VOLUME 2

CL ENVIRONMENTAL
ENVIRONMENTAL CONSULTANTS

PROPOSED RESORT DEVELOPMENT AT PARADISE PARK, SMITHFIELD, WESTMORELAND

ENVIRONMENTAL IMPACT ASSESSMENT

FINAL V. 2

DOCUMENT TITLE	**Environmental Impact Assessment for the Proposed Resort Development at Paradise Park, Paradise Pen, Westmoreland** **Volume 2**
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5.0 PUBLIC PARTICIPATION

5.1 APPROACH

5.1.1 Survey Area and Sample Size

The survey area for the perception study was established to be a five-kilometre radius around the proposed project land. Using the Raosoft calculator[1] set at 95% confidence level and the population within the 5km buffer of the proposed site (38,289 persons), the total sample size was estimated to be 381 persons. Using the ratio of the sample size versus the total survey area population (1:100.5), the sample sizes for each ED within the survey area was calculated (Figure 5-1). These ED sample sizes were used to guide the number of questionnaires randomly administered within each ED.

5.1.2 Target Groups and Questionnaires

Residents and fishers were the major target groupings for the public participation survey. Questionnaires (Appendix 14) were administered within the 5km survey area during the period October 3-11, 2024, to a total of 387 residents and 21 fishers. Additionally, introductory meetings were held with various stakeholders, including the National Fisheries Authority (NFA) and the Bluefields Bay Fishermen's Friendly Society (BBFFS) in order to garner their thoughts about the proposed expansion in relation to the fish sanctuary and fisheries activities in the area.

[1] Sample Size Calculator by Raosoft, Inc.

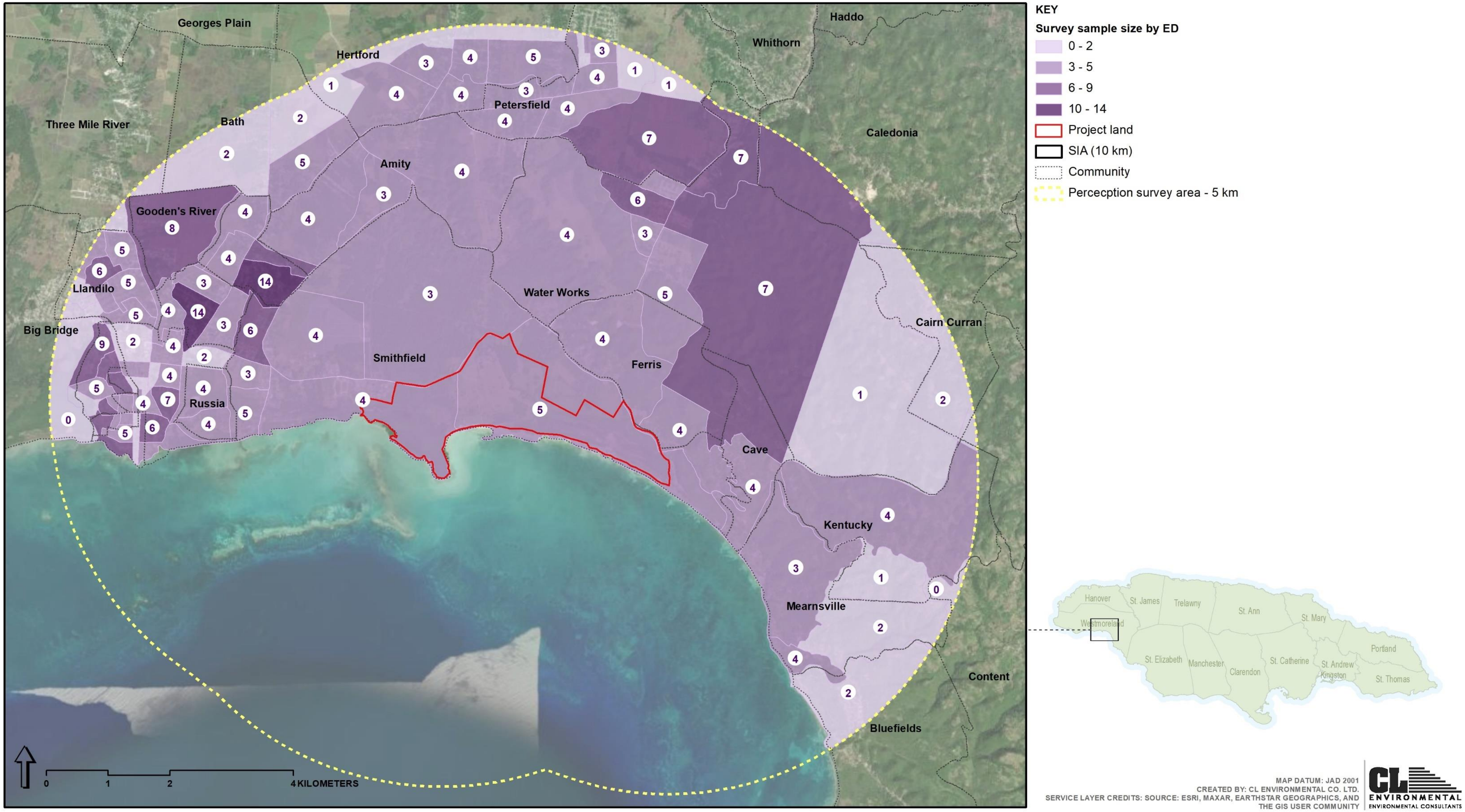


Figure 5-1 Survey sample size by ED for a 5 km buffer around the proposed project site

5.2 COMMUNITY

5.2.1 Cohort Description

For the community perception survey, a total of 387 respondents participated, with a gender distribution of approximately 60.7% male and 39.3% female. The age cohort breakdown is as follows: 7.7% were aged 18-24 years, 18.9% were 25-34 years, 15.8% were 35-44 years, 24.8% were 45-54 years, 20.7% were 55-64 years, and 12.1% were aged 65 and older (Figure 1). Respondents hailed from 14 main communities, including Savanna-la-Mar, Petersfield, Dunbar's Corner, Waterworks, Llandilo, Strathbogie, Galloway, Hertford, Torrington, Paradise, Cave, Amity Cross, Ferris, and Mearnsville. Table 1 shows the percentage distribution of respondents from each community. It's important to note that the percentages reflect only those respondents who provided answers to each specific question; individuals who did not respond to a particular question were excluded from the analysis for that question.

Table 5-1 Percentage Distribution of Survey Participants by Community

Community	% Distribution
Savanna-la-mar	19.9%
Petersfield	19.6%
Dunbar's Corner	12.4%
Waterworks	8.0%
Llandilo	7.8%
Strathbogie	6.2%
Galloway	5.7%
Hertford	4.1%
Torrington	3.6%
Paradise	3.4%
Cave	3.1%
Amity Cross	2.6%
Ferris	1.8%
Mearnsville	1.8%

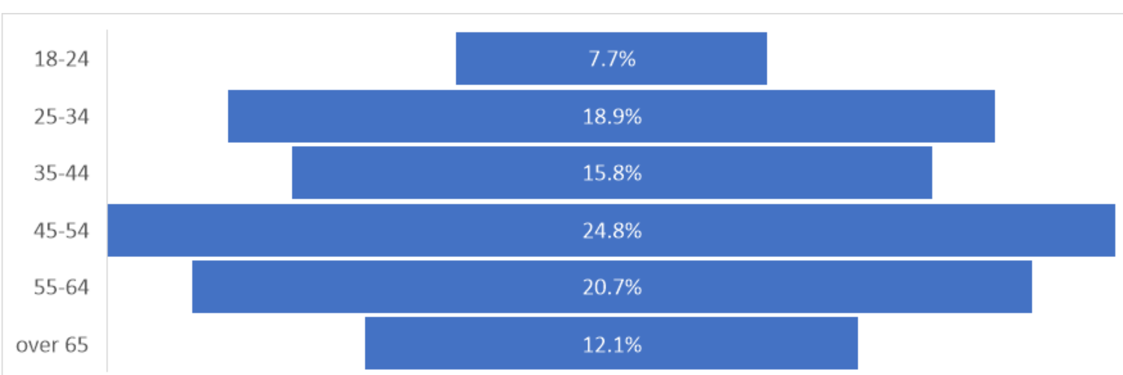


Figure 5-2 Age Cohort Distribution of Survey Participants

Of those persons interviewed who offered a response, 57.6% indicated that they were self-employed, 24.0% indicated that they were engaged in full-time employment, while 4.7% stated that they were employed on a part-time basis. Just under four percent (3.9%) stated they were unemployed. Approximately nine percent (9.3%) of individuals were retired. Less than one percent (0.5%) of respondents stated "other" but offered no further response. Additionally, 77.5% of interviewees when asked confirmed that they were the head of their household while 22.5% indicated that they were not the household head.

Regarding the number of persons residing in households, just over twenty-five percent (25.1%) of households had one occupant while 18.1% had two occupants, 20.4% had three occupants and 16.5% had four persons living in the household. Approximately ten percent (9.8%) had five persons living in the household and 10.1% of households had more than five persons residing.

On the issues of how long interviewees resided in their community, 84.1% resided in their community for more than fifteen years. Just under five percent (4.7%) stated that they lived in their community for between ten and fifteen years while 3.4% resided for between five and ten years. Approximately seven percent (6.5%) resided in their community for between one and five years and 1.3% for less than a year.

On the issue of where healthcare was mostly obtained, during the survey exercise it was realised that health clinic services are offered through the Savanna-la-mar Public General Hospital. Approximately forty percent (40.3%) of interviewees stated that their healthcare needs were mostly sourced through the public hospital, 55.3% stated the private doctor and 20.7% stated the public clinic. Less than one percent (0.3%) of interviewees stated the private hospital and 1.3% stated "other" and further that indicated that they did not seek medical attention but instead practiced herbal medicine (home remedies). As it pertained to the specific healthcare provider, the public hospital referenced was the Savanna-la-mar Public General Hospital, while the health centres/clinics referenced were the Petersfield Health Centre and "Savanna-la-mar Hospital." Percentages exceeded 100.0% as some respondents offered multiple responses and explained that care was sought based on the specific medical condition.

Of those interviewed, approximately forty-four percent (43.7%) of respondents declined to offer a response relating to their personal weekly income. Just over nine percent (9.3%) of persons indicated that they did not have a weekly income, while 5.9% indicated that their weekly income was under the current minimum wage of $15,000.00 per week. Approximately five percent (5.2%) of interviewees indicated that their weekly income was at the minimum wage of $15,000.00 per week; 3.6% stated that their weekly income was between $15,001.00 and $18,000.00, while 7.8% stated a weekly income ranging between $18,001.00 and $20,000.00. Approximately twenty-five percent (24.5%) indicated that their weekly income was more than twenty thousand dollars ($20,000.00).

Regarding the last school attended, over sixty-two percent (62.5%) of participants stated that high school. Less than one percent (0.8%) of interviewees stated that they did not attend any type of learning institution. Approximately seventeen percent (17.3%) stated primary/all age school as the last school attended, 3.6% college, 3.4% university and 12.4% HEART/Vocational Training Institution.

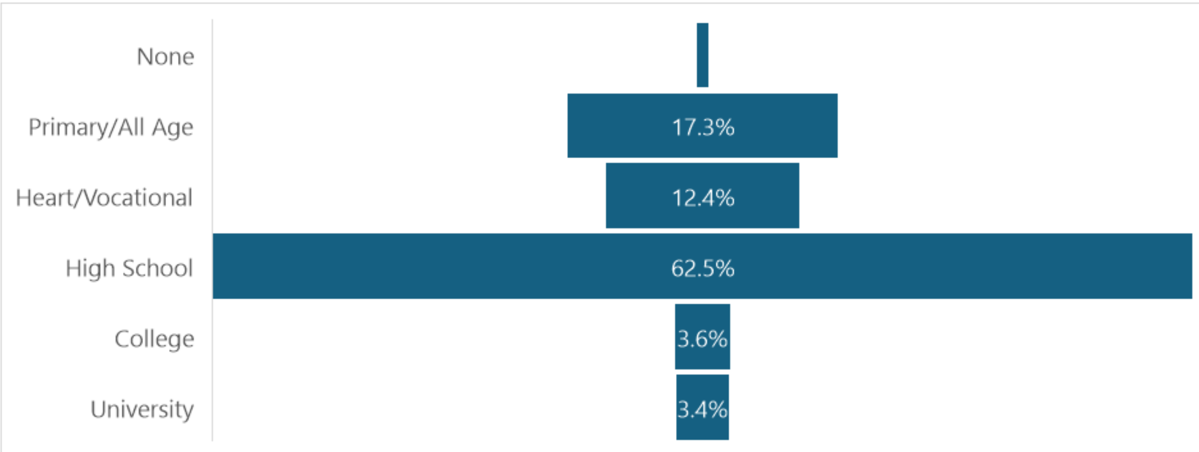


Figure 5-3 School last attended by survey participants

As it pertained to whether anyone within the household was currently attending school, 54.5% of those interviewed stated that no member of the household was currently attending school while, 45.4% of interviewees indicated someone in the household was attending school. As it related to the school being attended 23.9% stated that the school being attended was infant/basic, 55.1% stated primary/all age, 50.0% stated high school, 1.7% stated college, while 3.4% stated that HEART/a vocational training institute was the school being attended. No one (0.0%) stated university. It should be noted that percentages exceeded one hundred as multiple persons within households attend school.

When respondents were asked about the presence of recreational spaces in their community 37.2% of respondents indicated that a recreational space was present while 57.6% stated that no recreational space was present in the community. The remaining 5.2% of interviewees expressed uncertainty. **Error! Reference source not found.** presents the list of recreational spaces named by the 37.2% of respondents confirming that their community had a recreational space.

Table 5-2 Recreation Spaced identified by Survey Participants

Recreational Space	% Distribution
Petersfield High School Field	28.5%
Informal Community Greenspace	19.4%
Community Centres/Spaces (located in Savanna-la-mar)	15.3%
Wate works (Deans Valley) Community Centre	13.9%
Reno Football Field (Llandilo)	6.3%
Unity Primary School Field (Strathbogie)	4.9%
Roaring River Community Centre	2.8%
Youth Centre (Llandilo)	2.1%
Bath Playfield (informal greenspace)	2.1%
Petersfield HEART Playing Field	1.4%
Cokes View Primary School Field (Waterworks)	1.4%

Recreational Space	% Distribution
Independence Park (located in Savanna-la-mar)	0.7%
Paradise Sports Field (undeveloped greenspace)	0.7%
Not stated	0.6%

As it pertained to the recreational facility's accessibility to persons of all ages and those with special needs, 66.6% of those confirming that a recreational facility was present in their community stated that the facility was accessible, while 15.3% stated that the facility was not accessible to all ages and those with special needs. Approximately eighteen percent (18.1%) of respondents expressed uncertainty when asked about the facility's accessibility.

When asked if the facility was maintained in good condition 66.0% of interviewees confirming that a recreational facility was present in their community indicated that the facility was maintained and could be described as being in "good condition." Just under seventeen percent (16.6%) of respondents stated that the facility was not maintained while 17.4% indicated that they did not know if the facility was maintained.

5.2.2 Perception and Awareness

On the issue of respondents' awareness of a company named Paradise Park Development Corporation Limited, all interviewees (100.0%) offered a response. Of these persons 2.8% indicated that they heard of Paradise Park Development Corporation Limited while 97.2% stated that they had not heard of that company name.

As it pertained to respondents' awareness of the proposal by Paradise Park Development Corporation Limited to develop land at Paradise Park, in Smithfield Westmoreland all (100.0%) participants responded. Approximately ten percent (10.1%) of those interviewed stated that they were aware of the project while 89.9% stated that they were not aware. Of the 10.1% of interviewees confirming awareness of the proposed project, 2.6% stated that awareness of the project was via the television medium, and 97.4% stated "word of mouth' as the medium by which they were made aware of the project.

When asked about awareness of the project's details, 79.5% of survey respondents (confirming awareness of the proposed development) indicated that they were not aware of the project details while 20.5% confirmed awareness of the project of details. **Error! Reference source not found.** presents a summary of respondents' awareness of the project's details. Of the 20.5% of respondents confirming awareness of the project details, respondents were only aware of:

- 120 resort suites comprising land overwater and mangrove villas (87.5%)
- 200 rooms spread across seven (7) building strips (75.0%)
- 100 privately owned villas (25.0%)
- Sandy Wading/Swimming areas (12.5%)

It should be noted that respondents indicated that they heard that "a hotel was to be built" but were not aware of the exact number of hotel rooms.

Table 5-3 Respondents' Awareness of Specific Project Details

Specific Project Detail	% Awareness	
	Yes	No
120 resort suites comprising land, overwater and mangrove villas	**87.5%**	12.5%
200 rooms spread across 7 building strips	**75.0%**	25.0%
100 privately owned villas	**25.0%**	**75.0%**
Pro tour level Golf Course and Club House	0.0%	**100.0%**
Solar Farm	0.0%	**100.0%**
Water Treatment Plant	0.0%	**100.0%**
Equestrian Centre with Horse Stables	0.0%	**100.0%**
Polo Club	0.0%	**100.0%**
helicopter landing pad	0.0%	**100.0%**
Music Recording Studio	0.0%	**100.0%**
Schools (farming, cooking, art, and fragrance)	0.0%	**100.0%**
Rum bottling facility	0.0%	**100.0%**
Rock groynes	0.0%	**100.0%**
Sandy Wading/Swimming Areas	**12.5%**	**87.5%**
Dock and river training structure	0.0%	**100.0%**
Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)	0.0%	**100.0%**

5.2.3 Concerns

Pertaining to problems/issues on the proposed project site, all interviewees (100.0%) offered a response. Just over seventy-two percent (72.4%) of interviewees stated that there were no problems/issues while 26.4% indicated that they were unaware of the proposed site having problems/issues. Approximately one percent (1.2%) of respondents indicated that there have been problems/issues on the proposed site. Of this 1.2% confirming problems/issues on the site, the following problems were highlighted:

- The site is prone to flooding – (60.0%)
- Natural wildlife habitats have been lost – (20.0%)
- Sections of the property are swampy (waterlogged) – (20.0%)

Regarding respondents having any general concerns pertaining to the proposed development project, 2.3% of those interviewed expressed uncertainty while, 95.9% of interviewees indicated that they did not have any concern while 1.8% indicated that they had concerns with the project as proposed (**Error! Reference source not found.**).

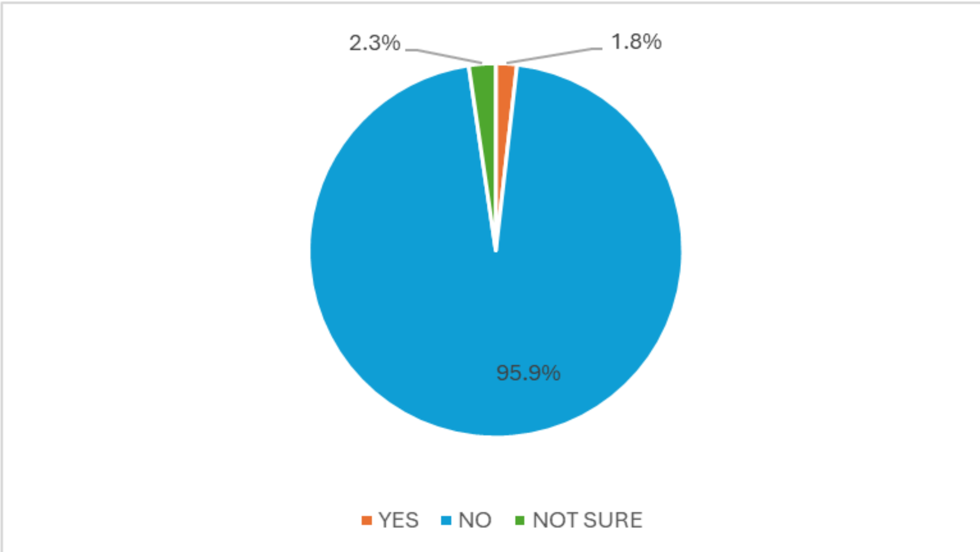


Figure 5-4 Percentage of respondents indicating if there are general concerns about the proposed project

When asked further about having concerns related to specific project components, the 1.8% of respondents expressing concern were specifically concerned about:

- 120 resort suites comprising land overwater and mangrove villas (85.7%)
- 200 rooms spread across seven (7) building strips (28.6%)
- The Solar Farm (14.3%)
- The Water Treatment Plant (28.6%)
- Rock Groynes (14.3%)
- Dock and River training structure (14.3%)

Table 5-4 presents a summary of the 1.8% of respondents expressing concern pertaining to specific project components.

Table 5-4 Respondents Concern regarding specific project components

Specific Project Detail	% Concern Yes	% Concern No
120 resort suites comprising land, overwater and mangrove villas	**85.7%**	**14.3%**
200 rooms spread across 7 building strips	**28.6%**	**71.4%**
100 privately owned villas	0.0%	**100.0%**
Pro tour level Golf Course and Club House	0.0%	**100.0%**
Solar Farm	**14.3%**	**85.7%**
Water Treatment Plant	**28.6%**	**71.4%**
Equestrian Centre with Horse Stables	0.0%	**100.0%**
Polo Club	0.0%	**100.0%**
helicopter landing pad	0.0%	**100.0%**

Specific Project Detail	% Concern Yes	% Concern No
Music Recording Studio	0.0%	**100.0%**
Schools (farming, cooking, art, and fragrance)	0.0%	**100.0%**
Rum bottling facility	0.0%	**100.0%**
Rock groynes	**14.3%**	**85.7%**
Sandy Wading/Swimming Areas	0.0%	**100.0%**
Dock and river training structure	**14.3%**	**85.7%**
Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)	0.0%	**100.0%**

Of the 1.8% of respondents expressing project concerns, 85.7% were specifically concerned about the 120 resort suites comprising land, overwater and mangrove villas, while 14.3% were not concerned. Concerns highlighted pertained to the following:

- The potential impact of the suites on the morass/wetland area - (40.0%)
- The loss of the fishing area – (40.0%)
- Possible damage to the coral reef – (20.0%)
- Loss of vegetation and wildlife – (20.0%)
- Loss of crab hunting area – (20.0%)
- Disturbance to marine life and the natural habitat – (20.0%)

Percentages exceeded 100.0% as some respondents expressed multiple concerns.

When asked about possible suggestions to address highlighted concerns, the following suggestions were put forward:

- Consider identifying ways for continued public fishing in the area– (40.0%)
- Implement measures to ensure that the coral reef is protected – (20.0%)
- Leave an undisturbed green space – (20.0%)
- Do not disturb the mangroves – (20.0%)
- Do not build the resort – (20.0%)

Percentages exceeded 100.0% as respondents offered multiples suggestions to mitigate identified impact.

When asked about specific concerns pertaining to the 200 rooms spread across seven (7) building strips 28.6% (of the overall 1.8% expressing concern) had concerns, while 71.4% had no concerns. Concerns highlighted were:

- Loss of crab hunting area - (50.0%)
- Improper disposal of sewage effluent – (50.0%)

Suggestions put forward to address highlighted concerns were:

- Do not build the resort – (50.0%)
- Ensure proper sewage system design and implementation - (50.0%)

Of the 1.8% of survey participants expressing project concerns, 14.3% were specifically concerned Solar Farm, while 85.7% were not concerned. Concern expressed was:

- Exposure to radiation from solar panels – (100.0%)

To address the highlighted concern interviewees suggested that:

- Solar panels should be installed at a safe distance from people – (100.0%)

Just under twenty-nine percent (28.6%) of the 1.8% of respondents confirming concerns with the project, were specifically concerned with the water treatment plant, while 71.4% of respondents were not concerned. Concern expressed was:

- Possible discharge of effluent into the sea – (100.0%)

To address the highlighted concern interviewees suggested that:

- Ensure that effluent is not discharged into the sea – (100.0%)

The rock groynes were an item of specific concern for 14.3% (of the 1.8% expressing concern) while 85.7% had no concerns. Concern highlighted was:

- The extent of disturbance the rock groynes would cause to the natural environment – (100.0%)

It was recommended that:

- Installation be done in a manner to cause the least environmental disturbance (100.0%)

Of the 1.8% of respondents expressing project concerns, 14.3% were specifically concerned about the dock and river training structure, while 85.7% were not concerned. Concern highlighted was:

- The extent of disturbance the dock and river training structure would cause to the natural environment – (100.0%)

It was recommended that:

- Installation be done in a manner to cause the least environmental disturbance (100.0%)

5.2.4 Site Use

In response to whether there was current use of the proposed site (land, beach, or sea) for any type of activity, all persons interviewed (100.0%) offered a response. Of these respondents, 5.2% of individuals confirmed that they used the proposed site while 94.8% stated that they did not use the site.

When asked further what aspect of the proposed site was used 70.0% of these respondents indicated that they used the land, 30.0% stated the beach and 15.0% stated that the sea was used. It should be noted that percentages exceeded 100.0% as some respondents used more than one aspect of the proposed site. On the issue of the specific purpose the proposed site was used for, the 5.2% of interviewees confirming that they used the area stated that it was used for:

- Crab Hunting – (50.0%)
- Recreation – (20.0%)
- Swimming – (20.0%)
- Fishing – (15.0%)
- As a source to cut sticks to fabricate fish pots – (10.0%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

In response to whether respondents used the proposed site in the past, all interviewees offered a response. Of these respondents, 11.1% of individuals confirmed that in past years they used the proposed site, while 88.9% stated that they did not use the site in past years. Regarding what aspect of the proposed site was used, 74.4% stated land was used, 34.9% stated that the beach was used and 18.6% indicated that in past years they used the sea. It should be noted that percentages exceeded 100.0% as some respondents indicated that in past years, they used more than one aspect of the proposed site. On the issue of the specific purpose the proposed site was used for, the 11.1% of interviewees confirming that they used the area in the past stated that it was used for:

- Recreation – (67.4%)
- Crab Hunting – (27.9%)
- Swimming – (16.3%)
- Fishing – (11.6%)
- Bird shooting – (2.3%)
- As a source to cut sticks to fabricate fish pots – (2.3%)

Percentages exceeded 100.0% as some respondents offered multiple responses.

As it pertained to the length of time interviewees used the site in past years, 41.9% (of the 11.1% of interviewees confirming that they used the area in the past) stated that they used the area for at least twenty years, 4.7% stated between 16-19 years; a similar 4.7% stated 11-15 years. Seven percent (7.0%) of interviewees stated that they used the area for 6-10 years, 20.9% stated 1-5 years and 11.6% less than a year. Just over nine percent (9.2%) of survey participants, were unsure of the number of years that they used the site in past years.

Survey participants were asked if they knew of anyone who used the proposed site for any type of activity, in response, 3.1% of interviewed individuals confirmed knowing of someone while 96.9% stated that they did not know anyone who used the site. It was further indicated that 16.7% used the land and 58.3% respectively used the beach and the sea. Percentages exceeded 100.0% as respondents stated that multiple aspects of the site were being used. Regarding the specific purpose of for which the site was being used, respondents stated that persons known to them used the site for:

- Fishing – (58.3%)
- Swimming – (33.3%)
- Crab hunting – (33.3%)
- A base for the Jamaica Defence Force – (8.3%)

Percentages exceeded 100.0% as multiple responses were offered.

5.2.5 Potential Impacts

On the issue of whether respondents thought the project would affect their life/livelihood, community or the environment, all interviewees (100.0%) offered a response. Just over sixty-four percent (64.1%) of respondents indicated that the project would have an impact, while 26.1% stated that the project would not affect their life/livelihood, community, or the environment. Approximately ten percent (9.8%) expressed uncertainty (Figure 5-5).

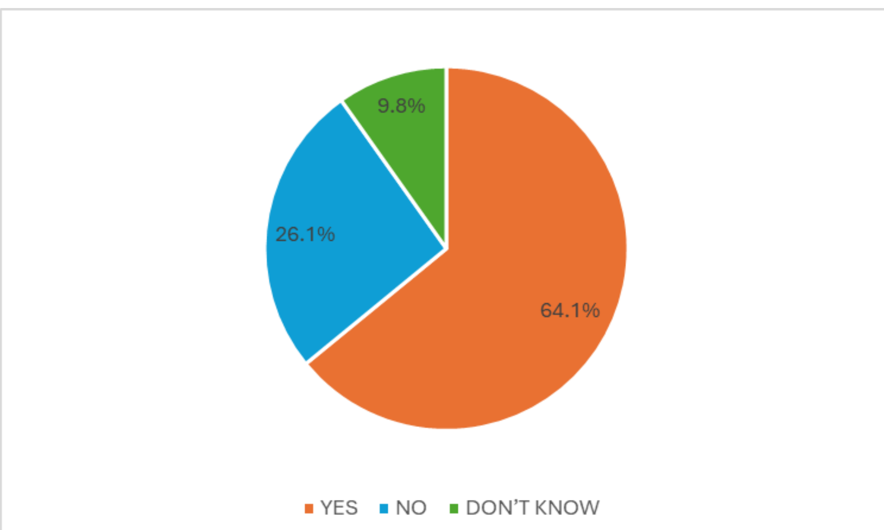


Figure 5-5 Respondents Perception of the Project Affecting Lives/livelihood, Community, Environment

Table 5-5 presents a summary of respondent's perception of the project's anticipated impacts on lives/livelihood, community, and environment.

Table 5-5 Respondents' Anticipated Impact of the Project on Lives/livelihood, Community & Environment

Anticipated Impact	Variable		
	Lives/Livelihood	**Community**	**Environment**
Positive	**60.1%**	**79.4%**	12.9%
Negative	1.6%	2.0%	7.3%
Both Positive & Negative	0.0%	1.6%	0.4%
Not at all (No impact)	26.6%	1.6%	**39.5%**
Not sure	7.3%	13.0%	**35.1%**
Not stated	4.4%	2.4%	4.8%

As it regarded the impact anticipated on lives/livelihood, 60.1% of interviewees (of the 64.1% anticipating an effect) anticipated a positive impact, while 1.6% anticipated a negative impact (Table 5-5). Approximately twenty-seven percent (26.6%) were of the view that the project would not impact lives/livelihoods. For those anticipating a positive impact on lives/livelihoods, the following were anticipated:

- Employment opportunity – 72.5%
- Increased opportunity to generate income – 16.8%
- Access to other recreational amenities (a new hotel) – 7.4%
- Improved road safety along the project area – 1.3%
- Reduced crime risk in the area – 1.3%
- Improved mental health – 1.3%
- Property appreciation – 1.3%

Percentages exceeded 100.0% as some respondents offered multiple responses.

As it pertained to anticipated negative impact on lives/livelihoods, the following were anticipated:

- Reduced potable water supply – 25.0%
- Increased criminal activity – 25.0%
- Loss of livelihood – 25.0%
- Loss of crab hunting area – 25.0%

Despite highlighting negative impacts, respondents did not offer suggestions to resolve the identified issues.

Over seventy nine percent (79.4%) of survey participants (of the 64.1% of interviewees anticipating an effect) stated that they expect that the project would have a positive effect on their community, while

2.0% anticipated a negative impact and 1.6% anticipated both positive and negative impacts (Table 5-5). Thirteen percent (13.0%) of interviewees were unsure of the project's potential impact on the community. For survey participants anticipating a positive impact on communities, the following were anticipated:

- Employment opportunity (for community residents) – 82.6%
- Community development – 19.4%
- Increased earnings from tourism – 6.5%
- Increased economic activity – 3.5%
- Access to other recreational amenities (a new hotel) – 2.0%
- Infrastructure upgrade – 1.5%

Percentages exceeded 100.0% as some respondents offered multiple responses.

As it pertained to anticipated negative impact on communities, the following were anticipated:

- Loss of beach access – 22.2%
- Increased criminal activity – 22.2%
- Loss of income for small business owners – 22.2%
- Further deterioration of roads from construction activity – 11.2%
- Reduced potable water supply – 11.1%
- Decreased income from crab hunting – 11.1%

When asked about suggestions to resolve the identified issues, respondents suggested that:

- (Public) Beach access should be maintained/allowed – 11.1%
- Potable water supply (into communities) should not be affected (reduced) – 11.1%
- No response offered - 66.8%

As it pertained to the project's anticipated impact on the environment, the greater percentage of respondents (of the 64.1% anticipating an effect) anticipated no impact on the environment (39.5%) or expressed uncertainty (35.1%). Approximately thirteen percent (12.9%) of interviewees anticipated a positive impact on the environment, while 7.3% anticipated a negative impact and 0.4% anticipated both positive and negative impact (Table 5-5). Anticipated positive impacts on the environment were:

- Infrastructure upgrade – 84.8%
- Improved waste handling and disposal – 6.1%
- Improved aesthetics – 6.1%
- Improved water quality – 3.0%

Percentages exceeded 100.0% as some respondents offered multiple responses. It should be noted that when asked many respondents anticipating a positive impact on the environment focussed on the physical environment. Regarding the anticipated negative impact on the environment, the following were anticipated:

- Possible pollution of the river nearby the property (Sweet River) – 36.8%
- Effluent discharge into the marine environment – 26.3%
- Loss of wildlife – 21.1%
- Loss of mangroves – 15.8%
- Destruction of the crab habitat – 10.5%
- Destruction of the coral reef – 10.5%
- Loss of vegetation – 10.5%
- Overall environmental degradation – 10.5%

Percentages exceeded 100.0% as some respondents anticipated multiple negative impacts. It should be noted that when asked identified negative impacts focussed on the biological environment and not the physical environment. When asked about possible solutions to address the highlighted negative impacts to the environment, interviewees suggested the following:

- Ensure that proper waste management systems are in place – 26.3%
- Ensure that there is no discharge of effluent into the marine environment – 15.8%
- Ensure that the natural environment is not (permanently) damaged – 15.8%
- Ensure that the nearby river (Sweet River) is not polluted – 5.3%
- Replant trees (to include mangroves and other species) after construction – 5.3%
- Do not destroy the mangroves – 5.3%
- No response offered 26.2%

5.2.6 Housing, Health and Social Services

As it related to housing 100.0% of interviewees offered responses. Approximately seventy-one percent (70.7%) of respondents stated that they owned the house they lived in, 8.3% lived in rented homes, 0.5% lived in government own housing, 0.3% indicated that the ownership status of the home they lived in was informal, while 20.2% stated that they lived in family-owned homes.

As it pertained to the land on which dwelling homes were located 100.0% of interviewees offered responses. Approximately thirty-one percent (31.2%) of respondents stated that they owned the land on which the house is located, 16.0% stated that the land was leased, 5.2% indicated that lands were government owned, 4.4% indicated that they squatted on the land, while 35.4% stated that their homes were built on family-owned land.

Just under eight percent (7.8%) stated "other" and indicated that the home they lived in was rented, but there was no arrangement made with respect to the land. Some of these of these respondents also stated that they lived on lands owned the WISCO (West Indies Sugar Company).

Regarding the type of wall that dwellings were made of 42.8% of interviewees indicated that the walls of their homes was made of concrete and blocks, 39.3% stated wood/board while 17.3% stated that walls were made of both concrete and blocks as well as wood/board. Less than one percent (0.3%) of respondents indicated "other" and specified concrete (cement) board as the wall construction material, while a similar 0.3% stated zinc as the wall material for the dwelling. It should be noted that for respondents who indicated that the walls of their homes were made of both materials, this was mainly due to structural additions to increase habitable living space.

Regarding the type of roof that dwellings had, 60.3% of respondents indicated that the roof of their homes was metal sheeting, while 25.8% stated concrete as the roof material. Just under thirteen percent (12.9%) of interviewees stated that their roofs were made of multiple materials, and specified metal sheeting and concrete as the materials. This was due to structural additions to increase habitable living space or more modern home design incorporating both materials as part of the design. One percent (1.0%) stated "other" as the roof material and specified fibre shingle as the type of roof material.

As it pertained to the type of toilet facility present 100.0% of respondents offered a response. Approximately eighty-six percent (85.7%) of respondents indicated that their homes had water closets, while 11.9% stated that pit latrine was the toilet facility. Just over two percent (2.1%) of participants indicated that they had both toilet facilities, pit latrine and water closet while 0.3% stated that they had no toilet facility.

As it related to what the household used for lighting 100.0% of respondents offered a response. Just over ninety-seven percent (97.4%) of interviewees stated that electricity was used while 1.6% stated kerosene oil was used for household lighting and 0.5% stated solar as the household lighting source. Less than one percent (0.5%) stated "other" and specified that candles and standby generators were used for household lighting.

For those survey participants who indicated that electricity was used for household lighting (97.4%), these respondents were further asked if they experienced problems with the electricity supply. Approximately ninety-three percent (92.8%) of these respondents stated that they had no problems with the supply, while 7.2% confirmed having problems with the electricity supply. Of these respondents (7.2%) the following problems were highlighted:

- Irregular supply/outages – 70.4%
- Other (low volage & illegal connections) – 14.8%
- Not stated – 14.8%

Anecdotally, some respondents stated that in instances outages resulted from the attempts of others to illegally abstract electricity.

Regarding the type of fuel used mostly for cooking 100.0% of respondents offered a response. Gas was named as the fuel used mostly for cooking by 97.9% of survey participants. This was followed by wood at 1.3%, coal at 0.5% and electricity at 0.3%.

On the issue of the main source of household domestic water supply, 100.0% of survey participants offered a response. Approximately ninety-four percent (94.3%) of respondents confirmed that their household domestic water supply was the public piped water supply. Just over one percent (1.3%) of respondents stated that the main source of domestic water was rainwater harvesting, 0.8% indicated the community tank, while 0.5% stated the public standpipe. Under one percent (0.3%) indicated the public standpipe and 1.0% stated private water truck, while 1.8% stated the spring/river as the main source for domestic household water. Less than one percent (0.5%) of participants stated "other" as the main source for domestic household water supply and further explained that water was sourced from nearby neighbours.

As it pertained to respondents' having any problems with the domestic water supply 100.0% of interviewees offered a response, and 17.8% of those who responded, indicated that there were problems with the water supply, while 82.2% indicated that there were no problems with the domestic water supply.

For those persons who confirmed that there were problems with the domestic water supply:

- 58.0% indicated that the water supply was irregular
- 37.7% stated that water pressure was low
- 5.8 % stated that the area had no water at all
- 2.9% stated water turbidity as the issue.

Percentages exceeded 100.0% as some respondents stated that they had multiple problems with the domestic water supply.

On the issue of telephone service used by survey participants, 100.0% of respondents offered a response. Just under ninety-one percent (90.7%) of interviewees indicated that that they used mobile telephone service, while 3.9% indicated that they used both mobile and fixed line service. Approximately four percent (4.1%) of respondents indicated that they did not use any type of telephone service, while 1.3% stated that they used a fixed line telephone service.

As it pertained to respondents' awareness of fixed line telephone service being in their community, 100.0% of respondents offered a response. Approximately twenty-five percent (24.8%) of respondents stated that they did not know of fixed line service being in the community, while 40.3% stated that the community did not have fixed line service. Just under thirty-five percent (34.9%) of interviewees stated that fixed line telephone service was present in the community.

Regarding the main method of garbage disposal for households 100.0% of respondents offered a response. Approximately ninety-two percent (92.2%) of those interviewed indicated that the public garbage truck was the main garbage disposal method, while 7.8% indicated that burning was the main method used to dispose of garbage. It should be noted that in some instances collection by the public garbage truck was not "house to house" within communities, residents indicated that garbage was taken to the main road for later collection.

On the issue of whether there were problems with garbage disposal, 63.6% of survey participants indicated that there were no issues with disposal. Regarding the 36.4% of survey participants who indicated that there were issues with garbage disposal, the following problems were identified:

- Irregular collection – 90.1%
- Illegal dumping – 6.4%
- Garbage truck does not enter the community to collect garbage – 3.5%

As it pertained to recycling, 90.7% of respondents indicated that they did not participate in recycling. Approximately four percent (3.6%) indicated that they participated in recycling sometimes, while 5.7% stated that they recycled. Anecdotal information from interviewees was that they did not participate in recycling efforts because:

- The existing public garbage collection does not have a system to collect waste for recycling separately from other waste types.
- There is no facility in the nearby area to make it "easy" to recycle
- Previous recycling initiatives are inactive e.g. collection by private entities have been discontinued (in the area).
- Public drop points are not known.

5.2.7 Natural Hazards

When asked about flooding, 100.0% of respondents offered a response. Of these respondents 77.8% of respondents indicated that their community was not affected by flooding, 1.3% indicated that they did not know if the community was affected, while just under twenty-one percent (20.9%) stated that their community experienced frequent flood events. Of the 20.9% of survey participants confirming community flooding 67.9% stated that flooding occurred only in times of heavy rainfall, 25.9% stated each time there was a rain event and 4.9% stated that flooding occurred only during times of hurricanes. Just over one percent (1.3%) expressed uncertainty. Regarding the frequency of rain events resulting in community flooding, respondents stated the following:

- Once weekly – 11.2%
- Once monthly – 24.7%
- Once in three months – 21.0%
- Once in six months – 3.7%
- Once in a year – 8.6%

- Less than once in a year – 12.3%
- Unsure – 18.5%

It should be noted that survey participants indicated that flood events will occur multiple times over a short period of time depending on the rainfall pattern. Additionally, it was consistently expressed that in some instances, flood events were as a result of blocked, inadequate, or deteriorated drainage systems in communities. The affected areas named were:

- The Town of Savanna-la-mar (to include the lower section towards the coastline)
  - Segree St
  - Hudson St
  - Barracks Road
  - Great George St
- The Petersfield area (to include the square and public main road) and other sub-communities
  - Carawina
  - Shrewsbury Housing Scheme
  - Amity
- Hertford community
- Hatfield community
- Paradise area and community (especially in the vicinity of the Sweet River and other rivers/tributaries)
- Cave Main Road and community homes
- Galloway main road and community
- Strathbogie main road and community
- Llandilo Housing Scheme (various phases) and scheme roads
- Waterworks main road
  - Dean's Valley Housing Scheme
- Wharf Road
- Bath Pen main road (Torrington area)

As it pertained to the depth of flood water, 40.7% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 39.5% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft). Just over one percent (1.3%) stated more than 1.5m as the depth of flood water while 18.5% expressed uncertainty.

Regarding whether there were problems with frequent flooding at or near the proposed site 100.0% of respondents offered a response. Just over sixty-seven percent (67.2%) of interviewees, stated that the area was not affected by flooding, while 26.9% stated that they did not know if the area was affected, and 5.9% stated that the area was affected by flooding.

Of the 5.9% of those stating that there were flooding problems at or near the proposed site, 87.0% stated flooding occurred only on times of heavy rains, while 4.3% stated that flooding occurred during hurricanes and 8.7% expressed uncertainty. When asked about the frequency of occurrence of rain events causing flooding at or near the proposed site, respondents stated the following:

- Once monthly – 4.4%
- Once in three months – 21.7%
- Once in six months – 17.4%
- Once in a year – 17.4%
- Less than once in a year – 8.7%
- Unsure – 30.4%

Affected areas named were:

- The entire project site
- The main road bordering the site
- The general Paradise area
- The Paradise area in the vicinity of Sweet River
- The Ferris area (in the vicinity of the bridge)
- The Main Road leading to Savanna-la-mar (in the vicinity of the D&G Depot)
- The Wakefield (Emmaville) Area
- Strathbogie.

As it pertained to the depth of flood water at or near the proposed site, 30.4% stated that water levels were less than 0.3 metres (1.0 foot) in depth, while 39.2% stated that water levels ranged between depths of 0.3-1.5m (1.0-5.0ft). Just over thirty percent (30.4%) of respondents expressed uncertainty. No one (0.0%) stated more than 1.5 metres (5ft).

On the issue of whether the proposed area was affected by sea level rise or storm surge 100.0% of interviewees offered a response. Approximately thirty-seven percent (36.4%) of respondents stated that they did not know if the area was affected while 60.7% stated that the area was not affected. Just under three percent (2.9%) of survey participants indicated that the area was affected by storm surge or seal level rise. When asked if the project site was affected by fires, 70.8% of respondents stated that the site was not affected by fires, while 28.9% expressed uncertainty and 0.3% confirmed that the site was affected by fires.

5.2.8 Protected Areas and Species

Regarding whether there was any site nearby considered to be a protected or important area (historical/cultural/environmental), 100.0% of interviewees offered a response. Just under thirty-eight percent (37.7%) of interviewees stated they did not know of any such area or site, 58.7% stated that no such area was located near to the proposed site, while 3.6% indicated that there was an area/site considered to be a protected area or area of historical, cultural or environmental importance. The main places named were:

- Barham Wharf (at the end of Great George St)
- The Clarke Family Great House in Paradise
- The Jamica Defence Force Military Base at Paradise
- (An old) Plantation house in the Galloway/ Petersfield area
- The Savanna-la-mar Courthouse
- (St George's Church) The Anglican Church on Great George St.
- The Mangroves
- The Fish Sanctuary

Survey participants were asked to indicate if they knew that birds, turtles, crocodiles, and manatees were protected by law. Majority of interviewees (68.2%) were aware that birds were protected by law. This was followed by 66.7% of interviewees who were aware that crocodiles were protected and 60.7% who indicated that turtles were protected by law. The lowest percentage awareness was for manatees as only 36.4% of survey participants were aware that manatees were protected by law (Table 5-6).

Table 5-6 Respondents Awareness of Birds, Turtles, Crocodiles & Manatees being Protected by Law

Species	**% Awareness**	
	Yes	**No**
Birds	68.2%	31.8%
Turtles	60.7%	39.3%
Crocodiles	66.7%	33.3%
Manatees	36.4%	63.6%

For each species, respondents were further asked if they had seen any or knew or anyone who consumed them. For birds 76.5% of interviewees indicated that they had never seen any, while 23.5% confirmed seeing birds. It should be noted that during the survey exercise, in giving an answer respondents for the most part indicated that they could not readily identify protected bird species, therefore "no" answers were based on the premise that respondents while seeing birds, we unclear if any were protected. Additionally, respondents in giving "yes" answers answered on the premise of seeing birds and did not consider whether any were protected as they too could not readily identify protected birds.

In response to where birds were specifically seen respondents indicated the following:

- The general environs
- The Paradise area (to include the project site)
- The Savanna-la-mar area
- Bath/Torrington
- Petersfield

- Wharf Road Beach
- Farm Pen/Llandilo
- Strathbogie

Just under ninety-three percent (92.8%) stated that they did not know anyone who consumed birds, while 7.2% stated that they knew of persons who consumed birds. As it pertained to turtles 79.8% of interviewees indicated that they had never seen any, while 20.2% confirmed seeing turtles. When asked to specify where turtles were seen, interviewees named the following areas/places:

- Streets/Areas in Savanna-la-mar
  - Hudson Street (Russia)
  - Segree Street
  - Rose Street
  - Seaton Crescent
  - Coastline in the general Savanna-la-mar area
  - Offshore by the reef (in the Savanna-la-mar area)
  - Offshore beyond the reef (in the Savanna-la-mar area)
- Target River (Savanna-la-mar)
- Sweet River (to include the beach and swamp area)
- Paradise area (to include Paradise River/Sweet River)
- Whitehouse
- Whithorn Pond
- Amity
- Bluefields main road
- Belmont
- Negril
- Salmon Point
- Little London (Jam West area)
- Roaring River
- Paradise to Belmont area
- Black River
- Llandilo
- Big Bridge/Cabarita River
- Wharf Road
- Hatfield River
- Cave Area

Just under ninety-three percent (92.8%) stated that they did not know anyone who consumed turtles, while 7.2% stated that they knew of persons who consumed turtles.

Regarding whether survey participants had ever seen crocodiles, 71.1% of those interviewed indicated that they had never seen a crocodile, while 28.9% of those interviewed stated that they have seen a crocodile. In response to where crocodiles were seen, interviewees named the following areas/places:

- Streets/Areas in Savanna-la-mar
    - Hudson Street (Russia)
    - Downtown Savanna-la-mar (bottom of Great George St)
    - Drains in the town
    - Darling St
    - Bartlett's River
- Sweet River (to include the mangroves)
- Paradise area (to include the proposed site and beach area)
- Whitehouse
- Black River
- Llandilo
- Big Bridge/Cabarita River
- Dunbar's River
- Wharf Road (to include the beach, swamp and river that flows through the community)
- Cave Area
- The (Hope) Botanical Gardens

Ninety-three percent (93.0%) stated that they did not know anyone who consumed crocodiles, while 7.0% stated that they knew of persons who consumed crocodile.

When asked about seeing manatees 97.2% of interviewees indicated that they had never seen any manatees, while 2.8% confirmed seeing manatees. In response to where manatees were seen, interviewees named the following areas/places:

- The Savanna-la-mar area in the vicinity of Barham Wharf (bottom of Great George Street)
- Mearnsville
- Negril
- Pelican Bar
- Alligator Pond
- Priory

Just over ninety-nine percent (99.2%) stated that they did not know anyone who consumed manatees, while 0.8% stated that they knew of persons who consumed manatees.

5.3 FISHERS

5.3.1 Cohort Description

A total of 21 individuals were identified as fishers. Of those interviewed, approximately 90.5% were male, while 9.5% were female. Of the 21 respondents, the age distribution was as follows: 4.8% were between 18-24 years, 23.8% were 25-34 years, 14.3% were 35-44 years, 19.0% were 45-54 years, 28.6% were 55-64 years, and 9.5% were 65 years or older.

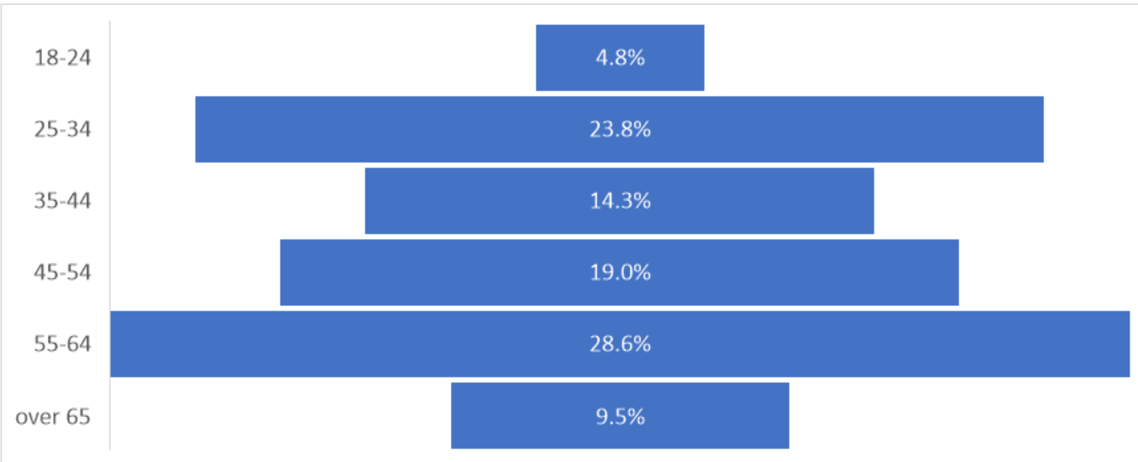


Figure 5-6 Age cohort distribution of interviewed fisherfolk

The fisherfolk were primarily from the following fishing areas: Wharf Road (42.8%), St. Mary's (47.6%), St. Anne (4.8%), and Paradise Fishing Beaches/Areas (4.8%). Regarding the communities in which the fisherfolk resided, 90.5% of respondents lived in the same community as the fishing beach, while 9.5% did not. Among those who did not reside in the same community, 50.0% reported living in the Hatfield community, while the remaining 50.0% did not provide a response. The percentages presented are based on the total number of respondents who answered each question. Those who did not provide a response were excluded from the analysis.

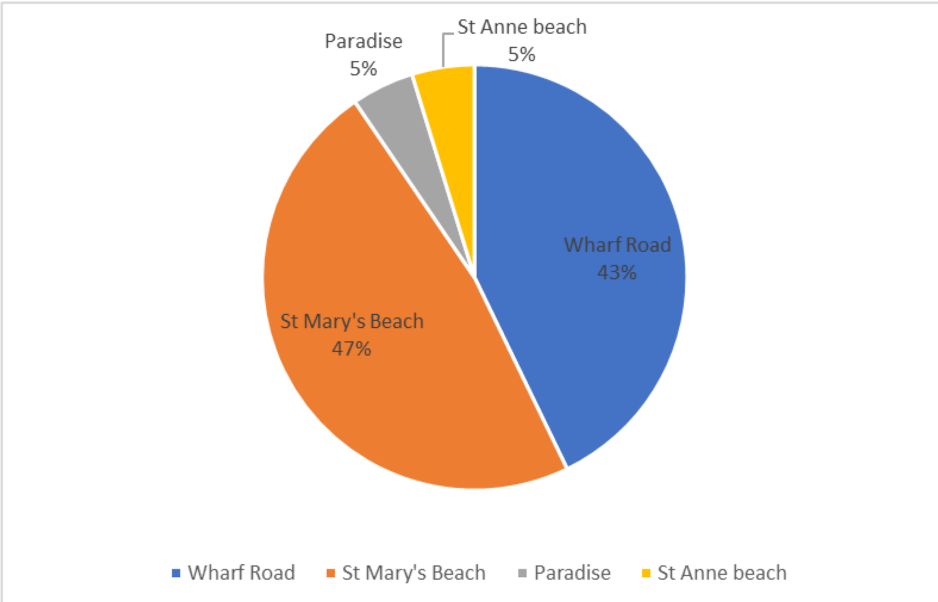


Figure 5-7 Distribution of fishers by Fishing Beach/Area

5.3.2 Fishing Methods and Catch

Additional information was gathered from fishers who "catch fish/go to sea" and vendors who "own a boat that goes to sea," making up 95.2% of all interviewed fishers. These respondents provided insights into various aspects of their fishing practices. Regarding affiliations with recognized organizations, 90.0% of fishers reported being registered with the National Fisheries Authority, while 10.0% were not. Additionally, 25.0% of fishers were members of the Bluefield's Bay Fisherman's Friendly Society, with 75.0% not belonging to the Society.

When it comes to fishing tools, the survey revealed that fishers used a variety of equipment. For example, 55.0% of fishers used fishing lines, 50.0% used spears, 70.0% used nets, and 60.0% used fish pots. Furthermore, 10.0% stated that they used a canoe with an engine, while 15.0% used a canoe without an engine. The total exceeds 100.0% because fishers commonly employed multiple tools during their fishing activities.

Fishers docked and launched their vessels at various locations. The majority, 55.0%, docked at St. Mary's Beach, followed by 40.0% at Wharf Road Fishing Beach, and 5.0% at Paradise Beach. In terms of where they fished, 40.0% of respondents fished in nearshore areas, 55.0% in deep-sea areas within 1.6 to 8.0 km from shore, and 30.0% ventured further out, fishing in deep-sea areas more than 8.0 km from shore. Given that fishers fish at different distances based on fish species and weather conditions, the total exceeds 100.0%. Fishers typically worked in waters extending from Negril in the west to Whitehouse in the east. Locations mentioned included Negril, Border, Leeward Bank, Windward Bank, Corner Reef, Tumbling Reef, Little Bay, Salmon Point, Cave, Belmont, Nigga Head, Whitehouse, Great Reef, Black River, Bluefields, and Paradise.

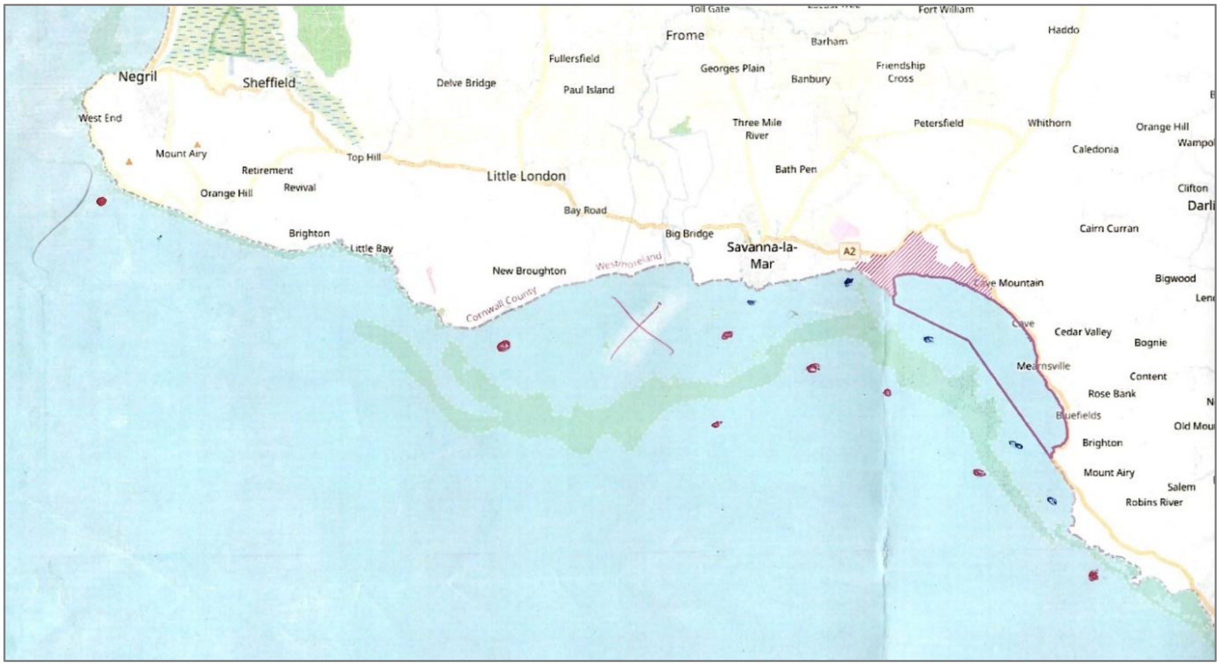


Figure 5-8 Identification of fishing area marked by survey respondents during the survey (Map 1)

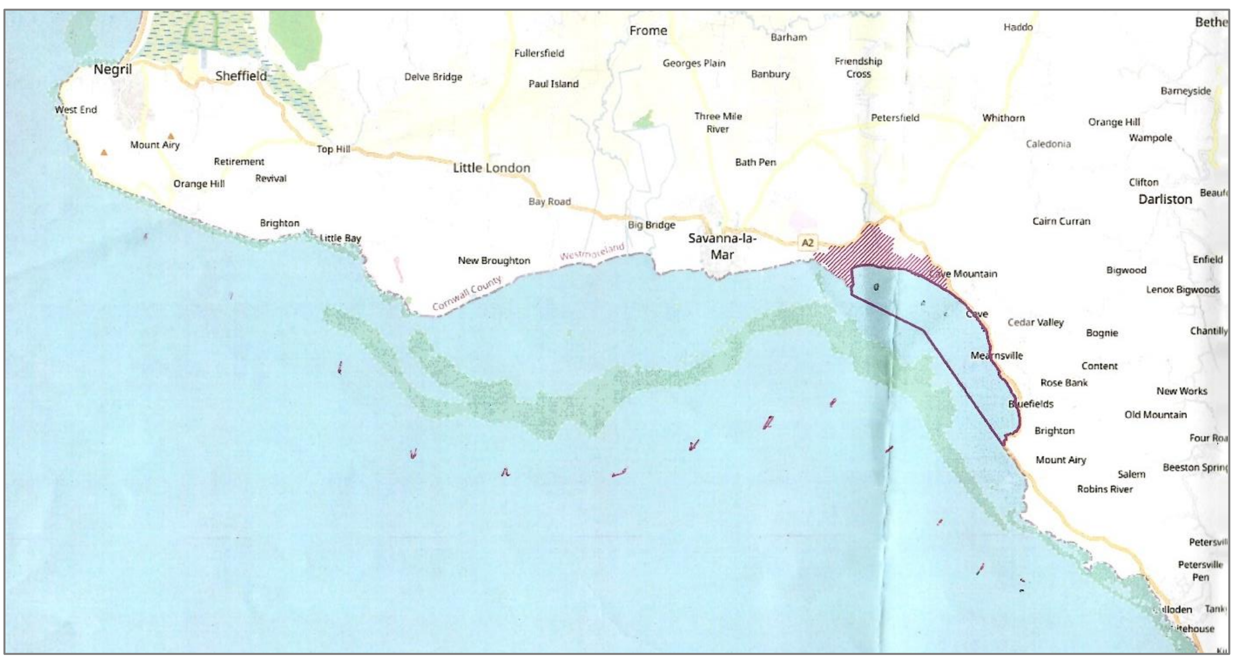


Figure 5-9 Identification of fishing area marked by survey respondents during the survey (Map 2)

Regarding the frequency of fishing, 5.0% of fishers went out three times per week, 15.0% went four times a week, 25.0% fished five times weekly, and the majority, 55.0%, fished more than five times each week. All respondents provided an answer to this question. On average, fishers reported varying catch sizes. Of those interviewed, 15.0% caught fewer than 10 pounds of fish per trip, 20.0% caught between 11 and 20 pounds, 30.0% harvested between 51 and 100 pounds, and 25.0% indicated that their average catch exceeded 100 pounds. Ten percent of fishers were unsure of their average catch.

When asked if other members of their household were involved in fishing, 52.4% of fishers reported that no one else in their household fished, while 47.6% confirmed that another household member was also a fisher. As for fishing as a primary source of income, 95.2% of fishers indicated that fishing was their full-time occupation, while 4.8% engaged in fishing part-time, with all of these respondents (100.0%) also working part-time in other areas.

Education levels among the fishers varied, with 14.3% having completed primary or all-age school, while the majority, 85.7%, had completed high school. In terms of experience, 14.3% of fishers had been in the industry for up to five years, 4.8% had 6 to 11 years of experience, and 14.3% had 12 to 17 years. A smaller portion, 9.5%, had 18 to 24 years of experience, 5.4% had been fishing for 25 to 30 years, and the majority, 52.3%, had more than 30 years of experience.

When asked about changes in their earnings or the size/type of fish harvested, 61.9% of fishers reported noticing a change, while 9.5% observed no change, and 23.8% were uncertain. Of those who reported a change, 23.1% noticed an increase, while 76.9% observed a decrease. Those who saw a decrease in their earnings or catch cited several reasons, including the use of small-diameter nets to catch juvenile fish (15.4%), a decrease in the fish population (7.7%), overfishing (7.7%), smaller fish sizes (7.7%), fewer customers (7.7%), a rise in the number of fishers (15.4%), pollution (7.7%), and improper fishing practices (7.7%). On the other hand, 15.4% of fishers who reported an increase attributed it to the rise in the cost per pound of fish.

These responses provide a comprehensive overview of the fishing practices, challenges, and socio-economic conditions faced by the fisherfolk in the region.

5.3.3 Livelihood and Education

Regarding the average weekly income derived from fish sales, all interviewees (100.0%) provided a response. Of these, 4.8% of fishers reported earning between $2,001.00 and $4,000.00 per week from fish sales, another 4.8% earned between $4,001.00 and $6,000.00, and 4.8% indicated a weekly income between $6,001.00 and $8,000.00. Additionally, 19.0% stated their average weekly income ranged from $8,001.00 to $10,000.00. The largest group, 33.3%, reported earning more than $10,000.00 weekly, while another 33.3% chose not to provide a response.

5.3.4 Perception and Awareness

In terms of awareness about the Paradise Park Development Corporation Limited, all interviewed fishers (100.0%) responded and indicated that they had never heard of the company. When asked about their awareness of a proposal by the Paradise Park Development Corporation Limited to develop land at

Paradise Park in Smithfield, Westmoreland, all participants responded. Approximately 9.5% of fishers were aware of the proposed project, while the remaining 90.5% were not aware.

Of the 84.6% of interviewees who confirmed awareness of the proposed project, all (100.0%) indicated that they learned about it through "word of mouth". When asked about their knowledge of the project's specific details, 50.0% of fishers stated they were not aware of the project's details, while the remaining 50.0% confirmed they had some knowledge of the project. Among the 50.0% of respondents who were aware of the project details, all indicated that they knew the project included 120 resort suites, which would consist of land, overwater, and mangrove villas. However, they were unaware of any other aspects of the project. Although some respondents mentioned hearing that "a hotel was to be built," they were not aware of the exact number of hotel rooms or any further details.

