Case 4	SW Corner	4.2	130

6 RESULTS AND OBSERVATIONS

6.1 Base Case:

At the end of the first 24 hours, the concentration of the tracer varied between 75 mg/L (t3, near the entrance) and 83 mg/L (Figure 6-1 and Figure 6-4), leading to the conclusion that the basin did not flush under these conditions. However, this case is not realistic because (a) it is unlikely that a contaminant would be released over the entire area and depth of water column simultaneously, and (b) there was no wind applied during this model run. It is anticipated that the presence of wind would encourage basin mixing. A more realistic case with wind applied over the domain was investigated in Case 2.

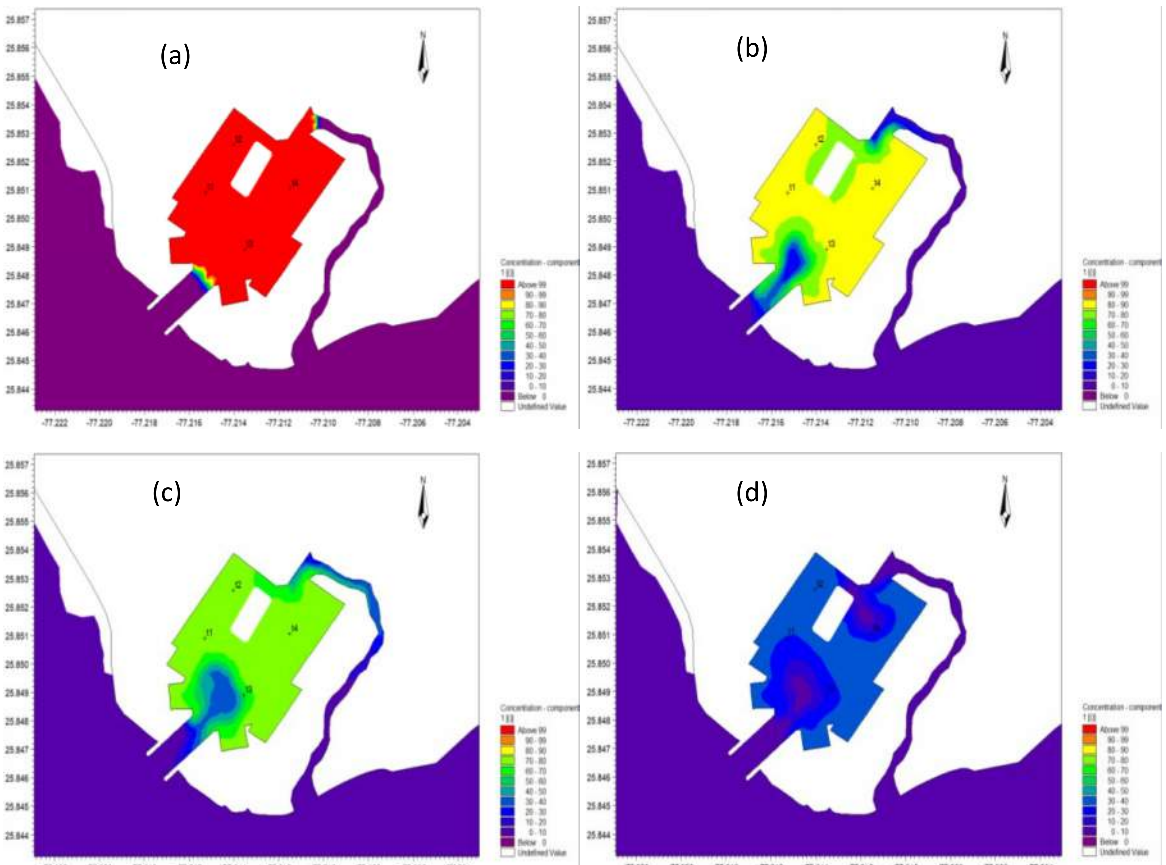


Figure 6-1 Tracer Concentrations at Various Time Steps – Base Case. (a) t = 0 hr; (b) t = 12 hr; (c) t = 24 hr; (d) t = 96 hr.

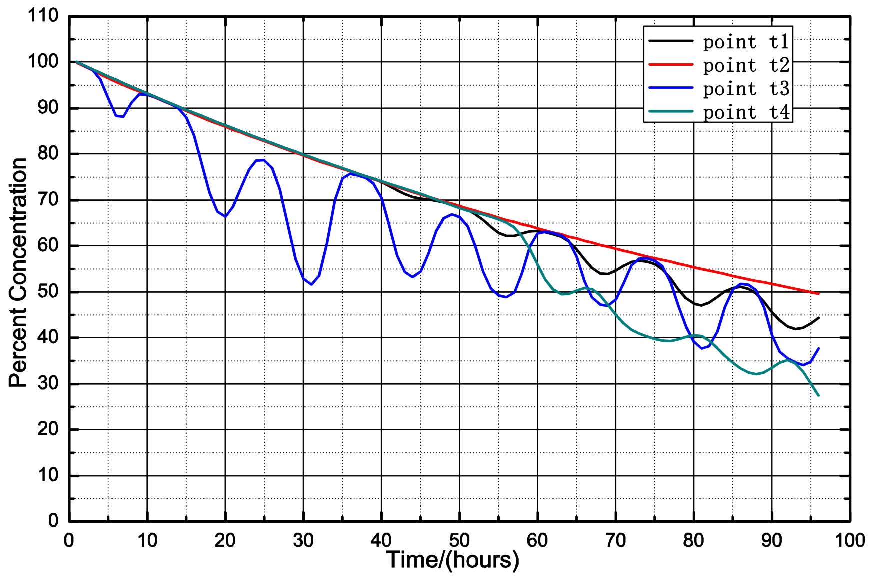
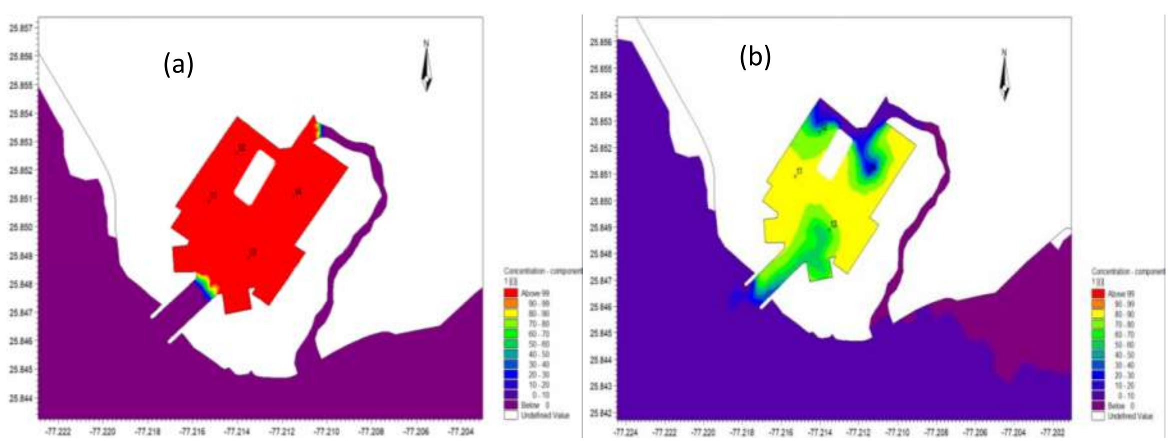


Figure 6-2 Time series of tracer concentrations at four locations.

6.2 Case 2:

Typical (i.e. non-storm event) winds were applied to the model to investigate the effect of tracer mixing. It was found that the winds altered the mixing patterns within the basin, and there was some effect on the resulting concentrations, especially at the area near the flushing channel. The result of applying a 4.2 m/s wind from 130° to the 'Base Case' is presented in Figure 6-3 and Figure 6-4. In this case the concentration does not meet the recommended EPA standards for flushing, although the overall concentration within the basin was reduced in comparison to the 'Base Case' (i.e. wind improved basin flushing).



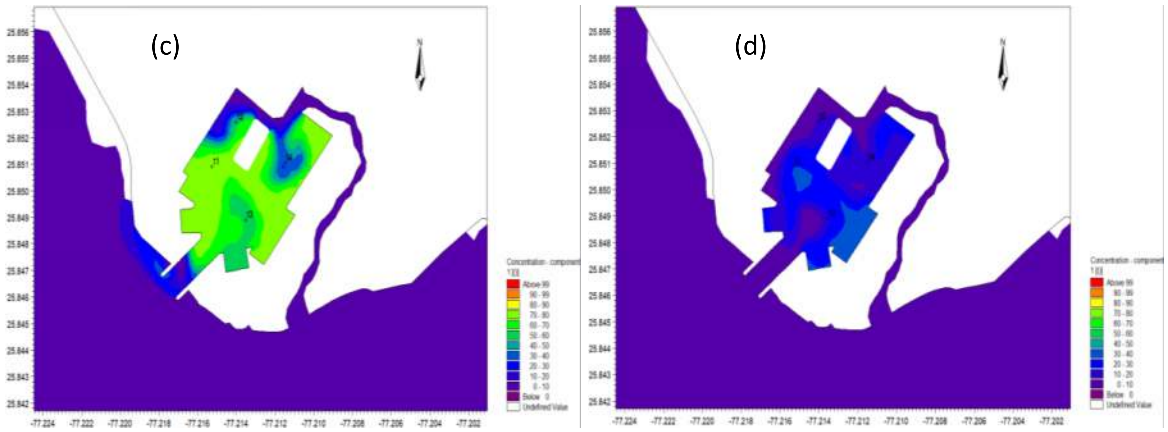


Figure 6-3 Tracer Concentrations at Various Time Steps – Base Case. (a) t = 0 hr; (b) t = 12 hr; (c) t = 24 hr; (d) t = 96 hr.

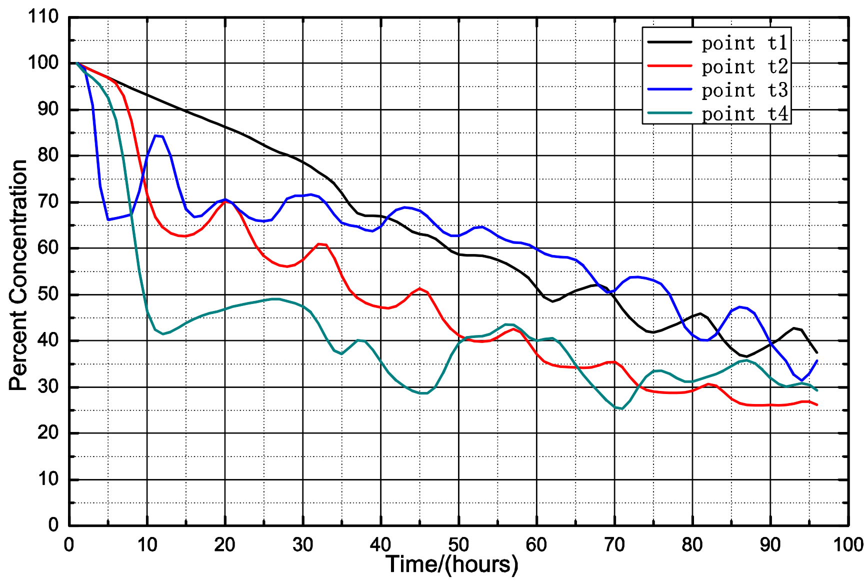


Figure 6-4 Time series of tracer concentrations at four locations.

