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Environmental Impact Assessment (EIA) for the Ki'ama Bahamas Project, by EcoIsland Elizabeth Limited Elizabeth Island, Great Exuma

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1.0 Executive Summary

This Environmental Impact Assessment (EIA) has as its prime objectives, the identification of the potential environmental impacts of the proposed development based on site investigations and make appropriate recommendations for minimizing or mitigating those impacts that would adversely affect the environment. In doing so, regard must be made to local legislation, international conventions, and best management practices. Guidelines for the drafting of the EIA was prepared in collaboration with the Department of Environmental Planning and Protection (DEPP), Ministry of the Environment and Natural Resources to facilitate the granting of the Environmental Clearance Certificate (CEC) for the commencement of project development activities.

Silent Resorts in partnership with ECOISLAND ELIZABETH LTD proposes to develop 36 acres of private land into a first-class fully sustainable, zero carbon, solar powered residence and yacht community termed **"Ki'ama Bahamas".** Resort guests and owners will have the ability to enjoy the world's most pristine and undiscovered destinations without negatively impacting the environment. The property is situated on the southern 1/3 of Elizabeth Island northwest of Guana Cay, southeast of Stocking Island, east of Crab Cay, and just three miles due east of bustling settlement of Georgetown on Gt. Exuma Island in the Bahamas. Its position within the Moriah Harbour Cay National Park (MHCNP) brings much attention to the project, as it relates to whether the activities scheduled are complementary to the Bahamas National Trust goals and objectives for the marine park, or adverse. (**Figure 2.1, Figure 2.2, and Figure 2.3**).

Key features of the development include:

- Investment of some BSD$73,000,000.00
- Modular 22 to 28 solar residences (shared and individual ownership) and solar powered, carbon negative home construction (use of hardwood timber and bamboo from sustainable resources)
- Beach Club (to include, restaurant/bar, and fitness centre)
- Protected Harbour (existing red mangrove lagoon), no dredging to the marine environment.
- Activities are complementary to the goals and objectives for the management of the Mariah Harbour Cay National Park (MHCNP), under the stewardship of the Bahamas National Trust (BNT)
- Solar-powered yachts and electric day boats
- Low impact in the development of only 18% of property (more than 80% retention of existing natural vegetation).
- Employment of 45 to 60 Bahamian construction workers for 3 to 4 years
- Employ permanently 80 to 85 Bahamians.
- Contribute 1% of each sale to Silent Catch (a local non-profit to support sustainable fishing, local culture, reef restoration and mangrove preservation.

The Back of House (BOH) operations to include an innovative R/O facility for potable water supply (low energy consumption water desalination), solid waste management system technology (zero-power, silent, odorless wastewater treatment system). Existing structures on property include a Club House, a two floating dock marina, a four-bedroom residence, and a backup diesel generator house.

1.2 Biological Baseline Studies

Assessments regarding botanical, avian and wildlife were undertaken to document baseline conditions and to analyze effectively the impacts associated with the proposed development.

The botanical survey identified four vegetative communities, namely, Coastal, Wetland, Interior Upland and Human Altered. Some ninety-four (94) vascular plants species were recorded, of which nineteen (19) are Protected Species. Additionally, two (2) invasive species were identified. The largest percentage of the vegetation is of the Dry broadleaved evergreen formation (DBEF), followed by Rocky Shoreline Formation (RS), then Sandy (Beach) Shoreline (SS). A Red Mangrove (coastal Lagoon wetland) Formation is dominant on the Western portion of the property (existing marina site), followed by three distinct Silver Buttonwood Formations at the eastern portion of property; and lastly the Human Altered Community (with existing building structures), in the West.

The Avian surveys identified the presence, abundance, and habitats of bird species. A total of nineteen (19) birds were recorded over two field surveys (June 2022 – summer session and September 2022 – winter session). Of the total birds recorded, one was endemic (Bahama woodstar). From the perspective of associated wildlife observed on property during field surveys, some ten (10) species of reptiles, insects and amphibians were recorded.

1.3 Environmental Impacts

Impacts were viewed in the context of how the physical environment will be impacted by both the infrastructural developments (roads, water supply, waste management infrastructure, solar powered systems) and resort development (residences, club house, pools, etc.) separately, utilizing qualitative criteria (i.e., nature, type, likelihood, scale, duration, reversibility, and significance) to assess impact.

The criterion of severity is used to measure the magnitude of impact an event has on the environment (i.e., terrestrial, fauna, wildlife, coastal, visual and aesthetics, hydrology, soils, and socio-economic, etc.). Severity in this circumstance was given ratings of 1 for low impact, 3 for medium impact and 5 for high impact.

The most direct impact associated with the Ki'ama Bahamas is that some 4.5 acres of natural vegetation (12.6%) will require some form of removal to accommodate the infrastructural development (new roads, solar systems, wastewater treatment system, R/O facility, etc.) and the footprint for the 28 solar residential home constructions (with associated facilities – club house, etc.). To mitigate this potential vegetation and avian, biodiversity habitat losses, the Developers will expand the size of existing nursery site on property, to accommodate the requirements for additional protected plants and native flowering plant species, subject to be planted within the landscaped areas of residences and other buildings. Further, notable protected species that fall within the footprint of the road reservation will be removed and relocated to the nursery site temporarily and replanted in human altered areas once development commences. Due to the relatively small size of the area, low density (1 residence per 1.28 acres of land) subject to vegetation removal, the qualitative criteria rating significance was negligible at best. Additionally, the magnitude of the severity of the overall average impact to the natural and physical environment was scaled as Low. Although noise levels and air quality impacts were rated as High, due to the anticipated construction activities, these will be temporal in nature once construction activities are completed. It is anticipated that the Protected Trees identified will be flagged for relocation where practicable and replaced at a ratio of 1 to 2 minimum, to follow the Forestry Unit standards and guidelines.

This direct removal of vegetation will be undertaken selectively, and no bulldozer equipment will be used. Residences and other buildings will be constructed on point load-piers to minimize impacts on natural vegetation. Native and endemic plant species will be used in the landscaped areas to offset any losses of protected trees. In this respect, particular attention will be given the Forestry (Declaration of Protected Trees) Order, 2021, in the selection of replacement trees for areas subject to landscaping.

The project in its current form and associated operational activities will have no negative impact on the surrounding marine environment (no marina dredging activities in wetlands, no sediments and runoff, existing R/O and R/O staging sites will be used during construction phases of project, no development on beach and sand dunes). Project development and operational activities are designed to be complementary to the goals and objectives of the management of the MHCNP by the Bahamas National Trust (BNT).

1.4 Socio-economic Impacts

Ki'ama Bahamas project construction timeline is anticipated to be up to five years. Total development costs are anticipated to be up to BSD$73,000,000. At full build, the project anticipates annually accommodating up to 36,000 guests spanning nearly 10,000 occupied room nights, or a projection of nearly 5,000 round trips to the Bahamas. The annual guest projection equates to roughly 100 average guests per day on both land and sea. Even if all guests were on land, this would equate to approximately three guests per acre. Despite the low-density nature of the project's occupancy, to mitigate potential impact to the environment during operations by utilizing electric golf carts, restriction of single-use plastics, significant wayfinding signage to ensure guests remain on gravel roads or established trails, and abundant waste and recycling receptacles reducing potential litter.

The project anticipates creating up to forty (40) jobs for Bahamians during construction and up to fifty (50) jobs for Bahamians during operations. The existing project design and engineering team is entirely Bahamian and spans multiple firms and disciplines. Given the advanced sustainability of the project, the development team anticipates significant training opportunities for Bahamian talent in the fields of modular construction, solar power, desalination, water purification, and electric boat operation and maintenance. These advancements are at the forefront of hospitality development trends and demand for these skills is only set to increase.

The project anticipates providing up to BSD$1.2MM in funding to Silent Catch – a non-profit organization focused on advancing sustainable fishing practices that is to be headquartered in the Bahamas. Phase – 1 startup funding of Silent Catch will be BSD$150,000.00. The organization will empower and train the local artisanal fishing community and local organizations to implement electric motors and solar charging thereby reducing the cost of local fishing and environmentally harmful externalities inherent to the practice. For example, this organization could work alongside the Bahamas National Trust team representing the Mariah Harbour Cay National Park (MHCNP) to benefit the local fishing fleet in the area.

Such a scale of investment is expected to contribute to the revitalization of the Exumas as one of the world's top touristic destinations as a place for vacation, but also a conduit for economic growth and development.

1.5 Key Mitigation Measures and Recommendations

Terrestrial:

- Relocate where practical, protected species identified within the footprint of the new road reservations and residences prior to construction activities.
- Expand existing nursey to accommodate propagation of native plant species for planting in landscape areas, and for temporal staging of removed protected trees for transplanting.
- Remove invasive species Australian pine (*Casuarina equisetifolia*) and Hawaiian sea lettuce *(Scaevola taccada)* from Human altered area and coastal areas.
- Plant native flowering plants protected species and endemic species in landscape areas.
- Maintain the existing vegetation (80% plus coverage) to function as wildlife corridors.

Avian:

- Maintain existing natural vegetation areas (more than 80% of total landscape) to encourage birds to continue to forage and roost, as these areas in situ adequately support avian life in area.
- The strategy for the loss of bird habitat will involve the replanting of indigenous native fruit bearing plants commonly used as food by birds (e.g., pigeon plum, gum – elemi, etc.), within landscaped areas of residences and other buildings.
- Protected trees identified and flagged for removal (upon receipt of a permit from the Forestry Unit, Ministry of the Environment and Natural Resources, under the Forestry Act, 2010), or to be maintained, where feasible.
- Train staff in the importance of birds.

Coastal:

- Regularly maintain existing beach stand and dune vegetation along beaches and rocky coastline.
- Remove invasive *Casuarina equisetifolia* (Australian pine) and *Scaevola taccada* species (Hawaiian sea lettuce).

Hydrology:

- R/O plant being proposed by Ki'ama Bahamas is innovative in dramatically minimizing the salinity of the brine by running on a lower recovery ratio. However, brine effluence will still be disposed of via deep well injection to best protect the surrounding marine environment.
- Implement fuel and chemical best management practices to ensure ground water resources are not negatively impacted.

Air Quality and Noise:

- Employ best practices in construction methods to minimize dust emissions which impairs air quality.
- Construction workers to wear PPE to include earplugs in areas with construction noise over 70dB.

Solid and Hazardous Waste:

- Solid waste generation is dramatically limited due to innovative construction methods including prefabricating deck, floor, wall, and roof panels of buildings in a remote prefabrication facility and shipping panels to the project site for final assembly. Most other waste will be vegetation removal from road and residence footprint.
- Vegetation removed will be reused/mulched for landscaping purposes.
- Solid and hazardous waste will be placed in containers and properly disposed of (removed to the mainland of Exuma Landfill Site) in accordance with Department of Environmental Health Services

(DEHS) regulations and standards.

Fire and Hurricane Preparedness:

- A Fire Control and Prevention Plan, to be prepared detailing steps to prevent, contain and control fires during construction and operation the residential resort.
- All residences and associated buildings will follow fire requirements of the Bahamas Building Code.
- A Hurricane Preparedness and Contingency Plan will be developed in the event the island is impacted by a storm or hurricane.

Occupational Health and Safety:

- Workers to be provided appropriate Protective Personal Equipment (PPE).
- All workers to be trained in handling of equipment, before starting work on property.
- Regular enforcement of occupational health and safety protocols on a weekly basis.
- Workers shall adhere to any currently mandated COVID-19 protocols.

Public Consultation and Involvement

The project developers held numerous formal meetings with the Exuma District Council, who provide written support (1st December 2021) to the project **(Appendix – C).** Meetings with the Exuma Ministry of Tourism officials were also supportive of the project and its associated benefits from a tourism perspective and its potential contribution to the economic growth and development for the Exumas. A presentation of the project components was made to the Bahamas National Trust (BNT) Executives on August 8th, 2022, and who are supportive of the project. (See Letter of Support at **Appendix – E**). The DEPP will facilitate a Public Consultative process with the EIA for public review and commentary at a date to be determined.

Environmental Management Plan

The purpose of the Environment Management Plan (EMP) is to outline the mitigation measures and monitoring necessary to reduce or eliminate the identified negative impacts associated with the project activities (both developmental and operational). The Plan will be developed once a No Objection to the EIA is received from the DEPP.

Conclusion:

The Ki'ama Bahama project site, situated within an ecologically unique Mariah Harbour Cay National Park (MHCNP); with its pristine natural state (dominant interior upland dry evergreen broadleaved formation and Red Mangrove lagoon estuary) offers an excellent opportunity for sustainable development of a low to zero carbon, low density residential and solar yacht resort community. The project with its investment of some BSD$73,000,000.00 is expected to generate much need economic stimulus for the Exumas (construction jobs, permanent jobs, and entrepreneurial activities). The project benefits far out way any limited unavoidable negative environmental impact identified.

Employment of best management practices, having regard to national environmental legislation and International Conventions and standards will ensure the project is developed and becomes operational in a sustainable manner. The developers have indicated their intention to, and based on the Masterplan, ensure that the project lives up to its expectations (low carbon, low density solar residences and solar yachts, solar energy, low impact, innovation in R/O and wastewater management) on the natural environment. Utilizing

the mitigation measures will guarantee that the negative impacts identified are reduced/or are mitigated and is sustained.

2.0. Description of Proposed Project and Scope

2.1. Description of Proposed Project

2.1.1. Conceptual Master Plan:

EcoIsland Elizabeth Limited intends to develop some 36 acres (southern portion of Elizabeth Island) ***(Figures 2.1, Figure 2.2 and Figure 2.3)***, into the world's first integrated land/sea, ultra-sustainable, exclusive, secure 100% solar-powered, luxury and adventure resort and residences (Ki'ama Bahamas). EcoIsland Elizabeth Ltd relationship with Silent-Yachts, the world's first 100% solar powered yachts, with ultra-low impact zero-carbon building and infrastructure systems, will allow guests and owners the ability to enjoy the world's most pristine and undiscovered destinations without negatively impacting the environment. The mission is to provide a sustainable resort community where guests can ***'Live Fully', 'Tread Lightly'*** and ***'Stay Silently'.***

Figure 2.1: *Map of the Commonwealth of the Bahamas, with Gt. Exuma Island as the Inset at top Right corner (Source: Google Maps 2022).*

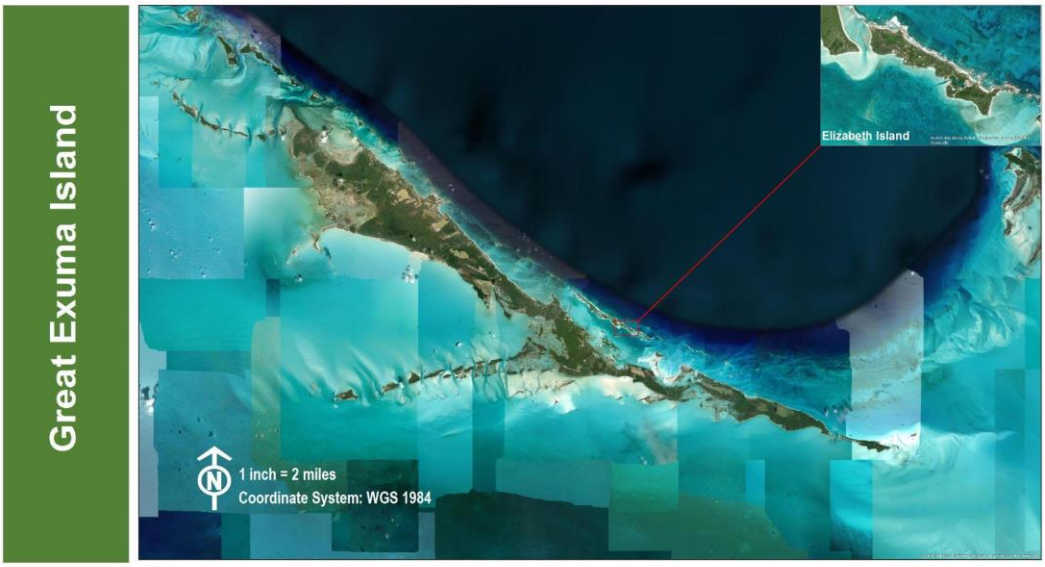


Figure 2.2: *Showing Gt. Exuma Island, with location of Elizabeth Island (project site location), inset at top Right Corner (Source: Google Maps, 2022)*

Figure 2.3: *Map depicting project site boundaries (south-eastern portion 1/3 of Elizabeth Island) Gt. Exuma Island, The Bahamas (Source: Google Maps, 2022).*

The conceptual Master Plan for Ki'ama Bahamas (**Appendix – A)** provides for the development of 28 detached solar residences, ranging from three to six bedrooms, **(Figures 2.4)** providing a low unit density of one residence per 1.28 acres. Other features include the use of the existing marina and docks, boat house, and four-bedroom residence **(Figure – 2.5).**

Figure 2.4*: Master Plan depicting proposed layout of solar residences, and associated facilities and amenit*ies (Source: Silent Resorts Masterplan 2022)

Figure 2.5*: Photo showing the existing structures on project site (Includes club house, 4-bedroom residence and two floating docks with an X Shore electric boat at berth).*

2.1.2 Business Plan

Some salient points of the Business model as extracted from the Business Plan **(Appendix – A)** include:

- Sixteen club residences and eight solar yachts, to be entirely investor owned upon full sell-out of ownership shares.
- Investor/owners to enjoy a minimum of 24 nights of residence occupancy per year, plus twelve days on the Silent Yachts.
- Once fully built out, residences can provide more than 36,000 room/yacht cabin nights per year, for high-net-worth individuals, either investor/owners or rental guests.
- Up to twelve additional whole ownership Ki'ama Bahamas estate homes with shared yachts for sale.
- Estate homeowners can make their residences available for rent, potentially 24,000 room/yacht cabin nights.
- Phasing construction and yacht and boat acquisition throughout the five-year sell-out period based on sales velocity.

2.1.3 Sustainable Innovations:

Some key features include the following sustainable innovations in buildings systems and methodologies:

- 'Carbon Negative Construction' using sustainably harvested hardwood and heavy timber construction.
- 'Silent Island Grid' – integrated high output solar electric systems.
- Hydrogen energy storage system – patented safe and clean (i.e., the conversion of solar powered energy into hydrogen, and stored in a low-pressure system, thus eliminating use of fossil fuel powered backup generators); thus, generating up to 40kWh of backup power, if needed.
- High efficiency water purification and solar-powered processing systems and pumps
- Non-invasive water storage 'bladders'
- Zero-power, silent, odorless wastewater treatment system.
- Modular, prefabricated structures.
- Recycled shipping containers remanufactured into luxury swimming pools means no excavation or poured concrete required. Pools are placed on piers to minimize environmental impact. Pre-engineered, prefabricated modular residences enable almost zero construction waste on site.
- Minimal use of concrete.
- All natural materials (fabrics, bamboo, timber, reclaimed wood) for structures and interiors)

***Figure 2.6**: Layout of proposed solar residences on the beach sand dune formation (Source: Silent Resorts Masterplan 2022)*

Figure 2.7: *Layout of Beach Club with swimming pool, situated southeastern portion of project site. (Source: Silent Resorts Masterplan 2022)*

Figure 2. 8: *North facing view of Beach Club with swimming pools in relation to solar residences (Source: Silent Masterplan 2022).*

Figure 2. 9: *Aerial view of Beach House, solar residences, and Silent Yacht (Silent Resort Masterplan 2022).*

2.1.4 Sustainable Residence, Beach Club, Spa and Restaurant Design, Solar Construction, and Infrastructure:

Key features ***(Figures 2.10 through Figures 2.16***) include ***(Appendix – A)***:

- Residence designs linear to allow construction to follow the natural contours of the sloping terrain.
- Residences will be one-storied with high ceilings (10 to 12ft) enhancing ventilation and light. In most locations for residences there is exposed rock, or rock very shallow under topsoil. In this case there will be minimal excavation. Exact locations of homes can be shifted slightly to optimize this condition. Pier bases will be maximum of 36 inches square and poured on the rock and pinned with 5/8-inch rebar. The number of piers per residence will be engineered to a minimum, and in all cases the residence structure will be well above the undisturbed natural ground level.
- Island-inspired tropical designs from Bali and the Caribbean.
- Use of sustainable harvest tropical hardwood timber.
- Use of highest quality natural fibres, bamboo, and timber, with light impact on the environment, engineered to withstand the tropical environment.
- Solid wood cabinetry, high-end appliances.
- Utilities and storage in twenty-foot and forty-foot containers typically located beneath the residences and not visible; to provide secure storage and shelter during storm events.
- Each residence will have a 20-foot container located under the structure and fully screened from view to hold all batteries and inverter equipment. In addition, there will be a central system housed at the existing boathouse for backup power, and to fully power the existing 2 docks with solar energy.
- Resort pools will be made of recycled shipping containers, completely self-contained with all pumps, filtration, and electronics, set on piers (like the residences) and integrated into topology, with no excavation of fill. The pools and other overhanging structures will require support beams, The beams will provide full support for the pools, which will sit on six (6) piers. No part of the pool or support structure will touch the ground.

- Structural timber frame designed to withstand at CAT 4 hurricane, naturally insect and fire resistant.
- Near net zero construction waste.
- Solar panels located on flat roof areas and shielded from view ***(Figure 2.17).***
- Use of warm white colour LED lighting, and exterior lighting will be "Dark Sky" compliant.

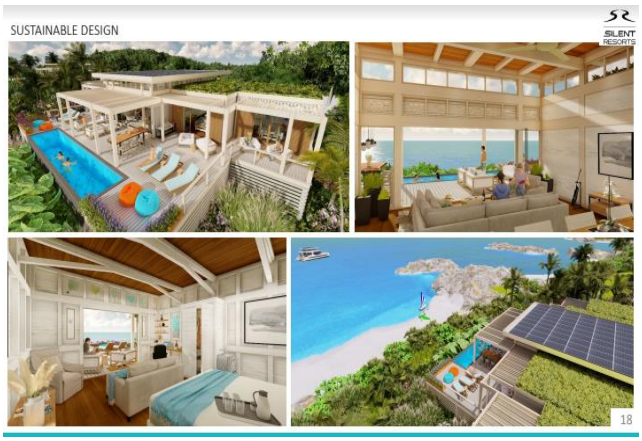


Figure 2.10 and Figure 2.11*: Sustainable design concept of residences (depicting building, room, and pool layout) (Source: Silent Resort Masterplan 2022)*

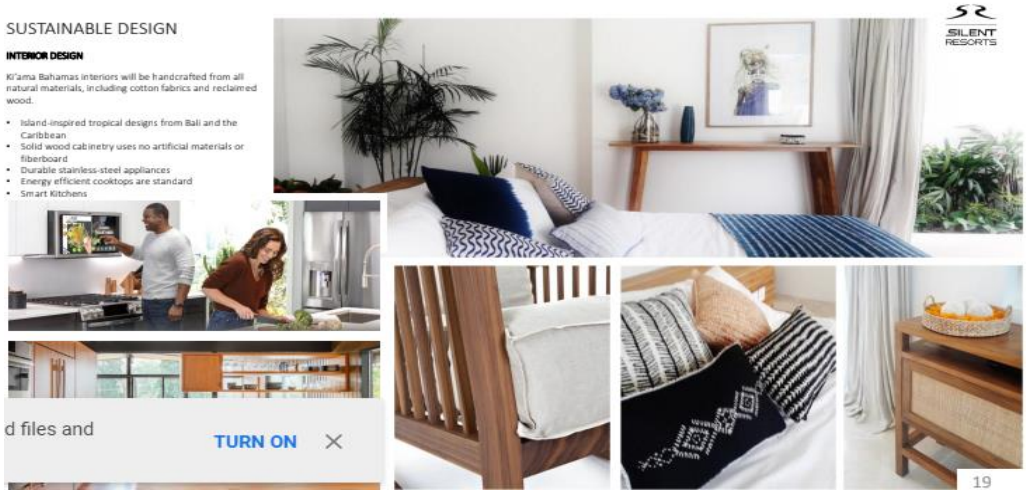


Figure 2.12*: Interior design features associated with the solar residences (Silent Resort Masterplan 2022)*

***Figure 2.13 and Figure 2.14**: Depicting sustainable construction and infrastructure techniques used in the residences, beach club and other amenities (Source: Silent Resort Masterplan 2022)*

***Figure 2.15**: Sustainable construction and infrastructure for amenities such as swimming pools (traditional vs. modular pool installation) (Source: Silent Resort Masterplan 2022)*

***Figure 2.16**: Depicting the use of integrated high output solar electric system and Hydrogen back-up system for various facilities and yachts (Source: Silent Resort Masterplan 2022).*

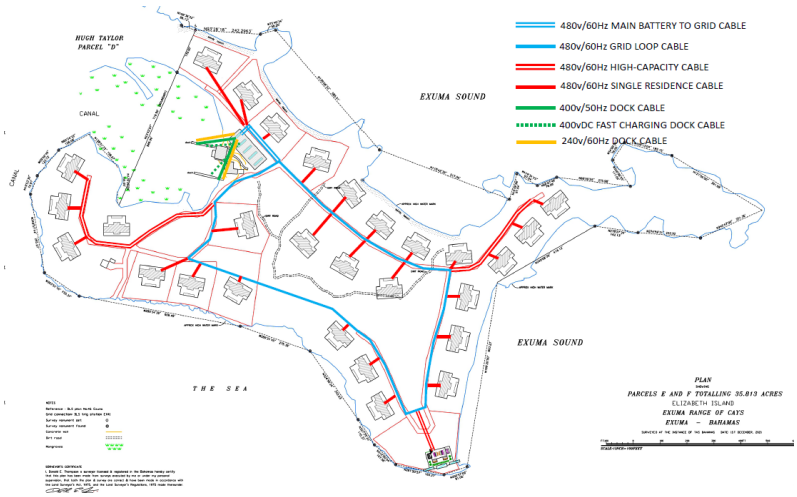


***Figure 2.16a**: Layout of solar power distribution*

2.1.5 Water System

A full water resource assessment determined no significant freshwater aquifers exist on the island. As such an Efficient Reverse Osmosis (R/O) of Seawater producing some 44.000 liters/day possible to upgrade to 88.000 liters/day reverse osmosis system (on-shore/land-based desalination and purification - 22m3/day nominal, 24 hours - 5812 gallons) is proposed for installation. The layout for the associated infrastructure is shown at ***Figures 2.17 and Figure 2.18a***. A maximum of 5 units is proposed to be installed in a central location.

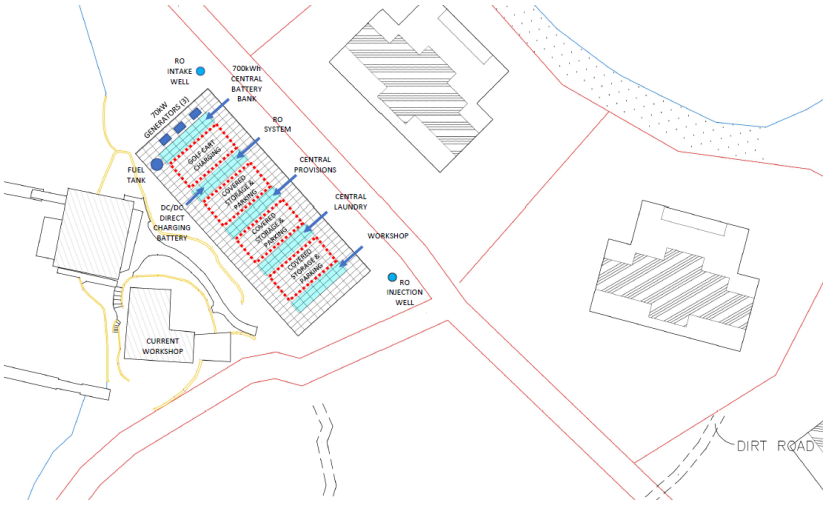


***Figure 2.17**: Location of R/O intake and injection/discharge wells.*

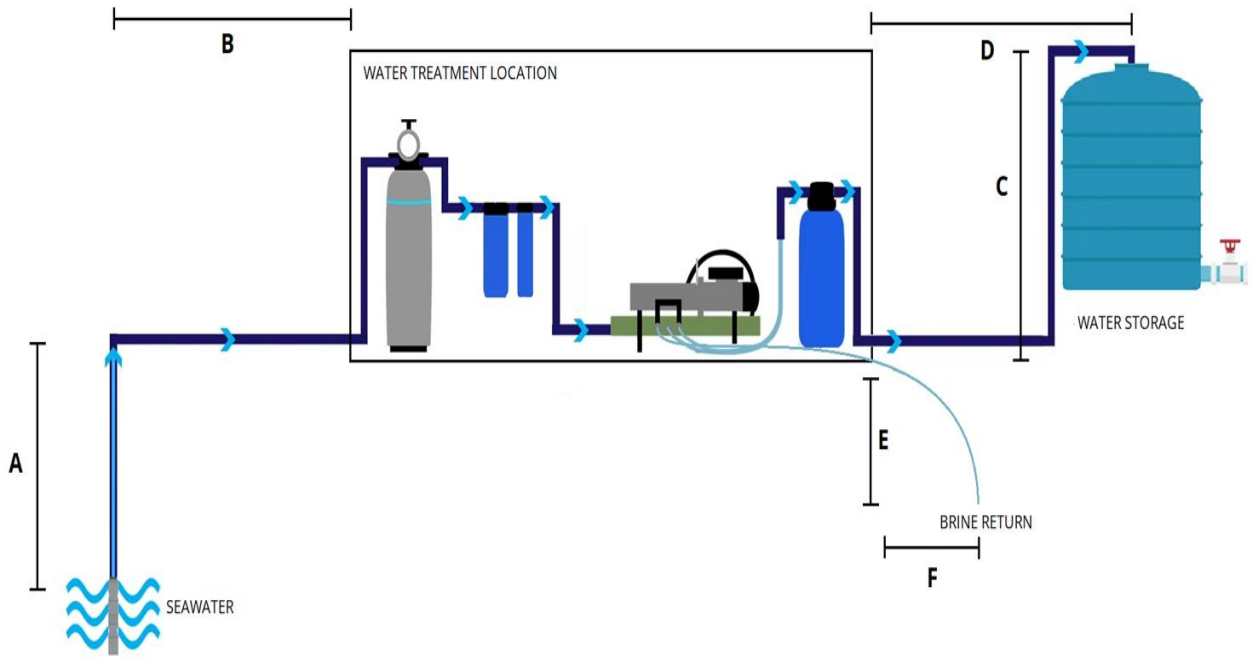


***Figure 2. 18a**: Proposed Design of R/O treatment system (Silent Resort Masterplan 2022)*

The unit operates with high energy efficiency and provides ease of operation. It includes product water salinity measurement, automatic membrane pressure control, automatic shut-down & fresh flush and GSM based monitoring with timer set operation ***(Table - 2.0)***. The desalination unit only requires 2,7 kWh/m³, while traditional desalination units for these relatively small water production capacities use 10 kWh/m³. The key features are highlighted at ***Figure 2.18a.*** Based on Water and Sewerage Corporation (WSC) Regulations, the Brine effluent disposal will be via deep well injection at 350 feet for Abstraction Well Schematics and Brine disposal Well Depth schematics, ***(Figures 2.18 b & c)*** respectively **(Appendix – D).**

Figure 2.18b Feedwater Abstraction Well Schematics design

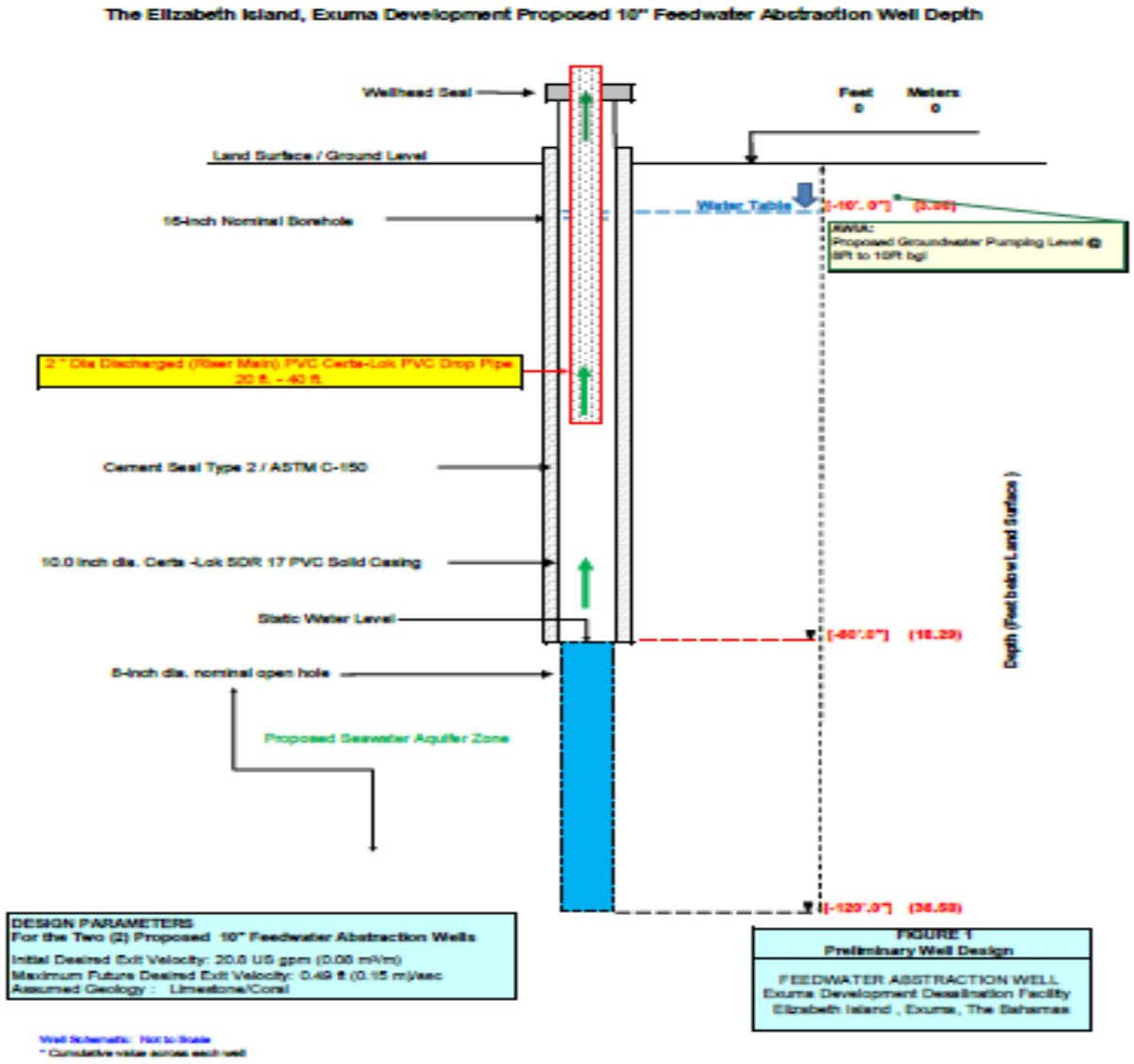


Figure 2.18c. Brine Disposal (Only) Well Depth Schematics

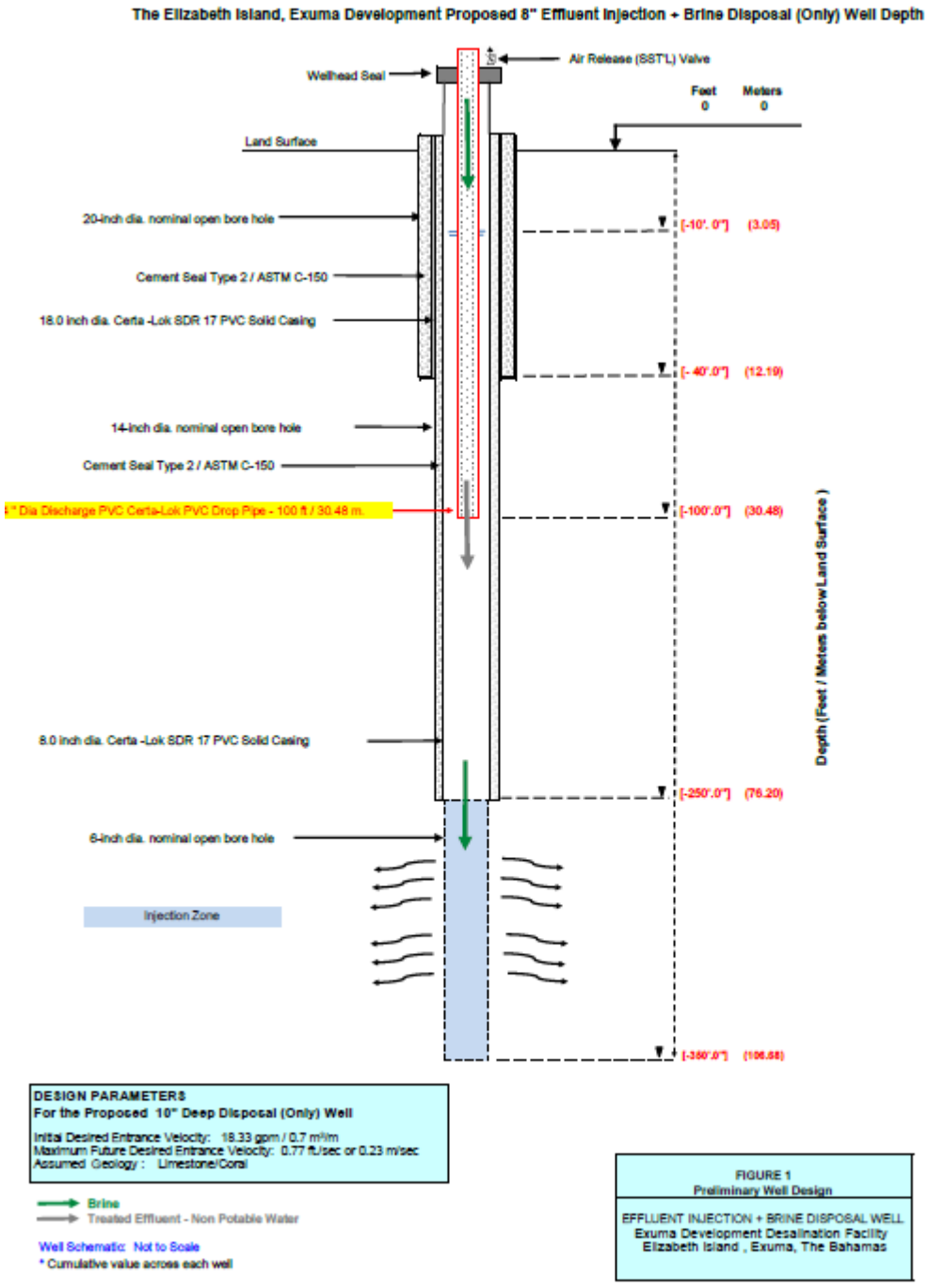


Table - 2.0 Water Treatments

Treatment	Description
Intake pump	Submersible pump with anodes and flow sleeve, to be confirmed
Pre-Treatment	Multi-media filter with multilayer glass media, manual backwash Cartridge filtration of 10-micron absolute & 5-micron nominal
Efficient water maker	2x22 m³/day seawater reverse osmosis unit incl. energy recovery Remote monitoring & control Float switch for automated start/shutdown
Fresh Flush	Automatic flush pump to rinse membranes during standby 20'' cartridge filter
Skid – Built	Containerized 20-ft pre-mounted water treatment system incl. skids, standard modifications & insulation with 45 mm rockwool for sound attenuation.