Table 5-7 Fishers' Awareness of Specific Project Details

Specific Project Detail	% Awareness	
	Yes	No
120 resort suites comprising land, overwater and mangrove villas	**100.0%**	0.0%
200 rooms spread across 7 building strips	0.0%	**100.0%**
100 privately owned villas	0.0%	**100.0%**
Pro tour level Golf Course and Club House	0.0%	**100.0%**
Solar Farm	0.0%	**100.0%**
Water Treatment Plant	0.0%	**100.0%**
Equestrian Centre with Horse Stables	0.0%	**100.0%**
Polo Club	0.0%	**100.0%**
helicopter landing pad	0.0%	**100.0%**
Music Recording Studio	0.0%	**100.0%**
Schools (farming, cooking, art, and fragrance)	0.0%	**100.0%**
Rum bottling facility	0.0%	**100.0%**
Rock groynes	0.0%	**100.0%**
Sandy Wading/Swimming Areas	0.0%	**100.0%**
Dock and river training structure	0.0%	**100.0%**
Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)	0.0%	**100.0%**

5.3.5 Concerns

Regarding potential problems or issues at the proposed project site, all fishers interviewed (100.0%) provided a response. Approximately 66.7% of respondents stated that they were unaware of any problems or issues at the site, while 33.3% indicated they were unaware of any potential problems. Notably, no fishers (0.0%) reported any existing issues at the proposed site.

When asked about general concerns regarding the proposed development, 19.0% of fishers expressed uncertainty, while 62.0% indicated they had no concerns. The remaining 19.0% of fishers did have concerns about the project as proposed.

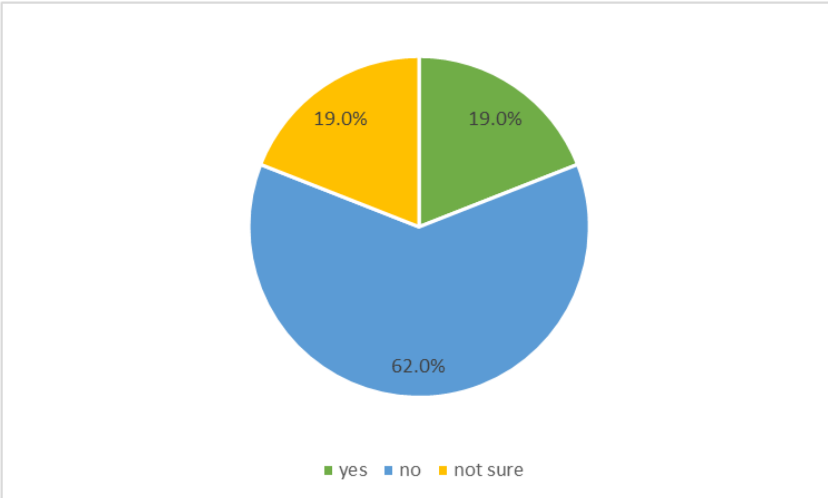


Figure 5-10 Percentage of fishers indicating if there are general concerns about the proposed project

For those who expressed concerns, the 19.0% of respondents were particularly concerned about several aspects of the proposed development. These concerns included the planned 120 resort suites comprising land, overwater, and mangrove villas (100.0% of concerned respondents), the 200 rooms spread across seven building strips (25.0%), the 100 privately owned villas (25.0%), and the Water Treatment Plant (50.0%).

Table 5-8 Respondents' Concerns Regarding Specific Project Components

Specific Project Detail	% Concern	
	Yes	No
120 resort suites comprising land, overwater and mangrove villas	**100.0%**	**0.0%**
200 rooms spread across 7 building strips	**25.0%**	**75.0%**
100 privately owned villas	**25.0%**	**75.0%**
Pro tour level Golf Course and Club House	0.0%	**100.0%**
Solar Farm	0.0%	**100.0%**
Water Treatment Plant	**50.0%**	**50.0%**
Equestrian Centre with Horse Stables	0.0%	**100.0%**
Polo Club	0.0%	**100.0%**
helicopter landing pad	0.0%	**100.0%**
Music Recording Studio	0.0%	**100.0%**
Schools (farming, cooking, art, and fragrance)	0.0%	**100.0%**
Rum bottling facility	0.0%	**100.0%**
Rock groynes	0.0%	**100.0%**
Sandy Wading/Swimming Areas	0.0%	**100.0%**
Dock and river training structure	0.0%	**100.0%**
Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)	0.0%	**100.0%**

Among the 19.0% of respondents who expressed concerns, all (100.0%) were specifically concerned about the 120 resort suites, including the land, overwater, and mangrove villas. The primary concerns voiced related to the loss of fishing areas (50.0%), the potential migration of fish (25.0%), the loss of mangroves (25.0%), and the loss of shoreline protection, particularly against heavy winds and hurricanes (25.0%). The total percentage exceeds 100.0% as some respondents raised multiple concerns. When asked for suggestions to address these concerns, the most common response (75.0%) was to not build the overwater suites in the proposed area, while 25.0% suggested preserving the mangroves.

For the concerns raised regarding the 200 rooms spread across seven building strips, 25.0% of the concerned respondents (which is 25.0% of the total 19.0% expressing concern) highlighted issues, with increased turbidity being the primary concern (100.0%). The suggested solution was to ensure that the project's construction and operation did not lead to increased turbidity (100.0%).

Similarly, for the 100 privately owned villas, 25.0% of concerned respondents expressed worries, with increased turbidity again being the primary issue (100.0%). The suggestion to address this concern was also to ensure that construction and operation did not contribute to higher turbidity (100.0%).

Regarding the Water Treatment Plant, 50.0% of the 19.0% expressing concern highlighted marine pollution from effluent and/or chemicals as their major worry. The suggestion put forward was to ensure that no harmful discharge such as effluent or chemicals would be released into the marine environment (100.0%).

In summary, while most fishers were not concerned with the development, a subset of 19.0% expressed specific worries, particularly related to the impact of the proposed project on their fishing livelihoods, marine life, and the environment.

5.3.6 Site Use and Potential Impacts

In response to whether the proposed site (land, beach, or sea) is currently used for any type of activity, all fishers interviewed (100.0%) provided an answer. Of these respondents, 23.8% confirmed that they currently use the site, while 76.2% stated that they do not use it (Figure 6). When asked what aspect of the proposed site they used, all (100.0%) of those who used the site indicated that they utilized the sea, specifically for fishing.

When asked whether they had used the proposed site in the past, all interviewees responded. 23.8% confirmed they had used the site in previous years, while 76.2% stated they had not (Figure 7). Of those who had used the site in the past, 80.0% reported using it for at least twenty years, with 20.0% unsure of the exact duration of their usage. Regarding whether they knew of others who used the proposed site, 14.3% of fishers confirmed they knew someone who used the site, while 85.7% did not. All (100.0%) of those who knew others using the site indicated that it was used for fishing.

On the topic of whether the proposed project would affect their life, livelihood, community, or the environment, all respondents (100.0%) provided a response. Just under 62% (61.9%) of fishers believed the project would have an impact, while 9.5% felt it would not, and 9.8% expressed uncertainty.

Table 5-9 Respondents' Anticipated Impact of the Project on Lives/Livelihood, Community, & Environment

Anticipated Impact	Variable		
	Lives/Livelihood	Community	Environment
Positive	7.7%	**76.9%**	0.0%
Negative	**38.5%**	7.7%	**38.5%**
Both Positive & Negative	0.0%	0.0%	0.0%
Not at all (No impact)	23.1%	0.0%	15.4%
Not sure	**30.7%**	15.4%	46.1%

Concerning the impact on lives/livelihoods, 7.7% of respondents (from the 61.9% who anticipated an effect) expected a positive impact, with the key benefit being an increased opportunity to generate income (100.0%). In contrast, 38.5% anticipated a negative impact on livelihoods, citing the loss of livelihood (80.0%) and loss of fishing areas (40.0%) as primary concerns. Some respondents offered multiple concerns, which is why percentages exceed 100.0%. To address these potential negative impacts, respondents suggested measures such as preventing marine pollution (20.0%), not increasing the size of the fish sanctuary (20.0%), and designating a fishing area for nearshore fishers (20.0%).

Regarding the community impact, 76.9% of fishers (from the 61.9% expecting an effect) believed the project would have a positive impact, specifically through employment opportunities for community residents (70.0%), community development (30.0%), and reduced criminal activity (10.0%). However, 7.7% anticipated a negative community impact, primarily loss of livelihood for fisherfolk (100.0%). Interestingly, no specific suggestions were provided to mitigate the negative community impact.

As for the environmental impact, 38.5% of fishers (from the 61.9% who anticipated an effect) expected a negative impact, with concerns including marine pollution (60.0%), loss of mangroves (40.0%), and increased turbidity (20.0%). Some respondents cited multiple environmental impacts, leading to percentages exceeding 100.0%. Suggested solutions to address these environmental concerns included ensuring that construction activities do not pollute the marine environment (20.0%), avoiding surface discharge into the marine environment (20.0%), and preserving mangroves and shoreline protection (20.0%).

On the subject of nearby protected or important areas (historical, cultural, or environmental), 100.0% of respondents offered a response. Approximately 28.6% did not know of any such areas, 33.3% indicated there were no such areas near the proposed site, and 38.1% confirmed the existence of areas of importance. The two primary areas mentioned were the Bluefields Bay Fish Sanctuary and Bluefields Bay.

When asked about the impact of the Bluefields Bay Fish Sanctuary on the fishing industry, responses included:

- Increase in fish population (33.3%)
- Increase in fish size (14.3%)

- No impact (14.3%)
- Uncertain or no response (38.1%)

Regarding the marine environment, responses to the sanctuary's impact included:

- Improvement in water quality (14.3%)
- Increase in seagrass beds (4.8%)
- No change in the marine environment (28.6%)
- Uncertain or no response (38.1%)

As for the legal protection of wildlife, fishers were asked about their awareness of the protection of birds, turtles, crocodiles, and manatees. The majority (95.2%) were aware that birds and turtles were protected by law, followed by 85.7% aware of crocodiles being protected, and 71.4% aware that manatees were protected.

Table 5-10 Fishers' Awareness of Species Protected by Law

Species	% Awareness	
	Yes	No
Birds	95.2%	4.8%
Turtles	95.2%	4.8%
Crocodiles	85.7%	14.3%
Manatees	71.4%	28.6%

Fishers were also asked whether they had seen or knew anyone who consumed these protected species. Regarding birds, 61.9% confirmed seeing them, though many respondents indicated they could not easily identify whether the birds they saw were protected. No one (0.0%) knew anyone who consumed birds. For turtles, 66.7% of fishers had seen them, particularly in areas such as the fishing areas, Wharf Road Fishing Beach, and the Paradise area. Approximately 90.5% did not know anyone who consumed turtles. Regarding crocodiles, 71.4% had seen them, particularly around Wharf Road Fishing Beach and Paradise area. Again, 90.5% did not know anyone who consumed crocodiles.

Finally, when asked about manatees, 97.2% had never seen one, but 2.8% had observed them in locations such as Savanna-la-Mar and Pelican Bar. Of those interviewed, 90.5% did not know anyone who consumed manatees.

In summary, fishers showed strong awareness of legal protections for certain species but expressed concerns about the potential impacts of the proposed development on their livelihoods, communities, and the environment. These concerns mainly centred around the loss of fishing areas, increased marine pollution, and the destruction of mangroves, with some offering suggestions to mitigate these impacts.

5.4 OTHER STAKEHOLDERS

5.4.1 National Fisheries Authority

Consultations were conducted with the National Fisheries Authority (NFA) concerning the proposed project through various meetings and email exchanges between 2023 and 2024. Key representatives from the NFA including Dr. Azra Blythe-Mallett (Senior Director, Research & Development), Mr. Junior Squire (Fisheries Management Specialist), and Miss Deandra Roberts (Research Officer).

The NFA facilitated the collection of valuable data by providing literature, statistics, and relevant information, and by directing the project team to additional sources of data. The NFA supported the EIA process by sharing key insights into the local fishing industry and its potential interactions with the proposed development. This included providing information about fishing areas, the types and numbers of fishers, which ultimately assisted in understanding the fishing industry's scale and its economic significance.

5.4.2 Bluefields Bay Fishermen's Friendly Society (BBFFS)

The project team also engaged with the Bluefields Bay Fishermen's Friendly Society (BBFFS) to gather information and insights on the role of the local fishing community and the significance of Bluefields Bay as a sanctuary. Consultations with the BBFFS included both in-person visits and discussions aimed at understanding the sanctuary and its role in conserving local biodiversity and sustaining fish populations, while also serving as a vital area for the local fishers.

Furthermore, the BBFFS provided a wealth of resources, including literature, reports, and data. These materials, which encompass a range of topics such as local fishing practices, biodiversity conservation, and the management of the Bluefields Bay sanctuary, were reviewed and integrated throughout the assessment. This information has been essential in providing a comprehensive understanding of the area's significance.

5.5 INDEX OF STAKEHOLDER QUESTIONS AND CONCERNS

Table 5-11 summarises the questions, comments and concerns voiced by stakeholders throughout the public participation process. For each concern, a summarised response from CL Environmental is provided, based on information collated and assessed within this EIA. Section numbers are included in the table for easy referencing; these sections provide detailed information specific to each concern and recommended mitigation measures for any potentially negative impact.

Table 5-11 Index of questions and concerns voiced by stakeholder and responses from CL Environmental for each

Stakeholder	No.	Question or comment	Response	Report Section
Community	1	Loss of vegetation and wildlife and in particular, potential impact on the morass/wetland area	The area to be impacted will be minimised as best as possible, and the recommended measures, once implemented, should assist in reducing the potential impact.	6.2.2.1, 0, 6.2.2.3, 6.2.2.4, 0, 6.2.2.6
	2	Disturbance to/ loss of marine life	The project will implement strict environmental management measures to minimize harm to marine life, including turbidity barriers, monitoring, and habitat conservation initiatives.	6.2.2.7, 6.3.3.5
	3	Loss of fishing areas	The area immediately offshore from the site falls within the Bluefields Bay fish sanctuary where fishing is prohibited. The areas on the western side of the headland indicated to be used for fishing during the perception survey, are unlikely to be affected by the construction and operation of proposed overwater features. The project will focus on reducing impacts on fishing areas through various strategies. Environmental management plans will be implemented during construction to prevent habitat degradation. Conservation efforts, including mangrove restoration and potential artificial reefs, will help sustain fish populations. The proponent is committed to collaborating with local fishers to minimize disruptions and promote long-term environmental sustainability.	6.3.4.12
	4	Loss of crab hunting area	The project site includes private land, and some access restrictions may be necessary for safety and environmental protection.	
	5	Improper disposal of sewage effluent, e.g. into the marine environment	A wastewater treatment plant (WWTP) will be constructed according to strict design standards, with the disposal of sewage effluent managed through a constructed wetland on the property.	**Error! Reference source not found.**, 6.3.4.4
	6	Exposure to radiation from solar panels	Solar panels do not emit harmful radiation. They operate by converting sunlight into electricity using photovoltaic cells, but this process doesn't release radiation like some other energy sources, such as nuclear power. Solar panels are designed to be safe and environmentally friendly, and they only produce energy when exposed to sunlight.	
	7	Extent of disturbance the rock groynes and dock would cause to the natural environment	The proposed layout significantly lowers nearshore wave heights within areas influenced by the groynes and sediment sink, helping to reduce wave-induced erosion and create more stable shoreline conditions. Wave energy is also redirected around the groynes, resulting in localized zones of calmer water. These effects are limited to the area surrounding the structures, with no impact on offshore propagation. Overall, the design, including sediment grain size, sill, sediment sink, and groynes, supports sediment retention in nearshore areas and reduces sediment transport from the property.	6.3.2.3
	8	Reduced potable water supply	Water demand and supply management strategies will be implemented, including rainwater harvesting, water conservation measures, and integration with municipal supply where feasible. The development will ensure that it does not negatively impact local freshwater availability	**Error! Reference source not found.**
	9	Increased criminal activity	The developer will collaborate closely with local law enforcement to implement proactive security measures.	6.3.4.6
	10	Loss of beach access	It is important to note that the property is currently private, and access to the beach is at the discretion of the owner. The developer will work to ensure that any changes made will be in line with local regulations.	
	11	Loss of income for small business owners	The specific businesses in question are unclear. However, the proposed development is expected to attract additional investors, business opportunities, and clients to the area, which could create new opportunities for local businesses and stimulate economic growth in the region.	6.3.4.1
	12	Further deterioration of roads from construction activity	The developer will collaborate with the Municipal Corporation to rehabilitate any roads affected by activities related to the development.	
	13	Possible pollution of the river nearby the property (Sweet River)	The use of eco-friendly substances for the golf course and stormwater management practices will reduce the potential for pollution of watercourses.	**Error! Reference source not found.**, 6.2.1.3
Fishers	14	Loss of fishing areas	See#3 above.	
	15	Potential migration of fish	While some localized fish movement may be affected by construction activities, artificial reef structures and habitat restoration efforts may help sustain fish populations. Water quality monitoring and sediment control will also be implemented to minimize long-term impacts.	6.2.2.7, 6.3.3.5
	16	Loss of mangroves	See #1 above.	

Stakeholder	No.	Question or comment	Response	Report Section
	17	Loss of shoreline protection, particularly against heavy winds and hurricanes	Mangroves will not be removed from the coastline, and the proposed coastal works are designed to enhance beach stability.	6.2.2.4, 6.3.2.3, 6.3.3.3
	18	Increased turbidity	Stormwater management practices, along with the proposed sediment sinks, will be implemented to reduce the amount of sediment entering water resources. These measures will help minimize any potential increase in turbidity within the water column.	6.2.1.3, 6.2.1.4, 6.3.1.5
	19	Possible discharge of wastewater effluent and chemicals into the sea	See #5 above.	
	20	Loss of livelihood	See #11 above.	
	21	Marine pollution	See # 5 and #13 above.	
National Fisheries Authority	22	Concern regarding type of boulders and materials used for coastal works, in relation to water quality impacts	Boulders used by SWIL typically have the following properties: ▪ Specific Gravity (2.4) ▪ Water Absorption (<4%) ▪ Los Angeles Abrasion Test (<30% after 500 revolutions) ▪ $MgSO_4$ Soundness (<10% losses after 5 cycles). ▪ Minimum Uniaxial Compressive Strength (30 MPa) Based on these properties, the boulders are durable and should not degrade excessively, nor should they contribute significantly to sedimentation or turbidity in the sea. However, extreme weather conditions, heavy storms, or significant physical disturbance could potentially lead to some degree of breakdown over time, though it is unlikely to cause substantial environmental impact. The sand used for beach nourishment will be locally sourced and imported from the Bahamas. It is expected to have suitable properties for beach restoration. To enhance the project's effectiveness, geotextile and geogrid materials will be used to reinforce the seabed and help control the flow of silt, preventing excessive sedimentation and ensuring stability in the area. Mitigation measures are recommended to reduce the impact on water quality.	**Error! Reference source not found.**, 6.2.1.4
Bluefields Bay Fishermen's Friendly Society (BBFFS)	23	Inquiries regarding the proposed project and potential opportunities for partnership and mutual support in managing and monitoring within Bluefields Bay	The proponent welcomes discussions to foster collaboration and assist in addressing any existing challenges and conditions.	6.3.4.13

6.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

6.1 IMPACT ASSESSMENT MATRICES

6.1.1 Approach

Impact matrices were developed for both the site preparation/construction and operational phases of the proposed project. Each potential impact was evaluated using specific criteria, which were grouped into Physical, Biological, and Human/Social categories (Ogola, 2007). The assessment criteria, including direction, duration, magnitude, and extent, as well as the ranking techniques, are outlined in the subsequent sections.

In addition to these core criteria, several other factors were incorporated into the impact analysis to enhance the accuracy and depth of the evaluation. These include the consultants' expertise and prior experience with similar projects, documented impacts from comparable projects, data gathered from field studies, and an in-depth analysis of the proposed project's processes. Information generated from predictive models, stakeholder concerns gathered through social surveys, and collaborative discussions within the EIA study team also played a significant role in the assessment. By integrating these diverse sources of information, the analysis provides a comprehensive and thorough evaluation of potential environmental impacts, ensuring that all relevant aspects are considered in the decision-making process.

6.1.2 Description of Criteria

6.1.2.1 Type

This criterion distinguishes between the direct (immediate) and indirect (secondary) impacts:

- **Direct:** Immediate impacts resulting from the project activities themselves, such as habitat destruction or water contamination.
- **Indirect:** Secondary impacts that arise from the direct effects but may occur over time or in different locations, for example changes in local economies.

6.1.2.2 Direction

The direction assesses the nature of the environmental impact, helping to classify it as:

- **Positive**: Beneficial impacts, such as improvements to local infrastructure or ecosystems.
- **Negative**: Adverse impacts, such as pollution or habitat destruction.

- **None**: No measurable impact, meaning the project does not cause any noticeable change to the environment.

6.1.2.3 Duration

Environmental impacts vary over time and must be assessed throughout different phases of the project cycle. Duration evaluates the period over which an impact occurs, determining whether it is reversible or irreversible and estimating the rate of potential recovery. It is categorized as follows:

- **Temporary (T)**: Short-term impacts lasting from a few days to weeks, fully reversible, for example, a temporary road blockage.
- **Short-Term (S)**: Lasting from the immediate phase up to 2 years, particularly construction phase impacts such dust, noise, or temporary changes in water quality.
- **Medium-Term (M)**: Spanning 2 to 5 years, typically involving natural recovery processes like vegetation regrowth after site clearance or stabilization of erosion control measures.
- **Long-Term (L)**: Impacts that last for more than five years, though not necessarily irreversible, such as temporary habitat loss where regrowth takes at least five years.
- **Permanent (P)**: Irreversible impacts that persist indefinitely, like the total loss of a wetland or a permanent alteration to the landscape.

6.1.2.4 Magnitude

Magnitude measures the severity of each potential impact. An impact's magnitude cannot be considered high if it can be effectively mitigated. The classifications are as follows:

- **None**: No measurable change, indicating no observable effect on resources, ecosystems, or communities.
- **Small (S)**: Minor changes in the form or function of ecosystems/resources, with no loss of community value. Only a small portion of the local community is affected.
- **Medium (M)**: Noticeable changes that impact the functionality of ecosystems/resources. Economic or environmental benefits may be slightly affected, with a moderate impact on the local community.
- **Large (L)**: Significant changes that severely affect ecosystems or resources, resulting in a substantial impact on both the environment and the community.

6.1.2.5 Extent

This determines the spatial extent or zone of influence of the impact. An impact can be site-specific and limited to the project area, regional, extending beyond the local area, or national, affecting resources on a national scale and potentially being trans-boundary (international):

- **None**: No spatial effect.

- **Local (L)**: Isolated effects, with the impact confined to the project site and its immediate locality, meaning it does not extend beyond the area directly affected by the project.
- **Regional (R)**: The impact extends beyond the local area, possibly affecting surrounding regions or spreading via dispersion pathways like water or air.
- **National (N)**: The impact has widespread effects, possibly affecting the entire country or crossing national borders, becoming transboundary (international).

6.1.3 Construction and Operational Phase Matrices

The impact matrices for the Site Clearance/Construction, and Operation phases are Table 6-1 and Table 6-2 respectively.

Table 6-1 Impact matrix for Site Clearance and Construction Phase

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
Environmental Receptor			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	***Drainage and Hydrology***	During initial phases, potential increased risk of flooding and runoff due to vegetation removal. Once implemented, stormwater management system will improve site hydrology	X				X	M	M	L
	Water Quality - Freshwater	Increased levels of suspended solids, heightened turbidity and sedimentation and potential contamination	X				X	M	M	L
	Water Quality - Marine	Increased levels of suspended solids, heightened turbidity and sedimentation and potential contamination	X				X	M	M	L
		Increased water turbidity and sedimentation, with potential spread by natural hydrodynamics	X				X	M	M	L
	Benthic Sediment	Disturbance of seabed and resuspension of sediments	X				X	M	M	L
	Noise	Increase noised levels, impacting the noise climate and potentially affecting nearby residents, wildlife, and the overall soundscape	X				X	M	S	L
	Air Quality	Emissions as well as fugitive dust emissions, potentially affect local air quality, health, and vegetation	X				X	M	S	L
	Pollution Sources	Increased solid waste, requiring proper management to prevent contamination	X				X	M	M	L
		Removal of agriculture and farm animals will reduce nutrient inputs, improving water quality	X		X			M	S	L
Biological	***Terrestrial Habitats***	Potential habitat and alteration loss	X				X	P	L	N
		Potential habitat fragmentation	X				X	P	M	L
	Terrestrial Flora	Potential smothering from dust	X				X	M	S	L
		Potential loss of endemics, such as Morass Royal (*Roystonea princeps*)	X				X	P	M	L
		Potential loss of ecosystem services	X				X	P	M	N
		Potential Relocation of Roystonea princeps, Epiphytes	X			X		P	S	L
		Potential introduction of invasive species		X			X	M	S	L
	Wetlands and Mangroves	Potential loss of mangrove carbon sequestration and storage	X				X	P	L	N
		Potential loss of biodiversity & ecosystem services	X				X	P	L	N
	Terrestrial Fauna	Potential species loss	X				X	M	S	L
		Noise and construction activities	X				X	T	S	L
		Introduction of Invasive Species		X			X	M	S	L
		Human-wildlife conflicts	X				X	T	S	L
		Lighting and artificial habitat alteration	X				X	M	S	L
	Freshwater Habitats	Potential habitat loss and or alteration	X				X	M	S	L
		Potential habitat fragmentation	X				X	M	S	L
		Potential shifts in community composition	X				X	M	S	L
		Potential loss of ecosystem services	X				X	M	S	L
	Benthic Habitats	Potential habitat loss and or alteration	X				X	P	M	L
		Potential loss of ecosystem services	X				X	P	M	L
	Seagrass	Potential seagrass species loss	X				X	P	M	L
		Potential decline or alteration in water quality	X				X	M	M	L
		Potential loss of carbon sequestration (stored and ability to sequester additional carbon).	X				X	P	L	N

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
Environmental Receptor			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
		Potential decline in water quality	X				X	M	M	L
	Reef Communities	Potential impact to coral colonies and reef communities		X			X	M	S	L
		Potential displacement of fish and mobile invertebrates	X			X		M	S	L
		Potential introduction of artificial substrates	X		X			T	S	L
	Fish and Invertebrate Communities	Potential displacement of fish and mobile invertebrates	X				X	M	S	L
	Sea Turtles	Potential disorientation of sea turtles and hatchings from lighting	X				X	M	S	L
		Potential loss of nursery, breeding, and foraging grounds	X				X	P	M	L
Socioeconomic / Cultural	***Employment***	At peak, expected to employ up to 1,000 people, resulting in creation of approximately 2,660 to 3,800 indirect and induced jobs	X	X	X			M	M	N
	Electricity Supply	May increase demand on the local electrical grid, leading to potential capacity issues and voltage fluctuations. Installation of a solar field will reduce grid reliance	X				X	M	S	R
	Water Supply	Impact expected to be temporary, as measures to optimize water use during operation will be implemented.	X				X	M	S	R
	Wastewater	Improper disposal of wastewater at the construction campsite could harm water quality.	X				X	M	S	L
	Solid Waste	Increased generation of solid waste and improper disposal of this waste poses risks	X				X	M	S	L
	Health and Safety	Potential accidental injuries and exposure to fugitive dust	X				X	M	S	L
	Land Use	Transformation of agricultural, residential, and recreational spaces into hospitality developments, impacting traditional land uses	X				X	M	M	L
	Vehicular Traffic	Potential disruption to traffic	X				X	T	S	L
	Maritime Traffic	Potential increase in accident risk	X				X	T	S	L
		Potential disruption in fishing and other maritime activities	X				X	T	S	L
	Aesthetics	Potential reduction in aesthetic appeal	X				X	M	M	L
	Cultural and Heritage	Potential disturbance and damage to the archaeological sites and artifacts	X				X	P	L	L

Table 6-2 Impact matrix for Operational Phase

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
Environmental Receptor			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	***Drainage***	Potentially improved drainage	X		X			P	M	L
	Water Quality - Freshwater	Potential reduction in water quality	X				X	P	S	L
		Potential improvement in water quality	X		X			P	S	L
	Water Quality - Marine	Potential reduction in water quality	X				X	P	M	L
		Potential improvement in water quality	X		X			P	M	L
	Wave Climate	Potential reduction in wave climate	X		X			P	M	L
	Currents and Sediments	Reduction in potential for resuspension of settled sediments	X		X			P	L	L
Natural Hazards	***Earthquake and Seismicity***	Located in an area with low spectral response for accelerations	X		X			P	M	L
	Hurricane Waves and Surge	Reduction in wave heights in the sheltered area behind structures	X		X			L	M	L
	Beach Stability	Potential increase in stability	X		X			P	M	L
	Flooding	Potential reduction in flooding	X		X			L	M	L
Biological	***Terrestrial Habitats***	Potential rehabilitation and restoration	X		X			L	L	N
	Wetlands and Mangroves	Potential rehabilitation and restoration	X					L	L	N
		Potential increase of mangrove carbon sequestration and storage	X		X			L	L	N
	Freshwater Habitats	Potential reduction in water quality and habitat	X				X	L	S	L
	Seagrass and Benthic Habitats	Potential long-term shading of seagrass	X				X	P	S	L
		Potential improvement in water quality	X		X			L	S	L
		Potential disturbance to marine fauna	X				X	L	S	L
		Potential introduction of artificial structures altering benthic composition	X		X			L	M	L
	Sea Turtles	Potential disorientation of sea turtles and hatchings from lighting	X				X	L	S	L
		Potential deterrence to use nearby nursery, breeding, and foraging grounds	X				X	L	S	L
Socioeconomic / Cultural	***Employment***	Expected to create 1,000 direct jobs, along with 1,840 indirect and 695 induced jobs	X	X	X			L	L	N
	Electricity Supply	With renewable energy from solar field and emergency backup generators, will reduce dependency on the grid and cut emissions by over 50%.	X			X		P	M	N
	Water Supply	Incorporating conservation strategies will minimize impact on the public water supply	X	X				P	M	L
	Wastewater	Comprehensive wastewater treatment plant will manage and treat wastewater	X			X		P	S	L
	Solid Waste	Potential increase, but comprehensive waste management plan will promote sustainability	X				X	L	S	L
	Vehicular Traffic	Potential traffic increases and slight decline in performance since corridors and intersections will generally maintain acceptable levels of service.	X				X	L	M	L
	Maritime Traffic	Potential increase in maritime activities	X			X		L	S	L
	Recreation	Introduction of a variety of new recreational amenities	X		X			L	M	N
	Tourism	Enhances region's tourism by offering high-quality accommodations and focusing on eco-tourism and sustainable practices	X		X			L	L	N
	Fisheries	May not directly affect fishing activities. Offers opportunities to support marine conservation initiatives such as coral nurseries and artificial reefs. May increase fish diversity		X	X			L	M	L

6.2 SITE CLEARANCE AND CONSTRUCTION

6.2.1 Physical

6.2.1.1 Geomorphology and Geotechnical Considerations

Impact

The property itself is underlain by an alluvial layer of clays and clayey sandy silts, which cover soluble limestone deposits conducive to Mantle Karst formation. While Mantle Karst has the potential to cause cover-collapse sinkholes, these events are rare and sudden. It is essential to conduct a site-specific geotechnical assessment to evaluate the potential for cover-collapse sinkholes at the project site. This assessment, involving geophysical surveys and borehole investigations, is critical for accurately identifying areas of concern and assessing the stability of the overlying cover. Only through such detailed analysis can the associated risks be properly understood and managed.

Recommended Mitigation

i. Geotechnical Assessment: A comprehensive geotechnical assessment should be conducted, including geophysical surveys and borehole investigations, to identify areas at risk of cover-collapse and evaluate the stability of the overlying cover.
ii. Site-Specific Engineering Solutions: Based on the findings of the geotechnical assessment, implement site-specific engineering measures, such as reinforcing foundations or stabilizing the ground, to mitigate potential risks associated with cover-collapse.

6.2.1.2 Drainage and Hydrology

Impact

During the initial phases of site clearance and construction (including the implementation of the stormwater management plan), there may be an increased risk of flooding and runoff due to vegetation removal, soil disturbance, and altered drainage patterns.

The proposed stormwater management plan (**Error! Reference source not found.**) focuses on several key measures to ensure the protection of hydrological balance and surrounding ecosystems. During construction, phased implementation will allow for the gradual integration of the stormwater management system, maintaining ongoing hydrological stability. To reduce flood risks, detention ponds, catch basins, and drainage systems will be installed to manage and control stormwater runoff. By collecting and storing excess runoff in the detention ponds, the system will slow the release of water into downstream areas, thus minimizing localized flooding and erosion. Additionally, proper grading and placement of stormwater infrastructure such as swales, catch basins, and piping systems will ensure that water is effectively captured and directed to the designated detention areas. This will enhance site drainage and prevent surface water from pooling in undesired locations, facilitating more controlled water movement across the construction site.

Erosion control measures, including silt fences and check dams, will reduce sediment transport during construction. These measures will slow the velocity of stormwater, allowing sediment to settle before reaching surrounding areas or stormwater infrastructure, which will help protect water quality and prevent downstream sedimentation. Furthermore, the detention ponds will be designed to control the velocity of water as it is released into downstream areas, reducing the risk of erosion, and protecting surrounding ecosystems from potential damage.

Overall, once implemented, the stormwater management system will improve site hydrology, reduce flood risks, and safeguard the surrounding environment.

Mitigation

The implementation of the proposed stormwater system will require ongoing monitoring, proactive maintenance, and potential adjustments to ensure long-term effectiveness.

i. To minimize disruptions to the hydrological balance, the stormwater management system will be integrated in phases, with close monitoring to ensure that each phase is functioning effectively before moving on to the next.
ii. The system should be designed to accommodate fluctuations in rainfall patterns and unexpected storm events.
iii. To improve water flow, regular cleaning, and maintenance of stormwater infrastructure (such as swales, catch basins, and piping systems) will be carried out. This will ensure the effective capture and diversion of water to the designated detention areas. The grading of the site will be periodically assessed to confirm that water flows in the desired directions and that any pooling of water is addressed promptly.
iv. Continuous monitoring and maintenance of silt fences, check dams, and sediment removal systems and other design features will be crucial. Regular inspections will ensure that these control measures are functioning properly, preventing sediment and pollutants from entering nearby water bodies and reducing the risk of erosion during construction.

6.2.1.3 Water Quality – Freshwater

Impact

The activities associated with earthworks, construction debris, and the storage of raw materials such as marl, as well as the handling of fuels and hazardous substances, can have significant impacts on water quality in the surrounding environment. Below are the key potential impacts on water quality:

- Increased Suspended Solids and Turbidity: Earthworks typically involve excavation, grading, and clearing, which can disturb soil and increase the likelihood of suspended solids being carried away by stormwater runoff. Construction debris, if not properly contained, may also contribute to sedimentation. During heavy rainfall, runoff from these disturbed areas can carry large amounts of sediment into nearby rivers, streams, and ponds. This elevated turbidity can reduce water clarity, which in turn impacts aquatic ecosystems by blocking light penetration. The reduction in light availability can inhibit photosynthesis, affecting primary producers like aquatic plants and phytoplankton, which are vital to the food chain.

- Sedimentation and Habitat Destruction: The sedimentation resulting from earthworks and construction debris can smother benthic habitats—those located at the bottom of water bodies—leading to the degradation of ecosystems. The smothering of aquatic habitats, such as riverbeds and pond floors, can disrupt the lives of benthic organisms, including important species like insects, molluscs, and bottom-dwelling fish. As sediment settles, it can also clog gills of fish, reducing oxygen uptake and impairing their survival.
- Groundwater Contamination: The storage and handling of hazardous substances, including fuels, lubricants, hydraulic fluids, and chemicals, pose substantial risks to water quality. Leaks or spills from construction equipment can lead to contamination of the surrounding soil. These chemicals can seep into the groundwater table, leading to long-term contamination of local water supplies. Once chemicals enter the soil or groundwater, they can spread, affecting water quality far beyond the immediate construction site and potentially impacting drinking water sources.
- Surface Water Contamination: In addition to potential groundwater contamination, hazardous materials stored on-site or in staging areas may be washed away by stormwater runoff, leading to surface water contamination. Chemicals such as oils, hydraulic fluids, and solvents, if not properly managed, can enter nearby streams, rivers, or ponds. These substances can be toxic to aquatic life, causing long-term harm to ecosystems. Even small quantities of hazardous materials can have significant detrimental effects on water quality, such as altering the chemical composition of the water and introducing pollutants that disrupt the health of aquatic organisms.
- Risk to Aquatic Life and Human Health: The contamination of both groundwater and surface water poses risks not only to aquatic life but also to human health. Polluted water may contain harmful levels of chemicals, heavy metals, or pathogens, which can negatively affect drinking water quality and aquatic food sources. Aquatic organisms may experience impaired reproduction, growth, or mortality due to exposure to pollutants. Humans who rely on nearby water sources for drinking, irrigation, or recreation could face health hazards, including exposure to toxins and diseases carried by contaminated water.

Primary Recommended Mitigation

i. Erosion and Sediment Control:
   a. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage.

These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. It may be necessary to have multiple layers of sediment barriers around work areas

b. Erosion Control Mats: Use erosion control mats and geotextiles on exposed soil to reduce erosion.
c. Conduct sediment dispersal calculation rates on coral reefs and seagrass beds within 200 meters of the proposed villas and other marine works and at control stations, on a monthly basis, for comparison to background levels. Pre-construction sedimentation rates should therefore also be conducted and used as a baseline for comparison.
d. All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.

ii. Stormwater Management:
   a. Retention Ponds: Construct retention ponds or sediment basins to capture and treat stormwater runoff before it enters water bodies.
   b. Drainage Systems: Design and implement efficient drainage systems to direct stormwater away from vulnerable areas and into treatment facilities.

iii. Proper Storage and Handling of Hazardous Materials:
   a. Raw Materials:
      i. Designate a central area for the storage of raw materials.
      ii. Area should be lined in order to prevent the leakage of chemicals into the sediment.
      iii. Stockpile fine grained materials (sand, marl, etc.) away from drainage channels and low berms should be placed around the piles, which themselves should be covered with tarpaulin to prevent erosion.
      iv. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne.
   b. Hazardous Substances:
      i. Storage of fuels and oils, and hazardous substances should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored.
      ii. Containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage.
      iii. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
      iv. Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.
      v. Refuelling of boats should only be done at anchor out at sea if the sea conditions are calm, otherwise, all refuelling should be done when docked at land.

Appropriate refuelling equipment (such as funnels) and techniques should always be used.

c. Transport:
   i. In terms of transporting equipment, utilise the paths of the planned roadways rather than creating temporary pathways just for equipment access.
   ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.
d. Spill Response Plan:
   i. Develop and implement a spill response plan, including spill kits and training for workers to handle and clean up spills promptly and effectively.
   ii. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags.
e. Construction Equipment Maintenance:
   i. Regular Inspections: Conduct regular inspections and maintenance of construction equipment to prevent leaks and ensure optimal functioning.
   ii. Designated Maintenance Areas: Perform equipment maintenance in designated areas with proper containment measures to prevent contamination of soil and water.

iv. Monitoring and Compliance:
   a. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity, and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
   b. Adaptive management, including stoppage of works during adverse weather conditions and using monitoring data to adapt and refine mitigation measures as needed to address any emerging issues promptly.

6.2.1.4 Water Quality - Marine

Impact

In addition to the land-based construction impacts outlined in section 6.2.1.3., additional coastal-based activities will potentially impact the marine environment. Coastal construction activities like dredging, the creation of temporary access roads/pads, and pile driving can potentially affect the marine environment, with elevated turbidity being the primary concern for water quality. The use of heavy machinery and equipment on or near the water has the potential to result in spills of fuels, oils, and other chemicals. These pollutants have the potential to impact a wide range of organisms, from plankton to larger fish and marine mammals.

Natural hydrodynamic forces, such as wave action and currents, can exacerbate the spread of sediments and pollutants; these forces can transport silt, other particulates pollutants from the construction site downstream, affecting a larger area than just the immediate vicinity of the project.

Recommended Mitigation

The following proposed mitigation measures are designed to specifically minimize impacts during the coastal construction process.

i. Turbidity Barriers:
   a. To prevent the spread of sediment and reduce water turbidity during construction, turbidity barriers will be installed around the work areas. These barriers will limit the dispersion of suspended particles into the surrounding water.

ii. Temporary Access Pads:
   a. Temporary access pads will be constructed to facilitate safe and efficient access for excavators. These pads will be used for the excavation of material, ensuring that machinery does not directly impact the sensitive coastal environment or cause unnecessary disruption to the beach area.
   b. These temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible.

iii. Settling Ponds:
   a. Settling ponds will be created at the back of the existing beach area to capture any runoff or excess sediment. These ponds will allow suspended particles to settle before the water is returned to the environment.
   b. The clean water will be carefully filtered and discharged back into the surrounding area to prevent contamination of the marine environment.

iv. Sand Nourishment:
   a. Sand nourishment will be undertaken to restore the beach to its required grade. To minimize environmental impact, only sand with low silt content will be used. This will reduce the likelihood of increased turbidity and ensure that the added material integrates smoothly with the natural beach ecosystem.

v. Boulder Washing:
   a. Prior to placement, all boulders will be thoroughly washed to remove any debris, dirt, or contaminants. This ensures that only clean material is placed in the coastal zone, preventing the introduction of pollutants or invasive species into the marine environment.

vi. Debris Removal:
   a. Any debris from the work site will be carefully collected and removed to prevent it from being washed into the ocean.

vii. Sensitive Species and Benthic Habitat Considerations:
   a. See section6.2.2.7, 6.2.2.8, 6.2.2.9 and 6.2.2.10.

Please also see Primary Recommended Mitigation under section 6.2.1.3, addressing land-based activities that are also applicable to marine water quality.

6.2.1.5 Benthic Sediment

Impact

Marine works, such as dredging, construction, or other activities that disturb the seabed, can potentially resuspend sediments. This resuspension can have several potential impacts on marine life, including seagrass, fish, coral, and other organisms.

Analysis of marine sediments in the project area revealed no detectable hydrocarbons and low levels of arsenic and lead, both of which were below Jamaica's soil standards. These findings suggest minimal contamination risk from these elements during marine works. Further, the low concentrations of arsenic and lead also suggests there is a low risk of bioaccumulation in marine organisms.

Recommended Mitigation

See Primary Recommended Mitigation under section 6.2.1.1.

6.2.1.6 Noise

Impact

TERRESTRIAL

The construction activities for the hotel and coastal works will involve site clearance using heavy equipment such as bulldozers, backhoes, and jackhammers. These activities and the equipment required have the potential to have a negative impact on the noise climate of the area.

Construction noise has the potential to lead to short-term impacts that vary in duration and magnitude. The noise levels produced during construction are influenced by several factors, including the scale of the project, the specific phase of construction, the condition and maintenance of the equipment, its operating cycles, and the number of pieces of equipment operating simultaneously. To understand the potential construction noise impacts that may arise from the project, typical noise levels associated with various types of construction equipment are identified in Table 6-3. The use of this equipment will inevitably increase noise levels in the vicinity of the construction site, potentially affecting nearby residents, wildlife, and the overall soundscape.

Table 6-3 Typical construction equipment noise levels

Type of Equipment	Typical Sound Level at 50 ft. (dBA Leq.)
Dump Truck	88
Portable Air Compressor	81
Concrete Mixer (Truck)	85
Jackhammer	88
Scraper	88
Bulldozer	87

Type of Equipment	Typical Sound Level at 50 ft. (dBA Leq.)
Paver	89
Generator	76
Piledriver	101
Rock Drill	98
Pump	76
Pneumatic Tools	85
Backhoe	85

Adapted from - Route 101A Widening and Improvements, City of Nashua Hillsborough County, New Hampshire; McFarland-Johnson, Inc. May 30, 2007

UNDERWATER

Underwater noise generated by coastal construction activities, such as pile driving, dredging, and machinery operation, marine vessels, can cover a broad range of frequencies, typically from low-frequency rumblings to high-frequency impacts. These noises can have various detrimental effects on fish and other tropical nearshore species:

Frequency and Intensity

- Low-Frequency Noise: Low-frequency sounds (below 1 kHz) can travel long distances underwater and may disrupt the migration patterns and communication of marine species. Species that rely on low-frequency sounds for navigation, such as some fish and marine mammals, may experience disorientation or stress.
- High-Frequency Noise: High-frequency sounds (above 1 kHz) can cause physical damage to hearing structures in fish and other marine animals. This can affect their ability to detect predators, locate prey, and communicate.

Behavioural Changes

- Disruption of Communication: Many marine species use sound for communication and social interactions. Increased underwater noise can interfere with these vocalizations, affecting mating behaviours, territory establishment, and predator-prey interactions.
- Altered Feeding and Breeding: Noise pollution can cause fish and other species to alter their feeding habits and breeding behaviours. Increased noise levels can lead to reduced feeding efficiency and decreased reproductive success.

Stress and Physiological Effects

- Increased Stress Levels: Prolonged exposure to high noise levels can lead to chronic stress in marine animals, affecting their overall health and survival. Stress responses may include changes in hormone levels and immune function.
- Hearing Damage: High-intensity sounds can cause physical damage to the auditory organs of fish and other species, leading to temporary or permanent hearing loss. This can impair their ability to detect important environmental cues.

Habitat Displacement

- Avoidance Behaviour: Fish and other marine species may avoid areas with high noise levels, leading to habitat displacement. This can reduce their access to critical habitats for feeding, breeding, and shelter.

Impact on Coral Reefs

- Coral Health: Excessive noise can also affect coral reef ecosystems indirectly by altering the behaviours of key species such as herbivorous fish. Changes in fish behaviour can impact coral health and the overall balance of the reef ecosystem.

In summary, underwater noise from coastal construction can significantly impact the behaviour, health, and distribution of tropical nearshore species, affecting their communication, feeding, reproduction, and overall well-being.

Recommended Mitigation

Noise generated from site clearance activities should be managed to ensure that levels in residential areas do not exceed 55 dBA during daytime hours (7 am – 10 pm) and 50 dBA during nighttime hours (10 pm – 7 am). If baseline noise levels already exceed these thresholds, the construction noise should not increase baseline levels by more than 3 dBA.

Appropriate mitigation measures can be implemented to minimize the impact of construction noise and ensure a more acceptable noise climate for surrounding communities and minimizing the disturbance to daily activities. These possible measures include:

i. Scheduling and Planning:
    a. Restrict construction activities to regular working hours (7 am – 6 pm) to avoid disturbances during nighttime.
    b. Schedule particularly noisy activities during times when they will cause the least disruption, avoiding early mornings, late evenings, and weekends.
    c. Minimize engine idling when equipment is not in use to reduce unnecessary noise.
    d. Where possible, position noisy equipment and staging areas as far from sensitive receptors
    e. Restricting noisy activities like construction and seismic surveys during breeding and migration seasons
ii. Equipment Management:
    a. Use equipment that has low noise emissions as stated by the manufacturers, and properly equip machinery with noise reduction devices, such as effective mufflers and silencers to reduce noise emissions. Newer models of construction equipment are typically designed to operate more quietly and should be considered.
    b. Ensure equipment is maintained to prevent excessive noise from worn or faulty parts.

iii. Worker Protection and Training:
   a. Construction workers operating noise-generating equipment should be provided with appropriate hearing protection. Workers handling equipment that produces continuous noise levels of 80 dBA or more for 8 hours or longer should use earmuffs. Those exposed to prolonged noise levels between 70 - 80 dBA should wear earplugs.
   b. Train construction workers on the importance of noise control and encourage best practices to minimize noise generation.

iv. Monitoring and Compliance:
   a. Conduct regular noise monitoring (monthly) at various points around the construction site to ensure compliance with noise standards.
   b. Adhere to the 24-hour construction noise guidelines as stated in the environmental permit (usually 70 dBA or 75 dBA).

v. Community Engagement:
   a. Provide advance notice to neighbouring businesses about upcoming noisy activities and expected durations.

6.2.1.7 Air Quality

Impact

Site preparation involves various activities such as excavation, land clearing (including digging, loading, and removal of materials by trucks), and the storage of raw materials like sand and marl. These activities may potentially have a dual direct negative impact on air quality:

- Air Pollution from Equipment and Transportation: The use of construction equipment and the transportation of materials generate emissions, contributing to air pollution. This includes the release of exhaust gases such as carbon monoxide, nitrogen oxides, and particulate matter, which can deteriorate local air quality.
- Fugitive Dust Emissions: Dust generated from construction areas and raw materials stored on-site or transported to the site can become airborne, creating fugitive dust. This dust can affect the health of construction workers and the resident population, causing respiratory issues and other health problems. Additionally, it can settle on and damage local vegetation, potentially disrupting the ecosystem.

Recommended Mitigation

i. Dust Control:
   a. Areas, including roads, should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter, more windy days, this frequency should be increased.
   b. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne; this includes those being transported on trucks.
   c. Minimize cleared areas to those that are needed to be used.

   d. Ensure material stockpiles and construction debris are stored away from the roadway

ii. Equipment Emissions:
   a. Utilize construction machinery and vehicles that meet stringent emission standards.
   b. Ensure equipment is regularly maintained to operate efficiently with minimal emissions.
   c. Implement policies to reduce unnecessary idling of construction vehicles and machinery.

iii. Monitoring and Compliance:
   a. Implement a monthly air quality monitoring program to regularly assess the levels of particulate matter and other pollutants.
   b. Ensure all activities comply with local air quality regulations and standards.

iv. Worker Protection:
   a. Provide construction workers with appropriate Personal Protective Equipment (PPE), such as masks and N95 respirators, to protect against dust and emissions.

v. Community Engagement:
   a. Keep local business informed about construction activities and potential air quality impacts.
   b. Provide a contact point for concerns and complaints.

6.2.1.8 Pollution Sources

Impact

- Increased Solid Waste from Workers: Construction and site activities will generate additional solid waste, including packaging materials, food waste, and construction debris. Proper waste management protocols will be necessary to prevent littering and contamination of nearby water bodies. See section 6.3.4.5 for further detail.
- Reduced Nutrient Inputs from Agriculture and Farm Animals: With the removal of agricultural activities and farm animals from the property, nutrient runoff from fertilizers and animal waste will decrease, leading to lower nitrogen and phosphorus inputs into adjacent water bodies. This change may result in improved water quality over time, reducing the risk of eutrophication in connected freshwater and marine systems. See section 6.2.1.3 for further detail.

Recommended Mitigation

See measures outlined under sections 6.3.4.5 and 6.2.1.3.

6.2.2 Biological

6.2.2.1 Overview of Biological Impacts and Conservation Approach

Net Gain Approach vs. No Net Loss in Ecosystem Services

The No Net Loss (NNL) approach aims to balance development impacts by ensuring that ecosystem services remain at their pre-impact levels. Under this model, any ecological damage caused by a project must be offset through mitigation measures, such as habitat restoration or conservation, to maintain the existing level of biodiversity, habitat function, and ecosystem services. While this approach prevents further degradation, it does not actively enhance or improve ecological conditions.

In contrast, the Net Gain approach goes beyond mere compensation by actively improving ecosystem services and biodiversity. Rather than simply maintaining baseline conditions, Net Gain projects seek to enhance habitat quality, restore degraded areas, and create additional ecological benefits. This strategy contributes to long-term ecosystem resilience, providing measurable environmental improvements beyond what existed before the project.

The project area demonstrates an unusual impact distribution for its size and type, with the majority of disturbances concentrated in the fields, which have been heavily modified by agricultural activities such as farming and cattle grazing. In contrast, the undisturbed habitats, including secondary forests and wetland areas, remain relatively intact, experiencing minimal impacts. This distinction highlights the unique ecological balance of the site, where human-altered landscapes dominate the affected areas, while much of natural habitats retain their functionality and biodiversity. To further preserve and enhance the ecological value of the remaining habitats, Conservation Areas are proposed. These areas not only protect critical ecosystems but also promote their enhancement through active management and potential rehabilitation efforts, ensuring long-term biodiversity and ecosystem functionality.

Terrestrial Habitat Conservation

The identified Conservation Areas (Figure 6-1) augment the "Ecological Zones" proposed as part of the project (section **Error! Reference source not found.**). It is recommended that a total of 150 hectares across five designated Conservation Areas on the property be conserved and, where necessary, rehabilitated to ensure ecological integrity. Conservation Areas 4 and 5 to the east of the site align with the proposed "Ecological Zones", while Conservation Areas 1, 2, and 3 cover the western portion of the development site.

By adopting a Net Gain approach, projects can provide broader ecological and socio-economic benefits, such as improved water quality, increased carbon sequestration, and enhanced habitat connectivity. This proactive strategy aligns with sustainability goals, ensuring that development not only minimizes harm but also leaves a lasting positive environmental legacy.

Table 6-4 Area (hectares) of terrestrial habitats within the proposed ecological Conservation Areas 1-5

Terrestrial Vegetation	**Conservation Area**					**Total (Ha)**
	1	**2**	**3**	**4**	**5**	
Secondary Forest		0.02	3.51			**3.53**
Wetland: Herbaceous Wetland		7.68		1.62		**9.30**
Wetland: Mangrove Forest	8.32	20.88	15.50	57.82		**102.52**
Wetland: Swamp Forest		8.80	0.53	13.38	11.71	**34.43**
Total	**8.32**	**37.38**	**19.54**	**72.82**	**11.71**	**149.78**

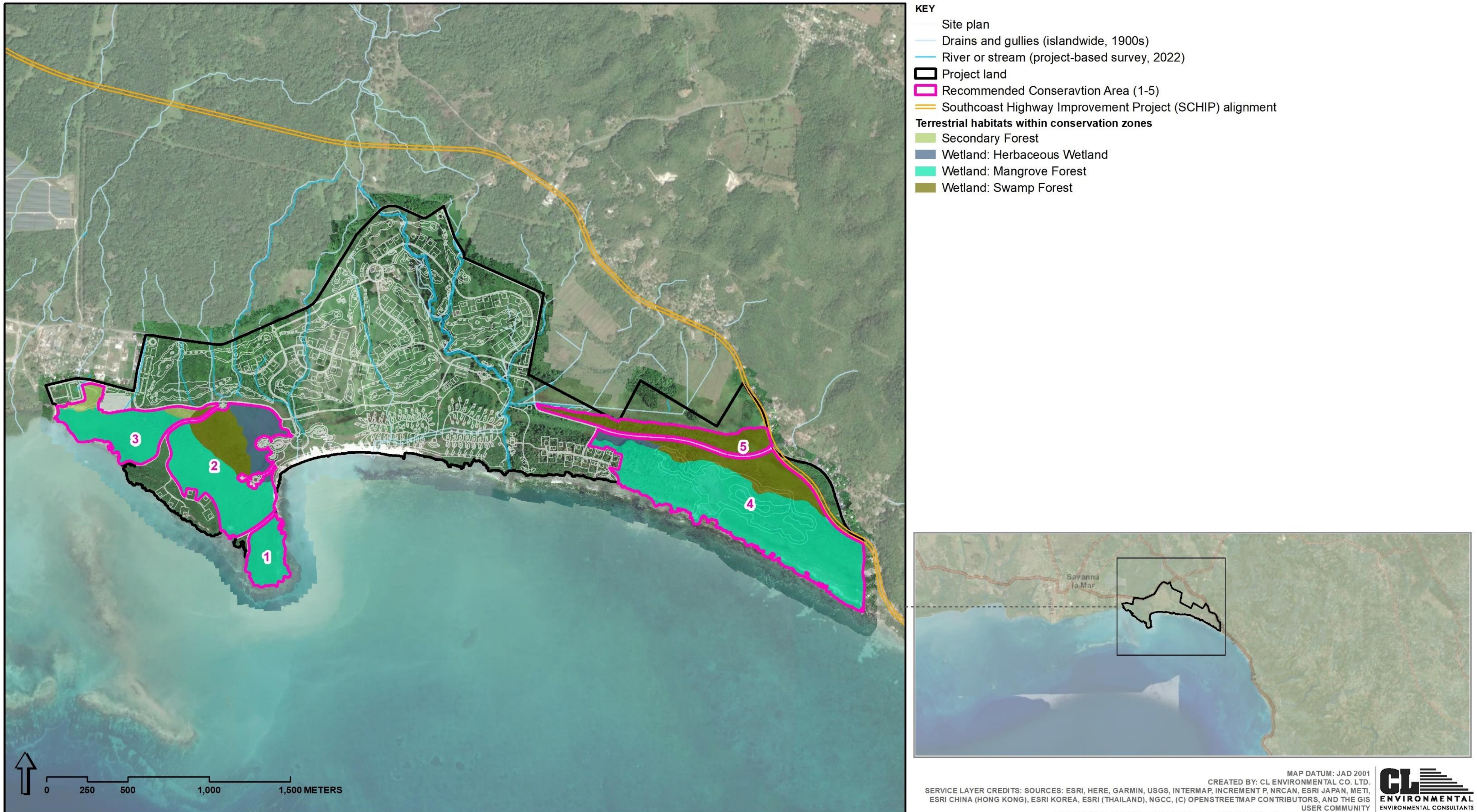


Figure 6-1 Proposed ecological Conservation Areas

Marine Habitat Conservation

Implementing a Net Gain approach in benthic environments presents unique challenges compared to terrestrial habitats. While the project will result in some loss of soft-bottom habitats, including sand and silt areas, as well as some seagrass cover (primarily nearshore *Halodule wrightii*), the broader impact on the Bluefields Bay Fish Sanctuary (BBFFS) is minimal, as the sanctuary remains a massive, well-established seagrass bed. However, a loss—no matter how small—still requires thoughtful ecological compensation.

To achieve a Net Gain, several measures are recommended to enhance habitat quality and ecological function. Beach modifications and hard structures, though typically associated with some negative impacts, will introduce much-needed habitat complexity within the sanctuary's boundaries. Currently, BBFFS lacks significant structural diversity, which limits the availability of shelter and substrate for various marine organisms. The introduction of artificial structures will provide additional ecological niches, fostering higher biodiversity by attracting reef-associated species, invertebrates, and juvenile fish populations.

Additionally, the establishment of coral nurseries are proposed to actively contribute to reef restoration. These nurseries will support coral propagation and transplantation efforts, helping to counterbalance habitat alterations by promoting reef resilience and expansion. This approach not only mitigates direct impacts but also enhances the overall ecological value of the area, ensuring that the project contributes to a net positive outcome for marine biodiversity.

By integrating these elements, the project aligns with the Net Gain framework—moving beyond simple mitigation to create lasting environmental benefits. Through habitat diversification, active restoration, and long-term monitoring, the goal is to ensure that ecological enhancements surpass the localized habitat changes, ultimately strengthening the resilience and biodiversity of BBFFS.

6.2.2.2 Terrestrial Habitats

Impact

The proposed project has the potential to negatively impact terrestrial habitats and their associated biota. In certain areas, the construction of buildings, roadways, walkways, and parking areas may result in the loss of natural habitats. Table 6-5 details the terrestrial habitats identified as potentially impacted, which includes the land-based project footprint and a 3-meter buffer. The total impacted area is 150.33 hectares, representing 33.1% of the project area (453.7 hectares) and 1.3% of the broader 6-km terrestrial study area (11,910.7 hectares). Figure 6-3 through to Figure 6-7 provide illustrations of the potentially impacted terrestrial habitats as an overview and by survey zone.

The assessment of habitat impacts across the four survey zones highlights the varying levels of potential disturbance caused by the project. It should be noted that variations in habitat quality, ecological function and sign of degradation are evident throughout the survey area.

- **Zone 1** has a baseline of 137.29 hectares, with 37.76 hectares impacted. The most potentially affected habitats in this zone include Secondary Forest (27.48 hectares, 53.5% impacted) and Wetland: Herbaceous Wetland (4.51 hectares, 29.9% impacted). The Beach habitat also shows significant disturbance, with 0.74 hectares impacted, accounting for 84.0% of its baseline.
- **Zone 2** covers 34.63 hectares, with 18.63 hectares impacted. Key impacts are observed in Wetland: Mangrove Forest (5.27 hectares, 60.7% impacted) and Fields (4.01 hectares, 40.9% impacted). Beach habitat is nearly fully impacted, with 3.26 hectares affected (95.3%).
- **Zone 3** has a baseline area of 135.56 hectares, with 11.84 hectares affected. The largest potential impact is seen in Wetland: Mangrove Forest (8.94 hectares, 11.9%), while Wetland: Swamp Forest and Fields show lower levels of impact at 2.23 hectares (6.2%) and 0.23 hectares (12.7%), respectively.
- **Zone 4** features the highest baseline area of 146.22 hectares, with 82.10 hectares potentially impacted. Fields are the most affected habitat in this zone, with 71.21 hectares impacted (59.8%). Secondary Forest is also notably impacted at 9.21 hectares (42.2%).

The fields are potentially the most altered areas within the project site (57.7%), experiencing moderate to minor changes in habitat quality and function due to their ongoing use for farming, cattle grazing, and other agricultural activities, compared to the secondary forests and wetland areas, which are less extensively impacted and retain higher ecological integrity (Figure 6-2). Approximately 4.01 hectares (93.0%) of beach area will undergo modification; however, unlike other habitats, it is expected to become larger and potentially more stable as a result of the planned beach works. Unlike other habitats in the study area, where some level of ecological loss occurs, the beach modifications represent a net gain in terms of beach extent and functionality. This expanded shoreline will enhance coastal resilience, provide increased recreational space, and improve overall beach stability. The modifications are designed to maintain or enhance ecological functions where possible while achieving a larger, more sustainable beach system.

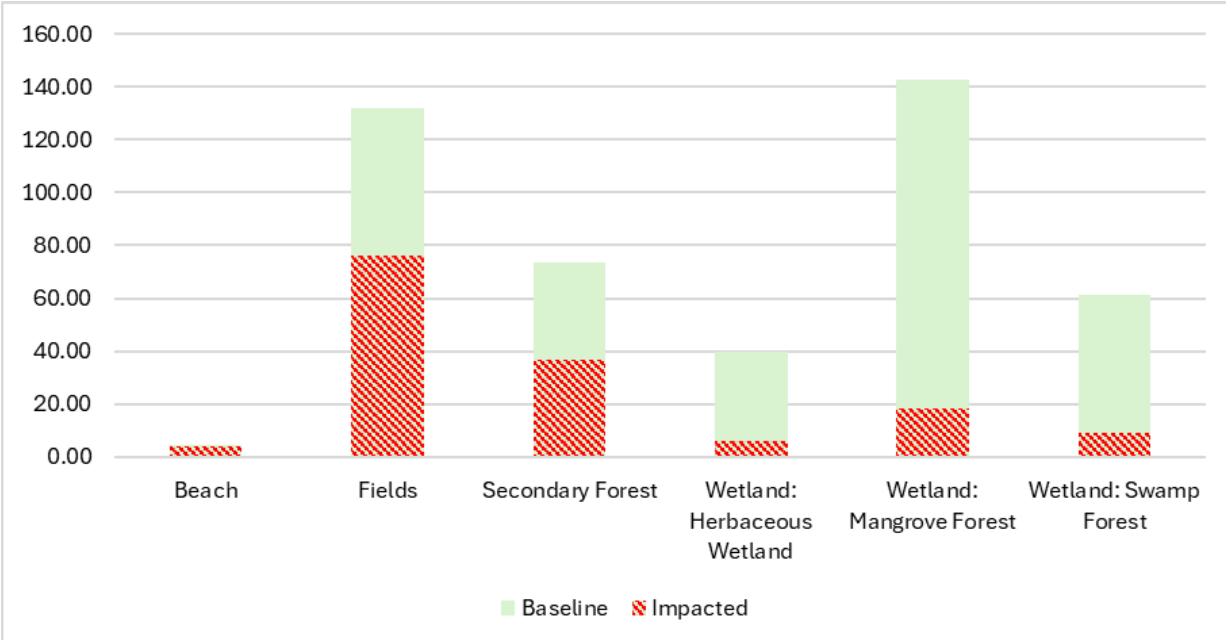


Figure 6-2 Bar chart showing area (hectares) of potentially impacted terrestrial habitats

In addition to loss of habitat within the development footprint, a reduction in habitat quality and ecological processes and habitat fragmentation are other potential impacts. Further details of the potentially impacted sensitive species (flora and fauna) and habitats (wetlands, mangroves, and freshwater) are given in subsequent sections.