6.3 Case 3:

It is more likely that a contaminant would be released in high concentration in a localized area within the basin (i.e. a fuel spill). Case 3 simulates the case in which the tracer was released in the SW corner of the basin. As Figure 6-1 illustrates the dispersion pattern over the model run, the SW and SE corners are the most critical corners in the basin. Moreover, as Figure 6-3 shows that the basin circulation direction is counter-clockwise, contaminants in the SW corner travel the longest distance to be flushed out of the basin. Therefore, the SW case represents the worst-case scenario for localized contamination. It was found that the highest concentration within the basin after 24 hours of tracer release was approximately 50 mg/L (Figure 6-6). This indicates that the basin would not meet EPA standards for a localized spill, under a "no wind" tidal condition.

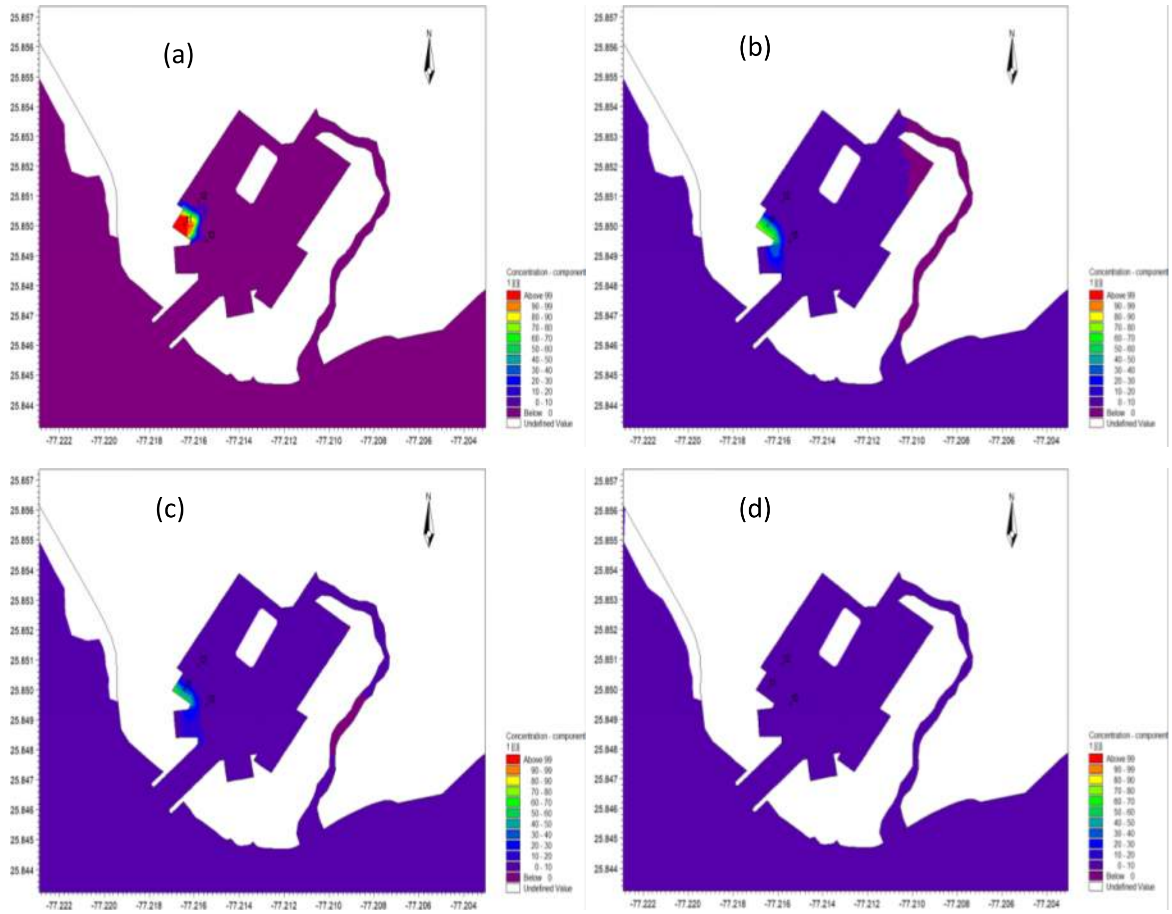


Figure 6-5 Tracer Concentrations at Various Time Steps – Base Case. (a) t = 0 hr; (b) t = 12 hr; (c) t = 24 hr; (d) t = 96 hr.

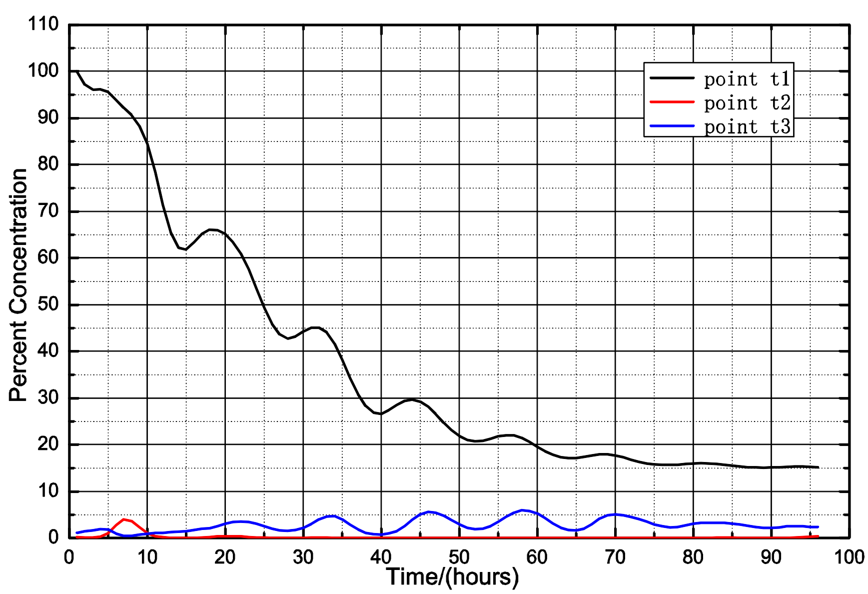


Figure 6-6 Time series of tracer concentrations at four locations.

6.4 Case 4:

This case combined a typical wind condition with placement of the tracer in the south-west corner. Like Case 2, the wind improved the basin flushing. The average concentration recorded within the basin after 24 hours was approximately 5 mg/L. After 4 days this value reduces to nearly 0 mg/L. The basin would meet EPA standards for a localized spill, under tidal and wind forcing.

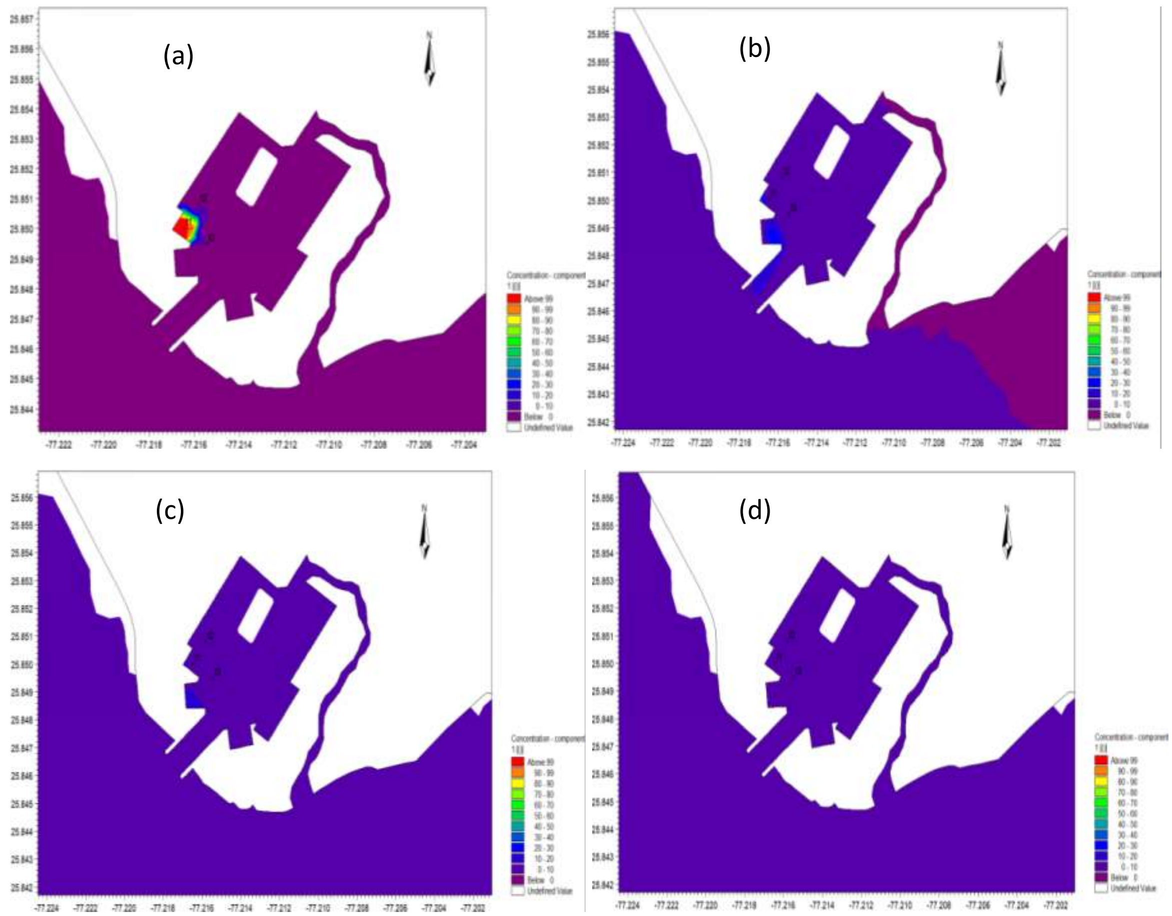


Figure 6-7 Tracer Concentrations at Various Time Steps – Base Case. (a) t = 0 hr; (b) t = 12 hr; (c) t = 24 hr; (d) t = 96 hr.

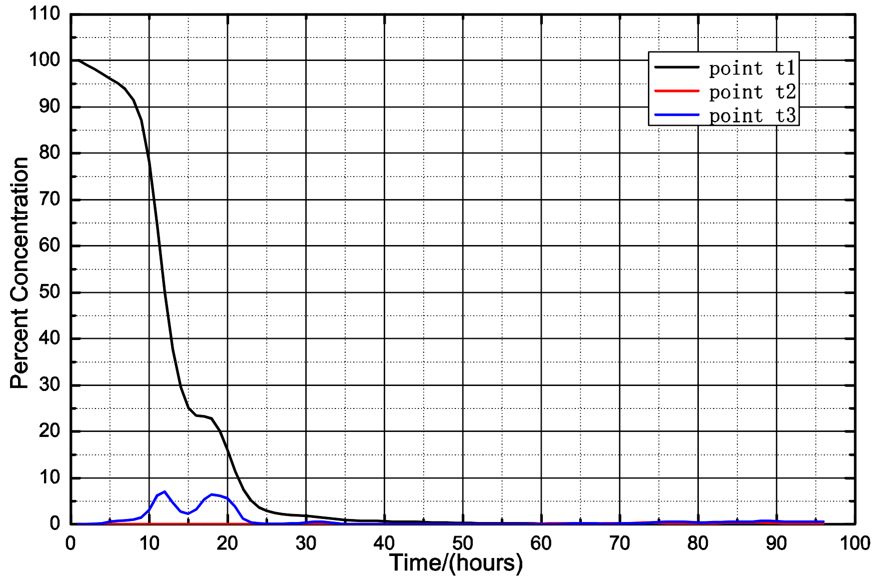


Figure 6-8 Time series of tracer concentrations at four locations.