Sustainability Advantages over traditional R/O plants:

- Minimizing the salinity of the brine by running on a lower recovery ratio
- Minimize the local impact by small-scale decentralized projects
- No chemicals are involved by avoiding the use of anti-scalants & CIP
- 70% less energy is required due to energy recovery.
- Solar energy to avoid the use of fossil fuels

***Figure 2.19**: Use of highly efficiency water purification system for supply of potable water to residences (Source: Silent Resort Masterplan 2022).*

All processing systems and pumps will be powered by solar electric. For the purposes of water storage each building will have its own bladder or tank situated under the covered deck of each building. These bladder

tanks are more efficient and less destructive than traditional subsurface concrete water tanks, and have a lifespan of 30 plus years, and are recyclable.

2.1.6 Zero Power Advanced Wastewater Treatment System

The system functions as a two-stage treatment plant (raw sewage enters primary tank provide pre-separation and initial breakdown of organic solids – Wastewater then passes through an effluent filter before discharge). Totally silent and odorless, with minimum maintenance, it allows for 100% recycling of wastewater for irrigation of landscapes ***(Figure 2.20).*** The system will be located under the raised structures, which means no excavations or filling in of the landscape; and no in-ground septic systems that can leak and pollute the groundwater resources. Like the solar electric and water purification systems, the wastewater treatment is modular and fully redundant, and is scalable to provide service for the entire resort, once fully constructed. The project's wastewater system is considered a system with the highest treatment efficiency of any sewerage treatment, with the smallest footprint.

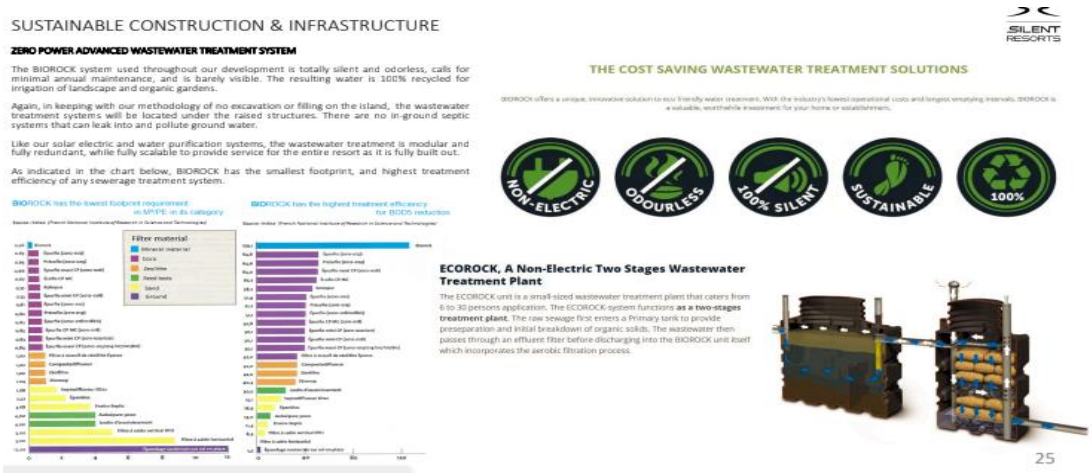
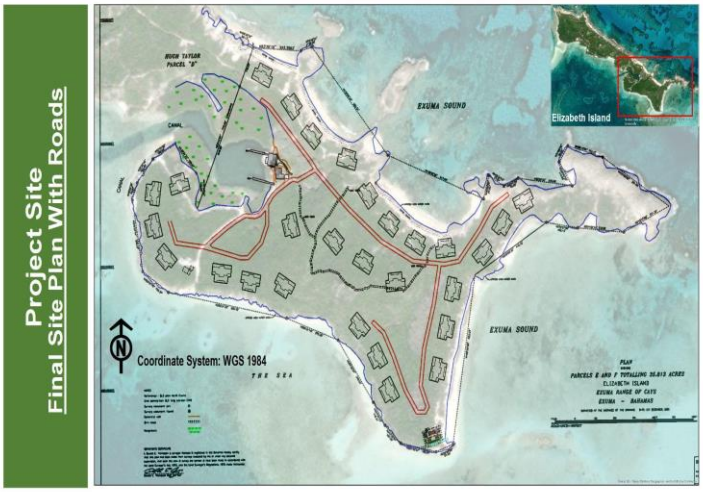


Figure 2.20*: Use of zero powered advanced wastewater treatment system) (Source: Silent Resort Masterplan 2022).*

2.1.7 Environmental Implications

Due to the sensitive topology of the location, with its highest elevation (close to 70 ft), with coastal dunes and pristine natural vegetation and associated fauna, all residences will be constructed on load-piers, raised above the existing topology, thus allowing minimal negative impact to the existing environment. Any new access roads will be constructed with a maximum width of 12 feet or less, using local permeable materials ***(Figure 2.21 and Figure 2.22***).

There will be no excavation or filling of any areas, with all natural drainage corridors and aquifer recharge areas left undisturbed. No construction activities will occur on coastal, beach or mangrove zones. This strategy and construction methods will result in a very high ratio of undeveloped land areas of over 80% ***(Table 2.1).***



Figures 2.21 and Figure 2.22*: Photo showing existing gravel road alignment and map showing proposed new road alignment to accommodate project infrastructure and solar residences construction.*

Figure 2.23*: Land Use requirements and Masterplan – implications for the natural environment) (Source: Silent Resorts Masterplan 2022).*

Table 2.1: Areas of undeveloped vs developed land for project site (to be read in concert with Figure 2.5)

Area Use	Acres	%
Undeveloped land Area		
• Permanent Nature Reserve	8.0	22.3%
• Buttonwood Grove Preserve	1.0	2.8%
• Permanent Mangrove & Marina Basin	2.0	5.6%
• Undisturbed Areas & Existing Trials		
• Organic Gardens	17.0	47.5%
	1.3	3.6%

TOTALS:	**29.3**	**81.8%**
Developed Land Area ● landscaped/cleared Areas ● New Roads ● New Construction Land Coverage **TOTALS:**	 2.0 1.0 3.5 **6.5**	 5.6% 2.8% 9.8% **18.2%**
PROJECT TOTALS:	**35.8**	**100.0%**

Positive impacts on the environment to include:

- The 4,000 sq ft structural timber solar residences will store over 264,000 pounds (132 tons) of carbon each (equivalent to a release of 46,200 litres of diesel).
- Upon completion Ki'ama Bahamas can sequester over 10,000,000 pounds of carbon, the equivalent of 1,750,000 litres of diesel.

2.1.8 Solar Powered Yachts

EcoIsland Elizabeth Limited (Ki'ama Bahamas project) will be the first in the world to have an international 100% solar-electric Tri-Deck Superyachts for use in the Bahamas. Owners and guests will be able to explore the Bahamian waters, utilizing eight (8) to ten (10) Tri-Deck Solar Silent Yachts (60 - 80ft) for charter use in the Bahamas, in silence and luxury and without the use of fossil fuel. **(Figure 2.24 & Figure 2.25**) Guests will enjoy the world's pristine and undiscovered destinations without negatively impacting the environment. **Figure 2.26** depicts a typical X Shore 100% silent Electric vessel. The maximum number of yachts that will be in the marina at one time will be 4 to 5. The other yachts will be on charter. In most cases there will be 3 to 4 yachts on average on the 2 existing 80-foot floating docks in the marina.

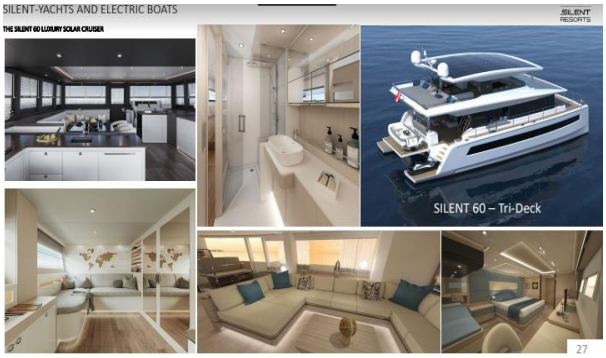


Table 2.24 and Figure 2.25*: Silent 60 Tri-Deck and Silent 80 Tri-Deck yachts to be acquired by Ki'ama Bahamas for use by residences and guest (Source: Silent Resort Masterplan 2022).*

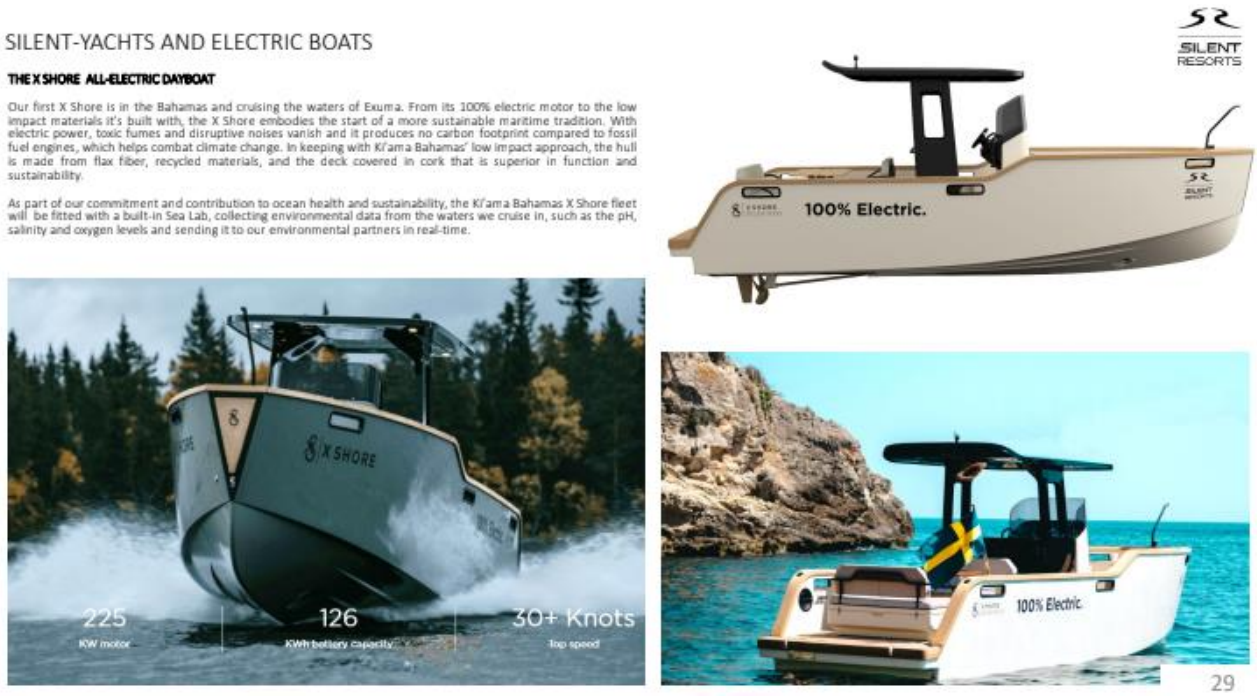


Figure 2.26: *Showing X Shore 100% Electric Day Boats for use by residences and guest (Source: Silent Resort Masterplan 2022).*

All residences, existing marina, island infrastructure, will be powered by the same technology used on the Silent yachts fleet, and will all be connected to the Silent Island grid. Yachts will share power with the island and vice versa.

2.1.9 Phased Approach to complete residence Build Out and Yacht Acquisitions

All capital for Phase- I of development has been raised and secured and allowed the Project to execute key initiatives:

- Purchase of the island
- Infrastructure improvements
- Construction of the Beach Club and three residences
- Acquisition of the first Silent Yacht, already on order.

The anticipated Development Timeline for the project build out is summarized in ***Table 2.2*** below, with Projected 3 to 5-year build-out of 22 to 28 residences. Start date is anticipated in January 2023 and completion in November 2026.

Table 2.2: Anticipated Development Timeline

YEAR	COMPONENT ACTIVITY
2023	• Initial Solar, Water Desalination, Wastewater Treatment, and other Infrastructure completed • Existing Boat House & Cistern House Renovation to Create New Welcome Center & Staff House • Completion of Beach Club, Restaurant, Pools, and Initial Back-of-House • Completion of Club Residences 1 and 2 • Arrival of First Guests • Yachts 1 & 2 Acquired
2024	• Completion of Spa & Fitness Center • Completion of Club Residences 3, 4, 5, 6, 7 & 8 • Yacht 3 & 4 Acquired • Expansion of Solar System as Needed to Accommodate Additional Structures
2025	• Completion of Club Residences 9, 10, 11, 12, 13 & 14 • Completion of Estate Homes 6, 7, 8 & 9 • Yachts 5 & 6 Acquired • Expansion of Solar System as Needed to Accommodate Additional Structures
2026	• Completion of Club Residences 15 & 16 • Completion of Estate Homes 10, 11 & 12 • Yachts 7 & 8 Acquired • Expansion of Solar System as Needed to Accommodate Additional Structures

2.1.10 A FRESH APPROACH TO SUPPORT THE WORLD'S OCEANS

Ki'ama Bahamas intends to contribute 1% of all sales revenues, plus an annual on-going contribution from resort operations to a newly formed local division for Silent Catch. The Silent Catch mission is to deliver innovative, scalable solutions with environmental, economic, and equitable impact in the world's fishing communities. The Project's five-year sales projections would contribute over $1,500,000.00 plus additional donations and funding from partners and international organizations.

Silent Catch will establish a dockside facility at George Town, designed to fund the employment of the local team to manage and support the services as highlighted below, and provide free solar powered charging of the electrified fleet and refrigeration to keep the catch fresh.

- **"Mangrove Preservation & Education** – Protect the mangroves of the Exumas, educate the public and developers of the importance of protecting existing mangroves and the benefits of enhancing their presence;"

- **"Reef Protection and Restoration** – Partner with organizations and government agencies dedicated to preserving Bahamas endangered reefs and fund the creation of new artificial reefs using the latest technology and techniques. To this end, Ki'ama Bahamas has funded a study of the reef, seabed, and water conditions around Elizabeth Island **(Appendix – B).**
- "**Local Fishing Fleet Electrification** – Silent Catch technology and infrastructure will support the electrification of the local and artisanal fishing fleet, for healthier, more sustainable, and more profitable fishing, and create a global example of excellence;"
- **"Sport Fly Fishing Fleet Electrification** – Silent Catch, in collaboration with international Fly-Fishing Associations and Clubs, will help fund and implement the use of all-electric boats for sport fly-fishing, to protect the pristine waters of the Bahamas;"
- **"Silent Caught Premium Fish Marketing** – Silent Catch will encourage the local fishing community and entrepreneurs to develop a local and international market for fish caught and processed using the all-electric artisanal fleet, and create a premium brand, "Silent Caught Bahamas" that will provide enhanced income for the local community".

2.2 Description of Alternatives

2.2.1 The "No-action" Alternative

With these type developments, there is always the "No Action" Alternative. In these circumstances, the "No Action" alternative would keep Elizabeth Island (southern 1/3 of Island) in the same undeveloped position currently, unless sold to another buyer. With no new constructions under consideration, this would eliminate the intended purpose for purchasing the property. Any economic activity, employment opportunities on the Island and mainland Georgetown, Exuma gained through construction jobs, permanent jobs, investment injections, increased tourism opportunities would be missed and lost.

2.2.2 Proposed Alternative

The site is privately owned, with minimal development footprint.

The site selection was based on:

- the land was available for purchase.
- the size of the project and its low negative environmental impact on the naturally pristine environment, made it ideal to accommodate the project components.
- The area is ideally located just 15 minutes by boat from the mainland Settlement of Georgetown, Exuma, and makes it attractive for private homeownership, and yacht visitation.

3.0 Agency Consultation and Public Involvement

3.1 Agency consultation activities and results

- Meeting and site visit to Elizabeth Island held with DEPP in June 2022 to observe and note existing site conditions and agree the Terms of Reference (TOR) for the EIA.
- Meetings held with the Local Council in George Town Exuma, who endorsed the project on 1st December 2021 (**Appendix – C).**
- Developer held meetings with the Ministry of Tourism Sub office officials in Georgetown Exuma, who fully endorsed the project.
- Virtual and in person meeting between the developers and the Bahamas National Trust dated Monday 8th August 2022. Developers provided an overview summary of the key components of the project and its zero-carbon, and socio-economic benefits on the environment. The Executives at BNT were incredibly supportive, excited, and overwhelming supportive of the project and look forward to reviewing the full EIA. A formal letter of support from the BNT is attached at **Appendix – E.**

4.0 Baseline Description of Affected Environment

4.1. Geographical Location and Boundaries

Elizabeth Island is located just northwest of Guana Cay, southeast of Stocking Island, east of Crab Cay, and just three miles east of the bustling settlement of Georgetown in the Exuma Island chain of the Bahamas ***(Figure - 4.1)***. The island is in a northwest to southeast orientation, lying along the eastern edge of the shallow Great Bahama Bank, with the windward side of the island facing Exuma Sound and the leeward side facing Elizabeth Harbour.

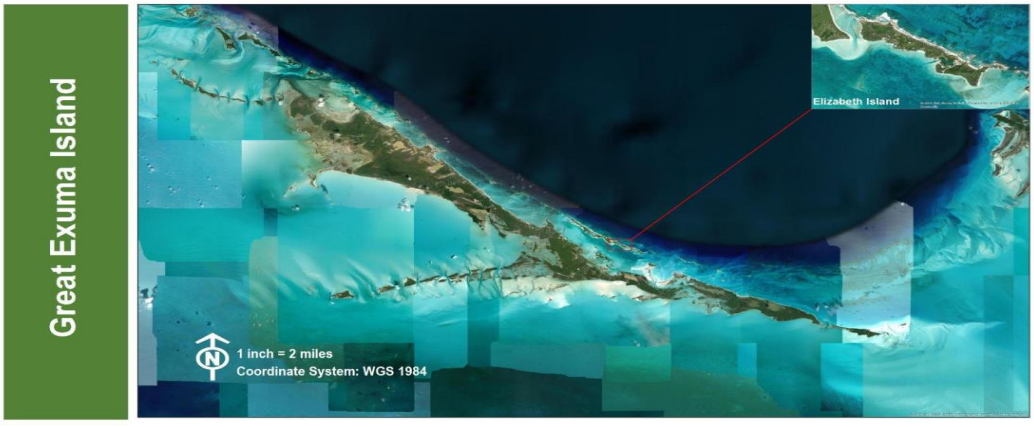


Figure 4.1: *Elizabeth Island and its proximity to the mainland of Gt. Exuma, The Bahamas (Source: Google Maps, 2022)*

The southern portion of the Island (36 acres), the subject of the development ***(Figure 4.2)***, has a latitude and longitude of 75° 72' 00" N and 23° 30' 00" W. The existing land use is residential development. The landscape remains in its natural vegetative state, with the proposed development intention is to maintain at least 80% of the site's original vegetation in its natural state.

Figure 4.2*: Location Overview of Project site in relation to the remaining 2/3 portion of Elizabeth Island (Source: Silent Resort Master Plan 2022).*

Figure 4.3: *Location and Access Points to Project Site, situated on the southern 1/3 of Elizabeth Island. Gt. Exuma, The Bahamas (Source: Silent Resort Master Plan, 2022.*

4.2 Physical Environment

4.2.1 Climate

The Bahamas' climate is classified as subtropical, influenced by the sea, in particular the Gulf Stream to the West. Cooler winters and higher amounts of rainfall are experienced more in the Northern Islands compared to the Southern islands, with drier conditions. According to Sealy (2006), temperatures are mild throughout the year and average varies from the low 70s °F during the winter to the low and high 80s °F during the summer. Prevailing winds come from the Northwest in winter and from the Southeast in Summer, lending a cooler influence, with average wind speed recorded at eight (8) knots.

Like the other Bahama Islands, Elizabeth Island enjoys a sub-tropical climate, with relatively warm, wet summers and drier, cooler winters. Persistent easterly trade winds predominate in the summer, which brings warm humid air to the island. The influence of a high-pressure cell in the winter produces drier continental air and is marked by the presence of cold fronts, which can bring occasional rainfall. The island is not subjected to freezing temperatures.

Figure 4.4 and Figure 4.5*: General N/W to S/E orientation of Project site with its various viewscapes (Source: Google Maps 2022 and Silent Resort Masterplan 2022).*

The Bahama Islands lie within the North Atlantic Hurricane Belt, where hurricanes pose a significant threat during the period 1st June to 31 November and can result in catastrophic damages to the natural and built environments and human mortality. The islands of New Providence, Andros and Grand Bahama were impacted by Hurricane Matthew in 2006 causing severe damage to coastal areas. In 2017, Hurricane Erma impacted the islands of Great Inagua and Crooked Island. No hurricanes impacted the islands in 2018. However, in 2019 significant areas of Abaco and Grand Bahama were devastated by Hurricane Dorian, with estimated damages amounting to US$3.4 Billion (IDB, 2019), significantly impacting the economy of those islands, and by extension the Bahamian economy. No storms impacted the islands in 2020 and 2021. Based on these datasets, there is the possibility that the Island of Exuma and its cays (Inclusive of Elizabeth Island) will experience a direct hit from a hurricane event in any given year.

4.2.2 Topography

Generally, the site topography varies along the length of the island (inclusive of the southern portion), with high relief areas dominating the leeward (southwestern) side ***(Figure 4.6)***. The highest point on the site is approximately 70 ft nearer the center of the site. Ground elevations range from 5 ft to 50 feet above high-water level (MHW) There are no permanent freshwater or brackish ponds on the site, but a seasonal wetland area to the far eastern portion of the site, comprising silver buttonwood formation.

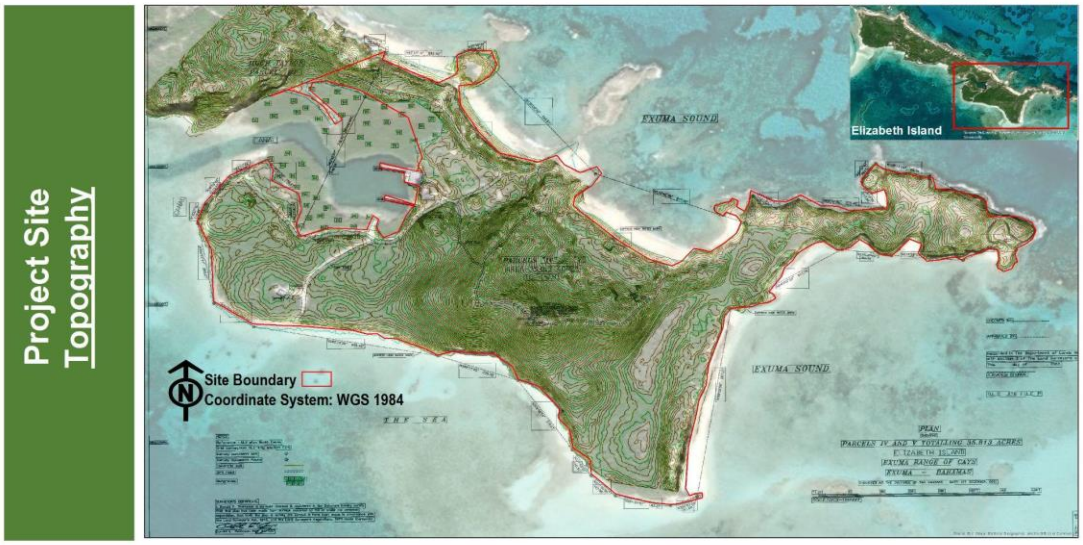


Figure 4.6: *Topographical map showing the contours arrangement. Note the highland areas in the center of the site, along with the three distinct depression areas near the eastern coastline (seasonal wetlands with silver buttonwood species); and Red Mangrove Formation (Lagoon entrance at Northwestern end of site). (Source: Silent Resort Masterplan 2022, and Google Maps 2022).*

4.2.3 Hydrogeology and soils

The Geological, hydrological and water resources of the Bahamas are directly linked, due to the lack of any rivers. Consequently, the only natural means of recharge for the underlying freshwater resources is via rainfall. Thus, the groundwater resources of the Bahamas comprise fresh, brackish, saline, and hypersaline waters, located in the subsurface, in lakes, ponds that intercept the land surface. In the Bahamas, the physical geology, hydrogeology, water resources, and coastal zone are diametrically linked, as there are no true rivers in The Bahamas. From the perspective of Elizabeth Island (project site), there are only three potential sources of water: groundwater (aquifers), collected rainwater, and manufactured water from reverse osmosis. Any changes to the island hydrology, pollution or contamination of groundwater sources, or introduction of pathogens, nutrients or excessive organic matter can have irreversible environmental impacts.

Figure 4. 7*: Photo of human altered environment, with shed and plant nursery site. Note the retention of native broadleaved species (Thatch palms, lignum vitae sp.) The area is indicative of a site with fresh-brackish groundwater resources. (Source: John Bowleg, 2022)*

Figure 4.8*: Typical formation of surface limestone solution feature (Source: John Bowleg 2022)*

On 12-July-2022, a site visit was conducted by Consultant Hydrologist, for review of hydrological and geologic conditions on the island. The hydrogeology observations of the proposed eco-friendly housing development for the Easternmost portion of the island were reviewed. The primary task was to utilize the natural water resources or provide suitable alternatives for freshwater. By World Health Organization (WHO) Drinking Water Guidelines; salinity levels of less than 600-mg/L chloride are acceptable for groundwater. Findings determined that the groundwater at site (collected surface water sample from wetland area), had a salinity range of 1,500-mg/L. ***Table – 4.0*** shows typical ranges of salinity in the Bahamas.

***Figure 4.9**: Typical fractured (Suture) limestone rock (Source: John Bowleg, 2022)*

***Figure 4.10**: Sand coastal dune ridge upon a fractured limestone base (Source: John Bowleg, 2022)*

***Figure 4.11**: Foreshore outcrop of coral-limestone Rock (Source: John Bowleg 2022)*

***Figure 4.12**: Oolitic sand coastal dune ridge over limestone base (Source: John Bowleg 2022)*

Table - 4.0: Ranges of Salinity levels in the Bahamas

Water Description	Dissolved Salts
Fresh	Less than 1,500 mg/L
Brackish	1,500 - 3000 mg/L
Salt	More than 3,000 mg/L
Saline	More than 30,000 mg/L

The salinity level of groundwater can increase because of human activities. Additionally, the intensification of seawater intrusion by any groundwater abstraction within this coastal zone area is further enhanced by sea-level rise. It was further determined that there is a direct connection of the landform to the marine area | coastal environment, solely separated by a typical mangrove vegetation buffer on the protected coastal flats (in this case, the present southwestern marina cove area of the proposed development area) ***(Figure 4.6)***. The natural means of recharge | existence for the underlying 'freshwater resources' is via rainfall.

The findings concluded that Freshwater options are limited on Elizabeth Island **(Appendix – D).** A limited fresh to brackish groundwater reserve exists on the Windward (East to Southeast) portion of the landmass but is not suitable or sustainable for the proposed development. With respect to the Geological conditions on the Island, it consists of a soft weathered to fractured hard limestone rock ***(Figures 4.8. to Figures 4.12),*** which further suggest that recharge of the resources is limited.

4.2.4 Air Quality

No issues or sources of air pollution, or air quality presently on the project site was identified, as the site is currently undeveloped, comprising a four-bedroom residence and boat house facility. As construction activities commence and based on the type of modular home construction techniques proposed to be employed, there are no expectations of air quality impairment.

4.2.5 Noise

Presently there is no issue of noise pollution. The only source of noise pollution is that of existing site management activities (i.e., diesel generator) at a distance away from the boat house and residence. Once construction activities commence, noise levels are expected to be raised, albeit temporarily as construction commences. Noise levels will return to pre-construction levels once development activities cease.

4.3 Natural Environment

Studies with respect to botanical, avian and biodiversity was undertaken over an initial three-day period (27 – 29 June 2022), and a further Avian study (Winter migrants) on 3rd September 2022. The objective, to map and assess the flora diversity, (inclusive of a protective tree species survey), identify any invasive species, fauna and abundance and identify associated biodiversity.

4.3.1 Terrestrial Surveys Methodology

The entire project site acreage (36 acres) was ground truced (walking) along the entire coastline, and trails within the interior upland vegetation areas. Using Areces et al. (1990), all vegetation types were recorded and used to compile a species list. Corell and Corell (1982) and the website for the Leon Levy Plant Preserve (Eleuthera) http://www.levypreserve.org/_m1810/Plants-Scientific-Name was used for Plant taxonomy. Invasive species encountered was referenced and identified, in accordance with the National Invasive Species Strategy (2013) for control/eradication. The presence and abundance of protected trees was undertaken, listed in accordance with the Forestry (Declaration of Protected Trees) Order 2021.

4.3.1.2 Terrestrial Ecosystems

Four distinct categories of terrestrial and non-terrestrial ecosystems were identified, and include: Coastal, Wetland, Interior Upland and Human Altered

4.3.1.2.1 Coastal

Sandy Shoreline, and rocky shoreline were the two distinct vegetations types categorized as Coastal.

a. Sandy (Beach Strand) Shoreline

Sandy shoreline vegetation dominated the northern coastline (two large strips in coves) and eastern coastline (one largest strip). **(Figure 4.13).** Other areas interspersed along the rocky shoreline at the extreme northeastern point of the property. (**Figure 4.14**). Species that dominate the northern sandy shoreline (beach Strand vegetation) formation include, *Suriana maritima* (bay cedar), *Argusia gnaphalodes* (Bay lavender, *Ambrosia hispida* (Bay Geranium), *Sesuvium portulacastrum* (sea purslane), *Scaevola plumieri* (black inkberry), *Ipomea pescaprae* (railroad vine) and *Uniola paniculate* (sea oats) (**Figure 4.15 and Figure 4.16)**. A common invasive species found was the *Scaevola taccada* (Hawaiian sea lettuce).

Figure 4.13*: Rocky outcrops with sandy shoreline at northern end of property, facing East.*

Figure 4.14*: Sandy Beach Strand Formation at eastern end of project site, and facing North*

Figure 4.15*: Sand dune ridge with typical beach Strand vegetation (sea oats and Sea grape) East facing.*

Figure 4.16*: Sand dune ridge dominated with Bay Geranium, Bay lavender vegetation, facing West.*

b. Rocky Shoreline

Rocky shoreline dominates the Windward side of the property (extending outwards into the ocean as fingers at the extreme Northeast end of the Property ***(Figure 4.17)***, Most of the Southern portion of property (leeward side) comprises rocky shoreline ***(Figure 4.18 and Figure 4.19)***. Sand deposits were found in rocky shore crevices, with dominant species being the *Rhachicallis americana* (Sandy Bush), *Strumpfia maritima* (mosquito bush), *Conocarpus erectus* (buttonwood), homogenously distributed in the areas, extending into the scrubland vegetation species.

Figure 4.17*: Rocky shoreline outcrop, facing NE.*

Figure 4.18*: Rocky foreshore with typical vegetation facing SW.*

Figure 4:19*: Rocky foreshore with associated vegetation, situated on southern boundary, facing East*.

4.3.1.2.2 Wetlands

The wetland features identified were of the inland formations, in areas of lower elevations (depression) accumulated to a depth that reached the water table level, or a drainage basin filled during heavy or prolonged rainfall.

a. Coastal Wetlands

The one dominant coastal wetland formation comprised *Rhizophora mangle* (red mangrove), situated at the southwestern edge of the project site (comprising a natural coastal lagoon ***(Figure 4.20, Figure 4.21, and Figure 4.22)***. Seasonal wetlands vegetation type is dominated by *Conocarpus erectus* (silver buttonwood) species, located in three separate areas on the eastern portion of the property site ***(Figure 4.23)***

Figure 4:20*: Red Mangrove Lagoon Formation Facing East*

Figure 4:21*: Entrance to the Red Mangrove Lagoon facing East*

Figure 4:22*: Red Mangrove Formation South facing*

Figure 4.23*: Seagrape species dominate sand dune foreshore formation, with Silver Buttonwood Formation in the background, facing South*

4.3.1.2.3 Interior Upland

The Upland Interior was of the Dry Broadleaved Evergreen Formation (DBEF), and related shrublands, of varied species composition and height. Areas exposed to the wind, and salt spray (windward side) were less than 6 feet in height (tight-knitted dwarf vegetation). Dominant species include, *Jacquinia keyensis* (Joewood), Coccoloba *uvifera* (sea grape) and *Bursera simaruba* (Gum elemi)

The western portion of the property comprised trees between 6 and 12 feet in height and dominated by species such as *Guaiacum sanctum* (Lignum vitae), ***(Figures 4.24 and Figure 4.25)*** *Jacquinia keyensis* (joewood), *Bursera simaruba* (gum elemi), *Lantana demutata* (Bahama sagebush), and *Malpighia polytricha* (touch-me-not). The area has presence of Karst sink holes in places. On the eastern portion of the project site, situated on the beach strand ridge, there is an abundance of *Coccothrinax argentata* (Silver thatch palm) Formation, and associated palms species.