Table 6-5 Potentially impacted terrestrial habitats within the project footprint and buffer

	ZONE 1			ZONE 2			ZONE 3			ZONE 4			Total		
Habitat	**Baseline**	**Impacted**	**% Impacted**	**Baseline**	**Impacted**	**% Impacted**	**Baseline**	**Impacted**	**% Impacted**	**Baseline**	**Impacted**	**% Impacted**	**Baseline**	**Impacted**	**% Impacted**
Beach	0.89	0.74	84.0%	3.42	3.26	95.3%	0.00	0.00		0.00	0.00		4.31	4.01	93.0%
Fields	1.18	0.69	58.0%	9.80	4.01	40.9%	1.85	0.23	12.7%	119.11	71.21	59.8%	131.94	76.14	57.7%
Secondary Forest	51.34	27.48	53.5%	0.09	0.06	64.6%	0.60	0.06	9.6%	21.79	9.21	42.2%	73.82	36.80	49.9%
Wetland: Herbaceous Wetland	15.07	4.51	29.9%	2.12	0.92	43.3%	22.16	0.37	1.7%	0.44	0.23	51.3%	39.80	6.03	15.1%
Wetland: Mangrove Forest	58.82	4.00	6.8%	8.67	5.27	60.7%	75.12	8.94	11.9%	0.00	0.00		142.61	18.21	12.8%
Wetland: Swamp Forest	9.99	0.35	3.5%	10.53	5.11	48.5%	35.83	2.23	6.2%	4.88	1.46	29.9%	61.23	9.15	14.9%
Total	**137.29**	**37.76**		**34.63**	**18.63**		**135.56**	**11.84**		**146.22**	**82.10**		**453.71**	**150.33**	

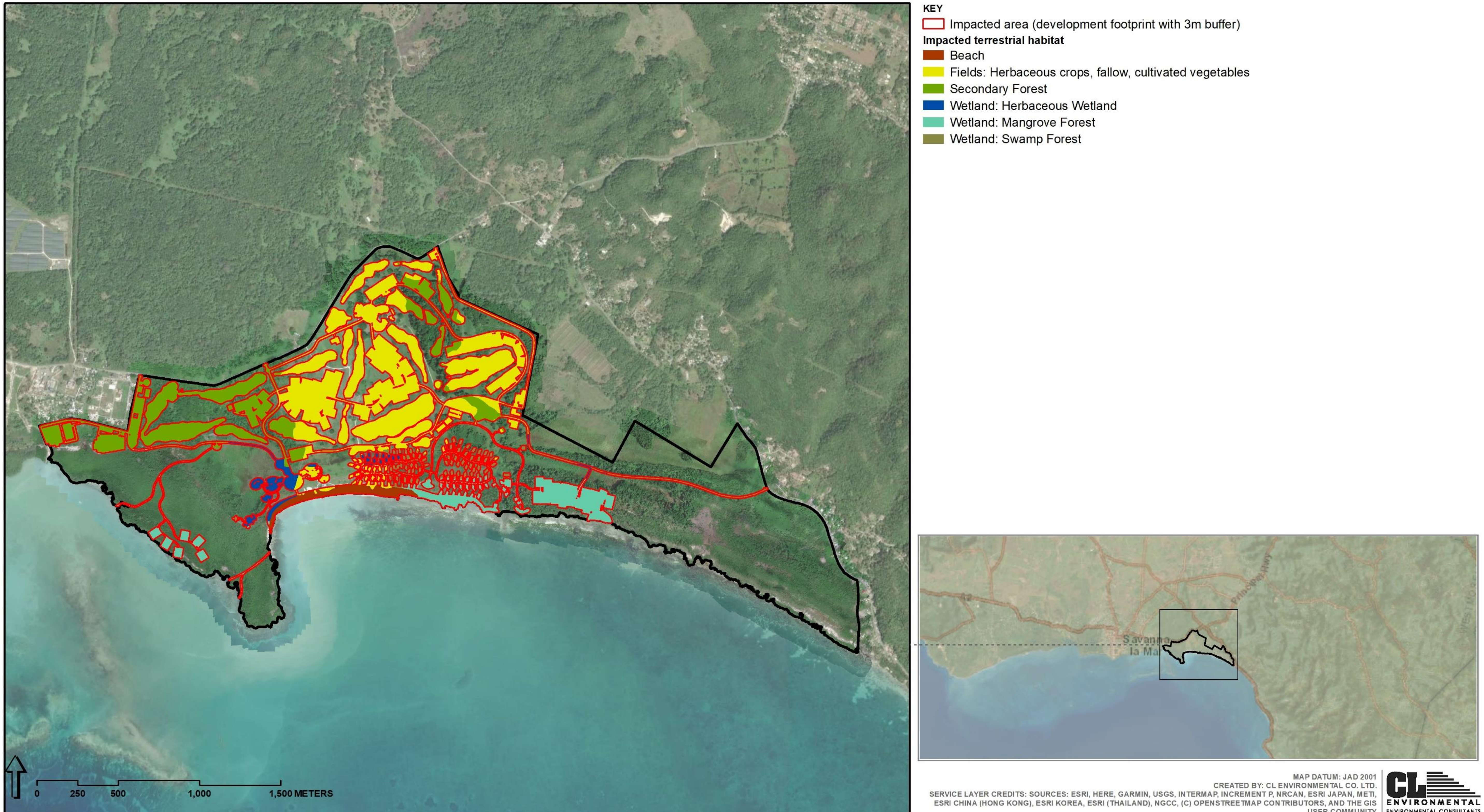


Figure 6-3 Overview of potentially impacted terrestrial habitats on the project land

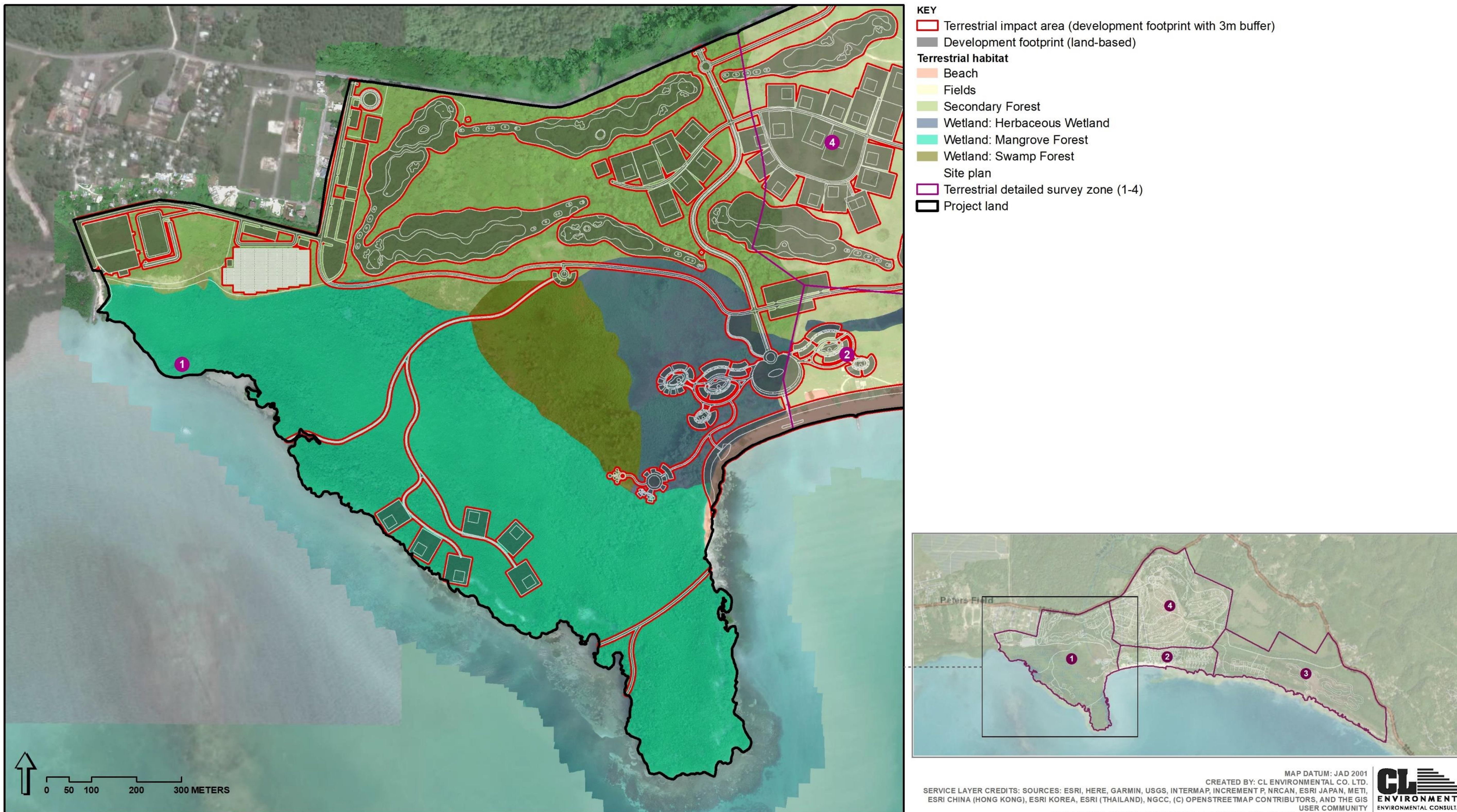


Figure 6-4 Potentially impacted terrestrial habitats, Zone 1

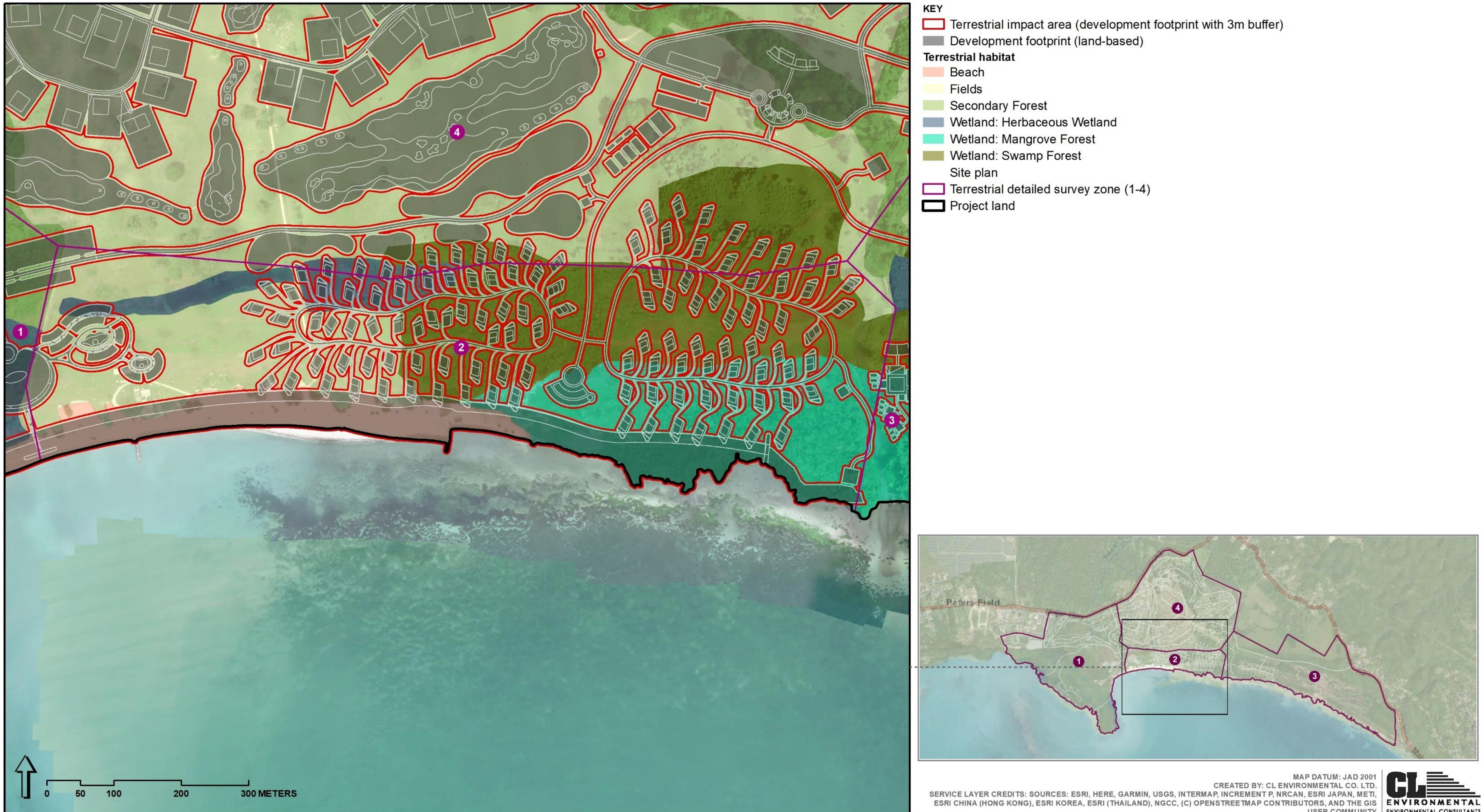


Figure 6-5 Potentially impacted terrestrial habitats, Zone 2

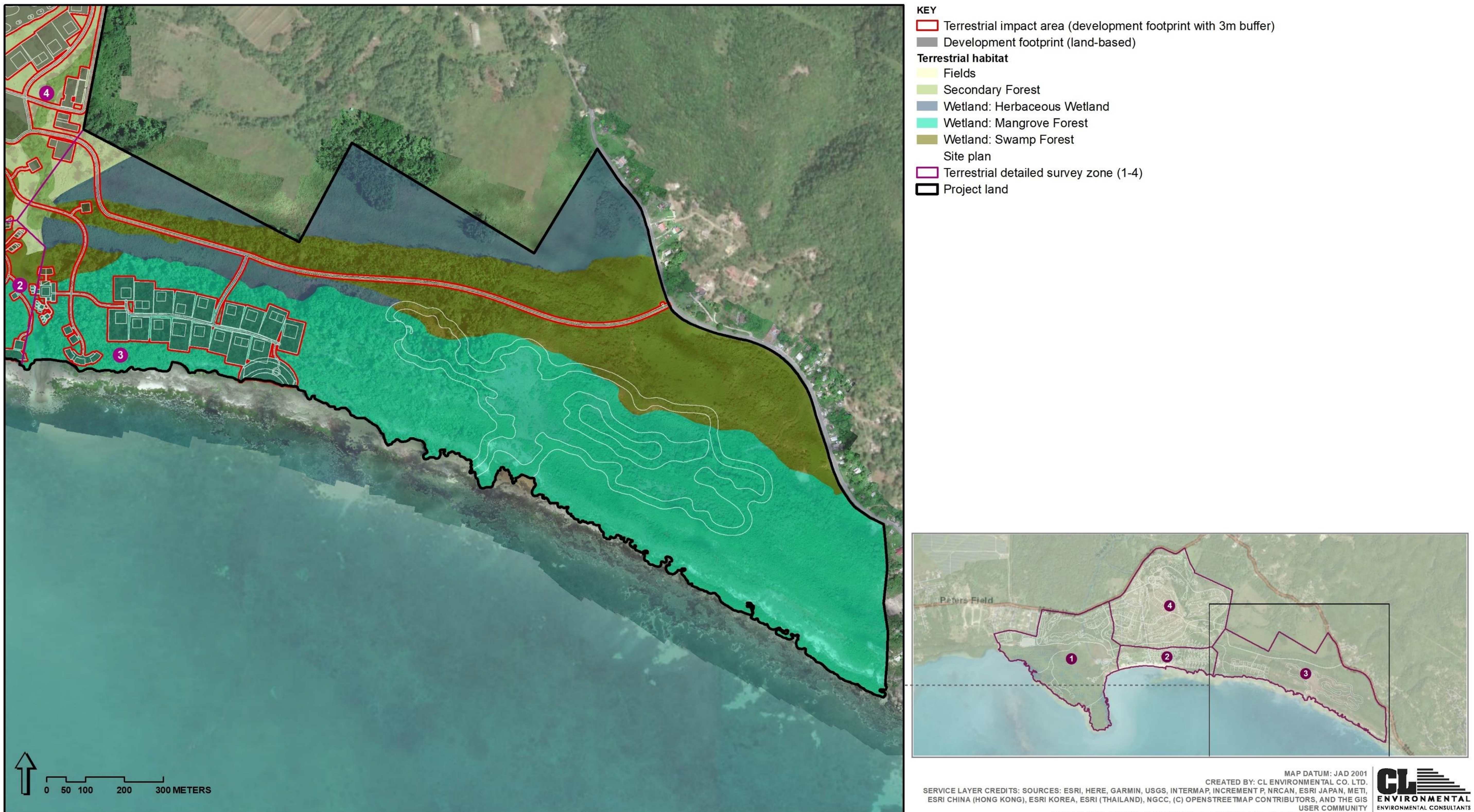


Figure 6-6 Potentially impacted terrestrial habitats, Zone 3

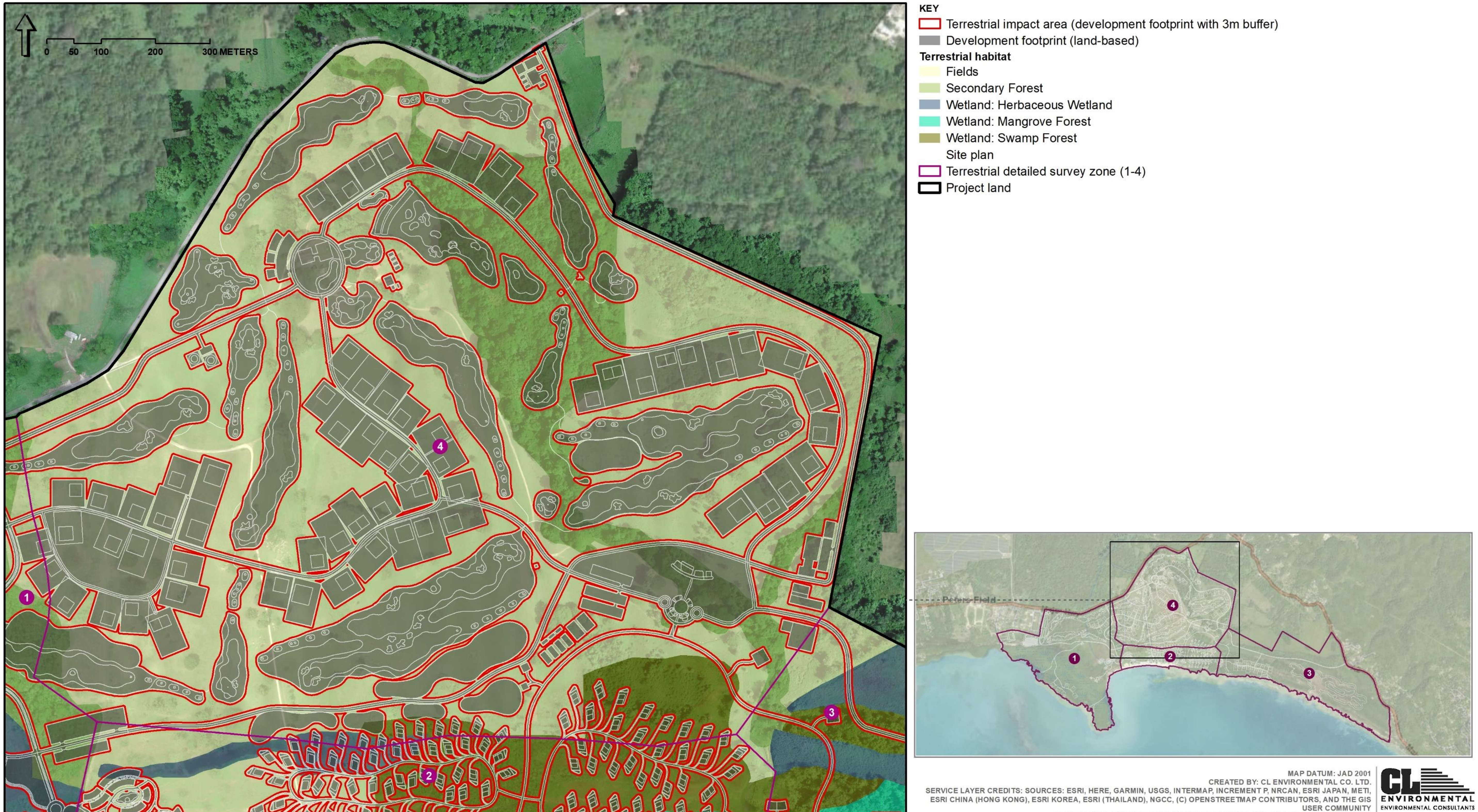


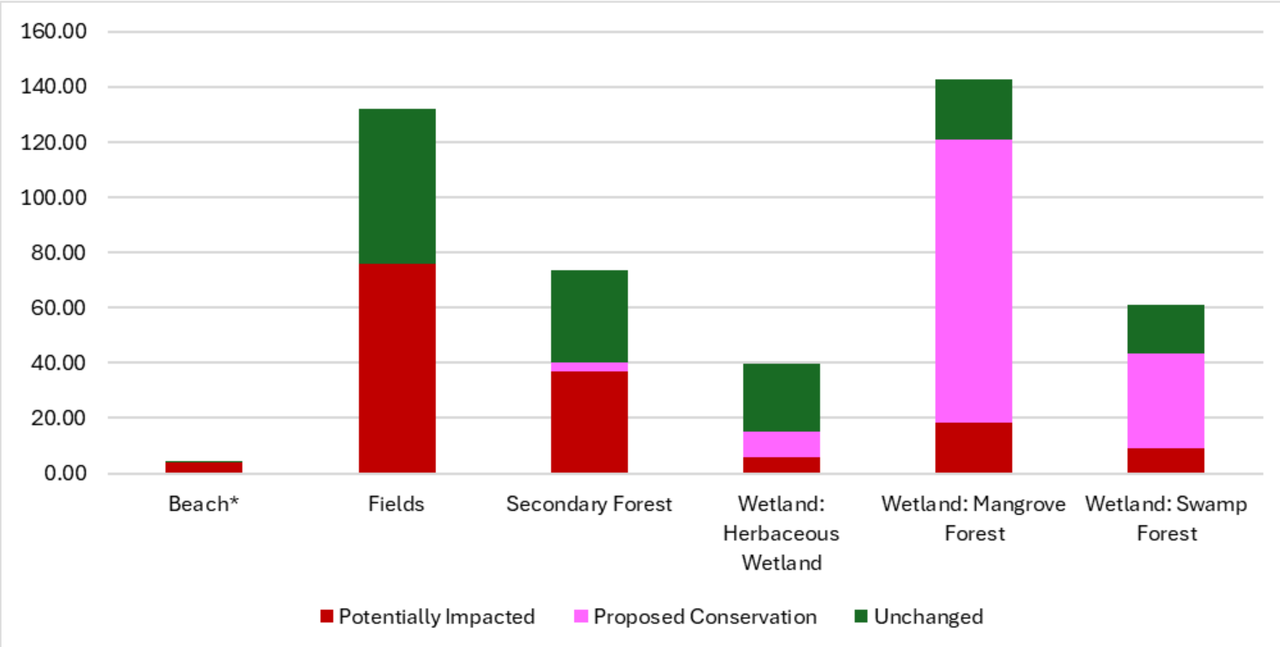
Figure 6-7 Potentially impacted terrestrial habitats, Zone 4

Recommended Mitigation

To mitigate the potential negative impacts of habitat loss and fragmentation caused by the proposed development, a range of strategies can be implemented.

i. Efficient space utilization and the integration of green corridors within the development can significantly reduce fragmentation by maintaining permanent connections between green spaces throughout the area. This approach supports the movement of wildlife and ensures habitat connectivity, which is essential for maintaining biodiversity.
ii. Establishing buffer zones around ecologically important areas, such as wetlands or forested regions, will help protect these habitats from the direct impacts of construction. These zones will reduce edge effects and provide transitional areas for species to migrate or find refuge.
iii. The recommended Conservation Areas (Figure 6-1), which are currently unmanaged, will be brought under active management to limit access and activities, reduce degradation, and implement rehabilitation actions where necessary, ensuring the protection and enhancement of these critical habitats. These Conservation Areas consist mainly of wetland habitat, covering 146.25 hectares (97.6% of the total conserved area), with a smaller portion of secondary forest, totalling 3.53 hectares (2.3% of the total conserved area) (Table 6-6 and Figure 6-8). Furthermore, the majority of the mangrove forest and swamp forest areas on the site are recommended for conservation, with 71.9% and 56.2% designated, respectively, while the impacted areas are smaller, at 12.8% and 14.9%, respectively.

Further detailed mitigation measures specific to key terrestrial flora and fauna species, as well as critical habitats, are provided in subsequent sections. Together, these strategies collectively aim to minimize the environmental impact of the development, while promoting biodiversity and preserving essential ecosystem services.



** Unchanged denotes the areas outside the impact area and those areas proposed for conservation.*

Figure 6-8 Bar chart showing area (hectares) of terrestrial habitats considered potentially impacted, proposed for conservation and unchanged.

Table 6-6 Areas (hectares) and percentages of terrestrial habitat mapped as baseline, considered potentially impacted, proposed for conservation and unchanged.

**Unchanged denotes the areas outside the impact area and those areas proposed for conservation.*

Terrestrial Habitat	Baseline	Potentially Impacted	% of Baseline	Proposed for Conservation	% of Baseline	Unchanged*	% of Baseline
Beach	4.31	4.01	93.0%		0.0%	0.30	7.0%
Fields	131.94	76.14	57.7%		0.0%	55.80	42.3%
Secondary Forest	73.82	36.80	49.9%	3.53	4.8%	33.49	45.4%
Wetland: Herbaceous Wetland	39.80	6.03	15.1%	9.30	23.4%	24.47	61.5%
Wetland: Mangrove Forest	142.61	18.21	12.8%	102.52	71.9%	21.88	15.3%
Wetland: Swamp Forest	61.23	9.15	14.9%	34.43	56.2%	17.65	28.8%
Total	**453.71**	**150.33**	**33.1%**	**149.78**	**33.0%**	**153.60**	**33.9%**

6.2.2.3 Terrestrial Flora

Impact

The proposed development may impact survey zones 1-4 and vary depending on the specific activities and development plans for each zone. In certain areas, the development may result in the removal of flora due to the space required for different components of the project. Site clearance and construction activities may also increase dust levels, potentially affecting the flora within and around the development area. Furthermore, the scale of the development could lead to potential solid waste pollution within the site and surrounding regions.

The loss of species within the affected habitats will result in the removal of their intrinsic ecological value, potentially limiting future uses of these species. Key species and habitats may be impacted, which could also affect the ecosystem services currently provided by these ecosystems.

SPECIES

The delineated impact area contains a total of 1,185 mapped trees, representing 43 different species across the four surveyed zones (Table 6-7, Figure 6-9 to Figure 6-12). *Samanea saman* has the highest total of 338 trees, with the majority in Zone 1 (234) and Zone 4 (100). *Sabal maritima* follows with 88 trees, predominantly in Zone 2 (71). *Roystonea princeps*, with a total of 79 trees (GPS mapped)[2], is most abundant in Zone 1 (53). *Bucida buceras* has a notable presence across all zones, with the highest count in Zone 2 (61), totalling 76 trees. *Cedrela odorata* is mostly concentrated in Zone 4 (67), with a total of 71, and *Ceiba pentandra*, present across Zones 1, 3, and 4, has a total of 31 trees. *Piscidia piscipula* is spread across Zones 1, 2, and 4, with a total of 36 trees. Many species such as *Artocarpus altilis*, *Ficus benjamina*, *Ficus maxima*, and *Spathodea campanulata* have lower counts in a few zones.

[2] This figure only includes trees mapped in the field using GPS. Additional trees were mapped from imagery, bringing the total number of *Roystonea princeps* to 368.

Table 6-7 Potentially impacted tree species by zone

Tree specie	Zone 1	Zone 2	Zone 3	Zone 4	Total
Acacia auriculiformis				1	1
Acacia sp.				3	3
Albizzia lebbeck				1	1
Artocarpus altilis	1			1	2
Avicennia germinans	3				3
Blighia sapida				2	2
Bucida buceras	12	61	1	2	76
Callistemon sp.				2	2
Cassia fistula				2	2
Casuarina equisetifolia				2	2
Catalpa longissima				2	2
Cecropia peltata	11			4	15
Cedrela odorata	4			67	71
Ceiba pentandra	16	1		14	31
Chlorophora tinctoria				1	1
Coccoloba uvifera	1	22			23
Conocarpus erectus	2	17			19
Cordia collococca	3			4	7
Dead tree		1			1
Delonix regia				9	9
Enterolobium cyclocarpum	6			10	16
Fagara elephantiasis	2			3	5
Fagara martinicensis	2			3	5
Ficus benjamina	2			4	6
Ficus maxima	2			4	6
Ficus sp.	1			6	7
Gliricidia sepium	2			33	35
Guazuma ulmifolia	37			14	51
Haematoxylon campechianum	4	3		6	13
Hibiscus elatus	3			1	4
Laguncularia racemosa	5	6			11
Mangifera indica				4	4
Metopium brownii		12			12
Nectandra antilliana	1			4	5
Nectandra hihua				6	6
Nectandra sp.	2			2	4
Other specie		9	1		10
Pimenta dioica				4	4
Piscidia piscipula	5	15		16	36
Roystonea princeps	53	3	10	13	79
Roystonea regia	2	2		35	39
Sabal maritima	8	71		9	88
Samanea saman	234	4		100	338
Spathodea campanulata	25			29	54
Unknown tree specie	1				1
Spondias mombin				6	6
Syzygium cumini	8				8
Tabebuia angustata	5				5
Tabebuia riparia		3		2	5
Tabebuia rosea		20		14	34
Tabebuia sp.				3	3
Terminalia catappa	1	1			2
Thespedia populnea		8			8
Zanthoxylum martinicensis	1			1	2
Total	**465**	**259**	**12**	**449**	**1185**

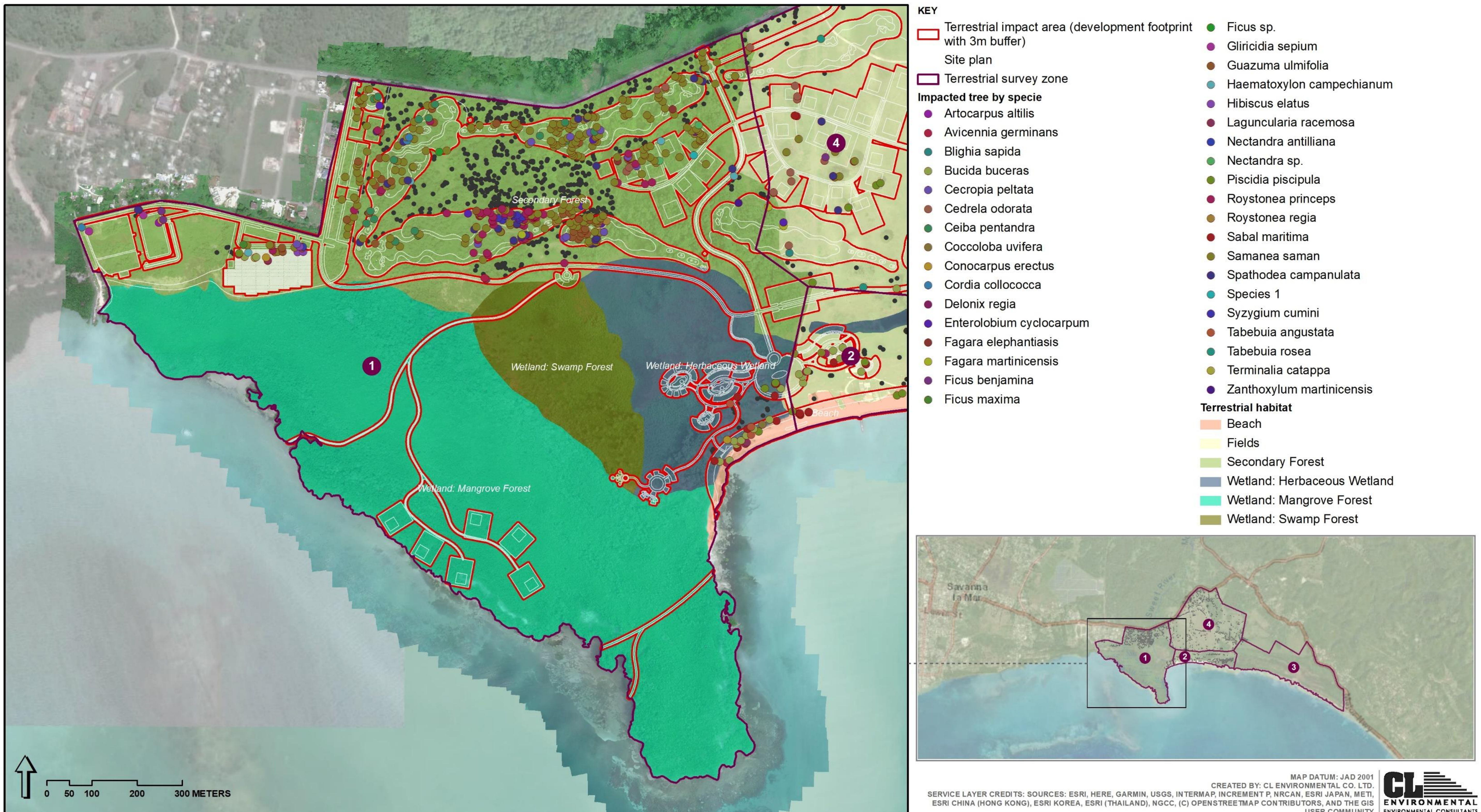


Figure 6-9 Impacted trees by specie, Zone 1

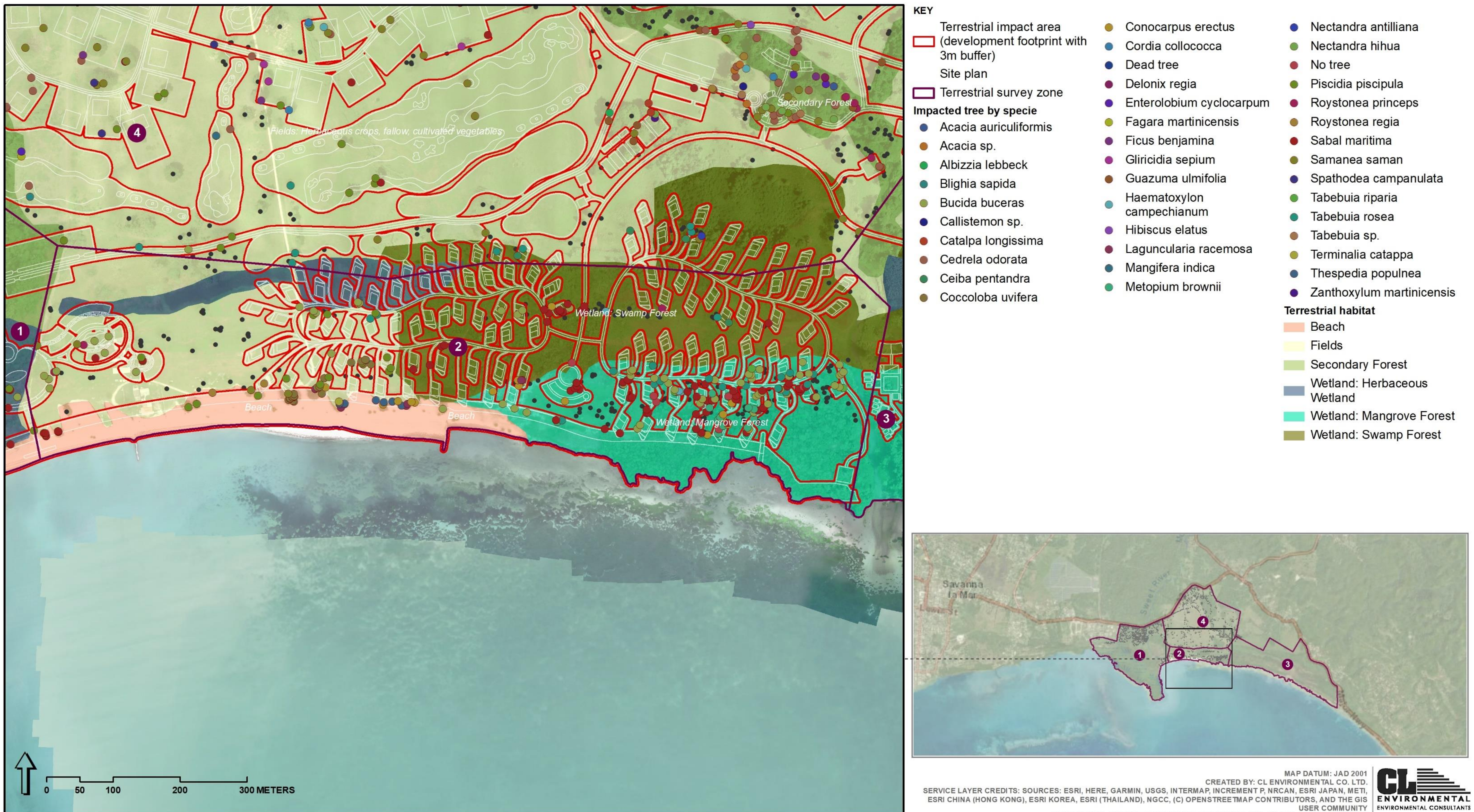


Figure 6-10 Impacted trees by specie, Zone 2

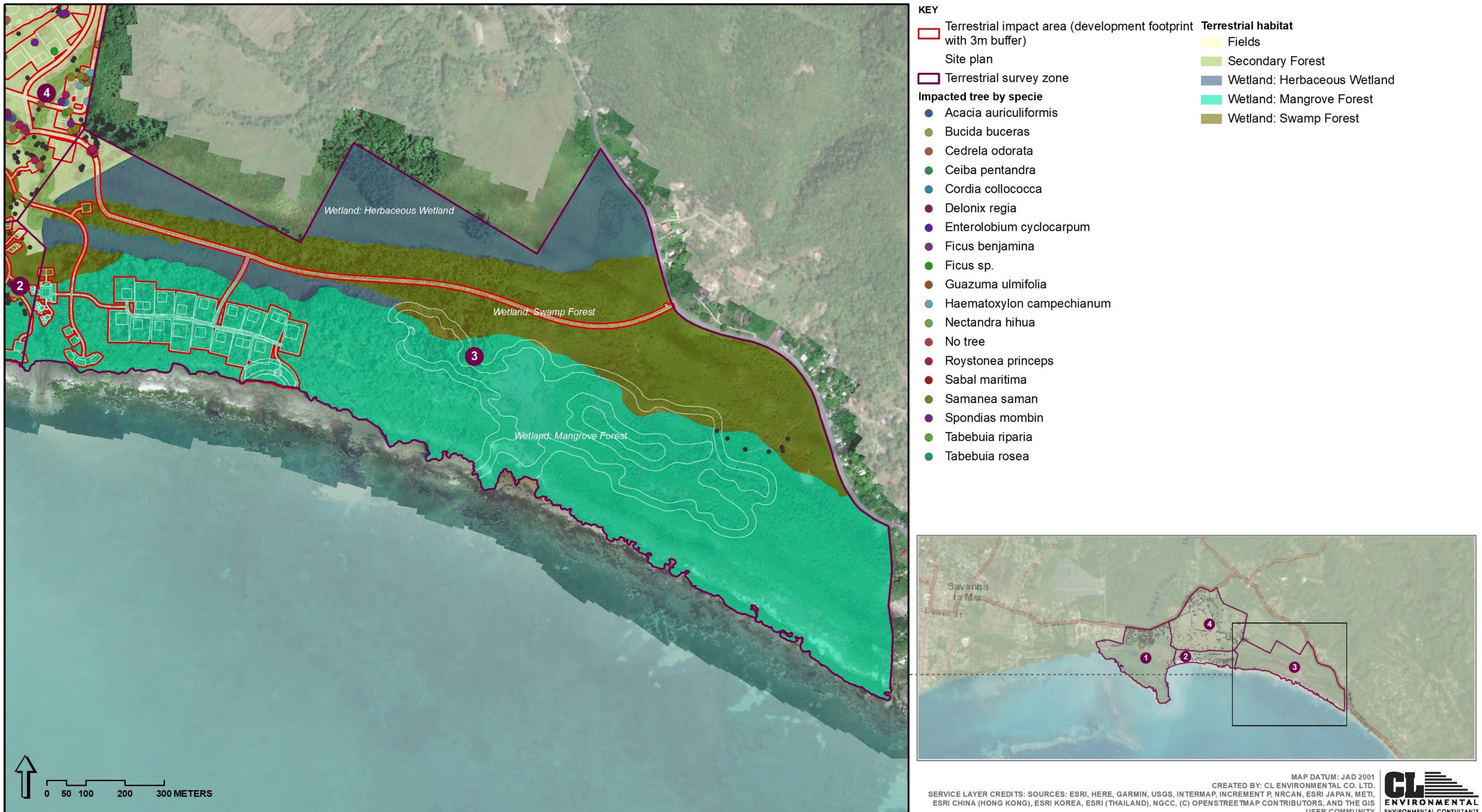


Figure 6-11 Impacted trees by specie, Zone 3

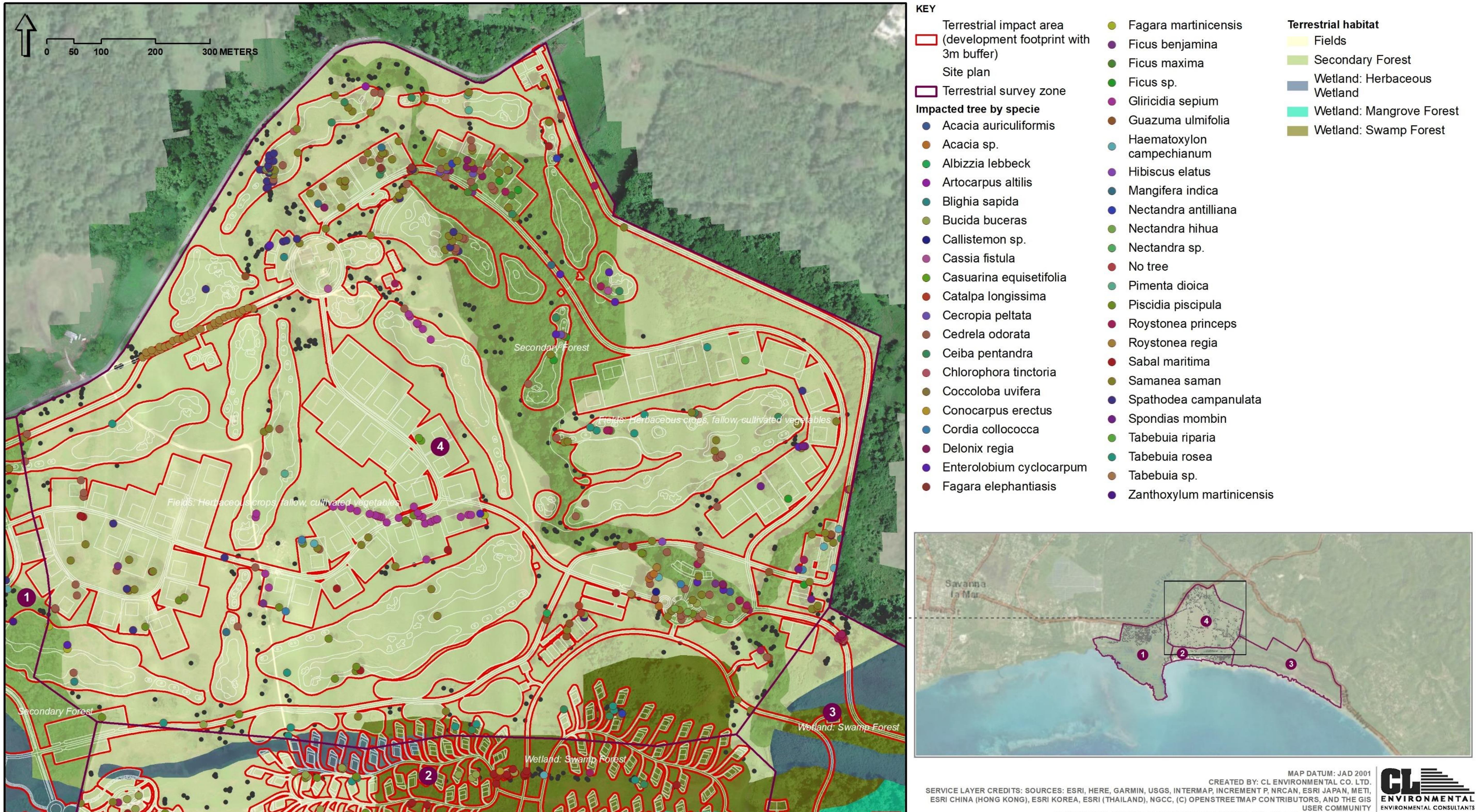


Figure 6-12 Impacted trees by specie, Zone 4

DBH

The largest impacted species include *Ceiba pentandra* (498.3 cm in Zone 4 and 239.7 cm in Zone 1), *Cedrela odorata* (240 cm in Zone 4), and *Samanea saman* (219.4 cm in Zone 4) (Table 6-8,Figure 6-13 through to Figure 6-16).

Table 6-8 Maximum measure DBH (cm) of potentially impacted trees by zone

Specie	Zone 1	Zone 2	Zone 3	Zone 4	Maximum DBH
Acacia auriculiformis				64.3	64.3
Acacia sp.				122	122
Albizzia lebbeck				88.3	88.3
Artocarpus altilis	31.3			42.8	42.8
Avicennia germinans	59.2				59.2
Blighia sapida				70	70
Bucida buceras	96.5	128	35.6	112	128
Callistemon sp.				38	38
Cassia fistula				45.6	45.6
Casuarina equisetifolia				65.3	65.3
Catalpa longissima				78	78
Cecropia peltata	51			52.9	52.9
Cedrela odorata	59.2			240	240
Ceiba pentandra	239.7	82.4		498.3	498.3
Chlorophora tinctoria				36.7	36.7
Coccoloba uvifera	33.5	105			105
Conocarpus erectus	113	86.5			113
Cordia collococca	35.7			82.1	82.1
Dead tree		99			99
Delonix regia				137.6	137.6
Enterolobium cyclocarpum	99.4			143	143
Fagara elephantiasis	42.7			41.8	42.7
Fagara martinicensis	36			84	84
Ficus benjamina	45.7			200	200
Ficus maxima	127.9			154.9	154.9
Ficus sp.	43.5			208.3	208.3
Gliricidia sepium	52.8			95.3	95.3
Guazuma ulmifolia	57.3			66.3	66.3
Haematoxylon campechianum	50	43.6		136	136
Hibiscus elatus	33.9			32.7	33.9
Laguncularia racemosa	144	65			144
Mangifera indica				196.5	196.5
Metopium brownii		54.6			54.6
Nectandra antilliana	31.5			81.3	81.3
Nectandra hihua				64	64
Nectandra sp.	34.5			39.5	39.5
Pimenta dioica				40.7	40.7
Piscidia piscipula	68.3	103		110	110
Roystonea princeps	40.8	35.6	40.9	47.2	47.2
Roystonea regia	37.7	47.5		60	60
Sabal maritima	53	60		68	68
Samanea saman	125.7	78.5		219.4	219.4

Specie	Zone 1	Zone 2	Zone 3	Zone 4	Maximum DBH
Spathodea campanulata	94			118.3	118.3
Species 1	54				54
Spondias mombin				137.4	137.4
Syzygium cumini	45				45
Tabebuia angustata	65				65
Tabebuia riparia		59.4		42.5	59.4
Tabebuia rosea		75.5		114.3	114.3
Tabebuia sp.				147	147
Terminalia catappa	52.9	38			52.9
Thespedia populnea		65			65
Zanthoxylum martinicensis	52.5			35	52.5
Maximum DBH	**239.7**	**128**	**40.9**	**498.3**	

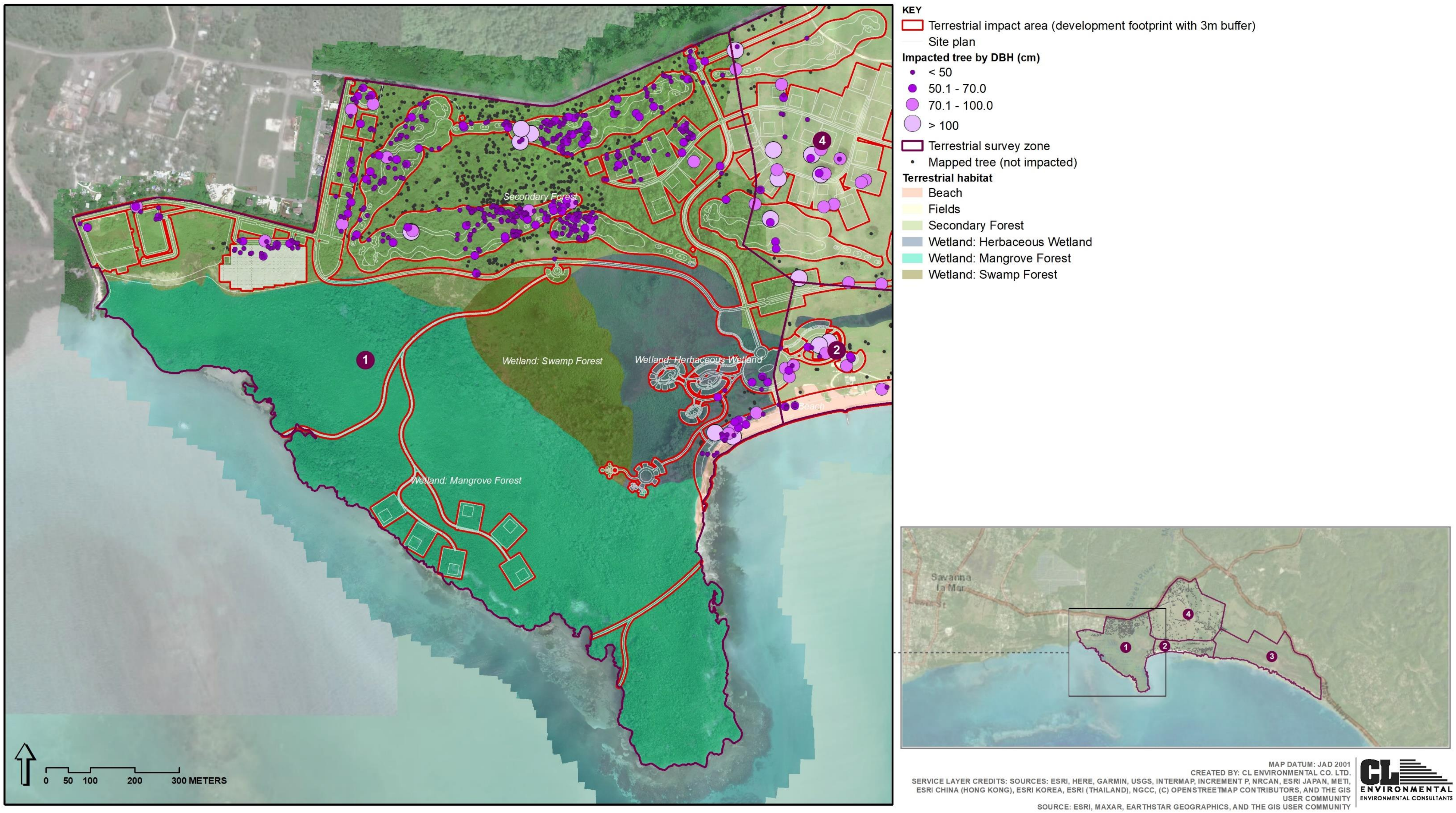


Figure 6-13 Impacted trees showing DBH, Zone 1

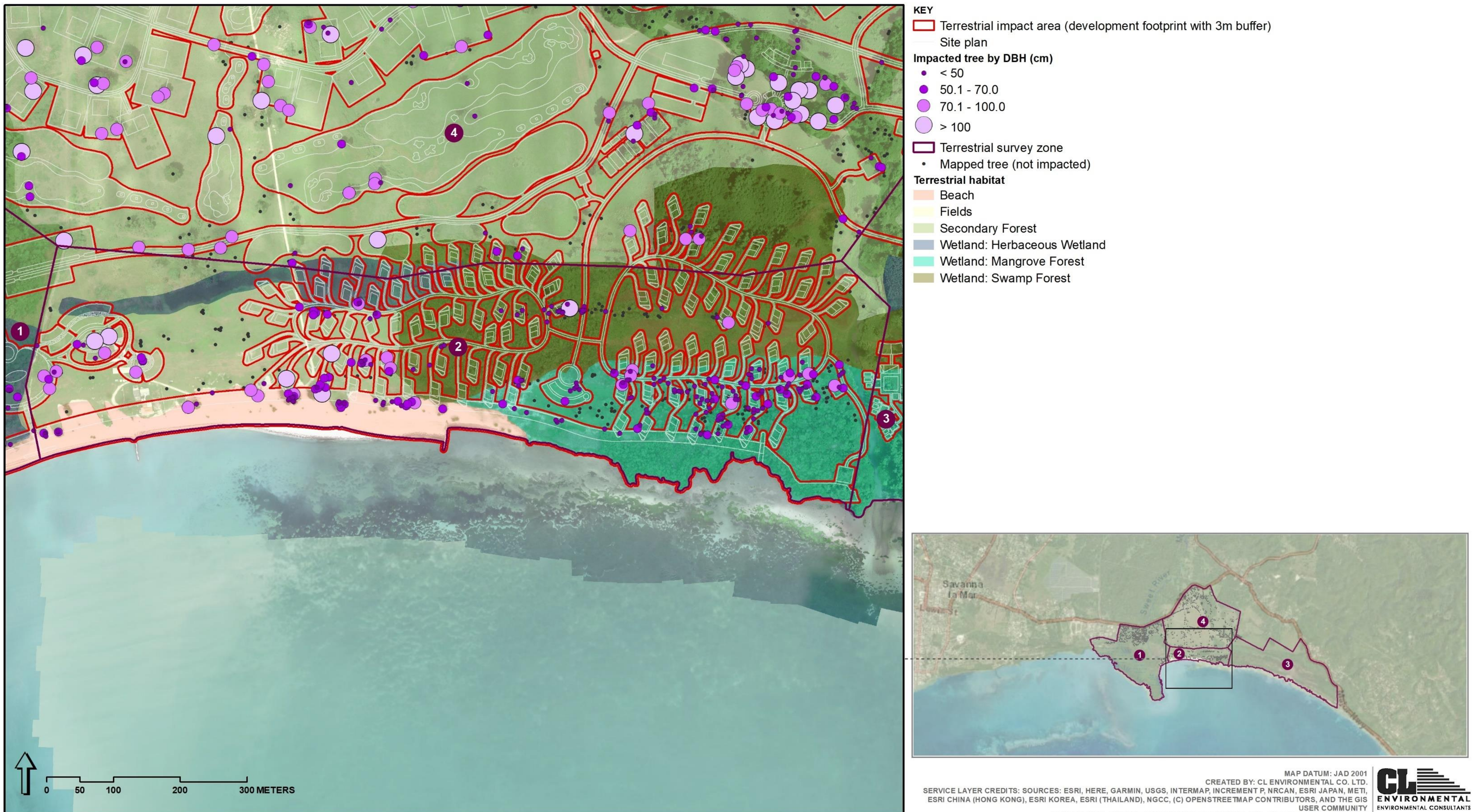


Figure 6-14 Impacted trees showing DBH, Zone 2

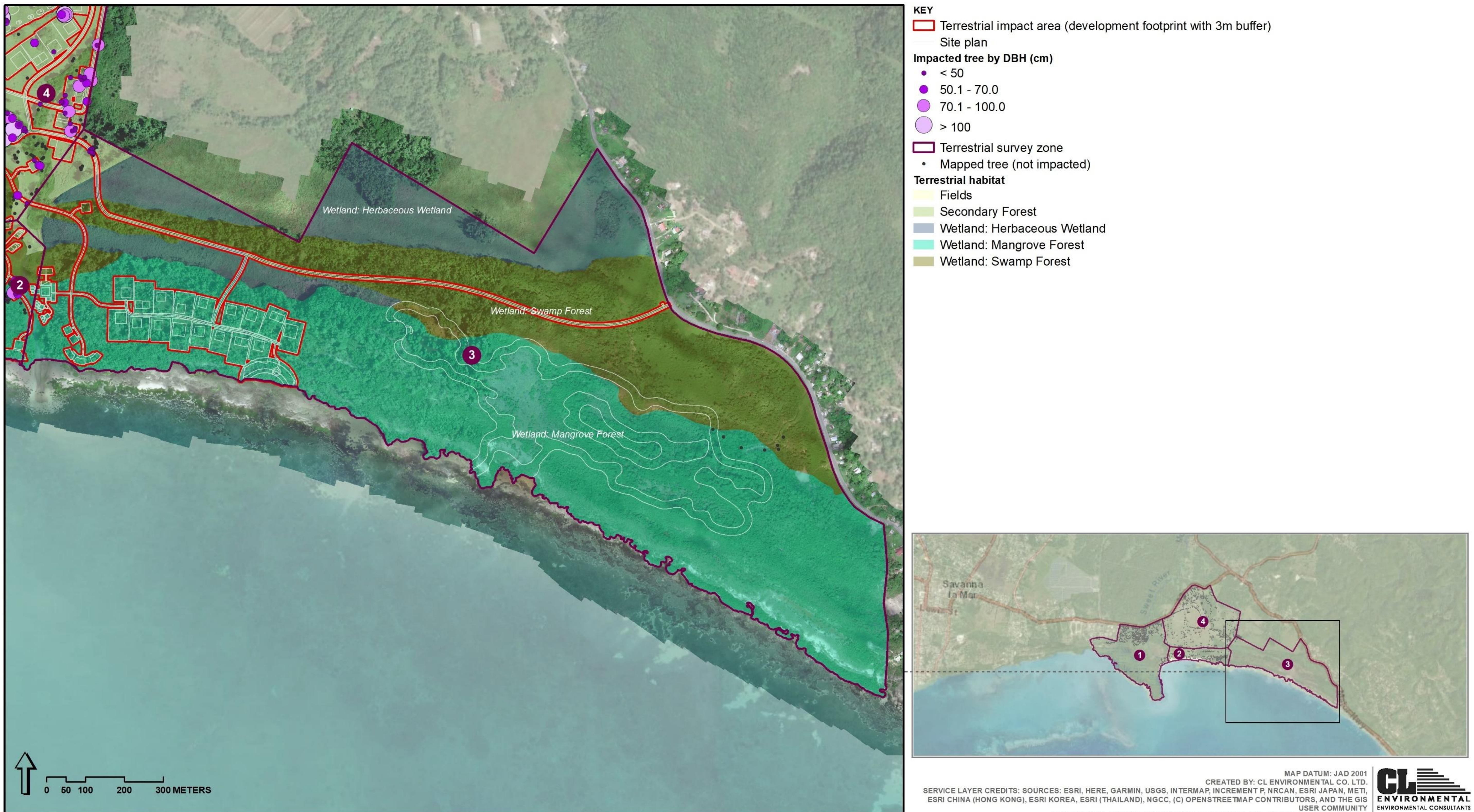


Figure 6-15 Impacted trees showing DBH, Zone 3

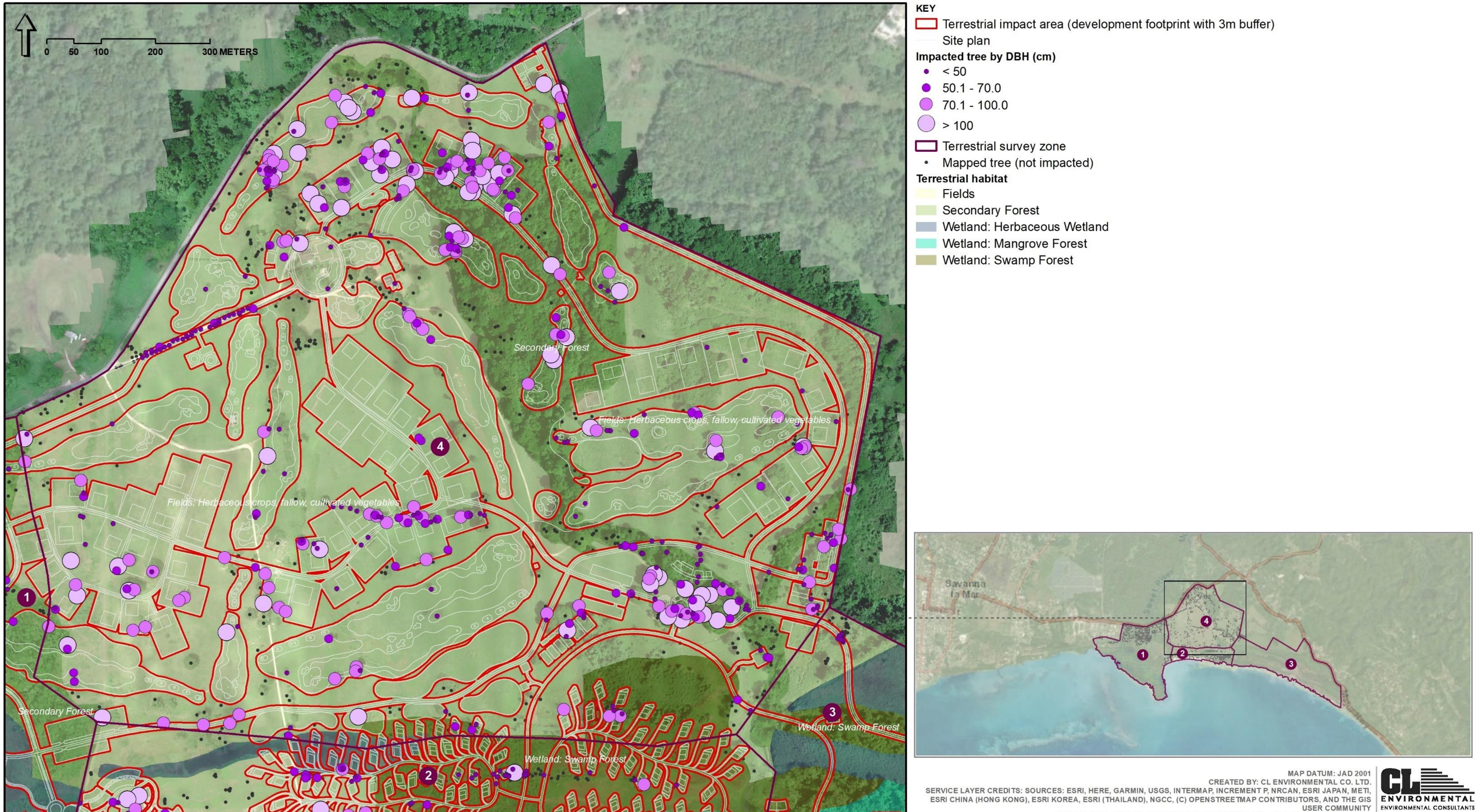


Figure 6-16 Impacted trees showing DBH, Zone 4

CONSERVATION STATUS

As shown in Table 6-11, exotic tree species are the most abundant, with 576 individuals, primarily concentrated in Zone 1 (285) and Zone 4 (261). Native species account for 501 trees, most of which are found in Zone 2 (216) and Zone 4 (161). Of particular significance are the 79 endemic trees classified as IUCN near-threatened, with 53 located in Zone 1. It is important to note, however, that these endemic species are not exclusive to this area and are not considered rare. *Roystonea princeps*, an endemic species, was mapped using GPS and supplemented by digitization from imagery, establishing a baseline total of 1,587 recorded individuals. Of this combined total, 368, or 2.2%, are considered potentially impacted and the majority of these are found in swamp and other wetland habitats within Zone 3 (Figure 6-26). The loss of species such as *Roystonea princeps* from the swamp forests may influence other species, alter the local microclimate, and potentially impact soil quality, which in turn could affect the overall quality of the habitat and the associated ecosystem services. These services include:

- Regulating services: Climate regulation and water filtration, including pollution control.
- Supporting services: Habitat for various species and carbon sequestration.
- Provisioning services: Generation of pharmaceutical resources, charcoal, and lumber.
- Cultural services: Opportunities for recreation, tourism, education, and aesthetic or cultural value.