7 CONCLUSION AND COMMENTS

Numerical simulations were carried out on the proposed South West Point Marina development using DHI's MIKE21 FM model. The model was constructed using a combination of collected field data and other available existing data. Model results were compared with EPA guidelines for new marina design that recommend a minimum 90% flushing reduction in the basin within 24 hours.

Several model cases were investigated involving tracer placement and typical (regional) wind conditions. A tracer with a concentration of 100 mg/L was used in all cases. The following conclusions were noted:

If a contaminant is applied over the entire basin (from the surface to the basin floor) then it is unlikely that the concentration of the substance within the basin area will reduce by 90% over a 24-hour period. However, this situation is extremely unlikely to occur and a point-source release of contaminant (such as a fuel spill) is a more likely scenario.

If there is no wind, when a contaminant is released in the corner of the basin, the average concentration would still not be reduced by more than 90% of the original contaminant concentration within the first 24 hours.

The typical regional wind generally improves basin flushing. The EPA criteria can be met when wind is applied, and a corner of the basin is contaminated. It is also likely that this effect is also underestimated in the model and more mixing will occur in prototype as a result of wind induced current shear in the water column.

It should be noted that the model is limited in its application and ability to replicate the true physical mixing and flushing processes. However, the results found during this investigation are conservative in nature. Therefore, the basin will flush more readily than the model demonstrates. This is especially true for the "no wind" cases that were tested since the addition of wind will promote vertical circulation and increase the flushing potential.

Some additional comments relating to the marina are as follows:

- If further flushing is required, a pump system could be installed in the flushing channel to increase its flushing capability. The width of the entrance channel can also be increased to allow more flow into the basin such that the basin would flush better;
- The shape of the marina could be modified with fewest segments possible (as per EPA suggested guideline);
- Besides minimizing environmental impacts, the facility layout should consider capacity (including surrounding development and long-term planning), aspects related to dredging (initial, maintenance and disposal, etc.), level of protection offered to vessels and infrastructure, and overall safety.

APPENDIX E – Economic Impact Analysis.

COMMERCIAL REAL ESTATE SERVICES

CBRE

Scott D. Smith
Managing Director

CBRE Hotels
3280 Peachtree Road NE
Suite 1400
Atlanta, GA 30305
+1 404 504 5948 Office
+1 404 558 3658 Mobile
Scott.Smith@cbre.com
www.cbrehotels.com

July 3, 2018

Mr. Ra'anan Ben-Zur
French Quarter Holdings, Inc
3443 Kingsboro Road, Suite 2313
Atlanta, GA 30326
Tel: 404-254-3573

Re: Economic Impact Study for the Proposed Lantern Head Rosewood Resort and South West Point Marina and Resort Project

Dear Mr. Ben-Zur:

In accordance with our engagement letter, we have completed our economic impact study in connection with your development opportunity of a mixed-use developments to be situated in the southeastern tip of Great Abaco, Bahamas.

PROJECT SUMMARY

Lantern Head is in excess a 600-acre site that is located 45 miles south of the capital city of Marsh Harbour and borders the Abaco National Park. The site contains approximately 10,000 feet of shoreline with elevations that top 100 feet. The town of Sandy Point is approximately 20 miles to the southwest and is served by a 4,500-foot air strip. The Marsh Harbour International Airport is located approximately half an hour north of the Subject site.

The South West Point site includes over 500 acres, 7,000 feet of Shoreline and has an elevation of 80". It is situated approximately four miles to the southwest of the Lantern Head site and will be accessed by a roadway taking approximately five minutes to traverse.

Part of the project (but off site) will be the renovation of the Sandy Point Airport which will be a port of entry airport fully equipped to service private aircraft.

The site plan for Lantern Head includes the following proposed developments:

- A 50-room luxury Rosewood Resort that will include a spa, gym, bar, casual restaurant and upscale restaurant;
- 76 residential branded units, some of which (43 units) to be put into a rental pool and included as room inventory;

- Beach Club with comprehensive offering of outdoor pools, pool side F&B offering, water sports and
- 18-hole golf course with three tennis courts and Clubhouse.

The site plan for South West Point includes the following proposed improvements:

- A 75-room upscale hotel and 100-room limited-service hotel;
- 136-slip Marina consisting of 23 300'-600' slips, 23 200' slips, and 40 slips of 175' and 50 of 150''. There will be a mixture of both rental and "for sale" slips;
- Each concrete floating dock will be state-of-the-art with waste removal, electrical hook ups and fuel;
- Marina Store, Yacht Charter, repair services, fishing and scuba shops;
- Port of Entry Customs Office;
- Full Service Restaurant; and Bar;
- 83 – Home Lots of which 44 will have individual 100'- boat slips.

At the direction of the client, we have assumed the both developments will be operational by January 2024. Our analysis will be based upon a comprehensive analysis and understanding of the market opportunities for these components.

ECONOMIC IMPACT ESTIMATES

CBRE Hotels has prepared estimates of the economic benefit associated by the operation of the proposed Lantern Head Resort and the South West Point mixed use development to be located in Great Abaco, Bahamas. The estimates of economic impact are for dollars spent and people employed within the Abacos. The following paragraphs summarize the methodology and assumptions used to prepare the estimates of economic impact.

OPERATIONAL IMPACT

<u>Methodology</u>

Estimates of economic impact were prepared based on the developer's estimates of revenues and expenses for five years of operation. CBRE Hotels reviewed the developer's operating proforma and compared it to our data base of similar operating hotels in the Caribbean region. The operating proforma provided by the developer appears to be reasonable. We utilized the revenues and expenses provided by Rosewood Hotels and estimated an additional five years of performance.

To measure the economic impact of the Subject Resort, the IMPLAN software system was utilized. IMPLAN is an economic impact assessment modeling tool and data set with economic impact multipliers for all 52 U.S. states and territories such as Puerto Rico and the U.S. Virgin Islands. The IMPLAN software system was originally developed by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency (FEMA) and the U.S. Department of the Interior Bureau of Land

Management. The data collected by IMPLAN is from the U.S. Department of Commerce, the U.S. Bureau of Labor Statistics, and other federal and state government agencies.

Despite our best efforts, we were unable to identify economic impact multipliers or similar data points for the Bahamas. As a proxy, we used the IMPLAN model for the U.S. Virgin Islands. We believe this to be the most comparable island with data available for use in this analysis.

Economic Impact Measurements

Three measures of economic impact were estimated:

- Output Impact: Revenues received by local businesses resulting from the operation of the Subject Properties. This includes the revenues received by the Subject Resort, money spent by hotel management to purchase goods and services, and money spent by employees of the hotel and employees at local vendors.

- Earnings Impact: Salaries and wages paid to employees at the Subject Properties, and employees at local vendors within the Abacos.

- Employment Impact: Full-time equivalent jobs at the Subject Properties and vendors within the Abacos.

Of these three impact measurements, the direct, indirect, and induced effects have been summed and included in our estimated impact. The definitions of these three effects as defined by IMPLAN can be found below.

- **Direct Effect**
  - For Output, these effects are either 1.00 or 0.00. For every dollar spent in an Industry, if the Industry exists in the region, there is one dollar's worth of activity in the local economy. If the Industry doesn't exist in the region, the effect is 0.00.

  - For Employment, the Effect represents the number of jobs per $1,000,000 of production in the Industry.

  - Wages Effects represent the Wages dollars per $1,000,000 of production in the Industry.

- **Indirect Effects**

  - For Output, the Effect represents the sum of local business to business purchases per dollar of Output.

- For Employment, the Effect represents the number of jobs per $1,000,000 of business to business purchases by all resultant rounds of local Industry purchases.

- Wages Effect represents the value of Wages dollars per $1,000,000 of business to business purchases by all resultant rounds of local Industry purchases.

- **Induced Effects**

  - For Output, the Effect represents the sum of local Household purchases per dollar of Output, based on Wages payments made by the target Industry and the local Industries from which they purchase.

  - For Employment, the Effect represents the number of jobs supported in local Industries per $1,000,000 of Direct spending in the target Industry because of Household purchases derived from Wages payments throughout all rounds of the impact.

  - Wages Effect represents the value of Wages dollars per $1,000,000 of Direct spending in the target Industry in local Industries because of Household purchases derived from Wages payments throughout all rounds of the impact.

For the purpose of our report, we have allocated the Direct, Indirect, and Induced effects under the respective Employment, Wages and Output impact

ESTIMATED IMPACT: LANTERN HEAD

The following table summarizes the estimated economic benefit to Abaco associated with the operation of the Subject Rosewood Resort for a stabilized representative year of operations, presented in 2024 Dollars. For the stabilized representative year 2024, total revenues were estimated to be $52,189,307 (2024 Dollars). The representative year's Total Revenues were determined by taking the stabilized year's revenues (fourth year) and discounting them back to the first year of operation (2024) at 3.0 percent.

Economic Impact - Proposed Lanternhead Resort

Impact Type	Employment	Wages	Output
Direct Effect	287	$22,879,730	$51,458,348
Indirect Effect	16	1,070,111	2,317,726
Induced Effect	76	3,837,404	10,891,207
Total Effect	379	27,787,246	64,667,281

Source: CBRE Hotels, IMPLAN

In order to project the future Wages and Output impact during stabilization, we have divided the Total Effect for both Wages and Output by the representative year's Total Revenues to determine the standard ratio for Wages and Output. The ratios used can be found in the following table.

	Total	Ratio
Rep. Year Total Revenue	$52,189,307	-
Output	64,667,281	1.24
Wages	27,787,246	0.53

The ratios are then multiplied by the Total Revenue for each year to determine the Wages and Output impact for each year. Economic Impact totals during the first ten years of operation can be found in the following table.

Summary of Estimated Annual Operating Results				
Year	Total Revenue	*Economic Impact*		
		Output	Wages	Total (Rounded)
2024	$42,160,125	$52,240,216	$22,447,390	$74,688,000
2025	$49,587,636	61,443,574	26,402,033	87,846,000
2026	$55,140,882	68,324,550	29,358,758	97,683,000
2027	$58,740,444	72,784,734	31,275,280	104,060,000
2028	$60,012,865	74,361,379	31,952,757	106,314,000
2029	$61,815,022	76,594,415	32,912,283	109,507,000
2030	$63,667,498	78,889,800	33,898,599	112,788,000
2031	$65,577,591	81,256,578	34,915,594	116,172,000
2032	$67,545,804	83,695,373	35,963,533	119,659,000
2033	$69,572,655	86,206,825	37,042,693	123,250,000
Total	**$593,820,521**	**$735,797,442**	**$316,168,919**	**$1,051,967,000**

Source: CBRE Hotels

Fiscal Impact

The Value Added Tax (VAT) was introduced in January 2015 as part of a broader tax reform in the Bahamas. This broad-based consumption tax is applied to most goods and services that are imported, bought, or sold for use in the Bahamas. Effective July 1, 2018, the VAT tax was raised from 7.5 percent to 12.0 percent and removed all breadbasket items (excluding sugar), medicine, residential property insurance, and certain residential utilities which would become effective August 1. Rates of VAT are applied which is the standard rate of 12.0 percent and a zero rate. Goods exported to customers abroad are classified as exempt from VAT or zero rated. For the purpose of this study, we have assumed that all goods and services fall under the standard rate.