Figure 4:24 Interior Upland species facing North

Figure 4:25 Interior Upland vegetation facing West

4.3.1.2.4 Human Altered

The current human altered area is limited to one area (2 acres) on the project site, situated just to the east of the club house and residence, cleared, and planted with *Cocos nucifera* (Coconut palm), and other ornamental, flowering plants, solitary trees, grasses, weeds, and invasive species such as the *Casuarina equisetifolia* (Australian pine) and *Scaevola taccada* (Hawaiian sea lettuce). The existing main residence house, club house and generator house, and two sea craft landing sites, are part and parcel of the cleared area ***(Figure 4.26).***

4.3.2 Vegetation Map

A Vegetation map at ***Figure 4.26*** below highlights the six (6) distinct vegetation types found on the project site. The most dominant type is the (1) Dry Evergreen Broadleaved Formation, followed by (2) sandy shoreline formation, (3) Rocky Shoreline (4), Coastal Lagoon (Red Mangrove) Formation, (5) Human Altered, and lastly (6) Silver Buttonwood Formation.

***Figure 4.26**: Map depicting the six (6) distinctive vegetation types found on the project site.*

4.3.3 Vascular Plant Diversity

Based on survey analysis, a total of ninety-four (94) species was identified from the site ***(Table 4.1).*** There is a high probability that this number does not represent all the species on site, nor the ornamental plants. One can conclude however, that the list is a fair representation of the extent of the diversity on the property.

Table – 4.1: Vascular plant species recorded on property

				LOCATION		
Botanical Name	**Common Name**	**SS**	**RS**	**DBEF**	**W**	**HA**
Acacia choriophylla	Cinnecord			√		
Agave sisalana	Sisal			√		
Ambrosia gnaphalodes	Bay lavender	√				
Amyris elemifera	White Torch			√		
Angadenia sargraei	Liceroot			√		
Annona glabra	Pond apple				√	
Avicennia germinans	Black Mangrove	√	√		√	
Ambrosia hispida	Bay Geranium	√				
Baccharis angustifolia	Saltbush			√	√	√
Blutaparon vermiculare	Salt weed				√	√
Borrichia arborescens	Bay marigold				√	
Bourreria ovata	Strongback			√		
Bursera simaruba	Gum elemi			√		
Cakile lanceolata	Sea rocket	√			√	
Capparis flexuosa	Limbar caper			√		
Capraria biflora	Goat weed					√
Casasia clusifolia	Seven-year apple		√			
Cassytha filiformis	Love vine			√		√

Casuarina equisetfolia	Australian pine	√	√			√
Coccoloba diversifolia	Pigeon plum			√		
Coccoloba uvifera	Sea grape	√		√		
Coccothrinax argentata	Silver thatch palm			√		
Cocos nucifera	Coconut palm	√				√
Colubrina arborescens	Soap bush			√		
Conocarpus erectus	Buttonwood			√	√	
Conocarpus erectus var. sericeus	Silver buttonwood			√	√	
Croton linearis	Granny bush			√		
Dichromena colorata	Star sedge				√	
Diospyros crassinervis	Featherbed			√		
Ernodea littoralis	Beach creeper	√	√		√	
Erythroxylum areolatum	Paper berry			√		
Erythroxylum rotundifolium	Ratwood			√		
Eugenia axillaris	White stopper			√		
Eugenia foetida	Spanish stopper			√		
Euphorbia mesembrianthemifolia	Coast spurge	√				
Evolvulus squamosus	Broom brush			√		
Ficus aurea	Golden wild fig			√		
Fimbristylis ovata	Flat spike rush grass				√	
Guaiacum sanctum	Lignum vitae			√		
Guapira discolor	Longleaf blolly			√		
Gymnanthes lucidus	Crabwood			√		
Haematoxylum campechiamum	Logwood				√	√
Helicteres jamaicensis	Cow bush			√		√
Heliotropium curassavicum	Seaside heliotrope	√			√	
Herissantia crispa	Bladder mallow			√		√
Hypelate trifoliata	White ironwood			√		
Ipomoea pes-caprae	Railroad vine	√				
Jacquemontia havanensis	Havana cluster vine			√		
Jacquinia keyensis	Joewood		√	√		
Jasminum fluminense	Jasmine vine					√
Krugiodendron ferreum	Black iron wood			√		
Laguncularia racemose	White Mangrove				√	
Lantana demutata	Bahama sagebush			√		
Lasiacis divarcata	Wild sage			√		
Leucaena leucocephala	Jumbay					√
Lysiloma latisiliquum	Wild tamarind			√		
Malpighia polytricha	Touch-me-not			√		
Manilkara jaimique subsp. Emarginata	Wild dilly	√		√		
Manilkara zapota	Sapodilla			√		
Metopium toxiferum	Poisonwood			√		
Myricanthes fragrans	Pale stopper			√		
Myriopus volubilis	Soldier vine			√		
Opuntia stricta	Prickly pear			√		
Parkinsonia aculeata	Jerusalem thorn				√	

Peltophorum adnatum	Sarah's toe			√		
Phyla nodiflora	Cape weed				√	
Phyllantus epephyllanthus	Rock bush			√		
Pilocerus polygonus	Old man's cactus			√		
Pithecellobium keyense	Ram's horn			√		
Pithecellobium unguis-cati	Cat's claw			√		
Plumieria obtusa	Wild frangipani			√		
Plumieria oleracea	Purslane					√
Pseudophoenix sargentii	Buccaneer palm			√		√
Reynosia septentrionalis	Darling plum			√		
Rhachicallis americana	Sandyfly bush		√			
Rhizophora mangle	Red mangrove				√	
Salicornia bigelovii	Glasswort				√	
Salmea petrobioides	Bushy salmea		√			
Scaevola plumieri	Inkberry	√				
Scaevola taccada	Hawaiian sea lettuce	√				√
Scleria lithosperma	Slender-nut rush			√		
Senna chapmanii	Stinking pea			√		
Sesuvium portulacastrum	Sea purslane	√	√		√	
Sideroxylon americana	Milkberry			√		
Sideroxylon foetidissimum	Mastic			√		
Smilax auricalata	Green China berry			√		
Smilax havanensis	China brier			√		
Sophora tomentosa	Pearl necklace	√				
Sporobolus virginicus	Seashore rush grass	√	√		√	
Suriana maritima	Bay cedar	√	√			
Turnera jamaicensis	Cough Vine			√		
Uniola paniculate	Sea Oats	√				
Urechites lutea	Wild alamanda			√		
Vallesia antillana	Pearl berry			√		
Zanthoxylum fagara	Wild lime				√	√

Key: SS = Sandy Shoreline, RS = Rocky Shoreline, DBEF = Dry Broadleaf Evergreen Formation, W = Wetland, H = Human Altered

4.3.4 Protected Tree Species Identified

A total of nineteen (19) protected species were identified from field surveys, including endemic or endangered, threatened, cultural. Historical and economic significance. ***(Table 4.2).***

Table – 4.2: Protected Species Recorded on Property

Botanical Name	Common Name	Status
Agave millspaughii	No known common name	EET
Bursera simaruba	Gum Elemi	CHE
Cocothrinax argentata	Silver top palm	CHE
Conocarpus erectus	Silver Buttonwood	CHE

Guaiacum sanctum	Lignum vitae	CHE
Guapira discolor	Beefwood	CHE
Ipomea-pes-caprae	Railroad vine	CHE
Jacquinia keyensis	Joewood	EET
Lantana demutata	Bahama sagebrush	CHE
Lysiloma latisiliquum	Wild Tamarind	CHE
Peltophorum adnatum	Sarah's Toe	CHE
Pseudophoenix sargentii	Buccaneer palm	CHE
Scaevola mangle	Inkberry	CHE
Senna chapmanii	Stinking pea	CHE
Turnera ulmifolia	Bahamian buttercup	CHE
Uniola paniculate	Sea oats	CHE
Avicennia germinans	Black Mangrove	CHE
Laguncularia racemose	White Mangrove	CHE
Rhizophora mangle	Red Mangrove	CHE

Key: EET = Endemic, Endangered or Threatened. CHE = Cultural, Historical and Economic

Figure 4:27 Lignum Vitae *(Guaiacum sanctum)*

Figure 4.28: Silver Buttonwood (*Conocarpus erectus)*

4.3.5 Invasive Species

A total of two (2) invasive species was observed and listed ***(Table 4.3)***. The National Invasive Species Strategy (2013) outlines recommendation for effective management of all invasive species.

Table 4.3: Invasive species listed and found on the project site

Botanical Name	Common Name	Presence on Site	Recommendations for Control *
Casuarina equisetifolia	Australian Pine	A few individuals within the human altered areas One individual along the most Southeastern point of the project site	Control
Scaevola taccada	Hawaiian sea lettuce	Numerous individuals along the shoreline (beach	Eradication

		strand) and scattered in the Human altered areas	

Figure 4.29: Australian Pine (*Casuarina equisetifolia*) found on the Eastern and northern shoreline of project site.

4.4 Avian Assessment

Two avian surveys were conducted on 27 – 29th June 2022 (Summer session) and 8th September 2022 (Winter session) to identify the presence, abundance and habitat utilization of the avian species found within the boundaries of the project site.

4.4.1 Methodology

The assessment comprised four days of active avian observations, commencing at 9am to 1pm on each day. The number of species were recorded in the abundance categories, Single (1), Few (2 – 10) and Many (11 – 100). Final abundance estimates were compiled. The IUCN categories were used to determine the Status of each species identified. **Table 4.4** below shows the comparison of species observed for Summer and Winter survey sessions periods, respectively.

4.4.1.1 Avian Survey Results

A total of nine (9) species was recorded during the summer session, and a total of Eleven (11) species recorded during the winter session. **(Table – 4.4)**

Table – 4.4: Avian observations – (Summer and Winter Sessions)

TABLE KEY		
Range	**Status**	**Habitat**
PRB = Permanent Resident Breeding	**LC** = Least Concern (Conservation – IUCN)	**FW** = Freshwater
WRN = Winter Resident Non-Breeding	**NT** = Near Threatened (Conservation – IUCN)	**IU** = Interior Upland
SRB = Summer Resident Breeding	**E** = Endemic	**HA** = Human Altered
	I = Introduced	**FO** = Fly Over
		CS = Coastal Shore

		RS = Rocky Shore
		SS = Sandy Shore
		TF = Tidal Flats
		W = Wetlands
		S = Saline

Scientific Name	**Common Name**	**Range**	**Status**	**Observation** (Summer Session -June 2022)	**Habitat Utilization**	**Observation** (Winter Session – Sept. 2022)	**Habitat Utilization**
West Indian whistling duck	*Dendrocygna arborea*	PRB*	NT	F	W	-	-
White-crowned pigeon	*Patagioenas leucocephala*	PRB	NT	M	FO/IU	F	FO
Common ground dove	*Colombina passerine*	PRB	LC	M	HA/IU	M	HA/IU
Antillean nighthawk	*Chordeiles gundlachii*	SRB	LC	F	HA/SS	S	HA/SS
Bahama woodstar	*Nesophlox evelynae*	PRB/E	LC	S	IU	S	IU
Laughing gull	*Leucophqeus atricilla*	PRB	LC	M	HA/FO	M	FO
Bananaquit	*Coereba flaveola bahamensis*	PRB/e	LC	F	IU/HA	F	IU/HA
Bahama Mockingbird	*Mimus gundlachii*	PRB	LC	.	-	S	IU
Black Crown Night Heron	*Nyctocorax nyctocorax*	PRB	LC	-	-	F	W
Belted King Fisher	*Megaceryle alcyon*	WRN	LC	-	-	F	W
Thick-billed vireo	*Vireo crassirostris*	PRB/e	LC	F	IU/HA	F	IU/HA
Roseate tern	*Sterna dougallii*	PRB	LC	M	FO	M	FO
TOTAL SPECIES				**9**		**11**	

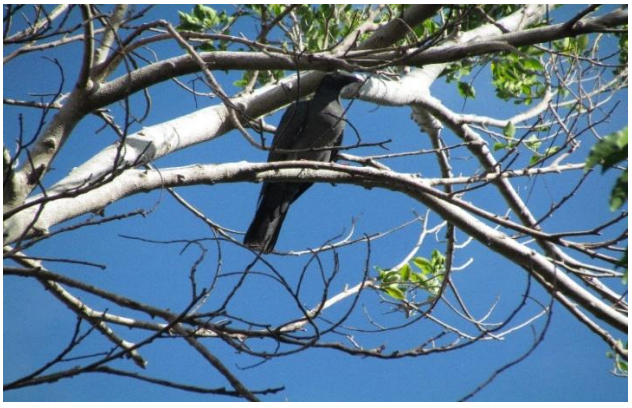


Figure 4.30: Bahama Woodstar (*Nesophlox evelynae)* **Figure 4.31**: White Crown Pigeon (*Patagioenas leucocephala*

Figure: 4.32: Bahama Mockingbird (*Mimus gundlachii)* **Figure 4.33:** Antillean Nighthawk *(Chordeiles gundlachii*

Figure 4.34: Antillean Nighthawk *(Chordeiles gundlachii*) young chick camouflaged within the humanaltered landscape.

4.4.1.1.1 Range

The geographical area where birds are consistently found is referred to as its Range. Birds classified as Migrant have seasonal range, whereas restricted species on some islands or in a region year-round.

- **Permanent Resident Breeding (PRB)**: refers to resident refers to species that live and breed all year round throughout the Bahamas. On the project site the predominant avian species identified included the white crown pigeon (*Patagioenas leucocephala),* Common ground dove (*Colombina passerine),* Laughing gulls (*Leucophqeus atricilla*) and Roseate terns (*Sterna dougallii).* Ten out of the eleven species (90%) found on property were PRB.

- **Winter Resident Non-breeding (WRN):** refers to the annual non-breeding fall/winter (generally October to April) migrants to the Bahamas from North America. The majority of the WRN birds

leave by the end of April to their home states during spring or summer. One specie (Belted King Fisher) was observed during winter session survey.

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- **Summer Resident Breeding (SRB)**: refers to species that breed in the Bahamas during the summer months (April to October) then return to other regions the rest of the year. SRB include both land and the sea birds. The Antillean nighthawk (*Chordeiles gundlachii*) was observed during the surveys. The seabirds: Laughing gull (*Leucophqeus atricilla)* and the Roseate tern (*Sterna dougallii*) breed on offshore cays and rocks and extremely difficult to survey (recorded as flyovers).

4.4.1.1.2 Endemic Species

Birds found in the Bahamas are referred to as Endemic. The Bahama woodstar *(Nesophlox evelnae)* was the sole endemic species observed.

4.4.1.1.3 Conservation Status

a. **Protected species**: All species observed are protected under the Wild Birds Protection Act Chapter 249 (Statue Law of The Bahamas).

b. **Endangered:** None of the species recorded are classified as endangered.

c. **Species of Concern**: Near Threatened (NT) by the IUCN classifies a species that may be considered threatened with extinction in the near future, although presently not qualified for the threaten status. The White-crowned pigeon *(Patagioenas leucocephala)*, and the West Indian Whistling duck *(Dendrocygna arborea)* currently designated as near-threatened status, were observed during the summer session surveys.

4.4.2 Habitat Utilization

a. Coastal Shore

The West Indian Whistling Ducks were recorded along the coastal lagoon shoreline (red Mangrove formation). Sea birds (laughing gull and roseate terns were observed flying over the project site.

b. Sand Strand

No bird species were observed in the sand strand vegetation.

c. Interior Upland

All other land birds were recorded in the upland vegetation, as well as Human Altered Areas, where food sources appear to be more in abundance, including bird species that are nectar feeders, insectivore species, fruits, and seed eaters.

d. Wetlands

Due to the seasonality of freshwater within the inland wetland habitats, no birds were observed within these features.

4.4.2.1 General Discussion

The dominance of the PRB species along with a few WRN species during Avian surveys confirms the adaptation of the species to sites of high biodiversity, abundance of food resources and the varied vegetation types for roosting and breeding purposes. Species abundance is correlated with size of the site, where on larger sites greater abundance of species is likely, versus small sites. The variation in habitat, supports the varied species normally associated with shorebirds, wading birds, waterfowl, and land birds. Also important is the timing of the surveys. Bird Surveys should be carried out in the summer months and winter months to have a representative sample of species associated with the seasons. The avian species found on the project site is indicative to what was expected, and typical of surrounding cays and the mainland of Gt. Exuma.

4.5 Biodiversity Assessment

In addition to the Botanical and Avian studies, any animals, insects, reptiles, amphibians, and other living creatures observed, were recorded as either Single (1), Few (2 – 10) or Many (11 – 100). **Table 4.5** provides a summary of the observations. **Figures 4.35 to Figures 4.38** below depicts photos captured of some observed species.

Table 4.5: Summary of observed wildlife from project site

Common Name	Scientific Name	Abundance
Yellow Butterfly	*Colias sp.*	M
Monarch Butterfly	*Danaus phexippus*	M
Black Dragon Fly	*Trames sp.*	M
Lion Lizard	*Leiocephalus sp.*	M
Bark anole	*Anolis* distichus	M
Brown Moth	*Cissusa asp.*	F
Golden silk spider	*Trichonephila clavipes*	F
Soldier Crabs	*Mictyris sp.*	M
Money Bats (Black witch moth)	*Ascalapha odorata*	S
White Land Crabs	*Cardisoma guanhumi*	M

Figure 4.35: Brown Moth *(Cissusa sp)*

Figure 4.36: Soldier Crabs *(Mictyris sp)*

Figure 4.37: White Crab *(Cardisoma guanhumi*)

Figure 4.38: Monarch Butterfly *(Danaus phexippus)*

4.6 National Parks and Protected Areas

There are numerous and highly significant National Parks and Protected areas within the Exuma chain of Islands. Of note is that the project site on Elizabeth Island is situated within the Moriah Harbour Cay National Park (MHCNP) **(Section 4.6.1). Figure 4.39** depicts Elizabeth Island in relation to the boundaries of the Moriah Harbour Cay National Park (MHCNP). The Ki'ama Bahamas project with its low-carbon footprint and innovation in the use of renewable energy systems, low density residential site planning, and low environmental impact, no marina expansion or dredging, complements with the notion of a fully sustainable resort development footprint within a pristine marine protected area (MPA) The development proposed will have no negative physical impact to the Marine National Park and can only enhance the parks management Objectives and Goals.

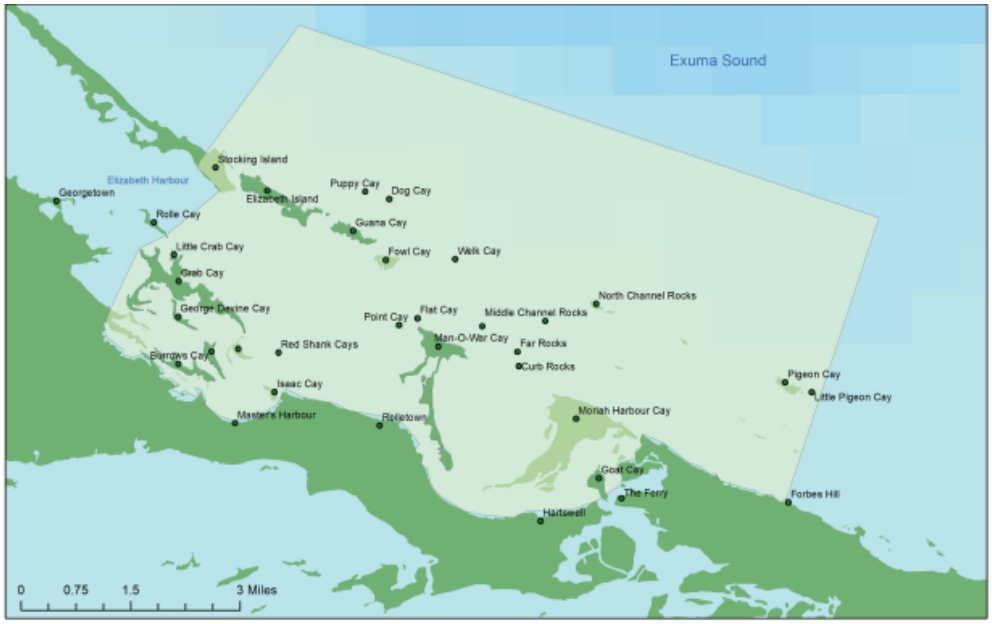

Figure 4.39: Depicts the location of Elizabeth Island within the boundaries of the MHCNP. *(Source: BNT General Management Plan – MHCNP, 2019).*

4.6.1 Moriah Harbour Cay National Park (MHCNP)

Ki'ama Bahamas project is situated within the Moriah Harbour Cay National Park **(Figure 4.39)**. The Park comprising some 16,800 acres, was established by the Government of the Bahamas in 2002, as part of the Bahamas National Trust (BNT) system of national parks, to protect the intrinsic value of the marine environment surrounding Moriah Harbour Cay. With a further expansion in 2015 to 27,286 acres, protection expansion represented nearshore marine habitats connecting Great and Little Exuma (Marine Protection Plan, 2020).

Key elements of the park showcase ecological diverse habitats, such as sand dunes and flats (bonefish), tidal creeks (turtles), mangroves, lagoons, coral reefs, blue hotels, sandy shorelines, and coastal plant communities. Of significance is the Park's importance as areas for spawning, nursery (fish and lobsters), nesting and migration of terrestrial and marine species.

Marine Habitats

Extracts from the General Management Plan (2019-2029) for the MHCNP, published by the Bahamas National Trust (BNT) identified the following habitats associated with the park, as follows:

- ***Blue holes*** – some ten (10) blue holes concentrated in the southwest portion of the park (near Crab Cay – 4 blue holes).
- ***Forereef*** – extending from drop-off at the islands edges at depths of 98 – 131 feet, with its own set of marine species.

- ***Hardbottom*** – areas of rocky substrate, comprising hard coral living and gorgonian, plains, sponges. Although fish species diversity is low, several fish species such as juvenile Nassau Grouper are present.
- ***Patch reefs*** – scattered across the northeastern portion of Moriah Harbour Cay.
- ***Reef Crest and Back Reef*** - large coral formations are key features, where wave energy levels and surges. Noted coral species found include *Diploria s*p. and *Porites astreoides*. Algae species include *Sargassum spp*. and *Turbinaria spp*. These habitats are found between Elizabeth Island and Guana Cay.
- ***Sand*** – abundance of marine animals find home on the sand banks, sandy creeks, and channels. Numerous fish species use the mangrove and seagrass as refuge. The continuous sand movement affects sand flats, creeks, channels, and shorelines within the park.
- ***Seagrass Beds*** – Dense seagrass are found in south side of Stocking Island and Elizabeth Islands and are a specialized group of marine plants. They serve as foraging grounds for rare and valuable species of fish and invertebrates, such as queen conch, snappers, spiny lobsters, grunts. They are also important for green turtle species which forage in the beds.

Management Goals

The BNT identified eight (8) management goals for the MHCNP as follows:

- Conservation of natural resources
- Conserve historical and cultural resources
- Protect and enhance natural landscapes and seascapes
- Conserve marine resources to support local and national economy
- Provide education, outreach, and interpretation opportunities
- Promote visitor experiences.

Management Zones

Three distinct Management Zones were also identified (Conservation zone, sensitive resource zone, and an administrative/visitor service zone), based on location, presence of conservation features, stakeholder use and activities **(Figure 4.40)**, visitor and recreation patterns and administrative needs. **Figure 4.41** shows the Management zones location.

Climate Change Mitigation Values

It is worth referencing the climate change mitigation value of the MHCNP. Sharp, et. al., (2017) utilized the InVEST Blue Carbon Model, to measure the total carbon stock of an area given the amount of carbon stored in plants (mangroves and seagrasses) in the Bahamas. On this basis, a determination was made by Arkema et. al., (2017) of the carbon stock density value of approximately 10 (thousands of tons) of CO2 per km2 for the park. The team applied a price of $12.58/metric ton of Carbon, based on the Interagency Working Group's 2015 social cost of greenhouse gasses (IWG 2016). It projected a value of carbon stock for the park at approximately 12.5 (B$ millions), in avoidable damages in carbon storage for climate mitigation.

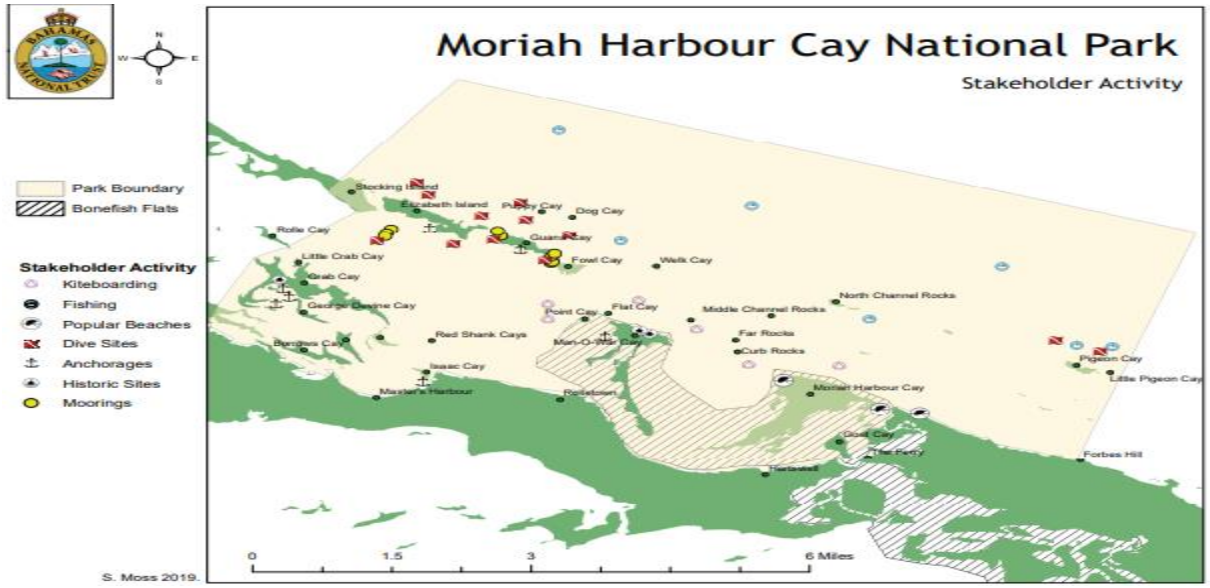

Figure 4.40: MHCNP stakeholder Activity and proximity to Elizabeth Island (Ki'ama Bahamas project) *(Source: BNT General Management Plan, 2019)*

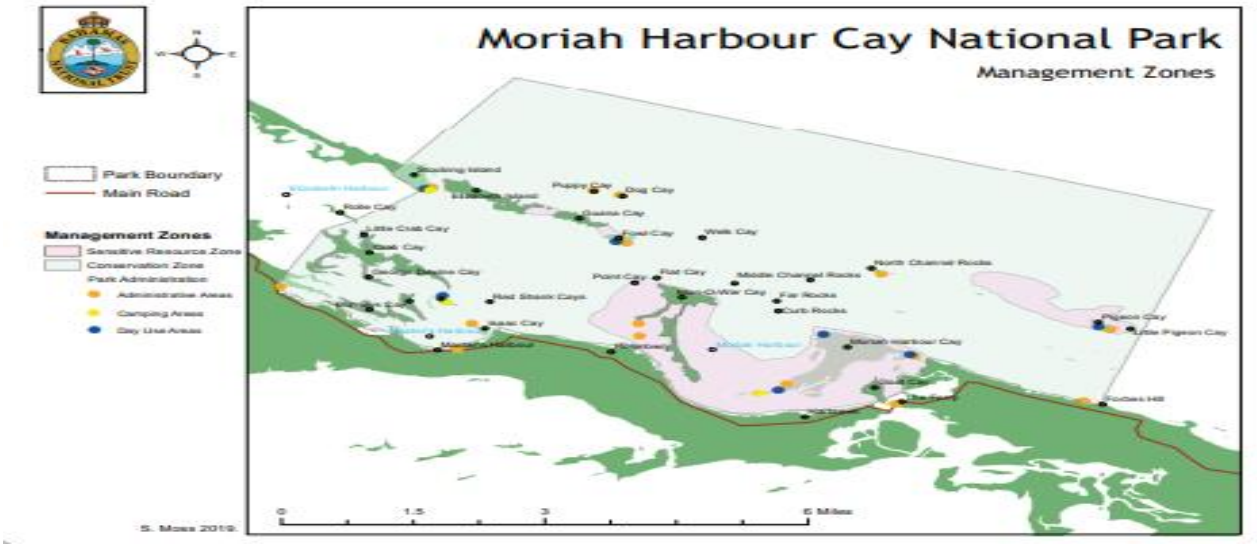

Figure 4.41: Depicts BNT Management Zones, MHCNP. Note Sensitive Resource Zone (shaded pink) between Elizabeth Island and Guana Cay. *(Source: BNT General Management Plan, 2019)*

Other notable National l Parks and Protected areas situated in the Exumas are summarized in **Table 4.6.**

Table 4.6: Protected Areas within the Exumas, and their extent.

Name	Island	Acres	Type	Managing Entity
Betty Cay	Exuma	3	Wild Bird Reserve	Min. of Env. & Natural Resources
Big Derby Island	Exuma	499	Wild Bird Reserve	Min. of Env. & Natural Resources
Big Galliot Cay	Exuma	20	Wild Bird Reserve	Min. of Env. & Natural Resources
Channel Cays &Flat Cay	Exuma	45	Wild Bird Reserve	Min. of Env. & Natural Resources
Cistern Cay (private)	Exuma	Unknown	Wild Bird Reserve	Min. of Env. & Natural Resources
Exuma Cays Land & Sea Park	Exuma	174,194	Marine & Terrestrial	Bahamas National Trust
Goat Cay	Exuma	30	Wild Bird Reserve	Min. of Env. & Natural Resources
Green Cay	Exuma	2,697	Marine	Not Assigned
Guana Cay	Exuma	5	Wild Bird Reserve	Min. of Env. & Natural Resources
Harvey Cay	Exuma	5	Wild Bird Reserve	Min. of Env. & Natural Resources
Leaf Cay	Exuma	Unknown	Wild Bird Reserve	Min. of Env. & Natural Resources
Little Derby Island	Exuma	336	Wild Bird Reserve	Min. of Env. & Natural Resources
Moriah Harbour Cay National Park	Exuma	22,833	Marine & Terrestrial	Bahamas National Trust
Pigeon Cay	Exuma	Unknown	Wild Bird Reserve	Min. of Env. & Natural Resources
Rock off Hog Cay	Exuma	3	Wild Bird Reserve	Min. of Env. & Natural Resources
The Exuma (Jewfish Cay) Marine Reserve	Exuma	37,165	Marine Reserve	Department of Marine Resources

4.7 Socio-economic Aspects

4.7.1 Land Use

The Ki'ama Bahamas project site is currently undeveloped private property, comprising an existing four-bedroom residence, boat house, generator house, and a small plant nursery shed. Access to the property (residence) is by boat utilizing two existing floating docks and marina. There is anchorage and moorings for (**Figure 4.40)** cruise sailors and visitors within the Moriah Harbour Cay National Park (MHCNP) (BNT management), although access to the site is prohibited. The existing road network is of gravel construction. The remainder of the site is in its original natural vegetative state.

4.7.2 Population

According to the Bahamas (2010) Census, the population of Great Exuma is approximately 7,300, with George Town Settlement being the primary entry point and nearest township to Elizabeth Island, has a population of 1,437 persons.

4.7.3. Economy

Due to the undeveloped nature of the Elizabeth Island (project site), there is little opportunity for economic opportunities (jobs), except perhaps a Caretaker role. Once project development proceeds, this circumstance is expected to change significantly.

4.7.4 Transportation

To move around in Gt. Exuma Island, and its many Cays there are car rental, taxi services, and water taxis for tourist attraction sites. There is also a local bus service that takes people around the island. Exuma is also served by various air carriers, such as Bahamas air, Western Airlines, American Airlines, and other charters services. Residents may also have access to their own cars and tourists can rent a car to drive.

Transport to Elizabeth Island is by water taxi, or private yacht. The informal gravel roads and footpath network connects the residential home to the landing docks, and to several beaches on the windward and leeward sides of the site.

4.8 Cultural Resources

Cultural resources represent the national patrimony and are of interest, and include:

- Archaeological sites of pre-European native people
- Archaeological sites of European and recent cultures
- Ruins
- Historic structures
- Cemeteries and any human burial sites
- Landscape features and sites of traditional cultural importance

There are significant cultural aspects of the Bahamas that Exuma residents enjoy. Exuma has significant cultural landmarks and includes the Bowe Family Plantation, the Rolle Town Tombs, and St-Andrews Anglican Church. These sites have a historical significance that builds the culture of the Bahamas as we now know today.

The Lucayan Indians, the indigenous people of the Bahamas, left behind their presence in the form of living sites (villages), and sacred burial grounds (including caves). There was no evidence that these types of sites existed or were observed during site surveys to project site.

4.9 Touristic and Recreational Areas

The major tourist attraction that occurs in Exuma is the annual Family Island Regatta where locals, and visitors migrate into George Town for a few days during the Easter week to watch the boat races, socialize and have a good time with friends and family.

Other tourist attractions in Exuma and its cays are the swimming pigs on Major Cay where you can interact with the pigs, feed them, and more. On Guana Cay, visitors and locals can interact with iguanas all over the

beach. The Exumas have beautiful crystal-clear water where one can swim, organized charter boat tours to explore the coral reefs and enjoy what the island's marine life has to offer.

The Moriah Harbour Cay National Park (MHCNP) which engulfs Elizabeth Island, is a pristine marine protected area, also used by boaters, and has an anchorage managed by the BNT **(Figure 4.39)**, for the benefit of visitors and locals, to explore the coral reefs and marine life.

4.10. Waste Streams

It is important to reference the fact that the sustainable management of waste requires an understanding of all sources of waste (i.e., solid and liquid).

4.10.1 Solid Waste streams

There is no existing solid waste collection system servicing Elizabeth Island. Solid waste generated from the local residence and boat house are collected and brought over to the mainland of Gt. Exuma and disposed of at the local landfill. As construction commences, there will be strictly limiting any single-use plastics from the development. Further, a glass crusher will be erected on site to crush all glass to a fine sand/rock which will be used on pathways and roadways. All organic/food waste will be composted for use as fertilizer/mulch for the organic gardens. For the remaining solid waste, there will be use of an on-island trash compactor to haul the compacted trash off island to a contracted Exuma landfill.

4.10.2 Liquid Waste streams

Elizabeth Island (Project site) has no waterborne sanitation. The residence and boat house rely on a septic system for the disposal of liquid waste. As part of Ki,ama Bahamas commitment to sustainable innovation. A Zero-power, silent, odorless wastewater treatment system will be installed to handle wastewater in a safer, more sustainable way, and the effluent will be used for local irrigation.

4.11 Utilities

There is no main power grid connecting (Bahamas Power and Light) Elizabeth Island to the mainland of Gt Exuma. There are no telecommunications presently. The previous owner had a BTC internet modem but is not operational. A Starlink internet connection is due for installation in the 3rd Quarter 2022.

4.11.1 Potable water

Ki'ama Bahamas Project site does not have municipal water supply. There are two cisterns below the Cistern/Guest House' (multi-story building), where the rainwater is being collected. A water pump in the Boat House (single story building) provides pressure for the Boat House and Guest House.

4.11.2 Electricity

As reference earlier, there is no main power grid connection to the Ki'ama Bahamas Project Site. The Boat House and Guest House are powered by about 40 solar panels with support from a backup older (GENSET) diesel powered generator (16KV), situated on property (backhouse) that supplies the residence and boat house presently. Once the new solar system becomes operationalized, with backup power from hydrogen cells, the diesel generator will be eliminated.

4.11.3 Fuel storage and distribution

Fuel storage presently consist of day tank storage for the backup generator. Once the project is solarized there will be no need for fossil fuel storage facilities.

4.11.4 Construction & Material Sources

Whereas building materials (sand, limestone, etc.) are available in George Town, to a limited extent, it is anticipated that most of the construction materials will be imported from Central America - Belize, (modular, prefabricated structures), stored and brought in by 40 - 80ft containers, and finally assembly on site.

5. Legal Aspects

All projects developed within the boundaries of the Commonwealth of the Bahamas are subject to compliance with national laws, regulations, international conventions, and guidelines. Additionally, Developers must consider, when relevant, mitigation measures, international financial guidelines, and world bank environmental, health and safety (EHS) guidelines

5.1 Local Legislation and Policies

Tables 5.1 and 5.2 depict the local legislations and policies that are relevant to the physical and natural environment and may apply to the project.