Table 6-9 Conservation status of potentially impacted trees by zone

Status *IUCN Category*	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Total**
Endemic	**53**	**3**	**10**	**13**	**79**
Near threatened	*53*	*3*	*10*	*13*	*79*
Exotic	**285**	**30**		**261**	**576**
Unknown				*2*	*2*
Data deficient				*4*	*4*
Least concern	*284*	*30*		*254*	*568*
Not listed	*1*			*1*	*2*
Native	**123**	**216**	**1**	**161**	**501**
Least concern	*94*	*84*		*81*	*259*
Not listed	*25*	*132*	*1*	*13*	*171*
Vulnerable	*4*			*67*	*71*
Unknown	*4*	*10*	*1*	*14*	*29*
Total	**465**	**259**	**12**	**449**	**1185**

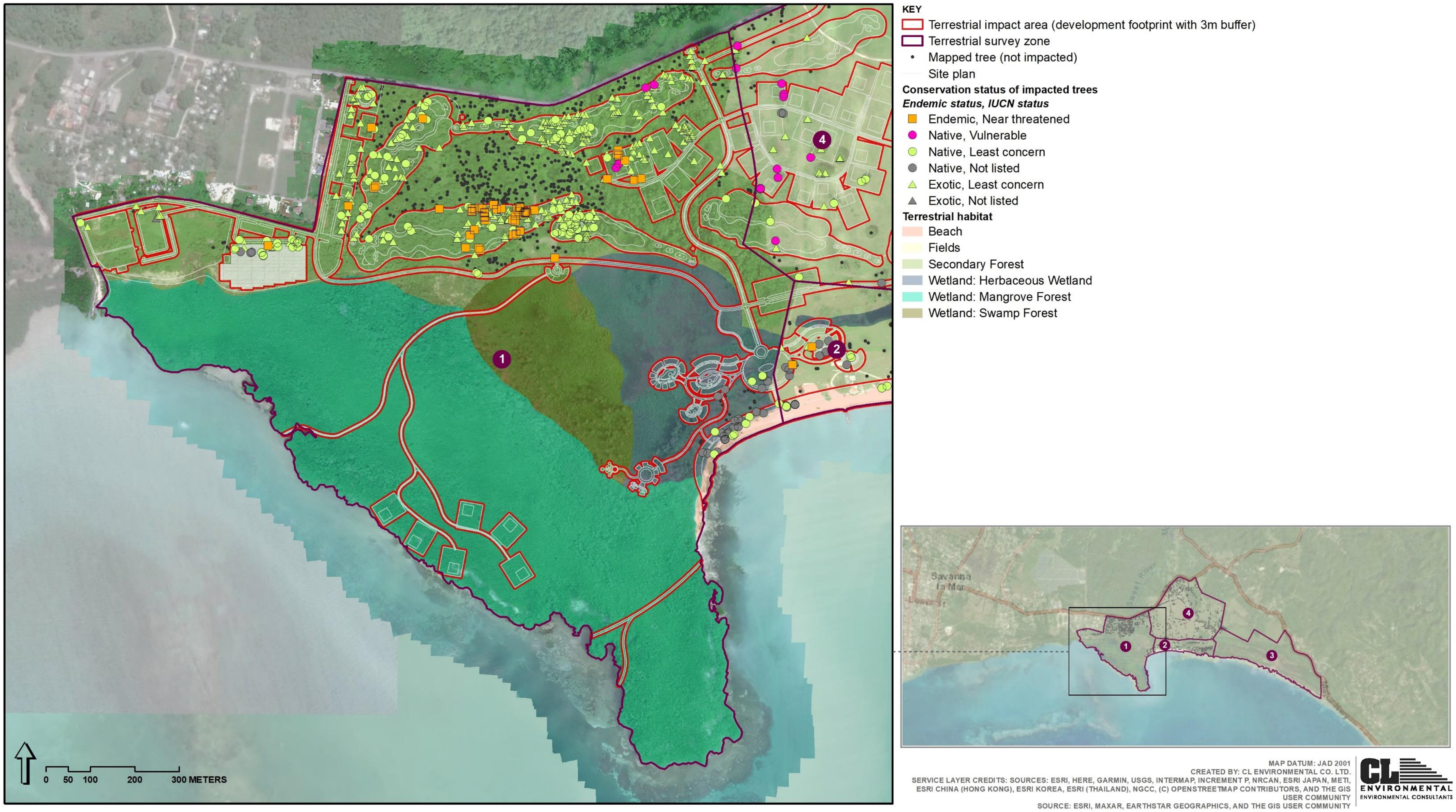


Figure 6-17 Conservation status of impacted trees, Zone 1

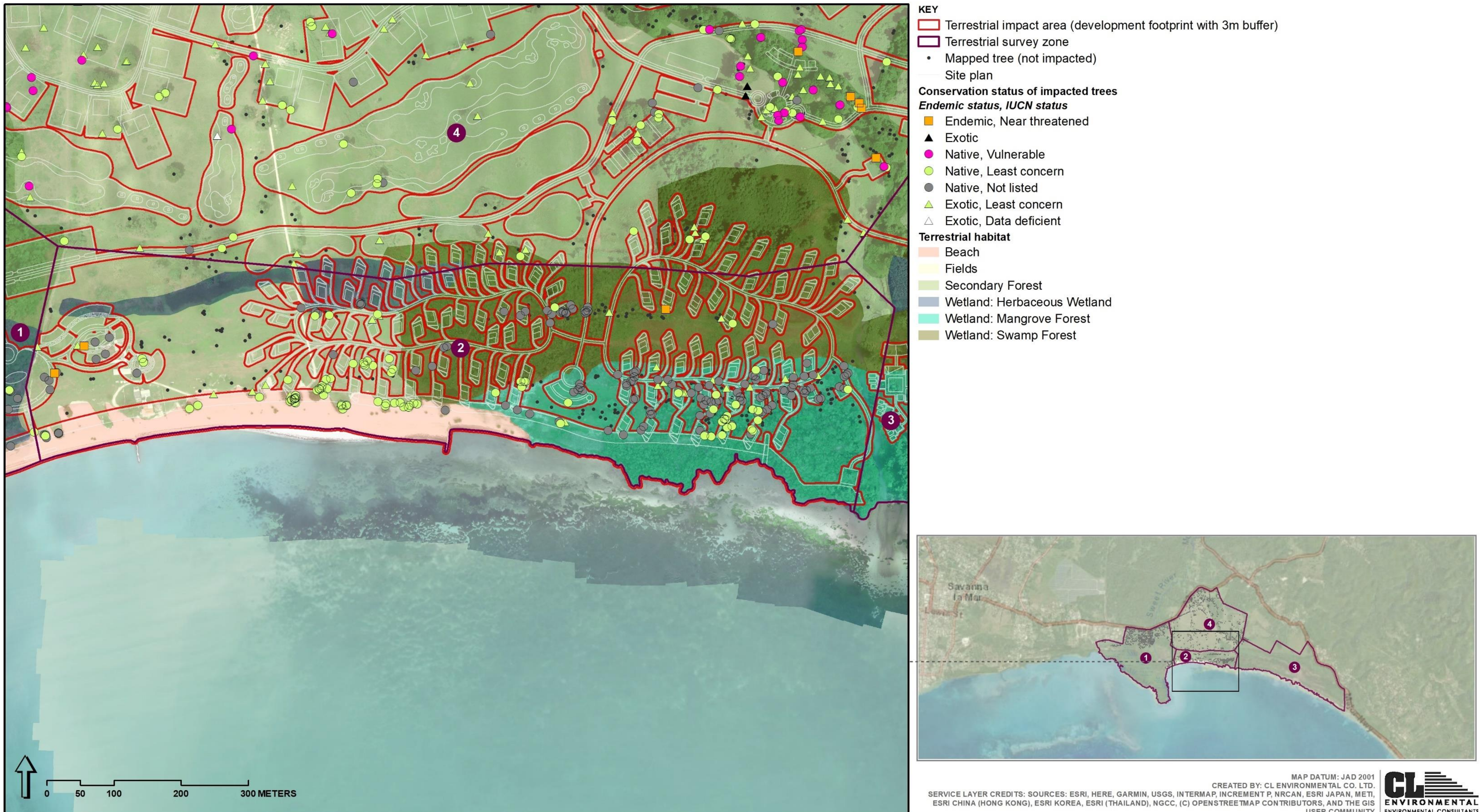


Figure 6-18 Conservation status of impacted trees, Zone 2

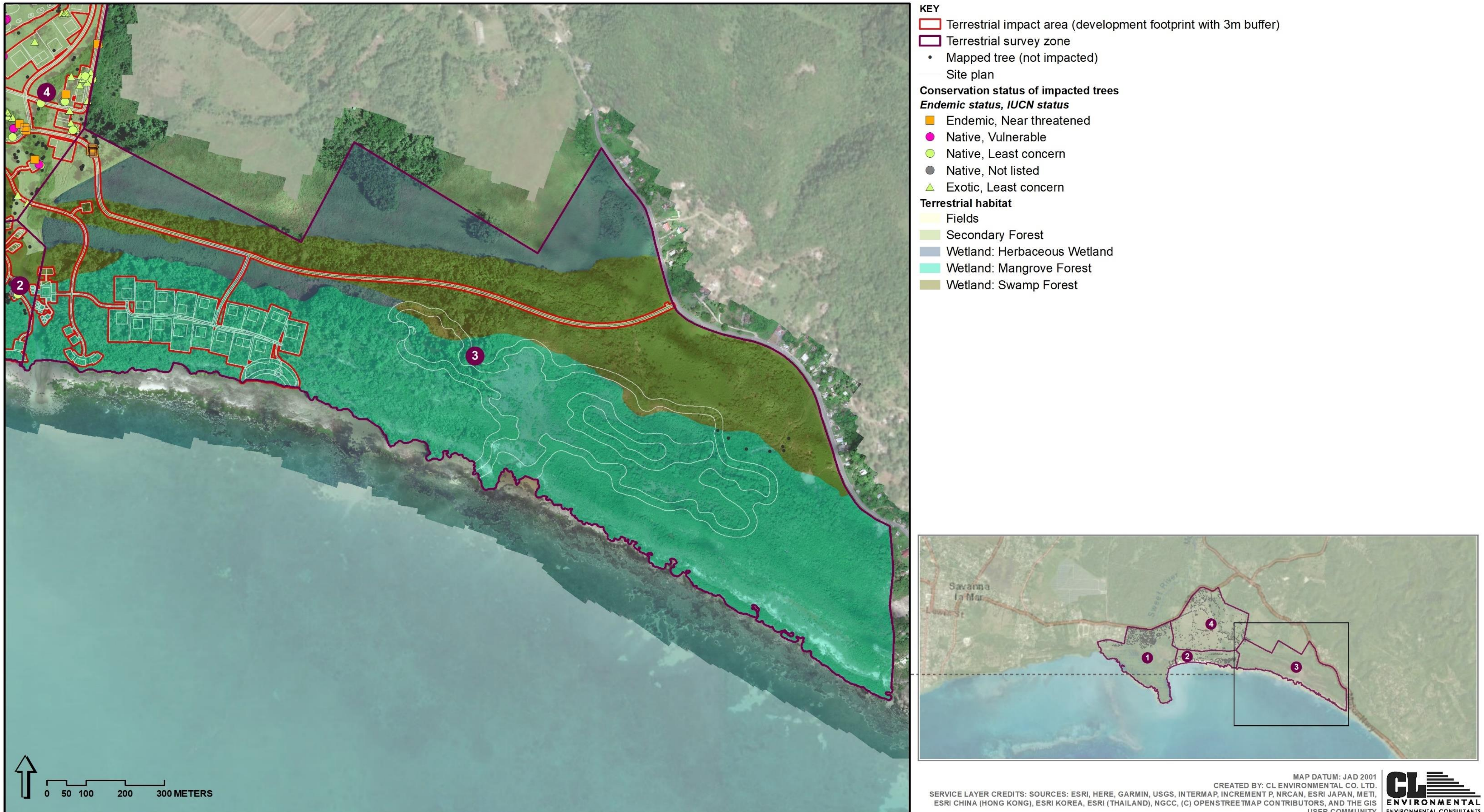


Figure 6-19 Conservation status of impacted trees, Zone 3

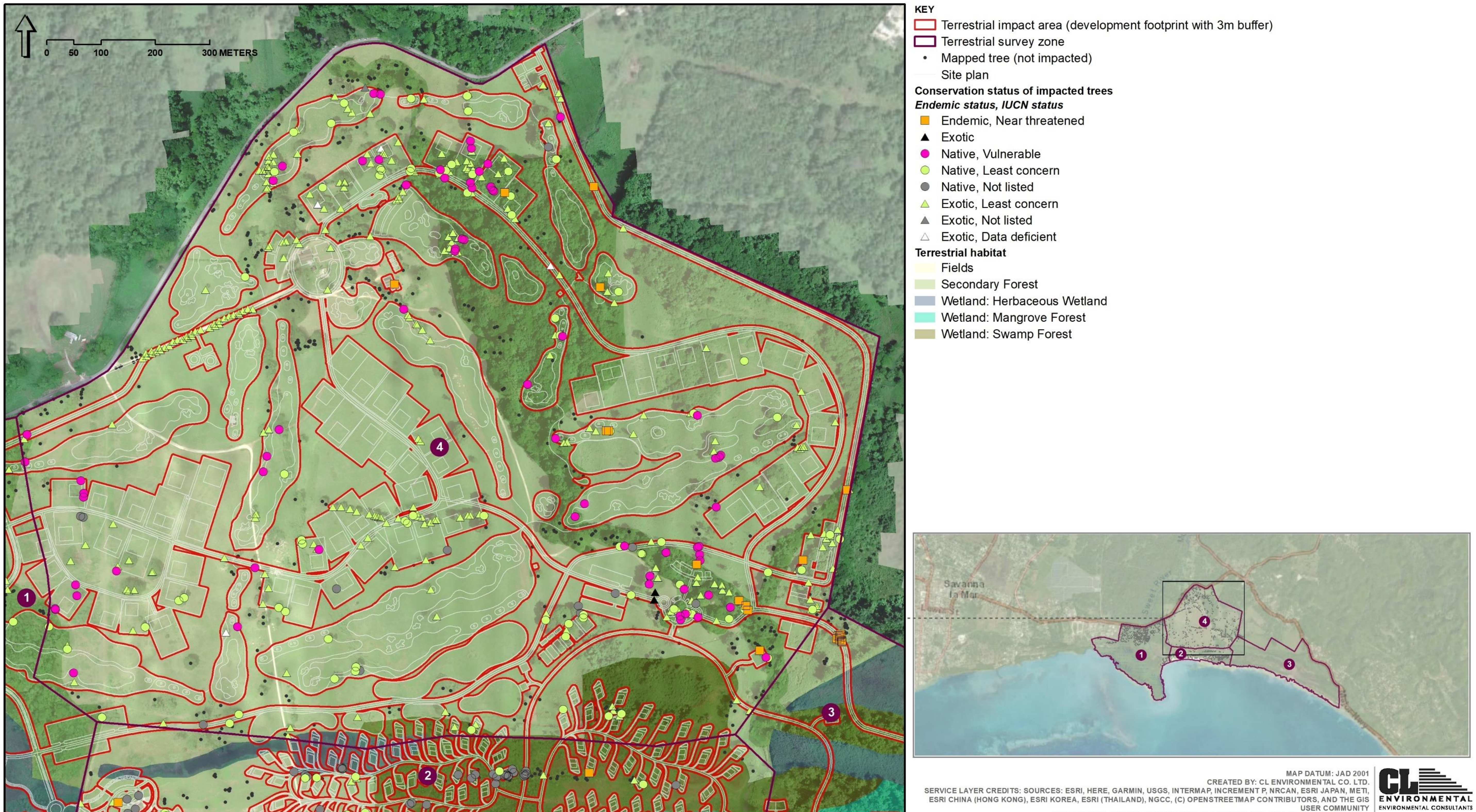


Figure 6-20 Conservation status of impacted trees, Zone 4

EPIPHYTES

A significant number of epiphytes, particularly bromeliads, were recorded in the survey areas. Dense aggregations of epiphytes and bromeliads function as biodiversity hotspots, supporting a high diversity of associated species, including invertebrates, amphibians, and birds, while contributing to ecological complexity. These bromeliads are primarily hosted on large trees scattered throughout the proposed development site. The proposed project activities have the potential to substantially impact these large trees, which provide micro-habitats and support other flora (e.g., bromeliads) and fauna species.

The recorded epiphyte data reveals that a total of 93 locations with single or multiple epiphyte species may potentially be impacted (Figure 6-22 to Figure 6-25), (Figure 6-21). At each of these locations, the estimated minimum number of epiphyte individuals were totalled, and it was found that Zone 2 contains at least 2,509 epiphytes, followed by Zone 4 totals with at least 1,001 species, Zones 1 and 3 with at least 34 and 10 epiphyte individuals. The total for all zones combined is 3,554 epiphytes, with the highest counts coming from a few dominant species. *Tillandsia usneoides* stands out with a grand total of 1000 individuals in Zone 1 solely and *Wittmackia sp.* also has a significant total of 735 individuals occurring in Zones 2 and 4 (Figure 6-21). *Tillandsia sp.*, another dominant species, totals 599 individuals across Zones 1, 2 and 4.

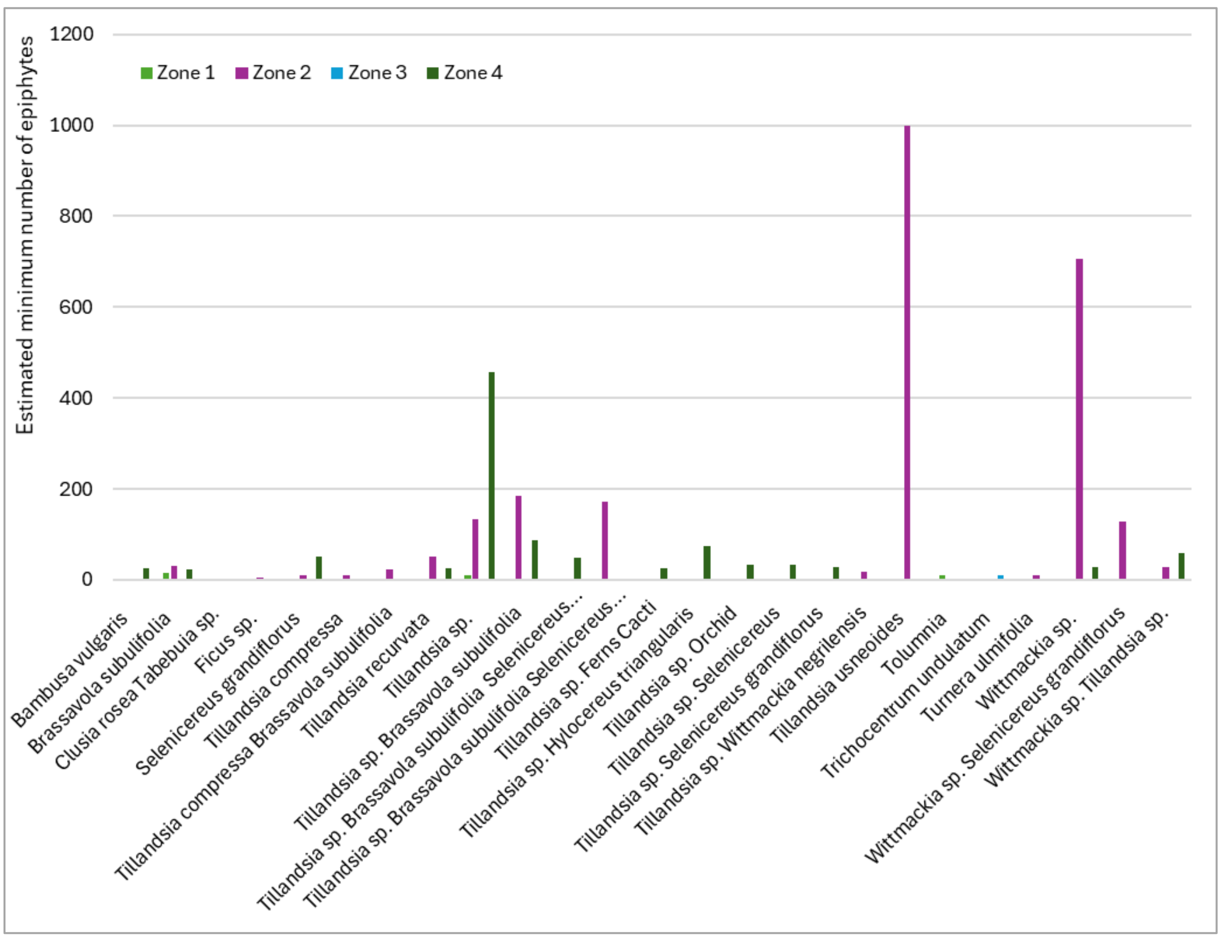


Figure 6-21 **Potentially impacted epiphyte counts by species and zone**

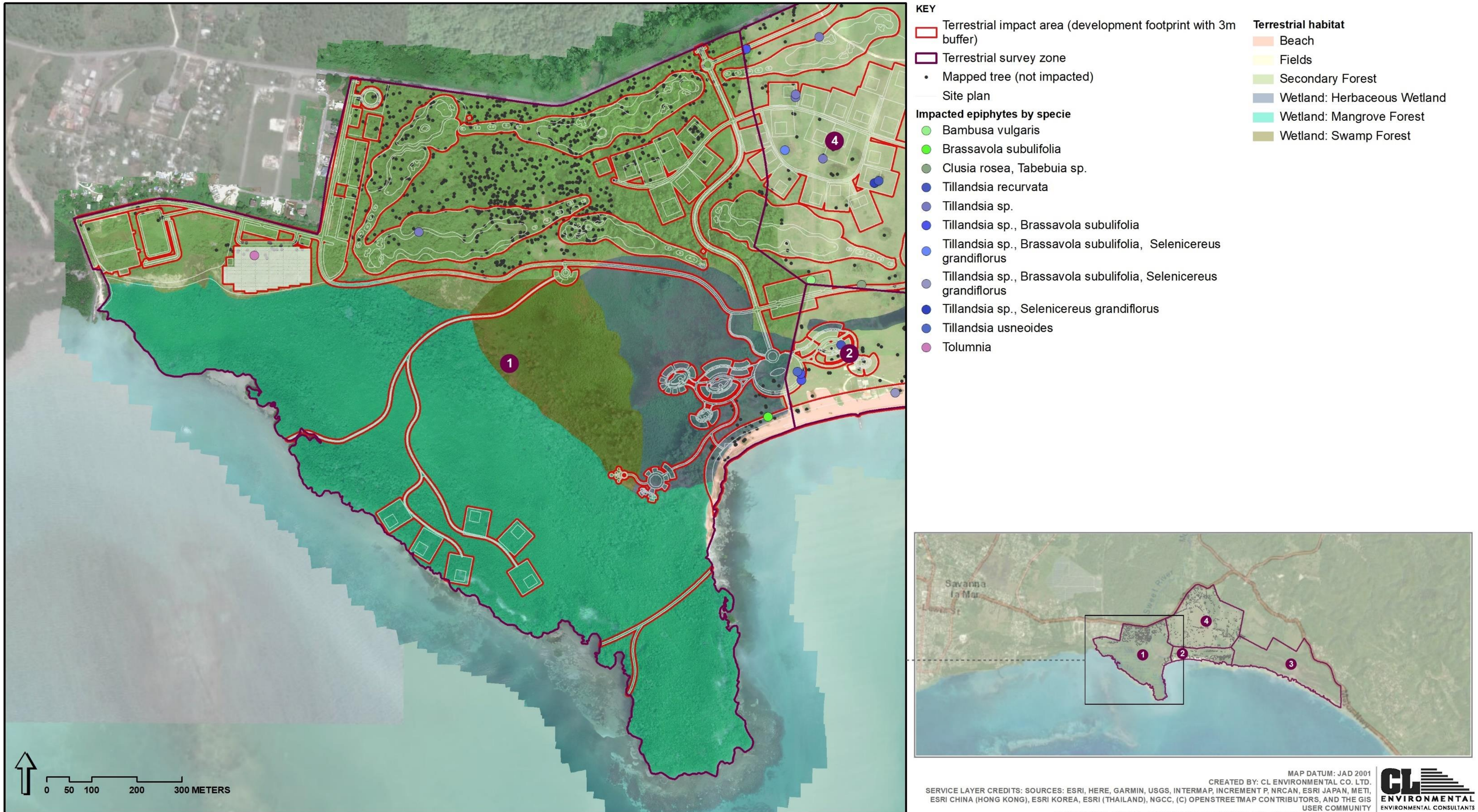


Figure 6-22 Impacted epiphytes by specie, Zone 1

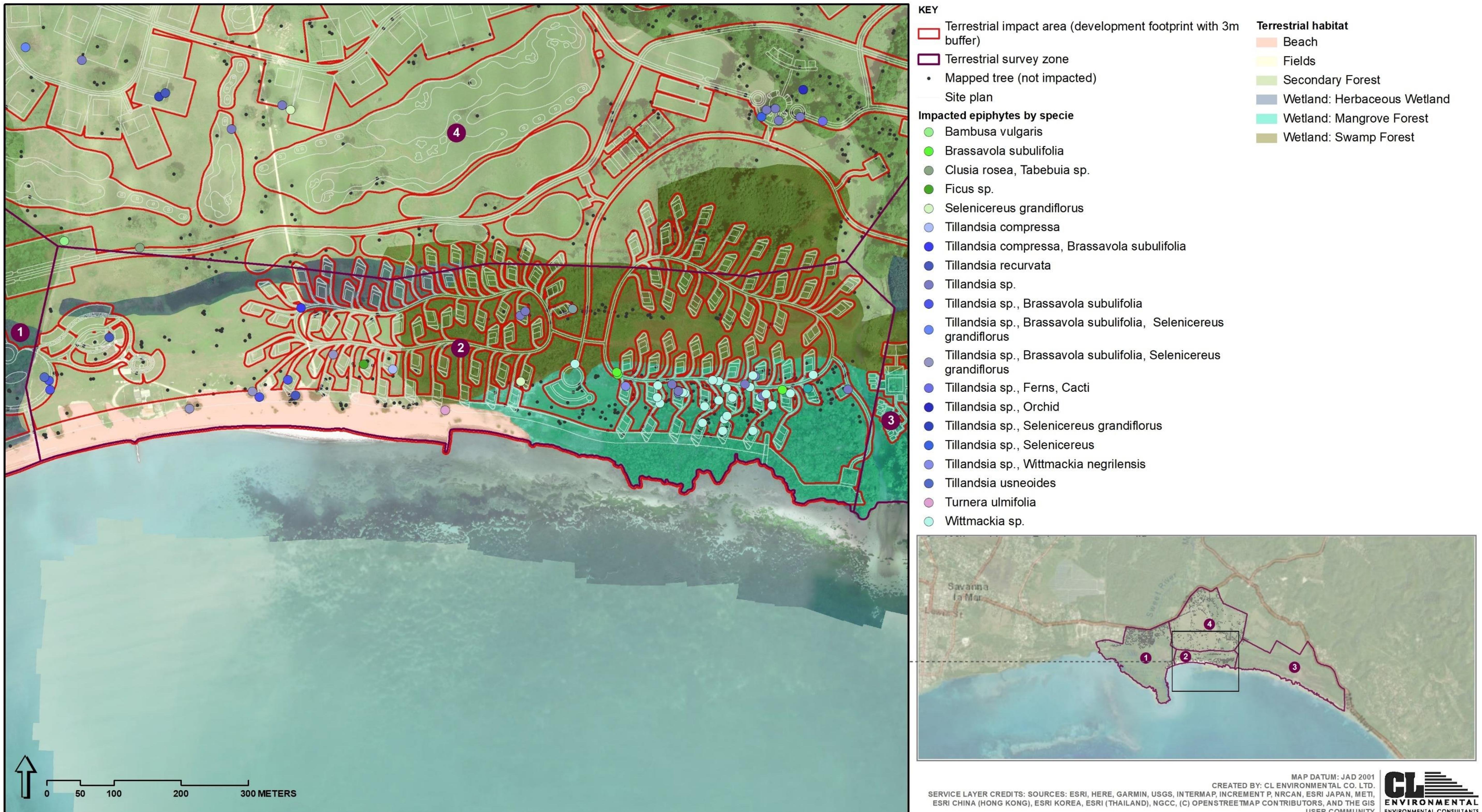


Figure 6-23 Impacted epiphytes by specie, Zone 2

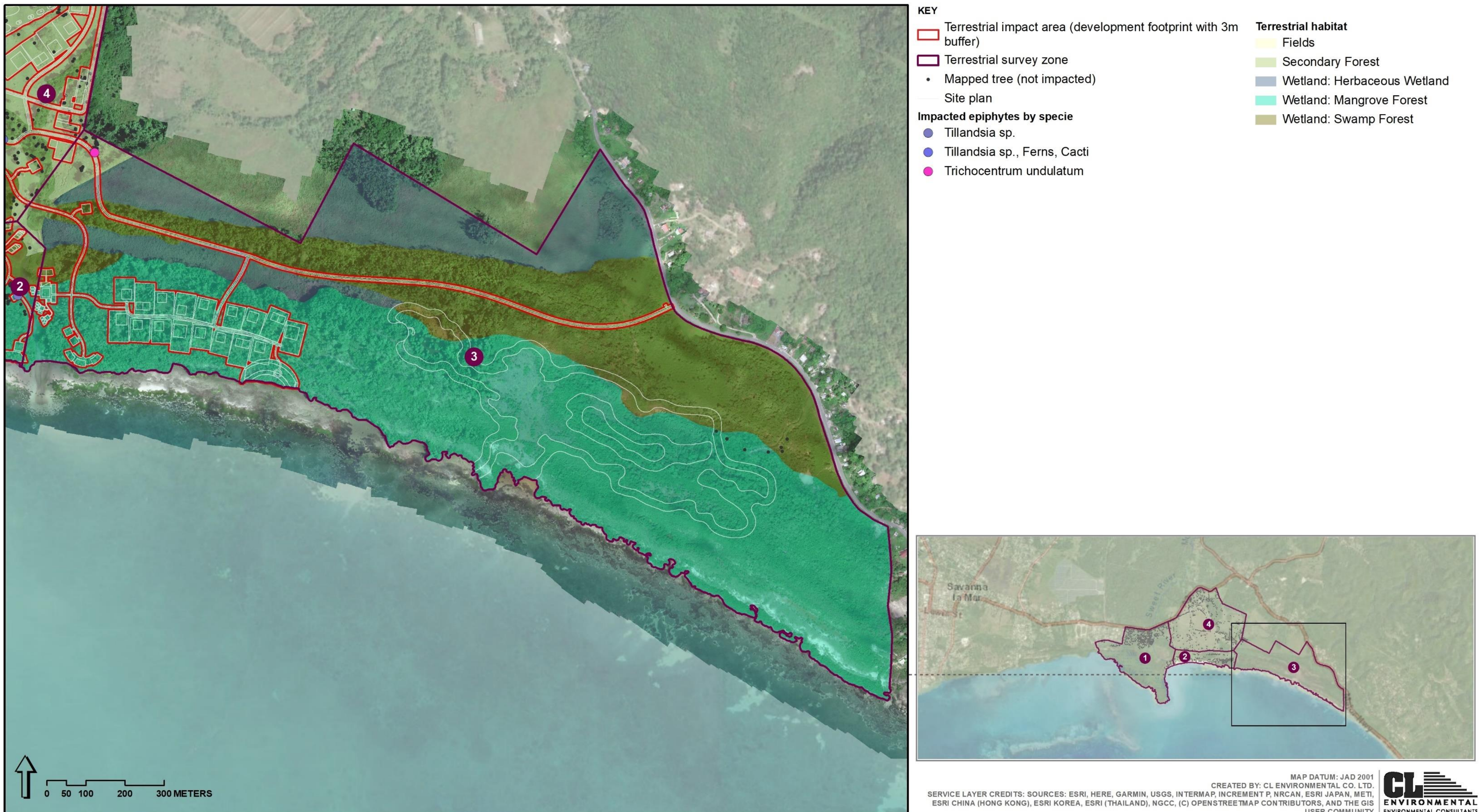


Figure 6-24 Impacted epiphytes by specie, Zone 3

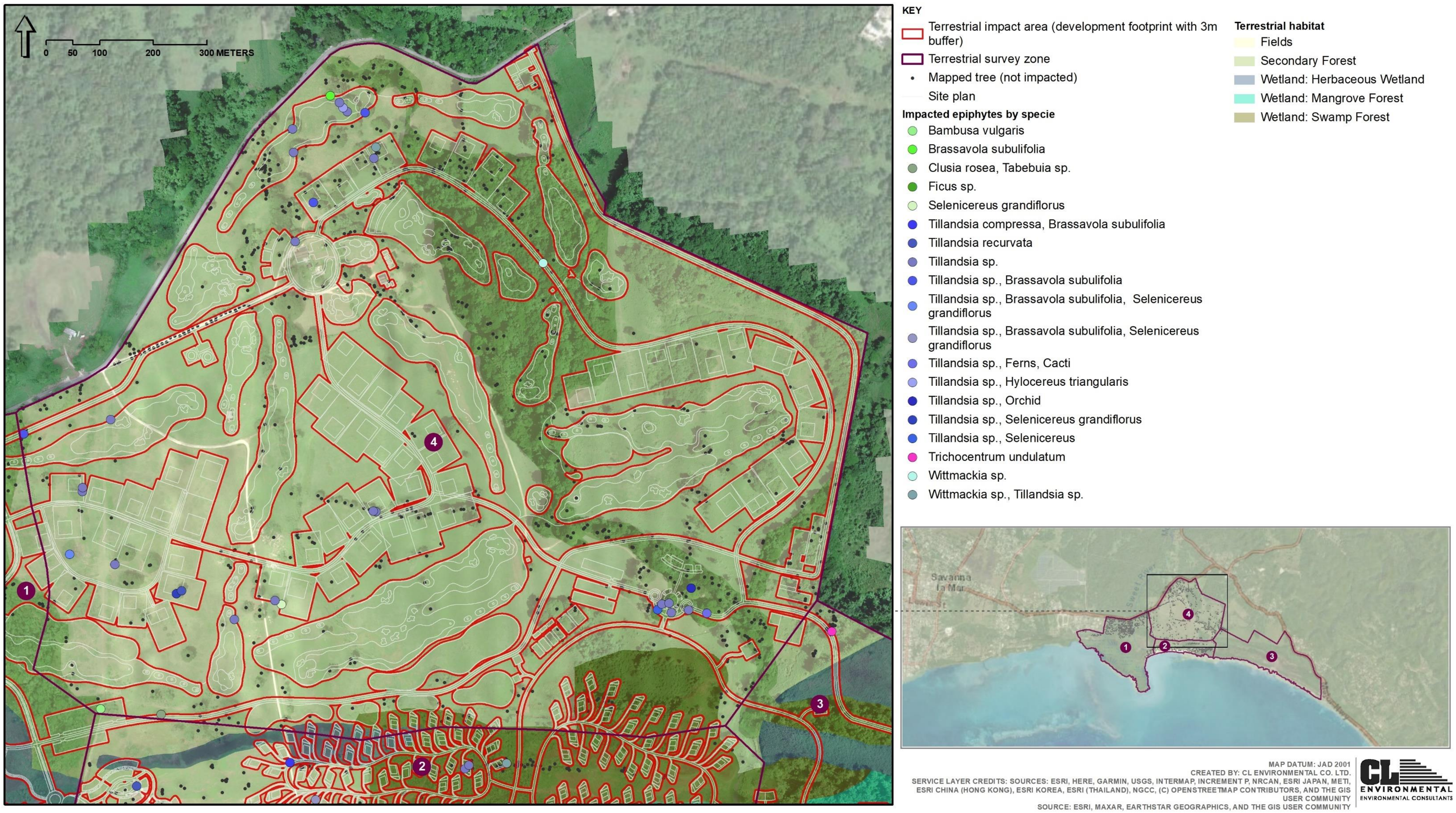


Figure 6-25 Impacted epiphytes by specie, Zone 4

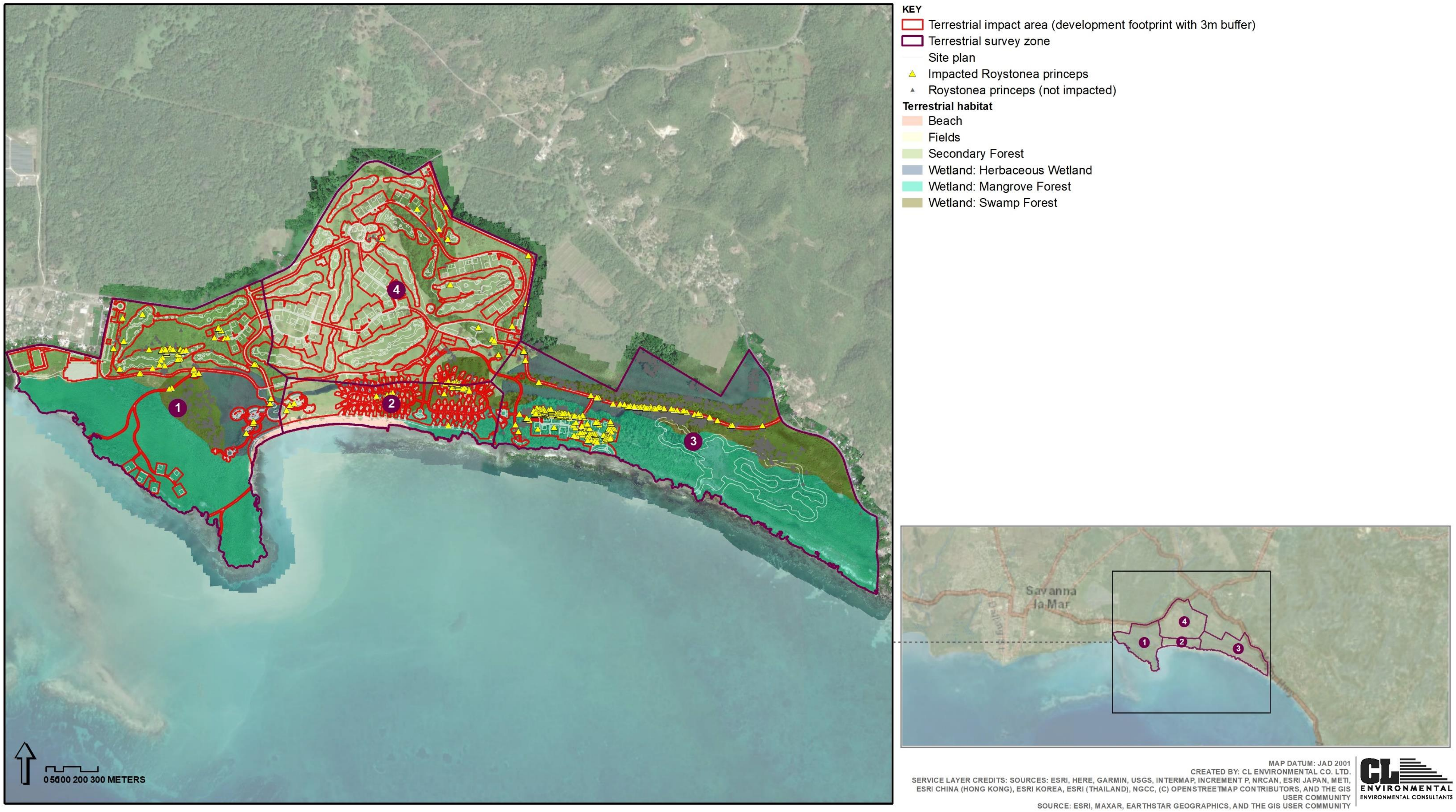


Figure 6-26 Impacted Roystonea princeps

Recommended Mitigation

Various mitigation measures can be implemented during site clearance and construction to reduce the potential impacts on terrestrial flora. Specific mitigation measures include:

i. **Relocation of key species before land clearance**: Specific attention should be given to species like *Wittmackia negrilensis* (Tank Bromeliad) and *Roystonea princeps* (Swamp Cabbage), which are of conservation concern. *Roystonea princeps* is listed as near-threatened on the IUCN Red List and should be relocated to designated green spaces within the development where possible. All bromeliads, epiphytic cacti, and orchids that will be impacted by land clearance must also be relocated prior to commencement of construction.

ii. **Invasive species management**: During land clearance, efforts should be made to prevent the spread of invasive species, such as *Haematoxylum campechianum* (logwood), through improper disposal of cut material. All vegetative material and seeds from invasive species should be properly disposed of in areas that are not designated for preservation or green spaces.

iii. **Integrating large trees into the development design**: Large trees, particularly those with a diameter at breast height (DBH) greater than 100 cm, should be considered for retention within the landscaping of the development. Special care should be taken with trees that support other flora, such as climbers, bromeliads, and orchids, as these contribute significantly to the local ecosystem. Retaining these trees will help maintain some of the ecosystem services provided by the flora in the area, such as carbon sequestration and habitat for fauna.

iv. **Establishing a nursery**: A nursery can be set up to temporarily house relocated species and nurture native seedlings that will be out planted within the development area. This ensures that the species are reintroduced to the site in a controlled and planned manner, helping to maintain biodiversity.

v. **Development of a plant relocation plan**: A competent botanist should be engaged to generate a relocation plan for plant species that need to be moved due to development activities. The plan should include species deemed necessary for relocation, especially those that are endemic or have special conservation designations. Ideally, seedlings or saplings should be relocated from the development footprint prior to land clearance.

vi. **Incorporating native species in landscaping**: It is essential to use native plant species in landscaping to maintain the biodiversity that is already part of the site's habitats. This approach avoids the introduction of non-native species, which can disrupt the local ecosystem. Some of these native species are key ecological players and help support the habitat's overall function.

vii. **Rehabilitation of degraded areas**: To work towards a Net Gain approach, degraded areas within the site that will not be developed can be rehabilitated through various activities (for example lands within Conservation Area 4). These efforts may enhance both the ecological function and resilience.

viii. **Designation of Conservation areas**: A small section of each land use type on the property should be designated as preservation areas outside the footprint of the project. These areas will allow for the preservation of naturally occurring species and provide valuable 'green space' for both biodiversity conservation and the relocation of plant species.

ix. **Monitoring and adaptive management**: Ongoing monitoring of the flora during and after construction is essential to assess the effectiveness of the mitigation measures. Adaptive management strategies can be implemented to modify actions based on observed impacts, ensuring that mitigation efforts remain effective over time.

By implementing these measures, the development can reduce the negative ecological impacts, enhance biodiversity, help maintain essential ecosystem services and increase resilience within the area.

6.2.2.4 Wetlands and Mangrove

Impact

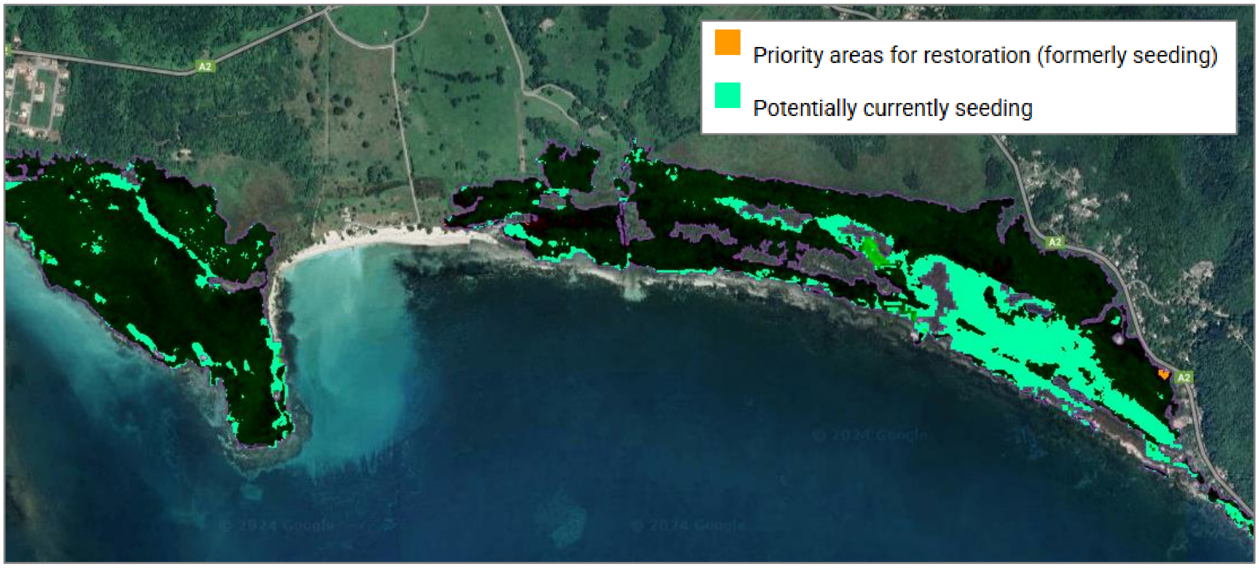
WETLAND HABITAT DISTRIBUTION

The proposed development may result in the loss and displacement of mature and developing forested wetland areas, along with their associated vegetation and soils, during site clearance and construction. Based on the development footprint and a 3-meter buffer zone, the total area of potentially impacted wetland is estimated at 33.38 ha (Figure 6-3). The estimated losses for each of the three categories of wetlands are detailed in Table 6-10. The proposed development site accounts for approximately 243.64ha forested wetlands, with a portion (13.71% or 33.39 ha) of this estimated to be impacted.

Table 6-10 Potentially impacted wetland area by type (wetlands highlighted in green)

Terrestrial habitat	Baseline (Ha)	Impacted (Ha)	% Impacted
Beach	4.31	4.01	93.00%
Fields	131.94	76.14	57.70%
Secondary Forest	73.82	36.8	49.90%
Wetland: Herbaceous Wetland	**39.8**	**6.03**	15.10%
Wetland: Mangrove Forest	**142.61**	**18.21**	12.80%
Wetland: Swamp Forest	**61.23**	**9.15**	14.90%
Wetland TOTAL:	**243.64**	**33.39**	**13.71%**
TOTAL (all terrestrial habitats)	**453.71**	**150.33**	

As part of the project's goal for sustainable development, with a focus on the importance of wetland ecosystems, the project includes areas designated for conservation and rehabilitation (**Error! Reference source not found.**). These areas, set aside for ecological preservation, appreciation, recreation, and leisure, within the site align with areas identified for restoration by the Nature Conservancy's Blue Carbon Explorer tool (The Nature Conservancy, 2024) . This strategic approach minimizes the impact on wetland habitats, preserves the most pristine and well-developed areas while implementing rehabilitation activities ensuring the continued protection and preservation of these vital ecosystems.



Source: (The Nature Conservancy, 2024)

Figure 6-27 Mangrove areas for restoration using NDVI change threshold of 0.1/-0.1, height threshold of 6ft.

MANGROVE CARBON SEQUESTRATION AND STORAGE

The removal of 18.21 ha of mangrove forest will result in the loss of approximately 8,032.61 Mg C stored in mangrove soils, based on an estimated carbon stock of 441.11 ±27.57 Mg C ha^{-1}. This represents a reduction in the site's total carbon storage capacity.

The total area of mangrove conservation zones is 124.4 hectares (see section 6.2.2.1). As a result, the soil carbon stored in these areas amounts to 124.4 (size) x 441.11 (MgC - average carbon values) = 54,874.084 Mg C.

HYDROLOGICAL DISRUPTIONS & CONNECTIVITY LOSS

The proposed development may disrupt natural hydrological flows within wetland and mangrove areas due to site clearance, road construction, and infrastructure development. Wetlands rely on interconnected water movement for maintaining ecological balance, and alterations can lead to water stagnation, reduced flushing, and changes in salinity levels, which may impact habitat quality. Temporary or permanent obstruction of natural drainage patterns could also affect wetland-dependent species, leading to potential die-back of vegetation and habitat degradation.

LOSS OF BIODIVERSITY & ECOSYSTEM SERVICES

Wetlands and mangroves support diverse flora and fauna, playing a key role in carbon sequestration, water filtration, flood control, and habitat provision. The removal of 33.38 ha of wetlands, including 18.21 ha of mangrove forest, could impact these ecosystem services, reducing habitat availability for wetland species and altering nutrient cycling. Additionally, the loss of wetland areas may diminish natural flood resilience, increasing the likelihood of coastal erosion and storm surge impacts.

Recommended Mitigation

It is recommended that the resort development adheres to the principle of Net Gain, going beyond the no net loss approach outlined in national policies. This commitment aligns with conservation objectives set forth by the Forestry Department and the National Environment and Planning Agency (NEPA), as well as the goals of the National Mangrove and Swamp Forests Management Plan (NMSFMP), which emphasize the preservation of private mangrove lands. The implementation of the strategies detailed in the following subsections will support the achievement of this net gain approach, ensuring enhanced ecological value and long-term sustainability.

RETENTION AND CONSERVATION OF EXISTING WETLANDS

The total area of wetland habitat within the Conservation Areas is estimated to be 146.25 ha, which is more than four times the size of the impacted wetland area (33.38 ha) (Table 6-6). The large mangrove and wetland areas located at the eastern and western ends of the property will largely remain undisturbed. Villas, resorts, and other amenities will be integrated into the landscape with minimal impact on the mangrove ecosystem. Conservation Area 1 represents the healthiest and most well-established mangrove and wetland habitat on the property conservation of this area will play an important role in preservation of ecological functions of the terrestrial environment but also the surrounding marine ecosystems.

In lieu of mangrove loss, the proposed mitigation strategy prioritizes the conservation of areas on the property that are more than double the size of the impacted area. Over time, replanting efforts may also be incorporated as part of broader rehabilitation activities to enhance the ecological function and resilience of these conserved habitats

The following measures are proposed to effectively implement the conservation of these wetland areas:

i. Restrict development completely within Conservation Area 1, the "Bluff" area. This area was identified as a very sensitive section based on the hydrology and resulting influence of outflows from the area to the sea. This point should have no alterations, pollution sources or changes in forest structure. Though the plans show a boardwalk structure to the North of this area, its construction must be closely planned and monitored to maintain the current hydrological regime.
ii. Development sites should be designed to prevent any negative impact on the hydrology and long-term sustainability of the conservation areas. Ensure the inclusion of culverts and other hydrological features to maintain connectivity across roadways and infrastructure that may otherwise isolate wetland sections. Temporary roadways built to facilitate construction though wetlands shall have culverts placed every 10-20 m to facilitate the areas unrestricted water movements. Studies have shown that even temporary water stagnation in mangrove forests and swamps can result in die-back and forested wetland loss.

iii. Wetland soil removed to facilitate temporary roadways, shall be replaced post construction when feasible. This facilitates the area retaining a high amounts of its original soil carbon, preserves soil structure and fertility, supports microbial activity, and promotes the re-establishment of native vegetation, thereby aiding in the recovery of ecosystem functions.
iv. The various Conservation Areas that are parallel to a boardwalk structure on the property, shall be demarcated using conservation marker boundaries that are in line of sight. This allows a clear boundary to keep the construction team out of these areas.
v. Conservation areas adjacent to main roads, highways and other settlements and communities, shall be aesthetically fenced to maintain the forest integrity and limit external influences from affecting the forest.
vi. A buffer zone around the development footprint will be maintained to reduce the direct impact on surrounding wetland areas. This buffer will help protect the integrity of the wetland ecosystem by limiting construction activities and disturbance near sensitive habitats.
vii. Construction activities should be avoided in sensitive or critical areas, such as key hydrological points, important nesting sites for fauna, regions with high carbon storage, and locations that feature "signature" tree species.
viii. Regular monitoring of wetland areas should be conducted throughout the construction process to assess any impacts on the environment. Adaptive management strategies will be employed to address emerging issues and ensure that mitigation measures remain effective in protecting the wetland habitats.

RELOCATION AND REHABILITATION

i. Prior to any construction activities a detailed Relocation Plan will be developed and submitted to the Agency for approval. This will include but not limited to identification of any significant wetland features or sensitive organisms, such as bromeliads or orchids as well as the proposed relocation measures. Identification and details of any temporary nurseries and proposed relocation sites must also be provided.
ii. Where possible, there will be proposed areas to potentially increase the mangrove population and enhance the site coastline. Though the majority of any potential wetland loss shall be mitigated for by designated new conservation areas, the development shall seek to rehabilitate mangroves in suitable degraded areas. Potential rehabilitation areas have been identified within the Conservation Areas.

MANGROVE CARBON SEQUESTRATION AND STORAGE

As mentioned previously, a mangrove conservation area totalling 124.4 ha will remain, preserving an estimated 54,874.08 Mg C in soil carbon. However, beyond conservation, net carbon gain measures will ensure that overall carbon sequestration is increased over time. These include:

- Enhancing carbon sequestration through targeted restoration in degraded areas.
- Reforestation efforts in designated zones to exceed the carbon lost from impacted areas.

HYDROLOGICAL DISRUPTIONS & CONNECTIVITY LOSS

- Use culverts and other drainage features to maintain natural water flow to wetland areas during both construction and operation.
- Ensure culverts are placed at appropriate intervals (every 10-20m in wetland areas) to facilitate unrestricted water movement.
- Avoid road alignments and construction in critical hydrological zones, such as areas with seasonal outflows to the sea.
- Monitor water levels and hydrological connectivity throughout construction to assess impacts and adjust mitigation strategies as needed.

LOSS OF BIODIVERSITY AND ECOSYSTEM SERVICES

See mitigation above

6.2.2.5 Terrestrial Fauna

Impact

The proposed development may potentially impact fauna. These impacts may vary depending on the location, size, and nature of particular project features. Some of the potential impacts on fauna during hotel construction include:

i. **Species Loss, Habitat Destruction and Alteration**:
   a. The clearing and modification of land for the development can result in the destruction and or modification of natural habitats for local wildlife. This could lead to the displacement and or loss of species, particularly those dependent on specific environments (e.g., wetlands, forests, or coastal areas). Notable species include:
      - Herpetofauna, which inhabit epiphytes, and particularly the tank bromeliad (*Hohenbergia* sp.). Bromeliads are distributed across trees in different habitats within the project area, with those potentially impacted identified in section 6.2.2.2. The removal or disturbance of these plants during construction would lead to the loss of this important habitat, potentially displacing or reducing populations of species that depend on these epiphytes for shelter, food, or breeding sites.
      - Crocodiles, which may inhabit the wetland areas. Potentially impacted wetlands were estimated to be 33.38 hectares, including mangroves, swamps, and herbaceous wetlands (please refer to section 6.2.2.1 for further detail). The modification and potential disruption of this wetland habitat could directly affect the crocodile population by altering their natural environment, limiting their access to breeding, feeding, and basking sites. Although crocodiles were not observed during the biological field surveys undertaken for this project, based on the perception survey, 28.9% of respondents reported that they had seen a crocodile, mentioning several locations including the Paradise area and the proposed site and beach.

b. Fragmentation of habitats can isolate wildlife populations, reducing their ability to migrate, find food, and breed effectively.
c. Alteration of natural features like waterways or forested areas may affect the migration or movement of certain species, such as amphibians, reptiles, and mammals.

ii. **Noise and Construction Activities**:
   a. Construction activities typically involve the use of heavy machinery, tools, and equipment that generate significant noise and vibrations. The continuous noise from machinery and activities may disturb the behaviour and natural processes of wildlife, particularly species that rely on quiet environments for feeding, breeding, or nesting.
   b. Noise can cause stress, displacement, and reduced activity levels in wildlife, potentially leading to long-term impacts on species that are sensitive to sound disturbances.
   c. Dust and particulate matter generated during construction can degrade air quality, impacting animals with respiratory vulnerabilities.
   d. The use of hazardous chemicals and materials on-site, such as fuels, oils, and construction debris, can contaminate the soil and water, posing direct risks to terrestrial and aquatic fauna.

iii. **Introduction of Invasive Species**:
   a. The movement of construction equipment, workers, and materials can inadvertently introduce invasive species to the site. These non-native species can outcompete local wildlife for resources and alter the ecosystem balance, potentially leading to the decline of indigenous species.

iv. **Human-Wildlife Conflicts**:
   a. As construction encroaches on natural habitats, wildlife may move closer to human activity in search of food, shelter, or water, increasing the likelihood of human-wildlife conflicts. This could result in harm to both animals and humans, particularly if dangerous species like crocodiles or large mammals are involved.

v. **Lighting and Artificial Habitat Alteration**:
   a. Artificial lighting associated with construction can disrupt nocturnal wildlife species, which rely on natural cycles of light and dark. Excessive lighting can interfere with their feeding, migration, and breeding patterns.

Recommended Mitigation

i. Habitat Preservation and Minimization of Disturbance:
   a. Where possible, areas with high biodiversity or critical habitats (such as wetlands and epiphytes) should be preserved. Efforts should be made to minimize clearing and avoid development within ecologically sensitive zones. See sections 6.2.2.4 and 0 for additional detail regarding wetland and epiphyte mitigation.

b. Establish buffer zones around sensitive wildlife habitats to reduce the impact of construction activities. These zones will act as a barrier to protect wildlife from direct disturbances and habitat fragmentation.
c. If certain species are in immediate danger due to construction activities, such as the tank bromeliad, develop a relocation plan to move them to safer, suitable habitats, ensuring that their survival is not compromised.

ii. Reduction of Noise and Vibration:
   a. See section 6.2.1.6.

iii. Protection of Nesting and Breeding Sites:
   a. Before construction begins, conduct a survey to identify and locate any nesting or breeding sites within the project area. Take steps to avoid disturbing these sites, especially during breeding or nesting seasons.
   b. If disturbance to nesting sites is unavoidable, arrange for the careful relocation of nests or eggs to safe areas, in consultation with wildlife experts.
   c. Implement seasonal construction scheduling where possible to avoid disrupting critical breeding seasons for birds, amphibians, and reptiles.

iv. Air and Water Quality Protection:
   a. See sections 6.2.1.3 and 6.2.1.7.

v. Control of Invasive Species:
   a. Prior to bringing equipment or materials onto the site, inspect and clean them to ensure they do not carry invasive species that could disrupt local ecosystems.
   b. Establish monitoring programs to detect and control the spread of invasive species during the construction process. If invasive species are identified, implement a management plan to remove them from the site.

vi. Mitigation of Human-Wildlife Conflicts:
   a. Should wildlife move into the construction zone in search of food, water, or shelter, implement a response plan to avoid harm.
   b. Any crocodile sighting in the area at any project stage should be reported to the National Environment and Planning Agency (NEPA) immediately.
   c. Provide training for construction workers on how to recognize and avoid harmful interactions with wildlife, particularly dangerous species like crocodiles.

vii. Minimization of Light Pollution:
   a. Use low-intensity, downward-facing lights during construction activities to reduce the impact of artificial lighting on nocturnal wildlife.
   b. Restrict lighting to essential areas and ensure that lights are turned off when not needed to avoid disrupting natural wildlife cycles.

viii. Post-Construction Habitat Restoration:
   a. After construction is completed, prioritize the restoration of any disturbed habitats. This may include replanting native vegetation, restoring wetland areas, or reconstructing wildlife corridors to help fauna return to their natural environment.

b. Continue to monitor the recovered habitats for several years to ensure that wildlife is returning, and the ecosystem is functioning as it should.

6.2.2.6 Freshwater Habitats

Impacts

The potential impacts on freshwater habitats all pose a risk to the loss of freshwater species and their ecosystem functions.

Species loss can result from habitat fragmentation, degradation and pollution removing sensitive clean water species and reducing biodiversity. Invasive species can outcompete and displace native species, reducing biodiversity. Habitat loss reduces organic matter input, exposes invertebrates to predators, increases water temperature and increases flood risk. Habitat fragmentation can result from the segmentation of the rivers and streams, or obstruction from dispersal as caused by dams and buildings. Change in community composition can result from the loss of permanent natural water bodies risks shifting the composition of the invertebrate community to favour species with shorter life cycles such as mosquitoes. This then serves to increase the risk of spread of mosquito-borne diseases with fewer natural predators to control mosquito populations.

Altering the natural landscape may potentially increase the risk of flooding in the area. Construction activities can potentially lead to increased erosion and sedimentation in the rivers and streams, and degrade habitat quality. Altered rates of erosion limit the movement of sediments and nutrients and removes necessary freshwater habitat. Eutrophication increases the nutrient content leading to mass die-offs of flora and fauna. Pollution from organic, solid, chemical, or thermal waste sources which are uncommon to the natural habitat of the area can result in significant changes in habitat quality and community composition.

Recommended Mitigation

To limit species and habitat loss, measures should include preventing the release of fertilizers and pesticides into water bodies, preserving natural vegetation and water channel features, and avoiding fragmentation of habitats in the area. Specifically, the following measures are recommended:

i. Rivers and streams must maintain their natural flow to allow species to disperse throughout freshwater habitats.
ii. Reducing habitat loss would also require establishing setback regulations for rivers, streams, ponds, and wetlands to safeguard aquatic and riparian vegetation along the banks and within water bodies.
iii. To preserve current species compositions, it is essential to maintain natural hydroperiods and limit the creation of temporary water bodies with short hydroperiods.
iv. Avoid the use of synthetic fertilizers, pesticides, oils, surfactants, and harsh chemicals like bleach or oxidizing agents in and around water bodies.

v. Waste management facilities at the resource site must be properly regulated, and waste should be treated correctly.
vi. Regular monitoring of water quality is necessary, as is the use of low-noise and low-emission machinery whenever possible.
vii. Implementing effective stormwater management systems is critical to prevent runoff pollution. See Primary Recommended Mitigation under section 6.2.1.3.

6.2.2.7 Benthic Habitats

Impact

Benthic habitats and the associated biota may be potentially negatively impacted by the proposed project. Table 6-11, Figure 6-28 and Figure 6-29 outlines the benthic habitats within the area identified as potentially impacted, encompassing the marine project footprint—coastal works to the east of the headland and overwater villas and amenities on the western side—as well as a buffered zone of 5m. The total impacted area is 18.56 hectares, which accounts for 20.4% of the nearshore detailed survey area (91.13 hectares) and 0.3% of the wider 6-km benthic study area (7074.1 hectares).

The largest affected area is Sand/silt/mud, with 11.790 hectares impacted. Seagrass habitats collectively account for a total impacted area of 5.719 hectares. However, when considering the composition of habitats in the nearshore area, seagrass emerges as the most significantly affected, with certain species and combinations experiencing higher levels of disturbance. Seagrass: Syringodium and Seagrass: Syringodium and Halodule may potentially experience high impacts of 96.0% and 82.5% of the detailed area. Other notable impacts include Sand/silt/mud (31.5%), Seagrass: Halodule (18.0%), and Seagrass: Thalassia and Syringodium (11.8%). In contrast, Seagrass: Thalassia and Halodule and Seagrass: Thalassia, Syringodium, and Halodule show minimal impacts of 0.3% and 6.0%, respectively. The Fringing Reef remains unaffected.