The following table contains the VAT tax totals for the ten-year estimate. Please note that the following nomenclature:

RR – Room Revenue, F&B – Food and Beverage, OOD – Other operated Departments, ROI – Rentals and Other Income

Summary of Estimated Annual Lodging and Sales Tax					
Year	*VAT* 12% of RR	*VAT* 12% of F&B	*VAT* 12% of OOD	*VAT* 12% of ROI	*Total Tax*
2024	$2,991,994	$1,046,920	$992,109	$28,192	$5,059,215
2025	3,809,995	1,118,909	988,568	33,044	5,950,516
2026	4,472,451	1,185,390	921,956	37,109	6,616,906
2027	4,921,445	1,232,727	855,343	39,338	7,048,853
2028	5,033,426	1,257,641	870,352	40,125	7,201,544
2029	5,184,641	1,295,371	896,462	41,329	7,417,803
2030	5,339,944	1,334,232	923,356	42,569	7,640,100
2031	5,500,150	1,374,259	951,057	43,846	7,869,311
2032	5,665,261	1,415,486	979,588	45,161	8,105,496
2033	5,835,276	1,457,951	1,008,976	46,516	8,348,719
Total	**$48,754,583**	**$12,718,886**	**$9,387,766**	**$397,228**	**$71,258,463**

Source: CBRE Hotels

ESTIMATED IMPACT: SOUTH WEST POINT - MARINA

The following table summarizes the estimated economic benefit to Abaco associated with the operation of the Proposed Marina for a representative year of operations, presented in 2024 Dollars. For the representative year 2024, total revenues were estimated to be $21,796,726 (2024 Dollars). The representative year's Total Revenues were determined by taking the stabilized year's revenues (fourth year) and discounting them back to the first year of operation (2024) at 3.0 percent.

Ecomonic Impact - Proposed South West Point Marina			
Impact Type	Employment	Labor Income	Output
Direct Effect	50	$1,703,116	$20,782,015
Indirect Effect	21	1,481,212	3,482,535
Induced Effect	10	515,392	1,462,771
Total Effect	81	3,699,720	25,727,321

Source: CBRE Hotels, IMPLAN

In order to project the future Wages and Output impact during stabilization, we have divided the Total Effect for both Wages and Output by the representative year's Total Revenues to determine the standard ratio for Wages and Output. The ratios used can be found in the following table.

	Total	Ratio
Rep. Year Total Revenue	$ 21,796,726	-
Output	25,727,321	1.18
Wages	3,699,720	0.17

The ratios are then multiplied by the Total Revenue for each year to determine the Wages and Output impact for each year. Economic Impact totals during the first ten years of operation can be found in the following table.

Summary of Estimated Annual Operating Results				
Fiscal	Total	*Economic Impact*		
Year	**Revenue**	**Output**	**Wages**	**Total (Rounded)**
2024	$15,741,811	$18,580,526	$2,671,974	$21,252,000
2025	$18,650,412	22,013,633	3,165,672	25,179,000
2026	$21,138,406	24,950,286	3,587,978	28,538,000
2027	$23,817,871	28,112,938	4,042,783	32,156,000
2028	$24,532,407	28,956,326	4,164,067	33,120,000
2029	$25,268,380	29,825,016	4,288,989	34,114,000
2030	$26,026,431	30,719,767	4,417,659	35,137,000
2031	$26,954,662	31,815,385	4,575,214	36,391,000
2032	$27,763,302	32,769,847	4,712,471	37,482,000
2033	$28,596,201	33,752,942	4,853,845	38,607,000
Total	**$238,489,884**	**$281,496,666**	**$40,480,652**	**$321,976,000**

Source: CBRE Hotels

Fiscal Impact

The Value Added Tax (VAT) was introduced in January 2015 as part of a broader tax reform in the Bahamas. This broad-based consumption tax is applied to most goods and services that are imported, bought, or sold for use in the Bahamas. Effective July 1, 2018, the VAT tax was raised from 7.5 percent to 12.0 percent and removed all breadbasket items (excluding sugar), medicine, residential property insurance, and certain residential utilities which would become effective August 1. Rates of VAT are applied which is the standard rate of 12.0 percent and a zero rate. Goods exported to customers abroad are classified as exempt from VAT or zero rated. For the purpose of this study, we have assumed that all goods and services fall under the standard rate.

The following table contains the VAT tax totals for the ten-year estimate.

Summary of Estimated Annual Sales Tax			
Fiscal Year	***VAT*** **12% of SR**	***VAT*** **12% of OI**	***Total VAT***
2024	$1,512,250	$376,768	$1,889,017
2025	1,814,700	423,350	2,238,049
2026	2,064,221	472,388	2,536,609
2027	2,334,157	523,987	2,858,145
2028	2,404,182	539,707	2,943,889
2029	2,476,308	555,898	3,032,206
2030	2,550,597	572,575	3,123,172
2031	2,627,115	589,752	3,216,867
2032	2,705,928	607,445	3,313,373
2033	2,787,106	625,668	3,412,774
Total	**$23,276,564**	**$5,287,536**	**$28,564,100**

Source: CBRE Hotels

ESTIMATED IMPACT: SOUTH WEST POINT - HOTELS

The following table summarizes the estimated economic benefit to Abaco associated with the operation of the Proposed 75-room Full Service hotel and 100-room Extended Stay hotel for a representative year of operations, presented in 2024 Dollars. For the representative year 2024, total revenues were estimated to be $28,949,063 (2024 Dollars). The representative year's Total Revenues were determined by taking the stabilized year's revenues (fourth year) and discounting them back to the first year of operation (2024) at 3.0 percent.

Ecomonic Impact - Proposed South West Point Hotels			
Impact Type	Employment	Labor Income	Output
Direct Effect	150	$12,325,204	$27,711,803
Indirect Effect	9	576,286	1,248,163
Induced Effect	41	2,067,163	5,866,959
Total Effect	200	14,968,653	34,826,925

Source: CBRE Hotels, IMPLAN

In order to project the future Wages and Output impact during stabilization, we have divided the Total Effect for both Wages and Output by the representative year's Total Revenues to determine the standard ratio for Wages and Output. The ratios used can be found in the following table.

	Total	Ratio
Rep. Year Total Revenue	$ 28,949,063	-
Output	34,826,925	1.20
Wages	14,968,653	0.52

The ratios are then multiplied by the Total Revenue for each year to determine the Wages and Output impact for each year. Economic Impact totals during the first ten years of operation can be found in the following table.

Summary of Estimated Annual Operating Results				
Fiscal Year	Total Revenue	*Economic Impact* Output	Wages	Total (Rounded)
2024	$28,949,063	$34,826,925	$14,968,653	$49,796,000
2025	$29,817,534	35,871,733	15,417,712	51,289,000
2026	$30,712,060	36,947,885	15,880,244	52,828,000
2027	$31,633,422	38,056,322	16,356,651	54,413,000
2028	$32,582,425	39,198,011	16,847,350	56,045,000
2029	$33,559,898	40,373,952	17,352,771	57,727,000
2030	$34,566,695	41,585,170	17,873,354	59,459,000
2031	$35,603,695	42,832,725	18,409,555	61,242,000
2032	$36,671,806	44,117,707	18,961,841	63,080,000
2033	$37,771,960	45,441,238	19,530,696	64,972,000
Total	**$331,868,559**	**$399,251,670**	**$171,598,826**	**$570,851,000**

Source: CBRE Hotels

Fiscal Impact

The Value Added Tax (VAT) was introduced in January 2015 as part of a broader tax reform in the Bahamas. This broad-based consumption tax is applied to most goods and services that are imported, bought, or sold for use in the Bahamas. Effective July 1, 2018, the VAT tax was raised from 7.5 percent to 12.0 percent and removed all breadbasket items (excluding sugar), medicine, residential property insurance, and certain residential utilities which would become effective August 1. Rates of VAT are applied which is the standard rate of 12.0 percent and a zero rate. Goods exported to customers abroad are classified as exempt from VAT or zero rated. For the purpose of this study, we have assumed that all goods and services fall under the standard rate.

The following table contains the VAT tax totals for the ten-year estimate.

Summary of Estimated Annual Lodging and Sales Tax			
Fiscal Year	*VAT*	*VAT*	*Total Tax*
	12% of RR	12% of OI	
2024	$2,792,250	$681,638	$3,473,888
2025	2,876,018	702,087	3,578,104
2026	2,962,298	723,149	3,685,447
2027	3,051,167	744,844	3,796,011
2028	3,142,702	767,189	3,909,891
2029	3,236,983	790,205	4,027,188
2030	3,334,093	813,911	4,148,003
2031	3,434,115	838,328	4,272,443
2032	3,537,139	863,478	4,400,617
2033	3,643,253	889,382	4,532,635
Total	**$32,010,017**	**$7,814,210**	**$39,824,227**

Source: CBRE Hotels

TOTAL PROJECTED ECONOMIC AND EMPLOYMENT SUMMARY

The table below presents the total projected economic, employment, and fiscal impact for the Proposed Resort's first ten years of operations.

Summary of Economic, Employment and Fiscal Impact	
Economic Impact - Total Economic Impact From Operations	
Proposed Lantern Head Hotel	$1,051,967,000
Proposed South West Point Marina	$321,976,000
Proposed South West Point Hotels	$570,851,000
Grand Total Economic Impact From Operations	$1,944,794,000
Employment Impact - Total Jobs From Operations	
Proposed Lantern Head Hotel	379 Jobs
Proposed South West Point Marina	81 Jobs
Proposed South West Point Hotels	200 Jobs
Grand Total Employment Impact from Operations	660 Jobs
Fiscal Impact - Potential Value Added Tax (Rounded)	
Proposed Lantern Head Hotel	$71,258,463
Proposed South West Point Marina	$28,564,000
Proposed South West Point Hotels	$39,824,000
Grand Total Potential Value Added Tax	$139,646,463

Source: CBRE Hotels, IMPLAN

Note: Economic and Fiscal Impact is the sum of the impact over a 10-year period.

It should be noted that there will be additional economic benefits associated with the renovation and operation of the Sandy Point Airport. These would include increased jobs, airport landing fees, and jet fuel sales. We also understand that the developer may include a casino in the South West Marina Village which would generate additional economic benefits.

We appreciate the opportunity to be of service to French Quarter Holdings, Inc and thank you for selecting CBRE Hotels for professional services. We look forward to discussing our findings with you.