Table 5.1 Local legislations

Environmental Law, Regulation and Policy	Summary
Antiquities, Monuments and Museum Act, 1998	"An Act to provides 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 related therewith…"
Disaster Preparedness and Response Act, 2006	"An Act to provide for the effective organization of the mitigation of, preparedness for, response to and recovery from emergencies and disasters…"
Road Traffic Act, 1962	"An Act to declare, amend and codify the law relating to motor vehicles, and to provide for the regulation of traffic on roads and of motor vehicles…"
Agriculture and Fisheries Act, 1964	"An Act to provide for the supervision and development of agriculture and fisheries in the Bahamas…"
Fisheries Resources (Jurisdiction and Conservation) Act	An Act to make provision with respect to the conservation and management of the fishery resources of the Bahamas and to extend the limits of the jurisdiction of the Bahamas over such fisheries resources and for matters connected therewith…"
Water and Sewerage Corporation Act, 1976	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…"
Building Regulations, 1971	An Act to regulate the construction, altercation and repair of buildings, provide for the re-instatement or removal of dangerous or dilapidated buildings, to authorize the publication of a building code and for purposes connected therewith…"
Environmental Planning and Protection Act, 2019	An Act to establish the department of environmental planning and protection; to provide for the prevention or control of pollution, the regulation of activities, and the administration, conservation, and sustainable use of the environment; and for connected purposes"
Environmental Planning and Protection (Extension of Application) Order, 2020	An Order to extend the Environmental Planning and Protection Act, 209 throughout the territory of the Bahamas, including every island and cay and to define procedures for proposed projects, monitoring and compliance, and the certificate of environmental clearance.
Environmental Impact Assessment Regulations, 2020	The regulations describe the procedure for proposed projects and requirements to apply and receive a Certificate of Environmental Clearance from the Department of Environmental Planning and Protections.
Bahamas Protected Areas Fund Act 2014	The Act establishes the BPAF as a Fund to ensure sustainable financing for protected areas in the Bahamas. The Fund allows for the solicitation of funds and donations from the Caribbean Biodiversity Fund, to fund protected areas in the country.
Conservation and Protection of the Physical Landscape of the Bahamas Act, 1997	An Act to make provision for the conservation and protection of the physical landscape of the Bahamas. The Act contains pats regarding administration, regulation of excavation and landfill operations, provisions governing dangerous excavations, landfill operations, quarries or mines, zoning of the Bahamas for the purposes of quarrying and mining operations, and general entries.

Environmental Health Service Act, 1987	"An Act to promote the conservation and maintenance of the environment in the interest of health, for proper sanitation in matters of food and drink and generally, for the provision and control of services, activities and other matters connected therewith…"
Environmental Health Services (Collection and Disposal of Waste) Regulations, 2004	Section 18 speaks to removal of construction waste and section 19 speaks to industrial waste disposal.
Forestry Act, 2010	An Act to provide for the conservation and control of forests and for matters related thereto;
Forestry Regulations, 2014	Provides for the application for a permit to harvest protected trees
Forestry (Amendment) Regulations, 2021	Amends the Forestry Regulations, 2014 to provide for reduced to be payable for royalties for the granting of licences, permits for the salvaging of damaged forest due to natural disasters, hurricane, or tornados.
Forestry (Declaration of Protected Trees) Order, 2021	An Order which increase the list of trees protected from a previous eleven (11) to some one hundred and twenty seven (127) trees/plants.
Planning and Subdivision Act 2010	The Act governs development and planning, both from a terrestrial and marine landscapes. It applies to both New Providence and the Family Islands and the Port area of Grand Bahama. While the Act is comprehensive, no formal land use plans have been developed
Wild Animals Protection Act 1968	The Act prohibits the taking, capturing, or hunting of any wild animal without a permit.
Bahamas Public Parks and Public Beaches Authority 2014	The Act allows the authority to control, plan, design, develop, administer, manage and maintain public parks and public beaches; to conserve their natural beauty and topography, propagate, protect, and preserve animals, plants and other organisms in those areas.
Bahamas National Trust Act 1959	The Act provides the BNT the mandate to promote the preservation of lands, buildings, underwater areas, and areas of natural interest. The Act also empowers the BNT to identify sites for protection and to administer areas declared protected; and manages national parks.
Wild Birds Protection Act 1959	The Act prohibits the taking, capturing, and hunting of any wild bird without a permit. It protects birds and eggs during the closed season. The Act also permits the Minister to establish wild bird reserves.

Table - 5.2. National Environmental Policies

Relevant National Environmental Policies	Summary
National Policy for Adaptation to Climate Change 2005	The policy outlines a framework to meet the goals and objectives of the United Nations Framework Convention on Climate Change (UNFCCC). Where the Bahamas committed itself to reducing greenhouse gases and address the impacts of climate change
National Invasive Species Strategy for the Bahamas, 2013	The initial policy was drafted in 2003, but subsequently updated in 2013, as part of a GEF funded project (MITIASIC) Mitigation the Threats of Invasive Alien

	Species in the Insular Caribbean; and sets out a management strategy for the control and eradication of invasive species
National Biodiversity Strategy and Action Plan, 1999	The Action plan calls the Bahamas to conserve biodiversity and pursue sustainable development. It further highlights the role of biodiversity in the social and environmental context and recommends measures to ensure its compatibility with future developments.

5.2 International legislation and Conventions of relevance

Table 5.3 depicts international conventions that are of relevance to the project, and regards must be made.

Table 5.3: International Conventions enforced in the Bahamas

International Convention/Organization	Summary
Cartagena Convention. Ratified: June 24, 2010	The Convention provides for the legal framework for cooperation in the wider Caribbean region. Three technical agreements apply: ● Protocol for co-operation in combating oil spills. ● Protocols for specially protected areas and wildlife (SPAW); ● Protocol concerning pollution from land-based sources and activities (LBS).
Convention on Biological Diversity. Signed: June 12, 1992	The convention has three main goals: ● Conservation of biodiversity. ● Sustainable use of components of biodiversity. ● The fair and equitable sharing of the benefits arising out of the utilization of genetic resources (ABS)
Convention on Wetlands of International Importance (RAMSAR Convention) Signed: June 7, 1997	Known as the RAMSAR convention. The convention provides the framework for the international protection of wetlands as contributors for avifauna which do not adhere to international borders.
Convention to Combat Desertification and Drought. Signed November 10, 2000	The Convention provides for sustainable development by addressing social and economic issues that directly impact land degradation.
United Nations Framework Convention on Climate Change. Signed: June 1992 Kyoto Protocol Signed: April 9, 1999 Paris Agreement Ratified: August 22, 2016	The Bahamas is a signatory to this convention. It establishes a framework with the aim to stabilize atmospheric greenhouse gases. The Kyoto Protocol was developed under the UNFCCC to provide emissions targets and timelines for developed countries. The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

5.3 Government Institutions

Table 5.4 summarizes the key government and non-government policy and statutory agencies, their responsibilities relevant to the project with respect to aspects of approvals and permitting, and the EIA Process.

Table - 5.4: Key Governmental and Non-governmental Agencies with responsibilities

AGENCY	SUMMARY OF RESPONSIBILITIES
Bahamas Investment Authority (BIA)	• A "one-stop shop" agency to reduce bureaucratic delays for domestic and international investors, seeking Government approval for development projects in the Bahamas
Ministry of the Environment and Natural Resources (MTENR)	• To manage, protect and conserve all land, water, and other tangible resources of the Bahamas, and have regard to the environmental, economic, and social benefits that may confer on the Bahamas. • Give advice on proposals from the private and public sectors that would significantly affect the Bahamas. • Overseas conservation of wild animals, birds and plants, and forests. • It administers the Wild Birds and Wild Animals Protection Acts.
Department of Environmental Planning and Protection (DEPP)	• To promote best practices in environmental management and to minimize harm to the environment. • Administer the EIA process, coordinate the public review of EIAs, and various national plans for natural resource management. • Promoting and enforcing compliance with the Environmental Planning and Protection Act, 2019
Forestry Unit (FU)	• The sustainable management, conservation, control, and development of the natural forest resources on state lands.

	• Promotion and regulation of forest industries. • Regulate the commercial utilization of the natural forest resources. • Protection of trees that are rare and of historical significance.
Department of Environmental Health Services (DEHS)	• Environmental control, solid waste collection and disposal of domestic, commercial and construction waste • enforcement of industrial regulation, public health guidelines, enforcing public sanitation. • Evaluate the effectiveness of pollution control measures to protect the health and safety of workers. • Issuance of effluent discharges and emission permits
Department of Fisheries (DOF)	• Oversees and enforces fisheries regulations and the establishment of Marine Reserves and Marine Protected Areas (MPAs)
Department of Local Government (DLG)	• Implements the provisions of the local government Act, thus ensuring sound and sustainable family island development
Ministry of Tourism and Aviation (MTA)	• Promotion of the tourism industry of the Bahamas • Encourage visitor arrivals by air and by sea throughout the Bahamas
Ministry of Public Works and Utilities (MPW)	• Overseas and maintains physical infrastructure in the country. • Responsible for building controls and Regulations
National Emergency Management Agency (NEMA)	• "Ensures that adequate preparedness and mitigation measures and response and recovery mechanisms are established to counteract the impact of natural, man-made

	and technological hazards…"
Department of Physical Planning (DPP)	• Administers the Planning and Subdivision Act, 2010, which includes the preparation of land use plans for the islands. • Controls development of the natural and built environments, via zoning.
Water and Sewerage Corporation (WSC)	• optimizes the development of the country's water resources and the water quality control. It shares with DEHS the responsibility for monitoring water quality. • Issue water supply franchises to developers, especially where the supply of water is impractical for the government or its agencies
Department of Labour	• Regulates Health and Safety under the Health and Safety at Works Act, 2002. • conducts inspections at workplaces to ensure adequate worker safety and regulations compliance
Bahamas National Trust (BNT)	• Established as a non-government entity (non-profit) by the BNT Act 1959. • To manage national parks and protected areas, historic preservation, public awareness, and environmental outreach

6. 0 Anticipated Environmental Impacts of the Proposed Project

6.1. Impact Assessment Methodology

It is important to recognize that Residential and Resort development on small islands require a process of risk and impact assessment that is standardized and objective. These tools are accepted for impacts that involve:

- degradation of terrestrial and marine species
- Where land-based sources of pollutants are introduced, and
- freshwater and nutrients are introduced to the island hydrology

The appropriate tool in this circumstance will involve a series of questions and appraisal, ranking and then prioritizing the potential risks and hazards.

6.1.1 Assessment Criteria Tool

Qualitative Assessment Criteria will be used to rank a source of activity for its environmental impact. With each phase and component described, evaluated for impacts, then mitigation measures are outlined **(Tables 6.1, 6.2 and 6.3)**. Significance level overall will be measured as:

- **Significant** – high impact, sufficient intensity, and duration to generate significant change(s), predominantly irreversible naturally. Site affected in the long term.
- **Moderate** – an effect for a limited time over the affected area, site condition is temporary altered, naturally reversible in the medium term.
- **Negligible** – effect is barely evident, short duration, site not altered, naturally reversible in the short term.

6.1.2 Severity Criteria Tool

Severity of an environmental impact is another tool used to measure the magnitude of impact an event has on the environment. Severity is usually given the numerical rating of 1 for low impact, 3 for medium impact and 5 for high impact. Factors that are measured for severity would include negative effect on flora and fauna, impact on wildlife, effects on air and water, noise, visual, and short-term vs long term recovery of the environment, among others **(Table 6. 4).**

Table 6.1 Qualitative Assessment Criteria for Impact Assessment

Qualitative Criteria	Choices	Description
Nature	• Direct • Indirect	Does origin/source activity Directly or Indirectly act on the environmental target (species or natural community)
Type	• Positive • Negative	Positive implies species or natural community will have a higher likelihood of persistence with increase viability Negative implies the opposite
Likelihood	• Not Likely • Potential • Certainly	Not Likely – 10% chance of impact occurring. Potential – 10 to 70%. Certainty – impact has greater than 70% chance of occurring.
Scale	• Specific habitats • Island environs • Regional	Restricted to specific habitats. Impact that impacts the entire Island of Elizabeth Island.

	• National or internationally	Regional Impacts (Gt. Exuma & Cays) International Impacts refer to CITIES species
Duration	• Temporary • Long-term	Temporary – impacts that last less than three years. Long-term – more than three years
Reversibility	• Reversible or • Irreversible	Reversible – impacted species or natural communities will recover. Irreversible – species or natural communities lost to project site, and impact should be mitigated

6.2. Impacts to the Physical Environment

Pre-construction/construction activities and project operation activities being reviewed as part of the impacts are outlined below:

1.0 *Pre-Construction/Construction Phase*:
- Site preparation and construction of Infrastructure:
  - Construction of gravel roads
  - Installation of R/O facility
  - Basic infrastructure solar panels for electricity generation
  - Installation of wastewater treatment infrastructure
- Construction/Assembly of first three residences, Club House, Swimming pools.

2.0 Project Operation Phase:
- Property Management
  - Management of coastal setback
  - Landscaping maintenance
  - Invasive species management
  - Pest control
  - Existing marina and boat house maintenance

6.2.1. Impact Assessment for Site Preparation and Infrastructure Development

Table 6.2: Summary of impact matrix developed for site preparation and infrastructure development (Ki'ama Bahamas project Elizabeth Island, Exuma)

Qualitative Criteria	Choices	Description
Nature	Direct	Direct impact on 1.0 acre for new road infrastructure and service areas. Roads will be of local stone construction and

		covered with permeable local sand/gravel mix. No concrete will be used.
TYPE	Positive Negative	With loss of some protected species (broadleaved), overall impact of site preparation will be positive. ➢ Protected species will be relocated where feasible to nature preserve areas, and within landscaped area, where possible, which will improve wildlife habitat. Application for permit to harvest protected trees will be made to the Forestry Unit, Ministry of the Environment and Natural Resources. Only 1.0 Acre of upland vegetation will be lost during road construction.
Likelihood	Certainty	Impacts and benefits will be the result once actions outlined are completed
Scale	Habitat – broadleaved evergreen forest. Island Environs	Positive impacts and better health of upland vegetation. Coastal strand and dune communities are not impacted. Removal of Invasive Species (Australian Pine – casuarina, and Hawaiian scaevola), will reduce seed sources on the island
Duration	Long Term	It is anticipated native plant communities will be stabilized in the upland area of impact
Reversibility	Irreversible	Natural ecological processes will be restored.
Overall Significance	Negligible	Impact barely visible in context. No dredging to the marine environment. Existing stage areas will be used for onloading and offloading of materials, equipment, and supplies. Site conditions are not altered to any significant extent.

6.2.2 Impact Assessment for Construction/Assembly of residences, Club House, Swimming pools.

Table 6.3: Summary of Impacts matrix for residences, club house and swimming pools (Ki'ama Bahamas project)

Qualitative Criteria	Choices	Description
Nature	Direct	Direct impact on 4.5 (9.8%) acres on upland vegetation (inclusive of select protected species) and wildlife habitat. Indirect impact on adjacent marine environment avoided due to intact coastal strand and dune communities.
TYPE	Negative	Loss of some protected species (broadleaved) and potential loss of habitat for wildlife species
Likelihood	Certainty	Impacts will occur

Scale	Habitat – broadleaved evergreen forest. Island Environs	Upland broadleaved species (inclusive of select protected species) will be loss. Relocation of protected species is recommended where practicable. Removal of Invasive Species (Australian pine – casuarina), and (Hawaiian sea lettuce), will reduce seed sources on the island
Duration	Temporary	If relocation plan for selected protected species is implemented
Reversibility	Irreversible	If site allowed to sit, and soil erosion occurs, the risks of invasive species being established is increased.
Overall Significance	Negligible	Impact barely visible in larger context of total area of project.

Table 6.4 summarizes the environmental impacts that are likely to occur for the Ki'ama Bahamas project, based on the Severity of Impact Criteria

Table - 6.4: Summary of Environmental Impacts based on Severity

Factor	Severity of Impact	Impact Description
Terrestrial	1	Removal of vegetation (i.e., dry broadleaved evergreen species, including selected protected trees species) for road infrastructure (limited to 12 feet in width) and residences will impact the natural landscape, resulting in the loss of vegetation (4.5 acres in total – 12.6% of total area of project) (**Figure 4.1**), but minimally. Also, no coastal or dune vegetation species will be affected.
Biodiversity (wildlife)	1	Due to the low footprint of the project development (6.5 acres – 18.2% of total – one residence per 1.28 acres – 28 residences in total), associated biodiversity (i.e., land animals, birds nesting sites) displacement impact is very low. Hence biodiversity impact is expected to be low, given the limited change in land use for construction of new roads, and footprint of residences and other buildings.
Avifuana	1	Noise levels generated by project activities may deter birds from utilizing sites temporarily, and birds and animals may return once construction activities are completed.
Visual and Aesthetics	3	Construction of residences, etc. will enhance the visual and aesthetics of the Ki'ama Bahamas project, given the low density of the residences and their locations, and eventual removal of all construction waste. (**Figures 2.4 and Figure 2.6**). Debris not removed adequately and timely, impairs the visual and aesthetics of the site for extended periods.
Coastal	1	The coastal environment (beach strand vegetation and sand dune formations) will not be impacted by project activities and will remain in its natural state. No construction will occur on dunes or wetlands. No dredging of marine environment. Existing staging areas (RO/RO) and

		floating marinas will be used.
Hydrological	1	Fuel, chemical spills, improper use of hazardous waste on project site can pollute groundwater resources. As ground aquifers will not be used as a source of potable water (use of R/O facility (Section) for Ki'ama Bahamas project, the likelihood of saltwater intrusion from over-extraction will not arise.
Erosion/Sedimentation	1	Whereas there will be some road construction, and drilling of foundational footing (point-load piers) for residences, there is the potential for some soil erosion and sedimentation at these footings. However, as the buildings will be elevated from the ground level the risk of higher levels of erosion is minimized, as such, the current drainage and runoff characteristics will not be changed.
Air Quality	3	Construction activities and use of associated equipment can generate significant volumes of dust that impair the air quality, and impact human health. There will be need to employ adequate management techniques to reduce impact to human health.
Noise	3	Noise levels tend to rise during construction activities, that disturb birds and animal species. Birds are likely to be displaced and leave the area, particularly where there nesting sites are disturbed. Human health is impacted by elevated noise levels. According to the CDC (2019), prolonged loud noise level exposure above 70dB may cause hearing damages.
Solid & Hazardous Waste	1	Solid waste that is not adequately disposed of can be an eyesore. In the case of hazardous waste, these can pose a threat to wildlife, and human health through attracting pests which are disease vectors. Hazardous waste not properly managed can also result in penetration into the soil, groundwater resources and marine environment (pollution).
Occupational Health and Safety	5	There are the risks of workers not wearing protective personal equipment (PPE). Additionally, the risk is high for the improper use of equipment and materials and non-compliance to standard safety protocols and procedures. Consequently, there could be physically damages and potential loss of human lives. The risk of contracting covid-19 is high where workers are in close proximately to each other.
Fire & Hurricane	5	Ki'ama Bahamas project site comprises predominantly of dry broadleaved evergreen formations, and silver thatch palms, which naturally shed leaves. Hence the forest floor can be covered with leaf litter and provide fuel in the event of a fire. Further, once humans are introduced to uninhabited areas, the risk for fires is likely to increase, especially when fires are intentionally lit, not

		controlled, or managed properly. As the Bahamas falls within the North Atlantic Hurricane Belt, with the season commencing June 1 to November 31. The risk of the Elizabeth Island (Ki'ama Bahamas project) being affected by a hurricane in any given year is relatively high. Hence the need for a Hurricane Preparedness and Recovery Plan.

6.3 Socio-economic Impacts

Table 6.5 below summarizes the socio-economic impacts that are likely to occur from the Ki'ama Bahamas project, based on the Severity of Impact Criteria

Table - 6.5: Summary of Socio-economic Impacts based on Severity Criteria

Factor	Severity of Impact	Impact Description
Land Use	1	Any development that brings change to the natural landscape will impact that landscape to a certain degree. The existing land use for the project site is residential. The development of the Ki'ama Bahamas project will require limited land use and removal of minimal natural vegetation. The project will afford the increase from one existing residence to a maximum of 28. Hence a low density of one residence for every 1.28 acres.
Economic (beneficial)	3	Ecolsland Elizabeth Ltd through the Ki'ama Bahamas project anticipates contributing to the revitalization of Exuma as one of the world's top touristic destinations, as a place for vacation, but also a conduit for economic growth and development. Projected investment in the Ki'ama Bahamas project is pegged at seventy-three million dollars (BSD$73,000,000.00). At full build, the project anticipates annually accommodating up to 36,000 guests spanning nearly 10,000 occupied room nights. This projection could entail nearly 5,000 round trip flights to the Bahamas Employ forty (40) jobs for Bahamians during construction and up to fifty (50) jobs for Bahamians during operations. Permanently employ 80 to 85 Bahamian resort skilled persons at completion. NIB contributions - BSD$800,000.00 The development team anticipates significant training opportunity for Bahamian talent in the fields of modular construction, solar power,

		desalination, water purification, and electric boat operation and maintenance - Entrepreneurial opportunities and Spin-Offs. The project anticipates providing up to $1.2MM in funding to Silent Catch – a non-profit organization focused on advancing sustainable fishing practices that is to be headquartered in the Bahamas. The organization will empower and train the local artisanal fishing community and local organizations to implement electric motors and solar charging thereby reducing the cost of local fishing and environmentally harmful externalities inherent to the practice. For example, this organization would work alongside the Bahamas National Trust team representing Mariah Harbour to benefit the local fishing fleet in the area. The overall economic impact to Elizabeth Island and by extension Exuma Island will be significantly positive and will contribute to a positive turn around in the tourism sector.
Cultural	1	No cultural resources were identified during field studies, and hence no impacts.

7. Proposed Mitigation Measures

Mitigation is how negative impacts identified are minimized, offset, or averted. This can be achieved through project design, restoration of disturbed areas, operational techniques, preventative management plans, and compensation for unavoidable impacts.

Table 7.1 below summarizes the mitigation measures recommended to minimize or eliminate any negative environmental impacts that may arise during Ki'ama Bahamas project development cycle.

Table - 7.1: Summary of Environmental Mitigation Measures

Factor	Mitigation Measures
Terrestrial	➢ The loss of potentially 4.5 acres of natural vegetation will be mitigated by the relocation where practical, the protected species identified within the footprint of the new road reservations and residences prior to construction activities. ➢ The existing nursery site on property will be expanded to accommodate the requirements for propagation of additional protected trees and native flowering plants. ➢ Protected trees removed will be staged temporarily at the expanded nursery, and transplanted within designated human altered areas, as mitigation for impacts of road reservation and residences construction activities.

	➢ Removal of all the invasive casuarina species Australian Pine (*Casuarina equisetifolia*) and Hawaiian sea lettuce *(Scaevola taccada)* from Human altered area and along the coastal areas. ➢ In areas where landscaping is being undertaken to plant native, flowering plants, and endemic species. ➢ Maintain the existing vegetation (80% plus coverage) so that they continue to function as wildlife corridors. ➢ Staff will be trained in the identification of protected trees.
Biodiversity	➢ The proposed footprint for the new road reservation is estimated at ½ acre in total area. The replanting of impacted flora and fauna habitats with native flowering and protected species within landscaped areas, and the avoidance of mangrove removals (particularly along the Red Mangrove Lagoon Formation area) by realignment of road reservation away from wetlands would offset any flora associated with the new access roads. ➢ There will be selective clearing of vegetation for road construction and building footprint (footing piers), rather than use of bulldozers. This action will minimize negative impacts to remaining vegetation and associated biodiversity. ➢ The expanded nursery will propagate the four protected mangrove species (red, white, black and buttonwood), should the need arise to reestablish any areas of mangroves impacted, along any coastal wetland suitable for mangrove restoration.
Avifuana	➢ Replanting of indigenous plants (protected species, native flowering plants, and fruit trees) used by fauna as food sources, within landscape areas for residences, and other human altered areas. ➢ Once all construction activities are completed, with reduced noise levels, it is expected that birds will return. ➢ Existing natural vegetation corridors along road reservations will be maintained with the intention to attract resident and migratory birds' species. ➢ Adequate natural vegetation areas exist (80 plus % of total landscape) and adequately supports the avian life on project site, whereby birds can forage and roast. ➢ Protected trees identified along areas subject to construction activities will be flagged for removal and replanting within landscape areas (a permit will be required from the Forestry Unit, Ministry of the Environment and Natural Resources, under the Forestry Act, 2010), or to be maintained, where feasible. ➢ Staff will be trained in the importance of birds, and not to interfere or harm the species in their natural environment.
Visual and Aesthetics	➢ Proper management and timely disposal of solid waste. ➢ Ensure land clearing is keep to a minimum (footprint of buildings). ➢ Use only native and endemic plant and tree species within

	landscaped areas of the development. No invasive plant species to be established on property.
Coastal	➢ Regularly maintain existing beach stand and dune vegetation along beaches and rocky coastline. ➢ Timely removal of invasive *Casuarina equistifolia* (Australian pine) and *Scaevola taccada* species (Hawaiian sea lettuce) plants
Hydrological	➢ As no groundwater resources are being utilized for potable water, the use of appropriately design R/O facility would avert any possible contamination of existing groundwater resources. ➢ Release of R/O effluence back into the sea (saltier than sea water) may impact marine life. R/O plant being proposed by Ki'ama Bahamas is an innovation, in minimizing the salinity of the brine by running on a lower recovery ratio. However, the brine effluence will be disposed of via deep well injection (**Appendix – D**) ➢ Adequate fuel and chemical management practices on site would ensure ground water resources are not negatively impacted.
Erosion/Sedimentation	➢ Land clearing will be undertaken manually to building and roads footprints limiting the solid waste generation. Existing footpaths will be enhanced and properly graveled. Protective handrails will be erected in areas of steep incline, to ensure safety of residents and visitors when navigating the landscape. This methodology reduces the likelihood of soil and sediment erosion.
Air Quality	➢ Employment of best management practices with regards to construction methods, to minimize emission of dust that can impair air quality. ➢ Maintain construction equipment to ensure air quality is not impaired.
Noise	➢ Construction workers will wear appropriate PPE (i.e., earplugs or earmuffs). ➢ High Noise levels will cause animals and birds to migrate elsewhere, however once construction activities are completed the animals and birds will return.
Solid and Hazardous Waste	➢ Solid waste generation will be limited to construction waste, and vegetation removal from road and residence footprint. ➢ Vegetation removed will be reused/mulched for landscaping purposes ➢ Solid and hazardous waste will be placed in containers and properly disposed of (removed to the mainland of Exuma Landfill Site) in accordance with Department of Environmental Health Services (DEHS) regulations and standards. ➢ Invasive species debris along with construction waste to be disposed

	to avoid inadvertent spread to other parts of Elizabeth Island
Fire and Hurricane	➢ Prepare a Fire Control and Prevention Plan, with detail steps to prevent, contain and control fires during construction and operation the residential resort (to include firebreaks and no smoking areas). ➢ All residences and associated buildings will follow fire requirements of the Bahamas Building Code. ➢ A Hurricane Preparedness and Contingency Plan will be developed in the event the island is impacted by a storm or hurricane (to include evacuation protocols, emergency and health provisions and recovery strategies).
Occupational Health and Safety	➢ All workers will be provided appropriate Protective Personal Equipment (PPE). ➢ All workers will receive training in the proper handling of equipment, before starting work on property. ➢ There will be regular enforcement of occupational health and safety protocols on a weekly basis. ➢ All workers will adhere to current COVID-19 protocols

8.0 Public Consultation Process

Public Consultation exercise will be conducted under the auspices of the Department of Environmental Planning and Protection, and in accordance with the EIA Regulations, 2020

9.0 Environmental Management Plan (EMP)

An EMP will be prepared for the project (drafted as a Standalone Document) and will cover the mitigation measures and monitoring. A draft outline and components are cited below. The EMP will be fully developed following No Objection to the EIA. Upon receipt of the No Objection to the EMP, the project will be issued a Certificate of Environmental Clearance (CEC) by the Department of Environmental Planning and Protection (DEPP). The CEC issuance would allow construction activities for the project to commence.

Executive Summary

A summary of the development project and proposed mitigation measures outlined

1.0 Introduction

Overview of project and location. Objectives of the EMP and scope with respect to mitigation measures

2.0 Project Description

Project is described, with location, inclusive of project master plan

3.0 Organization Chart and Communication Plan

4.0 Register of Significant Environmental Aspects

5.0 Environmental Legislation

6.0 Proposed Mitigation Measures

Mitigation measures are detailed as in project EIA, specifically in relation to the following:

6.1 Coastal

6.2 Hydrological

6.3 Erosion/Sedimentation

6.4 Air Quality

6.5 Noise

6.6 Solid and Hazardous Waste

6.7 Fire and Hurricane

6.8 Terrestrial

6.9 Ecology & Biodiversity

6.10 Occupational Health and Safety

7.0 Environmental Monitoring

7.1. Environmental Monitoring Checklist

7.2. Environmental Reporting

8.0 Conclusions

Conclusions remarks on implementing recommended mitigation measures

9.0 References

Citation of reference materials used in EMP preparation

10.0 Emergency Response Plans

10.1. Hurricane Preparedness and Recovery Plan

10.2 Health and Safety Plan

10.3. Fire Control Plan

10.4. Invasive Species Control Plan

11.0 Appendices

10.0 Conclusions Regarding Environmental Acceptability of the Proposed Project

Detailed and comprehensive baseline studies were undertaken in the assessment of the existing botanical, avian and biological resources of the Ki'ama Bahamas Project site on Elizabeth Island. The result is an environmental impact assessment (EIA) document which details the impacts that the low-density development of 28 solar residences and associated infrastructure will likely have on the natural pristine environment. The EIA identified no negative impact on the surrounding MHCNP, as its objectives are complementary to the management goals and objectives of the MHCNP, under management of the Bahamas National Trust (BNT).

The conceptual Masterplan prepared by the developers underscores their commitment to environmental conservation and resource sustainability with a low carbon footprint in the developmental phases of the project. Innovation and new concepts such as R/O facilities, Wastewater Management technology, low impact infrastructure development, silent (solar) modular homes (build on load-piers), design and use of natural sustainable material (bamboo, hardwood home construction), pool designs, silent net zero carbon solar powered yachts, no dredging to the marine environment, all presents a convincing case of innovation and sustainability. These innovations allow for the low negative impact on the existing environment, during construction and operational phases of the project. A projected 80% of the natural vegetation to remain in its natural state is a significant factor, as such type developments tend to be of higher density, and hence a higher percentage vegetation cover removal, and more negative effects on the overall environment.

With a projected capital investment of BSD$73,000,000, it is anticipated that the economic impact for Elizabeth Island and by extension Exuma Island will be boosted significantly. This boost will include new construction jobs, new entrepreneurial opportunities to provide goods and services, and new permanent jobs on the Island. The long-term sustainable effect will be a positive impact for the economy of Exuma.

It is anticipated that with proper planning, application of best management practices, and Mitigation Measures outlined in the EIA, incorporated within a comprehensive Environmental Management Plan (EMP), if conscientiously implemented, will minimize in the short-term any negative impacts identified from project development through to operations.

11. Recommendations

The following recommendations are highlighted below to underscore and reinforce the significance of understanding the measures necessary at minimizing the negative impacts on the existing environment, from the project development stages on to the operational phase.

a) Ensure that best management practices are employed during the construction phases, including practices that prevent soil erosion and sediment runoff.
b) Ensure permit to harvest protected tree species (for relocation/or removals from building footprints/ for infrastructure (roads, etc.) developments) is applied for and received from the Forestry Unit (Ministry of the Environment and Natural Resources), prior to any on site land clearing activities.
c) Expand the existing nursery to allow for the staging of relocated protected trees prior to replanting, and the propagation of additional protected species (including the four

mangroves' species), for replanting within human altered areas, to offset losses due to construction activities.

d) Remove invasive species (Australian pine and Hawaiian sea lettuce) from the human altered areas and the shorelines, in accordance with the National Invasive Species Strategy.

e) Planting and establishment of only native species within new landscape areas.

f) Maintenance of the remaining 80% plus of natural vegetation, thus ensuring continued biodiversity conservation and enhancement.

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13. Appendices

Appendix – A

Ki'ama Master Plan for development of the Residential Resort

SILENT RESORTS

Executive Summary

The world's first fully sustainable, zero carbon, solar-powered residence and yacht resort community

Ki'ama Bahamas – Master Plan

- 28 Solar Residences
- Whole and Shared Ownership
- Amenities
  - Clubhouse
    - Restaurant / bar
    - Fitness room
    - Game room
    - Swimming pool
  - Health & Wellness Spa
  - Protected Harbour (existing)
  - 8+ Solar-Powered Silent Yachts
  - Electric day boats
- Ultra-Low Impact – Only 18% of the island is developed
- Investment of $73,000,0000
- Employ up to 40 Bahamian construction workers
- Employ up to 50 Bahamian resort employees at completion
- Silent Catch: A local non-profit to support sustainable fishing, local culture, reef restoration, and mangrove preservation

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COMPANY PROFILE

NAME

EcoIsland Elizabeth LTD ("the Company") is incorporated as a Bahamian International Business Company and is owned by EcoIsland Elizabeth Holdings LTD, a BVI based company formed on December 31, 2021, as a company limited by shares. A copy of the Certificate of Filing under the file number is enclosed separately herewith. The Company will be beneficially owned by John Long, Steve Dering, and Greg Salley.

KI'AMA BAHAMAS

Ki'ama Bahamas, the first of a planned collection of Silent Resorts sustainable island and yacht communities will be entirely investor-owned upon full sellout of ownership shares. Investor/owners will purchase memberships that provide the right to stay in the island's residences for a minimum of 24 nights per year and will also grant access to twelve days on the Silent-Yachts. The Project will also include up to twelve estates homes for purchase. The investor/owners of EcoIsland can make their residences and yachts available for rental.

ECOISLAND DEVELOPMENT

EcoIsland Development, the venture developing and operating Ki'ama Bahamas, is the nexus of four real estate ventures: Silent Resorts, Equity Residences, Elite Alliance Real Estate, and Spectra Holdings. The team has in excess of 200 years of collective, institutional experience designing, developing, financing, and operating real estate projects in North America, the Caribbean, Southeast Asia, Africa, and the United Arab Emirates. Collectively, the team has facilitated the development and financing of over 35 real estate projects, raised and deployed in excess of $800 million into real estate offerings and generated in excess of $1 billion in real estate sales. The individual companies making up EcoIsland Development are global leaders in their respective real estate silos. The confluence of these expertise in sustainable development and construction, hospitality sales and operations, and capital stack optimization creates a truly unparalleled offering for the Bahamas and the Project's guests and owners.

CORPORATE ADDRESS

Per the attached Certificate of Filing
Nassau, The Bahamas

THE TEAM

Victor Barrett
Victor is the CEO and Founder of Silent Resorts. Sustainable development has long been a passion for Victor. When he discovered Silent-Yachts, the magic ingredients fell into place to combine an island, residences, and luxury yachts to create the world's first 100% solar-powered, fossil-fuel-free, resort community. Victor has extensive international development planning, architectural design, and technology experience. He has assisted developers and corporations in the successful development of sustainable luxury tourism projects in the U.S., Mexico, Caribbean, China, UAE, Southeast Asia, and Africa. Victor has successfully managed design/build logistics in remote and developing areas, utilizing location-specific value engineering. His mastery of pre-engineered and modular construction along with water purification, wastewater processing, and solar power systems, is especially valuable and cost-effective in beautiful but challenging locations.

John Long
John's passion for traveling and making smart investments led him to co-found Equity Residences, which has seen the successful launch and growth of two luxury real estate private equity funds. John has over 30 years' experience in management, consulting, and private equity. John, who holds an MBA from the Wharton School of Business and a Bachelor of Science from Rice University, began his career at McKinsey & Company and then personally advised companies on growth strategies, mergers and acquisitions, and new ventures. An avid traveler who's visited more than 50 countries, John currently lives in Playa Flamingo, Costa Rica with his family.

Steve Dering
Steve is the founding partner of Elite Alliance Real Estate. He pioneered the world's first private residence club (luxury fractional real estate ownership) at top-rated Deer Valley Resort in Park City, Utah. Subsequently, he structured and launched The Phillips Club in Manhattan, the world's first urban residence club and the highest grossing residence club in the world. Residence clubs created by Steve in the U.S. and internationally have generated more than $1 billion in sales. Steve was a member of Deer Valley Resort's first executive team; has been a featured speaker at international symposiums; quoted in the New York Times, Business Week, and Conde Nast Traveler; and was featured in two business books that included case studies of well-known business innovators in diverse industries.