Table 6-11 Potentially impacted benthic habitats within the project footprint and buffer

Benthic class	Baseline area within detailed survey area (hectares)	Impacted area, project footprint and buffer (hectare)	% of detailed survey area impacted
Not classified (Land/Beach)	2.39	1.053	44.0%
Sand/ silt/ mud	37.46	11.790	31.5%
Seagrass: Halodule	18.27	3.287	18.0%
Seagrass: Syringodium	0.28	0.269	96.0%
Seagrass: Syringodium and Halodule	0.04	0.033	82.5%
Seagrass: Thalassia	3.61	0.157	4.4%
Seagrass: Thalassia and Halodule	10.57	0.027	0.3%
Seagrass: Thalassia and Syringodium	16.48	1.938	11.8%
Seagrass: Thalassia, Syringodium and Halodule	0.15	0.009	6.0%
Fringing Reef	1.89	0.000	0.0%
Total	**91.13**	**18.563**	**20.4%**

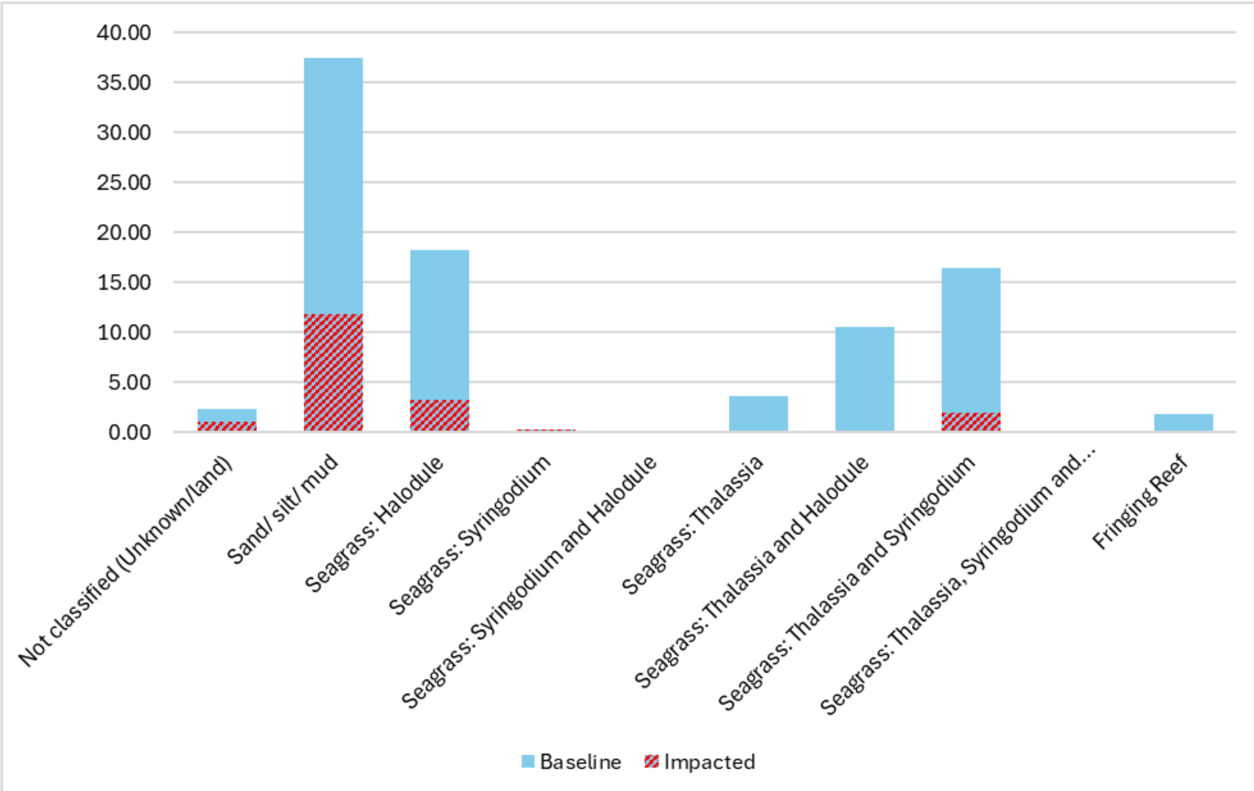


Figure 6-28 **Bar chart showing area (hectares) of potentially impacted benthic habitats**

The potential loss of benthic habitats in the impact and buffer areas is expected to lead to a reduction in some ecosystem services, such as food security and carbon sequestration. Benthic environments, including seagrass beds and coral reefs, sustain marine life, supporting local fisheries, and sequestering atmospheric carbon. There is the potential for permanent loss impacts where sections of these habitats undergo irreversible changes, others may be temporary as ecosystems gradually recover. Much of the detailed study area lacks complexity/rugosity, the addition of some hard structures may provide additional habitat, supporting a widder array of benthic species such as corals, fish, and invertebrates.

Details of the potentially impacted sensitive species (corals and seagrass) are given in subsequent sections (6.2.2.8 and 6.2.2.9).

Recommended Mitigation

The surrounding benthic communities including seagrass, hard corals, fish, urchins, and other invertebrates may be impacted by sedimentation and smothering, habitat fragmentation/loss, loss of suitable breeding, foraging and nursery grounds, increased water turbidity and suspended solids and species loss.

i. During construction, the project site should include sediment control measures such as turbidity barriers/silt screens and should be erected around the entire work area to prevent the dispersion of sediments and contaminants throughout the water column. These should be placed so as to reduce/contain the resultant sediment plume during the activities. Construction activities should only continue when these barriers are fully operational, that is; placed correctly; calm to moderate sea conditions; without damage. These barriers are particularly important when operations occur near or may influence sensitive ecosystems and species such as coral reefs and seagrass beds and or filter feeding organisms and fish. It may be necessary to utilize multiple/layers of barriers around marine work areas.
ii. Weekly monitoring of water quality parameters such as temperature, salinity, pH, Dissolved Oxygen, light irradiance, turbidity, and Total Suspended Solids (TSS) in and around the project area should be conducted during construction for the first 3 months of construction. Monitoring can be conducted fortnightly thereafter.
iii. Sediment dispersal calculation rates will be monitored at the locations identified in the EIA or in close proximity if a location falls within the footprint of construction activities. Monitoring will be conducted on a monthly basis to compare sedimentation rates against background levels. The rates established in the EIA will serve as the baseline for comparison.
iv. All activities should be limited to the minimal working area, and as such reducing the extent of the footprint. No activities and or placement of anchors or materials should be done placed outside the approved area.
v. Relocation of sensitive species should be done if; they are suitable for relocation (that is suitable substrate, health and over all viability), those species fall within the potential impact area; and if mobile invertebrates are in or around the potential impact area. Sensitive organisms and systems in and outside the impact area include; mobile invertebrates such as urchins, sea cucumbers, starfish, and conch.
vi. Alternative mitigations should be proposed when relocation is not suitable.
vii. Where possible, as little of the natural environment should be relocated or removed. Habitat fragmentation and species displacement should be temporary, with the placement of silt screens, construction materials and equipment as well as general human activity in the area.
viii. Structures placed on the seafloor may cause habitat fragmentation and displace some species, however they may also serve to add ecological volume, providing substrate for organisms to settle and colonize and eventually may serve some ecosystem functions.
ix. Any temporary floating structures and /or vessels should be placed in areas with less sensitive species where possible. Floating structures anchored or moored over seagrass beds or coral colonies should not be left for prolonged time periods as the resulting shading effects may cause deterioration in overall health of the seagrass bed and coral colonies.

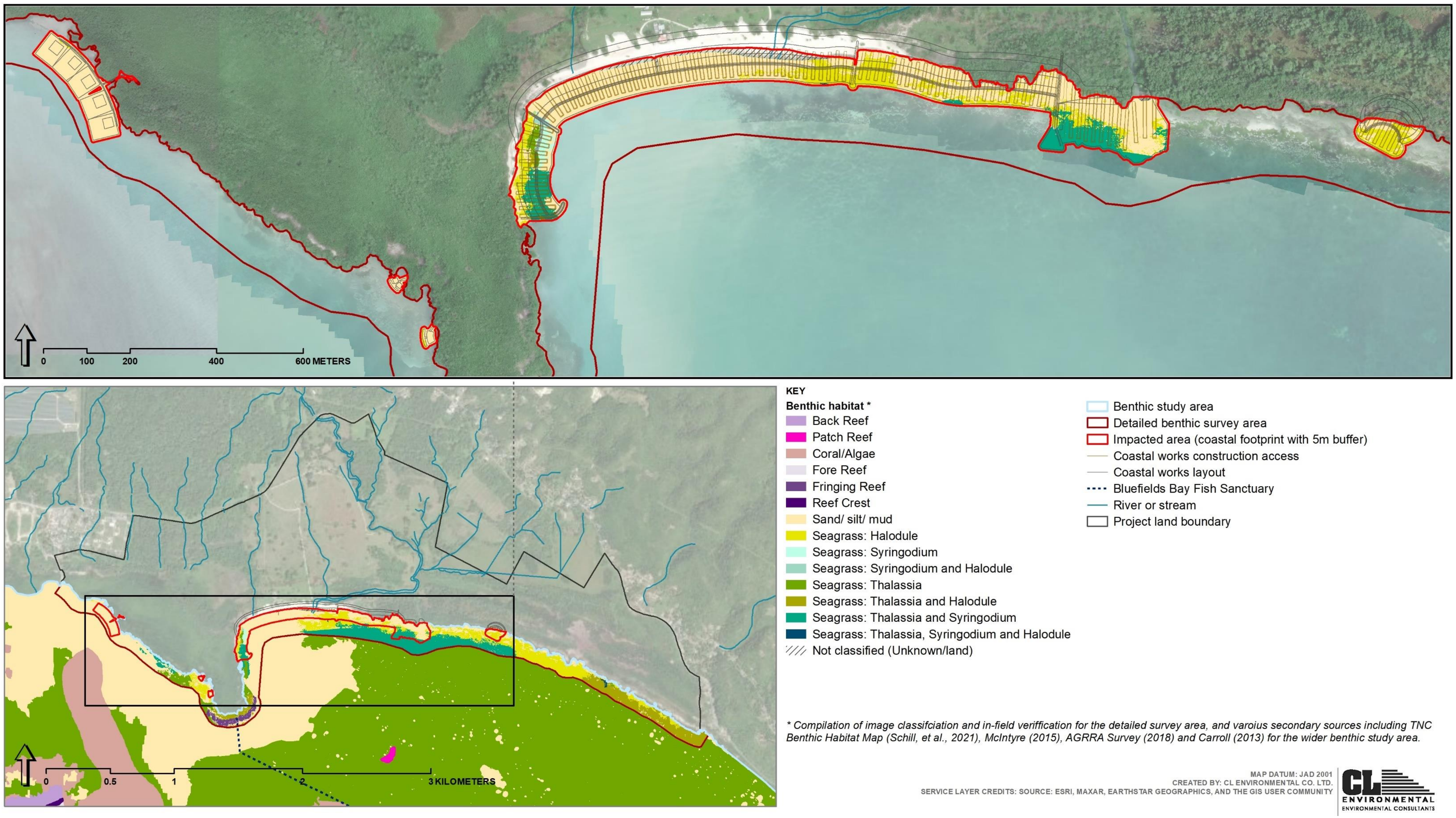


Figure 6-29 Potentially impacted benthic habitats within nearshore detailed survey area and wider benthic study area

6.2.2.8 Seagrass

Impact

Sections of the project footprint lie within an expansive seagrass bed. A 5-meter buffer outside of the project footprint was applied to account for the active working area and accidental seagrass damage during construction. Approximately 6.78 hectares of seagrass within the project footprint, including buffer areas, may be impacted (Table 6-11 and Figure 6-29). Estimates for seagrass coverage were determined based on density/percentage cover, reflecting the amount of seagrass present relative to the total surveyed area. This approach acknowledges that the total area surveyed includes habitats where seagrass may be absent or present at low densities, thus explaining why the total surveyed area differs from the total area covered by seagrass. This method accounts for variability in seagrass distribution and density across different substrate types and environmental conditions within the study area.

Seagrass suitability was evaluated based on substrate composition, species composition, and density within the project area. Areas characterized by very soft and silty sediment were deemed unsuitable for relocation. These conditions typically lack sufficient root structure and sediment stability required for successful transplantation. In locations where sediment depth and seagrass density were moderate, relocation suitability was considered suboptimal. Such areas may pose challenges in maintaining seagrass health during and after relocation efforts. Conversely, areas characterized by dense Thalassia cover and deeper sandy substrates would be suitable for relocation. These areas provide favourable conditions for robust seagrass growth and establishment, facilitating successful relocation initiatives.

Most of the potential seagrass impact area is characterised by a soft, silty substrate dominated by *Halodule*. While species density and distribution within the project footprint, these near shore areas are dominated by a relatively soft substrate, silty conditions increase closer to the shoreline, these are also areas that are either devoid of seagrass or have primary species such as *Halodule* and algae. Certain small areas with firmer sediment are dominated by *Thalassia* and may be suitable for relocation; however, the process is likely to cause additional damage to surrounding seagrass outside the footprint.

CARBON SEQUESTRATION AND STORAGE

As detailed in the baseline description of the seagrass beds, much of the seagrass habitat in question show large stands of grass with dense root systems (due to the presence of soft, easily penetrable substrates). Seagrasses found in mud and silt were seen to have greater carbon storage.

Researchers have repeatedly noted a positive correlation between sediment grain size and carbon content (Oreska M. P. J., 2017) (Röhr E., 2018) (Prentice C., 2020), with fine grained sediments having a greater available surface area, higher porosity (Dahl M., 2016), and more effectively binding organic carbon (Novak M., 2020).

The ability to store and sequester carbon varies within seagrass bed and substrate types. Based on the findings of the EIA, sections within the study area along west peninsula possessing large deposits of mud and silt as well as those along the eastern coastline affected by river outflows are seen to store more soil carbon, than areas with coarse sand which store less soil carbon. Most of the stored soil carbon within the impact area can be found in mud and silty arears.

Findings within the sampled sites yielded an average carbon value of 19.69 MgC/ha among all seagrass components (vegetative and soil). Within the detailed study area, the majority of sites possessed a mixture of *Thalassia sp* and *Syringodium sp*, large stands of the seagrass species *Halodule wrightii* exist along the eastern coastline which receives a high nutrient input from a nearby river carrying agricultural effluent. Here, an estimated *Halodule sp.* soil carbon storage value within the impact area of 40.82MgC and an estimated 226.91MgC is present within the detailed survey area. This increased organic carbon storage may be due to a number of factors. Farmland runoff contains high amount of nitrogen and phosphorous which promotes seagrass growth. These nutrient rich environments may also lead to the depletion of oxygen in sediments which create conditions that slow down the breakdown of organic material. River effluent also carries organic material from upstream sources which contribute to carbon storage.

Halodule wrightii, the dominant seagrass along the eastern coastline is expected in such conditions as they are characteristically tolerant of nutrient rich conditions, can survive in shallow waters (assisted by increased deposition from river), more tolerant to fluctuating salinities and thrives in softer substrates.

Carbon stored in the above and below ground biomass (roots and shoots) varies within the impact area. The ability to sequester and store more carbon is related to several environmental factors such as hydrodynamic activity and nutrient inputs. More sheltered areas of seagrass beds (reduced currents) in general have higher potential of carbon storage while areas with higher nutrient inputs such as run off and proximity to rivers, drains or gullies also have a higher potential for carbon storage.

According to (Fourqurean, 2012) (Kennedy, 210) (Lavery, 2013) and (Macreadie, 2019), carbon sequestration in seagrass beds can vary with substrate type. Seagrass beds are highly productive coastal ecosystems that play a significant role in carbon sequestration and storage. The substrate, or the type of sediment or soil in which seagrasses grow, can influence the carbon sequestration capacity of seagrass beds in several ways:

- Sediment Composition: The composition of the sediment can affect the availability of nutrients and organic matter, which are essential for seagrass growth and productivity. Different sediment types may vary in their organic carbon content, nutrient levels, and texture, which can influence the seagrass growth rate and, consequently, carbon sequestration.
- Particle Size and Porosity: The size and porosity of the sediment particles can affect water movement and nutrient exchange within the seagrass bed. Fine sediments with smaller particles

tend to have higher organic carbon content and provide more favourable conditions for seagrass growth and carbon sequestration compared to coarse sediments.

The IPCC have set a default rate for seagrass carbon sequestration (0.43 t C ha-1 yr-1) and research by (Oreska M. P. J., 2020) supported this value for initial restoration up to 10 years, but further research is considered necessary to confirm that the rate is applicable globally.

SEAGRASS PRODUCTIVITY

Seagrasses present within the impact area will critically suffer from construction activities which result in increased sedimentation, shading, water quality degradation, hydrodynamic changes, and biological interactions. The productivity of seagrass beds is typically dependent on the availability of light, wave activity, biodiversity, and the presence of nutrients within the water column. Results of baseline assessments conducted within the study area indicate slight variances in seagrass productivity as they fluctuate around +/- 0.03 g/m^{2-14} between sites.

Seagrass productivity may be impacted by marine construction activities through direct physical disturbance such as mechanical damage from dredging, anchoring and the movement of heavy equipment which can physically damage or uproot seagrass beds. Sediment displacement can lead to the possible burying of seagrasses which will hinder their ability to photosynthesize. Shading from structures during the construction and operation process will also lead to the reduction of light available for continued productivity and may result in death of beds within these areas.

Water quality degradation such as increased turbidity, nutrient runoff and pollutant discharge will promote unfavourable conditions for seagrass growth. These may lead to an increase in competition for light which may be brought about by eutrophication, algal blooms, and high turbidity. Where it is possible for pollutants to be discharged such as heavy metals and hydrocarbons, these toxins may be fatal to the existing ecosystem. Additionally, the disruption of sediment stability due to coastal construction may also change local hydrodynamics and result in altered water flow; this could result in the accumulation of pollutants within the impact and buffer areas which will negatively impact seagrass health. Increased erosion and sedimentation may also occur due to alterations in coastal morphology. Construction activities may lead to the long-term disturbance of fauna within seagrass beds. Fish and invertebrate species graze within seagrass beds may be removed leading to the overgrowth of epiphytes on seagrass blades.

Recommended Mitigation

See Primary Recommended Mitigation in section 6.2.1.3, as well as measures outlined in section 6.2.1.4. Additionally:

i. Habitat management and restoration within the Sanctuary may involve activities such as identifying areas for habitat or species restoration and rehabilitation, actively removing trash and litter, controlling invasive species, and implementing erosion control measures in seagrass beds.
ii. To offset the loss of blue carbon, and in collaboration with the BFBSFS, various carbon offset projects targeting blue carbon ecosystems will be carried out. These initiatives will focus on restoring and conserving seagrass beds, mangroves, and other crucial habitats. In addition, social outreach efforts will include educating and promoting sustainable fishing and aquaculture practices to reduce habitat disruption and carbon emissions. Active involvement from local communities and the sanctuary's management will ensure the adoption and long-term maintenance of these sustainable practices.
iii. Community engagement and citizen science initiatives in projects in and around the sanctuary.

6.2.2.9 Reef Communities

Impact

While the project footprint does not encompass any reef or coral areas, Thatch Reef, located near the peninsula, falls within the zone of influence, and may experience indirect effects. Other reef communities are positioned at the outer edges of the Bluefields Bay Fish Sanctuary boundaries, well beyond the immediate impact areas, ensuring their direct exposure to project activities remains

Recommended Mitigation

See Primary Recommended Mitigation in section 6.2.1.3, as well as measures outlined in section 6.2.1.4. Additionally, Coral nurseries, along with potential artificial reefs, should be established to support coral restoration efforts. These nurseries are designated structures or areas designed to cultivate and propagate corals for restoration purposes. They will focus on the cultivation and rehabilitation of various coral species, providing a scientifically-based method to preserve and restore impacted coral communities. Coral nurseries offer numerous benefits for the conservation and restoration of coral reef ecosystems, including the enhancement of biodiversity and ecosystem resilience:

i. Coral Reef Restoration: Coral nurseries provide a means to propagate and grow coral fragments in controlled environments. This allows for the production of a large number of healthy coral colonies that can be used for reef restoration projects. By transplanting these nursery-grown corals onto degraded reefs, the nurseries contribute to the recovery and resilience of coral reef ecosystems. (Bayraktarov, n.d.).
ii. Genetic Diversity Preservation: Coral nurseries can enhance genetic diversity in restored reefs by cultivating and propagating multiple coral genotypes. By selecting diverse parent colonies and incorporating different genotypes, nurseries can contribute to the overall genetic health and resilience of coral populations. (Consortium, 2017)
iii. Climate Change Resilience: Coral nurseries can assist in developing coral populations that are better adapted to changing environmental conditions, including ocean warming and

acidification. By selecting and propagating coral genotypes that exhibit higher thermal tolerance or resilience, nurseries can help create reef communities better equipped to withstand climate stressors (Van Oppen, 2015)

iv. Increased Habitat Complexity: Coral nurseries and artificial reefs enhance habitat complexity by providing three-dimensional structures that support diverse marine life. Artificial reefs offer shelter and breeding grounds, while nurseries supply resilient corals that can be transplanted onto these structures, accelerating reef development. Together, they increase biodiversity, improve ecosystem resilience, and contribute to the long-term health of marine habitats.

6.2.2.10 Fish Communities

Impact

Various project activities can influence fish populations and aquatic ecosystems, with both negative and potentially beneficial effects. Habitat destruction, increased sedimentation, and water pollution can disrupt fish behaviour, feeding, and habitat use, while noise and vibrations may lead to stress and displacement. The removal of benthic habitats can further alter biodiversity and ecosystem dynamics. However, the introduction of various underwater structures may increase habitat complexity, potentially benefiting certain species. Enhanced monitoring and management efforts can mitigate some of these impacts.

Recommended Mitigation

See Primary Recommended Mitigation in section 6.2.1.3, as well as measures outlined in section 6.2.1.4. and 6.2.2.9.

6.2.2.11 Sea Turtles

Impact

Although no turtles were observed in or around the study area, other beaches within the sanctuary are recognized as important turtle nesting sites. Site preparation and construction activities could lead to the temporary displacement of sea turtles that use the area for foraging and nesting. This displacement may be caused by the installation of silt screens, barriers, and other equipment, which could block or restrict access to various habitats and migration pathways, leading to fragmentation of their environment.

Nesting turtles maybe particularly sensitive to varying and increased noise (Wendy E.D Piniak, 2016). While studies have shown that turtles are capable of perceiving auditory cues, the full impact of noise on their ecology is not yet fully understood. Additionally, lighting associated with night-time construction activities could disrupt nesting and navigation for some turtle species.

Recommended Mitigation

i. All staff and workers should be sensitized to all sensitive ecosystems and species in the area, in particular turtles. The site should be inspected daily for any signs of turtle activity. If a nest is suspected or found, all activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs.
ii. The stakeholders, proponents and the NEPA should develop clear lines of reporting and communication in the event that action needs to be taken.
iii. Silt screens should be used to prevent sedimentation but should be removed promptly along with any other construction debris and material upon completion.
iv. Night-time activities should be limited or avoided when possible. No lights should be pointed out to sea confusion and disorientation of turtles or any other species that maybe affected by lunar activity.
v. Fixtures in direct line-of-sight from the beach should be shielded down-light only fixtures or recessed fixtures having low wattage "bug" type bulbs and non-reflective interior surfaces.
vi. Fixtures mounted as low in elevation as possible through use of low-mounted wall fixtures, low bollards, and ground level fixtures.
vii. Floodlights, up-lights, or spotlights for decorative and accent purposes that are directly visible from the beach, or which indirectly or cumulatively illuminate the beach shall not be used.
viii. For high intensity lighting applications such as providing security and similar applications shielded low-pressure sodium vapour lamps and fixtures shall be used.

6.2.3 Socioeconomic and Cultural

6.2.3.1 Employment

Impact

As the development advances, numerous construction-related job opportunities will be created, with a focus on employing local labour as these opportunities arise. Over the long term, the project is anticipated to provide substantial employment for the local community. Specifically, it will generate around 600 jobs in residential and hotel construction, along with 100 jobs in infrastructure and amenity construction. At its peak, the project is expected to employ up to 1,000 people. This will likely result in the creation of approximately 2,660 to 3,800 indirect and induced jobs during the construction phase.

The anticipated job opportunities during the construction phase are seen as a positive development, helping to address employment issues. At the time of the 2010 SDC household survey in Smithfield, unemployment was a significant issue, particularly among youth, with an overall youth unemployment rate of 28.5% for those aged 14-24. For the 2024 perception survey area, of the individuals interviewed who provided a response, 3.9% indicated they were unemployed. Regarding skills training, 9.9% of household heads from the 2010 SDC household survey in Smithfield were unemployed due to a lack of skills or qualifications, which served as a major barrier to employment. While the specific training areas for nearly 50% of household members were not identified, 10.2% of those with identifiable skills had training in construction and cabinet making, indicating some potential alignment with employment opportunities in the construction sector.

According to the perception survey, when asked about the anticipated impact on lives and livelihoods, 60.1% of interviewees (of the 64.1% who expected any effect) indicated they believed the impact would be positive. The most common response cited was the creation of employment opportunities, which would be welcomed by the community.

However, there is also a potential for an influx of individuals seeking employment or business opportunities into surrounding communities, which may lead to challenges such as squatting.

Recommended Mitigation

i. Prioritize sourcing potential workers from nearby communities to strengthen community relations and support local economies. JDV aims to prioritize local talent and labour for both the construction and operation of the hotel whenever feasible.
ii. Ensure that project-derived benefits are accessible to people of all genders, sexual orientations, and gender identities, fostering an inclusive environment where everyone can benefit equally from employment opportunities.
iii. Implement robust measures to prevent incidents of sexual and gender-based violence, including sexual harassment, exploitation, and abuse. Establish clear protocols for prompt and effective responses to any incidents of SGBV.
iv. Proactively identify and prevent risks and impacts related to gender, sexual orientation, and gender identity. When avoidance is not possible, mitigate and compensate for such impacts to ensure fairness and equality.
v. The project team will collaborate closely with the Westmoreland Municipal Corporation to manage and mitigate the potential issues of squatting and influx of people.

By adopting these measures, the Developer can enhance community relations, promote inclusivity, and ensure that the benefits of the project are shared equitably among all community members.

6.2.3.2 Electricity Supply

Impact

The potential impacts of the construction phase on electrical supply may include increased demand on the local electrical grid, as the hotel's energy consumption could raise the demand, particularly during peak times. This could lead to capacity issues and potential voltage fluctuations. Additionally, the need for backup power systems, such as generators or batteries, to maintain a consistent power supply during outages may consume additional resources and impact fuel supply, maintenance, and environmental emissions, particularly if fossil fuel-powered generators are used. These impacts are expected to be temporary, as a solar field will be constructed, reducing reliance on the grid and mitigating many of these concerns in the long term.

Recommended Mitigation

i. Efforts should be made to carefully manage the increased demand on the grid by working closely with the local utility provider to assess capacity and ensure the infrastructure can handle the added load. If necessary, grid upgrades or temporary solutions, such as load-shedding during peak demand, can be considered.
ii. For backup power systems, the use of energy-efficient, low-emission generators, such as those powered by LNG or renewable energy sources, should be prioritized to minimize fuel consumption, emissions, and noise pollution.
iii. Additionally, implementing an optimized generator maintenance schedule will help ensure the systems run efficiently and reduce environmental impacts.

Furthermore, as the solar field is constructed, reliance on the grid will decrease, providing long-term sustainability and reducing many of the temporary impacts associated with the construction phase.

6.2.3.3 Water Supply

Impact

According to the public perception survey, while most respondents reported no issues with their water supply, those who did experience problems highlighted concerns such as irregular supply, low water pressure, complete outages, and water turbidity. These issues may be exacerbated during the construction phase, when increased demand for water—due to activities such as dust suppression, concrete mixing, and landscaping—could strain the existing infrastructure. This is particularly relevant in areas where water resources are already limited or subject to seasonal fluctuations. Notably, the SIA does not solely depend on NWC water but rather reflects a blend of modern and traditional water access methods. While many households in the area are connected to public water sources, there is also a significant reliance on private sources, such as rainwater catchment, in some areas.

The impact on local water resources during construction is expected to be temporary, as the project incorporates several measures to optimize water usage during operation (see section 6.3.4.3).

Recommended Mitigation

To mitigate the increased demand on local water resources during the construction phase, several measures can be implemented:

i. Water use should be optimized through the use of water-efficient practices, such as recycling water for dust suppression and concrete mixing where possible.

ii. Alternative water sources, such as stored rainwater or groundwater, can be explored to reduce reliance on local water supplies.
iii. Scheduling construction activities that require large amounts of water during off-peak times, when demand on local water resources is lower, can also help ease pressure on the infrastructure.
iv. Work closely with local authorities and water suppliers to monitor water usage and ensure that any necessary permits or water access agreements are in place will help manage demand responsibly.
v. Regular assessments of the local water supply capacity should be conducted to ensure that construction activities do not strain existing resources, and adjustments can be made if necessary.

6.2.3.4 Wastewater

Impact

For every construction site, there arises the requirement to furnish construction workers with showers and sanitary facilities. The disposal of wastewater produced at the construction campsite may pose an adverse impact on water quality if inadequately handling wastewater. A deterioration in water quality may subsequently adversely affect aquatic ecosystems and pose health hazards to humans.

Recommended Mitigation

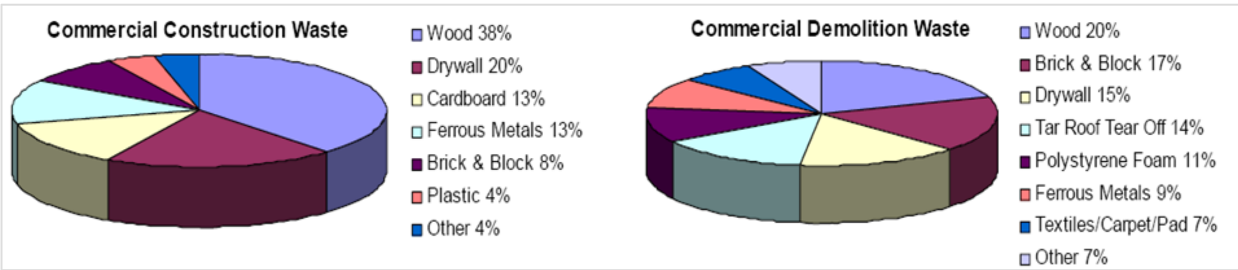
i. Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per chemical toilet should be used.
ii. Portable toilets should be located approximately 25 metres from the high-water mark, away from the shoreline to avoid discharge into the marine environment in the event of accidental spillage.

6.2.3.5 Solid Waste

Impact

During the construction phase of the proposed project, solid waste generation will occur mainly from construction activities, such as site clearance and excavation. Improper handling and disposal of this waste can lead to environmental pollution, habitat degradation, and unpleasant visual aesthetics. Furthermore, solid waste may attract vermin and pose health hazards to workers and nearby communities.

During the construction phase of the proposed project, solid waste generation will occur mainly from construction activities, such as site clearance and excavation. The USEPA estimates from surveys of non-residential construction that the average rate of solid waste generation is 22.95 Kg/square metre (or 1.6 to 8.5 lb/ft^2 (5.05 lb/ft^2)). With an estimated 166,041 m^2 (1,787,250.45 ft^2) of building floor area, then the estimated construction solid waste is 4,093.95 tonnes, comprised mainly of wood, blocks/bricks, cardboard, drywall, ferrous material, and plastics. Figure 6-30 and Table 6-12 shows the typical breakdown of this waste.



Source: "Construction and Demolition Waste Management Toolkit," WasteCap Wisconsin, June 2005

Figure 6-30 Composition of construction and demolition waste

Table 6-12 Estimated construction solid waste generation

BUILDING SIZE		**1,787,250.45 ft2**	**1,787,250.45 ft2**		
GENERATION RATE		**LOW 1.6 lb/ft²**	**HIGH 8.5 lb/ft²**		
MATERIAL	**COMPOSITION (%)**	**LBS**	**LBS**	**LOW TONNES**	**HIGH TONNES**
Wood	38	1,086,648.27	5,772,818.95	492.895	2618.504
Drywall	20	571,920.14	3,038,325.77	259.418	1378.16
Cardboard	13	371,748.09	1,974,911.75	168.622	895.8042
Ferrous	13	371,748.09	1,974,911.75	168.622	895.8042
Brick/Block	8	228,768.06	1,215,330.31	103.767	551.2641
Plastic	4	114,384.03	607,665.15	51.8837	275.6321
Other	4	114,384.03	607,665.15	51.8837	275.6321
TOTAL	100	2,859,600.72	15,191,628.83	1297.09	6890.801
AVERAGE		9,025,614.77		**4,093.95**	

The existing conditions regarding garbage disposal indicate that, for the most part, perception survey participants did not report significant issues. However, a notable portion of respondents who did mention problems highlighted irregular waste collection as the primary concern. Additionally, illegal dumping and the fact that garbage trucks did not always enter certain communities to collect waste were also cited as contributing factors. To avoid exacerbating any existing deficiencies, the Strategic Waste Management Plan for the construction phase prioritizes waste reduction through design and efficient construction practices, thereby minimizing the impact on solid waste (see section **Error! Reference source not found.**). This includes using prefabricated and modular materials, adapting temporary storage structures into the final design, and minimizing site disturbance. Environmentally friendly materials and accurate material take-offs will be prioritized, along with procurement agreements to minimize excessive packaging. Locally sourced materials will reduce shipping, and BIM modelling will prevent waste caused by clashes and rework. Waste will be segregated for recycling, with a focus on lumber, rebar, and metal. Frequent site cleaning and a quality control program will further reduce construction errors and waste generation.

Recommended Mitigation

In addition to the waste management plan detailed in section **Error! Reference source not found.**, the following may be considered:

i. Waste Management Plan:
   a. Develop a comprehensive waste management plan outlining procedures for waste segregation, recycling, and disposal. This should be approved by the National Environment and Planning Agency (NEPA) and the National Solid Waste Management Authority (NSWMA).
   b. Assign responsibilities to personnel for waste management and designate waste collection points on-site.
   c. Employees should be educated on impacts of solid waste and best practises.
   d. Prioritize waste minimization by reducing packaging materials, reusing construction waste where feasible, and recycling materials such as metal, wood, and concrete.
   e. Encourage contractors and suppliers to use eco-friendly packaging and materials that are recyclable or biodegradable.
   f. Solid waste collection points and the number of staff assigned to collection and disposal should be increased with every stage of construction and changes to the number of workers present.
ii. Waste Segregation and Storage:
   a. Skips and bins should be strategically placed within the campsite and construction site.
   b. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
   c. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
   d. Disposal of the contents of the skips and bins should be done at an approved disposal site.
   e. Establish separate bins or containers for different types of waste, including recyclables, hazardous materials, and non-recyclable waste.
   f. Clearly label bins and provide training to workers on proper waste sorting and segregation practices.
iii. Hazardous Waste Handling:
   a. Identify and properly handle hazardous materials such as paints, solvents, batteries, and chemicals according to regulatory requirements.

b. Store hazardous waste in designated areas with appropriate containment measures to prevent spills and leaks.

iv. Monitoring and Compliances:

a. Monitor waste generation, segregation, and disposal activities regularly to assess compliance with waste management objectives.

b. A ticketing system will be developed between both the Permittee and the Solid Waste Contractor to ensure effective management of waste and verification of disposal at the correct site.

6.2.3.6 Health and Safety

Impact

For instance, workers may be suspended at heights during various tasks, increasing the risk of accidents. Dust generated during construction can also pose health risks to workers, along with other potential hazards such as fire safety concerns, electrical risks, eye injuries, and radiation exposure. In the construction of coastal structures, the process of stockpiling and handling armour stones, using excavators to move and place them, poses additional risks for accidental injuries. The presence of a construction site may also encourage food vendors, or "cook shops," to set up, which could lead to improper food preparation and hygiene practices. This can introduce pathogens into the food supply, potentially causing foodborne illnesses. Furthermore, natural disasters such as earthquakes, floods, and hurricanes remain a concern during construction, presenting additional risks to both workers and the site.

The Safety Management Plan for the project emphasizes four key components: management leadership, employee involvement, measurement systems, and a continuous safety improvement process (see section **Error! Reference source not found.**). Given the inherent risks of certain activities, it is crucial for supervisors and workers to commit to promoting safety, with personal protective equipment (PPE) such as high-visibility clothing always required. The contractor will develop and implement Activity Hazard Analysis (AHA) plans, engaging the workforce in identifying hazards and controls. These plans will be regularly updated and monitored, with supervisory staff receiving training in accident reduction techniques. Special safety measures, such as full-body harnesses for roof construction and tie-off points for fall protection, will be implemented. Competent persons will be designated for specific tasks, ensuring safety compliance. Material lifts and scaffolding will be used under strict supervision to ensure safety in lifting operations. With these proposed measures in place, health and safety impacts will be minimized throughout the construction phase.

Recommended Mitigation

To supplement the proposed Safety Management Plan detailed in section **Error! Reference source not found.**, it is recommended:

GENERAL

i. Worker Protection:
   a. Provide comprehensive safety training and education programs for all construction workers, including hazard recognition, emergency response procedures, and proper use of personal protective equipment (PPE).
   b. If necessary, provision of lifelines, personal safety nets or safety belts and scaffolding.
   c. Ensure that workers wear PPE (hard hats, reflective vests, safety shoes, eye protection etc.)
   d. Establish Lockout -Tag Out (LOTO) procedures.
   e. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

ii. Emergency Preparedness and Response Planning:
   a. Develop emergency response plans and procedures for handling accidents, injuries, fires, and other emergencies on-site. Designing and implementing an Emergency Response Plan (ERP) in the event of any emergency. This should include:
      - Hurricane
      - Earthquake
      - Flooding
      - Fire
      - Civil Unrest and Riots
      - Bomb Threats and Acts of Sabotage
      - Acts of Terrorism and Armed Attacks
      - Petroleum and Hazardous Material Stockpiling
      - Security and Safety Information
      - Medical Emergency Information
      - Technological Emergencies
   a. Designate a qualified safety officer or supervisor responsible for emergencies and overseeing safety compliance and enforcement on-site. This person should be clearly identified to the construction workers.
   b. Conduct regular safety inspections, audits, and reviews to identify areas for improvement and implement corrective actions as needed.
   c. Site should be equipped with first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site.
   d. Ensure that there is an ambulance and requisite staff onsite for any eventualities.
   e. Make prior arrangements with staff at the closest heath facilities to accommodate any eventualities. The Savanna-la-Mar Public Hospital and the Savanna la Mar Health Centre are located 3.5 km west of the project area. Also, the Westmoreland Public Health Services fleet includes seven ambulances, most of which are based at the Savanna la Mar Public General Hospital.

   f. Make prior arrangements with the Savanna-la-Mar police and fire stations to accommodate any eventualities.

iii. Hazardous Material Management:
   a. Properly store, handle, and dispose of hazardous materials and chemicals used during construction, following regulatory requirements and best practices.
   b. Material Safety Data Sheets (MSDS) should be stored onsite.

iv. Communication and Reporting:
   a. Establish clear communication channels for reporting safety concerns, near misses, and incidents on-site.
   b. Encourage open dialogue between workers, supervisors, and management to address safety issues promptly and effectively.

TRENCH EXCAVATION

i. A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals.
ii. Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil).
iii. Spoil should be placed so that the channels rainwater and other runoff water away from the excavation.
iv. Take precautions regarding tension cracks
   - Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench.
   - Sliding or sloughing may occur as a result of tension cracks. [3]

VENDING AREAS

i. Provision of adequate supply of potable water.
ii. Monitoring of the various "cook shops" by public health authorities and the construction management team, to ensure proper hygiene is being followed.
iii. The provision of areas to adequately wash hands and utensils.
iv. Support the Westmoreland Municipal Corporation to ensure an orderly layout of vending areas.

MARINE

i. A safety officer, who is a competent swimmer and CPR trained, should be appointed.
ii. Spotters in the water will assist the heavy equipment in accurate placement of the armour units.
iii. The slopes and elevations of the armour layer will be demarcated with visual aids to guide the placement of boulders and to ensure they are properly interlocked.

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[3] Worker Health and Safety Guidelines as per OSHA #510 Construction Industry Standard 29 CFR Part 1926.

6.2.3.7 Land Use

Impact

The construction phase of the development at Paradise Park will lead to changes in land use, particularly as existing agricultural, residential, and recreational spaces make way for a new hospitality developments. Currently, the land is used for a mix of activities, including cattle farming, timber harvesting, dairy and poultry farming, and recreational purposes, alongside historical and archaeological sites. The conversion of these lands into construction areas will directly impact these traditional land uses and potentially alter the character of the area.

The landowner has identified land to relocate agricultural assets, livestock, and other farm animals.

Recommended Mitigation

To mitigate the impacts of land use changes during the construction phase, several strategies can be implemented:

i. Careful planning, phasing, and zoning should be used to minimize disruption to existing spaces and activities, ensuring a smooth transition.
ii. Where land conversion is necessary, efforts should focus on relocating activities to nearby available lands or creating new spaces to offset the loss. As noted, the current owner has already identified locations for relocating agricultural assets. For residents, the potential development will require arrangements for either compensation or relocation. Compensation packages should be fair and transparent and relocation assistance should include support in finding new housing and covering moving costs, ensuring the new homes meet residents' needs. Consultation will ensure residents' concerns are addressed and their preferences considered.
iii. Engage with local stakeholders to ensure their needs are considered and help facilitate a smooth transition throughout the construction phase into the operation of the resort.

6.2.3.8 Vehicular Traffic

Impact

During the construction phase, there will be an influx of construction vehicles (e.g., trucks, cranes, and delivery vehicles) to transport materials and equipment. This can potentially lead to temporary congestion on roads, especially if there is limited space for these vehicles to manoeuvre or park. The main road leading to the development could experience increased vehicle volumes, which may result in slower travel times, particularly during peak traffic hours.

Construction activities often involve traffic management measures like lane reductions, temporary traffic signals, or flagmen to control the movement of vehicles around the construction site. These measures can cause delays, especially during peak travel periods, leading to increased travel time for motorists and reduced overall road capacity.

Recommended Mitigation

To minimize the potential impact of increased traffic, it is highly recommended to implement traffic calming measures during the construction phase:

i. Improved road lighting to enhance visibility in low-light conditions.
ii. Appropriate traffic warning signs informing road users of the construction site entrance and instructing them to reduce speed.
iii. Flagmen should be employed to control traffic and assist construction vehicles as they enter and exit the project site, particularly for heavy vehicles.
iv. Rumble strips to improve oncoming vehicle awareness.
v. Schedule all major heavy vehicle traffic during off-peak hours to reduce the impact on the main road.

6.2.3.9 Maritime Traffic

Impact

Construction activities for the costal works may potentially have an impact on maritime activities. The presence of temporary construction access pads, vessels, machinery, and equipment in the water could temporarily affect local fishing operations outside the sanctuary, recreational boating, and other maritime activities. While the increased maritime traffic and construction activities may introduce some risk, the impact is expected to be limited, with measures in place to ensure safety for both construction workers and local maritime users.

Recommended Mitigation

i. Maritime Traffic Management:
    a. Clear Navigation Routes: Establish and clearly mark safe navigation routes for local fishers and recreational boaters to avoid construction areas.
    b. Exclusion/ Safety Zones: Establish safety exclusion zones around construction areas to prevent unauthorized access and reduce the risk of accidents. These zones should be clearly marked with buoys and warning signs to keep out other marine traffic and fishers from the work area and prevent potential accidents.
    c. Monitoring and Enforcement: Maritime patrols to monitor and enforce safety zones, ensuring compliance by all vessels operating in the area.
ii. Coordination with Local Maritime Users:
    a. Stakeholder Engagement: Engage with Bluefields Bay Fishermen's Friendly Society (BBFFS), local fishing communities and maritime users early in the planning process to understand their needs and concerns. Provide regular updates and opportunities for feedback throughout the construction phase.

b. Communication Protocols: Implement communication protocols to inform the BBFFS and maritime users of construction schedules, locations, and potential hazards through local notices to mariners and regular updates.
c. Compensation and Support: Consider compensation or support measures for the BBFFS, local fishers and maritime businesses adversely affected by the construction activities.

iii. Environmental Protection:
a. Minimize Turbidity and Pollution: Use turbidity curtains and other measures to minimize sediment disturbance and water pollution during construction. Ensure all vessels and machinery are well-maintained to prevent leaks and spills.
b. Timing Restrictions: Schedule construction activities to avoid peak fishing seasons or sensitive periods for marine wildlife to reduce disruption to local ecosystems.

6.2.3.10 Aesthetics

Impact

Construction activities may decrease the aesthetic appeal of the area; however, this will be for a short-term period during construction. Negative impacts on the aesthetics include:

- Visual Intrusion: The presence of construction machinery, equipment, and temporary structures can significantly alter the visual landscape, making it less attractive.
- Dust and Debris: Dust, debris, and waste materials from construction activities can contribute to a visually unappealing environment. In particular, trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing and in the process, affecting the conditions of other vehicles traversing the main road.
- Noise and Light Pollution: Construction noise and lighting can detract from the natural and serene ambiance of the area, particularly in residential or natural settings.
- Alteration of Natural Features: The removal of vegetation and changes to the natural landform during construction can permanently alter the visual character of the area.

Recommended Mitigation

i. Site Management:
a. Erect temporary hoarding or fencing around the construction site to obscure unsightly machinery and activities.
b. Maintain a clean construction site by regularly removing debris, waste materials, and dust. Implement dust control measures such as water spraying and covering stockpiles.
c. An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/marl from truck wheels.
d. A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/marl as possible.

   e. Use directional lighting to focus light only where it is needed and minimize spillover into surrounding areas. Employ low-intensity, warm-coloured lighting to reduce glare and light pollution.

ii. Minimize Visual Intrusion:
   a. Compact Site Layout: Organize the construction site to minimize the footprint and reduce visual intrusion. Place equipment and materials in less visible areas whenever possible.
   b. Camouflage and Landscaping: Use temporary landscaping or plantings to soften the visual impact of the construction site. Employ natural colours and materials to blend temporary structures with the surrounding environment.

As mentioned, negative impacts to the aesthetics of the area are short-term and the proposed landscaping plan includes the reintroduction of plants and the creation of visually appealing green spaces.

6.2.3.11 Cultural and Heritage

Impact

Paradise Park contains significant archaeological evidence linked to all of Jamaica's major historical settler ethnic groups: the Taino, Spanish, and British (Jamaica National Heritage Trust, 2023). The site holds high archaeological value due to its limited previous evaluation, having not undergone extensive invasive archaeological methodologies or excavation. The proposed development plan for the resort includes constructing structures near two identified archaeological sites, Paradise and Sweetwater, which were previously excavated by William F. Keegan. While the full extent of the sites remains uncertain, numerous surface and subsurface artefacts and artefact assemblages are still present. Any damage to these artefacts would result in a loss to Jamaica's archaeological heritage (Jamaica National Heritage Trust, 2023).

While the historical cultural assets on the Paradise Park property have been severely diminished over time due to natural and human factors, some significant features remain, including the overseer's house used by the JDF and the ancillary buildings of the great house, which are now repurposed as offices and a garage (Jamaica National Heritage Trust, 2023). Other historical elements, such as the foundation of the great house, a grave, cattle pen ruins, and the perimeter stone wall, may also potentially be impacted.

The location of a large Taino archaeological site in the wetland area east of the Deans Valley River, identified since the 1990s, adds complexity to the development plan. This site is believed to be one of Jamaica's earliest indigenous Amerindian settlements, containing remnants of the Ostionian and Meillacans cultures. Stretching about 85 metres, this rare redware type site may potentially be impacted by the proposed villas.

Recommended Mitigation

The Taino archaeological site in the wetland area east of the Deans Valley River is of significant archaeological importance and the JNHT strongly recommends preserving the Taino site for prosperity, possibly as a research site and integrating it into the overall development plan for future study and public education (Jamaica National Heritage Trust, 2023). Therefore, the following measures are recommended, which must be agreed upon with JNHT:

- The Taino archaeological site should be delineated by the JNHT to ensure the developer is aware of its boundaries.
- The developer must adhere to JNHT guidelines, with JNHT present on-site during any excavation activities to monitor the process and ensure full compliance with these protocols.

6.2.3.12 Community Relations

Impact

Community relations may be impacted by the lack of awareness and understanding surrounding the project. With a significant portion of the community, including 89.9% of general respondents and 90.5% of fishers, unaware of the proposed project, there is potential for misinformation or misunderstandings to arise. The reliance on word of mouth as the primary source of information could lead to fragmented or incomplete knowledge, which may affect trust and support for the development.

Given that the site is private property and the waters adjacent the beach is within the Bluefields Bay fish sanctuary, the majority of the community does not actively use or access the site. Only a small portion of the residential (5.2%) and fishing (23.8%) communities actively utilize the area; however, it is important to note the site holds particular importance for those who do. These users primarily engage in activities such as crab hunting, recreation and swimming and this small group may potentially feel marginalized if their concerns, particularly related to traditional practices like fishing and crab hunting, are not addressed

The community also generally views the development as a positive opportunity, believing it will bring jobs and foster economic growth in the area. However, concerns remain about potential environmental impacts and disruptions to traditional livelihoods, particularly for those who rely on nearby fishing areas and natural resources. The majority of community respondents (64.1%) believe the project will impact their lives, livelihoods, community, or the environment, with most anticipating positive effects, such as increased employment and income generation.

Among fishers, 61.9% also expect impacts, but their concerns are more focused on potential negative outcomes, including disruptions to local ecosystems, reduced water supply, increased crime, and the loss of fishing areas. Given that fishing is the sole activity reported by the 23.8% of fishers who use the site, any changes to the sea, such as construction or environmental impact from the project, could potentially affect their ability to continue fishing. Some fishers proposed mitigation measures, such as preventing marine pollution and preserving fishing zones. It is important to note that, according to the fishermen interviewed during the perception survey, fishing activities near the site mainly occur outside the boundaries of the fish sanctuary (section 5.3.2 and Figure 5-8).

While there are concerns, the impacts on the fishing industry as a result of the proposed development are expected to be minimal. In fact, in the long term, strategies for improvement, such as establishing coral nurseries and artificial reefs within the sanctuary, may be explored. These efforts should help enhance fish populations outside the sanctuary, ultimately benefiting the surrounding ecosystem and fisheries as part of a comprehensive long-term plan.

Raising awareness about the potential impacts of the proposed project is crucial, especially regarding the existence of nearby protected or important areas. The majority of community interviewees (58.7%) and some fishers (33.3%) indicated that no areas of historical/cultural/environmental importance exist near the proposed site; those fishers who were knowledgeable about such areas, mentioned the Bluefields Bay Fish Sanctuary and Bluefields Bay. These findings suggest that raising awareness and providing clear information about the proximity of sensitive sites, such as historical, cultural, or environmental areas, is essential.

Community concerns could potentially strain relations if the project does not adequately address environmental impacts, prioritize community involvement, and consider the needs and concerns of the local population during the planning and execution stages. To maintain positive relations, clear communication and effective mitigation measures will be crucial throughout the project. The community relations in Bluefields Bay are strong and dynamic, with a culture of collaboration and mutual support. Key organizations, such as the Bluefields People Community Association (BPCA) and the Bluefields Bay Fishermen’s Friendly Society (BBFFS), are instrumental in tackling local challenges, promoting sustainable development, and improving residents' quality of life. With these well-established relationships, communication about the project can be successful, as long as the community’s concerns are thoughtfully addressed and respected.

Recommended Mitigation

Proactively addressing concerns will help build a sense of inclusion and support, ensuring the community's needs are met while minimizing any negative impacts. Mitigation measures aimed at fostering positive community relations are crucial not only to address the concerns raised by local residents and the fishing community but also to introduce the project to the community and begin supporting and enhancing local resources and dynamics.

To establish and maintain a harmonious relationship with stakeholders, the following measures are recommended:

i. Alternative Spaces for Community Activities

   a. Provide alternative spaces for activities such as crab hunting, fishing, and recreation to minimize disruptions to local livelihoods and traditions.

ii. Compensation for Loss of Livelihood
   a. Offer appropriate compensation for any losses in livelihoods or traditional practices, ensuring that affected community members are fairly supported.

iii. Transparent Communication
   a. Engage in transparent communication by providing detailed information about the project and its potential impacts, addressing community concerns proactively.

iv. Grievance Redress Mechanism (GRM)
   a. Create a system that allows for timely responses to complaints from residents and stakeholders.
   b. Establish clear, accessible channels for stakeholders to submit complaints and concerns, ensuring transparency and responsiveness.
   c. Formulate a GRM to address all complaints, including reports of GBV, SEA, and discrimination.
   d. Ensure that grievances are addressed promptly and effectively, particularly sensitive issues such as GBV and SEA.
   e. Regularly engage with stakeholders to inform them about the GRM and encourage its use to report concerns.

v. Support for the Bluefields Bay Fish Sanctuary and Community Groups
   a. Establish a reporting mechanism with the Bluefields Bay Fishermen's Friendly Society (BBFFS) to ensure environmental stewardship within the sanctuary.
   b. Conduct regular environmental monitoring, especially within the sanctuary, and submit reports to the fish sanctuary management team.
   c. Facilitate partnerships and resources to help the BBFFS and other community groups maximize the positive impacts of the development while preserving local traditions and practices.

6.3 OPERATION

6.3.1 Physical

6.3.1.1 Drainage

Impact

Storage volume requirements were calculated for various return periods post construction (Table 6-13). Sub-catchments A, B, C, and E required the largest storage volumes, reaching up to 39,212 m³ for a 100-year return period. Similarly, sub-catchments G, H, and I needed up to 43,004 m³ for the same period. In contrast, sub-catchments D, F, and J were expected to drain directly into wetlands or the sea, eliminating the need for attenuation storage in these areas.

Table 6-13 Required storage volume needed for each resort sub-catchment

Catchment	*Pond Storage Required (m³)*			
	10yr	*15yr*	*25yr*	*100yr*
A, B, C, E	*1,224*	*12,380*	*21,484*	*39,212*
G, H, I	*586*	*11,161*	*19,477*	*43,004*
D, F, J	*These sub catchments are expected to drain directly into the wetlands and sea, and as such no need to attenuate flows were considered.*			

The rational method peak flow surface run-off model was used to determine the peak flow discharges affecting the development and primarily for sizing the components of the proposed conveyance system. The Soils Conservation Service (SCS) Curve Number (CN) Method[4] was used to calculate the detention volume required to adequately attenuate the post-construction run-off to be equivalent to, or less than that of the pre-construction flows from the site. The resultant peak flow for each sub-catchment is shown in Figure 6-31 through to Figure 6-35.

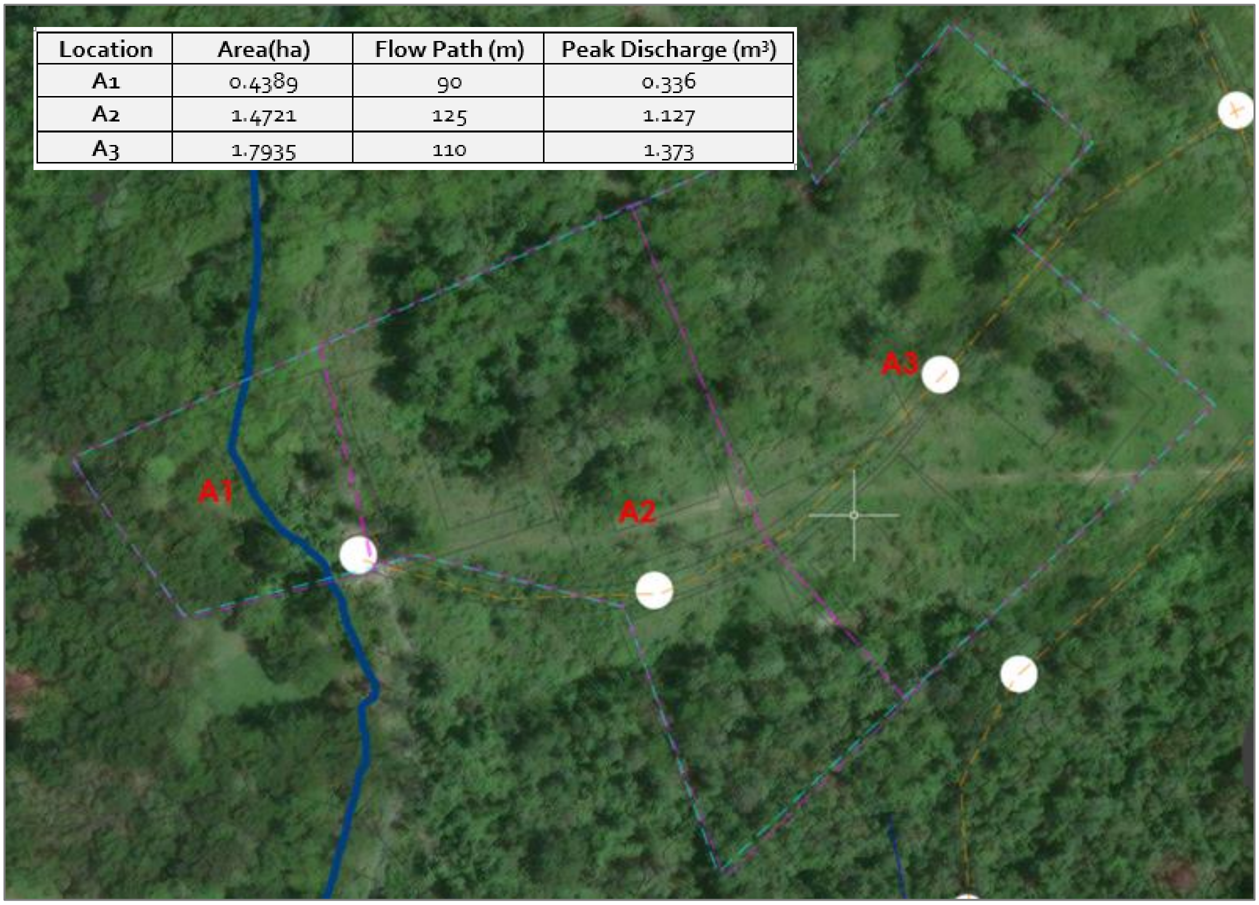
Table 6-14 Approximate post construction land cover values

Sub-Catchment	Total Area [ha]	Approximate Built Area [ha]	Approximate Green Area [ha]
A	40.1	4.6	35.5
B	33.6	1.4	32.2
C	25.2	1.4	23.8
D	33.1	1.2	31.9
E	37.0	5.0	32
F	31.0	4.5	36.5
G	25.1	2.1	23
H	61.2	2.8	58.4
I	24.0	1.7	22.3
J	26.7	1.4	25.3

Table 6-15 Sub-catchment characteristics post-construction

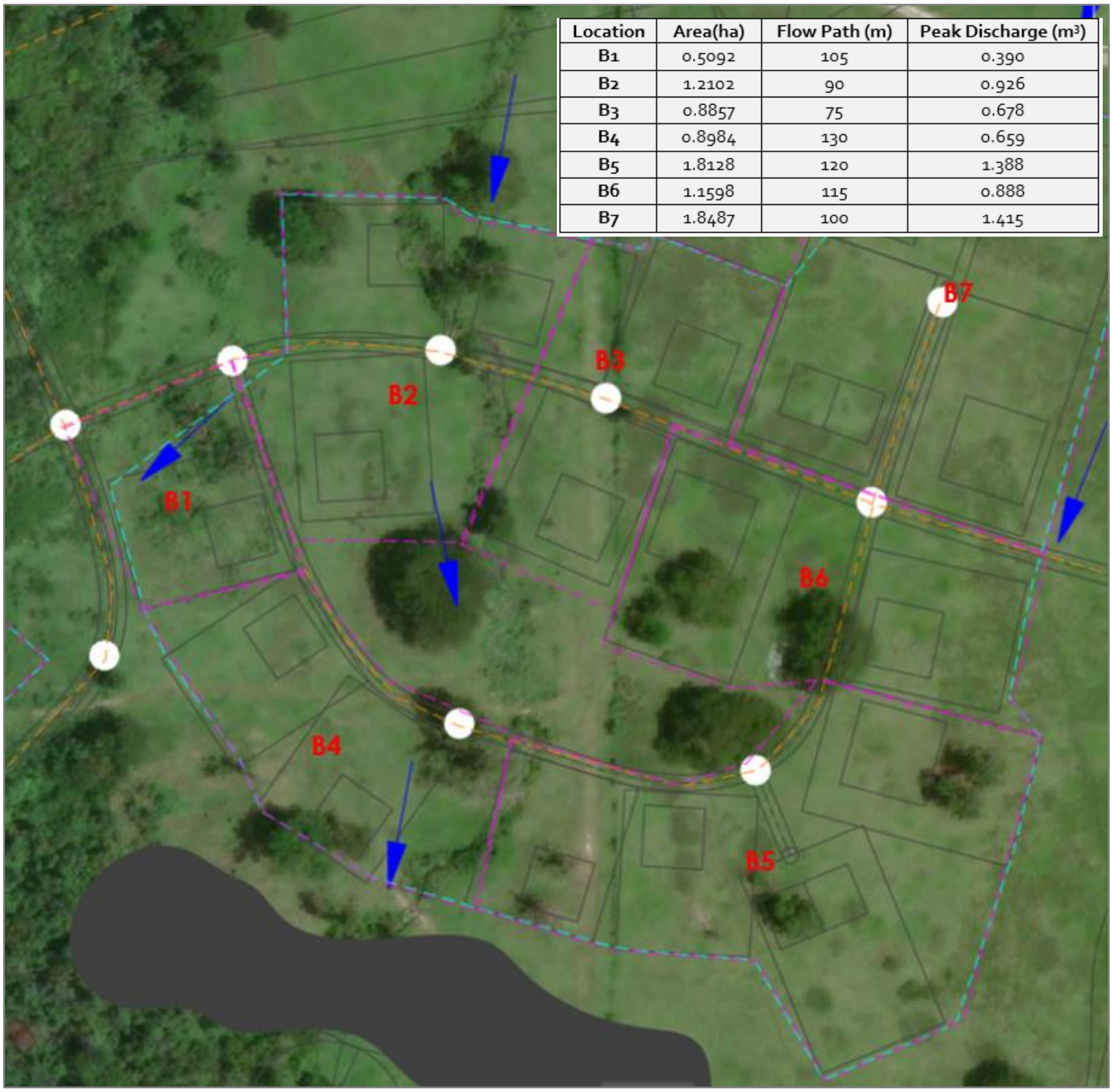
Sub-Catchment	Area [ha]	Flow Path [m]	Slope [~%]	Time to Peak [hrs]	Time of conc. [min]
A	40.1	675	2	12.07	18
B	33.6	1,160	2	12.17	27.2
C	25.2	695	1	12.13	25.3
D	33.1	710	2	12.07	18.7
E	37.0	1,543	2	12.23	34.5
F	31.0	727	1	12.13	26.2
G	25.1	966	2	12.13	23.5
H	61.2	1,059	2	12.13	25.3
I	24.0	1,128	2	12.13	26.6
J	26.7	738	2	1207	19.2

[4] Assuming flow path lengths remain the same; it is difficult to determine how flow paths would be affected at this stage. 30% of built area is assumed roadway. CN; 98 (paved, roof and roads), 74 (open spaces, golf courses; 75% or more grass cover)). In this case CN is of a higher significance.