Sincerely,
CBRE Hotels

TERMS AND CONDITIONS

1. The Terms and Conditions herein are part of an agreement for Consuting report services (the "Agreement") between CBRE, Inc. (the "Consutant") and the client signing this Agreement, and for whom the Consuting report services will be performed (the "Client"), and shall be deemed a part of such Agreement as though set forth in full therein. The Agreement shall be governed by the laws of the state where the Consuting report office is located for the Consutant executing this Agreement.
2. Client shall be responsible for the payment of all fees stipulated in the Agreement. Payment of the Consuting report fee and preparation of an Consuting report report (the "Consuting report Report, or the "report") are not contingent upon any predetermined value or on an action or event resulting from the analyses, opinions, conclusions, or use of the Consuting report Report. Final payment is due as provided in the Proposal Specifications Section of this Agreement. If a draft report is requested, the fee is considered earned upon delivery of the draft report. It is understood that the Client may cancel this assignment in writing at any time prior to delivery of the completed report. In such event, the Client is obligated only for the prorated share of the fee based upon the work completed and expenses incurred (including travel expenses to and from the job site). Additional copies of the Consuting report Reports are available at a cost of $250 per original color copy and $100 per photocopy (black and white), plus shipping fees of $30 per report.
3. If Consutant is subpoenaed or ordered to give testimony, produce documents or information, or otherwise required or requested by Client or a third party to participate in meetings, phone calls, conferences, litigation or other legal proceedings (including preparation for such proceedings) because of, connected with or in any way pertaining to this engagement, the Consuting report Report, the Consutant's expertise, or the Property, Client shall pay Consutant's additional costs and expenses, including but not limited to Consutant's attorneys' fees, and additional time incurred by Consutant based on Consutant's then-prevailing hourly rates and related fees. Such charges include and pertain to, but are not limited to, time spent in preparing for and providing court room testimony, depositions, travel time, mileage and related travel expenses, waiting time, document review and production, and preparation time (excluding preparation of the Consuting report Report), meeting participation, and Consutant's other related commitment of time and expertise. Hourly charges and other fees for such participation will be provided upon request. In the event Client requests additional Consuting report services beyond the scope and purpose stated in the Agreement, Client agrees to pay additional fees for such services and to reimburse related expenses, whether or not the completed report has been delivered to Client at the time of such request.
4. Consutant shall have the right to terminate this Agreement at any time for cause effective immediately upon written notice to Client on the occurrence of fraud or the willful misconduct of Client, its employees or agents, or without cause upon 30 days written notice.
5. In the event Client fails to make payments when due then, from the date due until paid, the amount due and payable shall bear interest at the maximum rate permitted in the state where the office is located for the Consutant executing the Agreement. In the event either party institutes legal action against the other to enforce its rights under this Agreement, the prevailing party shall be entitled to recover its reasonable attorney's fees and expenses. Each party waives the right to a trial by jury in any action arising under this Agreement.
6. Consutant assumes there are no major or significant items or issues affecting the Property that would require the expertise of a professional building contractor, engineer, or environmental consultant for Consutant to prepare a valid report. Client acknowledges that such additional expertise is not covered in the Consuting report fee and agrees that, if such additional expertise is required, it shall be provided by others at the discretion and direction of the Client, and solely at Client's additional cost and expense.
7. In the event of any dispute between Client and Consutant relating to this Agreement, or Consutant's or Client's performance hereunder, Consutant and Client agree that such dispute shall be resolved by means of binding arbitration in accordance with the commercial arbitration rules of the American Arbitration Association, and judgment upon the award rendered by an arbitrator may be entered in any court of competent jurisdiction. Depositions may be taken and other discovery obtained during such arbitration proceedings to the same extent as authorized in civil judicial proceedings in the state where the office of the Consutant executing this Agreement is located. The arbitrator shall be limited to awarding compensatory damages and shall have no authority to award punitive, exemplary or similar damages. The prevailing party in the arbitration proceeding

shall be entitled to recover its expenses from the losing party, including costs of the arbitration proceeding, and reasonable attorney's fees. Client acknowledges that Consutant is being retained hereunder as an independent contractor to perform the services described herein and nothing in this Agreement shall be deemed to create any other relationship between Client and Consutant. This engagement shall be deemed concluded and the services hereunder completed upon delivery to Client of the Consuting report Report discussed herein.

8. All statements of fact in the report which are used as the basis of the Consutant's analyses, opinions, and conclusions will be true and correct to Consutant's actual knowledge and belief. Consutant does not make any representation or warranty, express or implied, as to the accuracy or completeness of the information or the condition of the Property furnished to Consutant by Client or others. The conclusions and any permitted reliance on and use of the Consuting report Report shall be subject to the assumptions, limitations, and qualifying statements contained in the report.
9. Consutant shall have no responsibility for legal matters, including zoning, or questions of survey or title, soil or subsoil conditions, engineering, or other similar technical matters. The report will not constitute a survey of the Property analyzed.
10. Client shall provide Consutant with such materials with respect to the assignment as are requested by Consutant and in the possession or under the control of Client. Client shall provide Consutant with sufficient access to the Property to be analyzed, and hereby grants permission for entry unless discussed in advance to the contrary.
11. The data gathered in the course of the assignment (except data furnished by Client) and the report prepared pursuant to the Agreement are, and will remain, the property of Consutant. With respect to data provided by Client, Consutant shall not violate the confidential nature of the Consutant-Client relationship by improperly disclosing any proprietary information furnished to Consutant. Notwithstanding the foregoing, Consutant is authorized by Client to disclose all or any portion of the report and related data as may be required by statute, government regulation, legal process, or judicial decree, including to appropriate representatives of the Consuting report Institute if such disclosure is required to enable Consutant to comply with the Bylaws and Regulations of such Institute as now or hereafter in effect.
12. Unless specifically noted, in preparing the Consuting report Report the Consutant will not be considering the possible existence of asbestos, PCB transformers, or other toxic, hazardous, or contaminated substances and/or underground storage tanks (collectively, "Hazardous Material) on or affecting the Property, or the cost of encapsulation or removal thereof. Further, Client represents that there is no major or significant deferred maintenance of the Property that would require the expertise of a professional cost estimator or contractor. If such repairs are needed, the estimates are to be prepared by others, at Client's discretion and direction, and are not covered as part of the Consuting report fee.
13. In the event Client intends to use the Consuting report Report in connection with a tax matter, Client acknowledges that Consutant provides no warranty, representation or prediction as to the outcome of such tax matter. Client understands and acknowledges that any relevant taxing authority (whether the Internal Revenue Service or any other federal, state or local taxing authority) may disagree with or reject the Consuting report Report or otherwise disagree with Client's tax position, and further understands and acknowledges that the taxing authority may seek to collect additional taxes, interest, penalties or fees from Client beyond what may be suggested by the Consuting report Report. Client agrees that Consutant shall have no responsibility or liability to Client or any other party for any such taxes, interest, penalties or fees and that Client will not seek damages or other compensation from Consutant relating to any such taxes, interest, penalties or fees imposed on Client, or for any attorneys' fees, costs or other expenses relating to Client's tax matters.
14. Consutant shall have no liability with respect to any loss, damage, claim or expense incurred by or asserted against Client arising out of, based upon or resulting from Client's failure to provide accurate or complete information or documentation pertaining to an assignment ordered under or in connection with this Agreement, including Client's failure, or the failure of any of Client's agents, to provide a complete copy of the Consuting report Report to any third party.
15. LIMITATION OF LIABILITY. EXCEPT TO THE EXTENT ARISING FROM SECTION 16 BELOW, OR SECTION 17 IF APPLICABLE, IN NO EVENT SHALL EITHER PARTY OR ANY OF ITS AFFILIATE, OFFICERS, DIRECTORS, EMPLOYEES, AGENTS, OR CONTRACTORS BE LIABLE TO THE OTHER, WHETHER BASED IN CONTRACT, WARRANTY, INDEMNITY, NEGLIGENCE, STRICT LIABILITY OR OTHER TORT OR OTHERWISE, FOR ANY SPECIAL, CONSEQUENTIAL, PUNITIVE, INCIDENTAL OR INDIRECT DAMAGES AND AGGREGATE DAMAGES IN CONNECTION WITH

THIS AGREEMENT FOR EITHER PARTY (EXCLUDING THE OBLIGATION TO PAY THE FEES REQUIRED HEREUNDER) SHALL NOT EXCEED THE GREATER OF THE TOTAL FEES PAYABLE TO CONSUTANT UNDER THIS AGREEMENT OR TEN THOUSAND DOLLARS ($10,000). THIS LIABILITY LIMITATION SHALL NOT APPLY IN THE EVENT OF A FINAL FINDING BY AN ARBITRATOR OR A COURT OF COMPETENT JURISDICTION THAT SUCH LIABILITY IS THE RESULT OF A PARTY'S FRAUD OR WILLFUL MISCONDUCT.

16. Client shall not disseminate, distribute, make available or otherwise provide any Consuting report Report prepared hereunder to any third party (including without limitation, incorporating or referencing the Consuting report Report , in whole or in part, in any offering or other material intended for review by other parties) except to (i) any third party expressly acknowledged in a signed writing by Consutant as an "Intended User" of the Consuting report Report provided that either Consutant has received an acceptable release from such third party with respect to such Consuting report Report or Client provides acceptable indemnity protections to Consutant against any claims resulting from the distribution of the Consuting report Report to such third party, (ii) any third party service provider (including rating agencies and Client's auditors) using the Consuting report Report in the course of providing services for the sole benefit of Client, or (iii) as required by statute, government regulation, legal process, or judicial decree. In the event Consutant consents, in writing, to Client incorporating or referencing the Consuting report Report in any offering or other materials intended for review by other parties, Client shall not distribute, file, or otherwise make such materials available to any such parties unless and until Client has provided Consutant with complete copies of such materials and Consutant has approved all such materials in writing. Client shall not modify any such materials once approved by Consutant. In the absence of satisfying the conditions of this paragraph with respect to a party who is not designated as an Intended User, in no event shall the receipt of an Consuting report Report by such party extend any right to the party to use and rely on such report, and Consutant shall have no liability for such unauthorized use and reliance on any Consuting report Report. In the event Client breaches the provisions of this paragraph, Client shall indemnify, defend and hold Consutant, and its affiliates and their officers, directors, employees, contractors, agents and other representatives (Consutant and each of the foregoing an "Indemnified Party" and collectively the "Indemnified Parties"), fully harmless from and against all losses, liabilities, damages and expenses (collectively, "Damages") claimed against, sustained or incurred by any Indemnified Party arising out of or in connection with such breach, regardless of any negligence on the part of any Indemnified Party in preparing the Consuting report Report.

17. In the event Client incorporates or references the Consuting report Report, in whole or in part, in any offering or other material intended for review by other parties, Client shall indemnify, defend and hold each of the Indemnified Parties harmless from and against any Damages in connection with (i) any transaction contemplated by this Agreement or in connection with the Consuting report or the engagement of or performance of services by any Indemnified Party hereunder, (ii) any actual or alleged untrue statement of a material fact, or the actual or alleged failure to state a material fact necessary to make a statement not misleading in light of the circumstances under which it was made with respect to all information furnished to any Indemnified Party or made available to a prospective party to a transaction, or (iii) an actual or alleged violation of applicable law by Client (including, without limitation, securities laws) or the negligent or intentional acts or omissions of Client (including the failure to perform any duty imposed by law); and will reimburse each Indemnified Party for all reasonable fees and expenses (including fees and expenses of counsel) (collectively, "Expenses") as incurred in connection with investigating, preparing, pursuing or defending any threatened or pending claim, action, proceeding or investigation (collectively, "Proceedings") arising therefrom, and regardless of whether such Indemnified Party is a formal party to such Proceeding. Client agrees not to enter into any waiver, release or settlement of any Proceeding (whether or not any Indemnified Party is a formal party to such Proceeding) without the prior written consent of Consutant (which consent will not be unreasonably withheld or delayed) unless such waiver, release or settlement includes an unconditional release of each Indemnified Party from all liability arising out of such Proceeding.

18. Time Period for Legal Action. Unless the time period is shorter under applicable law, except in connection with paragraphs 16 and 17 above, Consutant and Client agree that any legal action or lawsuit by one party against the other party or its affiliates, officers, directors, employees, contractors, agents, or other representatives, whether based in contract, warranty, indemnity, negligence, strict liability or other tort or otherwise, relating to (a) this Agreement or the Consuting report Report, (b) any services or Consuting reports under this Agreement or (c)

any acts or conduct relating to such services or Consuting reports, shall be filed within two (2) years from the date of delivery to Client of the Consuting report Report to which the claims or causes of action in the legal action or lawsuit relate. The time period stated in this section shall not be extended by any incapacity of a party or any delay in the discovery or accrual of the underlying claims, causes of action or damages.

APPENDIX F – South West Point Survey Plan (beach access road illustration)

NOTE:

REFERENCE WAS MADE TO CROWN GRANT NUMBER B1–5, B1–12, B1–35, B1–61, B1–65, B5–17,

ALSO D .L. S. PLANS 1 AB., 1,450 AB. AND A PLAN BY CHEE–A–TOW AND COMPANY DATED JUNE 1996.