Adam Lloyd
Adam Lloyd is the co-founder and CEO of Spectra Holdings. Adam has over twenty years of experience in real estate with a focus in operations and finance. Prior to founding Spectra, Lloyd worked as a consultant and advisor to the executive management team of a large real estate investment product sponsor through his firm Peachtree Street Advisors, LLC. From 2002 to 2012, Lloyd worked for Wells Real Estate Funds, Inc., a national real estate investment management company that has invested more than $12 billion in commercial real estate for more than 300,000 investors in 18 publicly registered and 12 private investment programs.

COMPANY PROFILE AND PROJECT PARTNERS

The Team

Greg Salley
An experienced investor, management executive and consultant, Greg co-founded Equity Residences, a private equity fund, and successfully launched and grew the Equity Villa Fund and Equity Platinum Fund for the benefit of over 225 investors from around the world. Prior to his career as a real estate investor, Greg had executive management experience in private equity, business development, business strategy and mergers and acquisitions – both US and international.

Virginia Brown
Virginia has over ten years of legal experience in various roles in financial services, acquisition services, as well as representing REITs, BDCs, and other alternative investment vehicles. She has represented clients in public and private offerings of securities; ongoing securities law compliance, including SEC reporting and disclosure requirements and corporate governance matters. Virginia is a member of the State Bar of Georgia.

Jed Linsider
As Chief Investment Officer and Senior Vice President at Spectra Holdings, Jed Linsider oversees the firm's overall investment strategies, acquisitions, dispositions, asset management and financing strategy. He also serves as the portfolio manager of Vintage Funds with responsibility for the investment, asset management, financing and disposition strategy of more than $80MM of equity invested, as well as managing more than $400MM of real estate assets over four years. Linsider has more than 20 years of experience in real estate and capital markets activity, as well as strategic and financial planning.

Patty Kennedy
Patty Kennedy has more than twenty years of experience in conservation and environmental planning. She acted as the director of conservation management for the North American Land Trust, crafting and implementing conservation management strategies for protected lands. Prior to that she was the executive director of the Beaufort County Open Land Trust, where she successfully advanced local land protection for the Trust and Beaufort County's Rural and Critical Land Program.

Daniel Maloon
Daniel Maloon is responsible for leading and facilitating real estate acquisition and development projects, project due diligence, financial analysis, market research, and presentation development. Daniel has underwritten in excess of $2 billion in commercial and residential development opportunities in the United States. He also facilitated the design and pre-development process for more than $1 billion of hospitality, office, residential, and retail developments.

PROJECT PARTNERS

TAS Architecture, led by Mike Moss, is an award-winning architecture, design and consulting firm based in Nassau, Bahamas. Their work is inspired and informed by a culture of curiosity and discovery, with designs that have purpose, and create a positive change in people's lives.

Spectra Holdings is a next generation real estate development and private equity company. Spectra believes that development opportunities should not be judged on economic viability alone, but that the responsible use and preservation of natural resources should be equally considered.

Silent-Yachts is the world's first and only producer of 100% solar powered luxury yachts, with over a dozen yachts on the ocean, and nearly 40 in production. Silent Resorts is the exclusive partner for the development of solar powered resorts, real estate, and marinas worldwide.

Elite Alliance has set the standard for excellence in luxury fractional real estate, boutique hospitality management and luxury vacation home exchange. Always guided by commitment to integrity and innovation, Elite Alliance Real Estate has introduced residence clubs around the globe. Elite Alliance Hospitality provides robust hospitality and rental management services for residence clubs, hotels, resorts, and mixed-use developments. Elite Alliance Exchange has earned a first-class customer service reputation in facilitating and coordinating luxury home vacation exchanges.

Silent Catch is a non-profit organization founded by Silent Resorts to provide funding, education, and technology for the electrification of local artisanal fishing fleets and to support reef and mangrove restoration and protection.

The Oceans Project team is helping fishing communities and diving centers with marine protection and restoration of their local ecosystems. They have recently completed a reef report for the waters off Elizabeth Island, which can be seen in this presentation.

DESCRIPTION OF PROJECT

The Ki'ama Bahamas team is a true innovator in the luxury vacation and island resort/residential market and is very excited to present to the Bahamas Investment Authority our proposal for the development of Ki'ama Bahamas, its first Silent Resort location. The team is creating the world's first integrated land/sea, ultra-sustainable, exclusive, secure, 100% solar-powered, luxury and adventure resort and residences. Our proprietary relationship with Silent-Yachts, the world's first and only 100% solar powered yachts, and our unique ultra-low-impact zero-carbon building and infrastructure systems, will allow our guests and owners to enjoy the planet's most pristine and undiscovered destinations without harming the environment.

In this document, we will outline our development methods and show how our project will provide the following benefits:

- Leave over 80% of the island undisturbed and reserved for natural habitats
- Remove invasive plants and fully preserve protected species
- Develop with zero foundation excavation or fill
- Build with "carbon negative", modular, all-natural heavy timber and near zero construction waste
- Deploy a decentralized, redundant, and zero-carbon island infrastructure
- Preserve all mangrove and shoreline habitats

Our philosophy is to employ the natural environment as the chief design director. We are eager to fully engage with the government of the Bahamas to create an island development that will serve as a global example for sustainable development.

Ki'ama Bahamas offers its guests and owners sustainable luxury and adventure, while contributing to the preservation of the environment. Our resorts eliminate 100% of carbon emissions caused by typical resort development, operations, and yacht use.

Silent Resorts is a global brand that allows its owners and guests the opportunity to:

"Live Fully" – in the world's most pristine places blessed by the most dazzling aquatic experiences.

"Tread Lightly" – to do no harm to the environment and leave the surroundings the way we found them or better.

"Stay Silently" – to experience nature undisturbed by the sounds of fossil fuel engines and generators, leaving the environment unpolluted by their exhaust for the benefit of humans, flora, and fauna.

The key environmental benefits offered by our development and operations technology and business model include:

On The Sea:

- Luxury yacht cruising aboard Silent-Yachts Solar Electric Catamarans that eliminate the use of fossil fuel and its dangers not only to the global climate, but to also the delicate and pristine waters of the Bahamas
- Caribbean's first 100% electric day boats
- Our Silent Marina at Ki'ama Bahamas is 100% solar powered for charging electric boats and needs no fuel storage or dispensing equipment

On The Land:

- All residences and other accommodations and amenities are fully and independently solar powered
- Highly efficient water purification and desalination systems
- Advanced wastewater treatment systems require no power to operate and produce purified effluent that is used for landscaping and organic farming irrigation

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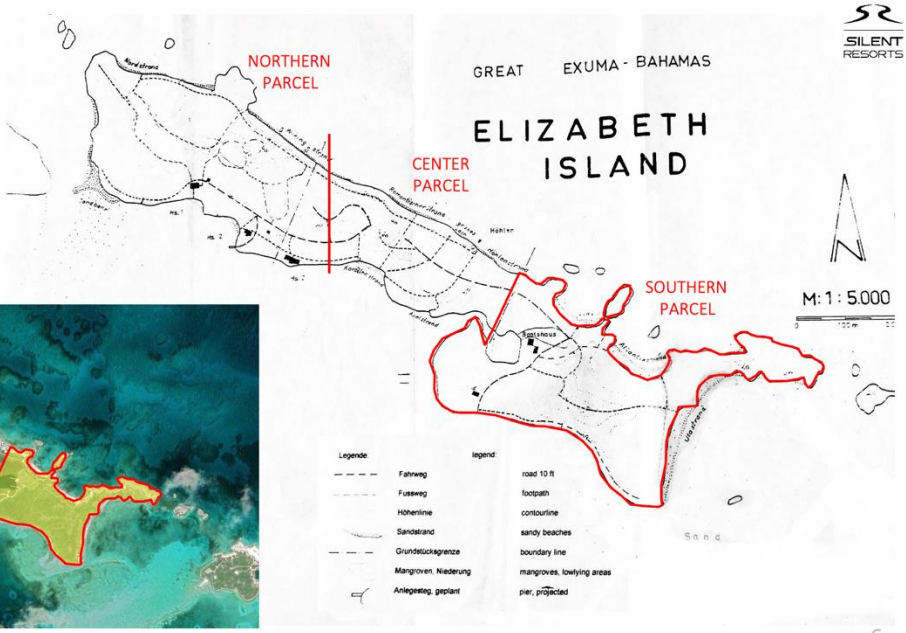
LOCATION – OVERVIEW

The Project will occupy the southern end of Elizabeth Island, the Southern Parcel, consisting of 36 acres with an existing marina, docks, boathouse, and four-bedroom residence.



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LOCATION – ISLAND ACCESS

Ki'ama Bahamas' location on Elizabeth Island is well-positioned to benefit from the expanded Exuma International Airport for convenient access via the newly paved road to George Town.

From George Town Dock, guests will take our all-electric day boat to the island, a short 10-minute ride.

SUPPORTING GROWTH

EXUMA AIRPORT EXPANSION

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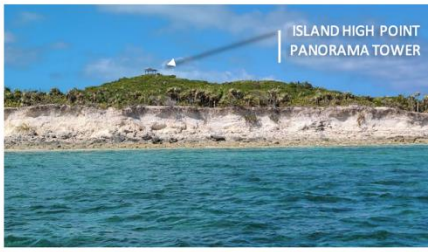
LOCATION – ISLAND PHOTOS



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LOCATION – ISLAND PHOTOS

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LAND REQUIREMENTS AND MASTERPLAN

Ki'ama Bahamas' masterplan provides for a maximum of 28 detached residences. The residences will range from three- to six-bedrooms, providing a low unit density of one residence per 1.29 acres. Maximum "keys" or bedrooms on the island will be limited to 140 or 3.9 per acre.

Utilizing the Silent Resorts "tread lightly" construction methods will result in a very high ratio of undeveloped island land areas of over 80%.

Sensitive topology at the highest elevations and the lowest, as well as all coastal dunes, are left undeveloped. All residences are constructed on piers and raised above the existing topology and vegetation, allowing light to reach all areas while providing for free inter-island movement of all terrestrial animal and insect life.

No excavation or filling of any areas is planned, and all natural drainage corridors and aquifer recharge areas will be left undisturbed. There is no construction activities of any kind within the coastal, beach, or mangrove zones.

New access roads are kept to a width of twelve feet or less and will be constructed of local permeable materials. Only small electric vehicles are permitted on the island.

Slides 17 through 25 provide technical detail related to sustainable construction methodologies and the significant progress made in implementing these cutting-edge solutions/technologies into the root of our design and program.

AREA USE	ACRES	%
UNDEVELOPED LAND AREA		
A – Permanent Nature Reserve	8.0	22.3%
B – Buttonwood Grove Preserves	1.0	2.8%
C – Mangroves & Marina Basin	2.0	5.6%
D – Undisturbed Areas & Existing Trails	17.0	47.5%
E – Organic Gardens	1.3	3.6%
TOTAL:	29.3	81.8%
DEVELOPED LAND AREA		
F – Landscaped/Cleared Areas	2.0	5.6%
G – New Roads	1.0	2.8%
H – New Construction Land Coverage	3.5	9.8%
TOTAL:	6.5	18.2%
PROJECT TOTALS:	**35.8**	**100.0%**

The Silent Resort Master Plan leaves over 80% of the island undisturbed and requires no relocation of protected species. Sensitive topology at the highest elevations and the lowest, as well as all coastal dunes, are left undeveloped.

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SILENT-RESORTS

Solar Residences

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SILENT-RESORTS

Master Plan

Master Plan

A – Arrival Dock & Marina

B – Beach Club / Health & Wellness

C – Club Ki'ama Shared-Ownership Residences

D – Solar Residences Whole-Ownership

E – Organic Gardens, Back of House, and Utilities

F – Future Development

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SILENT-RESORTS
Master Plan
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MANAGEMENT AND PERSONNEL REQUIREMENTS

While Ki'ama Bahamas will primarily engage Bahamian professionals and employees, the Project will also require the experience and the expertise of non-Bahamians in both the construction and operational phases of the Project. In this regard, it is anticipated that no less than twenty work permits will be required over the construction and operation phases of the resort. These individuals will provide adequate training for advancement of local employees to managerial positions and skilled trades labor.

For yacht operations, it is anticipated that both foreign and domestic captains and crew will be employed initially, with the long-term goal for a majority of permanent crew to be Bahamian. In addition, the Project team anticipates the creation of several spin-off and subsidiary businesses in the building technology sector, as well as the maintenance and repair for solar electric systems on land and our yachts that could be managed and owned by Bahamian entrepreneurs. Please see the 'Economic Impact and Business Plan' section for an expanded narrative regarding entrepreneurial opportunities. All staffing projections are derived from assumptions relying upon current market conditions and are subject to variation.

EMPLOYMENT PROJECTION

SILENT RESORTS

During the construction phase, Ki'ama Bahamas will employ a local Bahamian Project Manager who will hire subcontractors and tradespeople to perform all construction activities. In addition, during certain phases of the Project, non-Bahamian senior management will be required on a non-permanent basis. It is estimated that during the construction phases an average of approximately 40 Bahamian skilled tradespeople will be required to be working on the Project full-time during the five-year anticipated buildout of the Project. The fully completed and operational resort will require a permanent staff of approximately 70 to 75 personnel.

Employment Projections by Category	2022	2023	2024	2025	2026
Construction Workers	25	45	55	45	25
Construction Management	1	2	2	2	1
Operations General Manager		1	1	1	1
Assistant Managers / Reception	1	2	2	2	3
Housekeeping	1	4	8	8	10
Chef & Kitchen Staff	2	3	4	6	6
Wait Staff	1	2	4	6	6
Concierge & Valet	1	1	1	2	2
Marina Operations & Water Sports	1	2	2	2	2
Building Maintenance		2	2	4	6
Yacht & Boat Maintenance	1	2	3	3	3
Yacht and Boat Crew	2	6	10	14	20
Security	1	1	1	2	2
Local Sales Representative	2	2	2	2	2
Landscaping/Organic Farm Staff	2	4	6	6	6
TOTALS	41	79	103	105	95

ENVIRONMENTAL IMPACT – OVERVIEW

SILENT RESORTS

The Environmental Management Plan (in progress) for Ki'ama Bahamas is rooted in its Carbon Negative Construction, Zero Emissions Resort Operations, and Ultra-Low Emissions Yachting. The following detail provides technical insight into each of these key initiatives:

Carbon Negative Construction

Residences and other structures are built using our unique pre-engineered modular system:

- Proven system utilizing sustainable harvest hardwood timber
- Near zero construction waste on site
- Controlled cost and build schedule
- On-site labor reduced to a minimum
- Our 4,000 square foot structural timber Silent Residences store over 264,000 pounds (132 tons) of carbon each, the equivalent of what would be released by burning 46,200 litres of diesel
- A completed Silent Resort can potentially sequester over 5,000,000 pounds of carbon, the equivalent of 875,000 litres of diesel

SEQUESTER 2,500 Tons of Carbon

Zero Emissions Resort Operations

The Project operates on 100% solar energy:

- Conventional island resorts depend on diesel fueled generators for power
- Silent Resorts uses a proprietary "Silent Solar Grid" that integrates the solar systems on the island with the solar systems on the yachts.
- This yacht/island power-sharing and balancing eliminates the need for back-up diesel generators
- Fuel Cell back-up power
- A diesel generator emits 2.5 pounds of carbon per kWh
- A Silent Resort will use an average of 750,000kWh of power per year, saving over 1,875,000 pounds of carbon, the equivalent to 330,000 litres of diesel

ELIMINATE 930 Tons of Carbon Emissions per Year

Ultra-Low Emissions Yachting

Yachts are 100% solar powered:

- Yacht fleet is 100% solar/electric
- The yachts carry an emergency diesel generator to charge the batteries while at sea in the event of an extended period of low sun conditions or the need for extended high-speed cruising
- A 60- to 80-foot motor yacht running an average of 1,000 hours per year can burn 100,000 litres of diesel
- Assuming a 95% diesel savings per yacht, a Silent Resort average fleet of 8 yachts can save up to 720,000 litres of diesel per year, or the equivalent of 4,000,000 pounds of carbon

SAVE 2,000 Tons of Carbon Emissions per Year

ENVIRONMENTAL IMPACT – MITIGATION, SUPPORT, AND BUILDING TECHNOLOGIES

SILENT RESORTS

As indicated in the previous sections, the environmental impact to the local flora, fauna, and surrounding waters is extremely low. Key points that would normally need to be mitigated and studied as to the effect on the environment for typical development projects are addressed as follows:

- Removal, cutting, and clearing of native vegetation that affect wildlife habitats
  - All structures will be built on point-load piers which will be anchored to the natural rock of the island with minimal excavation for setting of piers.
  - The trees and plants under the new structures will be trimmed down and left in place. Only selected areas for the installation of water storage and utilities under the structure will be leveled and covered. This coverage amounts to just over 9% of the total site land area.
- Excavation and filling that will alter the current run-off and stormwater drainage
  - No change to the island topography is required. All new construction will be elevated, and the current drainage and runoff characteristics will not be materially changed.
- Roadwork that will create impervious surfaces, increased run off
  - All new access roads will be private and limited to twelve feet in width. Material will be local stone. For shaping and contouring required, the stone will be covered with a permeable, local sand/gravel mix. No concrete or asphalt will be used.
- Retaining walls, large foundations structures, and raised roadways that will impede the free movement of ground dwelling animals
  - No area of the island will be blocked or made impassable to the native ground dwelling animals on the island.
- Overwater docks and structures that will shade and disturb the seabed
  - No new overwater docks, piers, or pilings will be constructed.
- Clearing of mangroves
  - No clearing of mangroves will be conducted. All existing mangrove areas will be preserved as natural habitat.
- Reshaping beaches or the construction of rock jetties and breakwaters
  - No construction activity of any kind, temporary or permanent, will be conducted on any beaches. No breakwaters, jetties, or rock abutments will be constructed into the surrounding waters.
- Insensitive multi-story construction that will be visually intrusive
  - All construction will be limited to one story and placed within the landscape and topology to respect the views to and from the island.
- Construction on top of dunes, hilltops, or in wetlands
  - No construction will take place on dunes, or over wetlands. All buildings will be located below the highest elevations on the island as to not break the natural top ridge of the island. An existing observation tower/platform will be repaired and will not exceed a size of twenty feet by twenty feet nor a height of twenty feet above the island's highest natural elevation.
- Protected and invasive plant species
  - A full island inventory of the existing trees and plants will be conducted, and the masterplan adjusted as required. Initial surveys have found Buttonwood groves on the island, and these will be preserved as indicated on the master plan. Invasive species will be dealt with in the manner recommended by the Forestry Department.
  - An extensive area of the island has been designated as permanent reserve and will be used as to relocate any protected species if it is needed.

Cutting-edge and sustainable building technologies and systems are at the forefront of Ki'ama Bahamas' mission to provide a sustainable resort community where guests can 'Live Fully', 'Tread Lightly' and 'Stay Silently'. The Ki'ama Bahamas team intends to include the following sustainable innovations in building systems and methodologies in its development plan.

- 'Carbon Negative Construction' via sustainably harvested hardwood and heavy timber construction
- 'Silent Island Grid' – integrated high output solar electric systems
- LAVO Systems' hydrogen battery back-up system
- High efficiency water purification and solar-powered processing systems and pumps
- Non-invasive water storage 'bladders'
- BIOROCK's zero-power, silent, odorless wastewater treatment system
- Silent-Yachts and X Shore Dayboats – solar powered yacht fleet and all-electric dayboats, which collects and reports environmental data from water
- Modular, pre-fabricated structures
- Minimal concrete in pool construction
- Pre-engineered, zero on-site waste structures
- Minimal use of concrete
- All natural materials (fabrics, bamboo, timber, reclaimed wood) for structures and interiors

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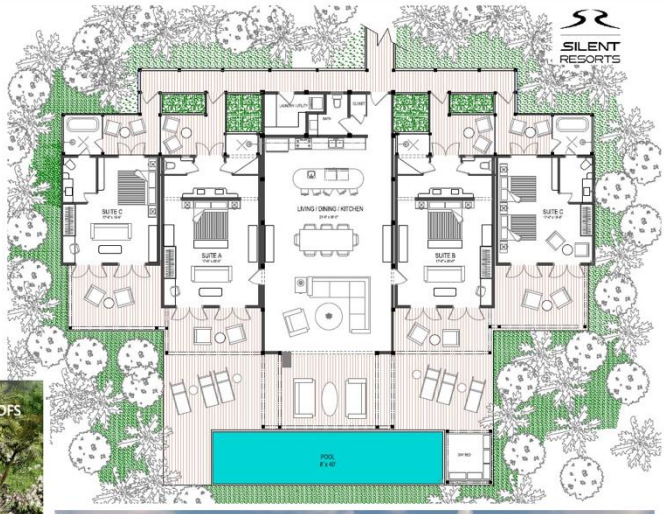
SUSTAINABLE DESIGN

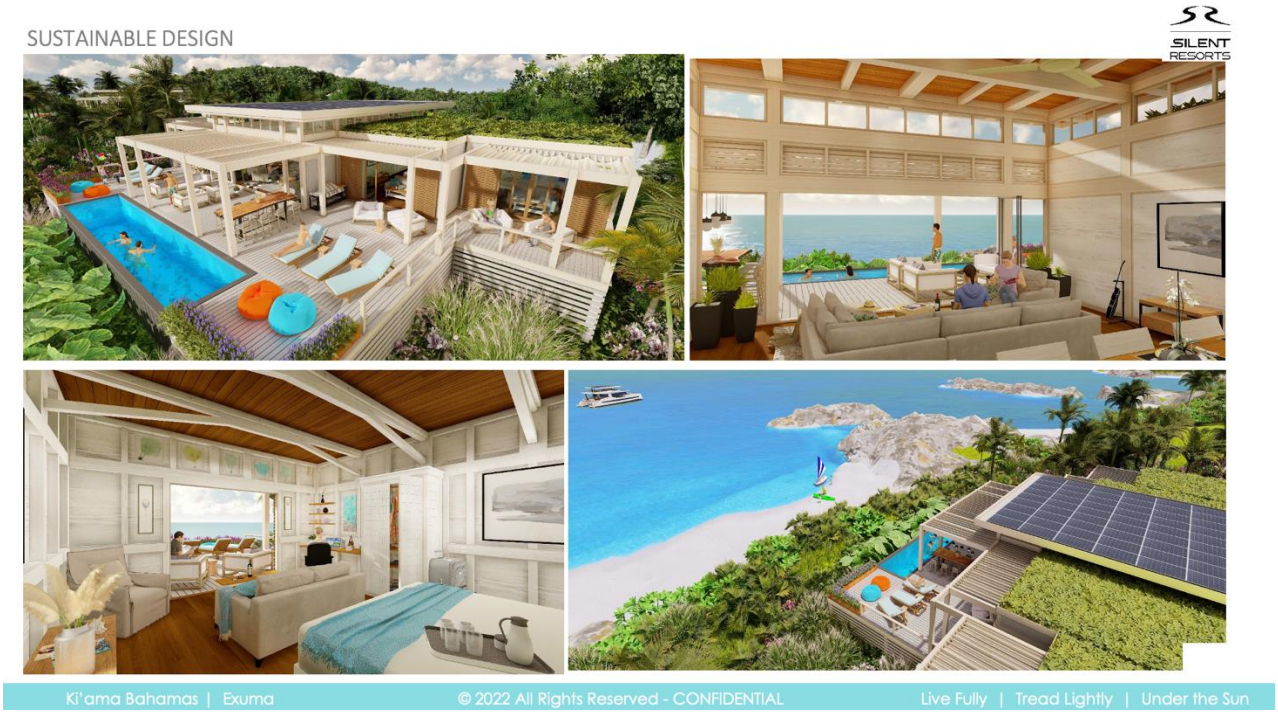
SILENT RESORTS

RESIDENCE DESIGN

The Ki'ama Bahamas residences will range from three to six bedrooms. The design incorporates the following key features:

- To better respect the island topology, our residence designs are linear to allow the construction to follow the natural contours of the sloping land
- The residences are one-story, and the ceiling heights are ten- to twelve-feet to provide for enhanced ventilation and light
- All bedrooms are ensuite with private work desks and ample closets
- Utilities and storage will be in twenty-foot shipping containers that will be located below the residence and not visible. These steel containers provide secure storage and shelter during any storm event.
- The structural timber fame and opening protection will be designed to withstand a CAT 4 hurricane, and heavy timber is naturally insect and fire resistant.
- Solar panels will be located on the flat roof areas and shielded from view.
- Roof areas that do not have solar panels will be fitted with a "living roof" system
- All lighting is controlled by a Silent Residence Smart House App. Only warm white color LED lighting is used. Exterior lighting will be "Dark Sky" compliant.

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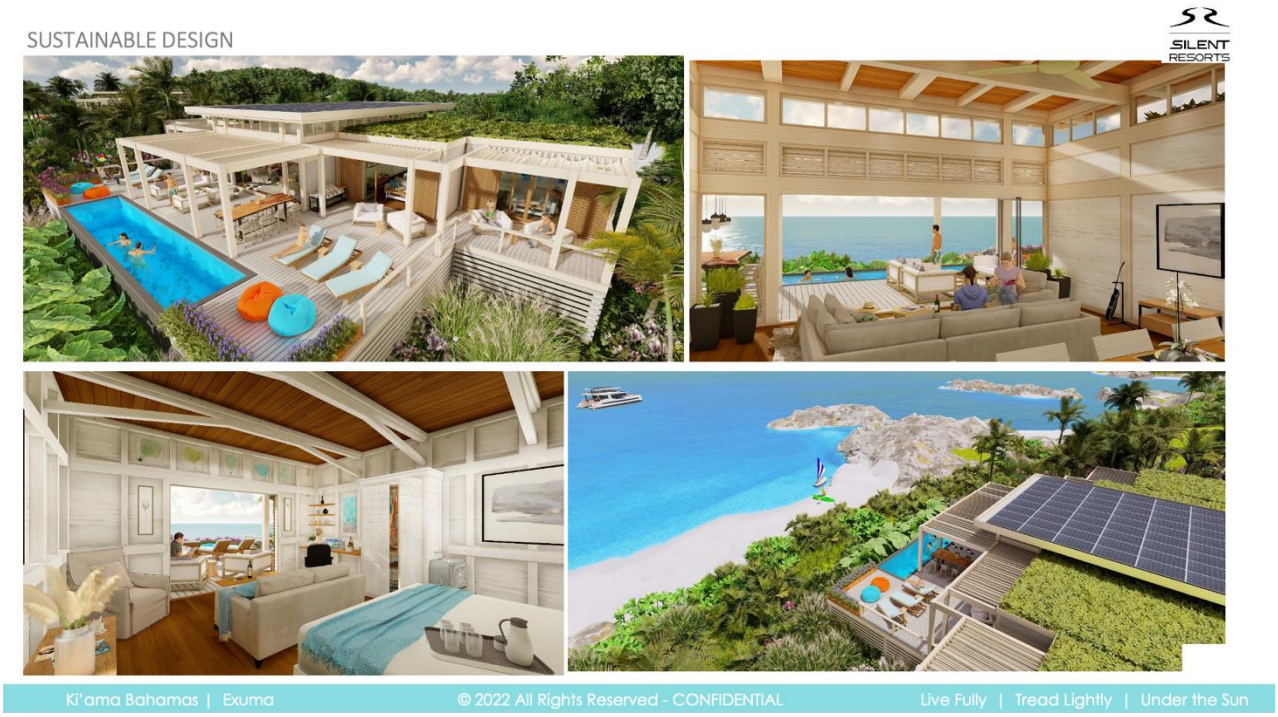
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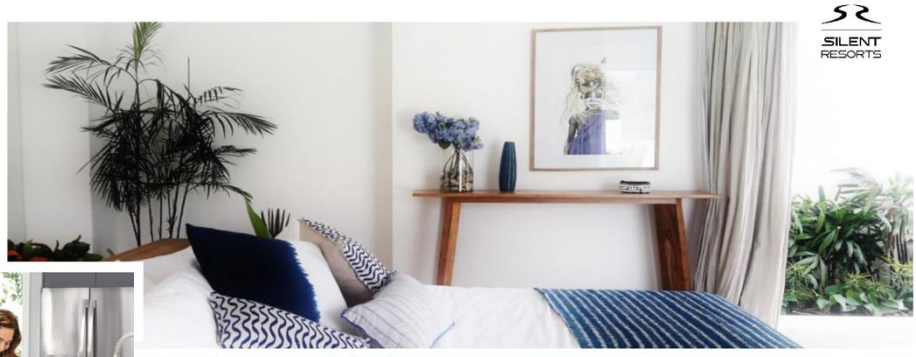
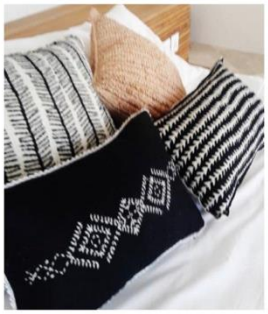
SUSTAINABLE DESIGN

INTERIOR DESIGN

Ki'ama Bahamas interiors will be handcrafted from all natural materials, including cotton fabrics and reclaimed wood.

- Island-inspired tropical designs from Bali and the Caribbean
- Solid wood cabinetry uses no artificial materials or fiberboard
- Durable stainless-steel appliances
- Energy efficient cooktops are standard
- Smart Kitchens





SUSTAINABLE CONSTRUCTION & INFRASTRUCTURE

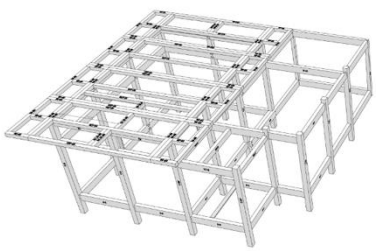
SUSTAINABLE HARVEST TROPICAL HARDWOOD HEAVY TIMBER CONSTRUCTION

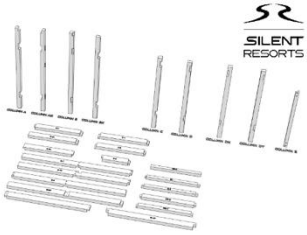
Ki'ama Bahamas residences and other structures will be built using our unique pre-engineered modular system:

- Proven system utilizing sustainable harvest hardwood timber
- Near zero construction waste on site
- Controlled cost and build schedule
- Efficient use of skilled on-site labor
- Our 4,000 square foot structural timber Silent Residences store over 264,000 pounds (132 tons) of carbon each, the equivalent of what would be released by burning 46,200 litres of diesel.
- Upon completion, Ki'ama Bahamas can sequester over 10,000,000 pounds of carbon, the equivalent of 1,750,000 litres of diesel.

QUALITY EMPLOYMENT, NEW SKILLS, AND NEW OPPORTUNITIES

The Ki'ama Bahamas team is committed to building in the most ecologically sensitive and efficient way possible. During the construction of Ki'ama Bahamas, the Project team and our building technology partners will be looking to create long term relationships with local Bahamian companies and entrepreneurs to bring these technologies and methods to the greater Bahamas market.





CARBON NEGATIVE CONSTRUCTION

As opposed to concrete, steel, and aluminum, which are all extremely energy intensive and are among the biggest contributors to greenhouse gas emissions and global warming, heavy timber is actually "carbon negative". Trees removes carbon dioxide from the air and for as long as those trees are not burned or decay on the forest floor, they hold that carbon forever. As the numbers above to the left illustrate, our sustainably harvested timber takes carbon out of the air and allows for new trees to grow and absorb more carbon, reducing atmospheric carbon dioxide.

SUSTAINABLE CONSTRUCTION & INFRASTRUCTURE

'TREAD LIGHTLY' AMENITY DESIGN

The Ki'ama Bahamas Beach Club, Spa, and Restaurant amenities will be uniquely constructed in our signature *"Tent & Timber"* buildings.

Made of the highest quality natural fabrics, bamboo, and timber, these structures are very light in their impact to the environment yet engineered to withstand the tropical environment.

Built to withstand tropical storm winds, and with a twenty-year canvas guarantee, in the event of a hurricane, fabrics and furnishings can be removed, and the steel frame structure is designed to withstand the strongest of gales.

SUSTAINABLE CONSTRUCTION & INFRASTRUCTURE

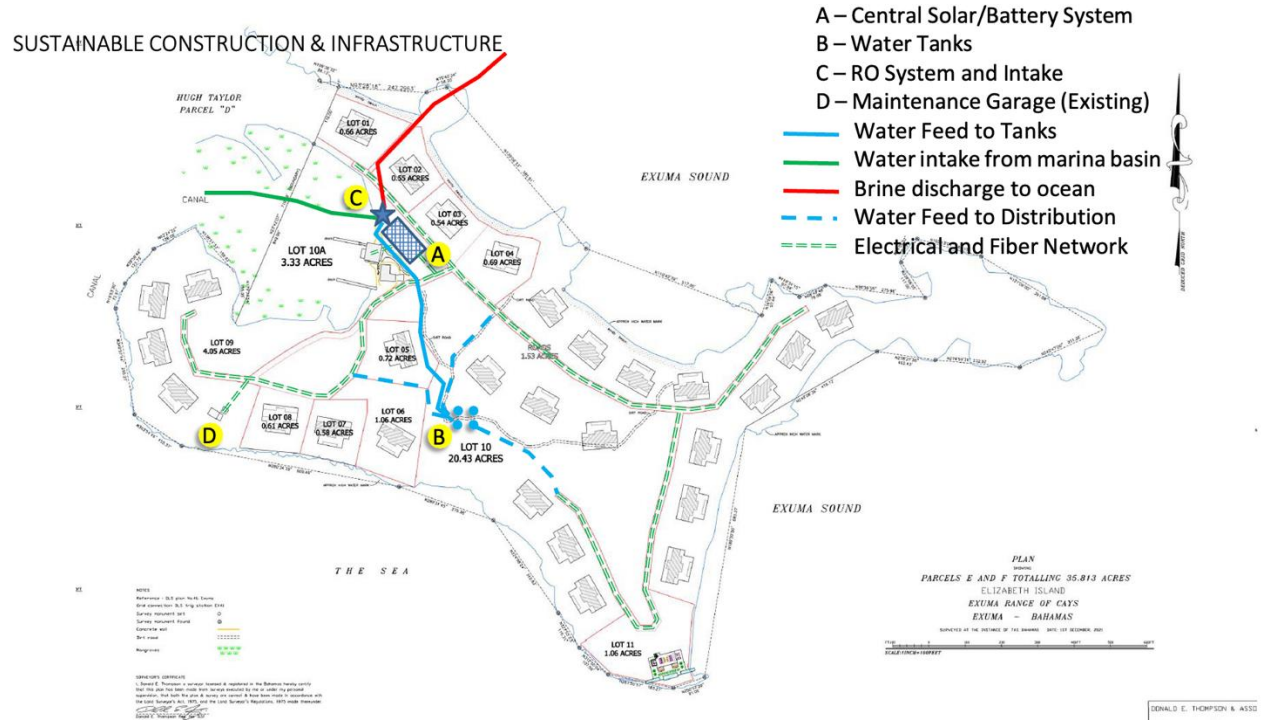
MINIMIZING THE USE OF CONCRETE

The traditional construction of pools use lots of concrete; needs extensive foundations, excavation, and steel reinforcement; and produce lots of construction waste.

Ki'ama Bahamas pools are made from recycled shipping containers and are completely self-contained with all pumps, filtration, and electronics. The pool is set on piers just like the residences and integrated into the topology and landscape with no excavation or fill.

TRADITIONAL POOL CONSTRUCTION

MODULAR POOL INSTALLATION



SUSTAINABLE CONSTRUCTION & INFRASTRUCTURE

MANAGED HIGH EFFICIENCY WATER PURIFICATION

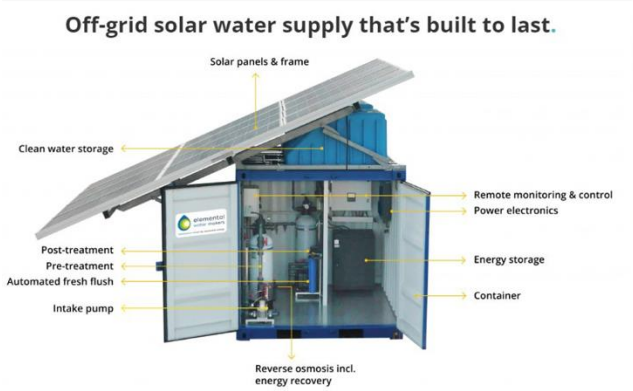
The is no surface water on the proposed site. The community water supply will be obtained by advanced seawater desalination.