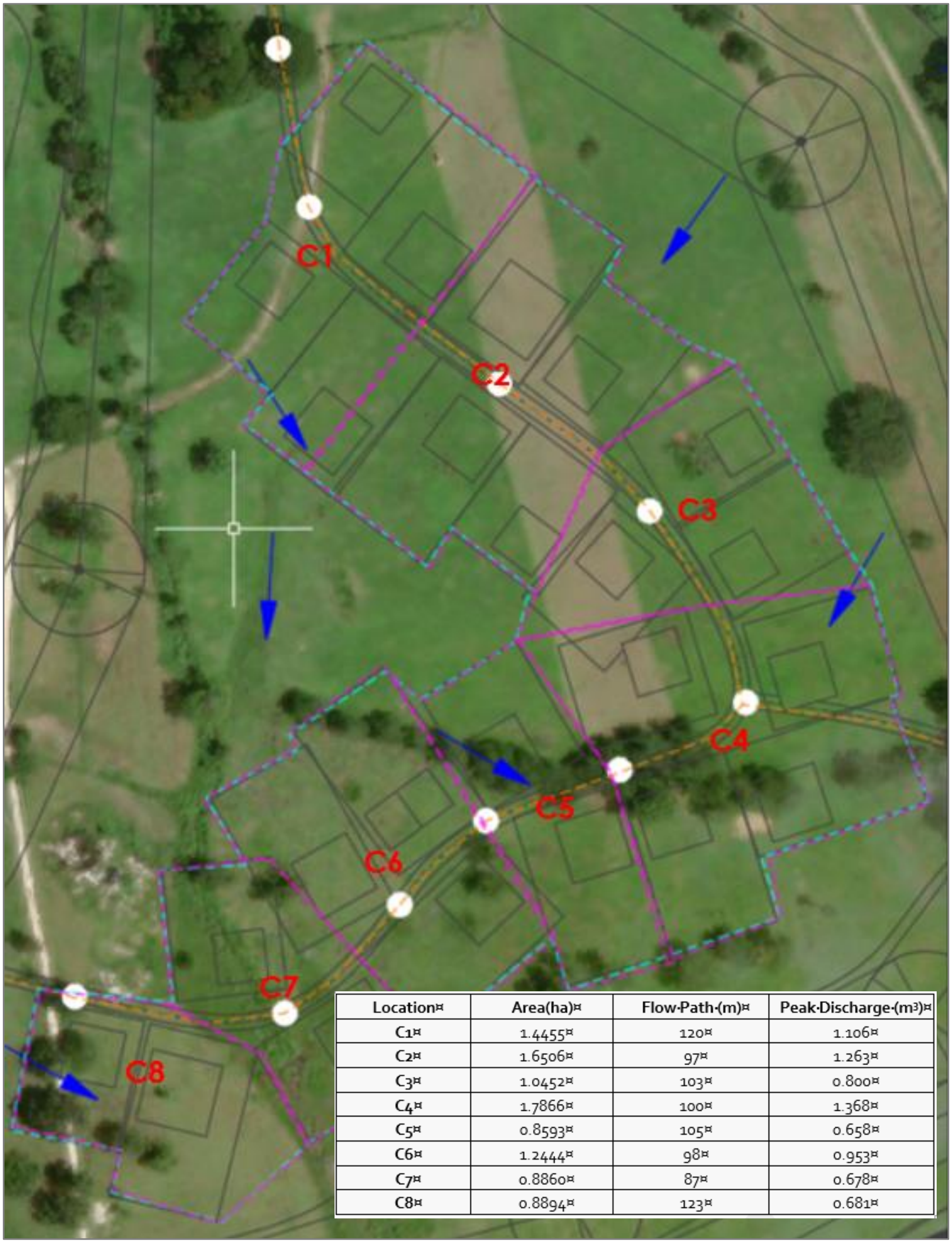
Location	Area(ha)	Flow Path (m)	Peak Discharge (m^3)
A1	0.4389	90	0.336
A2	1.4721	125	1.127
A3	1.7935	110	1.373

Figure 6-31 Post construction peak flow for sub-catchment A



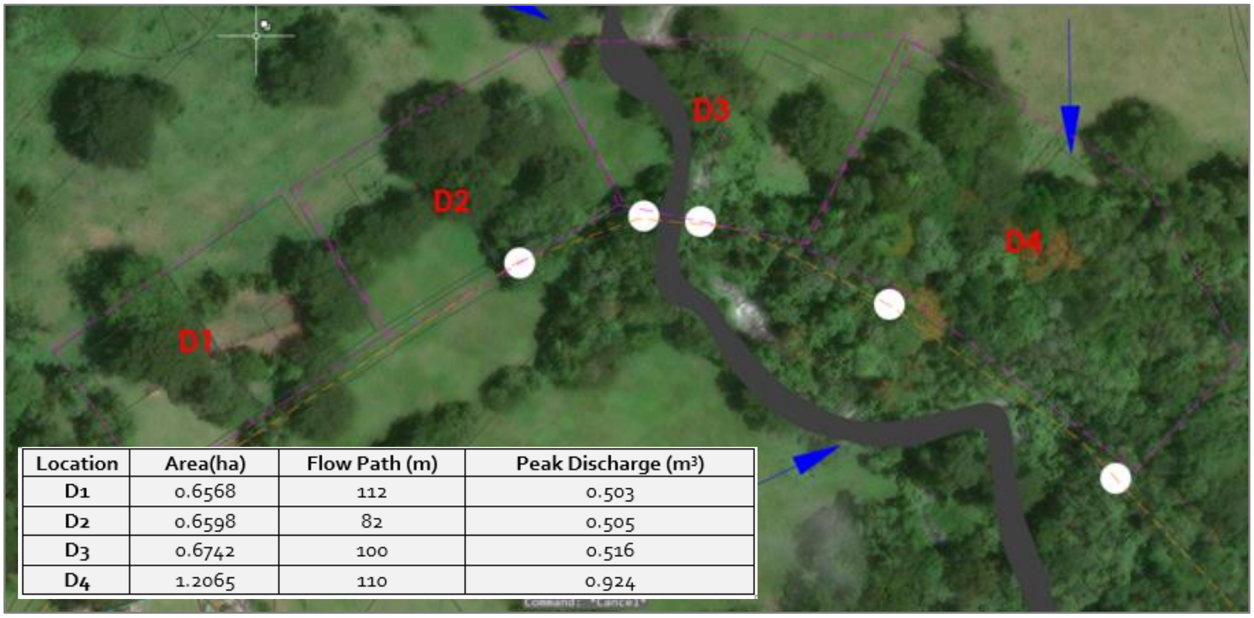
Location	Area(ha)	Flow Path (m)	Peak Discharge (m^3)
B1	0.5092	105	0.390
B2	1.2102	90	0.926
B3	0.8857	75	0.678
B4	0.8984	130	0.659
B5	1.8128	120	1.388
B6	1.1598	115	0.888
B7	1.8487	100	1.415

Figure 6-32 Post construction peak flow for sub-catchment B



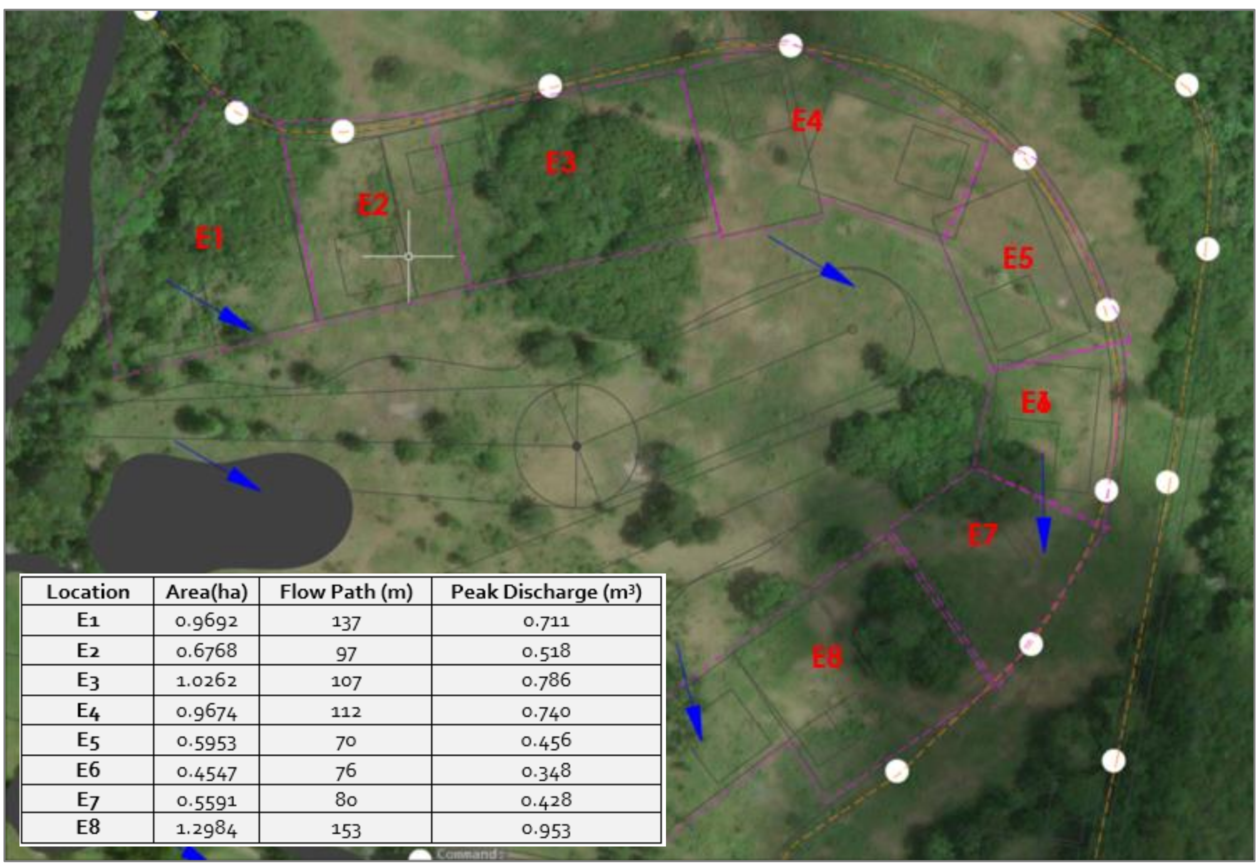
Location	Area (ha)	Flow Path (m)	Peak Discharge (m^3)
C1	1.4455	120	1.106
C2	1.6506	97	1.263
C3	1.0452	103	0.800
C4	1.7866	100	1.368
C5	0.8593	105	0.658
C6	1.2444	98	0.953
C7	0.8860	87	0.678
C8	0.8894	123	0.681

Figure 6-33 Post construction peak flow for sub-catchment C



Location	Area(ha)	Flow Path (m)	Peak Discharge (m³)
D1	0.6568	112	0.503
D2	0.6598	82	0.505
D3	0.6742	100	0.516
D4	1.2065	110	0.924

Figure 6-34 **Post construction peak flow for sub-catchment D**



Location	Area(ha)	Flow Path (m)	Peak Discharge (m³)
E1	0.9692	137	0.711
E2	0.6768	97	0.518
E3	1.0262	107	0.786
E4	0.9674	112	0.740
E5	0.5953	70	0.456
E6	0.4547	76	0.348
E7	0.5591	80	0.428
E8	1.2984	153	0.953

Figure 6-35 **Post construction peak flow for sub-catchment E**

Recommended Mitigation

Implementing the following mitigation measures will enhance the resilience of the drainage infrastructure, minimize environmental impacts, and ensure sustainable management of stormwater within and around the project area:

i. Monitoring and Maintenance: Establish a comprehensive monitoring program to regularly assess the functionality and efficiency of the drainage system. This includes inspecting swales, open channels, and retention ponds to ensure they are free from obstructions and operating as designed.
ii. Training and Awareness: Conduct training sessions for maintenance staff and relevant stakeholders on the proper upkeep of drainage infrastructure. This ensures that personnel are equipped to identify and address any potential issues promptly.

6.3.1.2 Water Quality - Freshwater

Impact

Day-to-day operations, such as landscaping, cleaning, outdoor events, and maintenance activities, can disturb soil and increase the likelihood of suspended solids and hazardous materials being carried into water bodies by stormwater runoff.

The project as proposed includes several strategies aimed at minimizing impacts on freshwater water quality (section **Error! Reference source not found.**). Stormwater generated on the property will be managed through a combination of open, natural, and engineered channels, along with subsurface structures where needed. Stormwater runoff will be attenuated using detention ponds, with planned discharge to vegetated areas that act as sediment and quality control mechanisms before it reaches receptors such as the river or sea. Additionally, the golf course will utilize environmentally friendly products, including organic fertilizers and natural insecticides.

While there are potential risks to water quality, these risks are low. The hotel will have a vested interest in maintaining and enhancing water quality to ensure the health and safety of guests and other users.

The removal of farm animals and agricultural activities from the area may lead to improved water quality by reducing nutrient inputs, particularly nitrogen and phosphorus, which are commonly introduced through animal waste, fertilizers, and runoff. This reduction can help minimize eutrophication, lower the risk of harmful algal blooms, and improve overall clarity and oxygen levels in surrounding water bodies. Decreased sedimentation and organic matter input may also support the recovery of aquatic ecosystems, benefiting seagrass beds, coral reefs, and marine life.

Recommended Mitigation

To enhance and further support the proposed strategies, the following are recommended:

i. Manage Runoff and Sedimentation: In addition to implementing effective stormwater management systems, such as those proposed in the project description, establishing vegetated buffer zones along water bodies can help filter runoff before it reaches rivers or streams.
ii. Proper Waste Disposal and Chemical Management: Ensure that all waste materials, including chemicals, oils, and cleaning agents, are disposed of properly and stored securely in designated areas. Regularly inspect storage areas to prevent leaks or spills. Using non-toxic, biodegradable cleaning products and avoiding harmful chemicals on hotel grounds can significantly reduce pollution risks.
iii. Maintain Groundwater Protection Measures: To prevent groundwater contamination, ensure that all hazardous substances, such as fuels, oils, and lubricants, are safely stored and handled. Implement spill prevention and response procedures to minimize the risk of contamination. Consider using environmentally-friendly alternatives in hotel operations, such as green cleaning products and non-toxic pest control methods.
iv. Control Chemical Use: Following the approach taken for the golf operations, reduce the use of harmful chemicals on hotel grounds, such as pesticides and fertilizers, by adopting organic landscaping practices. Implement integrated pest management techniques and use native plants to reduce the need for chemical treatments.
v. Monitor Water Quality: Regular water quality monitoring can help detect and address any contamination issues early. Monitoring should include both surface and groundwater sources to track potential pollutants, such as chemicals or heavy metals, and assess the overall health of aquatic ecosystems.
vi. Staff Training and Guest Awareness: Train hotel staff on best practices for waste management, chemical handling, and water conservation. Educate guests about the importance of protecting local water resources and encourage eco-friendly behaviour, such as using less water and minimizing waste.

6.3.1.3 Water Quality - Marine

Impact

In addition to the land-based operational impacts outlined in section 6.3.1.2, additional coastal-based activities will potentially impact the marine environment.

Boating and water sports can increase the potential for fuel spills and oil leaks, which may all potentially contribute to water contamination. These activities may also lead to resuspension of sediments, which may reduce water quality and clarity.

Recommended Mitigation

In addition to the measures outlined under section 6.3.1.2, the following mitigation measures specific to marine activities are proposed:

i. Develop and enforce guidelines for fuelling and maintenance procedures to minimize the risk of fuel spills and oil leaks. Provide regular training for boat operators on best practices for spill prevention and emergency response.
ii. Limit activities that disturb the seabed, such as anchoring in sensitive areas.
iii. Establish a regular water quality monitoring program to track any changes in water clarity and quality, particularly in areas with high boating and water sport activity.
iv. Educate boaters and water sports enthusiasts on the environmental impacts of their activities and the importance of responsible practices to protect the marine environment.
v. Create designated zones for boating and water sports to minimize impact on ecologically sensitive areas, such as seagrass beds or coral reefs.

6.3.1.4 Long-Term Wave Climate

Impact

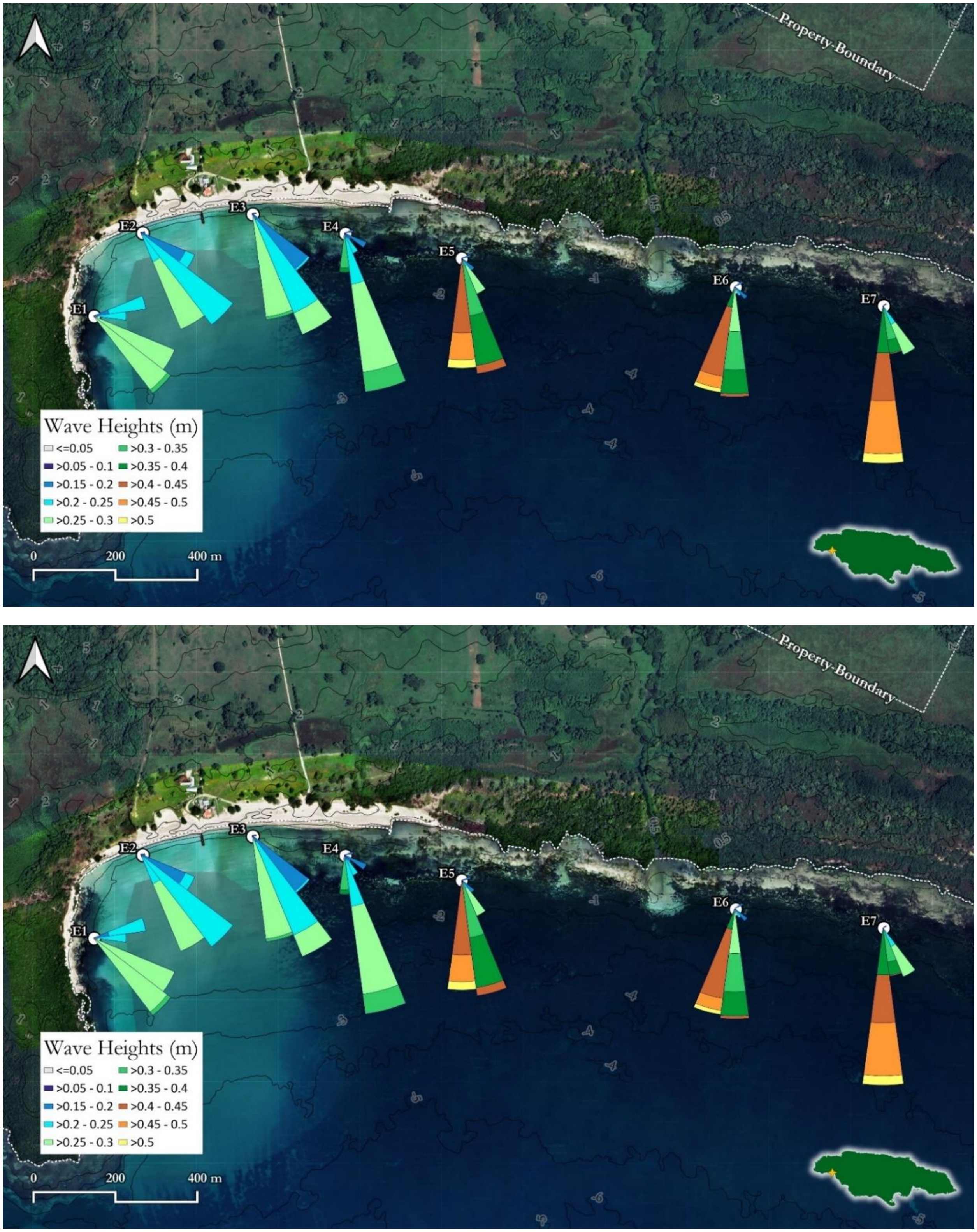
Key scenarios from the baseline conditions model (section **Error! Reference source not found.**) were revisited to assess the potential impacts of the coastal enhancement works on the surrounding areas. This involved re-running the validated model with the proposed design elevations and parameters integrated into the simulations. The proposed layout introduces several coastal engineering interventions, such as groynes, a sediment sink, and a sill. These modifications will potentially influence wave conditions as follows:

- Wave Energy Reduction:
  - The wave roses at P1 to P5 (Figure 6-36) indicate a reduction in wave energy near the shoreline. Wave heights predominantly fall below 0.3 m, improving the beach's safety and usability for recreational purposes.
- Wave Direction Modulation:
  - The directional spread of waves is more focused near the protected areas, as seen at P3 and P4 (Figure 6-36). This suggests that the proposed structures are deflecting and attenuating incoming wave energy.
  - At P6 and P7, wave heights remain relatively higher (>0.45 m), indicating less protection in these areas due to their position outside the primary sheltered zone or further offshore.

Overall, from a spatial 2D perspective, the wave model indicates that the impacts from the proposed layout are localised to the immediate vicinity of the interventions (Figure 6-37). The proposed layout reduces wave energy along the central and western portions of the site, making these areas more suitable for recreational use. The wider ambient wave conditions remain unaffected, with changes confined to the areas influenced by the proposed structures.

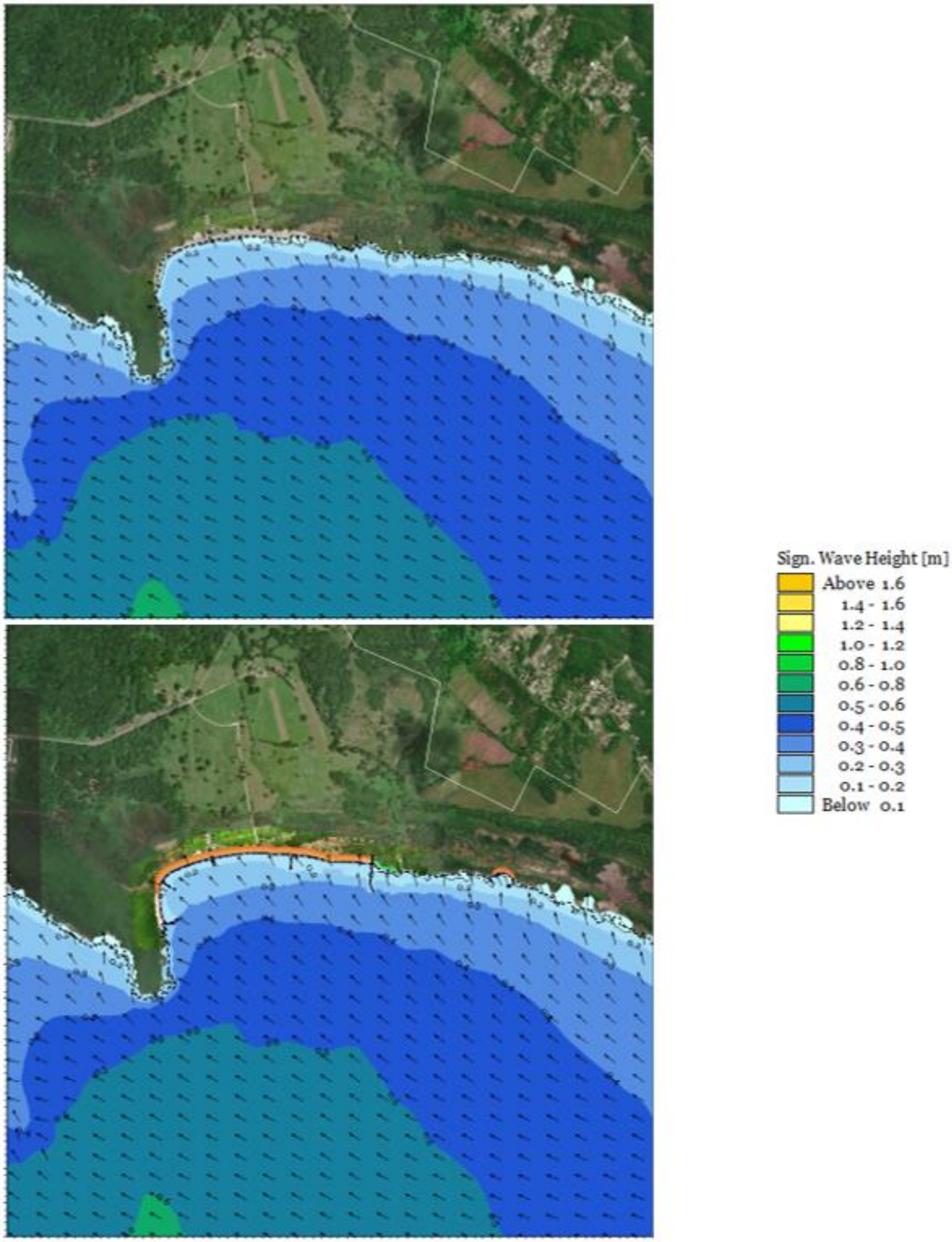
Recommended Mitigation

No mitigation required.



Source: (Smith Warner International Limited, 2025)

Figure 6-36 Wave roses under existing (top) and proposed (bottom) conditions



Source: (Smith Warner International Limited, 2025)

Figure 6-37 Average significant wave heights along the Paradise Park shoreline for existing conditions (top) and with the proposed design in place (bottom)

6.3.1.5 Currents and Sediments

Impact

As described for the wave climate, key scenarios from the baseline conditions model (section **Error! Reference source not found.**) were revisited to assess the potential impacts of the coastal enhancement works on the surrounding areas. The proposed layout introduces several coastal engineering interventions, such as groynes, a sediment sink, and a sill, which will potentially influence sediment dispersal as follows:

- Sediment Sink Effectiveness:
  - The proposed sediment sink, approximately 2 m deep and 40 m wide, is positioned to trap suspended sediments carried by wave and current action. The depth and width are designed to minimise wave oscillation effects within the sink, creating an environment that encourages the efficient settlement of suspended particles and preventing dispersal into adjacent areas.
  - The sediment sink acts as a buffer zone, reducing the transport of fine sediments further into the nearshore environment and helping maintain water clarity.
- Sill Efficiency:
  - The sill located behind the sediment sink provides an additional safeguard by dispelling any suspended sediments that may bypass the sediment sink. This dual-layered approach supports sediment management and reduces the risk of siltation in recreational areas.
- Localised Wave Dynamics:
  - The proposed design limits the potential for resuspension of settled sediments by reducing wave oscillation and energy within the sediment sink. This supports the layout's sediment management objectives.

Overall, the combination of the sediment sink, sill and localised wave dynamics will potentially improve sediment management by creating a controlled environment for settlement. This approach reduces the risk of suspended sediments reaching the enhanced beach, maintaining its usability and quality.

Recommended Mitigation

No mitigation required.

6.3.2 Natural Hazards

6.3.2.1 Earthquake and Seismicity

Impact

Jamaica has a history of significant seismic activity, with notable events such as the 1692 Port Royal quake, the 1907 Kingston earthquake, and more recent tremors, including over 1,000 recorded earthquakes between 2011 and 2020. While none of these events have been catastrophic, they highlight the ongoing seismic risk in the region. The closest recorded earthquake epicentre to the site occurred in 1895, just 1 km to the northwest. Additionally, two faults—one with a west-east orientation and another with a northwest-southeast orientation—traverse the site. The Paradise Park site is located in an area with relatively low spectral response for both short-period and long-period accelerations, suggesting that seismic activity could still cause ground shaking, but the impact may be less severe compared to areas with higher spectral response. However, given the proximity of fault lines and the historical seismic activity, there is a potential for ground movement and structural damage during future seismic events.

Recommended Mitigation

To mitigate the seismic risks during the operational phase, the following measures should be implemented:

i. Building Design and Inspections:
    a. Ensure that all structures are designed to meet earthquake-resistant standards, including seismic bracing, flexible foundations, and materials that can absorb and dissipate seismic energy.
    b. Conduct regular inspections of infrastructure and buildings to identify potential vulnerabilities related to seismic activity. Routine maintenance and reinforcement should be prioritized, especially in areas that are near fault lines.
ii. Emergency Preparedness Awareness and Plans:
    a. Develop and implement emergency response plans that include evacuation procedures, communication strategies, and protocols for dealing with post-earthquake damage.
    b. Educate workers and residents on earthquake preparedness, including how to respond during and after an earthquake. Regular drills and training sessions will ensure everyone is ready in case of a seismic event.

6.3.2.2 Hurricane Waves and Surge

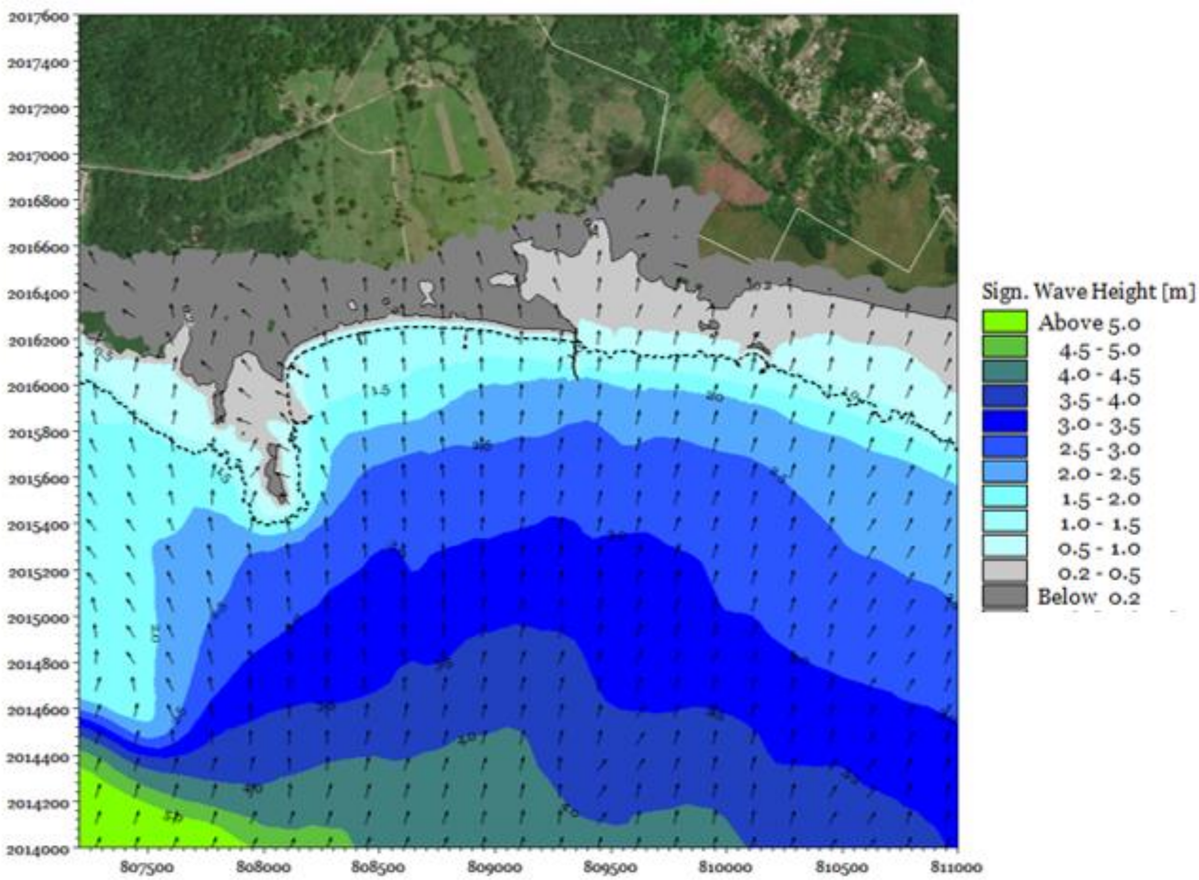
Impact

HURRICANE MODELLING

Hurricane modelling has identified vulnerabilities at the site due to its low elevation (section**Error! Reference source not found.**). Impact modelling was conducted with proposed design levels to assess whether the planned interventions provide additional resilience during extreme events. Results for the 100-year storm are presented in Figure 6-38, Figure 6-39 and Figure 6-40 with climate change considerations included (section **Error! Reference source not found.**).

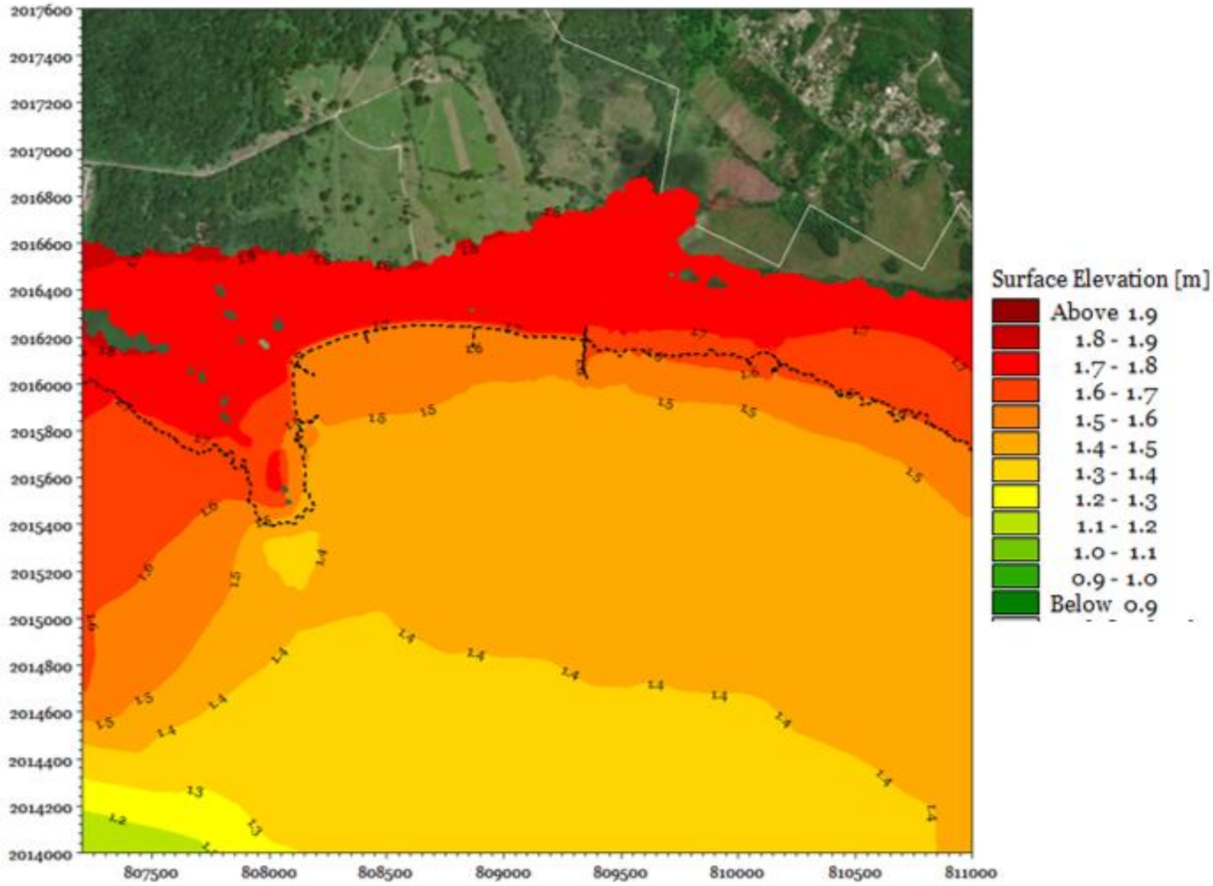
The analysis indicates negligible differences between the existing and proposed conditions during the hurricane event. Because the groynes have low elevations, they were submerged during the simulation, which limited their ability to attenuate waves beyond their immediate area. Hurricane waves showed only slight reductions over the groynes, but these changes had minimal impact on the overall shoreline dynamics (Smith Warner International Limited, 2025).

Hurricane surge levels at the shoreline were calculated to reach +1.7 m above MSL, with inundation depths varying from approximately 1.0 m near the coastline to 0.1 m further inland. This information is critical for determining finished floor levels for structures within the inundation zone and assessing the



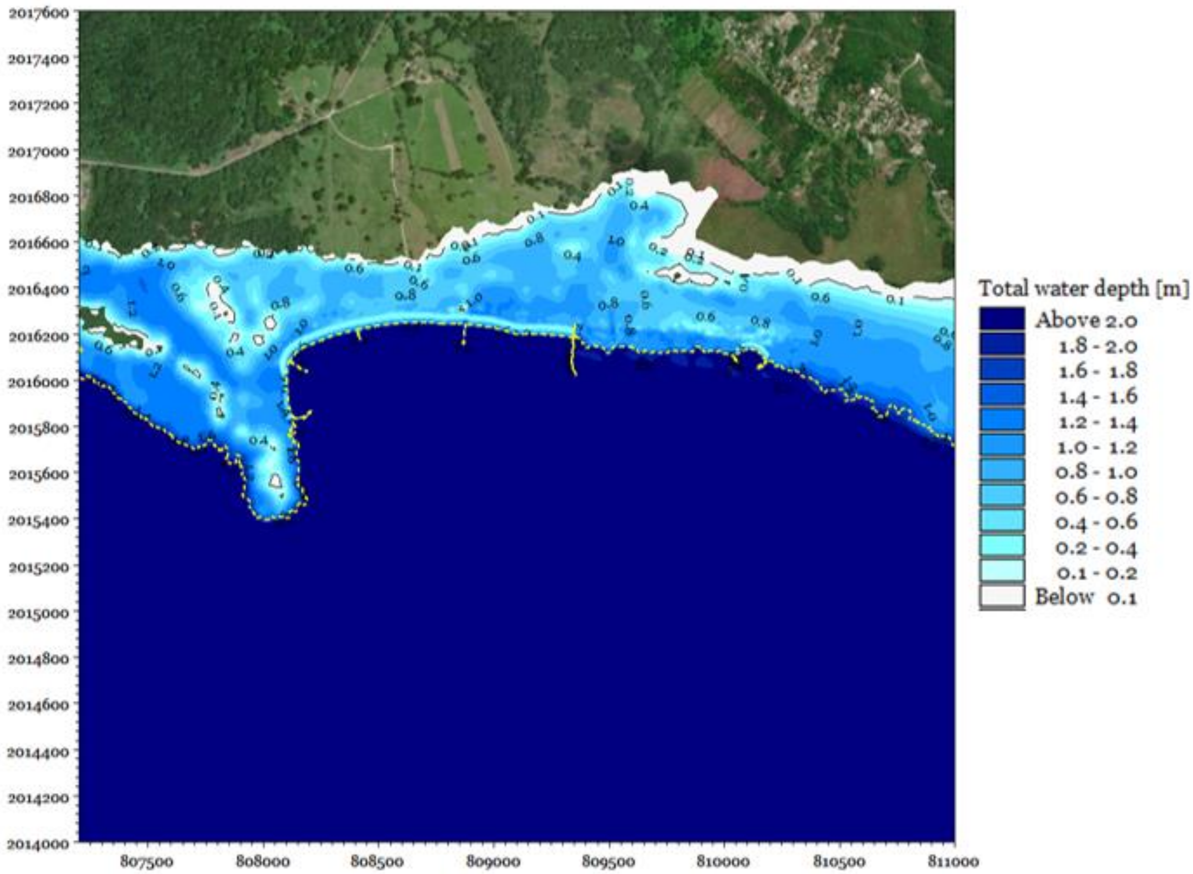
Source: (Smith Warner International Limited, 2025)

Figure 6-38 Hurricane wave heights during the 100-year storm with a 2070 sea level rise horizon under proposed conditions



Source: (Smith Warner International Limited, 2025)

Figure 6-39 Hurricane storm surge during the 100-year storm with a 2070 sea level rise horizon under proposed conditions



Source: (Smith Warner International Limited, 2025)

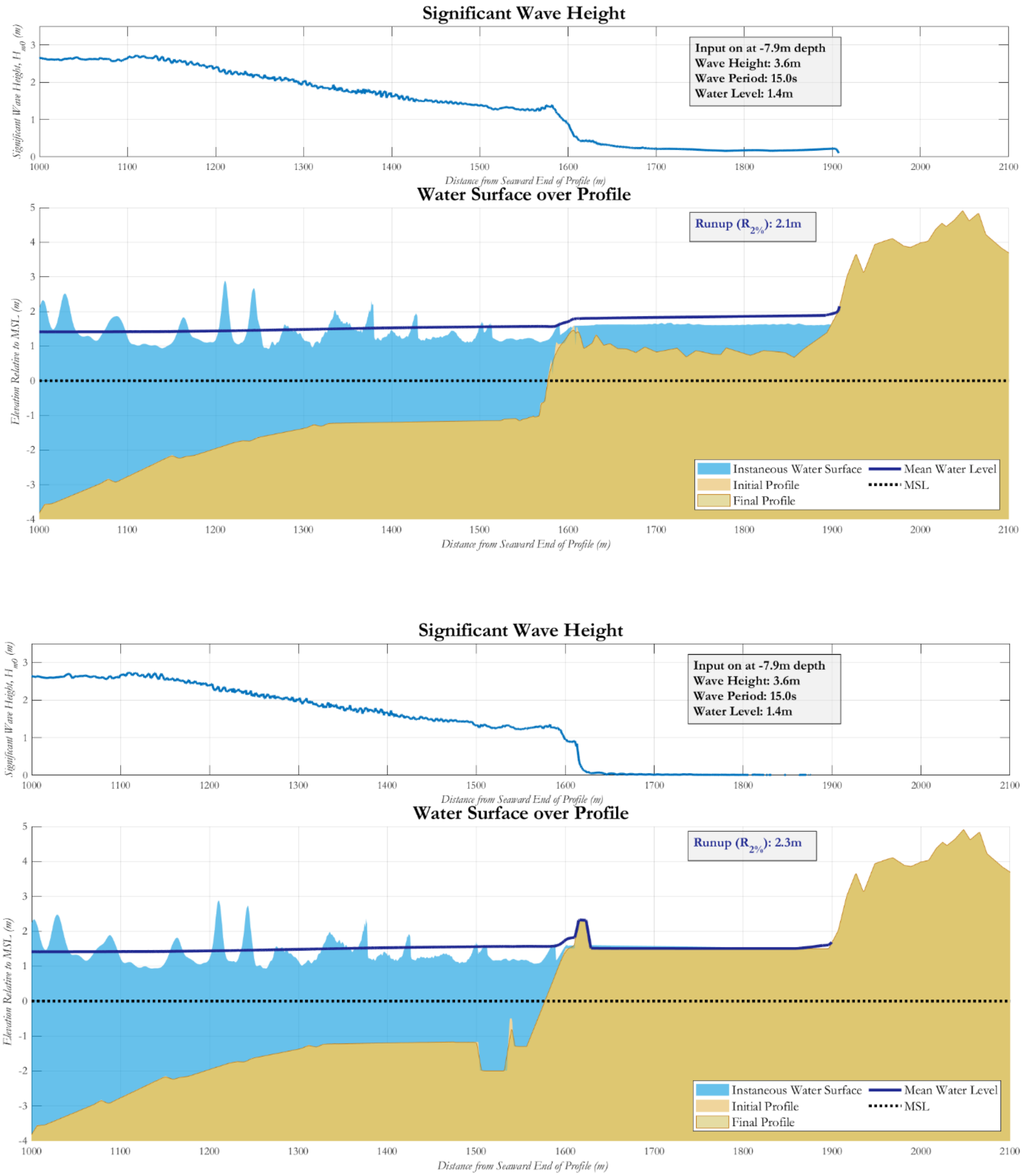
Figure 6-40 Hurricane inundation during the 100-year storm with a 2070 sea level rise horizon under proposed conditions

DYNAMIC STORM SURGE INUNDATION WITH BERM

The XBeach numerical model results indicate that implementing the proposed berm and increasing the land elevation to 1.5m above mean sea level (MSL) significantly reduces coastal inundation. Under the existing conditions, the dynamic wave runup reaches a maximum elevation of 2.1m above MSL, contributing to overwash and potential flooding inland (Smith Warner International Limited, 2025).

In contrast, the inclusion of the proposed berm alters the wave energy dissipation and reduces the effective runup height. The model demonstrates that the proposed layout mitigates inundation, confining it to a sheet flow over the berm's crest. This effectively decreases the wave runup impact, lowering it from 2.1m to approximately 1.5m above MSL (Smith Warner International Limited, 2025).

These results highlight the effectiveness of the proposed berm and elevation adjustment in minimizing wave-driven flooding and improving coastal resilience under storm conditions (Smith Warner International Limited, 2025).



Source: (Smith Warner International Limited, 2025)

Figure 6-41 Existing storm surge run up (top) and proposed storm surge run up with proposed berm.

SUMMARY

The shoreline along the length of the property is highly vulnerable to storm surge, with the site being completely inundated during both the 50 and 100-year events, including those exacerbated by climate change. In the 50-year event, water levels could rise 0.4 to 1.0 meters above the existing ground level. To mitigate this flooding risk, the property and its buildings must be elevated to at least +2.25 meters above Mean Sea Level (MSL) to prevent inundation, considering both static and dynamic storm surges. Hurricane simulations further indicate that the low elevation of the property contributes to a high exposure risk.

Recommended Mitigation

To address this significant vulnerability described, it is recommended to implement a vegetated berm with a 1 in 5 slope and a crest height of 2.3 meters above MSL at the back of the beach. This berm will help reduce the impact of storm surges on the property.

Additional mitigation measures to consider include:

i. Design Standards: Adhere to robust engineering standards that account for both wave-induced currents and storm surge dynamics. Implementing these standards ensures that coastal developments withstand extreme weather events while maintaining beach stability and minimizing risks to adjacent structures.
ii. Monitoring and Adaptive Management: Establish a monitoring program to assess the performance of coastal structures over time. This programme should include regular assessments of wave conditions, sediment transport patterns, and the effectiveness of mitigation measures. Adaptive management strategies can then be employed to adjust designs or operations based on observed performance and evolving environmental conditions.

6.3.2.3 Beach Stability

Impact

Swell wave events were shown to impact the nearshore beach area under the existing conditions (section **Error! Reference source not found.**); the previously modelled swell event was also set to run under the proposed operational design conditions. The potential impacts of the coastal works on waves, currents and bed levels during the modelled swell event are outlined below.

WAVE-INDUCED CURRENT COMPARISON

Figure 6-42 shows localized changes in the wave-induced current patterns under the same swell wave event, specifically:

- Current Magnitudes:

    - Nearshore currents are reduced within the zones influenced by the groynes and sediment sink, with magnitudes decreasing to <0.20 m/s. This indicates a reduction in flow velocity near the protected areas.
    - Offshore currents beyond the influence of the interventions remain comparable to those in the existing conditions.
- Flow Directions:
    - The dominant westward flow observed in the existing conditions is preserved, with modifications limited to the immediate vicinity of the interventions.
    - There is localised deflection of currents occurs near the groynes. This redirection contributes to sediment retention within the site.
- Localized Impacts:
    - The sediment sink reduces current energy, encouraging the deposition of finer sediments. The sill helps to limit the offshore transport of sediment while allowing controlled water movement.
    - Acceleration of currents around groyne tips is observed, with potential localised effects on sediment distribution.
    - The proposed interventions influence local patterns, with limited changes to flow dynamics beyond the project boundaries.

Overall, the interventions reduce nearshore current magnitudes in targeted areas, particularly within the zones influenced by the groynes, sill, and sediment sink. Offshore current magnitudes are not significantly affected. Near the sediment sink, currents slow and vary in direction, facilitating sediment deposition in this protected zone. The proposed sediment grain size, sill, sediment sink, and groynes promote sediment retention in nearshore areas, reducing sediment transport from the property.

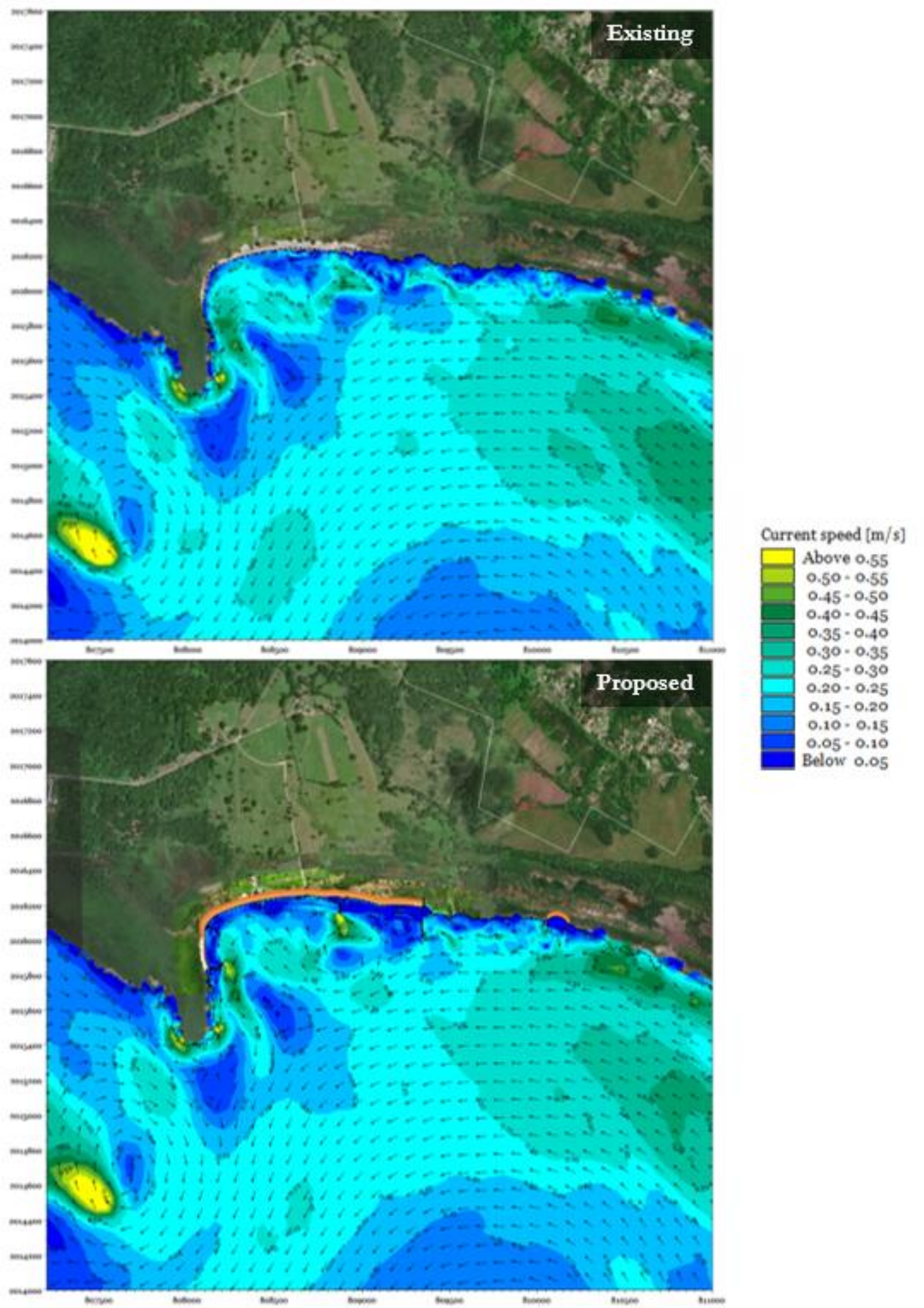


Figure 6-42 **Current speeds during the peak timestep of the swell event for existing and proposed conditions**

WAVE IMPACT COMPARISON

The wave comparison is shown in Figure 6-43; the following observations may be made:

- Wave Heights:
    - Nearshore wave heights within the protected areas (central and western sections) are reduced to 0.2–0.4 m, indicating effective wave attenuation by the proposed structures.
    - Offshore wave heights remain unchanged, with values exceeding 1.0 m in deeper waters, confirming that the modifications primarily affect the nearshore zone.
- Wave Propagation Patterns:
    - The groynes disrupt wave propagation near the shoreline, creating zones of reduced wave energy behind the structures. This results in calmer conditions within the protected areas.
    - In the eastern section, where no groynes are present, wave propagation patterns remain similar to the existing conditions, with minimal disruption.
- Localized Impacts:
    - The sediment sink reduces wave oscillation and energy near the central section, promoting calmer conditions conducive to sediment deposition.
    - The sill further minimises wave-induced energy in the nearshore zone, particularly in areas with direct exposure to incoming waves.

Overall, the proposed layout reduces nearshore wave heights significantly within the areas influenced by the groynes and sediment sink; this reduction mitigates wave-induced erosion and creates more stable conditions for the shoreline. Additionally, wave energy is redirected around the groynes, resulting in localised zones of calmer waters. These changes are confined to the immediate vicinity of the structures, with offshore propagation remaining unaffected.

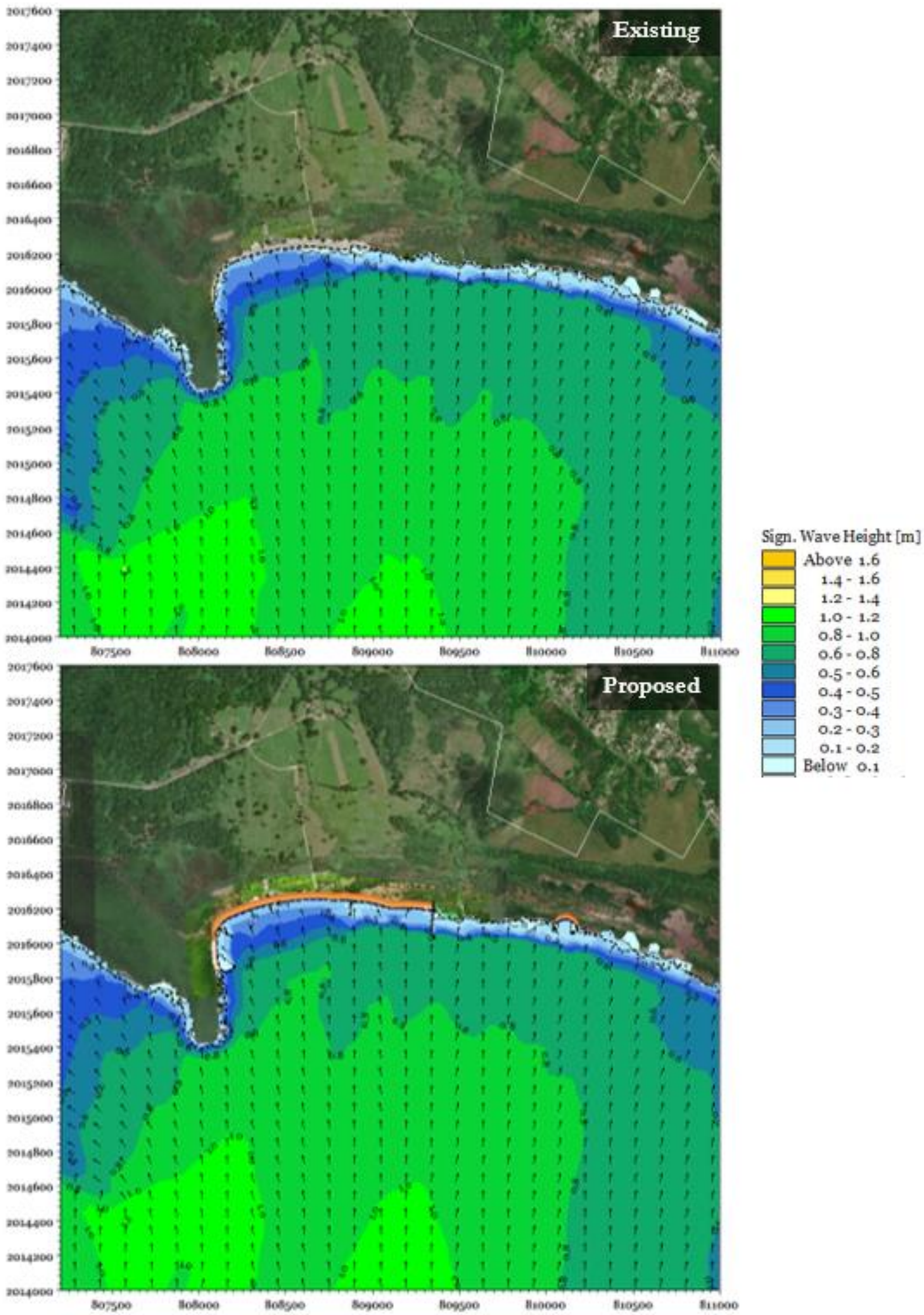


Figure 6-43 Wave heights during the peak timestep of the swell event for existing and proposed conditions

BED LEVEL CHANGE IMPACTS

Figure 6-44 shows the bed level change impacts under existing and proposed conditions, with the following observations:

- Localised Erosion Around Structures:
  - Erosion is concentrated around the tips of the proposed groynes, with bed level changes ranging between -0.20 m and -0.40 m in these areas. This reflects the redirection of wave energy and currents caused by the structures.
  - The erosion at the groyne tips suggests a need for additional stabilisation measures, such as the placement of geogrids and geotextile layers on the seafloor.
  - The sediment sink shows a calm deposition zone, consistent with its design purpose.
- Minimal Impact Outside the Project Area:
  - Bed level changes outside the immediate vicinity of the proposed structures remain similar to the existing conditions, with minor erosion and deposition patterns. This suggests that the proposed modifications have localised effects and do not significantly impact the surrounding areas.

The bed level changes outside the proposed layout align with the existing conditions, indicating that the interventions are not causing widespread sediment redistribution or erosion along adjacent shorelines. The model results therefore validate the localised focus of the design and intended function without significant external impacts.

SUMMARY

In summary, bed level, wave and current results show an overall cross-shore movement of sediment, which results in sediment erosion during swell events. Outside of these events, lower wave heights reintroduce sediment. Therefore, there is no permanent sediment loss, and the shoreline will be stable over the long term.

Recommended Mitigation

The concentration of erosion around the groyne tips highlights areas requiring structural stabilisation. Using geogrids and geotextile will help mitigate seafloor instability and reduce potential scouring in these zones.

No further mitigation required.

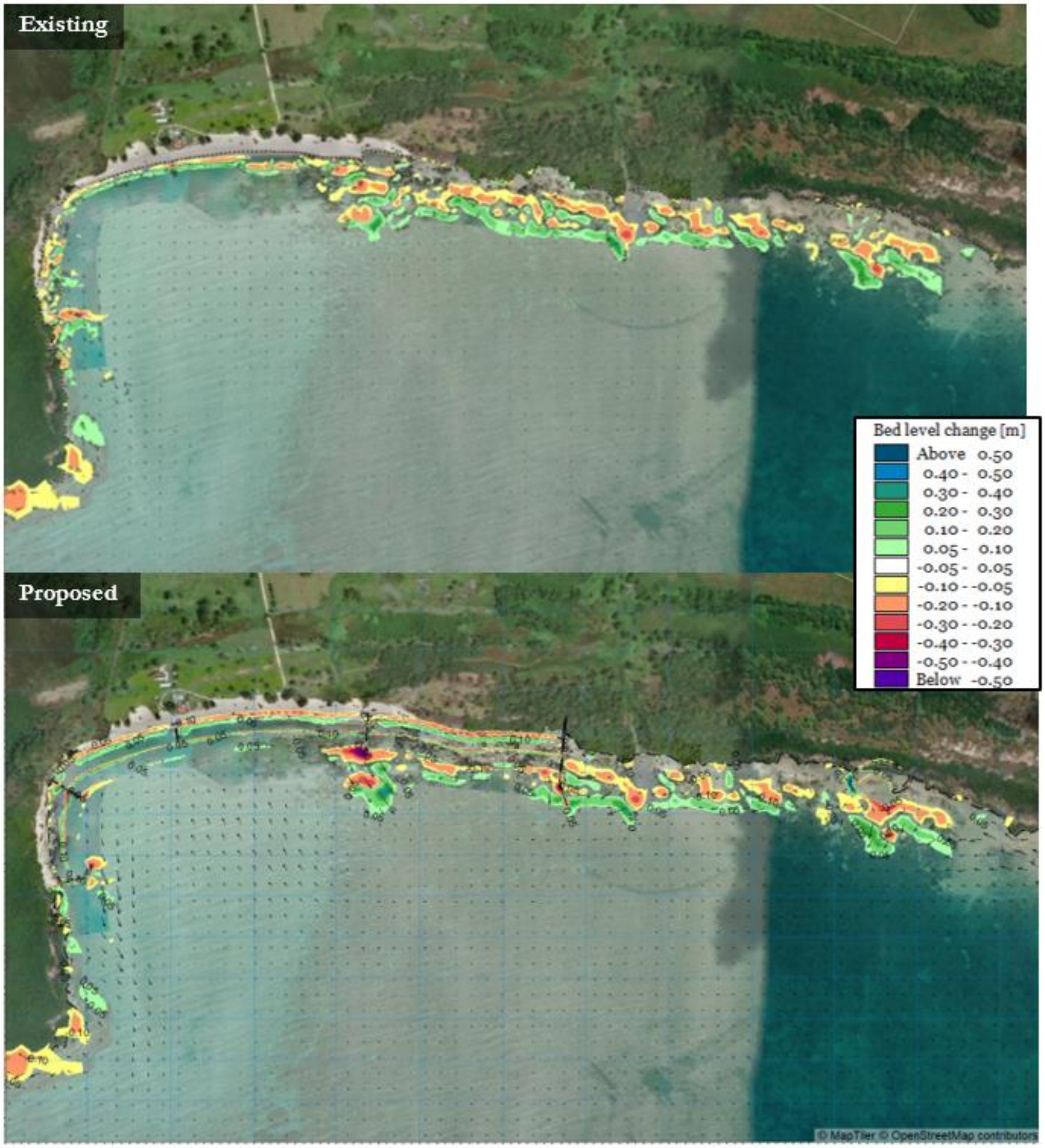


Figure 6-44 Bed level change during the peak timestep of the swell event for existing and proposed conditions

6.3.2.4 Flooding

Impact

The flood inundation model indicates that there are areas on site which experience inundation levels between 0.1m to approximately 0.47m, in the particularly low-lying areas, primarily comprised of existing wetlands (**Error! Reference source not found.**).

Sediment load, in addition to water flow, forms a critical factor in flood events. Historical accounts of the 1979 floods reveal that the severity of the event was worsened by the large volume of sediment carried by the streams, causing the water to abandon its original channel and carve a new path.

Recommended Mitigation

Suggested mitigation measures to reduce the impact of stormwater intrusion include raising site levels in these areas by at least 0.45m, constructing a protective berm along the western boundary of the Dean Valley River in the flood-prone zone to a height of no less than 0.7m, or placing the potentially affected structures on stilted foundations, elevating them above the 0.47m flood level.

To prevent damage associated with sediment loads, it is essential that the river channels area capable of managing both peak discharge from rainfall and the sediment load. Without this capacity, the channel could become overwhelmed, leading to shifts and sediment deposition that may cause damage.

6.3.2.5 Karstic Hazards

Impact

The property itself is underlain by an alluvial layer of clays and clayey sandy silts, which cover soluble limestone deposits conducive to Mantle Karst formation. While Mantle Karst has the potential to cause cover-collapse sinkholes, these events are rare and sudden. No such incidents have been reported in the area, and the known karst features are small, suggesting a low risk of significant sinkholes. However, continued monitoring and assessment are recommended to detect any changes in geological conditions early and ensure ongoing safety.

Recommended Mitigation

Ongoing geological monitoring should be conducted to detect any changes in karst features or underlying conditions, with consultation from geological experts to identify and address emerging risks promptly.

6.3.3 Biological

6.3.3.1 Terrestrial Habitats

Impact

The operational phase includes ongoing efforts to maintain and rehabilitate conservation areas, ensuring the long-term health of local ecosystems. Landscaping activities will prioritize the incorporation of native plant species, supporting biodiversity and enhancing habitat stability. Further, the golf course will specifically promote biodiversity through diverse plantings, including native grasses, wildflowers, and shrubs around turf areas, while considering water quality and local regulations. The creation of habitats for beneficial insects, birds, and other wildlife will foster natural pest control and ecosystem health. Efforts to minimize vegetation removal, along with the construction of lakes in the golf course, will further boost biodiversity by providing new habitats for various species and promoting the growth of plant and animal life.