GRID CONNECTION WAS MADE TO A 53 AND A 54

ALL BEARINGS ARE GRID, ALL DISTANCES ARE TRUE.

LEGEND:

DENOTES BOUNDARY MARKERS TO BE SET

DENOTES ROCKY SHORELINE

SURVEYOR'S CERTIFICATE

I, DALE J.S. GRANT, A SURVEYOR REGISTERED AND LICENSED IN THE BAHAMAS, HEREBY CERTIFY THAT THIS PLAN HAS BEEN MADE FROM SURVEYS EXECUTED BY ME, OR UNDER MY PERSONAL SUPERVISION, THAT BOTH THE PLAN AND SURVEY ARE CORRECT, AND HAVE BEEN MADE IN ACCORDANCE WITH THE LAND SURVEYORS ACT, 1975, AND THE LAND SURVEYORS REGULATIONS, 1975, MADE THEREUNDER

DALE J.S. GRANT LIC. NO. 060

RECORDED IN THE DEPARTMENT OF LANDS AND SURVEYS IN ACCORDANCE WITH SECTION 3 OF THE LAND SURVEYORS ACT

1975 AS PLAN NO . ABACO. THIS DAY OF

2019.

SURVEYOR GENERAL

CHECKED BY

APPROVED BY

DLS FILE NO.

LINE TABLE

LINE	LENGTH	BEARING
L1	101.93'	N 282°31'25"
L2	180.61'	N 73°07'56"
L3	141.31'	N 199°06'39"
L4	103.00'	N 154°26'39"
L5	138.06'	N 91°56'26"
L6	84.23'	N 182°23'12"
L7	136.30'	N 271°57'56"
L8	108.39'	N 218°01'07"
L9	114.92'	N 293°41'16"
L10	182.27'	N 212°10'17"
L11	100.53'	N 325°35'14"

DESCRIPTION

PROPOSED PLAN
SHOWING

SITUATE
ALONG THE SEA COAST FROM HIGHBANK TO SOUTHWEST POINT
IN THE ISLAND OF

SOUTH ABACO - BAHAMAS

PREPARED AT THE INSTANCE OF TYRZOS FAMILY HOLDINGS

A T A METRICS
WINDSOR BUSINESS PARK
WINDSOR FIELD ROAD
NASSAU – BAHAMAS
PHONE (242)–424–9334
email: info@atametrics.com
www.atametrics.com

JOB NAME: SOUTH ABACO RESORT

LOCATION: SOUTHWEST POINT

SURVEYED BY: DALE GRANT

DRAWN BY: DG AND AW

CHECKED BY: ER

SCALE: 1" = 200'

DATE: 2019–03–14

JOB NUMBER: A1901002

SHEET No. 2 OF 2

APPENDIX G – Letters of Support by Local Government.

LOCAL GOVERNMENT AUTHORITY
SOUTH ABACO DISTRICT
SANDY POINT, ABACO
BAHAMAS
Telephone: 366-4022/3
Email:sadcouncil@hotmail.com

October 27th, 2020

Ms. Candia Ferguson,
Director- Bahamas Investment Authority
Nassau, Bahamas

Re: Tyrsoz Family Holdings Proposed – South Abaco Development Project EIA

Last year, April 9th, 2019, the South Abaco District Council Board was invited to attend a Town Hall meeting at the Hurricane Shelter in Sandy Point, South Abaco. The meeting was hosted by Mr. Ra'anan (Ronnie) Ben-Zur, the Tyrsoz Family Holdings Group's General Manager and Investor. Mr. Ben-Zur so aptly shared the overall goal of the proposed development, during which time he said the Tyrsoz Family's ultimate goal once the proposal is approved will be to create a world class environmentally-sustainable luxurious community on the site while maintaining its natural appeal as an unspoiled Island Paradise.

The hall was filled to capacity with no standing room left; approximately 500 persons were in attendance some of whom would have travelled from as far as Crown Haven in the North, including persons from Central Abaco, the communities of South Abaco and Moore's Island. The meeting was very productive as the majority of persons attending opined that this development if approved, will be the catalyst that is needed to stimulate and boost the District's economic growth; that is opening doors that remained closed for many years due to lack of vision, uncaring Governments over the years and limited knowledge. Mr. Ben-Zur's presentation was very informative, passionately shared with emphasis placed on preserving our ecosystem and the well-being of the Bahamian populace. The overall consensus was that this development will bring about the desired change and economic growth that is urgently needed at this time. The majority of persons in attendance expressed their overwhelming support for the project.

A second meeting was held on December 12, 2019 at the St. Martin's Anglican Parish Hall, Sandy Point which was also filled to capacity. Persons yet again expressed the urgent need for this project to move forward. All feedback was positive from all present including those who would have opposed the project. In attendance was the Administrator for the Southern District along with Local Government practitioners.

The South Abaco District Council Board, shares the vision of the Developer, and has sent numerous writings to our past and present Governments, for many years, requesting varying partnerships in our quest to make South Abaco the leading touristic destination in the region. We still opined that the South Abaco District is a goldmine with so many natural resources available throughout the South Abaco District and once harvested and manufactured can be additional contributors to our fiscal revenue, income increase and poverty reduction. We are confident, once the proposed project becomes a reality and work begins on the site, Mr. Ben-Zur will partner with us in our continued quest to take South Abaco to the next level. As a result, we envision the creation of jobs and the formation of many small businesses which will lend for a robust economy and more importantly increase in revenue generation with a trickle-down effect impacting not only South Abaco but the entire Bahamas.

Despite a number of negative articles circulating throughout the Bahamas in May of 2019, by various Interest Groups, with hidden agendas to perhaps frustrate and discourage the Investors and our Government to revisit and decline the proposal, my opinion remains favorable in this matter. In all of our dealings with Mr. Ben-Zur, we have found him to be a man of integrity and one that has placed the preservation of the ecosystem surrounding the proposed site as being of utmost importance and a priority as evidenced in his proposal. I commend him on his stance in this regard.

Being an environmentalist in my own rank it is my opinion that this proposed investment would impact the Bahamian economy positively, attract tourists to our shores, open up added gateways to the island, create jobs, enhance our national parks, wetlands, coppices, feeding and fishing grounds with minimal damage, all elements of this investment working for the overall good of the Bahamas and our Bahamian families.

It is the Board's opinion that partnering with the Tyrsoz Holdings Family Group will bring restoration to the declining economic growth of South Abaco and thus have an immense impact on the social and economic climate for the good people of Abaco.

Therefore, the South Abaco District Council is pleased to advise that we fully endorse and support the proposed project, in tandem with the overwhelming support from the Bahamian public who would have expressed their support as well through two Petitions, and ask kindly that consideration be given by The Department of Environmental Planning and Protection to expedite the approval to move this project forward urgently. This development will not only bring about change and stability to a declining economy that was left from the 90's to survive on its own, worsened from the impact of the pandemic and a devastating hurricane last year and is in dire need of a stimulus to revive the already declining economy but it will bring back economic stability through the creation of jobs and startups of new businesses.

We wish to commend our Government for their stellar performance to date and thank them in advance for their kind consideration and approval of this long-awaited proposed development, which will positively impact the Bahamian community at large.

Thanking you in advance.

Sincerely,

Ms. Jacquelyn Estevez
Chief Councilor
South Abaco District

JW/cd

Cc: Mr. Ra'anan "Ronnie" Ben-Zur – Tyrsoz Family Holdings Group
Ms. Serena Williams – Public Relations, Tyrsoz Family Holdings Group

LOCAL GOVERNMENT AUTHORITY
SOUTH ABACO DISTRICT
SANDY POINT, ABACO
BAHAMAS
Telephone: 366-4022/3
Email: sadcouncil@hotmail.com

April 26, 2019

MEMORANDUM

Ms. Nicole Campbell
Permanent Secretary
Office of the Prime Minister
Nassau, The Bahamas

Attn: The Hon. Dr. Hubert Minnis, Prime Minister

Re: Town Hall Meeting -Tyrsoz Family Holdings Proposed – South Abaco Project

A Town Hall meeting was held on Tuesday, April 9th, 2019, at the Hurricane Shelter, Sandy Point, Abaco, to introduce the Investor and General Manager, Mr. Ra'anan (Ronnie) Ben-Zur who presented on the overall goal of the project which is to create a world-class, environmentally-sustainable luxury community in South Abaco, while maintaining South Abaco's natural appeal as an unspoiled Island Paradise.

The Hall was filled to capacity with no standing room left; that is approximately 500 persons who travelled from as far as Crown Haven in the North and Central inclusive of persons from the various South Abaco Townships seeking to be informed, on the project and employment opportunities. Overall, the meeting was very productive and the majority of persons left excited and expressed their overwhelming support for the project. It is the opinion of the South Abaco District, that a project of this magnitude is badly needed not only to boost the economy of the South Abaco District Council but also act as a stimulus to boost the economies of the entire Island of Abaco. The trickled down effect will positively impact and be beneficial to the entire Bahamas.

Most recently, a number of negative articles have been circulating throughout the Bahamas, by various Interest Groups, who have hidden agendas for their own personal gain and not that of Bahamian people. These naysayers have collaborated together with the intent to frustrate and discourage the Investors and our Government to have second thoughts and decline the proposal.

The South Abaco District experienced a drastic decline economically, beginning in the late nineties and this trend continues to this present date. It would appear despite the decline that for all intent and purpose the District was neglected by former Governments providing reduced budget allocations and constraints, thus creating more hardship for our people here in South Abaco. I hasten to say, that the South Abaco District has the natural resources and precious gems, once explored, to become financially viable, self- sustaining and be positioned to become the highest revenue contributor in the Bahamas. Partnering with the Tyrsoz Holdings Family Group will bring restoration to the declining economic growth of South Abaco and thus an immense impact on the social and economic climate for the good people of Abaco.

We have written many letters to the various Interest Groups requesting their partnerships to assist in the restoration of the Hole in the Wall Lighthouse, the surrounding buildings as well as to convert the National Park into a state of the art park in keeping with the International standard that we have become accustomed to. While they would have expressed interest, their response was we do not have any money, and or Government has no funds.

It is our opinion, that the Hole in the Wall Lighthouse in tandem with the South Abaco National Parks is a goldmine like no other in this hemisphere. We have received many telephone calls from International Groups, worldwide over the years, expressing their desire to visit the site. The Groups comprise of thirty (30) persons and in some cases more. Presently, we see a small number of bird watchers and wild life enthusiasts visiting the site periodically. We believe that every day the Lighthouse remains closed we have lost the opportunity to generate additional revenue for the consolidation fund largely due to the lack of vision. Mr. Ben-Zur has indicated his desire to fund the full restoration of the Lighthouse which would be welcomed by the entire community, the BNT and the country as a whole.

Being an environmentalist in my own rank, it is my opinion that this proposed investment would impact the Bahamian economy positively, attract tourists to our shores, open up added gateways to the Island, create jobs and yet enhance our national parks, wetlands, coppices, feeding and fishing grounds with minimal damage, working on a compromise basis for the overall good of the Bahamas and our Bahamian families. Birds and wild life will migrate in order to survive, that is how we are all made.

With this in mind, we are in grave opposition to the Interest Groups and their rhetoric and are indeed focused and committed to do whatever we can as the South Abaco District Council to see this proposed project to fruition. Therefore, the South Abaco District Council is pleased to advise our support of the proposed project, in tandem with the overwhelming support from the Bahamian public who would have expressed their support as well and ask kindly that consideration be given to move the project forward, despite the negative naysayers, working in collaboration to stop this project.