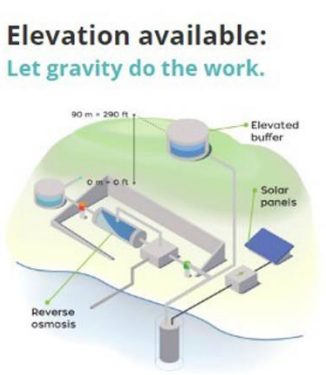
All groundwater resources in the Bahamas is subject to possible contamination during storm surge events, and depletion. Our water system produce water directly from unlimited sea water.

Water desalinization and purification will be conducted by very high efficiency marine grade equipment that has been proven to be robust and energy efficient. All water processing systems and pumps will be powered by solar electric.

Sustainable desalination is more than only using solar energy to power the desalination unit. This is how we turn the growing promise of seawater into something 'sweet' for generations to come:

- Minimizing the salinity of the brine by running on a low recovery ratio
- Minimize the local impact by small-scale decentralized projects
- No chemicals are involved by avoiding the use of antiscalants & CIP
- 70% less energy is required due to energy recovery.
- Solar energy to avoid the use of fossil fuels





- Solar energy Reverse Osmosis
- Uses gravity-assisted storage
- Lowest operational expenses
- Makes use of natural elevation
- 24/7 water production
- Reduced brine impact

SUSTAINABLE CONSTRUCTION & INFRASTRUCTURE

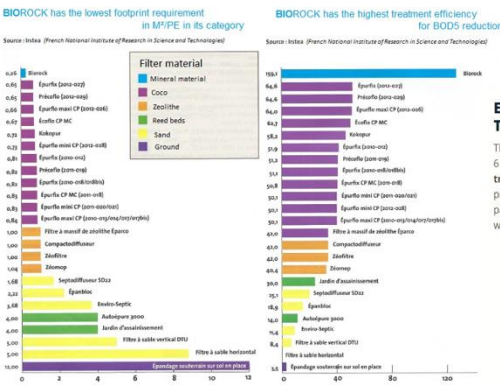
ZERO POWER ADVANCED WASTEWATER TREATMENT SYSTEM

The BIOROCK system used throughout our development is totally silent and odorless, calls for minimal annual maintenance, and is barely visible. The resulting water is 100% recycled for irrigation of landscape and organic gardens.

Again, in keeping with our methodology of no excavation or filling on the island, the wastewater treatment systems will be located under the raised structures. There are no in-ground septic systems that can leak into and pollute ground water.

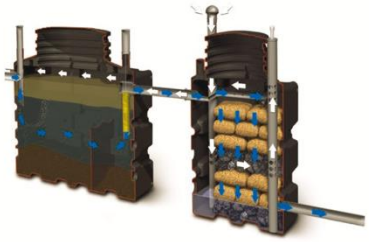
Like our solar electric and water purification systems, the wastewater treatment is modular and fully redundant, while fully scalable to provide service for the entire resort as it is fully built out.

As indicated in the chart below, BIOROCK has the smallest footprint, and highest treatment efficiency of any sewerage treatment system.



ECOROCK, A Non-Electric Two Stages Wastewater Treatment Plant

The ECOROCK unit is a small-sized wastewater treatment plant that caters from 6 to 30 persons application. The ECOROCK-system functions **as a two-stages treatment plant**. The raw sewage first enters a Primary tank to provide preseparation and initial breakdown of organic solids. The wastewater then passes through an effluent filter before discharging into the BIOROCK unit itself which incorporates the aerobic filtration process.



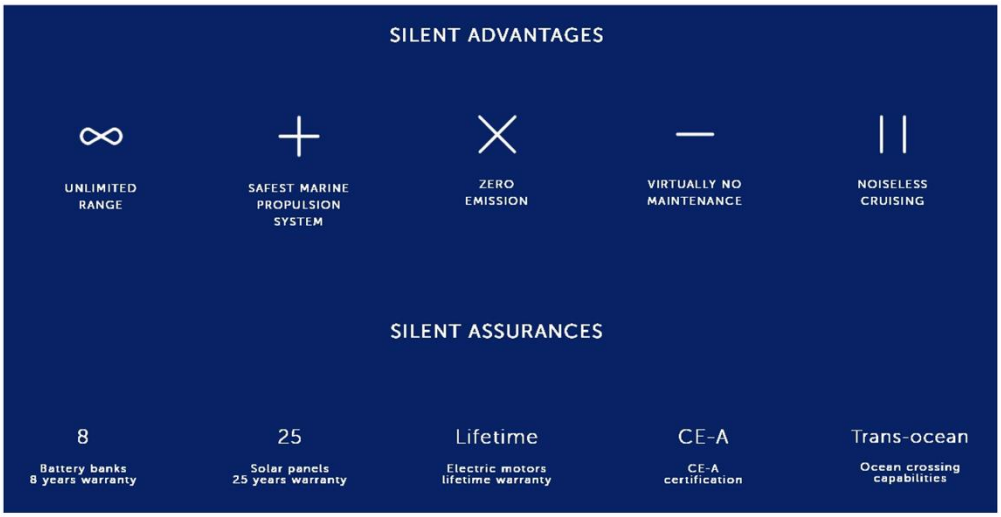
SILENT-YACHTS AND ELECTRIC BOATS

ZERO EMISSIONS LUXURY YACHTING

Ki'ama Bahamas will be the first in the world to utilize an all-electric fleet of luxury yachts and day boats. The Project team has partnered with the world's only proven and production solar yacht builder to bring the very first of the next-generation 100% solar-electric Tri-Deck super yachts to the Bahamas.

Ki'ama Bahamas owners and guests will be able to explore the Bahamian waters in silence, luxury, and completely fossil fuel free.

Ki'ama Bahamas will have an international fleet of eight to ten Silent Yachts, both 60- and 80-foot models, for charter use in the Bahamas.



SILENT-YACHTS AND ELECTRIC BOATS

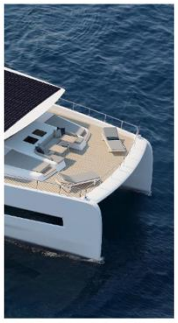
THE SILENT 60 LUXURY SOLAR CRUISER





SILENT-YACHTS AND ELECTRIC BOATS

THE SILENT 80 SUPER YACHT SOLAR CRUISER




SILENT-YACHTS AND ELECTRIC BOATS

THE X SHORE ALL-ELECTRIC DAYBOAT

Our first X Shore is in the Bahamas and cruising the waters of Exuma. From its 100% electric motor to the low impact materials it's built with, the X Shore embodies the start of a more sustainable maritime tradition. With electric power, toxic fumes and disruptive noises vanish and it produces no carbon footprint compared to fossil fuel engines, which helps combat climate change. In keeping with Ki'ama Bahamas' low impact approach, the hull is made from flax fiber, recycled materials, and the deck covered in cork that is superior in function and sustainability.

As part of our commitment and contribution to ocean health and sustainability, the Ki'ama Bahamas X Shore fleet will be fitted with a built-in Sea Lab, collecting environmental data from the waters we cruise in, such as the pH, salinity and oxygen levels and sending it to our environmental partners in real-time.

ENVIRONMENTAL IMPACT – REEF REPORT

SUPPORTING THE REEF

Elizabeth Island is within the expanded Moriah Harbour Cay National Park, and our low-density development respects this location. In addition, no construction activity will disturb any of the listed protected habitats.

Ki'ama Bahamas has recently completed a study of the reef and seabed areas around Elizabeth Island, a copy of which is hereby attached.

Preliminary assessment of the Coral Reefs off Elizabeth Island, Exuma islands, Bahamas

A report for *Silent Resorts*, Elizabeth Island

Research and Report

Sophie Schonherr, BSc. Maastricht University
contact: sophie.schoenherr97@gmail.com

Supporting Images

Andy Lange, Founder OCEANS Project
contact: andy@oceansproject.net

May 2021

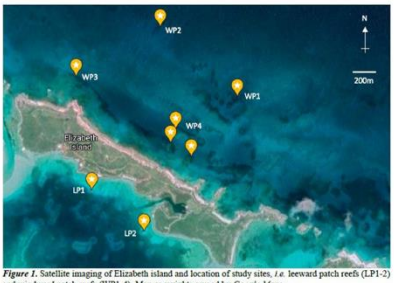


Figure 1. Satellite imaging of Elizabeth island and location of study sites, *i.e.* leeward patch reefs (LP1-2) and windward patch reefs (WP1-4). Map copyrights owned by *Google Maps*.

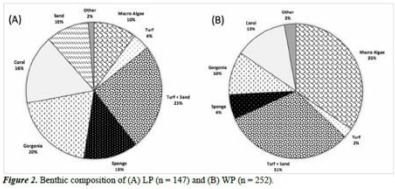
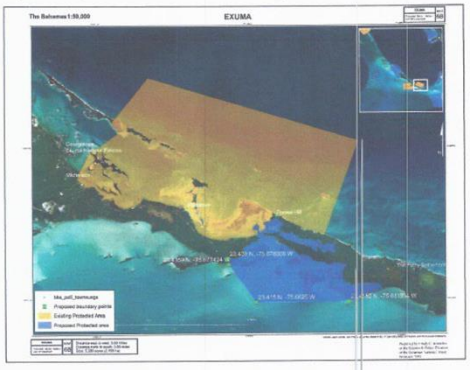


Figure 2. Benthic composition of (A) LP (n = 147) and (B) WP (n = 252).

Size: 5,349 acres (2,165 ha)
Conservation targets and other resources: mangroves, tidal creeks, sand/mud, seagrass, nursery habitat for fish and lobster, bonefish flats, turtle habitat
Location: south of Forbes Hill settlement, southwest of the Ferry settlement
Threats: unsustainable development (filling in of wetlands), illegal fishing, dredging, sedimentation
Proposed management: zoned in accordance with existing park management structure



Background and site description: Moriah Harbour Cay National Park (MHCNP) was established in 2002 as part of the Bahamas National Trust system of national parks, to protect the intrinsic value of the marine environment surrounding Moriah Harbour Cay. In 2015, the Government of The Bahamas expanded the park from 16,800 acres to 27,286 acres, protecting representative nearshore marine habitats that connect Great and Little Exuma. The park showcases ecologically diverse habitats, including sand flats, tidal creeks, lagoons, mangroves, coral reefs, rocky and sandy shorelines, sand dunes, blue holes, and coastal plant communities; and important areas for spawning, nursery, nesting, and migration of marine and terrestrial species. Community members on Exuma requested that sensitive creek and mangrove system and nurs

ENVIRONMENTAL IMPACT – SILENT CATCH

A FRESH APPROACH TO SUPPORT THE WORLD'S OCEANS

Ki'ama Bahamas will contribute 1% of all sales revenues, plus an annual on-going contribution from resort operations to a newly formed local division for Silent Catch. The Silent Catch mission is to deliver innovative, scalable solutions with environmental, economic, and equitable impact in the world's fishing communities. The five-year sales projection for the Project would indicate a contribution of over $1,500,000, plus additional donations and funding from partners and international organizations.

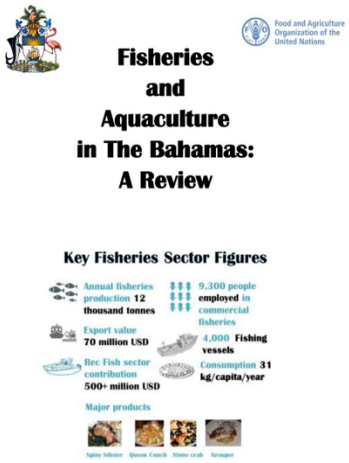
Silent Catch will establish a dockside facility at George Town, with the goal of supporting the following activities:

- Mangrove Preservation & Education – Protect the mangroves of the Exumas and educate the public and developers of the importance of protecting existing mangroves and the benefits of enhancing their presence.
- Reef Protection and Restoration – Partner with organizations and government agencies dedicated to preserving Bahamas endangered reefs and fund the creation of new artificial reefs using the latest technology and techniques. To this end, Ki'ama Bahamas has already funded a study of the reef, seabed, and water conditions around Elizabeth Island, which can be seen on the previous slide.
- Local Fishing Fleet Electrification – The number one cost of going out to catch local fish is fuel and followed then only by the cost of maintaining gas and diesel engine in the harsh seaside environment. Silent Catch technology and infrastructure will support the electrification of the local and artisanal fishing fleet, for healthier, more sustainable, and more profitable fishing, and create a global example of excellence.
- Sport Fly Fishing Fleet Electrification – Silent Catch, in collaboration with international Fly-Fishing Associations and Clubs, will help fund and implement the use of all-electric boats for sport fly-fishing, to protect the pristine waters of the Bahamas.
- Silent Caught Premium Fish Marketing – Silent Catch will encourage the local fishing community and entrepreneurs to develop a local and international market for fish caught and processed using the all-electric artisanal fleet, and create a premium brand, *"Silent Caught Bahamas"* that will provide enhanced income for the local community.

The Silent Catch dockside facility at George Town is designed to fund the employment of the local team to manage the above services and provide free solar powered charging of the electrified fleet, and refrigeration to keep the catch fresh.

SILENT RESORTS

SILENT CATCH



BUSINESS PLAN

Club Ki'ama consists of sixteen club residences and eight solar yachts, which will be entirely investor owned upon full sell-out of ownership shares. Investor/owners will enjoy a minimum of 24 nights of residence occupancy per year and will also have twelve days on the Silent Yachts.

Upon full buildout, Club Ki'ama residences can provide in excess of 36,000 room/yacht cabin nights per year, occupied primarily by high-net-worth individuals, either investor/owners or rental guests. Because they are enjoyed by multiple owners and rental guests, fractionally owned vacation homes realize significantly higher occupancy than hotels, resorts, and rental homes (many of which sit empty most of the year) in the same destination. The investor/owners and rental guests typically have a higher household income than hotel and resort guests. This translates to higher spending, which will benefit Great Exuma businesses.

There will also be up to twelve additional whole ownership Ki'ama Bahamas estate homes with shared yachts for sale. Estate homeowners also will be able to make their residences available for rent, offering another potential 24,000 room/yacht cabin nights.

The Ki'ama Bahamas team anticipates phasing construction and yacht and boat acquisition throughout the five-year sell-out period based on sales velocity. Therefore, there will be no debt on the property or improvements.

The investor profile for our residence and yacht resort community ownership will mirror that of other luxury vacation homeowners in the Bahamas. Our typical buyers can afford their own Exuma home but know they would only use it only three to five weeks per year. They can't rationalize the high purchase price and annual costs of traditional ownership relative to personal use. This is why residence clubs (luxury co ownership) has once again become a fast-growing segment of the vacation home market. They are a natural fit for the new sharing economy and once again are being enthusiastically embraced by affluent families. The investor/owner and rental guest profiles and spending habits and profile will be an immediate and significant benefit to the local and national economies given the available number of room nights and high occupancy generated from a very low impact development and operations.

'FAIL-PROOF' DEVELOPMENT

SILENT RESORTS

The capital raise and phased development have been strategically designed to avoid the possibility of failed development or an inoperable, partially-built project. Regardless of future economic conditions, the Elizabeth Island project will be a successful, fully sustainable private community for owners.

- All capital for Phase I of development has been raised and secures the Project with the ability to execute on the following key initiatives:
  - Purchase of the island
  - Infrastructure improvements
  - Construction of the Beach Club and three residences
  - Acquisition of the first Silent Yacht, which is already on order
- The Ki'ama Bahamas development team only commences additional phases of construction and yacht acquisition as it raises capital from new investor/owners.
  - Using this strategy, the Project is protected against the typically speculative, risky nature of traditional hospitality development.
  - If capital markets or the global macroeconomic conditions change, the Project can stand alone with a fraction of the residences completed, the existing marina, and the new Beach Club.
- Projected 3- to 5-year build-out of 22 to 28 residences. However, the Project can be stopped at any time relative to sales pacing and operated as a smaller community of homeowners on Elizabeth Island and offer a fully functional and profitable resort and employment at any scale.

LOCAL SUPPORT AND INVOLVEMENT

EXISTING LOCAL PRESENCE

The Principals of the Company are already members of the local community as they own a vacation home on Little Exuma. Love Beach House in Forbes Hill, Little Exuma, is owned by Forbes Hill Beach House LTD.

BAHAMAS ADVISORY COUNCIL

The Company has retained local Exuma and national Bahamas strategic council from the following advisors:

- Godfrey Gray, Chief Councilor, Exuma District
- Mike Moss, Managing Partner, TAS Architecture Limited
- Chris Russell, Managing Partner, Russell Craig & Associates
- Leslie O. Pindling, Managing Director, Leslie Pindling Consulting Agency

BIA APPROVAL

In early 2022, the BIA approved in principle the proposed Project. The Project team has been engaged with the BIA to continue the process of finalizing concessions agreements.

EXUMA DISTRICT COUNCIL – NO OBJECTION LETTER

No: DLG/ED/3/030
In replying please
Quote this number

Mr. John Long
Silent Resorts
Elizabeth Island
Exuma

Dear: Mr. Long:

Re: Silent Resort Exuma, Project

I have been directed to advise that at the Exuma District Council Meeting, held on December 1, 2021; councilors discussed the above mentioned.

I have been further directed to advise you that the Council has no objection to the construction of the proposed development at Elizabeth Island in the Exuma.

Yours Truly,

Godfrey Gray
Chief Councillor
Exuma District

GG/ccm

cc: Exuma District Council

ECONOMIC IMPACT

Ki'ama Bahamas looks forward to fulfilling the Deputy Prime Minister and Minister of Tourism, Investments and Aviation the Hon. Chester Cooper's E-Vision 2030. Ki'ama Bahamas will align its development plans with the key initiatives of the Davis-Cooper administration's approach to reigniting tourism in Exuma and combatting climate change in alignment with the National Energy Policy. Our team is excited to facilitate establishing Exuma as one of the world's top tourist destinations both as a vacationing locale and conduit for local economic enhancement. We intend to do so with the following development initiatives:

- National Insurance Board Revenue Projection
  - It is estimated that the five-year build-out and initial operations of the Project will generate National Insurance Board contributions in excess of $800,000.
- National Economic Benefits
  - Full compliance with new national regulation of vacation rentals and affiliated VAT measures
  - Significant foreign direct investment into the Bahamas from high-net-worth investors/owners of the Project
- Entrepreneurial Opportunities and Spin-Offs
  - Ki'ama Bahamas will attract global attention as the first Silent Resorts property in the world, opening the way for positioning the Bahamas as a leading destination for future like-minded development. Evolving tourist expectations and desires indicate that future hospitality and island development will be increasingly focused on sustainability and seamless integration into natural surroundings.
  - Significant local entrepreneurial opportunity exists by gaining expertise in sustainable building techniques and operation/maintenance of new sustainable building technologies. Given the trend noted above regarding the potential for sustainable hospitality development growth, a thorough understanding of our sustainable building methods; water, stormwater, wastewater, and storage systems; solar grid systems (construction/maintenance); and operation of solar- and electric-powered boats will undoubtedly be in high demand moving forward. This presents a unique opportunity for Bahamians to gain expertise in these innovations and for the Bahamas to become a world-leading talent pool for implementation and maintenance of these technologies.
  - Silent Catch will create another opportunity for the Bahamas to be on the forefront of global fishing sustainability and sensitive ocean environments protection.

PERFORMANCE & IMPACT – BY THE NUMBERS*

85% Anticipated Stabilized Occupancy

60,000+ Potential Annual Guest Nights

4,900+ Anticipated Annual Flights to Bahamas

$17.2MM+ Anticipated Gross Food and Beverage, Excursion, and Ancillary Guest Annual Revenues

**All target projections assume full project sell-out and are subject to revision relative to changing market conditions.*

Appendix – B

Preliminary assessment of the Coral Reefs off Elizabeth Island, Exuma islands, Bahamas

Preliminary assessment of the Coral Reefs off Elizabeth Island, Exuma islands, Bahamas

A report for *Silent Resorts*, Elizabeth Island

Research and Report

Sophie Schönherr, BSc. Maastricht University
contact: sophie.schoenherr97@gmail.com

Supporting Images

Andy Lange, Founder OCEANS Project
contact: andy@oceansproject.net

May 2021

Table of Content

Summary Coral reefs are of tremendous economic, environmental and social importance, supporting 500 million people worldwide by providing income, food security and coastal protection (Cesar et al., 2003; Beck et al., 2018). Additionally, accounting for their essential roles in the diving tourism, the medical and pharma industry and marine fisheries, coral reefs are estimated to have a total economic value of 30 billion US dollars (Hoegh-Guldberg et al., 2015). However, coral reefs are in decline worldwide, particular in the Greater Caribbean Region. Coral degradation has been driven by a multitude of factors, most of which are associated to human activities. Examples include pollution, overfishing and climate change. To save coral reefs, coral monitoring and coral restoration measures have become indispensable. The construction of the eco-hotel *Silent Resorts* will increase human activities on the presently undisturbed coral reefs of Elizabeth Island. However, potential negative impacts on the reefs can be prevented if adequate measures are implemented from the very start. Accordingly, this study served as preliminary assessment of the reefs offshore Elizabeth Island. For this purpose, benthic composition, coral abundance and composition and abundance of fish families were determined at six different study sites around Elizabeth Island. Study sites were grouped into two categories: (i) the shallower (1-4m), wave-protected leeward patch reefs (LP) and (ii) the slightly deeper (3-8m) and wave-exposed windward patch reefs (WP). Employed survey methods comprised the Roving Diver Technique, Point Intercept Transects and Photo Quadrats (including subsequent ex-situ analysis via point sampling method). Overall, the coral patch reefs surrounding Elizabeth Island were in a partially satisfactory state. A total of 19 coral groups was observed across all sites. Highest coral diversity and abundance was recorded at two windward patch reefs (WP3 and WP4). However, algae (turf and macroalgae) cover and sedimentation on reefs was high at all sites and was most pronounced on the windward side of the island. Algae dominance and sedimentation are very likely the aftermath of Hurricane Dorian, which hit the island in 2019. Coral diversity was high at windward patch reefs while leeward patch reefs were often dominated by few fast-growing coral species (*e.g. Porites* spp.). Abundance of fire corals (*Millepora* spp.) was high at all study sites. Since fire corals are sensitive to wave-induced fragmentation and since they have the ability to rapidly reattach and colonize new habitats, the observed agglomeration of fire corals might also be a consequence of Hurricane Dorian. While *Millepora* corals can be detrimental to other corals (spatial competition and overgrowth), they can increase coral survival chances during outbreaks of the coral-eating starfish *Acanthaster planci* (Kayal & Kayal, 2017). Furthermore, their complex structures provide habitat for other marine life including corals and fish (Dube et al., 2019). In total, 20 fish families were recorded around the reefs of Elizabeth Island. Except for the herbivores (Scaridae and Acanthuridae), most of the commercially and functionally important fish families were more abundant at the LP sites. A large proportion of the observed individuals (particularly of the wrasses, grunts and snappers) on the leeward patch reefs were juveniles. High presence of juveniles on these reefs may be the result of close-by mangrove and seagrass habitats, which are important fish nurseries (Thorhaug, 1981; Abu El-Regal & Ibrahim, 2014). On the windward patch reefs fish tended to be larger, especially the piscivorous fish such as groupers (Serranidae) and snappers (Lutjanidae). Herbivores were more abundant at WP sites compared to LP sites, though their abundance was generally low compared to the abundance of other fish guilds. These reduced numbers might be influenced by the large abundance of pomacentrid fish, which defend territories against free-ranging herbivores (Lewis & Wainwright, 1985). No butterflyfish (Chaetodontidae) were observed during the survey times at WP sites. Butterflyfish are corallivores and as such are habitat specialists, *i.e.* fish that rely on a certain coral reef habitat. According to Lawton et al. (2011) coral-feeding butterflyfish are among those species of reef fish that have highest risk of extinction due to global climate change. To guarantee the conservation of butterflyfish at Elizabeth Island, further research and monitoring of this fish family is strongly recommended.

Overall, fish family diversity and abundance were satisfactory at Elizabeth Island. Especially the presence of ecologically and functionally important groups such as herbivores (Scaridae and Acanthuridae) and piscivores (Lutjanidae and Serranidae), which are important to maintain reef health and integrity, were present in reasonable numbers. This might partially be a result of the marine protected area on the windward side of the island, which eliminates fishery pressures and thereby allows the proliferation of fish in these areas. Maintaining the integrity of the reefs as well as the current diversity of observed coral species and fish families will be important to the island's economic future. Therefore, further monitoring of the coral reefs at Elizabeth Island is strongly recommended. In particular, grazing populations including fish (surgeon fish and parrot fish) and invertebrates (*Diadema* spp.) should be closely examined. Given the high abundance of algae on the reefs, efficient wastewater management must be considered before the construction of the eco-resort to control and limit nutrient run-off into the ocean. Furthermore, it is strongly advised to keep the marine protected area in the North of the island to guarantee the proliferation of fish on the reefs. Ideally, the marine protected zone should be enlarged to encompass all the reefs of the windward side of the island. An active management and regulations enforcement plan are strongly recommended for all regulations around the coral reefs of Elizabeth Island. To further facilitate the conservation of coral reefs (in particular WP3 and WP4), partial restoration of the reefs could considerably boost coral reef health and lead to a potential increase in abundance and diversity of coral and fish species.

1. Introduction

Coral reefs are unique ecosystems of exceptionally high biodiversity (Fisher et al. 2015; Snelgrove et al., 2016) which are of tremendous economic, environmental and social importance. They provide food security, income and coastal protection, thereby supporting an estimated 500 million people worldwide (Cesar et al., 2003; Hoegh-Guldberg et al., 2015; Beck et al., 2018). Furthermore, their indisputable significance for the diving tourism (Lal, 2004), their potential for the medical and pharmaceutical industry (Bruckner, 2002) and the central role they play for marine fisheries around the world (Munro JL, 1984) make of coral reefs a trillion-dollar economic asset (Cesar et al., 2003; Hoegh-Guldberg et al, 2015).

Reef-building corals, commonly referred to as "stony corals", are the keystone species in these ecosystems as they constitute the reef's structure and thereby provide habitat for millions of other marine organisms (Putnam et al., 2017). For example, Coker et al. (2014) demonstrated that a total of 320 fish species from 39 different families rely on live coral habitats, thus highlighting the importance of corals for the diversity and productivity of reef fish assemblages. Multiple studies support these findings (Graham, 2014; Pratchett et al., 2014; Rogers et al., 2014) and further emphasize that a loss of the structural complexity of reefs will certainly lead to a decline in fisheries.

Given the extensive importance of coral reefs, it is of concern that coral reefs worldwide and in particular the reefs of the wider Caribbean region have undergone rapid declines in abundance and diversity over the past decades (Wilkinson, 2000; Gardner et al., 2003; Bruno & Selig, 2007; Paddack et al. 2009). Indeed, coral cover of Caribbean reefs has declined over 50% between 1970 and 2011 (Jackson et al., 2014). This degradation has been driven by a multitude of natural and anthropogenic factors such as the dramatic decrease of the herbivorous sea urchin *Diadema antillarum*

(Lessios, 1988; Hughes et al., 1999), increasing sea surface temperatures leading to coral bleaching, disease outbreaks (Bruckner&Bruckner,1997), eutrophication, sedimentation and overfishing (Hughes et al., 2018).

While the coral reef degradation has occurred at a fast pace all over the world, there is however still hope to restore and conserve reefs if adequate reef management is implemented. This research study aimed to assess the current state of the patch reefs around Elizabeth Island (23.5090° N, 75.7292° W), a small island three miles off the eastern coast of the Great Exuma Island, Bahamas. The island is predominantly uninhabited, and the reefs offshore the northern coast of the island are located in a marine protected area. Consequently, anthropogenic stressors on the reefs were expected to be low. The planned construction of the eco-resort *Silent Resorts* will however increase human activities on and around Elizabeth Island. Coral reef monitoring thus becomes an essential tool to ensure (i) appropriate reef management, and (ii) the conservation of the local coral reefs of Elizabeth Island.

2. Methods

Study sites

Study site selection was based on satellite images and water depth records of Elizabeth Island obtained from *Google Maps* and *Raymarine* Navigation Charts, respectively. For this study, a total of six different reef sites was selected (*Figure 1*). All six reefs are patch reefs, two of which are located on the shallower (1-4m) and wave-protected leeward side of Elizabeth Island with the remaining four on the slightly deeper (3-8m) and wave-exposed windward side of the island.

Data collection & presentation

At each study site, data on the composition and abundance of reef-building corals, reef substrate and local fish populations was collected via scuba dives or snorkeling. All data was collected between 10:00 a.m. and 5:00 p.m. in April 2021. Data collection comprised different survey techniques and methods, precisely, the Roving Diver Technique, 10m-Transects and Photo Quadrats (as described in Hill & Wilkinson, 2004).

- *Coral and Fish Abundance*

Fish and corals were counted via the Roving Diver Technique. This survey method involved a 30-minute random swim during which all fish families and coral groups as well as an estimation of their respective frequency of occurrence were recorded on a slate. Next, the abundance of observed fish and corals was averaged across the leeward sites and windward sites, respectively. Numerical abundance per fish group was transformed into mean Log10 index, resulting in the following logarithmic-based categories:

- Index Score 0 (None) = No individuals of a coral/fish species/group were observed during the survey
- Index Score 0-1 (Few) = Two to ten individuals observed
- Index Score 1-2 (Many) = 11-100 individuals observed
- Index Score 2-3 (Abundant) = > 100 individuals observed

To obtain the relative abundance of each fish group, frequency of abundance (%) was calculated and then multiplied by the

respective index score. Sighting frequency was determined by dividing the number of surveys in which the fish group was observed by the total number of surveys. For further analysis, fish were categorized into fish guilds (*i.e.* group of individuals that share common characteristics and consequently play similar roles in a given ecosystem) based on their diet. Precisely, fish families were classified as "herbivores" (algae-eating), "piscivores" (fish-eating), "invertevores" (feeding on invertebrates), "corallivores" (coral-eating) and "planktivores" (feeding on plankton).

Corals were identified to species level or to genus level if the species could not be determined. Individuals of each species or genus were then counted based on their size using the following categories: 4.1 – 10 cm, 10.1 – 50 cm, 50.1 – 100 cm and > 100 cm. Coral recruits (coral colonies < 4 cm) were not included in this survey. For visual representation of coral abundance and composition, the collected data was grouped into young coral colonies (colony size between 4.1 and 50cm) and older coral colonies (colony size above 50 cm). For each of the latter two categories, abundance of the individual coral species/genus was calculated and represented as percentage of the total recorded corals. Corals with less than 5% abundance of occurrence were grouped together into a common category named "Others".

- *Point Intercept Transects (PIT)*

Benthic composition of the windward patch reefs was assessed via the Point Intercept Transect (PIT) method. For this purpose, a 10m transect line was randomly placed onto the reef and the benthic category directly below the transect line at 0.5m intervals (0, 0.5m, 1m, …, 9.5m, 10m) along the 10m-transect was recorded. The benthic categories included in this study were the following: "Macro Algae", "Turf","Turf+Sand","Sponge", "Gorgonia", "Coral", "Sand", "Unidentified" and "Other". In total, three 10m-transects were assessed per study site. Percent cover of the individual benthic categories was determined for each site and then averaged across leeward and windward patch reefs, respectively.

- *Photo Quadrats*

Benthic composition of the leeward patch reefs was assessed via the Photo Quadrats method because their study area was too small to apply the PIT survey method. First, a 1m-line was placed onto the reef for spatial and visual reference. Next, photographs of an approximated 1m x 1m area of the reef (with the 1m-reference-line at the horizontal center of the photograph) were taken from 1m above the reef surface with a GoPro 7. In total, three Photo Quadrats were set up at each of the two study sites. Percentage cover of the benthic communities was determined ex-situ via the point sampling method and the PAPPARA(ZZ)I software (*see Appendix*). For the analysis, 25 random points were generated onto the six Photo Quadrats and the substrate underneath those points was determined using the same benthic categories as for the PIT analysis.

- *Statistical Analysis*

Statistical analysis was completed using Microsoft Excel 2019 (Version 16.29). Descriptive statistics including mean, standard deviation, and standard error of the mean (SE) was analyzed for the fish and coral data. Furthermore, the Pearson's correlation coefficient was calculated with Microsoft excel to establish whether or not a linear relationship between herbivore abundance and macro algae cover (%) existed. Due to small sample size, significance of the correlation coefficient could not be determined.

3. Results

Benthic Composition

The benthos of the leeward patch reefs (LP) constituted predominantly of turf-and-sand-mats (25%) followed by gorgonian corals (Octocorallia: Gorgonacea) (20%), corals (16%) and sponges (13%). The windward patch reefs (WP) were clearly dominated by macro algae (35%) and turf-and-sand mats (31%), with only 13% of coral cover. Overall, algae and sand accounted for almost half (49%) of the benthic composition of the LP sites, and for more than two thirds (68%) of the benthic composition of the windward reefs.

Coral composition

A total of 19 coral groups was observed around Elizabeth Island. In general, coral abundance varied between leeward and windward patch reefs as well as between the individual windward patch reefs, though a general pattern could be observed (*Figure 3*). Precisely, at all study sites most of the recorded coral sizes were below 50cm, the majority ranging from 10.1 to 50cm. All sizes combined, the highest number of corals was recorded at sites WP3 and WP4, followed by LP. WP1 had the least amount of corals, followed by WP2. Remarkably, none of the observed corals at WP2 exceeded 50cm in size. Similarly, all recorded corals of WP1 were below 100cm.

Coral species diversity was highest at WP4 across all coral size groups. Interestingly, the species diversity at the leeward patch reefs was highest for the smallest coral size group and then decreased with increasing coral size groups. All sizes combined, the highest coral species diversity was recorded at WP4 followed by WP3, and lowest at WP2 followed by LP.

In terms of numerical abundance, the younger coral colonies (stony corals of 4.1-50 cm diameter; hereafter called YCC) of the leeward patch reefs comprised five major coral groups (*Figure 5A)*: *Porites porites* (19%), *Millepora* spp. (19%), *Orbicella* spp. (17%), *Siderastrea siderea* (15%) and *Porites astreoides* (15%). *Agaricia* spp. (7%) still contributed to almost one tenth of the observed YCC, however they were considerably less abundant than the latter mentioned coral groups. Collectively, poritids (*P. porites* and *P. astreoides*) clearly dominated the reefs of the leeward side of the island, contributing to more than one third (34%) of the observed YCC. Similar to the leeward patch reefs, the YCC of the windward patch reefs comprised four major coral groups (*Figure 5B)*: *Porites astreoides* (19%), *Millepora* spp. (18%), *Pseudodiploria* spp. (15%) and *Orbicella* spp. (11%). Four more coral groups - *Siderastrea siderea* (7%), *Agaricia* spp. (6%), *Diploria labyrinthiformes* (6%) and *Montastraea cavernosa* (5%) - were also frequently observed, yet their abundance was considerably lower compared to the latter mentioned coral groups. Overall, the windward patch reefs showed a higher YCC species diversity compared to the leeward patch reefs (eight *versus* six coral groups with >5% abundance of occurrence, respectively).

Older coral colonies (stony corals of >50 cm diameter, hereafter called OCC) of the leeward patch reefs were observed in only four coral groups (*Figure 6A)*, namely *Orbicella* spp. (37%), *Siderastrea siderea* (27%), *Porites porites* (18%) and *Millepora* spp. (18%). Remarkably, the *Orbicella* complex and *Siderastrea siderea* accounted for almost two thirds of the observed OCC. While those same two coral groups also contributed to over 50% of the observed OCC of the windward patch reefs, the reefs on the windward side of the island comprised OCC of five other main coral groups (*Figure 6B*). Overall, the OCC

species diversity was considerably higher on the windward patch reefs compared to the leeward patch reefs (seven *versus* four coral groups with >5% abundance of occurrence, respectively).

Fish population of Elizabeth Island

A total of 20 fish families were observed across all study sites. These included eight ecologically and socio-economically important families, namely Acanthuridae (surgeonfish), Chaetodontidae (butterflyfish), Haemulidae (grunts), Lutjanidae (snappers), Pomacentridae (damselfish, chromies), Scaridae (parrotfish) and Serranidae (groupers) (*Figure 7*). Abundance of algae-eating fish such as Acanthuridae, Pomacentridae and Scaridae was higher at WP while carnivorous fish including Haemulidae and Lutjanidae were more abundant at LP. Remarkably, Chaetodontidae were only present at LP sites. Groupers (Serranidae) were recorded at both leeward and windward patches, though their abundance was relatively low at all sites.