Recommended Mitigation

In addition to properly implementing the various efforts proposed as part of the project:

i. Ongoing Monitoring and Adaptive Management: A robust monitoring program may be implemented to assess the health of local ecosystems and the success of conservation efforts. Adaptive management practices should be employed to address any unforeseen impacts or to adjust strategies based on new ecological data, ensuring long-term sustainability.
ii. Employee and Guest Education: Educate hotel staff and guests about the importance of protecting local biodiversity, encouraging environmentally conscious behaviour such as avoiding littering, minimizing light pollution, and respecting natural habitats.

6.3.3.2 Terrestrial Flora and Fauna

Impact

Conservation areas will remain undisturbed during operations, with activities focused solely on habitat enhancement and ecological stewardship. Other green spaces, including the golf course, may experience routine maintenance such as landscaping and vegetation management, which could cause minor, localized impacts. However, these activities are not expected to significantly affect overall biodiversity.

Recommended Mitigation

See measures in section 6.3.3.1.

6.3.3.3 Wetlands and Mangroves

Impacts

The five designated conservation areas are designed to maintain a high level of ecological stability and integrity within the wetlands on-site. The use of boardwalks will facilitate guest access while protecting the wetlands by preventing trampling and erosion, thus helping to maintain the critical hydrological and ecological flows. To preserve these areas further, it is essential to carefully manage human activity during hotel operations.

Recommended Mitigation

i. Conservation Area Boundaries & Monitoring Stations:
   a. The boundaries of the Conservation Areas, which were previously marked with visible line-of-sight markers during the construction phase, will be enhanced to promote responsible use during the operational phase.
   b. These markers will be numbered and act as permanent monitoring stations to track and assess any impacts from hotel operations, e.g. such as water quality, habitat stability, and overall biodiversity. Monitoring will help identify any deviations from conservation goals, ensuring swift corrective actions if necessary.
   c. Enhance the boundary markers with educational signs, maps, lookout points, and relevant laws and regulations, which may inform persons about the ecological importance of the wetlands and promote responsible behaviour. This should be done in accordance with the Forestry Department's Forest Reserve Jamaica's National Mangrove & Swamp Forests Management Plan.
   d. Conduct periodic inspections of the markers and monitoring stations to ensure they remain functional and provide the intended support for wise use and conservation management.
ii. Management of Pruning and Vegetation:
   a. Pruning within conservation areas shall be restricted to the inner extent of these markers.
   b. Any mangrove pruning will only be performed by trained professionals or certified mangrove arborists, in adherence to best practices outlined by the National Environmental and Planning Agency (NEPA). Pruning will be done according to guidelines that ensure the health and integrity of the mangrove ecosystem.
   c. Ongoing vegetation management will focus on maintaining ecological balance without compromising the wetland's stability or biodiversity.
iii. Protection from External Disturbances:
   a. Conservation Areas located near main roads, highways, settlements, and communities will be tastefully fenced to prevent unplanned encroachment and reduce the risk of

illegal activities such as dumping or damage from accidental disturbances. This fencing will blend with the environment and serve as a clear boundary for conservation areas.

iv. Relocation of Species & Ongoing Maintenance:
   a. Any relocated epiphytes or other species within the Conservation Areas will be carefully monitored for survival and adaptation. This may include regular watering, maintenance, and adjustments to the care plan to ensure the successful establishment of these species in their new environment.
   b. Regularly track the health of relocated species and implement additional measures as needed to support their viability, ensuring that these species continue to thrive and contribute to the biodiversity of the wetlands.

v. Public Engagement and Compliance:
   a. Provide clear educational signage and informative materials on-site to help visitors understand the importance of the Conservation Areas and adhere to rules and regulations. This can include messages about respecting boundaries, minimizing disturbances to wildlife, and the legal protection of certain areas.
   b. Any tours or activities conducted within or near the Conservation Areas should be guided to ensure that visitors follow the designated paths, respect the ecosystem, and are educated on the best practices for preserving the wetlands.
   c. Work with local authorities to enforce rules regarding access to Conservation Areas, ensuring that violations, such as unauthorized entry or harm to the ecosystem, are promptly addressed.

vi. Long-Term Sustainability & Management:
   a. Develop a management plan to ensure long-term sustainability; a draft outline for a Wetland Management Plan is provided in section 8.2.1.
   b. Ensure that the management plan is adaptable and flexible, allowing for updates based on changes in the wetland ecosystem. Regular reviews should be conducted to adjust the management strategy based on monitoring results and emerging threats to the conservation areas.
   c. Engage the surrounding communities and local stakeholders in the ongoing protection and management of the Conservation Areas. This could include joint monitoring efforts, awareness programs, and community-led conservation initiatives.

6.3.3.4 Freshwater Habitats

Impacts

During the operation of the hotel, several activities could impact freshwater habitats:

- Routine hotel activities, such as landscaping, cleaning, and maintenance, can result in runoff that may carry pollutants like chemicals, fertilizers, and sediments into nearby freshwater habitats.

This can lead to water quality degradation, nutrient pollution, and potentially harmful algal blooms.

- Landscaping and maintenance activities could inadvertently introduce invasive plant species or pests into freshwater habitats, disrupting local ecosystems. Preventing the spread of non-native species by using local, native plants in landscaping, along with regular monitoring, can help reduce this risk.
- Although conservation areas will remain undisturbed during hotel operations, regular maintenance on surrounding green spaces and the golf course could lead to minor, localized disturbances in freshwater habitats, especially if machinery is used near water bodies.
- Wastewater generated from hotel operations, including cleaning and laundry activities, could potentially impact nearby freshwater habitats if not properly treated.

Recommended Mitigation

Recommendations made for the construction phase also apply during operation (section 6.2.2.6), as well as those outlined for freshwater quality in section 6.3.1.2.

6.3.3.5 Benthic Habitats

Impact

Benthic communities, including seagrass beds, corals, and other sessile organisms within the impact area, are expected to recover and return to baseline conditions over time. Natural recolonization processes and adaptive resilience mechanisms will support the regeneration of these habitats following project activities.

Pilings and other installed structures will contribute to the ecological volume both on the seafloor and in the water column. These hard surfaces will act as artificial substrates, facilitating the settlement and colonization of various marine organisms. Over time, the species composition of these colonizing communities is expected to evolve, reflecting natural successional processes.

Seagrass beds may experience intermittent shading throughout the daytime due to structural elements, boat traffic and infrastructure maintenance. Some seagrass species are naturally adapted to lower light conditions in turbid environments and may tolerate periodic shading. However, prolonged, or excessive shading can lead to reduced photosynthetic efficiency, declining seagrass health, and potential habitat loss if light availability falls below critical thresholds. Physical damage may also occur as a result of modified coastlines which may change wave patterns leading to shoreline erosion eventually damaging seagrass meadows.

Habitat fragmentation may occur due to changes in current patterns and the introduction of permanent hard structures. This can potentially alter larval dispersal and recruitment dynamics, influencing population connectivity. However, given the expected minimal extent of these changes, no specific mitigation measures are recommended at this time.

Recommended Mitigation

See recommended mitigation strategies in section Benthic Habitats 6.2.2.7 and 6.2.2.8.

6.3.3.6 Fish Communities

Impact

Fish may benefit from the pilings and shaded areas. These will act FADs (Fish Aggregation Devices). This area may also be more managed and as a result the fish may benefit from some protection from overfishing. Filter feeders should see normal conditions return over time.

Recommended Mitigation

See recommended mitigation strategies in section 6.2.2.10.

6.3.3.7 Sea Turtles

Impact

Operational activities, obstructions and lighting may impact turtle nesting and foraging activity.

Recommended Mitigation

I. All staff and workers should be sensitized to the sensitive ecosystems and species in the area, in particular turtles. The beaches should be inspected daily for any signs of turtle activity. If a nest is suspected or found;
   a. The nest should be cordoned off and remain undisturbed until it is hatched in approximately 60 days.
   b. All activity nearby should stop until an expert can determine if there is a nest and how to relocate the eggs if the nest is located in a highly vulnerable area.

II. Turtle-friendly lighting and light positioning (if any) should also be placed on the overwater villas. Hotel operators should also educate their guests on sea turtle conservation and the correct actions to take if a sea turtle is observed nesting on the beach.

III. The Hotel should also develop a Sea Turtle Monitoring programme which would include tagging and hatchling release. This could add to their attraction offerings (turtle watching).

6.3.4 Socioeconomic and Cultural

6.3.4.1 Employment

Impact

The operation of the resort development will generate significant employment opportunities for the local community, with an estimated 1,000 direct jobs in areas such as hospitality, management, maintenance, and support services. In addition, the project is expected to create approximately 1,840 indirect jobs and 695 induced jobs. This expectation aligns with the views of many respondents in the perception survey, who believe the proposed project will positively impact the community, particularly through job creation.

The anticipated job creation from the hotel development is particularly important given the demographic and employment trends in the area. The working-age population (15-64 years) in the SIA constitutes 62.8% of the population, which, while slightly below the national average, still indicates a sizable labour force. This provides a solid foundation for supporting new employment opportunities. With a significant proportion of the population under the age of 24 (29.0% in the SIA, 43.6% in Smithfield), the hotel's operations will help address the pressing need for skill development and job creation, particularly for youth. Indeed, unemployment, especially among youth, was a major issue in Smithfield, with a 28.5% youth unemployment rate in 2010. Many individuals in the area currently hold low-skill jobs, and the lack of training and access to higher-level employment opportunities has been a barrier to economic mobility.

The expected generation of direct and induced jobs will contribute to alleviating the reliance on the working-age population to support dependent groups, such as children and the elderly, as indicated by the area's high dependency ratios. This job creation will not only provide immediate employment but also offer a platform for skill development and career growth, helping to break the cycle of poverty and disconnection from essential services. Additionally, with many in the community currently facing challenges related to employment, the hotel development presents an opportunity to address these gaps, improve living conditions, and foster long-term economic growth.

Recommended Mitigation

i. Inclusive Hiring Practices:
   To ensure the maximum benefit to the community, it is crucial to prioritize inclusivity in hiring practices. Addressing barriers faced by individuals from diverse sexual orientations and gender identities is essential to ensuring equitable access to employment opportunities and fostering a more inclusive workforce environment. This approach will not only maximize the positive impact of job creation but also contribute to greater social equity and cohesion in Lucea.
   a. Anti-Discrimination Policies: Develop and enforce strict anti-discrimination policies that ensure fair hiring practices regardless of gender, sexual orientation, or gender identity.

b. Diverse Recruitment Channels: Use diverse recruitment channels to reach a broad range of candidates, ensuring that job opportunities are accessible to all segments of the community.

To ensure inclusive and equitable employment practices and to mitigate potential negative impacts, the above measures should be implemented. It should be noted that, despite the implementation of measures to prevent Sexual and Gender-Based Violence (SGBV), including sexual harassment, exploitation, and abuse, there remains a potential for such incidents to occur. Therefore, standard response procedures should be employed to address any incidents of SGBV swiftly and effectively.

ii. Training and Development:
   a. Comprehensive Training Programs: Implement training programs that provide all employees with the necessary skills and knowledge, ensuring they can perform their roles effectively and progress in their careers.
   b. Diversity and Inclusion Training: Offer training on diversity and inclusion to all staff members to foster a supportive and respectful workplace culture.

iii. Community Engagement:
   a. Outreach Programs: Conduct outreach programs to engage with local communities, particularly marginalized groups, to inform them about job opportunities and the inclusive hiring process.
   b. Feedback Mechanism: Create a feedback mechanism for employees and community members to voice concerns and suggestions regarding employment practices and inclusivity.

6.3.4.2 Electricity Supply

Impact

The proposed electrical systems for the development are designed to ensure a reliable power supply for the project, addressing common issues reported in the perception survey regarding electricity reliability. While 97.4% of respondents indicated they used electricity for household lighting, a portion experienced supply problems, with 7.2% highlighting issues such as irregular outages (70.4%) and low voltage or illegal connections (14.8%). To mitigate these challenges, the development will integrate power from Jamaica Public Service (JPS) along with renewable energy from a solar field, ensuring a stable supply. Additionally, provisions for emergency backup generators will be made to address potential disruptions, ensuring continuous power for the project.

As detailed in section **Error! Reference source not found.**, the electrical systems for the hotel, resort, and villas will integrate JPS power through 24kV, 50Hz three-phase connections. Specifically, the hotel will combine JPS supply with a 5MW solar field and standby low voltage generators. The resort's system will include a medium voltage ring distribution network with multiple transformers and switches, and three 2.5 MW generators. The villas will receive stepped-down 220V power, each equipped with individual meters, a Main Distribution Panel (MDP), and standby generators with automatic transfer switches.

While the development will rely on JPS for part of its power, it aims to reduce its dependency on the utility grid by generating its own power through the solar field. The development will therefore reduce its reliance on carbon-based energy, cutting emissions by over 50% (estimated). The solar field's contribution will significantly lower greenhouse gas emissions and help the project meet sustainability goals by relying on clean, renewable energy. Standby low voltage generators will ensure uninterrupted power during outages, maintaining critical operations and reducing reliance on the grid during power interruptions. Additionally, as outlined in section **Error! Reference source not found.**, advanced smart glazing, superior insulation, and energy-efficient LED lighting with motion sensors will minimize energy consumption. An advanced Building Management System will optimize temperature control and energy use, while solar-powered lights for exterior areas will reduce electricity demand and infrastructure costs. These measures together will enhance sustainability and energy efficiency throughout the development.

Overall, the project's electrical systems will be designed to optimize energy use, reduce environmental impact, and contribute to long-term sustainability goals. With a strong focus on renewable energy through the solar field, energy-efficient lighting, and the integration of advanced power management systems, the project will not solely rely on JPS for power but will actively contribute to reducing the carbon footprint and increasing energy resilience. Furthermore, all systems will comply with local and international electrical codes, including JS 316: 2018, NEC, NFPA, and JPS Electrical Standards, ensuring safety, efficiency, and sustainability throughout the development. These proposed systems are crucial, as reliance on public utilities may increase due to the growing population and potential influx of people into the community and surrounding areas as a result of the development.

Recommended Mitigation

The proposed electrical systems and energy conservation strategies and designed to enhance energy resilience. The following additional mitigative measures could further strengthen these efforts, helping to minimize environmental impacts, improve energy efficiency, and support a more sustainable and resilient energy future for the hotel, resort, and villas.

i. Reduction of Grid Dependency
    a. To mitigate potential issues related to solar power generation (e.g., intermittency), energy storage solutions or backup generators should be employed to ensure consistent power supply.
    b. Any excess power generated by the solar field can be fed back into the grid, potentially offsetting other energy demands in the area.

ii. Energy Efficiency

a. The use of energy-efficient LED fixtures for both interior and exterior lighting throughout the hotel, resort, and villas will reduce power consumption and decrease the carbon footprint. Motion sensors, dimmable drivers, and daylighting controls should also be considered.

b. The installation of energy management systems will help monitor and control electricity use across the properties. These systems will ensure that power is used efficiently and only, when necessary, further reducing unnecessary energy consumption.

iii. Sustainable Materials and Waste Management

a. Proper disposal and recycling measures will be put in place for electrical components, including old transformers, batteries, and other materials, ensuring they are disposed of in an environmentally responsible manner. All electrical waste will be handled in compliance with local regulations to prevent contamination and pollution.

b. The project will utilize sustainable and low-impact materials wherever possible, including eco-friendly wiring and electrical components that are energy-efficient and non-hazardous.

iv. Electromagnetic Field (EMF) Management

a. Given the installation of medium-voltage power lines and transformers, the project will adhere to local and international standards for electromagnetic field (EMF) emissions, ensuring that the levels of EMF exposure around the electrical systems are within safe limits for the health of residents, workers, and visitors.

b. Transformers, power lines, and electrical systems will be strategically located to minimize EMF exposure to sensitive areas such as guest rooms and recreational zones.

v. Water Conservation and Management

a. Energy-efficient water heating systems (such as solar water heaters or high-efficiency electric water heaters) will be used to minimize electricity demand for hot water production, reducing the overall energy load on the electrical system.

b. Integrated water leak detection systems will be incorporated into the plumbing infrastructure to prevent water wastage and reduce unnecessary energy consumption for pumping water.

vi. Community Engagement and Awareness

a. Guests and residents will be educated on the importance of energy conservation through signage and educational materials. This will help promote energy-saving habits such as turning off lights and appliances when not in use.

b. Incentives may be offered to encourage the use of renewable energy sources (e.g., solar-powered devices) or participation in energy-saving programs.

vii. Climate Change Resilience

a. The design and construction of the electrical systems will take into account the potential effects of climate change, such as increased frequency of storms or extreme heat events.

The systems will be built to withstand extreme weather conditions, and backup power systems will be sized to handle peak loads during these events.

b. The solar field not only contributes to sustainability but also provides resilience by offering an alternative power source in the event of grid failure caused by climate-related incidents.

6.3.4.3 Water Supply

Impact

The project will be serviced by a water reticulation system consisting of two 1,000,000 US gallon storage tanks, supplied by the National Water Commission (NWC) infrastructure. The water supply will also be supplemented by local wells and rivers. The NWC infrastructure will need to be extended 3.5km from the west to connect to an existing 14-inch potable main, with potential water source development from nearby wells. Additionally, to reduce water usage, the project will implement several water conservation strategies, including grey water recycling for landscape irrigation, rainwater collection to supplement drinking water supplies, and the installation of water-saving plumbing fixtures to reduce consumption (see section **Error! Reference source not found.**). The golf irrigation system will be designed with a strong emphasis on water conservation, aiming to minimize water usage while ensuring optimal turf health. Additionally, staff will receive training on conservation practices to foster a culture of sustainability.

While the resort's infrastructure is designed to manage its water usage efficiently, overall demand in the area may rise due to the growing population and potential influx of people into the community and nearby areas as a result of the development. Furthermore, the expansion of local businesses driven by the Paradise Park development may increase water demand. However, with effective water conservation tactics in place, the development is expected to minimize its impact on the public piped water supply, which 94.5% of residents currently rely on. It's also important to note that 93.0% of these residents already face challenges such as irregular supply, lack of water, absence of piped connections, and low water pressure.

Recommended Mitigation

To supplement the proposed water conservation strategies, the following additional measures should be considered. These measures aim to ensure the development does not adversely affect the local water supply infrastructure, particularly the public piped water system, and to alleviate challenges already faced by residents, such as irregular supply and low water pressure.

i. Supplementary Water Sources: Explore the development of local water sources, including wells and nearby rivers, to supplement the water supply. This approach will help reduce pressure on the existing public water system.

ii. Monitoring and Reporting: Implement regular monitoring of water usage to assess the effectiveness of conservation measures and quickly address any emerging issues.

6.3.4.4 Wastewater

Impact

The sewer system for the proposed development is designed to manage an average daily wastewater flow of 1,053,000 litres (12.19 L/s), based on an average water use of 1,170,000 litres per day. During wet weather, inflows and infiltration are expected to contribute an additional 20% to the flow, adding 210,600 litres per day (2.44 L/s), bringing the total wastewater flow to 14.63 L/s. To account for peak demand, a peak factor of 3 has been applied, ensuring the system can accommodate a peak flow of 43.88 L/s.

To effectively handle and treat this wastewater, the development's wastewater treatment plant (WWTP) will include essential components such as a pump station, blower pad, manual bar screen, aerated grit chamber, aerobic digester, Orbal Basin, clarifiers, chlorine contact tank, sludge drying bed, and a constructed wetland. These systems will work in tandem to efficiently manage wastewater, ensuring that the rising wastewater generation is addressed sustainably while minimizing environmental impact.

The projected increase in wastewater generation in the study area (SIA) underscores the benefit of developing an independent wastewater treatment system, reducing reliance on NWC infrastructure.

Recommended Mitigation

No mitigation required.

6.3.4.5 Solid Waste

Impact

The operation of the hotel development has the potential to significantly increase solid waste generation in the area, driven by daily activities of guests and staff, including food waste, packaging materials, paper, plastics, and other refuse. Improper disposal of this waste can lead to environmental pollution, negatively affecting local land, water bodies, and marine ecosystems, particularly if the hotel is near a beach. Littering and illegal dumping can cause aesthetic degradation, harm wildlife, and attract vermin, posing health risks to both guests and local residents.

In response, the proposed, as proposed, will implement a comprehensive waste management plan aimed at reducing, reusing, and recycling materials to minimize its environmental impact. This plan includes working with suppliers to reduce excess packaging, using energy-efficient lighting, promoting recycling with clear targets, and educating staff and guests on waste segregation and sustainability practices. The resort will track recycling efforts, collaborate with local companies for efficient processing, and incentivize participation through reward programs. Hazardous waste will be handled and disposed of in compliance with regulatory guidelines, while regular monitoring, audits, and progress updates will ensure continuous improvement. Additionally, staff and guest engagement will be encouraged through workshops and feedback channels, ensuring active involvement in sustainability efforts.

Recommended Mitigation

To supplement the proposed waste management strategies, the following should be considered:

i. Storage Bins and Skips:
   a. Strategic Placement: Place solid waste storage bins and skips at strategic locations throughout the hotel premises to ensure easy access for both guests and staff.
   b. Adequate Capacity: Ensure that the bins and skips have adequate capacity to handle the expected volume of waste without overflow.
   c. Secure Bins and Skips: Use bins and skips designed with secure lids to prevent access by vermin and other pests, minimizing health risks and maintaining hygiene standards.

ii. Monitoring and Cleanup:
   a. Beach Garbage Monitoring: Regularly monitor and clean the beach area to prevent littering and maintain the aesthetic appeal of the coastal environment.
   b. Routine Inspections: Conduct routine inspections of the hotel grounds to promptly address any waste management issues.

iii. Waste Collection and Disposal:
   a. Private Contractor Engagement: Contracting a private contractor to collect solid waste in a timely fashion to prevent a build-up.
   b. Scheduled Collections: Establish and adhere to a regular waste collection schedule to ensure consistent and efficient removal of waste.
   c. Proper Disposal: Ensure that all collected solid waste is disposed of at approved disposal sites, complying with local regulations and environmental standards.
   d. Verification System: Develop a ticketing system between the hotel (Permittee) and the solid waste contractor to ensure effective management and verification of waste disposal.
   e. Record Keeping: Maintain records of waste collection and disposal activities to monitor compliance and identify areas for improvement.

iv. Waste Sorting and Recycling:
   a. Facilitate Sorting: Implement a waste sorting system to separate plastics, paper, glass, organic waste, and other recyclables. Provide clearly labelled bins to encourage proper waste segregation.
   b. Promote Recycling: Partner with local recycling programs to ensure that sorted materials are recycled and not sent to landfills.

v. Employee and Guest Education:

a. Training Programs: Provide training for staff on waste sorting, handling, and disposal procedures to ensure effective implementation of the waste management plan.

6.3.4.6 Health and Safety

Impact

The operation of the proposed hotel development will involve a significant influx of workers and guests, which increases the potential for illnesses, accidents, and emergencies occurring on-site. The development is also vulnerable to natural disasters, such as earthquakes, floods, storm surges, and fires, all of which pose serious risks to health and safety.

The Savanna la Mar Health Centre and Hospital are the closest public healthcare facilities to the proposed hotel development, and private healthcare options, such as Royale Medical Hospital and several medical centres, are within a few kilometres. Despite the availability of healthcare services, the local ambulance fleet, while recently supplemented with two new ambulances, faces limitations due to its aging vehicles. Residents of Smithfield also face several challenges in accessing healthcare services, including long waiting times, financial constraints, and poor transportation options, although some indicated no significant barriers. The hotel development could positively impact healthcare access by offering support to local medical services, potentially improving transportation options for guests and staff, and collaborating with emergency medical services to enhance response times. Additionally, the resort could introduce health and wellness programs that may benefit both visitors and the local community.

Fire emergency services in the Paradise Park development area are provided by the Savanna-la-Mar and Negril fire stations. The Savanna-la-Mar station, located about 4 km from the proposed site, is the closest and is equipped with first-response units, including fire engines, ambulances, and a water tanker. While these stations serve the community and surrounding areas, the proposed hotel development could have a positive impact by strengthening emergency response coordination and support.

The Smithfield area does not have a dedicated police station and relies on the Savanna-la-Mar Police Station, which is located 4 km away. While this station supports Smithfield and surrounding areas, the lack of on-site police facilities can delay rapid and effective responses to safety issues. Additionally, public safety concerns are exacerbated by inadequate street lighting, with nearly half of residents citing it as a significant issue. The proposed hotel development could have a positive impact by potentially increasing local security presence, offering enhanced lighting around the hotel and surrounding areas, and collaborating with local authorities to improve overall community safety.

Recommended Mitigation

i. First Aid Kits:

a. Equip various sections of the development with well-stocked first aid kits, ensuring they are easily accessible in case of emergencies.
b. Regularly check and restock first aid kits to ensure they are always ready for use.

ii. Emergency Response Plan:
a. Design and implement a comprehensive emergency response plan that covers all potential scenarios, including medical emergencies, natural disasters, and fires.
b. Conduct regular training sessions for staff to familiarize them with the emergency response procedures and ensure they can act swiftly and effectively during an emergency.
c. Healthcare Facilities: Establish mutual assistance agreements with local healthcare facilities, such as Savanna la Mar Health Centre and Hospital, to ensure quick and efficient medical care for any eventualities. Coordinate with associated doctors and nurses to facilitate prompt treatment.
d. Fire and Emergency Services: Arrange prior agreements with the Savanna-la-Mar Fire Station to ensure rapid response in the event of a fire or other emergencies requiring firefighting services.
e. Police Services: Coordinate with the Savanna-la-Mar Police Station to ensure prompt law enforcement support for any security or safety incidents that may arise.

iii. Natural Disaster Preparedness:
a. Conduct a risk assessment to identify potential vulnerabilities to natural disasters such as earthquakes, floods, and storm surges.
b. Develop and implement a disaster preparedness plan that includes evacuation routes, safe zones, and communication protocols for staff and guests.
c. Organize regular drills and simulations to practice emergency procedures and ensure all staff and guests are familiar with the actions to take during a natural disaster.

iv. Safety Infrastructure:
a. Ensure that all buildings are equipped with clearly marked emergency exits and safety signage to guide occupants during an emergency.
b. Install and maintain fire safety systems, including smoke detectors, fire alarms, and sprinkler systems, to enhance fire prevention and response capabilities.

v. Collaboration with and Support for Local Services and Community:
a. Work with the healthcare facilities to improve transportation options for staff, guests, and local residents, ensuring timely access to medical care.
b. Strengthen coordination with the Savanna-la-Mar and Negril fire stations by engaging in regular fire safety drills and providing support for local fire services. This could involve contributing resources or assisting with fire-fighting equipment to enhance their response capacity.

c. Enhance local security by increasing the presence of trained security personnel, with coordinated efforts with the Savanna-la-Mar Police Station. The hotel can also consider establishing a local security station or patrol in partnership with the police.
d. Address public safety concerns by improving street lighting around the hotel premises and nearby areas. This will help mitigate the issues raised by local residents regarding inadequate street lighting and improve overall safety in the community.
e. Coordinate with the Savanna-la-Mar Police Station to ensure prompt law enforcement support for any security or safety incidents that may arise.

vi. Communication Systems:
   a. Establish robust communication systems to quickly disseminate information during an emergency, including loudspeakers, alarms, and mobile alerts.
   b. Maintain open lines of communication with local emergency services and authorities to ensure coordinated and efficient response efforts.

vii. Health and Safety Training:
   a. Implement ongoing health and safety training programs for employees to ensure they are knowledgeable about potential risks and the appropriate response measures.
   b. Provide guests with information on emergency procedures and safety protocols upon check-in to ensure they are prepared for any eventuality.
   c. Conduct regular fire drills for staff and guests to ensure readiness in case of emergency.

6.3.4.7 Vehicular Traffic

Impact

METHODOLOGY

The traffic impact study utilized a screen line analysis to determine the additional capacity required on the corridor based on the projected traffic within the development's design horizon. As the development connects to the main road network, the impact of vehicles turning into and out of the development on the performance of the corridor was assessed. The analysis considered two separate years, the existing year (2027) and the future year (2036), during both the morning and evening peak periods.

Both the analysis of the affected corridors and intersections were conducted following the methods outlined in the Highway Capacity Manual (HCM) 2000 Edition. The Level of Service (LOS) analysis was performed using Sidra traffic analysis software, which evaluated traffic operations based on intersection LOS and queue length analysis. Under the HCM 2000 methodology, delays were calculated only for those movements that needed to stop and wait until a sufficient gap was available. For unsignalized intersections, delays were reported in average seconds per vehicle and given a corresponding letter grade for each movement rather than for the entire intersection.

The evaluation included both peak periods, although the morning peak occurred before the facility opened for business. The analysis also considered performance in the current year (2024) and two future scenarios:

- Scenario A: Existing Traffic + Background Growth only
- Scenario B: Existing Traffic + Background Growth + Paradise Park

Intersections

Traffic conditions at signalized intersections were evaluated using the HCM 2000 methodology for signalized intersections. This method assessed capacity using the volume-to-capacity (v/c) ratio and evaluated LOS based on controlled delay per vehicle. For signalized intersections, Level of Service (LOS) was determined based on the controlled delay, with LOS A representing no delay and LOS F indicating excessive delays due to congestion. For unsignalized intersections, the primary measure used to estimate LOS was control delay. According to the HCM 2010 methodology, delay was calculated for those movements that had to stop and wait until a sufficient gap became available. Delay was reported in average seconds per vehicle and assigned a corresponding letter grade for each movement rather than for the entire intersection.

Corridors

For two-lane highways, the capacity was considered to be 1,700 passenger cars per hour (pc/h) for each direction of travel, with the capacity independent of the directional distribution of traffic. The Highway Capacity Manual defined two types of two-lane highways: Class I and Class II. Class I highways were considered major intercity routes or primary arterials designed for high-speed travel. The performance of these highways was determined by both the average travel speed and the percent of time spent following other vehicles. Class II highways, serving shorter trips, focused on mobility with LOS determined based solely on the percentage of time vehicles spent following others, without considering average travel speed. Based on the current road hierarchy, the Sav-La-Mar Main Road (A2) was classified as a Class I corridor, while the Ferris Cross to Mackfield corridor was assessed as a Class II corridor.

VEHICULAR GENERATION ASSUMPTIONS

Vehicular trip generation for the proposed development was calculated based on trip rates provided by the Institute of Transportation Engineers (ITE) Trip Generation Manual (9th Edition). The trip generation for the facility was based on the following assumptions:

1. The development was assumed to be occupied in 2027 at the start of the analysis, regardless of construction schedules.
2. Turning volumes from the development and at the intersections were allocated according to the existing ratios on the main road.
3. Background traffic growth was assumed to be 3%.

4. Vehicular access and egress to the property were assumed to occur via the access point on the Sav-La-Mar Main Road.
5. The Sav-La-Mar Main Road was classified as a Class I corridor, while the Ferris Cross to Mackfield road was treated as a Class II highway, according to the HCM methodology.

The land uses and vehicular trip generation rates used in the study were as follows:

- All Suites Hotel (ITE Code 311)
- Recreational Home (ITE Code 260)

TRAFFIC VOLUMES

Using an annual background growth rate of 3%, the peak-hour flow on Sav-La-Mar Main Road is expected to grow to 10,290 vehicles in the design year, while volumes on Ferris Cross to Mackfield will increase to 6,732 vehicles per day (Table 6-16).

Table 6-16 Daily traffic volumes

Source: (Transmodel, 2025)

Roadway	DAILY TRAFFIC VOLUMES		
	Existing	Future	Future with Dev
Sav-La-Mar Main Road	7,657	10,290	12,603
Ferris Cross to Mackfield	5,009	6,732	7,333

The proposed development is expected to generate 2,313 daily trips in total. Of these, 601 vehicles will be assigned to the Ferris Cross to Mackfield corridor, while the remaining will be allocated to the Sav-La-Mar Main Road, resulting in future daily traffic volumes of 12,603 vehicles on the Sav-La-Mar Main Road and 7,333 vehicles on the Ferris Cross to Mackfield corridor.

For the morning peak period, the development is expected to generate 170 new trips, while the evening peak will generate 202 trips. Traffic on Sav-La-Mar Main Road will increase from the current 566 vehicles to 930 vehicles in the design year with background growth and development combined. Similarly, the Ferris Cross to Mackfield corridor will see an increase in morning peak volumes from 518 vehicles to 824 vehicles, while the evening peak will grow from 453 vehicles to 666 vehicles as a result of development traffic (Table 6-17).

Table 6-17 Peak hour volumes

Source: (Transmodel, 2025)

	AM PEAK			PM PEAK		
	Existing	Future	Future Dev	Existing	Future	Future Dev
Sav-la Mar Main Rd	566	761	930	361	485	687
Ferris Cross to Mackfield	581	781	824	453	609	666

CORRIDOR AND INTERSECTION PERFORMANCE

Sav-La-Mar Main Road

In the future, with no development, travel speed is expected to fall to 86 km/h, and the time spent following increases to 52%, resulting in a decline to LOS C. With the development, travel speed will decrease further to 84 km/h, and the time spent following will increase to 58.9%, maintaining LOS C. In the evening peak period with background growth, travel speed will decrease to 86 km/h, and time spent following will rise to 36%, keeping the performance at LOS B. With the addition of development traffic, travel speed will further decline to 81 km/h, and the percent time spent following will rise to 53.4%, resulting in a performance drop to LOS C.

Table 6-18 Corridor performance, Sav-La-Ma Main Road

Source: (Transmodel, 2025)

Corridor		PERIOD	Performance		
			PTSF	ATS	LOS
Sav-la-Mar Main Road	AM	EXISTING	42	89	B
		FUTURE	52	86	C
		FUTURE DEVELOPMENT	58.9	84	C
	PM	EXISTING	28	88	B
		FUTURE	36	86	B
		FUTURE DEVELOPMENT	53.4	81	C

Ferris Cross to Mackfield

During the morning peak period with background growth, the performance will remain at LOS B, but the time spent following will increase to 53%. With development, the performance will remain LOS B, though the time spent following will increase to 54.8%. During the evening peak period, with background growth, performance will degrade to LOS C, with time spent following increasing to 55%. With development, the time spent following will increase further to 58.7%, but the performance will remain at LOS C.

Table 6-19 Corridor performance, Ferris Cross to Mackfield

Source: (Transmodel, 2025)

Corridor		PERIOD	Performance		
			PTSF	ATS	LOS
Ferris Cross to Mackfield	AM	EXISTING	43	88	B
		FUTURE	53	85	B
		FUTURE 43DEVELOPMENT	54.8	85	B
	PM	EXISTING	46	49	B
		FUTURE	55	47	C
		FUTURE DEVELOPMENT	58.7	46	C

Intersection Performance at Ferris Cross

In the future, with background growth, the delay at the intersection will increase to 12.0 seconds, but the performance will remain at LOS B. With the addition of development traffic, the delay will increase slightly to 13.3 seconds, maintaining LOS B. In the evening peak period, with background growth, the delay will increase to 12.4 seconds, keeping the performance at LOS B. With development traffic, the delay will rise to 13.6 seconds, but the intersection will continue to perform at LOS B.

Table 6-20 Intersection performance, Sav-la-Mar Main road/Ferris Cross to Mackfield AM

Source: (Transmodel, 2025)

INTERSECTION	PERIOD	AM PEAK HOUR		
		V/C	DELAY	LOS
Sav-la-Mar Main Road/Ferris Cross to Mackfield	EXISTING	0.512	10.6	B
	FUTURE	0.695	12.0	B
	FUTURE WITH DEVELOPMENT	0.775	13.3	B

Table 6-21 Intersection performance Sav-la-Mar Main road/Ferris Cross to Mackfield Rd PM

Source: (Transmodel, 2025)

INTERSECTION	PERIOD	PM PEAK HOUR		
		V/C	DELAY	LOS
Sav-la-Mar Main Road/Ferris Cross to Mackfield	EXISTING	0.484	10.9	B
	FUTURE	0.671	12.4	B
	FUTURE WITH DEVELOPMENT	0.727	13.6	B

Development Entrance/Sav-La-Mar Main Road

At the entrance of the development, during the morning peak period, the performance of the Sav-La-Mar Main Road is expected to be LOS A, with delays of 0.8 seconds for the eastern leg and 1.1 seconds for the western leg. No queues are expected, except for a 1.6m long right-turn queue into the development from the west. The development leg will perform at LOS C, with a delay of 16.4 seconds and an estimated queue length of 7.2m.

During the evening peak period, the performance of the entrance will remain at LOS A for both legs of the main road, with minimal delay from right-turning vehicles. The development leg will continue to operate at LOS C, with delays of 17.2 seconds and a queue length of 10.2m.

Table 6-22 Development entrance performance AM

Source: (Transmodel, 2025)

INTERSECTION	PERIOD	Leg	Performance		
			Delay (Sec)	Queue (m)	LOS
Sav-la-Mar Main Road/Development Entrance	AM	Sav-la-Mar West	1.1	1.6	A
		Paradise Development	16.4	7.2	C
		Sav-La-mar East	0.8	0	A

Table 6-23 I Development entrance performance PM

Source: (Transmodel, 2025)

INTERSECTION	PERIOD	Leg	Performance		
			Delay (sec)	Queue (m)	LOS
Sav-la-Mar Main Road/Development Entrance	PM	Sav-la-Mar West	0.9	1.3	A
		Paradise Development	17.2	10.2	C
		Sav-La-Mar East	0.7	0	A

SUMMARY OF FINDINGS

The analysis of the corridors reveals that, during the morning peak period, the Sav-La-Mar Main Road (Class I corridor) currently operates at LOS B but is expected to degrade to LOS C due to background growth. However, with the development, the performance remains at LOS C. In the evening peak period, performance remains at LOS B with background growth but falls to LOS C with the addition of development traffic.

The Ferris Cross to Mackfield corridor (Class II) operates at LOS B during the morning peak, with performance unchanged in the future, whether or not the development occurs. In the evening peak, the corridor performs at LOS B, but degrades to LOS C with background growth, and remains at LOS C when development traffic is included.

The intersection at Ferris Cross (Sav-La-Mar Main Road/Ferris Cross to Mackfield) maintains LOS B during both the morning and evening peak periods, even with the inclusion of development traffic.

The performance at the development entrance shows that the main road will perform at LOS A during both peak periods, with the development leg performing at LOS C, with minor delays and queuing.

In summary, while the development will result in some decline in performance, the corridors and intersections generally maintain acceptable levels of service with or without the development.

Recommended Mitigation

Based on the modelling of the critical intersections and the corridors within the influence area of the development, it has been determined that, in general, the development will not cause significant degradation of performance on the main road network. However, to ensure smooth traffic flow and minimize any potential impacts, the following mitigation measures are recommended:

i. Development Entrance:

a. The entrance to the development should be widened to accommodate a turning lane for vehicles approaching from the west. This lane should include 50 meters of storage and a 45-meter taper to ensure efficient and safe entry into the development.
b. To facilitate safe turning from the east, a deceleration lane should be provided, extending 50 meters in length.

ii. Signage: To alert drivers of the intersection and the presence of the development, appropriate signage should be installed on both approaches to the development. Signs should be placed at 50-meter and 100-meter intervals from the entrance, ensuring that drivers are adequately warned of the intersection ahead. This will help reduce abrupt manoeuvres and improve overall traffic safety in the area.

The proposed improvements to the entrance and signage are expected to further mitigate any potential impacts and ensure that the development integrates smoothly with the surrounding road network.

6.3.4.8 Maritime Traffic

Impact

The presence of overwater rooms and coastal structures on the western side of the headland could potentially disrupt existing maritime activities. Overwater rooms have the potential to obstruct established navigational paths, which may hinder the safe passage of maritime vessels. This obstruction could also increase the risk of accidental collisions, particularly under low visibility conditions, such as at night or during adverse weather events.

Recommended Mitigation

i. Visible Marker Buoys: Installing permanent, highly visible marker buoys around overwater rooms to clearly indicate their presence and boundaries to maritime vessels.
ii. Navigation Lights: Implementing turtle-friendly lighting and strategically positioning lights on overwater structures to ensure visibility for marine vessels during nighttime operations, reducing the risk of collisions.
iii. Clearance and Safety Zones: Establishing and maintaining clearances and safety zones around overwater rooms in accordance with maritime regulations to facilitate safe navigation and prevent congestion.
iv. Monitoring and Compliance: Regular monitoring of maritime traffic patterns and compliance with navigational safety standards to assess any potential impacts and adjust mitigation strategies, as necessary.
v. Public Awareness and Education: Conducting outreach and education campaigns to inform maritime stakeholders about the presence of overwater rooms, their potential impacts on navigation, and the importance of adhering to safety measures.

6.3.4.9 Land Use and Zoning

Impact

The proposed resort development may alter the current land use of the area, which is presently utilized for a mix of activities such as animal farming, timber harvesting, and recreational purposes. Notably, the development will preserve the region's agricultural heritage, which has been a longstanding and historically significant land use, by incorporating a farming school focused on Jamaican agricultural practices. Additionally, the project will revitalize a part of the site's history by reintroducing a golf course. While the overall transformation of the land to accommodate hospitality and related uses, including guest accommodations (villas, hotels, etc.), recreational amenities, and utility infrastructure (such as a solar field and WWTP), may change the area's character, it also presents an opportunity to diversify and enhance the region's economic activities.

The site falls within The Town and Country Planning (Westmoreland Area) Provisional Development Order 2018, (Confirmation Notification, 2021) and is subject to its guidelines and regulations. The area is zoned for rural development and agricultural use further inland, with the coastal zone designated for wetlands and mangrove conservation. A section of the project area also overlaps with the Bluefield/Whitehouse Stand-alone Priority Conservation Area and extends into a small portion of the Savanna-La-Mar Local Planning Area, which is earmarked for residential development. While the site is not located within a protected area or marine park, its landward boundary runs parallel to the Bluefields Bay Fish Sanctuary, and proposed coastal works fall within the sanctuary's boundaries.

While the land use changes will require careful consideration of existing zoning and ecological factors, the proposed development offers a chance to balance sustainable development and economic growth with environmental stewardship. Special attention will be given to the planning and execution of coastal works to ensure compatibility with the fish sanctuary and local environmental concerns.

Recommended Mitigation

i. Engage in consultations with local planning authorities to ensure compliance with zoning requirements and seek any necessary adjustments to zoning classifications if required.
ii. Develop coastal works in close consultation with environmental experts and stakeholders to ensure compatibility with the Bluefields Bay Fish Sanctuary. Please also see section 6.3.4.12 regarding fisheries.
iii. Involve local communities in the development process through consultations and employment opportunities. Provide avenues for the community to participate in the planning, ensuring that the development brings economic benefits without negatively impacting traditional land uses like farming and recreation.

6.3.4.10 Recreation

Impact

The proposed resort development will introduce a wide range of recreational amenities for guests, significantly enhancing the recreational offerings in the region. While the existing recreational activities, particularly those centred around river-based recreation enjoyed by local river goers, may be altered or displaced, the development will provide opportunities for a diverse array of new recreational experiences, such as golf, tennis, pickleball, polo club, art, and music recording.

These new amenities will offer cultural, wellness, athletic, artistic, and culinary experiences, aligning with global trends in experiential travel and has the potential to attract new visitors and diversify the types of recreational activities available, thereby enhancing the region's appeal as a tourism destination.

Recommended Mitigation

i. To mitigate the potential displacement of existing river-based activities enjoyed by local river goers, the resort should explore opportunities to incorporate or support these activities in a modified form. For example, designated areas along the river could be set aside for local residents, or the resort could offer river-based experiences like kayaking or eco-tours for both guests and the community. Engaging with local stakeholders to understand their needs and ensuring that traditional recreational activities are respected will help minimize disruptions.
ii. While the development introduces new recreational amenities, such as golf, tennis, polo, and art/music facilities, it is important to ensure that local residents have access to some of these amenities. This could be achieved through discounted rates, special access hours, or partnership programs. By involving the local community in the resort's recreational offerings, the development can create a shared space for both visitors and residents, fostering positive relationships and ensuring that the development benefits the community.
iii. The introduction of new recreational activities should be carefully planned to ensure they align with the region's environmental and cultural values. For instance, golf courses and polo fields should be designed with sustainable landscaping practices, using native plants, and minimizing water and chemical usage. Additionally, cultural sensitivity should be integrated into the resort's art and music programs, highlighting local traditions and talents, and ensuring that these offerings resonate with both visitors and the local community.
iv. The resort can actively encourage guests to explore surrounding areas by providing information about nearby attractions, including local recreational sites, historical landmarks, and nature reserves, encouraging them to venture beyond the resort and explore the broader area. This can be done by offering guided tours, community-based excursions, or cultural experiences that highlight the unique aspects of the local community and wider Jamaican landscape. For example, guests could be invited to visit nearby villages, engage in local cultural festivals, or participate in workshops that teach traditional crafts, music, or cooking. This would allow guests to experience the authentic local lifestyle and create a sense of connection between the resort and the community.

v. The resort could partner with local businesses, artisans, and cultural institutions to promote their offerings to guests. The resort could host cultural events, such as music performances, dance shows, or art exhibitions, which showcase the talent and traditions of the local community. These events could be open to both resort guests and local residents, fostering interaction and mutual appreciation.

6.3.4.11 Tourism

Impact

The proposed resort development on the South Coast of Jamaica, particularly in the Bluefields Bay area, is positioned to significantly impact the region's tourism landscape. The South Coast is renowned for its natural beauty, laid-back atmosphere, and cultural richness, offering a unique and diverse experience compared to the more commercialized resorts of the North Coast. With a focus on eco-tourism, the area is well-suited to capitalize on the growing global demand for sustainable and authentic travel experiences.

Currently, Bluefields Bay offers a limited range of accommodations, catering primarily to small to medium-sized groups. Options such as Horizon Cottages, Bluefields Bay Villas, and Bluefields Bay Resort provide varying levels of service, from basic amenities to high-end luxury, but there is a noticeable gap in the quality of service between these accommodations. The proposed hotel would fill this gap by offering a high standard of service, potentially bridging the divide between basic and luxury options. By doing so, it could attract a wider range of visitors, from eco-tourists seeking more affordable, nature-focused experiences to high-end travellers seeking luxury amenities.

The development could enhance the appeal of the South Coast as a tourism destination by increasing the availability of quality accommodations, improving local infrastructure, and providing new opportunities for both international and domestic visitors. The introduction of a new hotel could also create a more balanced offering of accommodations, allowing the region to cater to a broader market.

In conclusion, the proposed hotel has the potential to positively impact tourism in the Bluefields Bay area by enhancing accommodation options, attracting a broader range of visitors, and supporting eco-tourism and sustainable practices. Careful planning and alignment with local conservation goals will be key to ensuring that the development enhances the region's tourism appeal while preserving its natural and cultural heritage.

Recommended Mitigation

It is important to carefully manage the development to ensure that the unique character, ecological significance, and protected status of Bluefields Bay is preserved. The hotel should complement the existing eco-tourism initiatives and align with conservation efforts in the area. Responsible development practices will help maintain the delicate balance between tourism growth and environmental protection, ensuring that the region continues to attract visitors seeking authentic and sustainable experiences.

6.3.4.12 Fisheries

Impact

The proposed hotel development could potentially impact local fisheries, particularly in the Bluefields Bay region, which plays a vital role in Jamaica's fishing industry. Westmoreland is the second-largest parish in terms of registered fishers and the highest number of boat licenses issued between October and December 2023. Several nearby fishing beaches, including Belmont, Cave, Smithfield, and St. Anne, support active fishing communities that contribute significantly to the local economy. In fact, the proposed hotel development has raised concerns among a small portion of local fishers in the Bluefields Bay area, with 19.0% of respondents from the perception survey expressing specific worries. The primary concerns include the potential impact of the development on fishing areas, fish migration, and marine life. It is important to note that, according to the fishermen interviewed during the perception survey, fishing activities mainly occur outside the boundaries of the fish sanctuary (section 5.3.2 and Figure 5-8). The areas on the western side of the headland indicated to be used for fishing are unlikely to be affected by the proposed overwater features. The area immediately offshore from the site falls within the Bluefields Bay fish sanctuary, where fishing is prohibited.

The Bluefields Bay Fish Sanctuary holds significant ecological and commercial value, home to species like spiny lobsters, surgeonfish, and parrotfish. The sanctuary is governed by a community-driven approach with strong local support, playing a vital role in marine conservation and sustainable fishing. While the hotel's development may initially introduce some challenges, such as increased foot traffic or potential pollution, it also opens up opportunities for long-term environmental benefits. For instance, the project could support initiatives like coral nurseries and artificial reefs within the sanctuary, which would help boost fish populations outside the sanctuary. These efforts would not only strengthen the local ecosystem but also enhance local fisheries, creating a positive, sustainable impact on the surrounding marine environment.

Recommended Mitigation

i. Collaboration with Local Fishermen and Fishery Organizations:
    a. The resort can work closely with the Bluefields Bay Fishermen's Friendly Society (BBFFS) and other local fishery groups to develop a shared management plan for the protection of the Bluefields Bay Fish Sanctuary and surrounding fishing areas. This collaboration should include regular consultations and joint monitoring of fishing activities to ensure the resort's operations do not interfere with fishers' livelihoods.
    b. As part of its commitment to environmental stewardship, the resort can participate in or fund local marine habitat restoration programs. These efforts would help improve the

health of marine ecosystems and support sustainable fisheries. The resort can also consider setting up artificial reefs to enhance local fish habitats.

c. The resort can support local fishers by encouraging the use of sustainable fishing techniques and adhering to fishing regulations. This can be achieved by providing fishers with access to resources, such as better equipment or training in sustainable practices, and by offering preferential contracts for sourcing local, sustainably caught seafood for the resort's restaurants.
d. To minimize disruption to local fisheries, buffer zones or restricted fishing areas could be established around the resort to protect key marine habitats and ensure that local fishers continue to have access to productive fishing grounds. These zones could be agreed upon through discussions with the local fishery management bodies and stakeholders.
e. A comprehensive monitoring program should be implemented to track the impact of the resort's activities on local fisheries. This includes monitoring fish populations, water quality, and habitat health, particularly in and around the Bluefields Bay Fish Sanctuary. Regular reports should be submitted to local authorities and stakeholders, ensuring transparency and prompt action in response to any negative environmental impacts.

ii. Environmental Management and Pollution Control:
   a. The resort should implement a robust environmental management plan (EMP) that addresses potential sources of pollution, such as wastewater, solid waste, and chemical runoff. Regular monitoring of water quality near the sanctuary should be carried out to ensure compliance with environmental standards.

iii. Guest Education and Awareness Programs:
   a. To promote awareness of the local marine environment and the importance of sustainable fishing practices, the resort can develop educational programs for guests. These could include guided tours of the Bluefields Bay Fish Sanctuary, workshops on the region's fisheries and conservation efforts, and opportunities to engage in sustainable tourism activities. This would foster respect for the local fishing community and the preservation of marine resources.

6.3.4.13 Community Relations

Impact

The proposed hotel development in the Bluefields Bay area could potentially impact the local community dynamics, which are currently characterized by strong collective action, mutual support, and effective organizations like the Bluefields People Community Association (BPCA) and the Bluefields Bay Fishermen's Friendly Society (BBFFS). These organizations are vital in driving both environmental sustainability and socio-economic progress in the area.

The development could potentially introduce tensions within the community, as concerns have been raised by a small portion of residents during the perception survey regarding potential impacts on their livelihoods and the local environment. Several respondents have expressed concerns about the impact of the proposed resort, particularly regarding the development's effects on local fishing areas, loss of wildlife habitats, and environmental degradation. As these activities are vital to the community's economic and cultural practices, these concerns suggest that the development could disrupt established community dynamics, if not addressed.

While the majority of the community remains optimistic about the development, there is a need for careful management and engagement to address all voiced concerns. Ensuring that the hotel's development is compatible with the local way of life and does not disrupt the community's established systems of mutual support and environmental stewardship will be key to preserving the area's strong community dynamics.

Recommended Mitigation

i. Community Engagement and Consultation:
    a. It is crucial to maintain an ongoing dialogue with the local community, particularly with organizations like the BPCA and the BBFFS. Regular consultation sessions should be held to keep the community informed, address concerns, and involve local stakeholders in decision-making processes. This will help foster a sense of inclusion and ensure that the development aligns with the community's values and needs.
    b. Involve local communities in the development and operation of the hotel by prioritizing the hiring of local staff and sourcing materials and produce locally. Additionally, local artisans and cultural performers could be featured within the hotel to highlight the region's cultural heritage.
    c. Once the development is underway, continuous monitoring should be implemented to assess its impact on the community and the environment. This should include regular feedback from local stakeholders and the adaptation of management strategies as needed to minimize any adverse effects.

ii. Preservation of Local Livelihoods:
    a. To alleviate concerns about the potential loss of fishing grounds and other local resources, the development should prioritize preserving access to these areas for the community.
    b. Initiatives to support local crab hunting and other traditional activities should be integrated into the resort's operations.
    c. To address any concerns regarding disruption to local livelihoods, the development should explore opportunities to integrate the community into the resort's operations. This could include offering employment opportunities to local residents, supporting small businesses, and promoting cultural tourism that highlights the area's traditions and way of life.

i. Claims and Complaints Absolution Programme

a. With the aim of establishing and maintaining a harmonious relationship between the stakeholders (both internal and external) and the Project, a Claims and Complaints Absolution Program will be implemented, whose general objective is to create a system that allows timely response to complaints from residents who are perceived to be affected or harmed by any aspect of the Project.
b. A Grievance Redress Mechanism (GRM) to include reports of allegations of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination will also be formulated. The objectives of the GRM are outlined below:
   - Ensure a fair and rapid response by the representatives of the Project to the questions, concerns and / or complaints of the stakeholders, so that they do not become negative impacts.
   - Provide alternative methods to solve potential complaints in substitution of legal actions between the parties.
   - Properly document complaints and claims, elaborating respective formats for each stage of the process.
   - Build a process of mutual trust with local and regional groups of interest.
   - Clearly defining policy statements about the handling of complaints and claims (including, when appropriate, mechanisms to ensure confidentiality and access to the information).
   - Clearly establishing organizational responsibilities such as the assigning of specific personnel from the operation, managers, and/or functional units to implement the GRM, designating access points for complaints.
   - Defining, documenting, and disclosing workflow procedures and standards to ensure that all complaints are understood and analysed, as well as the criteria for decisions to determine the appropriate responses.
   - Establishing clear communications mechanisms with claimants, both regarding how to bring problems to the attention of the authorities and how those authorities communicate with the claimants.
   - Establishing systems to register and follow up on all complaints, disputes, or claims.
   - Establishing an appeal process (or other solutions) for cases where the parties involved in a complaint, or a dispute do not agree with the decisions at the operational level.

6.4 NATURAL RESOURCE VALUATION

6.4.1 Purpose and Limitations

The goal of an Ecosystem Service and Natural Resource Valuation (ESV and NRV) is to assess the economic value of the natural resources in the area, including wetlands, mangroves, seagrass, and coral reefs, and to evaluate the potential losses from their destruction due to the development. This type of assessment is crucial for informing EIAs and guiding decision-making processes regarding major infrastructure projects. It also highlights the importance of considering the economic and social benefits of protecting coastal ecosystems, such as their role in disaster risk reduction, fisheries, and tourism, and suggests potential mitigation strategies, like conservation measures, to offset environmental damage and reduce costs. Ultimately, the assessment aims to provide key stakeholders with valuable information to guide decisions on development alternatives and mitigation actions (EcoNexus Consulting Group LLC, 2025).

However, applying NRV techniques has limitations. For example, the time constraints of the EIA process often don't allow for the extensive data collection needed for accurate valuation, particularly when primary data is required. These data collection methods can be expensive and time-consuming and may not be feasible for smaller projects. In some cases, it might be more appropriate to estimate ecosystem values at a larger, national, or regional level through external studies. Additionally, NRV often focuses on public goods, estimating the broader societal benefits of natural systems. In the context of coastal tourism development, many affected ecosystems are on private land or leased to private entities, meaning the public may bear the environmental costs unless there is a legal framework to compensate private owners for preserving these ecosystems. Without such frameworks, development may result in environmental degradation that impacts society at large (EcoNexus Consulting Group LLC, 2025).

6.4.2 Methodological Overview

Ecosystem services are the benefits that natural environments provide to human society, such as clean air, water, biodiversity, and recreational opportunities (EcoNexus Consulting Group LLC, 2025). Some services, like biodiversity and wildlife viewing, are not traded in markets and require non-market valuation methods to estimate their economic worth. Estimating the public ecosystem services associated with the potential area to be impacted can be done following these steps:

1) The geographic/spatial, ecological, and economic scope of the study site is identified;
2) The existing characteristics of the ecosystem (mangroves) and potential changes in the flow and value of ecosystem services based changes or pressures;
3) Existing data is used to estimate average economic values (including $ per unit area) for ecosystem service streams that are identified.

The goal is to provide a framework to evaluate trade-offs between development options, including mitigation and restoration efforts, and to inform decision-making on the impacts of the proposed resort development on key ecosystems like mangroves, seagrasses, and coral reefs (EcoNexus Consulting Group LLC, 2025).

The methods used in this analysis highlights the monetary value that the development area contributes to the community through mitigation and other services as well as the replacement cost for the ecosystem. This method has been employed as a means of enabling stakeholders to see the real value of natural resources (EcoNexus Consulting Group LLC, 2025). To achieve this, the valuation identified the main streams of ecosystem services at the proposed site; some of the ecosystem services of mangroves seagrasses and coral reefs include:

- Surface water detention; (mangroves)
- Nutrient transformation; (mangroves, seagrass)
- Sediment and other particulate retention; (mangroves, seagrass, coral reefs)
- Coastal storm surge detention; (mangroves, seagrass, coral reefs)
- Shoreline stabilization; (mangroves, seagrass, coral reefs)
- Provision of fish and other shellfish habitat; (mangroves, seagrass, coral reefs)
- Provision of wildlife habitat; (mangroves, seagrass, coral reefs)
- Conservation of biodiversity; (mangroves, seagrass, coral reefs)
- Carbon sequestration (mangroves, seagrass)

The most relevant ecosystem services applicable to the Paradise Park project were assessed and where feasible, economic estimates derived using value transfer approaches (EcoNexus Consulting Group LLC, 2025). The key ecosystems of note are:

1) the non-market (public good) values associated with coastal ecosystems (corals, seagrasses, sandy shore, and wetlands);
2) proxy values for coastal fisheries associate with these ecosystems;
3) carbon sequestration services (terrestrial and coastal/marine) and
4) other proxy values associated with coastal protection services.

Relevant ecosystem services and economic valuation literature were used as the basis for the methods applied to the ecosystem services of interest.

6.4.2.1 Millennium Ecosystem Services Framework

This framework categorizes ecosystem services into four types: Supporting, Regulating, Provisioning, and Cultural/Recreational. The analysis assesses both intermediate and final services, focusing on the benefits derived from ecosystems like mangroves, seagrasses, and coral reefs. The approach distinguishes between "use values" (e.g., recreational activities, resource harvesting) and "non-use values" (e.g., cultural significance). The analysis aims to support sustainable development policies by incorporating economic valuation and promoting transparency in decision-making (EcoNexus Consulting Group LLC, 2025).

6.4.2.2 Benefit and Value Transfer

The study applied benefit transfer methods, which estimate the economic value of ecosystem services by adapting data from previous studies conducted in other locations. This method is often used when original valuation studies are too costly or time-consuming. It relies on existing literature and may be supplemented by model simulations. For example, values for services like fisheries or carbon sequestration may be adapted from other regions, with sensitivity analyses to account for differences in environmental quality and management practices (EcoNexus Consulting Group LLC, 2025).

6.4.2.3 Damage Cost Avoided Approaches

This method estimates the value of ecosystem services by calculating the costs of avoiding damages due to service loss, the costs of replacing the services, or the cost of providing substitute services. It was applied to assess the economic benefits of protecting lives, livelihoods, and property, as well as reducing carbon emissions through the preservation of coastal ecosystems (EcoNexus Consulting Group LLC, 2025).

6.4.2.4 Economic Value of Carbon

The study also examined the economic value of carbon sequestration by tropical ecosystems, including mangroves, seagrasses, and coastal wetlands. This involved reviewing relevant literature and using metrics such as the social cost of carbon (SCC) to estimate the economic benefits of removing carbon from the atmosphere (EcoNexus Consulting Group LLC, 2025).

6.4.3 Economic Values of Key Ecosystem Services

The proposed development at Paradise Park is expected to impact key coastal ecosystems, including seagrasses and mangroves, which provide essential non-market services such as storm protection, carbon sequestration, and fisheries support. Other impacted ecosystems include secondary forests, disturbed cropland, and the beach.

Coastal ecosystems like mangroves, coral reefs, and seagrasses are critical for various services, but estimating their economic value is challenging. Valuation methods include avoided damage, replacement cost, and stated preference approaches. The uncertainty surrounding climate change impacts on these ecosystems adds complexity to their valuation. A meta-analysis of 67 studies provided estimates for the economic value of marine and coastal ecosystem services, showing that coral reefs, mangrove forests, and marine waters provide highly valued services, particularly in recreation, tourism, and fishing. The economic value of provisioning services ranged from $99 to $1,535 per hectare per year, while cultural services ranged from $45 to $2,170 per hectare, and recreation/tourism services from $185 to $895 per individual annually. However, these estimates should be used cautiously due to the limited number of studies and reliance on value transfer methods (EcoNexus Consulting Group LLC, 2025).

The economic value of fisheries supported by coastal ecosystems can vary depending on location and scale. For instance, mangrove fisheries in the Gulf of California were valued at USD 37,500 per hectare annually, while in Bangladesh, mangrove fisheries contributed significantly to household incomes, with an estimated habitat value of USD 976 per hectare. In contrast, saltmarshes in Australia had economic values ranging from AUD 2,500 to 25,000 per hectare annually (EcoNexus Consulting Group LLC, 2025).

This valuation uses existing literature to conduct benefit and value transfer estimates for key ecosystems at the site, including coastal wetlands, mangroves, seagrasses, and disturbed secondary forests. The analysis considers carbon sequestration values and the potential lost values from impacted areas. The coral reef at the site is not expected to be affected by development, so its economic importance is highlighted separately (EcoNexus Consulting Group LLC, 2025).

The values presented are primarily comparative and based on global per-hectare data, with site-specific data used for carbon sequestration estimates. These values should be viewed as non-market benefits, rather than direct market prices, reflecting the broader societal value of these ecosystems.

6.4.3.1 Natural Resource Values of Mangroves

Mangroves provide a wide range of ecosystem services, including non-use values that reflect their mere existence, separate from any direct or future use. These values, along with market and non-market approaches, also consider services like carbon sequestration. However, studies on wetland valuation vary greatly in methodology, geography, and the types of services being valued. This analysis focuses on regulating services such as coastal protection and carbon sequestration (EcoNexus Consulting Group LLC, 2025).

A study by Brander et al. (2006) found that the most significant service provided by coastal wetlands, including mangroves, is biodiversity, estimated at US$17,000 per hectare annually. Other valuable services include water quality, flood protection, recreational fishing, and aesthetic values. However, transferring values from one study to another should be done cautiously due to geographic and socio-economic differences. Recent studies have estimated that mangroves provide an average of US$805.5 for provisioning services, US$1,446.4 for regulating services, US$112.8 for supporting services, and US$1,720.9 for cultural services per hectare per year (EcoNexus Consulting Group LLC, 2025).

For carbon sequestration, the analysis uses literature on the economic valuation of carbon services. Mangroves are known to store large amounts of carbon, with some studies estimating that they hold three to four times more carbon than other forests. However, as mangroves are rapidly vanishing, much of this carbon storage is at risk. Market-based mechanisms, such as carbon offset programs, could help conserve mangroves while providing financial incentives for emission reductions (EcoNexus Consulting Group LLC, 2025).

Estimating Mangrove Carbon Stocks

Mangrove carbon storage varies by region, with carbon primarily stored in the soil rather than in biomass. Global averages show that mangroves store around 386 Mg/ha of carbon in the top meter of soil, though this varies depending on the region. For example, mangroves in North and Central America contain the highest carbon-rich soils, while those in Southeast Asia have moderate carbon content. This analysis applies global estimates to the Paradise Park Resort site and uses Tier 1 estimates for blue carbon stocks to calculate carbon sequestration values for mangroves, wetlands, seagrasses, and disturbed cropland. Table 6-24 shows global averages for carbon stock for mangroves, tidal salt marsh and seagrass beds (EcoNexus Consulting Group LLC, 2025).