The respective petitions are still being circulated throughout Abaco and today 500 persons would have signed up already in support of this project. Once the petitions are returned to our office they will be forwarded to you, under separate cover.

Thanking you in advance.

Sincerely,

Ms. Jacquelyn W. Estevez
Chief Councilor
South Abaco District

JWE/cd

Cc: Investment Authority Board
Mr. Montez Williams, Permanent Secretary, Office of the Prime Minister – Abaco
Mr. James Albury, Parliamentary Secretary, Office of the Prime Minister – Abaco
Hon. Darren Henfield M.P, Minister of Foreign Affairs
Mr. Donald Rolle, Administrator, South Abaco & Moore's Island Districts
Ms. Serena Williams, Media & Public Relations, Tyrsoz Family Holdings

APPENDIX H – Saltwater Intrusion Mitigation Report (Rev.1): Proposed South West Point Marina - Great Abaco, The Bahamas.

Saltwater Intrusion Mitigation Report (REV. 2):

Proposed South West Point Marina

Great Abaco

The Bahamas

57 Raphia Close East

Airport Industrial Park

Nassau, N.P., The Bahamas

03 November 2020

Introduction

This document presents the methodologies proposed to mitigate possible salt water intrusion into the fresh water reserves at South West Point (SWP) due to the proposed construction of a 136-slip superyacht marina. The proposed marina will be excavated inland, with a possibility of intersecting one of the large fresh water lenses on Great Abaco. This excavation opens the area of land to seawater, posing the potential for saltwater intrusion into the fresh water reservoir, if indeed present.

South Abaco, from Crossing Rock to Hole in the Wall has been identified as one of the nation's largest fresh water lenses (USACE, 2004). The reservoir covers an enormous percentage of the total area of South Abaco, and ranges in depth from 17- 20 ft below the water table (USACE, 2004). Figure 1 below shows a map of the fresh water lenses for Abaco. Though the scale of the marina is minute compared to that of the freshwater lens from Crossing Rocks to Hole in the Wall (less than 0.1%), remediation measures are proposed to limit the impact on valuable freshwater resources.

Remediation measures will be taken to address two of the major causes saltwater intrusion due to the construction of the proposed marina:

1. Physical Disturbance Through Excavation
2. Saltwater Ponding as a Result of Storm Surge

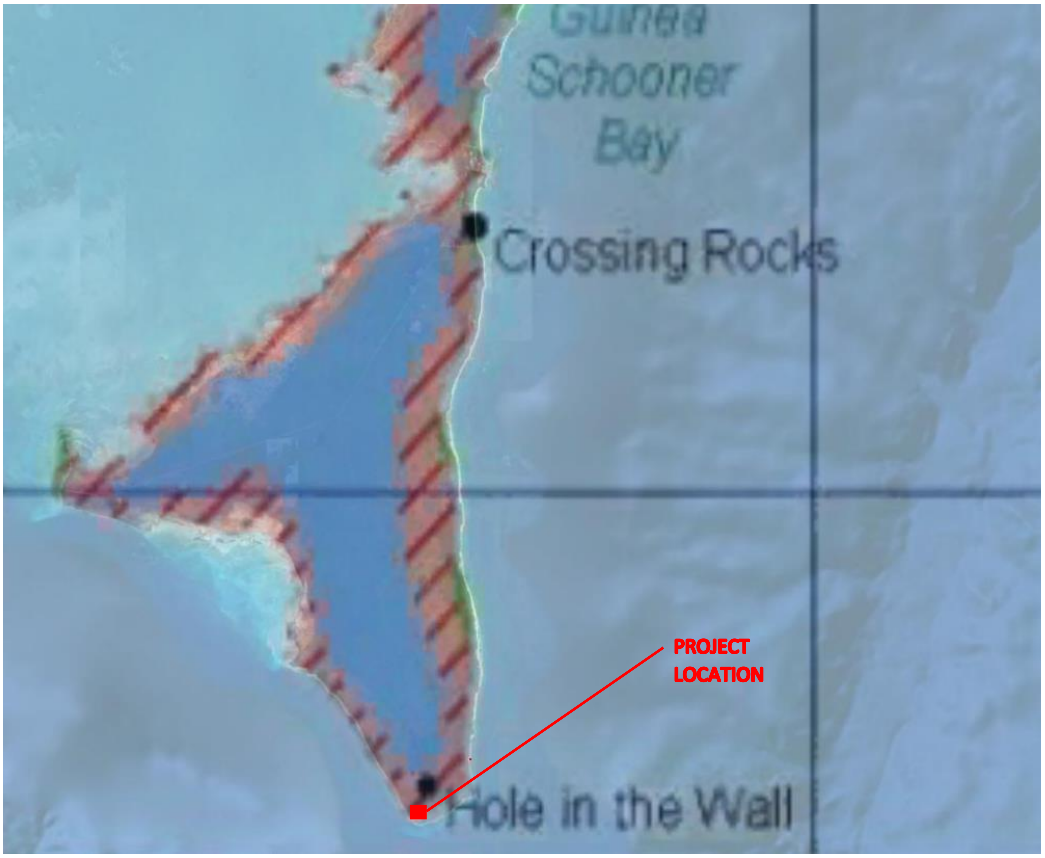


Figure 1. Location of Freshwater Lenses on Abaco Island (USACE, 2004) with Google Earth background

Caribbean Coastal Services Ltd.
P.O. Box CB-11524 Nassau, The Bahamas | Phone (242) 327-5348 | Fax (242) 327-4981
info@caribbeancoastal.com | www.caribbeancoastal.com

Physical Disturbance Through Excavation

Physical disturbance of freshwater lenses is caused by construction of marinas, and waterways which are connected to the sea. Through excavation, saltwater is introduced to an area, which may be predominantly occupied by freshwater. The saltwater intrusion has the potential to permanently damage the fresh water supply.

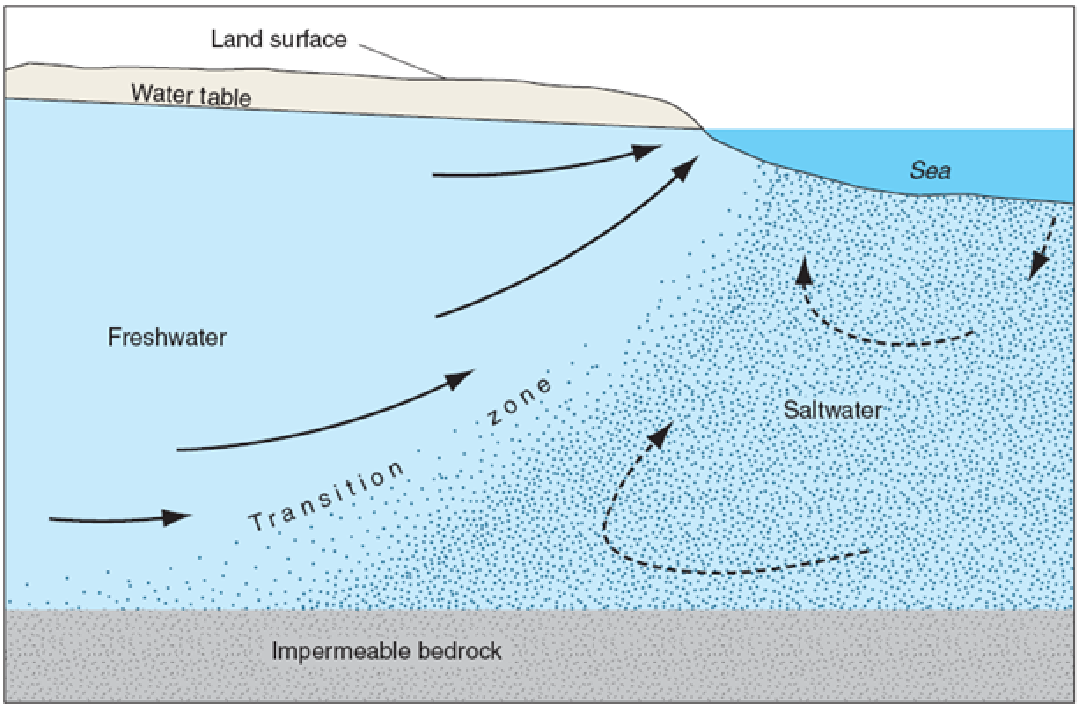


Figure 2. Saltwater Intrusion in a Coastal Aquifer (Barlow, 2003)

The most effective way to limit the extent of this physical disturbance is through the use of a physical, very-low permeable or completely impermeable barrier. The proposed marina has a depth -15ft MLLW for the main basin, and -10ft MLLW for the flushing channel. Due to these geometric parameters of the proposed marina, soil retention will be necessary.

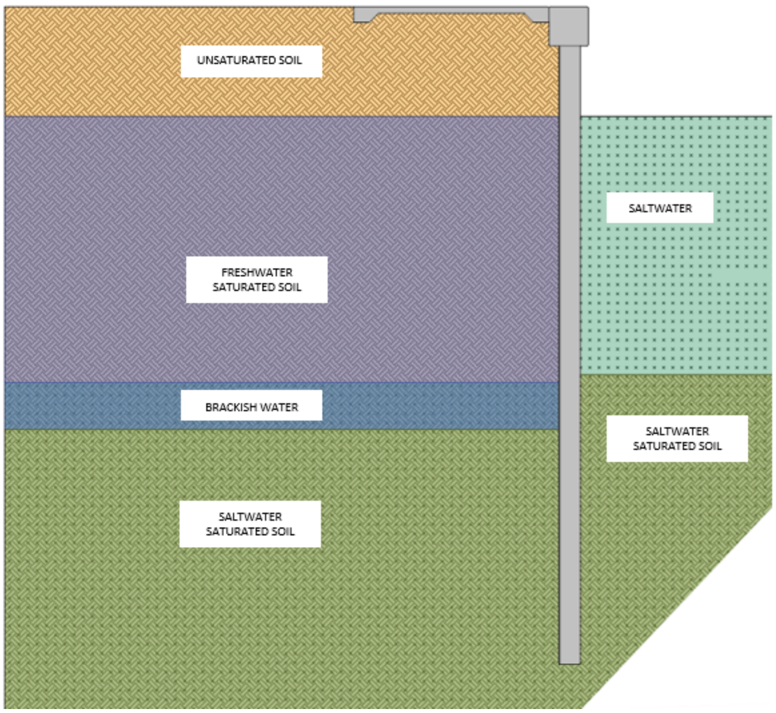
There are two acceptable ways to achieve the required soil retention. Vertical bulkhead and boulder revetment.

It is planned to use the vertical bulkhead method for the majority of the marina covering the entire perimeter of the marina. Vertical bulkhead wall requires less area of high-value land for the retention of the upland area. This land can therefore be used for high-end commercial, recreational and residential development, which is critical for the economic model of any development project.

The revetment boulder methodology will be used along the flushing channel.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524 Nassau, The Bahamas | Phone (242) 327-5348 | Fax (242) 327-4981
info@caribbeancoastal.com | www.caribbeancoastal.com

In the case of the vertical bulkhead, the structure itself will perform as an impermeable physical barrier to prevent saltwater intrusion inland. Figure 3 illustrates this concept. In the case of boulder revetment, it is possible to install a cutoff wall landward of the crest of the revetment to mitigate saltwater intrusion. Cut-off walls are used to limit groundwater seepage into an excavation. The wall is formed by the construction of a very low permeability barrier around the perimeter of the proposed excavation. The cut-off wall proposed is non-structural, comprised of a cement-bentonite mixture. Bentonite is an inert, natural clay material. This method provides a very cost effective, low impact approach to stop fresh groundwater flow and subsequent loss into the marina basin. Figure 4 illustrates this concept.