Abundance of different fish guilds varied considerably between WP and LP sites (*Figure 8*). Indeed, relative abundance of herbivores and planktivores was higher at WP sites compared to LP sites. On the other hand, piscivores were dominant on the leeward patches. Coral-eating fish (corallivores) were only recorded on the leeward side of the island, while invertivores were very abundant at all sites.

Herbivores versus Macro Algae

A positive linear relationship was determined between herbivore abundance and macro algae cover (*Figure 9*). Given the small sample size, however, this result is statistically not significant.

4. Discussion

Benthic composition

Algae, sponges and gorgonians are all strong competitors for space, and as such negatively affect corals in two different ways. First of all, they can impede settlement of coral recruits (*i.e.* newly settled corals) by simply reducing available space on the reef (Chadwick & Morrow, 2011). On the other hand, they also constitute a threat for already existing coral colonies as they can partially or fully overgrow those colonies, which ultimately kills the underlying live coral tissue (Chadwick & Morrow, 2011). Excavating sponges of the *Cliona* spp. are of particular concern as they are fast-growing bioeroders. Essentially, these sponges degrade coral skeletons via chemical and mechanical processes, in some cases accounting for up to 90% of carbonate removal from coral skeletons (Halperin et al., 2015). Since reef structure is fundamentally provided by coral skeleton, an excess loss of carbonate – a crucial component of coral skeletons - can eventually lead to the deterioration and even collapse of entire reef structures (Halperin et al., 2015). While abundance of *Cliona* sponges was scarce around Elizabeth island, algae were the dominant space competitors across all study sites. This high presence of algae might be the result of old partial mortality of coral colonies. Indeed, dead coral skeleton is usually rapidly overgrown by fast-growing coral competitors such as turf and/or macro algae (McManus & Polsenberg, 2004). Considering the low percent cover of corals (13-16%) as well as the prevalence of algae (up to 68%), it becomes apparent that the reefs of Elizabeth island are currently algae-dominated. However, it is unclear when this phase-shift, *i.e.* the change from coral- to algae-dominated reef, occurred at

Elizabeth Island as research of these reefs was unprecedented up until now. In general, phase shifts have been observed all over the world in the past decades (Rogers & Millers, 2006; Hughes et al., 2010). For example, a study from Hughes (1994) revealed that coral cover has dramatically decreased over the past 15 years while percent algae cover increased significantly over the same period. Remarkably, the observed changes in percent cover were most pronounced in shallow waters (water depth of 7m). These results are of particular relevance for Elizabeth Island, given its location on the Great Bahama bank where water depths generally do not exceed 10m / 33 feet (Schmaltz & Scott, 2009).

The observed algae dominance at Elizabeth Island might have been triggered and/or enhanced by Hurricane Dorian, a category 5 storm, which hit the island in 2019. Indeed, hurricanes can lead to increased terrestrial run-off, which in turn raises the nutrient level in the water column, thereby favouring algae growth. Additionally, hurricane Dorian might have further induced macro algae outbreaks via a temporal reduction of grazers (herbivores). Reduced numbers of sea urchins (*Diadema* spp.) and to a lesser extent parrotfish and surgeonfish from the reefs decreases predation pressure on macro algae which can consequently lead to the proliferation of the algae (Hughes, 1994; Dahlgren & Sherman, 2020). On the other hand, however, the powerful wave action generated by hurricanes can also detach macro algae from the reef. Removal of macro algae creates space for other marine settlers including new coral recruits. Yet, the newly created space is often readily overtaken by other fast-growing, harmful organisms such as turf algae which trap sediments. This becomes very clear in the example of Elizabeth Island, where turf and sand accounted for more than a quarter of the reef's substrate at all study sites. Similarly, Dahlgren and Sherman (2020) observed that turf algae and sediment cover had increased at several of their studied reef sites across the Bahamas after Hurricane Dorian. Reefs such as those of Elizabeth Island that are close to very shallow areas or exposed banks where sediments are resuspended during storms have a particularly high risk of sedimentation. Dahlgren and Sherman (2020) further argued that turf algae are often the precursor to macro algae growth. Likewise, an earlier study reported that Hurricane Hugo had caused a dramatic increase in algae within a year of its impact in St. John, US Virgin Islands, in 1989 (Rogers et al., 1991). These results together suggest that the considerably high percent cover of turf, sand and macro algae are most likely a consequence of Hurricane Dorian.

Overall, the effects of a hurricane on coral reefs depend on a combination of factors such as the proximity of the reef to land, water depth, land use near the reef, the condition of the reef prior to the storm, the morphology of corals forming the reef as well as the characteristics of the hurricane itself (intensity, duration, direction and distance from the reef) (Dahlgren & Sherman, 2020). Besides increasing algae growth, hurricanes can have further deleterious effects especially on shallow reefs by physically damaging reefs via intense wave action or impact from debris which ultimately can lead to changes in coral composition and size (Hughes, 1994; Dahlgren & Sherman, 2020).

Coral composition

At all study sites, the majority of the observed coral colony sizes were less than 50cm. This preponderance of small colonies is unsurprising because this size group comprises three different kinds of coral colonies: [1] young coral colonies, [2] old coral colonies that have suffered partial mortality and [3] bigger coral colonies that might have broken into smaller fragments as a consequence of hurricane Dorian (Dahlgren & Sherman, 2020). Furthermore,

some coral species such as *Agaricia agaricites* exhibit very slow growth (less than 2cm annually). In fact, some colonies of *A. agaricites* can remain fixed at one size or even shrink (University of the West Indies, St. Augustine, n.d.).

For this research study, presence and/or species of coral recruits was not recorded. Still, it is important to report that coral recruits were observed in high numbers at all sites. This may have been yet another consequence of hurricane Dorian. Indeed, hurricanes typically occur around coral spawning times which can positively impact coral settlement (*i.e.* removal of the space-competing macro algae) and larvae dispersal (Dahlgren & Sherman, 2020; Lugo-Fernandez & Gravois, 2010).

In general, coral species diversity was higher at WP sites compared to LP sites. This observation was true for small coral colonies (< 50cm), and even more pronounced for big coral colonies (>50cm). The leeward patch reefs of Elizabeth Island can be portrayed as an agglomeration of smaller corals that have settled onto a few big boulder corals (*e.g. Orbicella* spp and/or *Siderastrea siderea*). Remarkably, these reefs were dominated by fast-growing coral species such as *Porites porites, Porites astreoides* and *Agaricia agaricites*. Peckol et al. (2003) obtained comparable results from the reefs of San Salvador in the Bahamas where reefs were dominated by a few coral species, such as *Porites porites*, *Agaricia agaricites*, *Porites astreoides and Montastraea annularis* complex (which accounted for 40% of the coral composition). Windward patch reefs at Elizabeth Island were not dominated by a single coral species but instead were composed of a multitude of different coral species including *Porites astreoides*, *Millepora* spp, *Pseudodiploria* spp., *Orbicella* spp., *Siderastrea siderea, Agaricia* spp., *Diploria labyrinthiformes* and *Montastraea cavernosa*. Again, these results were confirmed by Peckol et al. (2003), which reported higher coral species richness at windward patch reefs compared to leeward patch reefs.

The high numbers of the fast-growing *Porites* spp. at the reefs of Elizabeth Island are very likely a consequence of Hurricane Dorian. For example, Peckol et al. (2003) observed that *Porites porites* colonies were replacing dead coral colonies on all sites at San Salvador. Likewise, high abundance of *Agaricia* spp. and *Porites* spp. were reported in Jamaica after Hurricane Allen (Hughes, 1994). Considering these results, it becomes evident that fast-growing coral species have a competitive advantage after hurricane events. This might also explain the elevated numbers of fire corals (*Millepora* spp.), which accounted for almost 20% across all sites at Elizabeth Island. Rapid colonization of fire corals is facilitated by rapid growth rates, high fecundity and their ability to propagate via fragmentation (Lewis, 2006; Dube et al., 2019). Fragmentation is the process by which parts of a colony break off and subsequently reattach to grow as a separate unit. Studies on the biology and ecology of fire corals revealed that fire corals easily break in rough water conditions (Lewis, 2006; Dube et al., 2019). Consequently, hurricane Dorian may have led to increased fragmentation of fire corals, which combined with the ability of fire corals to rapidly colonize new spaces might explain the observed aggregations of *Millepora* corals at Elizabeth Island. Although fire corals often compete with other corals, they play a crucial role in coral survival during outbreaks of the coral-eating starfish *Acanthaster planci* who tend to avoid fire corals (Kayal & Kayal, 2017). Furthermore, the complex structures of fire corals provide habitat for other reef organisms such as crustaceans, fish and even hard corals (Dube et al., 2019). Thus, their high abundance on the reefs of Elizabeth Island might be beneficial for the reef and its inhabitants. Further examination of this generally understudied coral genus

(*Millepora*) will shed light on the importance of fire corals for the reefs at Elizabeth Island.

Overall, the healthiest reefs were observed at sites WP3 and WP4 where species diversity and coral abundance was highest across all sizes. Remarkably, the reefs at the other two windward sites WP1 and WP2 were the most degraded of all, even compared to the reefs of the LP sites. Interestingly, WP1 and WP2 were located furthest offshore. The higher percent cover of corals at LP sites compared to sites WP1 and WP2 might however be the result of the dominance of the fast-growing *Porites* species at the LP sites. In other words, the LP sites of Elizabeth Island constituted of a very large number of few coral species while reefs at the windward site presented higher coral diversity.

Fish population of Elizabeth Island

Except for the herbivores (Scaridae and Acanthuridae), most of the commercially and functionally important fish families were more abundant at the LP sites. This might be due to the close proximity of mangrove and seagrass habitats, which are important fish nurseries (Thorhaug, 1981; Abu El-Regal & Ibrahim, 2014). In fact, juveniles comprised a large proportion of observed individuals (particularly of the wrasses, grunts and snappers) on the leeward patch reefs. On the windward patch reefs fish tended to be generally larger, especially groupers and snappers, but also triggerfish and angelfish. Fish size was not recorded for this study but should be considered a next important step for further research. Herbivores were more abundant at WP sites compared to LP sites, though their abundance was generally low compared to the abundance of other fish guilds. This relatively low abundance of herbivorous fish might be influenced by the large abundance of pomacentrid fish, which defend territories against free-ranging herbivores (Lewis & Wainwright, 1985). In fact, Lewis & Wainwright (1985) reported an inverse relationship between pomacentrid density and abundance of surgeonfish and parrotfish. The higher abundance of herbivores at WP sites might also explain why those reefs are generally showing higher coral abundance and species diversity – key factors of a healthy reef.

Interestingly, butterflyfish (Chaetodontidae) were not observed during the survey times at WP sites. According to Pratchett et al. (2013), this fish family is rarely abundant on reefs. It is however important to note, that butterflyfish are corallivores and as such are habitat specialists, *i.e.* fish that rely on a certain coral reef habitat. Predictions from Alvarez-Filip et al. (2015) raise concern, since habitat specialists are expected to be more negatively affected by future changes of coral reefs than habitat generalists, which use a broad array of habitats. This evidence is further emphasized by Lawton et al. (2011) who state that coral-feeding butterflyfish are among those species of reef fish that have highest risk of extinction due to global climate change. To guarantee the conservation of butterflyfish at Elizabeth Island, further research and monitoring of this fish family is strongly recommended.

Overall, fish family diversity and abundance were satisfactory at Elizabeth Island. Especially the presence of ecologically and functionally important groups such as herbivores (Scaridae and Acanthuridae) and piscivores (Lutjanidae and Serranidae), which are important to maintain reef health and integrity, were present in reasonable numbers. This might partially be a result of the marine protected area on the North side of the island, which eliminates fishery pressures and thereby allows the proliferation of fish in these areas.

Macro algae abundance & herbivores

A positive linear relationship was established between macro algae cover and herbivore abundance. The general trend indicated that herbivore presence was elevated at sites where macro algae was more abundant. Given the small sample size, however, this result is statistically not significant. Multiple reasons may explain these findings: [1] Grazing fish might have only recently recovered and/or moved back to shallower reefs after Hurricane Dorian. Indeed, studies have reported that storms can lead to shifts in habitat selection and fish composition (Walsh, 1983). [2] According to Lewis (1985) some herbivorous fish only graze on certain algae species. Whether or not this is the case at Elizabeth Island requires further research to determine macro algae and grazing fish species. [3] The obtained result may suggest that grazing activities of other marine organisms such as the sea urchin *Diadema antillarum* are more significant than the ones of the herbivorous fish.

However, a long-term study of Caribbean reefs by Suchley et al. (2016) stated that percent cover of macroalgae was generally not correlated to the presence of herbivorous fish. This underlines the need to consider complementary measures such as wastewater management and abundance of other grazing organisms (*e.g. Diadema* sea urchins) to control and reduce algae growth on coral reefs.

5. Conclusion

General state of the reefs

The health state of the reefs around Elizabeth Island was partially satisfactory. Especially reefs on the windward side of the island close to shore (WP3 and WP4) showed complex reef structures that created suitable habitat for multiple coral species and fish families. However, high coverage of turf and macroalgae as well as sedimentation were observed on all reefs around Elizabeth Island and should be of primary focus for future reef management plans.

Implications for Coral Reef Management

Maintaining the integrity of the reefs as well as the current diversity of observed coral species and fish families will be important to the island's economic future. Therefore, further monitoring of the coral reefs at Elizabeth Island is strongly recommended. In particular, grazing populations including fish (surgeon fish and parrot fish) and invertebrates (*Diadema* spp.) should be closely examined. Given the high abundance of algae on the reefs, efficient wastewater management must be considered before the construction of the eco-resort to control and limit nutrient run-off into the ocean. Furthermore, it is strongly advised to keep the marine protected area in the North of the island to guarantee the proliferation of fish on the reefs. Ideally, the marine protected zone should be enlarged to encompass all the reefs of the windward side of the island. An active management and regulations enforcement plan are strongly recommended for all regulations around the coral reefs of Elizabeth Island. To further facilitate the conservation of coral reefs (in particular WP3 and WP4), partial restoration of the reefs could considerably boost coral reef health and lead to a potential increase in abundance and diversity of coral and fish species.

6. Recommendations for Snorkeling

Leeward patch reefs (LP1, LP2): Located in shallow (water depth less than 4m / 12 feet) and calm waters, very close to shore. Absence of surge (*i.e.* wave-action at shore) allows easy access from the beach. These patch reefs serve as teaser for what can be expected on the other side of the island. These reefs are ideal for beginning snorkelers and/or for families with kids.
Potential hazards: [1] Fire corals are abundant in the area. Physical contact with fire corals can lead to itchiness, rashes and mild burns. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life. [2] Presence of sea urchins on the reefs. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life. [3] Presence of stingrays on the sand. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life. [4] Occasional mild boat traffic in the area. Advise tourists to snorkel close to shore.

Windward patch reefs (WP3, WP4): The reefs at sites WP3 and WP4 were the healthiest in terms of reef structure and coral/fish abundance and diversity. The reefs are still located in shallow waters (water depths up to 8m / 24 feet), which makes snorkeling still possible. Reef structure including arches and small cavities make these sites particularly interesting for snorkelers and/or free divers. However, these sites being on the wave-exposed side of the island, surge is elevated and needs to be taken into account before visiting these sites. Access to WP3 is only recommended via boat (*e.g.* organized half-day or full-day snorkeling trips from the hotel). WP4 sites could be accessed from beach. However, care is advised as the surge can be strong. In general, it is recommended that WP3 and WP4 are visited by advanced snorkelers only!
Potential hazards: [1] Potential strong currents depending on tides. Advise tourists based on daily weather conditions. Strong swimmers only! [2] Potential strong surge depending on wind conditions. Advise tourists based on daily weather conditions. Strong swimmers only! [3] Presence of fire corals in the area. Physical contact with fire corals can lead to itchiness, rashes and mild burns. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life. [4] Presence of sea urchins on the reefs. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life. [5] Presence of stingrays on the sand. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life.

Southern Bay of Elizabeth Island: The bay between Elizabeth Island and Guana Cay offers a protected swimming and snorkeling area sheltered from any wave- and/or boat-action. Except for a very small patch of corals scattered around the main rock of the bay, this location does not offer any reef. However, the bay is covered in seagrass which is another key habitat for marine organisms, especially the queen conch (*Strombus gigas*). The shallowness of the bay (water depths < 3m / 10 feet) and the very easy access by beach makes this spot ideal for beginning swimmers, snorkelers and families with children.

7. Recommendations for Scuba Diving

Windward patch reefs (WP1, WP3, WP4): The reefs at sites WP3 and WP4 were the healthiest in terms of reef structure and coral/fish abundance and diversity. Their reef structure including arches and cavities make these reefs of particular interest for scuba diving. However, these sites being on the wave-exposed side of the island, surge and/or currents can be elevated and need to be considered before the dives. Access to the reefs via boat only. It is recommended that *Silent Resorts* offers half-day or full-day scuba diving trips to these reefs. Site WP1 is located further offshore. Coral/Fish abundance and diversity is lower compared to WP3 and WP4. However, turtles and stingrays were sighted at this site. Access only possible by boat. It is recommended that *Silent Resorts* offers half-day or full-day scuba diving trips to this reef.

Potential hazards: [1] Potential strong currents depending on tides. Advise tourists based on daily weather conditions. Strong swimmers only! [2] Potential strong surge depending on wind conditions. Advise tourists based on daily weather conditions. Strong swimmers only! [3] Presence of fire corals in the area. Physical contact with fire corals can lead to itchiness, rashes and mild burns. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life. [4] Presence of sea urchins on the reefs. Advise tourists to keep a safe distance from the reef and to not touch any marine life for their own protection as well as to protect and conserve the reef and marine life.

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9. Appendix

Figures

Figure 1. Satellite imaging of Elizabeth island and location of study sites, *i.e.* leeward patch reefs (LP1-2) and windward patch reefs (WP1-4). Map copyrights owned by *Google Maps*.

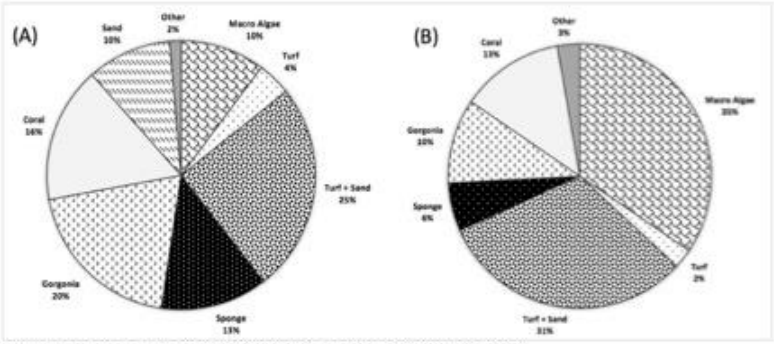


Figure 2. Benthic composition of (A) LP (n = 147) and (B) WP (n = 252).

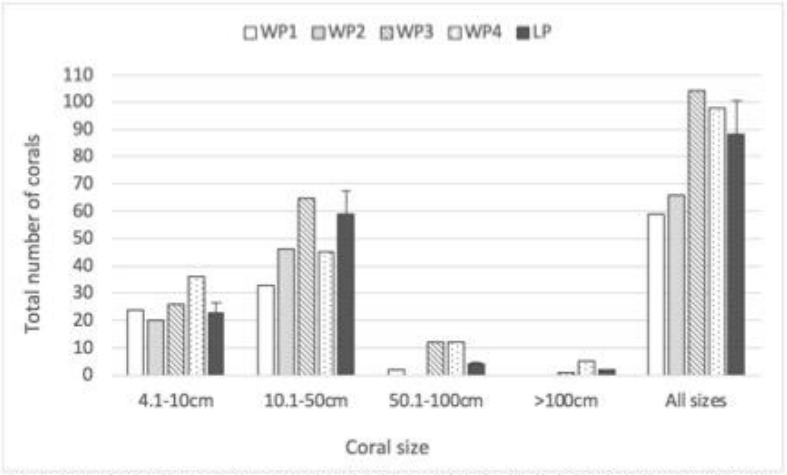


Figure 3. Coral abundance per size category and all sizes combined of the individual windward patch reefs (WP sites 1-4 represented by white, grey, striped and dotted bars, respectively) and averaged across the leeward patch reefs (LP, shown by black bars). Error bars show Standard Error of the Mean (SEM).

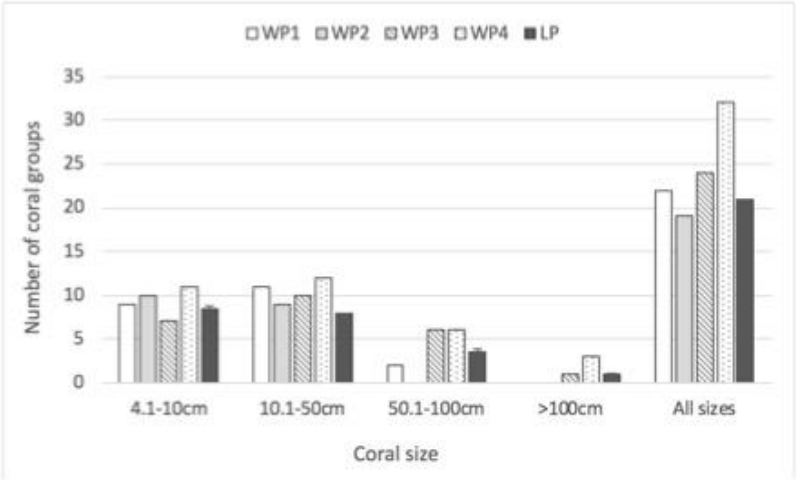


Figure 4. Coral species diversity per size category and all sizes combined of the individual windward patch reefs (WP sites 1-4 represented by white, grey, striped and dotted bars, respectively) and averaged across the leeward patch reefs (LP, shown by black bars). Error bars show Standard Error of the Mean (SEM).

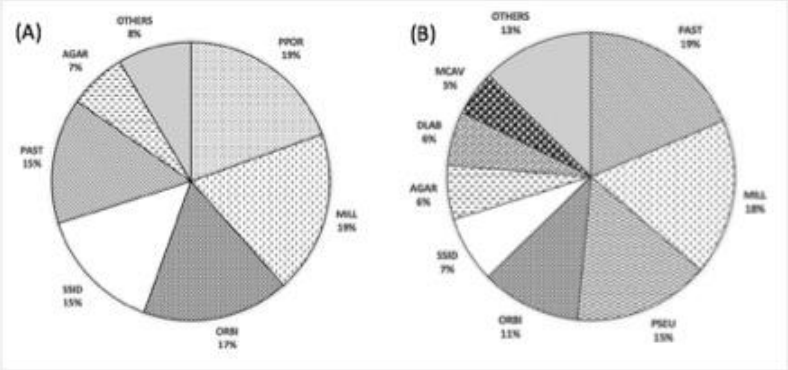


Figure 5. Coral composition and mean relative abundance of the most abundant stony corals (4.1-50 cm diameter) at (A) leeward patch reefs (n = 164) and (B) windward patch reefs (n = 295). PPOR = *Porites porites*, MILL = *Millepora* spp., ORBI = *Orbicella* spp., SSID = *Sidastrea siderea*, PAST = *Porites astreoides*, AGAR = *Agaricia agaricites*, PSEU = *Pseudodiploria* spp., DLAB = *Diploria labyrinthiformes*, MCAV = *Montastraea cavernosa*, OTHERS = combined coral species, each with <5% abundance of occurrence.

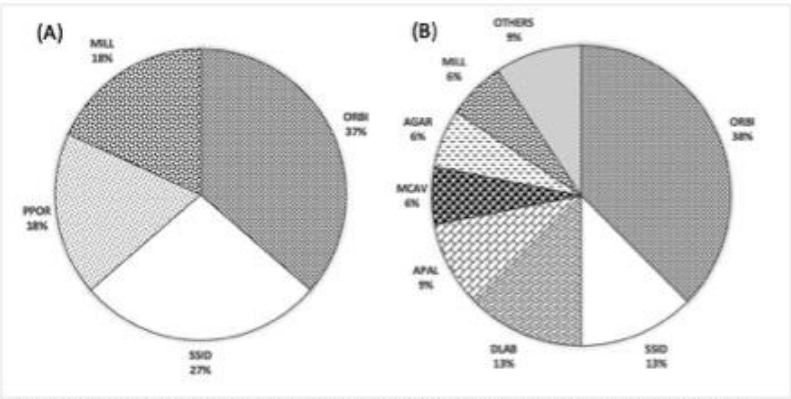


Figure 6. Species composition and mean relative abundance of the most abundant stony corals (>50 cm diameter) at (A) leeward patch reefs (n = 11) and (B) windward patch reefs (n = 32). ORBI = *Orbicella* spp., SSID = *Sidastrea siderea*, PPOR = *Porites porites*, MILL = *Millepora* spp., DLAB = *Diploria labyrinthiformes*, APAL = *Acropora palmata*, MCAV = *Montastraea cavernosa*, AGAR = *Agaricia agaricites*, OTHERS = combined coral species, each with <5% abundance of occurrence.

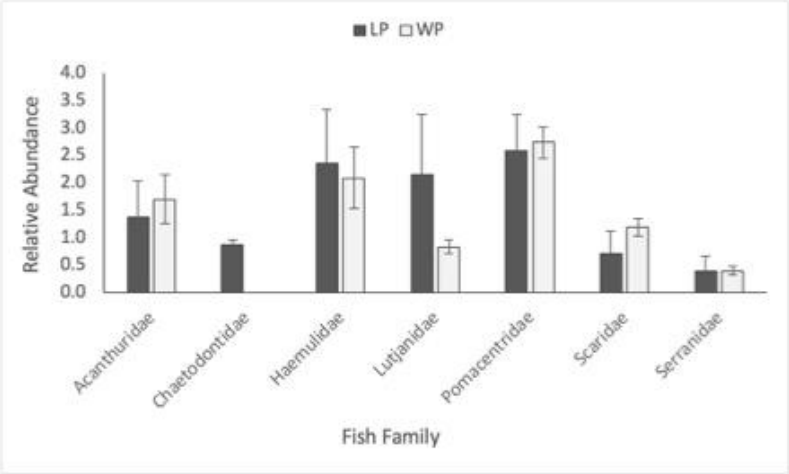


Figure 7. Relative fish abundance per fish family at leeward patch reefs (dark grey bars) and windward patch reefs (light grey bars). Error bars show Standard Error of the Mean (SEM). Relative abundance categories: 0-1 (few), 1-2 (many), >2 (abundant).

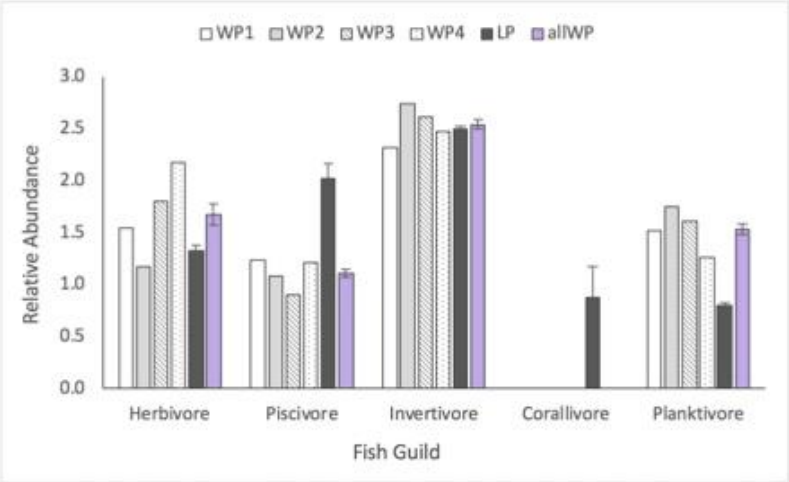


Figure 8. Relative fish abundance per fish guild at individual windward patch reefs (white, light grey, striped and dotted bars), averaged across all windward patch reefs (lila bars) and averaged across all leeward patch reefs (dark grey bars). Error bars show Standard Error of the Mean (SEM). Relative abundance categories: 0-1 (few), 1-2 (many), >2 (abundant).

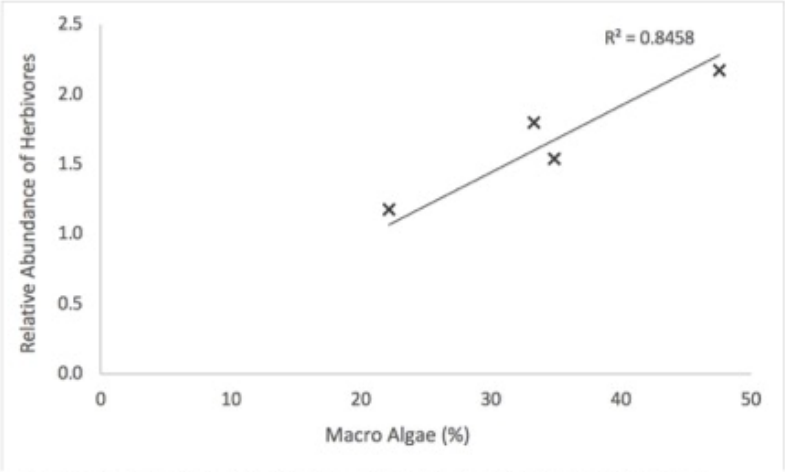
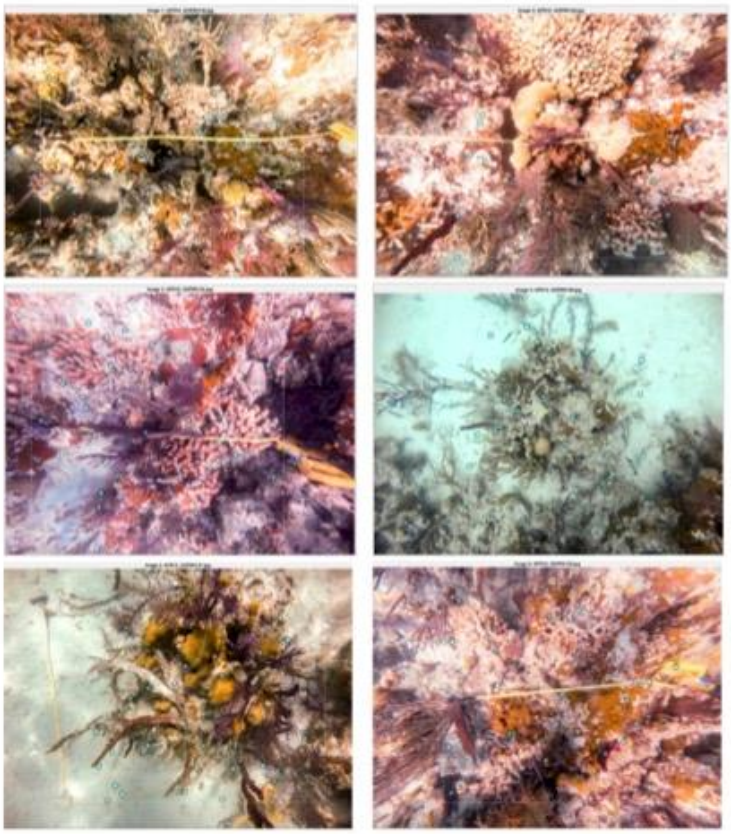


Figure 9. Relative abundance of herbivores in comparison to percent macro algae coverage at the windward patch reef sites. Correlation coefficient $R^2 = 0.8458$.

Photos used for PAPPARA(ZZ)I Analysis



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Appendix – C

No objection Letter from the Exuma District Council, in support of the Ki'ama project.

SILENT RESORTS

EXUMA DISTRICT COUNCIL – NO OBJECTION LETTER

No: DLG/ED/3/030
In replying please
Quote this number

Mr. John Long
Silent Resorts
Elizabeth Island
Exuma

Dear: Mr. Long:

Re: Silent Resort Exuma, Project

I have been directed to advise that at the Exuma District Council Meeting, held on December 1, 2021; councilors discussed the above mentioned.

I have been further directed to advise you that the Council has no objection to the construction of the proposed development at Elizabeth Island in the Exuma.

Yours Truly,

Godfrey Gray
Chief Councillor
Exuma District

GG/ccm

cc: Exuma District Council

Appendix – D

Elizabeth Island Exuma, The Bahamas Residential Property Development Hydrological Assessment

ADARIE ENGINEERING AND ENVIRONMENTAL SERVICES

ELIZABETH ISLAND
Exuma, The Bahamas

RESIDENTIAL PROPERTY DEVELOPMENT
HYDROLOGICAL ASSESSMENT

AUGUST 22, 2022

ADARIE ENGINEERING AND ENVIRONMENTAL SERVICES

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ADARIE ENGINEERING AND ENVIRONMENTAL SERVICES

ELIZABETH ISLAND, EXUMA [NW OF THE CRAB CAY + MAINLAND EXUMA]
An Eco-Friendly Preferred Site {required water with low energy use}

EXECUTIVE SUMMARY

Freshwater options are limited on Elizabeth Island. A small fresh to brackish groundwater reserve exist on the Windward (East to Southeast) portion of the landmass, but not suitable or sustainable for the proposed development. The following recommendations for water use on the island are:

[1.] TO ADDRESS ANY IMMEDIATE REQUIRED FRESHWATER AT SITE (FOR LIMITED SUPPLY OF FRESH-BRACKISH WATER, & NOT DEVELOPMENT PURPOSES), THE FOLLOWING WELL LOCATION GUIDANCE IS:

- A 20Ft to 30Ft (Maximum), 6-Inch to 8-Inch (Maximum) Borehole can be constructed in the general vicinity of the existing garden area (photo below):

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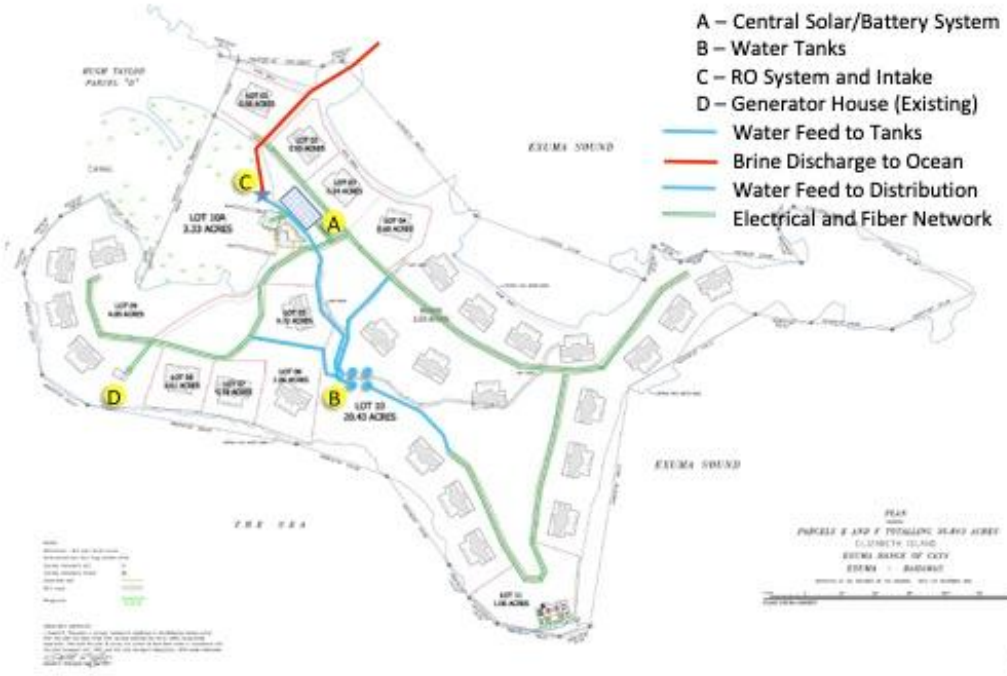
[2.] PER PRELIMINARY UTILITY DOCUMENTS [PLAN BELOW FROM DEVELOPERS], FOR THE REQUIRED SEAWATER REVERSE OSMOSIS (SWRO); AEES CAN QUICKLY ADVISE OF THE FOLLOWING:

- In The Bahamas, both the SWRO feed-water supply ('RO System and Intake') and the brine discharge ('Brine Discharge to Ocean') must be specified as boreholes / groundwater wells. SWRO supply/disposal well design is included in the present service proposal and shall be provided.
- An additional AEES service proposal shall be submitted for the required SWRO well permitting procedures, inclusive of the separate hydro-geological assessment for the wells & well construction oversight for the drilling activities. Well design efforts are included within the existing signed proposal (for minimum estimated 15-Hours/Site).
- AEES recommends that all associated approvals be in place, prior to the deployment of a drill-rig to site – so that all the required supply & disposal wells (for SWRO and wastewater treatment) can be installed.