Caribbean Coastal Services Ltd.
P.O. Box CB-11524 Nassau, The Bahamas | Phone (242) 327-5348 | Fax (242) 327-4981
info@caribbeancoastal.com | www.caribbeancoastal.com

Figure 3. Conceptual Bulkhead Section

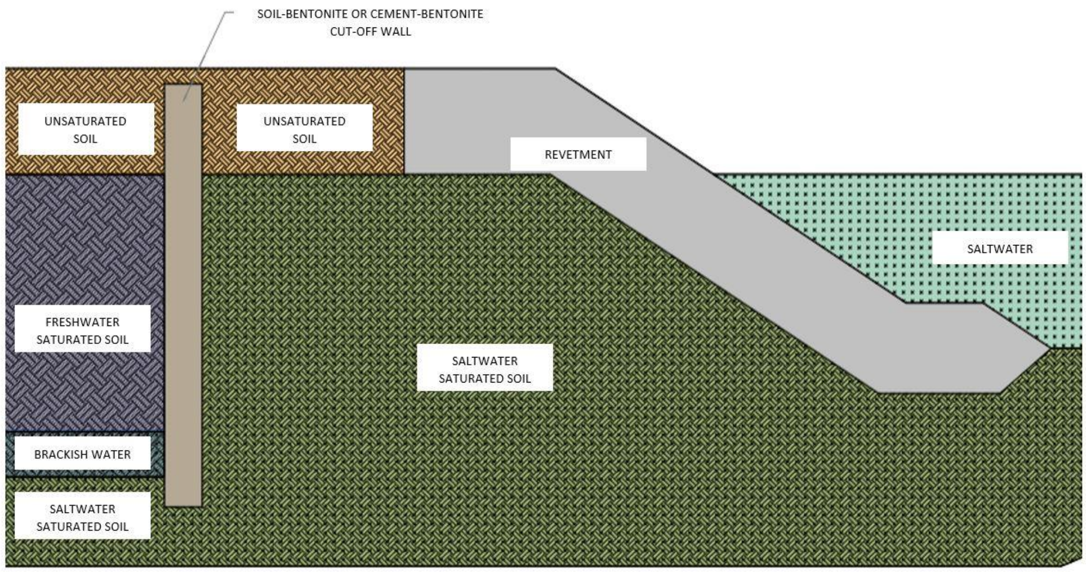


Figure 4. Conceptual Revetment Section

Construction phasing also plays a critical role in the mitigation of saltwater intrusion inland. Due to its size, the excavation of the marina basin can take considerable time to complete. It is vital that saltwater intrusion mitigation measures be but in place, temporarily, permanently, or a combination of both, prior to extensive excavation.

This approach also has potential to yield cost savings in the excavation of the marina basin and construction of the bulkhead. Excavation of a dry basin can be orders of magnitude more economical than seaborne dredging activities, and can yield a higher quality end result. This is also the case with construction in a dry basin. Preventing water intrusion into the basin makes it considerably easier and therefore more economical to keep dry, as water is prohibited from seeping through the cut faces. Therefore, preventing saltwater intrusion is both necessary from an environmental protection perspective and in the interest of the developer.

The proposed phasing strategy for the main basin is outlined below, with accompanying Figure 5.

1. Basin construction/excavation to commence at the landward-most extents.
2. As much bulkhead construction as possible will be conducted prior to excavation.
3. Predetermined segments of excavation will be enclosed in a perimeter of soil-bentonite or cement-bentonite slurry cut-off wall and bulkhead.
4. Dewatering will then be conducted as necessary, and in accordance with best management practices.
5. Bulkhead will be exposed and the outer face aesthetically finished as required.
6. The segment will then progress as required, repeating steps 1-5. Bentonite slurry from demolished cut-off walls should be recycled and re-used.
7. As the last phase of excavation, the entrance channel will then be excavated, allowing the basin to flood.

8. The walls of the entrance channel will then be constructed as necessary.

The flushing channel will be phased similarly, with works commencing at the landward most extent, and finalizing with the excavation opening the channel up to the sea.

Figure 5. Conceptual Basin Excavation Phasing (Red – Impermeable Bulkhead; Dashed Line – Temporary Cut-off Wall)

Caribbean Coastal Services Ltd.
P.O. Box CB-11524 Nassau, The Bahamas | Phone (242) 327-5348 | Fax (242) 327-4981
info@caribbeancoastal.com | www.caribbeancoastal.com

Saltwater Ponding as a Result of Storm Surge

Another threat to fresh water supplies is storm surge and the resultant saltwater ponding. Storm surge from tropical cyclones can flood upland areas. Without considerable run-off, standing seawater can seep through porous soil and infiltrate fresh groundwater reservoirs. The proposed inland marina potentially increases the exposure to storm surge. To address this, the deck elevation has been designed to be +7ft above MSL. Additionally, the hard surface immediately around the marina will encourage drainage and shedding of saltwater back into the marina once seawater surfaces have receded, and therefore reduce ponding.

The proposed perimeter road presents a good opportunity to organically integrate drainage separation into the overall design, with the intent of allowing clean rainwater to be drained through the permeable soil to replenish the possible freshwater lens below ground. The elevation of this roadway will be determined based on the potential water levels associated with the 100-year storm event. The land between the perimeter road and the marina will be designed to flow into a catchment system, filtered as per best management practices and returned to the sea. The area of land landward of the perimeter road will be allowed to flow through a filtration system and be drained through the soil. A cut-off wall is proposed to be installed at the road location to mitigate saltwater intrusion upland through groundwater flow. This cut-off wall can be substantially shallower in depth than the marina bulkhead, as the net drainage design will limit seawater ponding, and subsequently the seawater head at the perimeter road location.

This approach creates two clearly defined zones for the marina development site with respect to storm surge; Localized Storm Surge Management Zones and Storm Surge Exclusion Zones. Within the Local Storm Surge Management Zone, proposed designs will be required to manage extreme storm surge levels on a local level, i.e. seawalls, flood barriers, high finish floor elevations, etc. Within the Storm Surge Exclusion Zone, proposed designs should still consider the possibility of extreme flooding events, but can do so less extremely than in the Localized Storm Surge Management Zones.

Please note that all areas with potential to introduce pollutants to ground water, such as back of house areas, parking lots and roadways, will be specially and thoroughly designed. A preliminary conceptual sketch can be seen below in Figure 6.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524 Nassau, The Bahamas | Phone (242) 327-5348 | Fax (242) 327-4981
info@caribbeancoastal.com | www.caribbeancoastal.com

Figure 6. Storm Surge Management Plan (Blue Arrows – Net Rainwater drainage direction; Yellow Arrows – Net Seawater and Rainwater drainage direction; Orange – Perimeter Road; Purple – Special Drainage Design Areas, Hatched Area – Localized Storm Surge Management Zone)

Summary

Saltwater intrusion is being addressed on two fronts for the proposed South West Point Marina project. The first front is to limit saltwater intrusion by physical disturbance through the use of impermeable walls. These proposed walls will extend from the final ground elevation, deeper than the fresh water lens and provide a physical barrier to eliminate groundwater flow in both directions, saltwater further inland, and freshwater lost into the basin. The second front is to minimize saltwater intrusion by storm surge flooding and resultant seawater ponding through the site drainage and topography. Storm Surge Exclusion Zones will be created through well designed site drainage. These areas will be allowed to act as rainwater drainage fields, which can help with recharging the fresh water lens. The area of land which will be susceptible to storm surge will be designed to drain efficiently to reduce seawater ponding. Localized flood control measures will be taken on a case-by-case basis within this zone, and is not covered within this report.

Caribbean Coastal Services Ltd.
P.O. Box CB-11524 Nassau, The Bahamas | Phone (242) 327-5348 | Fax (242) 327-4981
info@caribbeancoastal.com | www.caribbeancoastal.com

APPENDIX I – Baseline Photo Log.

Photo Log

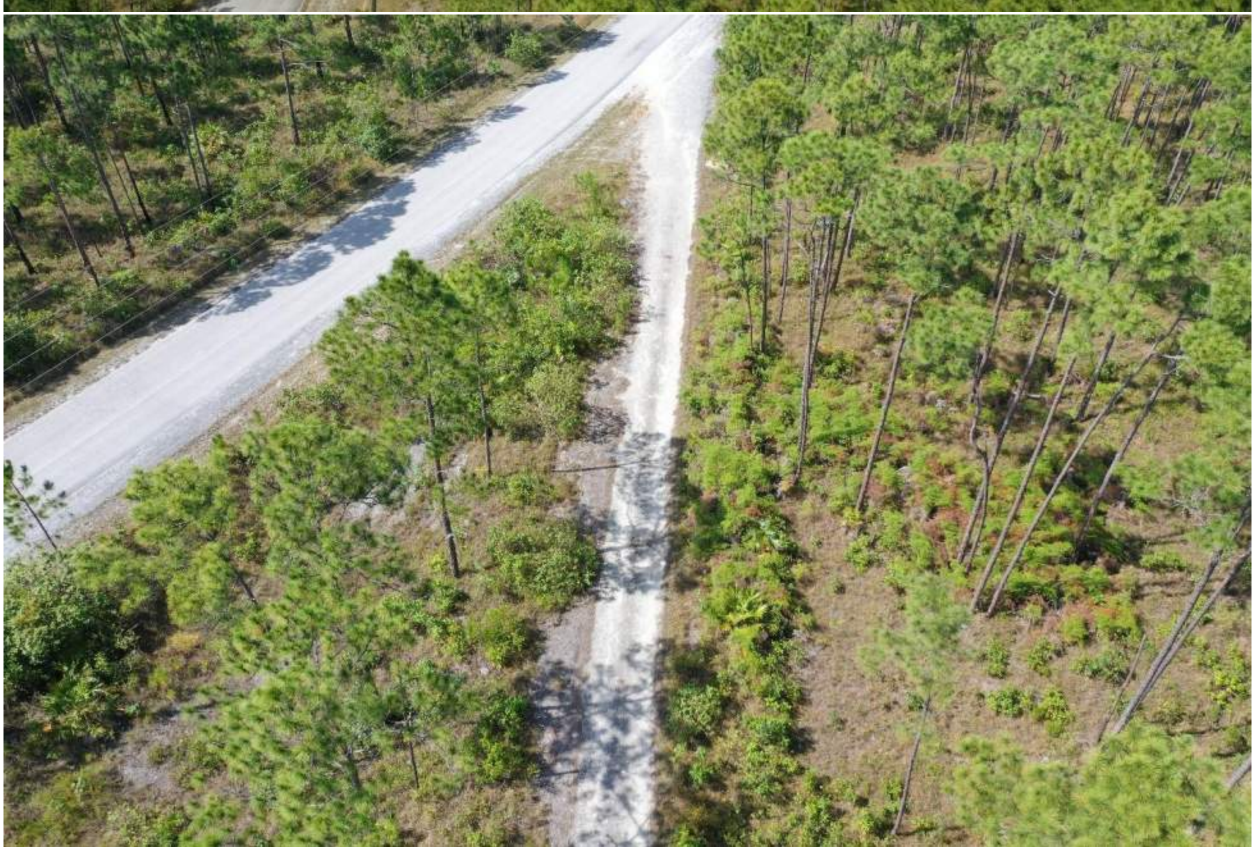
Lantern Head Site Photos


South West Point Site Photos


Hole in the Wall Lighthouse


Blue Sky
ENERGY
SOLAR BOOST 50


Entrance & Y Road









Offsite Alexandria Ruins