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PROJECT OVERVIEW

The rapid assessment aims to identify the potential hydrological impact to the island and surrounding coastal zone, either due to the natural (climatic) | construction (development) effects.

Other environmental protection and mitigation measures were also detailed, per guidance of typical Environmental Impact Assessment | Environmental Management Plan (EIA/EMP). All site plans and maps to be referenced within the EIA/EMP documents.

A brief hydrogeological | water resources review was conducted to evaluate information & data achieves, assess the limits of the freshwater lens, note the existing hydro-geological features, and to determine influences between the landform and the marine environment.

The proposed development shall comprise of some thirty (30) structures – assumed single to multi-family dwellings. The conservative anticipated freshwater water demand for the development is approximately 25,000-Gallon/Day (94,635-Litre/Day or 94.635-m^3/Day).

All required reverse osmosis well infrastructure, shall be designed for the planned phased expansion of the property development.

WATER RESOURCES

For The Bahamas, all freshwater is by way of rainfall, which percolates and collects as groundwater.

Salinity levels of water are expressed in parts per million (ppm) or milligrams per litre (mg/l) of the chloride content in the water, which is a constituent of the total dissolved solids.

The total concentration of dissolved solids or salts (TDS, expressed in mg/L or ppm) is utilized as a water quality indicator.

The three main classes of water distinguished are: fresh, brackish and saline (salt | saline) water. For the purposes of this particular site and the proposed water use, the conservative range of salinity follows:

Water Description	Dissolved Solids
Fresh….....	Less than 1,000-mg/l
Brackish…	1,000 – 3,000-mg/l
Salt….....	More than 3,000-mg/l
Saline…	More than 30,000-mg/l

TERRESTRIAL VEGETATION OF THE BAHAMAS

The terrestrial vegetation may be classified into three types in three (3) zones from the North to South, in The Bahamas.

The islands of the northern Bahamas [Zone-1] are covered by a forest of pine, (*Pinus caribea var, bahamanesis*) in the interior of the islands, with a coastal strip of broad-leaf, coppice, and hardwood species on the windward side of the islands. The tidal flats on the protected side of the islands are typically covered with mangroves, (*Rhizophus mangle*) as the dominant species.

The islands of the central Bahamas [Zone-2] are covered by broad-leaved vegetation similar to that of the exposed coastal strip of the northern Bahamas [Zone-2]. This vegetation type is dominant on all islands in the central zone. Mangroves similarly cover protected, leeward, and coastal flats of the central Bahamas.

A mixture of broad-leaf coppice with an increasing amount of drought resistant species progressively further southeastward covers the islands of the drier Southeast Bahamas [Zone-3]. Vegetation of this zone is of lower drought resistant species progressively further southeastward. Vegetation of the zone is of lower stature, becoming scrub-like with an increasing number of xerophytic types. As with the previous two zones, mangroves are present on protected coastal flats.

SITE GEOLOGIC CONDITIONS

Per 'Origin of Late Holocene Stranplains in the Southern Exuma Islands, Bahamas by Michael Savarese, 2016' - "Hanna Bay Member limestones, belonging to the Rice Bay Formation, are extensively distributed around the periphery of the southern Exuma Islands, including Little Exuma and Great Exuma, and provide a record of late Holocene carbonate deposition and sea-level effects on development and spatial distribution of coastal environments. Three lithofacies occur here, as elsewhere in the Bahamas, and represent foreshore, backshore, and dune environments. Dune forms are remarkably well preserved and exposed, and exhibit original lee and stoss surfaces, physical sedimentary structures, and vegetative and fauna! Trace fossils. Though these ridges were formed as low amplitude parabolic dunes, they have catenary or zetaform shapes, mimicking the geomorphology of the active coast. This suggests that the ridges originated through wave action, but were later enlarged by eolian deposition."

"Foreshore and backshore deposits sit either stratigraphically below or outboard and laterally adjacent to eolian sands, indicating that dune facies often prograded over beach deposits, in at least some instances, or that beach deposits were involved in strandplain ridge formation. Outcrops commonly exhibit multiple phases of foreshore deposition and erosion."

HYDROGEOLOGICAL FIELD SURVEY

On 12-July-2022, a site visit was conducted for review of hydrological and geologic conditions on island. The hydrogeology observations of the proposed eco friendly housing development for the Eastern most portion of the island was reviewed. Our primary task is to utilize the natural water resources, or provide suitable alternatives for freshwater. By World Health Organization (WHO) Drinking Water Guidelines; salinity levels of less than 600-mg/L chloride are acceptable for groundwater.

ADARIE ENGINEERING AND ENVIRONMENTAL SERVICES

Groundwater at site (collected surface water sample from wetland area); has a salinity range of 1,500-mg/L. The salinity level of groundwater can increase as a result of human activities. Additionally, the intensification of seawater intrusion by any groundwater abstraction within this coastal zone area is further enhanced by sea-level rise. In the Bahamas, the physical geology, hydrogeology, water resources, and coastal zone are diametrically linked, as there are no true rivers in The Bahamas. The natural means of recharge | existence for the underlying 'freshwater resources' is via rainfall. There is a direct connection of the landform to the marine area | coastal environment, solely separated by a typical mangrove vegetation buffer on the protected coastal flats (in this case, the present southwestern marina cove area of the proposed development area).

Freshwater options are limited on Elizabeth Island, Exuma. A limited fresh to brackish groundwater reserve exist on the Windward (East to Southeast) portion of the landmass, but not suitable or sustainable for the proposed development.

Geological conditions consist of sandy conditions with a soft weathered to fractured hard limestone rock subsurface, and further suggest that recharge of the freshwater resources is very limited. Any small area of fresh to brackish tolerant vegetation is solely due to the surface fractured zones of the medium-hard limestone, where rainwater ponds/collects.

PHOTO DESCRIPTION – Typical fractured (suture) limestone features of the island

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PHOTO DESCRIPTION – Typical formation of surface limestone solution features

PHOTO DESCRIPTION – Typical broad-leaf palm, suggests fresh-brackish groundwater

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Geological features suggest that rainfall is quickly lost to sea as runoff, due to the combined elevation / hard natural limestone surface / sandy coastal condition of the landform. Photos of the typical coastal zone state follow:

PHOTO DESCRIPTION – Elevated fractured (suture) limestone & eolian sand area

PHOTO DESCRIPTION – Sand coastal dune ridge, upon a soft porous limestone base

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PHOTO DESCRIPTION – Coral-limestone graded toward the sand beach coastline

PHOTO DESCRIPTION – Foreshore outcrop of coral-limestone rock

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PHOTO DESCRIPTION – Sand coastal dune ridge, upon a fragmented limestone base

PHOTO DESCRIPTION – Oolitic sand coastal dune ridge, over a limestone base

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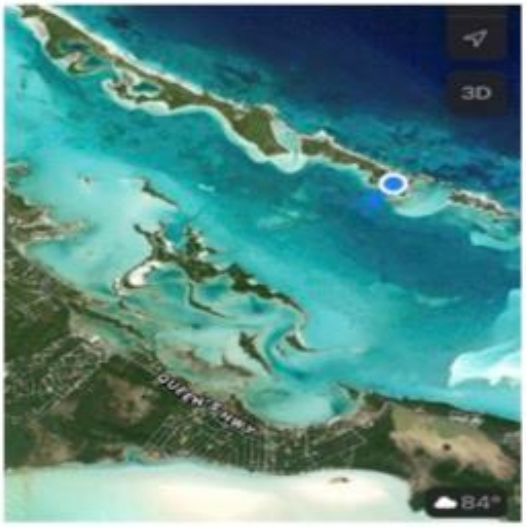
The following series of photos are from the elevation on Elizabeth Island
(Vantage point from the temporary elevation deck, for pre-development record)



Looking toward Crab Cay and Mainland Exuma - South {Windward Shore}

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Facing North West toward the Existing Residence

Facing North toward the Atlantic {Leeward Shore}

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Facing North East toward the sole significant water resources area / wetlands

Looking toward the East of Elizabeth Island

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WATER SUPPLY ALTERNATIVES - RAPID ASSESSMENT

All water supply recourse should be considered along with the wastewater treatment possibilities for the development. The immediate water supply options are:

[1.] Onsite Seawater Reverse Osmosis [SWRO], Two (2) Supply Wells, One (1) Combined Brine/Effluents Disposal Well and Buried Elevated Storage Tank (or, Sizable Storage Containment under structures and definitely for the structure @ highest elevation).

All wells should be drilled at the lower elevation – a suitable location is in the general vicinity of the present southwestern receiving area @ Present Garage Storage,

[2.] Underwater Pipeline from Mainland Exuma via Crab Cay - storage still required. Additional requirements would be necessary for the pressurization of the on island distribution systems. This option should be presented with possible incentives from the Government, as the Government Owned Water Utility shall gain potential clients (prior to and following the development), and

[3.] Other Onsite Hybrid Freshwater Provision - Solar / Wave / Photo-Voltaic (PV) powered assisted water options by desalinization may be explored - storage still required.

ON-SITE DESALINATION BY SWRO: THE MOST VIABLE OPTION FOR WATER

Per 'Review of Water Resources and Desalination Technologies by James E. Miller, 2003' - "Desalination has now been practiced on a large scale for more than 50 years. During this time continual improvements have been made, and the major technologies are now remarkably efficient, reliable, and inexpensive. For many years, thermal technologies were the only viable option, and multi-stage flash (MSF) was established as the baseline technology. Multi-effect evaporation (MEE) is now the state-of-the-art thermal technology, but has not been widely implemented. With the growth of membrane science, reverse osmosis (RO) overtook MSF as the leading desalination technology, and should be considered the baseline technology. Presently, RO of seawater can be accomplished with an energy expenditure in the range of 11-60 kJ/kg at a cost of $2 to $4 per 1000 gallons. The theoretical minimum energy expenditure is 3-7 kJ/kg."

SWRO DOCUMENT REVIEW: 'elemental water makers'

Per review of the standard 'Efficient Desalination Offer for Silent Resorts | The Bahamas' [V-2022-08-08] for the containerized 44m^3/day expandable to 88m^3/day equipment: please advise the supplier that the systems shall operate from supply wells – intake & discharge.

The required well pumps shall have to be specified, abstracting from 30-40Ft or 9 to 12-meter below ground elevation. The containerized equipment option is advised for shipment to the island. But, due to the aggressive island environment conditions of the development site, AEES recommends that the desalination equipment be contained within a structure.

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PHOTOVOLTAIC SOLAR POWERED SWRO - CONSIDERATION

Per 'Design Optimization of a Solar-Powered Reverse Osmosis Desalination System for Small Communities, August 2013' - "Since solar energy from photovoltaic panels is unavailable after sunset, and can be highly variable throughout the day, an off-grid system requires battery storage to maintain steady operation. RO systems are typically require around 4 hours of maintenance per day for back-washing the membrane modules, changing defective modules and other repairs. During the maintenance period, there is no production of fresh water, but the power draw of the desalination plant is significantly reduced. To take advantage of the typical daily power availability cycle, the maintenance period is assumed to happen between midnight and 4:00am every day. Aside from maintenance, the RO system has no hard restrictions on being run at partial load or even complete shutdown (in case of power unavailability) so long as: i) turbulence flow levels in the membrane modules are maintained to prevent fouling, and ii) change of state happens via a smooth ramp-up/down."

ENVIRONMENTAL PROTECTION & MITIGATION MEASURES

For the detailed environmental protection and mitigation measures, an Environmental Impact Assessment (EIA) | Environmental Management Plan (EMP) shall be required. A preliminary review was conducted to evaluate information & data achieves, assess the limits of the freshwater lens & the existing hydrological features, and note any influences between the land and the marine environment. A documentation search was executed to collect data for:

1. Groundwater Lens Configuration - confirmation of groundwater resources – limited freshwater resources,
2. Potential impact of the project to the groundwater resources – no significant groundwater resources exist on the island,
3. Groundwater contamination, mitigation, specific water use, and discharges – required well (borehole) use for all intake | discharge. Direct intake | discharge to the surrounding marine environment is not permitted for reverse osmosis (desalinization) / drainage (runoff from developed areas) / effluent (from sewer),
4. Review of present or required groundwater mitigation | remediation plans or goals - no significant groundwater resources exist on the island,
5. Elevated storage requirements for freshwater – large cistern should be built into the structure at highest elevation (guidance per civil design plans),
6. Preliminary Construction Sediment Flow | Coastal Surge Projections – erosion & sediment control required due to land elevations (measures per civil design plans),
7. Preliminary Marine & Coastal Surveys – impact by project construction | operations – existing areas shall not be modified and/or altered, and
8. Other Potential Environmental Hazards – for wetlands & associated water features – existing areas shall not to be modified and/or altered.

Recommendations intend to both identify & alleviate the projects potential impacts due to the construction activities | operation of the proposed residential property development – for groundwater | hydrology | water resources | water quality | wetlands.

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RECOMMENDATIONS | CONCLUSIONS

The hydrogeological & limited coastal survey involved the confirmation, status, and sustainability of any water resources | wetland features. The option of the Eco-Friendly Development is encouraged; where the proposed properties and structures are built into the natural environment, with limited impact to land elevation / ridges / sand dunes / coastline.

The following recommendations are made to minimize negative impacts to the resources:

- The natural site area is predominated by terrestrial vegetation of Zone-2 (Broad Leaf Vegetation) and wetland features (mangrove cover | coastal flats) – guidance per vegetative assessment of the required species to be maintained.
- Alternative freshwater for the development is required, as the existing resources are not sustainable for the proposed development. An immediate temporary supply well has been specified for minimal water provision – 20Ft to 30Ft (Maximum) depth, with 6-Inch to 8-Inch (Maximum) casing to 10Ft.
- We recommend | support the required freshwater supply by seawater reverse osmosis (SWRO), with a solar-power package and/or 100% off-grid solar-powered solution.
- Per guidelines established from the Water & Sewerage Corporation (WSC) Act of 1976, SWRO supply source and brine discharges must be by groundwater wells. The SWRO supply well | associated brine/wastewater disposal well design specifications shall be provided by AEES, with WSC approvals to follow [ALL TO BE FURNISHED].
- AEES well design & SWRO review were included under the existing signed proposal (for minimum estimated up to15-Hours/Site). AEES services for any additional required SWRO well permitting procedures, inclusive of further hydro-geological assessments for any boreholes | well construction oversight for the drilling activities | well pump testing | water quality tests for the SWRO source water, shall be quoted in advance – for services in excess of the estimated 15-Hours.
- Per the Bahamas Professional Engineer's Act of 2004, a Bahamian Engineer-Of-Record (EOR) shall be required for the related design of the water & sanitation systems. AEES responsibilities are solely for the required well infrastructure, which shall be incorporated into the water | sewer system design. The EOR is responsible for the permitting of the water | sewer design, under the Civil Drawings.
- AEES recommends that all associated approvals be in place, prior to the deployment of a drill-rig to site – so that all the required supply & disposal wells (for SWRO and wastewater treatment) can be installed per requirements of the proposed phased development.
- Additional hydrological-wetland assessments may be required to ascertain the level of impact to the mangrove coppice, along with other project density analysis.

Appendix – E:

BAHAMAS NATIONAL TRUST

October 18, 2022

Christopher Russell
Managing Principal
Russell Craig & Associates Limited (RCA)
Nassau, Bahamas

Re: Ki'ama Resorts Development within Moriah Harbour Cay National Park

Dear Mr. Russell and Associates,

This letter is to acknowledge that in August 2022 the Bahamas National Trust (BNT) was briefed on the proposed Ki'ama Resort on Elizabeth Island, Exuma by the Silent Resorts Team. In this presentation, it was clarified that the Ki'ama Resort location is indeed within the boundaries of the Moriah Harbour Cay National Park (MHCNP) managed by the BNT.

The BNT recognizes the intentions of the developer to minimize impact to the terrestrial and marine environment during the construction and operations of the Resort, and the developer's intentions to introduce advanced sustainable elements to the process of building and operating the resort. If the developer adheres to the design as presented, the Resort as proposed may be compatible with the management objectives of MHCNP. If your stated development objectives are achieved and the sustainable standards maintained, it is not inconceivable that Ki'ama Resorts could indeed serve as a replicable model for development within, adjacent to or within proximity to national parks.

It should be noted that the Resort will be required to obtain permissions from the BNT and relevant authorities for any activities that may impact the marine environment around Elizabeth Island which are waters managed within the boundaries of MHCNP by the BNT. In addition, it is required that any activities that involve research and/or environmental monitoring that take place within the boundaries of MHCNP be properly permitted through the Department of Environmental Planning and Protection (DEPP) and the BNT.

The BNT looks forward to working with you and your clients to foster a supportive relationship based on good corporate citizenship and respect for the environment. Please do not hesitate to contact me or our Park staff to learn more about the MHCNP and the BNT.

Managing National Parks | Preserving Our Future
P.O. Box N-4105 | Main Headquarters, Bay St. East, Nassau, The Bahamas
Phone: 242-393-1317 | Fax: 242-393-4978 | Toll Free: 1-866-6778-4838 | Email: bnt@bnt.bs | www.bnt.bs

We look forward to receiving the EIA as soon as possible so that our BNT Team can review and offer your client our comments.

Please let us know if you need additional information at this time.

Regards,

Eric Carey
Executive Director

Managing National Parks | **Preserving Our Future**
P.O. Box N-4105 | Main Headquarters, Bay St. East, Nassau, The Bahamas
Phone: 242-393-1317 | Fax: 242-393-4878 | Toll Free: 1-866-9778-4838 | Email: bnt@bnt.bs | **www.bnt.bs**

APPENDIX - F

Curriculum Vitae for Environmental Consultants

ENVIRONMENTAL CONSULTANT – 1

Christopher Russell

PRESENT EMPLOYMENT

Managing Principal and Lead Environmental Consultant – Russell Craig & Associates Ltd

Duties**:**

- **Business development**
- **Staff recruitment and training**
- **Delivery of client services**
  - **Environmental policy**
  - **Environmental education, awareness, and promotion**
  - **environmental planning.**
  - **Environmental permitting**
  - **EIA/EMP development**

EDUCATION:

1994-1995	**University of Otago,** Dunedin, New Zealand Professional Master's Degree in Regional and Resource Planning (MRRP.)
1989-1992	**Bangor University**, (formerly University of Wales at Bangor), North Wales, United Kingdom.B.Sc. (Hons.) Forestry and Wood Science
1986-1988	**Cyprus Forestry College**, Republic of Cyprus Diploma & Certificate in Forestry

LECTURESHIPS, MEMBERSHIP AND ASSOCIATIONS

Past Adjunct Professor in Geography – CELEARN (formally CEES) – **University of the Bahamas.**

Past Adjunct Professor in Geography (100 level), Plant Biology (200 level), Comparative Geography of Small Island States (200 level), Environmental Impact Studies (EIA) (400 level) – (School of Environment and Life Sciences), **University of the Bahamas.**

Past Council Member - **Bahamas National Trust.**

Past Board Member – **Bahamas Public Park and Public Beaches Authority.**

Past President (2005/06) – **Rotary Club of New Providence** – The Commonwealth of the **Bahamas.**

Paul Harris Fellow – **Rotary International**.

Member, **Bahamas Society of Engineers (**MBSE)

FELLOW: (FIMMM) – **Institute of Materials, Mining and Minerals**, UK.

CONSULTANCIES:

1) Forestry Consultant - Food and Agricultural Organization of the United Nations, (FAO). Contributing to the following publications:
- **i)** "Forestry Policies in the Caribbean – Volume 1: Proceedings of the Expert Consultation, 1998"
- **ii)** "Forestry Policies in the Caribbean – Volume 2: Reports of 28 selected countries and territories, 1998"
- **iii)** "Global Forest Resources Assessment 2005 – Progress towards sustainable forest management, 2006"
- **iv)** "The World's Mangroves 1980 – 2005, 2007"

Previous Employment History:

2010 – 2012 - ***Director of Forestry*** *– Ministry of the Environment and Natural Resources*

- Director of the Forestry **Unit.**
- Administer the provisions of the Forestry Act 2010 and Forestry Regulations **2014.**
- Preparation and implementation of the National Forest Plan for the **Bahamas.**
- Budget preparation and oversight, recruitment, **supervision,** and training of **staff.**
- Development of **short-, medium- and long-term** strategic plans for the development of the Bahamas' forest resources within the national forest **estate.**
- The promotion of forestry industry development for the **Bahamas.**
- Solicit international grant funding to assist the Bahamas in the implementing of forest management plans, programs and **projects.**
- Analyze and evaluate project proposals for forestry development for Government's **consideration and** provide oversight of timber license **operations.**

- Served as National Focal Point and Project Coordinator for FAO/ TCP Forestry Pilot Training program for the Forestry Unit staff, Bahamas National Trust Park Wardens, Department of Environmental Planning and Protection, **Officers,** and Department of Environmental Health Services Environmental **Officers.**
- Drafted technical provisions for various environmental legislations, (**i.e.,** Forestry Act 2010, Forestry Regulations, 2014, Forestry (Amendment) Act 2014, Bahamas Public Parks Authority Act, 2014, Forestry (Amendment) Regulations 2018, Forestry (Amendment) Regulations 2020, draft National Forest Bill 2020, Forestry (Declaration of Protected Trees) Order, 2021
- Provide technical advice to the Minister and Permanent Secretary on Forestry and Environmental **matters.**

2009 – 2010 - **Deputy Permanent Secretary** – Ministry of the Environment

- Drafting of Cabinet **memoranda.**
- Project development, management, and supervision to produce the first order land use and zoning plan for New Providence **Island.**
- Assist the Minister of State for the Environment with portfolio responsibilities (i.e. policies matters relating to the management of Bahamas Electricity Corporation and Water and Sewerage Corporation);
- Assist with the implementation of Ministry's environmental policies, programs, plans and projects;
- Develop the legal framework and institutional arrangements for the establishment of the Forestry Unit of the Ministry of the Environment.

2007 - 2009 **Chief Housing Officer** (on Secondment to the Department of Lands and Surveys)

- Responsible for the processing of applications for the lease of Crown **Lands.**
- Supervision of staff dealing with Crown Land **Management.**
- Supervise staff, and activities of the Survey and Mapping Section of the Department. (**i.e.**, coordination of all **cadastral** land surveys, survey plan recordings, and Crown Grant document preparation).

2006 - 2007 **Chief Housing Officer** (on Secondment to the Office of the Prime Minister)

- Advised the Prime Minister on matters related to the disposition of Crown lands to individuals making application for the lease of Crown Lands for **development.**
- Assist the Parliamentary Commissioner in determining electoral boundary changes to the constituencies in the country, in preparation for the general elections of **2007.**
- Finalized the Bahamas constituency boundary maps with legal descriptions subject to gazettement prior to General Elections, 2007.

2003 – 2006 - **Chief Housing Officer** – Department of Housing (Ministry of Housing and National Insurance)

- Administrative Head of the Department of Housing, coordinated and managed the Government's affordable housing program;
- Administer the Government Guaranteed Loan **Program and** acted as technical advisor to the Housing **Commission.**

- Manage the sale of residential lots offered by the Department of Housing, including preparation of conveyances in relation to the Government Guaranteed Loan **Program.**
- Prepared cases for obtaining legal advice from the Department of Legal Affairs **regarding** delinquent clients, lending institutions and **homeowners' complaints.**
- Assist in the planning and development of technical designs for government subdivisions throughout the **Bahamas.**
- Analyze applications from banks and insurance companies seeking approval of the Minister to be placed on the Approved Builders **List.**
- Provide advice to the Permanent Secretary and the Minister as necessary.

PUBLICATIONS, ARTICLES AND DISSERTATIONS

- Russell, Christopher. The Conservation of Biodiversity in the Natural Pine Forest of the Bahamas. *El Pitre – Journal of the Caribbean Ornithology Society*. 1993.

- Russell, Christopher. *Country Report on Forest Policy in the Bahamas*. Consultancy Report, GCP/RLA/132/EC TF No. 64335, FAO, Rome, Italy. 1997.

- Russell, Christopher. The Future of Forestry in the Bahamas. *Bahamas Journal of Science*. Volume 5, Number 3. June 1998.

- Russell, Christopher. *Forestry Policies in the Caribbean, Volume – 1: Proceedings of the Expert Consultation*. Contributing Consultant. FAO, Rome, Italy. 1998.

- Russell, Christopher. *Forestry Policies in the Caribbean – Volume – 2: Reports of 28 selected Countries and Territories*. Contributing Consultant. FAO, Rome, Italy. 1998.

- Russell, Christopher. *Bahamas Country Report: Forestry Outlook Study for the Caribbean*. FAO, Rome, Italy. 30pp. 2000.

- Russell, Christopher. *Bahamas Country Report: The use of Forest for Ecotourism*. Caribbean Regional Workshop on Forest for Ecotourism, FAO, Castries, St. Lucia, May 2003.

- Russell, Christopher. *Position Paper on Forestry Development in the Commonwealth of the Bahamas.* Department of Lands and Surveys, Office of the Prime Minister. Nassau Bahamas. 2007

- Russell, Christopher. *The Status of Forestry Development in the Commonwealth of the Bahamas.* TNC Pine Rockland Conference: "Rockland Forest in a Changing World", Miami, Florida and Andros Island, Bahamas, February 2008.

- Russell, Christopher, et. al. *Report on the production of the First Order Existing Land Use and Zoning Maps for the Island of New Providence,* Bahamas. Ministry of the Environment,

Nassau Bahamas, 2010.

- Russell, Christopher; Miller, Ingeria; Daniels, Mark. *Cost Benefit Analysis of Casuarina Species Management at Governors Harbour, Eleuthera Island, Bahamas: A Case Study*. Proceedings from MTISAIC Conference. Policies Strategies and Best Practices for Managing Invasive Alien Species (IAS) in the Insular Caribbean, Trinidad and Tobago, 2014.

- Russell, Christopher; Miller, Ingeria. *Post Hurricane Dorian impact on the pine forest resources of Abaco and Grand Bahama Islands: A Rapid Resource Assessment Report*. Forestry Unit, Ministry of the Environment and Housing, Nassau, Bahamas. 2019.

- Russell, Christopher. *The Impact of Hurricane Dorian on the pine forest ecosystem on Abaco and Grand Bahama Islands*. TNC Pine Rockland Working Group Virtual Conference, Miami, Florida, USA, 2020.

- Russell, Christopher; Curry, Andrew; Rodgers, Terrance. *Environmental Baseline Study (EBS) for the Carmichael Village Subdivision*, Carmichael Road, Nassau Bahamas. Department of Housing, Ministry of the Environment and Housing. 2021.

- Russell, Christopher. *Environmental Management Plan (EMP) for the Carmichael Village Subdivision*, Carmichael Road, Nassau Bahamas. Department of Housing, Ministry of Transport and Housing.

ENVIRONMENTAL CONSULTANT - 2.

JOHN A. BOWLEG, PE C.Eng, C.Env, C.Sci (Hydrology)
Chartered Water and Environmental Manager
M.ASCE, M.BSE, M.CIWEM

#7 Wild Tamarind Drive, 'BlueCloud' Camperdown
PO Box EE-17345, Nassau, The Bahamas
Mobile #'s: (242) 557-2775

855 W. Commercial Blvd, #103
Fort Lauderdale, Florida 33309
Email: JBowleg@AEESconsultants.com

EXPERIENCE:

6/05 – Present **CONSULTING PROFESSIONAL CIVIL-ENVIRONMENTAL ENGINEER | HYDROLOGIST | ANALYST**

ADARIE Engineering & Environmental Services [AEES] | AEES Consulting Group, LLC {Since Sept-2021}

Fort Lauderdale, Florida USA | Atlanta, Georgia USA.

Project management for civil engineering works, environmental monitoring, hydrological design, reverse osmosis, renewable energy, waste, and wetland projects. Construction site inspections, prepare final reports, and expert witness in defense of environmental matters. Independent environmental laboratory data review for clients. International project works for land development, water & natural resources management, climate change | disaster risk reduction & mitigation mechanisms, and the scaling of resilient water-energy technologies. Ocean Thermal Energy Conversion (OTEC) research | development.

- ***American Institute of Hydrology [AIH] – Member***
- ***American Society of Civil Engineers [ASCE] | Environmental & Water Resources Institute [EWRI] – Member***
- ***Greenhouse Gas Management Institute [GHGMI] Inventory Courses (2022)***
- ***Ocean Thermal Energy Association [OTEA] – Member (2020 – Present)***
- ***United Nations [UN] Department of Safety and Security [BSAFE] Certification (2021 - Present)***
- ***UN Food & Agricultural Organization [FAO] Forest & Water Nexus – Intro (21Nov2021)***
- ***UN Development Programme [UNDP] | UN Environment Programme [UNEP] Consultancies (2021 -Present)***
- ***UNESCO-IHP, EcoHydrology Working Group for Latin America & Caribbean – Head (2021 - Present)***
- ***UNESCO-IHP Latin America & Caribbean (LAC) – Consultant (2020 – Present)***
- ***World Meteorological Organization [WMO] – Hydrological Advisor for the Bahamas (2004 – Present)***

7/99 – Present **WATER RESOURCES CONSULTANT | SR. HYDROLOGIST [Groundwater Management | WaSH].**

{2021/2022 Pre- **Water & Sewerage Corp. [W&SC] – Water Resources Management Unit [WRMU]. Nassau, The Bahamas.**

Retire Leave} Water & Environmental Manager with responsibility for the assessment & monitoring of the groundwater resources, thru the Engineering & Planning Department of WSC. Provide guidance on the development / management of the groundwater resources & coastal zone. Involved in matters concerning groundwater abstraction, reverse osmosis processes, wastewater effluent disposal, and Water Sanitation & Hygiene [WaSH]. In accordance with a key international environmental convention, served as Chairman of the National Wetlands Committee [Ramsar Convention] to implement the countries goals/policy regarding wetlands. Additional international duties for water | hydrology | environment are:

- ***Global Water Partnership – Caribbean [GWP-C], Bahamas Water Resources Representative (2000 – 2021)***
- ***International Water Association [IWA] Specialist Group – Caribbean Representative (2013 – Present)***

- ***Ramsar Convention on Wetlands – Caribbean Representative (2003 – 2008), Vice-Chairman of Standing Committee (2005– 2008), & Member of the Management Working Group (2009 – 2012)***
- ***UNESCO-IHP, Hydrological Representative for the Bahamas | Caribbean (Aug 2007 – Present)***
- ***Water Resources Government Representative to the Organization of American States [OAS] (2002 – Present), & Inter-American Water Resources Network [IWRN] Board Member (2009 - 2012)***

4/99 – 7/99 **CONTRACT CIVIL | ENVIRONMENTAL ENGINEER. George V. Cox & Co. Nassau, NP, The Bahamas.**

Family Island Infrastructure Study - Great Exuma, Little Exuma | Exuma Cays, & Cat Island, The Bahamas.

Collection of data for the physical condition of government facilities. Project site data integrated into a Global Information Systems (GIS) Project. Facilities consist of Docks, Airports, Buildings, Bridges, Roads, and Utilities. Hazardous substances and potential environmental impacts also identified.

6/98 – 3/99 **PROJECT ENGINEER | CONSTRUCTION MANAGER. Willmer Engineering, Inc. Atlanta, Georgia, USA.**

Project management of landfill closure, asphalt testing at airports, and asbestos surveys | abatement monitoring. Construction Quality Control | Assurance (CQC | CQA) services for the testing & inspection of fill density | compaction, asphalt & concrete pavements, building footings, and structures. Conduct construction site inspections, and prepare final CQA Certification Reports for landfill projects.

9/97 – 6/98 **CONTRACT CIVIL | DESIGN ENGINEER. EMCON Environmental Services. Duluth, Georgia, USA.**

Designs of solid waste landfills & transfer facilities, site development, and hydrological analysis. Environmental Phase I & II Surveys, Corrective Acton Plan (CAP) analysis, site closure, and remediation for Environmental Projects. CQA, site inspections, and CQC for landfill projects.

8/96 – 9/97 **CIVIL ENGINEER | TECHNICAL SPECIALIST. GZA GeoEnvironmental, Inc. Gwinnett, Georgia, USA.**

Solid waste landfill | transfer facility design, site development, drainage studies, & environmental site assessments. Engineering | hydrological design calculations using AutoCAD, and EaglePoint Software.

12/93 – 7/96 **ENVIRONMENTAL ANALYST. Analytical Services Inc. [ASI]. Norcross, Georgia, USA.**

Extraction methodologies | organic analysis for analytical methods following the US Environmental Protection Agency (EPA) Solid Waste Regulations (SW-846). Performed the review and report of clientele results for sample extracts following EPA-8270, 625, 525 methods | regulatory guidelines, including all required QA/QC Protocols for US Army Corp Of Engineers Project Sites. [ASI - Norcross, GA Environmental | Lab is presently PACE Analytical]

PUBLICATIONS | RESEARCH:

Frontiers | Frontiers in Water Publication, Community Case Study, Intervention and solutions for water supply on small islands: The case of New Providence, The Bahamas (Welch | Bowleg, 2022), DOI: 10.3389/frwa.2022.983167

Climate Change, Water Resources, & Renewable Energy in The Bahamas, 2022, DOI: 10.13140/RG.2.2.22283.98084

Water-Energy Nexus: Case Study on Climate Change and Water Resources, in The Bahamas. {Use of the reverse geothermal conditions, towards adaptation measures - OTEC | SDC/SWAC | SWRO} – September 2017 | December 2020 | Ongoing Research Activities (Bowleg, 2017, DOI: 10.13140/RG.2.2.28981.91369)

Water Resources - Challenges for Groundwater Management & Climate Change in the Caribbean | Commonwealth of The Bahamas, North Andros and Grand Bahama Storm Surge Data (UNESCO International Science School - Havana Cuba, Bowleg, 2018, DOI: 10.13140/RG.2.2.22690.45765)

UNESCO Ecohydrology, Ecosystem Change & Management Response on Tropical Island Systems: Case Study of Great Exuma linking Land Use Change, Coastal Wetlands and Marine Fisheries (Exuma Bahamas, Sealey | Bowleg, 2015)

UNESCO Graphic Publication (CRC Press), Climate Change Effects on Groundwater – Chapter 5, Effects of storm surges on groundwater resources, North Andros Island, Bahamas (Bowleg | Allen, 2011)

UNEP 1st Expert Workshop on Vulnerability of Coastal Aquifers in the Insular Caribbean, Impact to North Andros Water Resources, due to storm surge – presentation of data, following Hurricane Frances (Havana City Cuba, Bowleg, 2004)

Mobil Oil Corporation, 'Biological Activated Carbon for Removal of Gasoline Contaminants in Groundwater', Determination of Isotherm(s) associated with the Competitive Adsorption of Benzene, Toluene, Ethylbenzene, & O-Xylene using Calgon Filtrasorb-400 Granular Activated Carbon (Howard University School of Engineering, Washington DC, 1993)

PROFESSIONAL REGISTRATIONS | AFFILIATIONS:

American Society of Civil Engineers [ASCE], Member (#296012)
Bahamas Professional Engineers Board [PEB] Registration for Civil & Environmental (#10129)
The Bahamas Society of Engineers [BSE], Member (#0131)
The Chartered Institution of Water and Environmental Management [CIWEM], Member (#27901)
UK Chartered Engineer (C. Eng.) Register – (Registration #542642)
UK Chartered Environmentalist (C.Env.) Register – (Registration #3505)
UK Chartered Scientist (C.Sci.) Register – (Registration #WEM/105/000293)

EDUCATION:

IHE DELFT INSTITUTE FOR WATER EDUCATION | Groundwater Hydrology Studies | Certificate – Short Course [2015]

UNV. OF COLORADO BOULDER – UCAR Comet | Hydrometeorology Analysis | Certificate – International Course [2008]

MASHAV – SHEFAYIM, ISRAEL – CINADCO | Water Resources Management | Certificate – International Course [2000]

HOWARD UNV. | Mobil Oil Removal of Gasoline Contaminants in Groundwater | Senior-Graduate Research [1993]

HOWARD UNIVERSITY | School of Civil / Environmental Engineering | Bachelor of Science (BSc) [1988 – 1993]