Table 6-24 Global mean and range of values of soil organic carbon stocks (1m depth) for tropical coastal ecosystems and CO2 equivalents

Ecosystem	Carbon Stock Mg/Ha	Range Mg/Ha	CO_2M equiv/Ha
Mangrove	386	55 – 1,376	1,415
Tidal salt marsh	255	16 – 623	935
Seagrass	108	10 – 829	396
Disturbed Cropland	1	na	3.67
Secondary Forest	175	na	642

Adapted from Hoyt et al 2014 and IPCC Supplements

Source: (EcoNexus Consulting Group LLC, 2025)

Social Cost of Carbon (SCC)

The social cost of carbon (SCC) represents the monetized damage caused by emitting one additional ton of carbon dioxide. This concept reflects the external costs of emissions and is used to calculate the cost of reducing carbon emissions or the potential tax on emissions. The SCC varies widely due to its complex calculation, which involves factors like economic output, discount rates, and the atmospheric concentration of carbon dioxide. For this analysis, the SCC is calculated using a discount rate of around 2 percent, with the median SCC for Latin America and the Caribbean estimated at $48 per ton of carbon. A higher SCC value of $185 per ton is also considered, based on recent studies on climate change impacts (EcoNexus Consulting Group LLC, 2025).

The SCC is an essential tool for valuing carbon sequestration and understanding the environmental and economic benefits of conserving ecosystems like mangroves.

Cost of Lost Carbon (Impacted Areas)

The analysis estimates that the impacted areas, including cropland, secondary forest, wetlands, and seagrass beds, will result in the emission of 20,032.8 tonnes of carbon, equivalent to 73,453.6 tonnes of CO2. According to a 2023 report by the International Finance Corporation, the current average carbon price for coastal ecosystems, or "blue carbon," ranges from $15 to $35 per tonne of CO2 equivalent, with the potential for higher prices based on project specifics and market conditions. Prices in the voluntary carbon market are rising due to increasing demand for blue carbon credits, and by 2040, carbon prices are expected to range from $40 to $65 per tonne. Blue carbon projects are anticipated to fetch higher prices than traditional carbon offset projects, which generally have a lower range of $8 to $10 per tonne (EcoNexus Consulting Group LLC, 2025).

For the Paradise Park site, using a social cost of carbon (SCC) of $48 per tonne of carbon, the value of annual carbon sequestration is calculated at $1,055,936. Alternatively, if carbon were priced at $15 per tonne in the carbon market, the cost of lost carbon due to impacts would be valued at $329,982. This highlights the economic significance of carbon sequestration and the potential financial benefits of conserving these ecosystems (EcoNexus Consulting Group LLC, 2025).

Table 6-25 Annual value of lost carbon sequestration values for Paradise Park from impacted areas.

Ecosystem Type	Impacted (Ha)	Tonnes C	SCC ($48/tC)	Market Price C ($15/tC)
Fields	76.14	76.14	$3,655	$1,142
Secondary Forest	36.8	5,520	$264,960	$82,800
Wetlands	33.83	15,024.24	$721,164	$225,364
Seagrass	5.719	1,378.279	$66,157	$20,674
Total Sequestration Area	**152.489**	**21,998.66**	**$1,055,936**	**$329,9802**

Source: (EcoNexus Consulting Group LLC, 2025)

Value of Mangrove Protection (Avoided Damages)

At present, coastal flooding from storms in Jamaica is estimated to result in US$136.4 million in damages every year, in the presence of mangroves. If these mangroves were lost, the expected damages from flooding would increase to $169 million annually. Thus, mangrove forests in Jamaica provide over US$32.7 million in annual flood reduction benefits to built capital (more than US$2,500 per hectare per year). Historically, climate events in Jamaica have caused considerable damage to transport infrastructure. The costliest disasters in the country were due to floods and storms (USAID 2018). Mangroves at this site are currently providing coastal protection ecosystem services at the site (EcoNexus Consulting Group LLC, 2025).

Economic Contribution of Mangroves to Nearshore Fisheries

Mangroves contribute to coastal fisheries through two main ecological mechanisms: high primary productivity and the physical structure they provide as habitat. The primary productivity from mangroves, seagrasses, and other producers supports secondary consumers, forming the basis of food chains for commercially important species. Additionally, mangroves offer a physical environment that provides attachment points for species and shelter from predation, serving as vital nursery grounds for juvenile species that later move to coral reefs or offshore areas (Hutchinson et al., 2014).

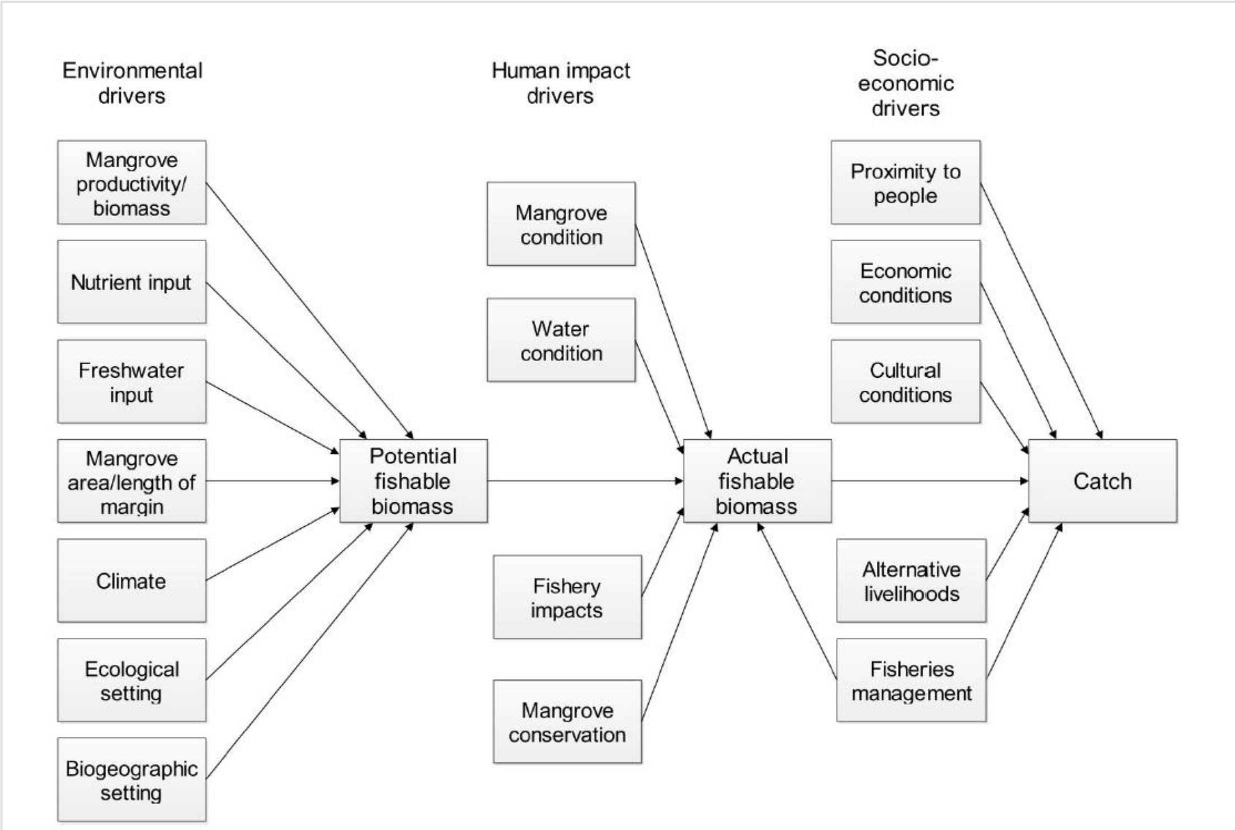


Figure 6-45 Conceptual Model of the drivers of mangrove fisher catch and value (from Hutchinson et al 2014)

Source: (EcoNexus Consulting Group LLC, 2025)

Mangroves support the commercial harvest of various species such as mullets, crabs, oysters, and other estuarine species. Some species, like snapper, use mangroves during their juvenile stages before moving to coral reefs as adults, while others enter mangroves at high tide to feed. This highlights the importance of habitat linkages in fisheries productivity, although it can be challenging to isolate the exact role of mangroves in supporting fisheries in these mixed habitats (EcoNexus Consulting Group LLC, 2025)..

Estimating the economic value of mangrove-associated fisheries is difficult, particularly at regional or global scales (Hutchinson et al., 2014). Many studies focus on individual species or specific fishing methods, making it hard to capture the full value of mangroves in fisheries. Estimates of mangrove contributions to offshore fisheries vary, influenced by factors such as the quality of the habitat along the seaward edge or "fringe" of mangrove forests (Aburto-Oropeza et al., 2008).

Several studies provide estimates of mangrove contributions to fisheries. For example, annual commercial fish harvests from mangroves have been valued between US$6,200 per km² in the United States and US$60,000 per km² in Indonesia (Bann, 1997). Other studies estimate that mangroves contribute 5-25% to offshore fisheries (Spurgeon, 2002), with some studies showing up to a 31.7% contribution (Aburto-Oropeza, 2008), translating to $15,000 per acre. In Malaysia, mangrove contributions to coastal food chains and fisheries were valued at US$846 per hectare annually (Chong, 2007).

This analysis uses a value transfer approach, linking the area of mangrove to its potential contribution to nearshore fisheries. This approach is based on studies that have employed a production function-based method to estimate fisheries values, relying on biophysical parameters that correspond to changes in fish and seafood output. Global studies indicate that mangrove-associated fisheries economic values can exceed US$1,000 per hectare annually. The median global values for finfish fisheries are US$77 per hectare per year, while mixed-species fisheries can generate US$213 per hectare per year (Hutchinson et al., 2014). These values reflect a broad range of estimates, with mixed-species fisheries values ranging from $17.50 to $3,412 per hectare per year (EcoNexus Consulting Group LLC, 2025).

The derived estimates of annual economic contributions of mangroves and seagrasses to small-scale and mixed fisheries are shown in Table 6-26. These values are based on median global estimates and should be viewed as rough guides, given the high variability due to local ecological, social, and economic factors. For example, studies in Australia estimate mangrove fisheries values at US$13,250 per hectare per year (Jänes et al., 2020). Overall, while the figures provide a broad range of values, the economic contribution of mangroves to nearshore fisheries is significant, particularly in the context of Jamaican coastal ecosystems (EcoNexus Consulting Group LLC, 2025).

Table 6-26 Estimated annual economic contribution of seagrasses and mangroves to small-scale and mixed fisheries

	Seagrass	Mangrove
Fish Type		
Nominal Value	$445.83	$2,570.26
Net Present Value (25 years, 6% discount rate)	$5,699.20	$32,856.55
Mixed Fisheries		
Nominal Value	$1,233.27	$7,109.94
Net Present Value (25 years, 6% discount rate)	$15,765.33	$90,888.90

Source: (EcoNexus Consulting Group LLC, 2025)

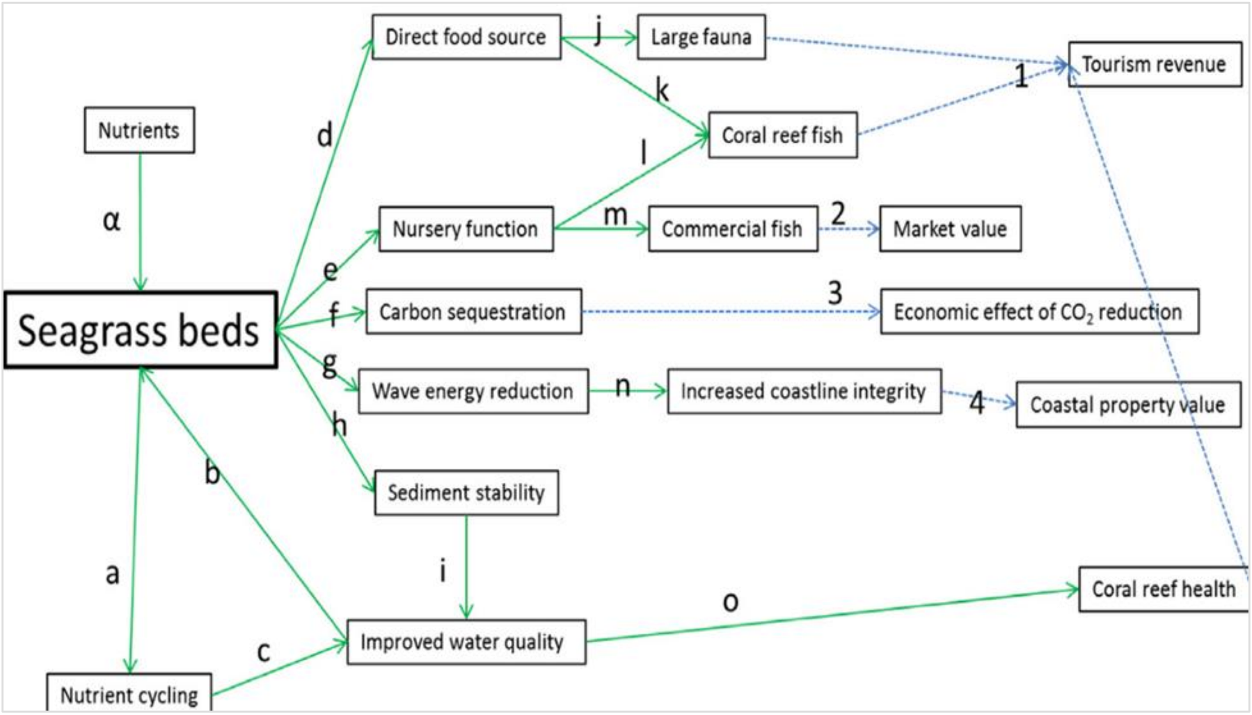
6.4.3.2 Natural Resource Values of Seagrass Beds

Seagrass ecosystems do not have much direct market value, which makes it challenging to estimate their economic worth (EcoNexus Consulting Group LLC, 2025). Most studies rely on indirect methods to assess their value, based on the ecosystem services seagrasses provide. These services often lead to social benefits, making traditional market methods insufficient for determining their full economic value. There is a lack of data on the non-use value of seagrass ecosystems, which has been a challenge for valuation studies (Dewsbury et al., 2016).

The replacement model is commonly used to assess the economic value of seagrass ecosystems, particularly when estimating the costs incurred by vessels that damage seagrass beds. Another method is the productivity method, which connects the ecosystem structure and function of seagrasses to marketable services, such as fish production. For example, a study by McArthur and Boland (2006) used this method to estimate the overall economic contribution of seagrass habitats in Australia at US$103.74 million per year. In addition, some studies use hedonic pricing, which estimates the value of coastal properties based on their characteristics, including the presence of seagrasses that help reduce coastal erosion (Pompe and Rinehart, 1995).

Until recently, the role of seagrasses in carbon sequestration was not widely documented. However, seagrasses can store up to 19.9 billion metric tons of organic carbon in their meadows annually (EcoNexus Consulting Group LLC, 2025). The loss of seagrass meadows, however, releases carbon into the atmosphere, contributing to climate change. This highlights the need to protect seagrass ecosystems to prevent the loss of valuable carbon sinks.

To better connect ecological and economic models for seagrasses, the Sea Grass Ecosystems Valuation (SEV) model proposed by Dewsbury et al. (2016) provides a conceptual framework for incorporating both ecological and economic data. This model helps address the challenges of undervaluing seagrasses due to the lack of appropriate metrics for their ecosystem services.



Source: (EcoNexus Consulting Group LLC, 2025)

Figure 6-46 Conceptual diagram for seagrass ecosystem value (adapted from Dewsbury et al 2016). Green arrows represent ecological function, blue arrows represent economic contribution.

Published seagrass ecosystem economic valuations (from Dewsbury et al 2016) show a range of per hectare economic values for seagrasses based on a variety of services and metrics. Depending on the type of ecosystem service and policy context annual per Ha values range from as low as US$78/ha/yr to $100Million/ha/yr. Values for carbon sequestration, tourism and sediment stabilization range from approximately US$394/ha/yr for carbon storage to $960,000/ha/yr that represents consumer surplus or willingness to pay (nonmarket values) (EcoNexus Consulting Group LLC, 2025).

6.4.3.3 Natural Resource Values of Coral Reefs

Coral reefs provide a diverse array of goods and services to the people and economy of Jamaica. They buffer coastlines from storms; slow erosion; provide habitat for commercial, artisanal, and sport fisheries; attract local and international tourists to the coast; and are a source of cultural and spiritual significance to many people. However, their value is often not reflected in policy and development decisions (EcoNexus Consulting Group LLC, 2025)..

A non-market valuation study (contingent valuation and choice experiment method) of the recreational value of Jamaica's coral reefs and their associated ecosystems (seagrass beds and beaches) estimated an annual value of US$217 Million (Edwards, 2009). The study was based on the value of the coral reefs located on the northern coast of Jamaica in other words those reefs that directly and indirectly support the coastal tourism product. The economic values reported here represents the "worth" of a beach and coral reef vacation to the average visitor. It does not represent costs and expenditures associated with the tourism industry. This value represents the amount over and above what each person has already spent on their beach-related vacation (EcoNexus Consulting Group LLC, 2025)..

While the economic value for the reef system at the proposed Paradise Park Resort site may be captured within the aggregated estimate for Jamaica, it is not possible to estimate per hectare value as the policy context for the valuation studies do not lend itself to that. Other meta-analyses estimated global estimates of value for a range of biomes and ecosystems and derived estimates for coral reef ecosystem services at approximately US$350 thousand per hectare per year (de Groot et al., 2012; Costanza et al., 2014).

The fringing coral reef at the project site is not expected to experience any direct impact (loss). Using most recent values from de Groot et al 2012 which cited US$352,249 per Ha in value for coral reef (fisheries) the areas of reef (1.89 Ha) results in 2025 nominal (today's) value of $665,750. Using a 6% discount rate over 25 years coral reef value is equivalent to $8,510,527 dollars (EcoNexus Consulting Group LLC, 2025)..

Coral reefs provide substantial protection against natural hazards by reducing wave energy by an average of 97% (Ferrario et al 2014). Reef crests alone dissipate most of this energy (86%). Their study confirmed the important risk reduction benefits from reefs by showing that coral reefs can provide comparable wave attenuation benefits to artificial defences such as breakwaters, and reef defences can be enhanced cost-effectively. Their analysis showed that costs of building tropical breakwaters ranged between US$ 456 and 188,817 m−1 with a median project cost of US$ 19,791 m−1. While the construction costs of structural coral reef restoration projects ranged between US$ 20 and 155,000 m−1 with a median project cost of US$ 1,290 m−1. On average, the costs of the restoration projects were significantly cheaper than costs of building tropical breakwaters. Keeping the existing coral reefs on the Paradise Park site healthy or finding ways to enhance them via a combination of grey-blue or hybrid restoration approaches will result in cost savings for coastal protection. More recent studies have also estimated the hazard risk reduction benefits of coral reefs in significantly reducing flooding for vulnerable populations. Reguero et al. (2021) estimated that the annual flood risk reduction benefits of coral habitats in the US were over US$1.8 billion, using 2010 as the baseline year (EcoNexus Consulting Group LLC, 2025)..

The studies referenced above demonstrate that there are significant values associated with coral reef and beach ecosystem services. This is particularly so for the near-shore coral reef ecosystems of Jamaica's north coast. Maintaining or rehabilitating these ecosystems is equivalent to investing in the coastal "bio-infrastructure" that supports the tourism industry. Although not easily "traded in the marketplace" it is important to consider these values when making development decisions including trade-offs (EcoNexus Consulting Group LLC, 2025).

7.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

7.1 PURPOSE AND OVERVIEW

The discussion and analysis of alternatives should consider other practicable strategies that aim to eliminate or reduce negative environmental impacts. This section, required by the National Environment and Planning Agency (NEPA), is crucial for identifying the most environmentally responsible development options. By evaluating various alternatives, the goal is to find a development approach that minimizes environmental disturbance while still meeting project objectives.

The project alternatives identified include the No-Action Alternative, which evaluates the implications of not proceeding with the project to understand the potential environmental benefits and drawbacks of maintaining the status quo. By thoroughly examining project alternatives, the EIA aims to ensure that the chosen development path aligns with both environmental protection and project goals.

Eight (8) project alternatives have been identified:

- **Alternative 1 - The "No-Action" Alternative**
- **Alternative 2 - The Project as Proposed in the EIA**
- **Alternative 3 - The Project as Proposed in the EIA with Rearrangement of 120-key Resort, 200-key Hotel and 100-key Villas and Addition of Lagoon**
- **Alternative 4 - The Project as Proposed in the EIA with Beach Option 1**
- **Alternative 5 - The Project as Proposed in the EIA with Beach Option 2**
- **Alternative 6 - The Project as Proposed in the EIA with Beach Option 3 and Addition of Lagoon**
- **Alternative 7 - The Project as Proposed in the EIA with Golf Course situated to the East**
- **Alternative 8 - Proposed Development with 500-key Hotel and 125 Private Residences without Coastal Works**

Each alternative is described in further detail in subsequent sections, and Table 7-1 outlines the advantages and disadvantages of each in relation to the physical, biological, and human/social environments.

Table 7-1 Advantages and disadvantages associated with each project alternative

Alternative	Advantages			Disadvantages		
	Physical	*Biological*	*Human/Social*	*Physical*	*Biological*	*Human/Social*
Alternative 1 - The "No-Action" Alternative	▪ No nuisance from construction activities (dust, noise etc.) ▪ No increased turbidity and sedimentation in the marine environment ▪ No potential spillage of fuel/oil/lubricants in the marine environment ▪ No change in hydrodynamics ▪ No change to the seafloor ▪ No additional light pollution	▪ Terrestrial habitats, flora and fauna remain undisturbed ▪ No permanent seagrass and other benthic habitat loss ▪ No permanent benthic species loss ▪ No smothering and sedimentation of seagrass and associated macrofauna ▪ No disturbance of possible turtle nesting by obstacles in water, increased noise, and lighting ▪ No change in terrestrial, coastal and marine ecosystem services ▪ No change in blue carbon sequestration	▪ Maritime activities will not be affected by the physical presence of the overwater rooms ▪ No increased maritime accident potential in the form of vessel collision with overwater rooms structures ▪ No increased water usage and solid waste generation	▪ Continued silt deposition in marine environment ▪ No improvement in beach stabilisation	▪ No provision of added ecological volume from groynes, breakwaters and overwater rooms pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna ▪ No creation of Fish Aggregation Devices (FADs) by the presence of coastal structures	▪ No additional economic benefits to the community and economy ▪ No increased employment and creation of indirect and induced job opportunities ▪ No broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product ▪ No further increase the room offerings
Alternative 2 - The Project as Proposed in the EIA	▪ Potential to increase shoreline protection ▪ Potential to improve water quality (operational phase) ▪ Potential to reduce sediment loading	▪ Potential to add ecological volume from groynes, breakwaters and overwater rooms pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna ▪ Potential to create Fish Aggregation Devices (FADs) by the presence of groynes, breakwaters, and the pilings ▪ Potential for turtle nesting areas will be better protected (from poachers and animals) ▪ Potential to conserve and rehabilitate wetland areas on site	▪ Additional economic benefits to the community and economy ▪ Increased employment and creation of indirect and induced job opportunities ▪ Broadening of the tourism client base and overall diversified and enhanced Jamaican tourism product ▪ Further increase the room offerings of the island Potential to provide support and resources to community initiatives ▪ Potential for increased educational awareness in community	▪ Potential noise and dust nuisance to surrounding residential communities from construction activities ▪ Potential to reduce water quality in the marine environment during construction ▪ Potential spillage of fuel/oil/lubricants in the marine environment ▪ Potential changes to drainage ▪ Potential changes in hydrodynamics	▪ Potential loss of flora and associated fauna ▪ Potential habitat loss including wetlands and seagrass ▪ Potential species loss and displacement ▪ Potential smothering and sedimentation of seagrass and associated macrofauna ▪ Potential disturbance of possible turtle nesting by obstacles in water, increased noise, and lighting	▪ Potential to affect maritime activities by the physical presence of the overwater rooms ▪ Potential to increase maritime accident potential in the form of vessel collision with overwater rooms structures ▪ Potential solid waste generation ▪ Potential strain on public utilities (e.g. water and electricity)
Alternative 3 - The Project as Proposed in the EIA with Rearrangement of 120-key Resort, 200-key Hotel, and 100-key Villas	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ Development in eastern wetland area may potentially affect natural drainage and hydrology	▪ Increased potential impact to wetland habitats and species to the east (potential conservation area)	▪ As outlined for Alternative 2
Alternative 4 - The Project as Proposed in the EIA with Beach Option 1	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ Increased beach/recreational area in comparison to Alternatives 1 and 5 ▪ With the sedimentation channel, less silt is expected in the wading area	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2

Alternative	Advantages			Disadvantages		
	Physical	*Biological*	*Human/Social*	*Physical*	*Biological*	*Human/Social*
Alternative 5 - The Project as Proposed in the EIA with Beach Option 2	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ Increased beach/recreational area in comparison to Alternative 1, but smaller area in comparison to Alternative 4 ▪ Management of siltation at the source	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2
Alternative 6 - The Project as Proposed in the EIA with Beach Option 3 and Addition of Lagoon	▪ As outlined for Alternative 2	▪ Greater potential to add ecological volume from groynes, breakwaters and overwater rooms pilings resulting in more available space for recruitment and colonization of hard coral and other sessile fauna ▪ Greater potential to create Fish Aggregation Devices (FADs) by the presence of groynes, breakwaters, and the pilings ▪ Potential for turtle nesting areas will be better protected (from poachers and animals)	▪ Increased beach/recreational area in comparison to all Alternatives	▪ As outlined for Alternative 2	▪ Greater potential impact to flora and associated fauna ▪ Greater potential habitat loss including wetlands and seagrass ▪ Greater potential species loss and displacement ▪ Greater potential for smothering and sedimentation of seagrass and associated macrofauna ▪ Greater potential disturbance of possible turtle nesting by obstacles in water, increased noise, and lighting	▪ As outlined for Alternative 2
Alternative 7 - The Project as Proposed in the EIA with Golf Course situated to the East	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ As outlined for Alternative 2	▪ Development in eastern wetland area may potentially affect natural drainage and hydrology	▪ Increased potential impact to wetland habitats and species to the east (potential conservation area)	▪ As outlined for Alternative 2
Alternative 8 - Proposed Development with 500-key Hotel and 125 Private Residences without Coastal Works	▪ No change in hydrodynamics ▪ No change to the seafloor	▪ No permanent seagrass and other benthic habitat loss ▪ No permanent other benthic species loss ▪ No smothering and sedimentation of seagrass and associated macrofauna ▪ No disturbance of possible turtle nesting by obstacles in water, increased noise, and lighting ▪ No change in marine ecosystem services. ▪ No change in blue carbon sequestration	▪ Greater number of keys than Alternative 2; therefore, overall greater potential for economic benefits, increased employment and broadening of the tourism client base ▪ Beach/recreational area will not be increased ▪ Maritime activities will not be affected by the physical presence of the overwater rooms ▪ No increased maritime accident potential in the form of vessel collision with overwater rooms structures	▪ Hotel development in eastern wetland area may potentially affect natural drainage and hydrology ▪ As outlined for Alternative 1	▪ Increased potential impact to wetland habitats and species to the east (potential conservation area) ▪ As outlined for Alternative 1	▪ Not financially viable

7.2 DESCRIPTION OF ALTERNATIVES

7.2.1 Alternative 1 - The "No-Action" Alternative

The "No Action" alternative represents the scenario where no changes are made to the existing conditions. It serves as a baseline against which other project alternatives are compared. This Alternative involves no development and offers several environmental advantages, including no construction-related disturbances like noise, dust, or increased turbidity. It preserves both the existing terrestrial and marine environments by avoiding any changes, ensuring that biological habitats, flora, and fauna remain undisturbed, with no impact on terrestrial, coastal, or marine ecosystem services. Additionally, maritime activities would continue without disruption, and there would be no increase in water usage or waste generation. However, this alternative would also result in no enhancements to beach stabilization or the creation of new economic benefits, such as job opportunities or growth in tourism.

7.2.2 Alternative 2 - The Project as Proposed in the EIA

Alternative 2 is the proposed project in the EIA described in detail in section **Error! Reference source not found.**. The proposed Paradise Park resort development includes five land use programs: Resort, Hotel, Villas, Golf, and Service Facilities. The Resort will feature 120 keys, the Hotel will offer 200 keys, and the Golf Course and Villas will consist of 100 keys. Utility facilities, various resort recreational amenities and coastal works are also included in the plan.

This alternative offers several potential benefits, including enhanced shoreline protection and reduced sediment loading. It could also increase ecological volume through the installation of groynes, breakwaters, and overwater room pilings, providing space for coral and other marine life, as well as creating Fish Aggregation Devices (FADs). Turtle nesting areas may benefit from better protection, and there is potential for wetland conservation and rehabilitation. Furthermore, the project could bring economic advantages, create job opportunities, expand tourism offerings, and support community initiatives, promoting educational awareness. However, there are potential drawbacks, such as construction-related noise and dust, temporary degradation of water quality, the risk of fuel/oil spills, and possible changes to drainage and hydrodynamics. There may also be habitat loss, species displacement, and disturbances to turtle nesting areas. Additionally, the project could impact maritime activities and increase strain on public utilities.

7.2.3 Alternative 3 - The Project as Proposed in the EIA with Rearrangement of 120-key Resort, 200-key Hotel and 100-key Villas

As shown in Figure 5-1, Alternative 3 includes the same number of keys for the resort, hotels, and villas, sharing many of the same benefits and potential drawbacks as Alternative 2. However, the spatial arrangement differs, with the development of the eastern wetland areas to accommodate the resort rooms. This introduces an increased potential for impacts on wetland habitats in the eastern area and may also affect natural drainage and hydrology.

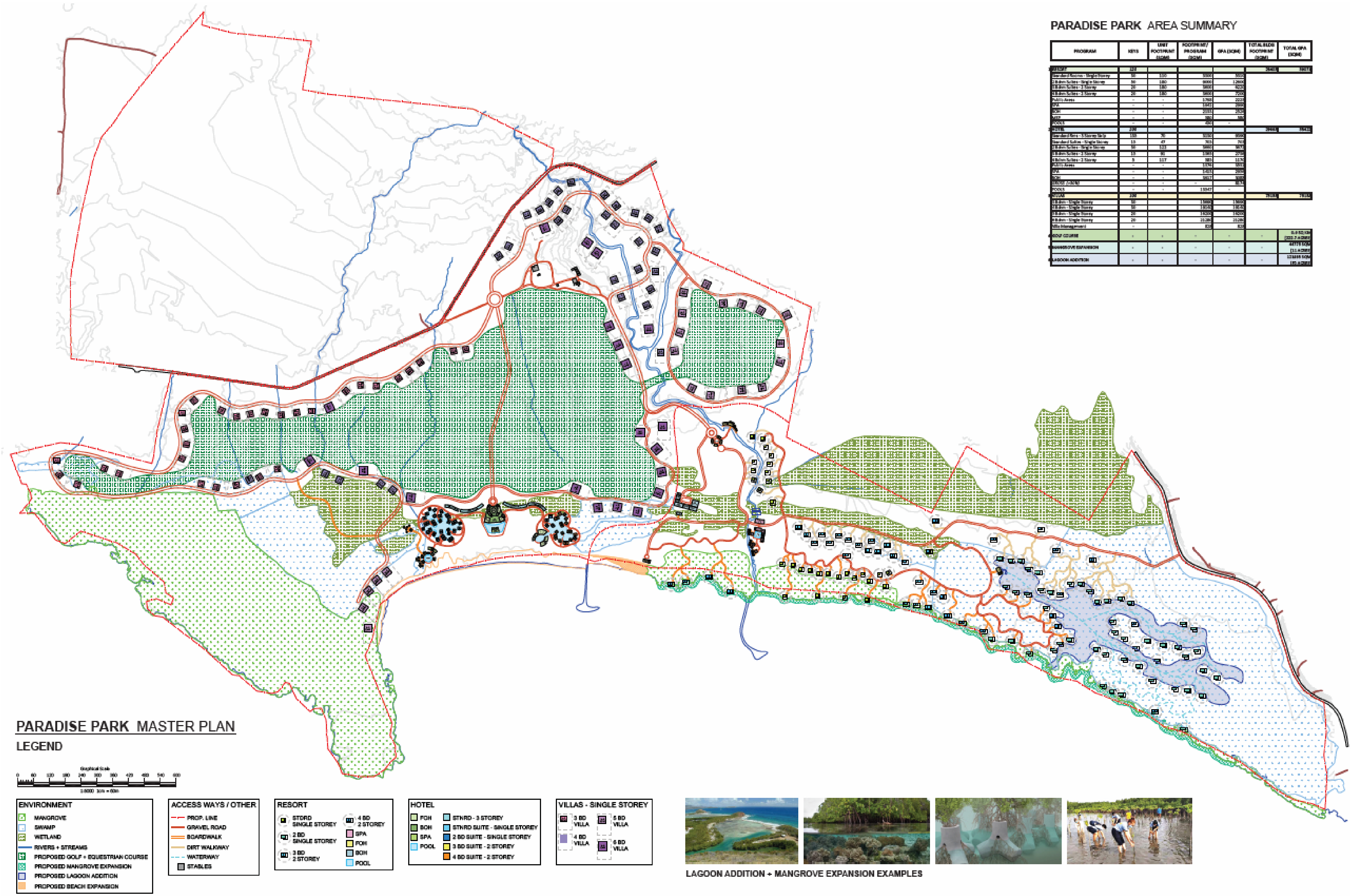


Figure 7-1 Master plan layout for Alternative 3 - The Project as Proposed in the EIA with Rearrangement of 120-key Resort, 200-key Hotel and 100-key Villas and Addition of Lagoon

7.2.4 Alternative 4 - The Project as Proposed in the EIA with Beach Option 1

This Alternative comprises a different beach layout to that proposed in the EIA. Figure 7-2 shows Beach Option 1, which includes an area of work covering 800m by about 110m. Beach nourishment would widen the existing beach by about 10 meters and create a 20-meter-wide sandy underwater zone. Three groynes of varying lengths—98 meters (western), 43 meters (central), and 110 meters (eastern)—would anchor the beach nourishment. Additionally, a 30-meter-wide sedimentation channel would be dredged in the nearshore to capture silt outside the nourished beach area. The benefits of these measures include a larger sandy beach for visitors to enjoy and reduced silt in the wading area due to the sedimentation channel.

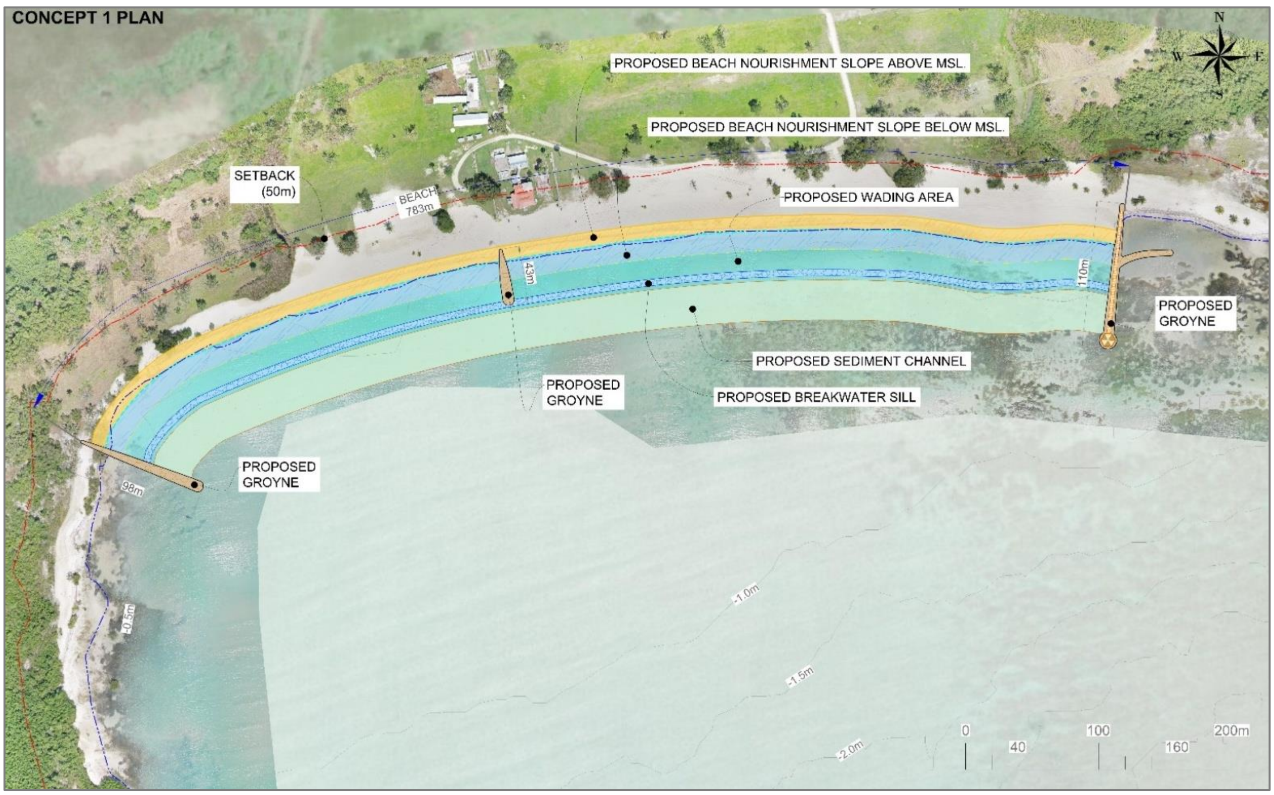


Figure 7-2 **Beach Option 1 plan, Alternative 4**

7.2.5 Alternative 5 - The Project as Proposed in the EIA with Beach Option 2

Similar to Alternative 4, this alternative features a beach layout that differs from the one proposed in the EIA. Beach Option 2 (Figure 7-3) is a scaled-back version of Beach Option 1 (Alternative 4), focusing on the coastline in front of the hotel. This option involves a trade-off where beach reduction is balanced by the addition of river training to reduce silt and debris in the nearshore of the main beach area. The design footprint includes 200m by 90m on the beach and 150m by 15m at the mouth of the Murfitts River (Deans Valley River). Features include beach nourishment along 200m of shoreline, supported by two groynes, each 84m long. The existing central groyne would be rehabilitated for use as the western groyne. The nourishment area would also feature a breakwater sill and sedimentation channel to reduce silt settlement in the wading area. At the river mouth, a 150m-long groyne would redirect the river flow, creating a shadow zone, and incorporate a small boat dock for tours or water sports. Dredged material would be used to reclaim land at the eastern mangrove forest, which would then be replanted with mangrove seedlings. Benefits of this concept include reduced overall costs and better management of siltation at the source.

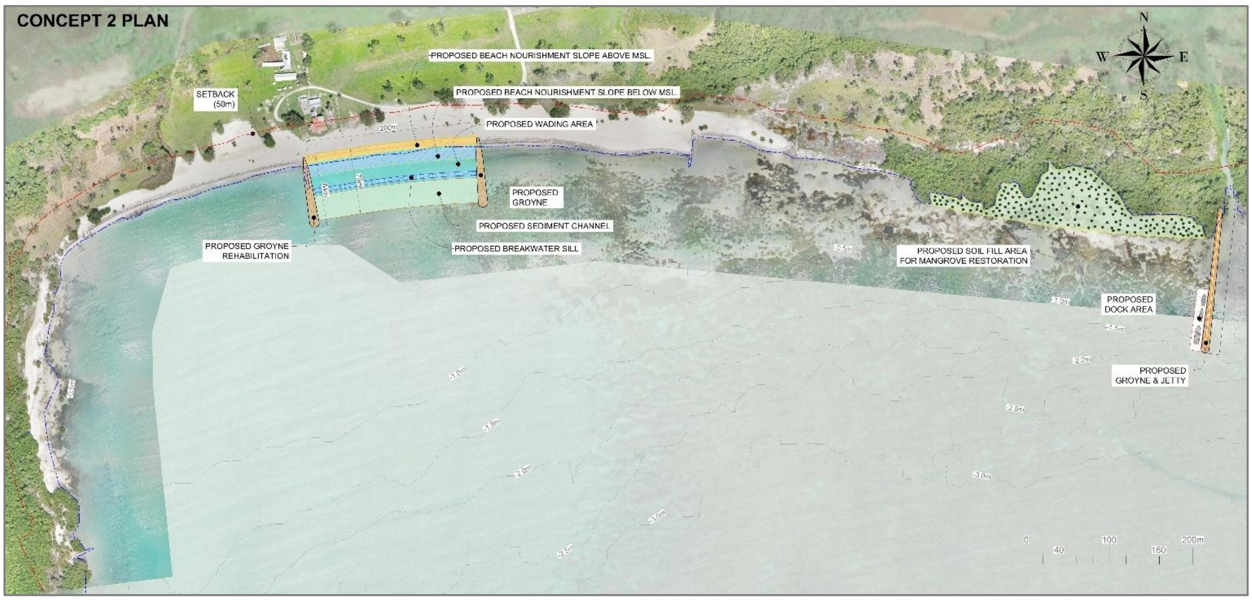


Figure 7-3 **Beach Option 2 plan, Alternative 5**

7.2.6 Alternative 6 - The Project as Proposed in the EIA with Beach Option 3 and Addition of Lagoon

Alternative 6, the proposed project with an expanded Beach Option 3 and the addition of a lagoon (Figure 7-4), offers several benefits similar to Alternative 2, with greater potential for ecological enhancements. These include increased ecological volume from coastal structures, providing more space for coral and marine life, as well as creating more Fish Aggregation Devices (FADs). Turtle nesting areas may also be better protected. Additionally, this option offers a larger beach and recreational area compared to the other alternatives. However, it presents greater potential risks, such as increased habitat loss, including wetlands and seagrass, species displacement, and disturbances to turtle nesting due to water obstacles, noise, and lighting. The impact on flora and fauna, as well as the potential for smothering and sedimentation of seagrass, is also higher compared to Alternative 2 (project as proposed).

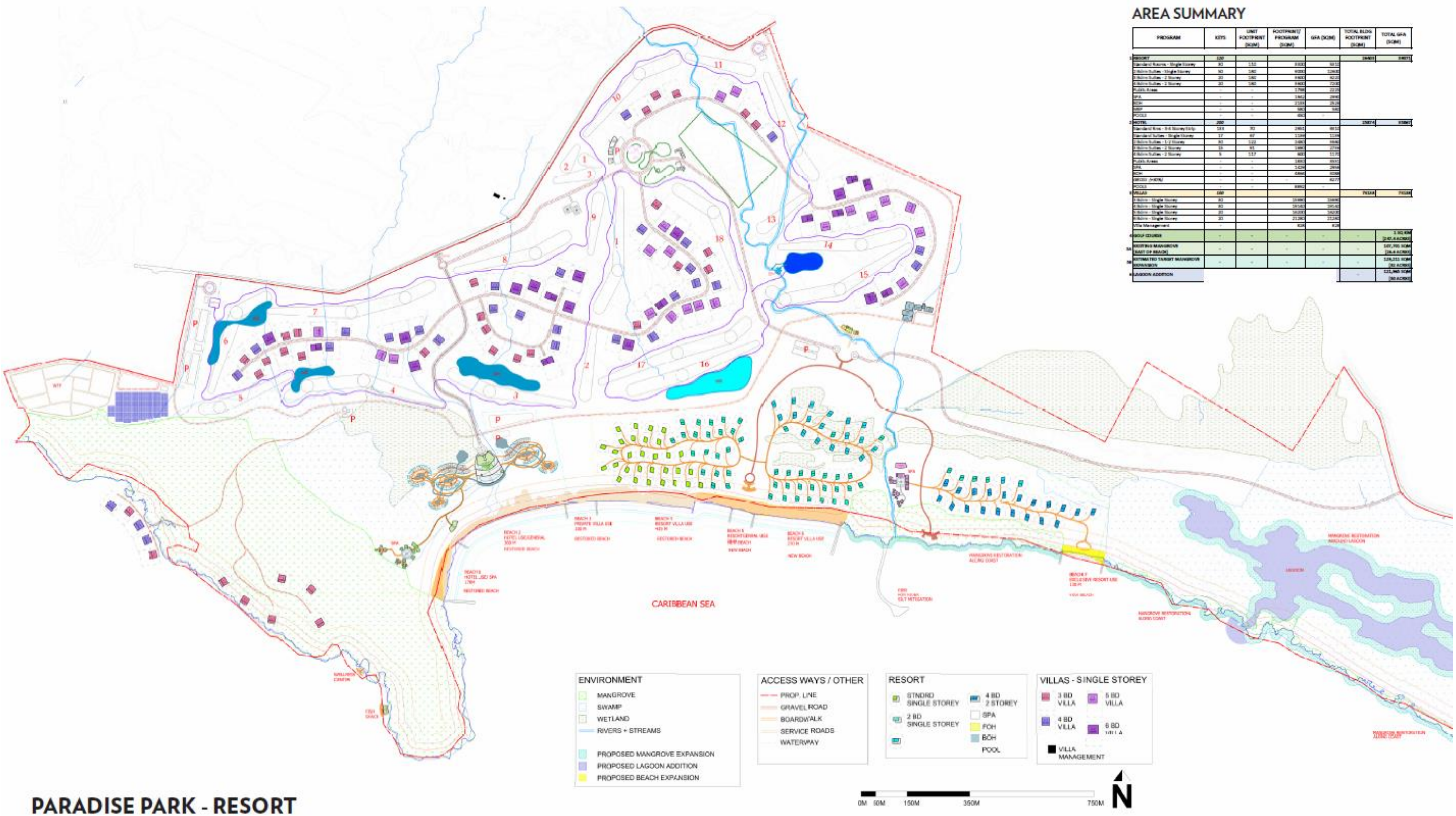


Figure 7-4 Master plan layout for Alternative 6 - The Project as Proposed in the EIA with Beach Option 3 and Addition of Lagoon

7.2.7 Alternative 7 - The Project as Proposed in the EIA with Golf Course situated to the East

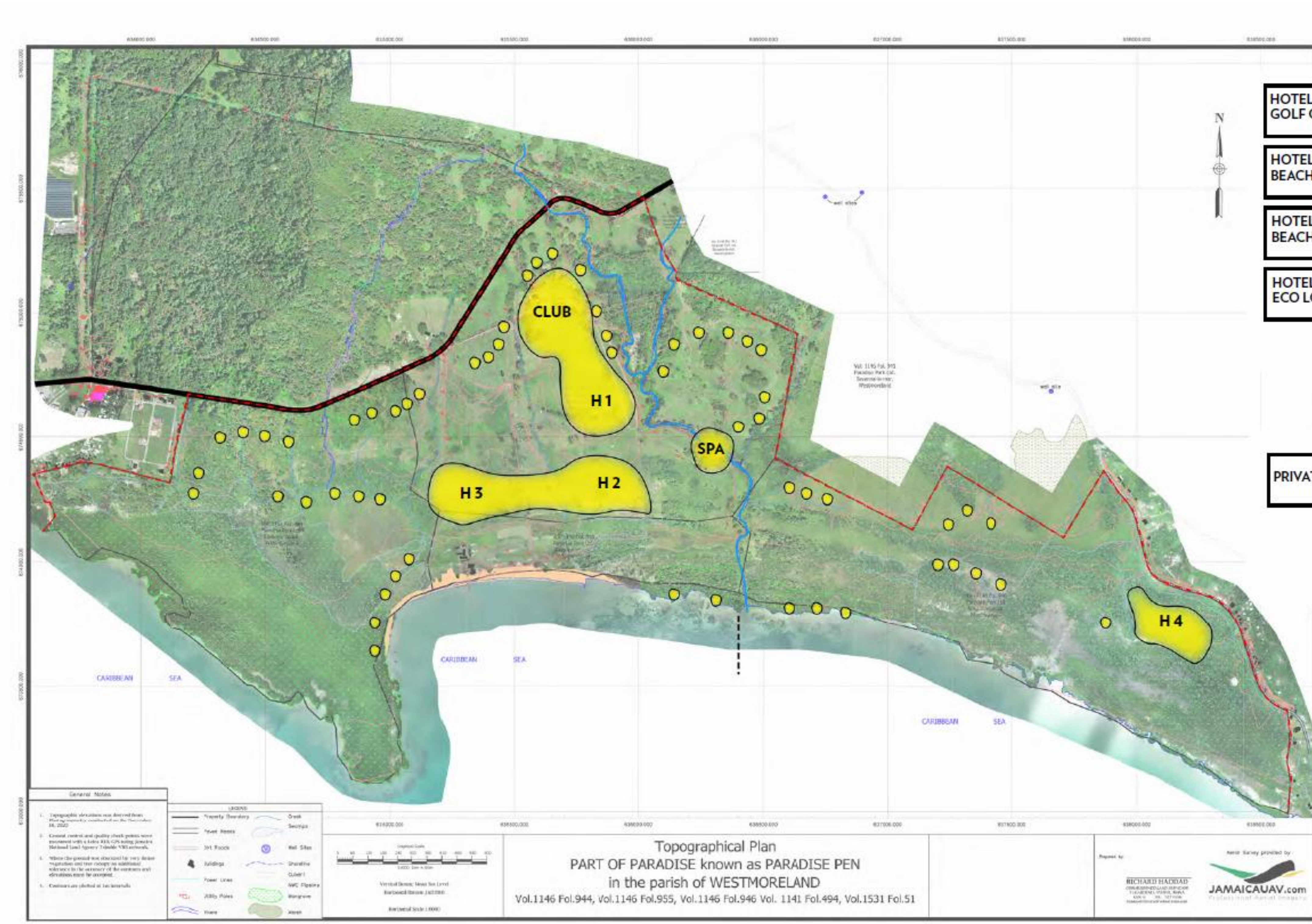
Alternative 7, the proposed project with the Golf Course located to the East, shares many similarities with Alternative 2 but introduces the development of the golf course in the eastern wetland area. This could potentially affect wetland habitats and species in that area, which may serve as a conservation zone. Additionally, it may impact natural drainage and hydrology. Other potential impacts are similar to those identified in Alternative 2.

7.2.8 Alternative 8 - Proposed Development with 500-key Hotel and 125 Private Residences without Coastal Works

Alternative 8, a proposed development with a 500-key hotel and 125 private residences (Figure 7-5) has a greater number of accommodations compared to Alternative 2, and this would potentially bring increased economic benefits, employment, and tourism opportunities. However, the beach area would remain unchanged without coastal works, and this would result in no changes to hydrodynamics, the seafloor, or marine ecosystem services. It would avoid permanent loss of seagrass and benthic habitats, as well as disturbance to turtle nesting. Maritime activities would not be impacted, and there would be no increased risk of vessel collisions. However, similar to Alternative 1, the hotel development in the eastern wetland area could affect drainage and hydrology, and there would be an increased potential impact on wetland habitats and species.

7.3 THE PREFERRED ALTERNATIVE

The preferred alternative is **Alternative 2 – the Project Proposed in the EIA**. This option offers a valuable opportunity to rehabilitate and enhance ecological function on-site, while also supporting community initiatives aimed at managing ecological habitats in the surrounding area. Additionally, it contributes to enhancing tourism offerings along Jamaica's south coast and provides employment opportunities for surrounding residents. By minimizing ecological disruption and promoting local stewardship, this alternative ensures the project's long-term feasibility and success.



	SUITES	VILLAS	TOTAL KEYS
HOTEL 1 GOLF CLUB AND HOTEL	200	-	200
HOTEL 2 BEACH-SIDE FAMILY	50	25	100
HOTEL 3 BEACH-SIDE ADULTS	100	25	150
HOTEL 4 ECO LODGES	-	50	50

500 HOTEL KEYS

	FOREST	GOLF	WATER FRONT
PRIVATE RESIDENCES	ABOUT 50	ABOUT 50	ABOUT 25

ABOUT 125 PRIVATE RESIDENCES

Figure 7-5 Master plan layout for Alternative 8 - Proposed Development with 500-key Hotel and 125 Private Residences without Coastal Works

8.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

8.1 DRAFT ENVIRONMENTAL MONITORING PLAN

An Environmental Management System (EMS) is an important tool which can be used to assist operations managers in meeting current and future environmental requirements and challenges. It can be used to measure a company's operations against environmental performance indicators, thereby helping the company to reach its environmental targets. A good management system will integrate environmental management into a company's daily operations, long-term planning, and other quality assurance systems.

It is therefore recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but are not limited to the following:

1) Water Quality to include but not be limited to:
    a. Nitrates
    b. Phosphates
    c. BOD
    d. pH
    e. TSS
    f. Turbidity
    g. TDS
    h. Faecal Coliform
2) Noise
3) Sediment Loading
4) Coral and Seagrass
5) Traffic
6) Maritime Operations
7) Solid Waste Generation and Disposal
8) Sewage Generation, Treatment and Disposal
9) Equipment Maintenance
10) Health and Safety

8.1.1 Site Preparation and Construction Phase

8.1.1.1 Water Quality

- Undertake monthly water quality monitoring (for the first 6 months, then monthly thereafter) for temperature, salinity, pH, Dissolved Oxygen, light irradiance and turbidity and laboratory parameters for Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), Nitrates, Phosphates and Faecal Coliform in and around the project area, or at a frequency agreed to with NEPA to ensure that the construction works are not negatively impacting on water quality. Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. This is estimated to cost approximately J$450,000 per monitoring exercise.

- Additional turbidity monitoring will be conducted on both the inside and outside of silt screens during coastal works. The results of the data collected will be compared with preconstruction values.

8.1.1.2 Noise

- Inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g., 7 am – 7 pm).
- In addition to environmental noise monitoring, a noise survey should be undertaken to determine workers exposure and construction equipment noise emission. Noise monitoring to be conducted monthly at the site and residential areas near to site. The project engineer / site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed. Each noise monitoring exercise is estimated to cost approximately J$400,000.

8.1.1.3 Particulates

- Monitoring to ensure that fugitive dust from raw materials is not being entrained in the wind and creating a dust nuisance.
- The project engineer / site supervisor should monitor the construction work hours.
- NEPA should conduct spot checks to ensure that this stipulation is being followed.

8.1.1.4 Traffic

- Traffic and maritime operations should be monitored to ensure approved management plans at critical areas are being followed. NEPA and NWA and other relevant authorities should perform spot checks to ensure compliance.
- Conduct daily inspections to ensure that flagmen where necessary are in place and that adequate signs are posted along the roadways where heavy equipment interact with existing roads. This is to ensure that traffic have adequate warnings and direction.

8.1.1.5 Site Maintenance, Health and Safety

- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal.
- Monitoring of vehicle refuelling, and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of water/soil/sand contamination from spills. Spot checks should be conducted by NEPA.

- Regular assessment to determine that there are adequate numbers of portable toilets and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.
- Contractors should conduct daily toolbox meetings including EHS, best practices and other relevant information, for example, undertake inspections to ensure that workers are wearing adequate personal protective equipment (PPE), such as hard hats, hard boots, air protection, safety glasses, reflective vests and fall protection is necessary. Ensure that safety signage is in place.
- Health, safety, and emergency response plans should be prepared prior to site preparation and construction phases.

8.1.1.6 Employment

- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment.

8.1.1.7 Benthic Monitoring

- Photo Inventory and/or Roving Surveys.
- Fish species and counts.
- This is estimated to cost approximately J$ 525,000 per monitoring exercise.

8.1.1.8 Sediment

- Monitor the potential sediment impact from construction activities on the marine environment. The sediment traps will be retrieved monthly, its contents analysed and redeployed to determine the rate of sedimentation (mg/cm2/day) and dispersal patterns over the area. The sediment trap will have an internal diameter of 3”. Traps will be taken to a Ministry of Health certified laboratory for analysis. This is estimated to cost approximately J$760,000 per monitoring exercise.
- Onsite observations will also be included where possible for example, sediment plumes.
- Drone monitoring may also be used to identify areas where sediment is escaping work areas.

8.1.2 Operational Phase

8.1.2.1 Water Quality

Monitoring should be conducted quarterly and in the case of adverse events after construction. If three to six results demonstrate that the site or parts of the site have stabilised, the sampling frequency and sampling locations may be reviewed, reduced, or discontinued as per an approved monitoring plan. This is estimated to cost approximately **J$ 450,000** per monitoring exercise.

A report shall be prepared by the Contracted party. It shall include the following data:

i. Dates, times, and places of test.
ii. Weather condition.

iii. A defined map of each location with distance clearly outlined in metric.
iv. Test Method used.
v. Parameters measured
vi. Results
vii. Conclusions

The report will be submitted to the Client or their designate within two weeks to one month after the completion of monitoring, depending on the lab results, which have a two-week turnaround time.

In the event that the water quality does not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken and a re-test shall be scheduled at the earliest possible time and a new report submitted.

8.1.2.2 Benthic Monitoring

Benthic monitoring is a key component of the hotel's operational environmental plan, focusing on the assessment of the seabed and surrounding aquatic environments to track changes in habitat quality and biodiversity. This monitoring will involve regular surveys to evaluate the health of benthic ecosystems, including the presence of key species and the condition of critical habitats such as coral reefs and seagrass beds. The Bluefields Bay Fish Sanctuary should be included in all monitoring and reporting activities within the sanctuary. Reports should also detail the status of fisheries.

8.2 OTHER MANAGEMENT PLAN FRAMEWORKS

8.2.1 Wetland Management Plan

A Wetland Management Plan is a strategic document that outlines the actions, goals, and guidelines for the conservation, restoration, and sustainable use of wetland areas. The plan will aim to integrate conservation principles with sustainable land use to ensure the long-term ecological health of the wetlands while accommodating development and community participation. Examples of components to be included in the plan can be found in Section 6.3.3.3.

8.2.1.1 Background and Context

Regional and Local Setting

The Paradise Park wetlands are part of the Bluefields Bay, which act as buffer zones against storm surges and contribute to local water filtration and biodiversity. The current land use in the area includes a mix of pasturelands, recreational spaces, and valuable coastal and wetland ecosystems. However, the proposed land use aims to introduce resort development, conservation areas, and the potential for eco-tourism, offering opportunities for sustainable economic growth. To protect the environment and reduce human impact, the zoning plan incorporates buffer zones around sensitive areas, ensuring that these regions remain safeguarded from development and overuse. This approach helps maintain the ecological integrity of the area while supporting sustainable land use practices.

Legal and Regulatory Framework

KEY LEGISLATION

- The Natural Resources Conservation Authority (NRCA) Act, 1991 and its Regulations
- Wildlife Protection Act, 1945 and Wildlife Protection (Amendment of Second and Third Schedules)
- Regulations, 2016
- The Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000 (Amended 2015)
- The Forest Act, 1996 and Forest Regulations, 2001
- The Town and Country Planning Act, 1957 (amended in 1999)
- The Beach Control Act, 1956 (amended 2004)
- The Fisheries Act, 2018
- The Jamaica National Heritage Trust Act, 1985

KEY INSTITUTIONS

- National Environment and Planning Agency (NEPA)
- Forestry Department
- Bluefields Bay Fish Sanctuary (BBFFS)

POLICIES AND PLANS

- National Mangrove and Swamp Forest Management Plan (2023-2033)
- Jamaica's Coastal Zone Management Plan

INTERNATIONAL AGREEMENTS

- United Nations Convention on Biological Diversity (UNCBD), 1992
- Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, "Ramsar Convention," 1971
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1997
- Convention concerning the Protection of the World Cultural and Natural Heritage (ratified 1983)
- United Nations Framework Convention on Climate Change (UNFCCC)
- Paris Agreement (ratified 1995)
- United Nations Framework Convention on Climate Change (UNFCCC) Reducing Emissions from
- Deforestation and forest Degradation (REDD+) programme, 2015.
- Regional Agreement on Access to Information, Public Participation and Justice in Environmental
- Matters (or the Escazu Agreement), 2019
- High Ambition Coalition for Nature and People, 2021

SWOT Analysis and Stakeholder Consultations

The SWOT analysis will help identify the key strengths, opportunities, weaknesses, and threats that affect the wetland ecosystem and its management. By assessing strengths such as rich biodiversity and institutional support, opportunities like eco-tourism, and threats including climate change and unregulated development, the analysis offers a clear understanding of the current situation. Stakeholder consultations further enhance this process by ensuring that all relevant parties—including local communities, government bodies, NGOs, and industry representatives—are actively involved in the planning process. Their input provides valuable perspectives, helping to refine the analysis and ensure that the management plan addresses the needs and concerns of those most impacted by wetland management. Together, these tools facilitate a collaborative and informed approach to conservation and sustainable use.

8.2.1.2 Management Plan Outline

- Goals and Objectives
- Implementation Period
- Guiding Principles
- Stakeholders and Conservation Partners
- Management and Governance Framework
- Legal Framework
- Protection and Enhancement of Ecological Functions and Services
- Awareness and Education
- Research and Monitoring

8.2.2 Benthic Management Plan

The Benthic Management Plan will include a combination of coral and seagrass monitoring exercises, water quality monitoring and sediment dispersal monitoring, before, during and after construction. The activities will be conducted by qualified and trained marine scientists and SCUBA divers.

8.2.2.1 Roving Coral Reef and Seagrass Bed Surveys

Roving surveys will be conducted in and around the project area via snorkelling and/or SCUBA diving. Observations and photographs will be taken to include but not be limited to; incidence of coral disease and bleaching, general seagrass bed health and excess sedimentation.

8.2.2.2 Water Quality Monitoring

Water quality monitoring is part of the general construction monitoring (see section 8.1.1) and will be included as part of the monitoring report.

Onsite observations will also be included where possible.

8.2.2.3 Sediment Dispersal

Sediment dispersal is part of the general construction monitoring (see section 8.1.1) and will be included as part of the monitoring report.

Onsite observations will also be included where possible.

8.2.2.4 Phasing and Monitoring Frequency

The Monitoring Programme will be conducted as part of the general site monitoring. Roving surveys will be conducted at least once per month during construction.

Any suspected mass bleaching, marine disease outbreak, new potential invasive species and any other significant change/disaster observed will be immediately reported to NEPA.

9.0 CONCLUSION AND RECOMMENDATIONS

The Environmental Impact Assessment (EIA) for the Paradise Park Resort Development has evaluated the potential environmental, social, and economic implications of the proposed project. The findings indicate that while the project presents certain environmental challenges, mitigation measures and environmental management strategies will significantly reduce negative impacts and promote long-term sustainability.

The project will contribute to economic growth and job creation, supporting local businesses and the tourism sector. Environmental concerns related to habitat loss, water quality, sedimentation, and coastal stability have been identified and addressed with targeted mitigation strategies. Sustainable features, including renewable energy use, wastewater treatment, and conservation programs, will support environmental integrity. Long-term success will depend on ongoing environmental monitoring, adaptive management, and stakeholder engagement.

To ensure the sustainable execution of the Paradise Park Resort Development, several recommendations are proposed. Strict adherence to mitigation measures outlined in the EIA is necessary to minimize environmental degradation, ensuring all construction and operational activities align with best environmental practices. Establishing a long-term environmental monitoring program will allow tracking of ecosystem health, water quality, and habitat recovery while implementing an adaptive management framework to address unforeseen environmental impacts.

Maintaining open communication with local stakeholders, including fishers, community members, and regulatory authorities, is essential. Providing community benefits such as employment opportunities and environmental education programs will enhance local engagement. Ensuring full compliance with national environmental regulations and international best practices will help align the project with evolving environmental standards, while periodic review and updates to operational plans will improve sustainability.

Ecosystem conservation and restoration efforts should include marine and terrestrial conservation initiatives, such as mangrove restoration and artificial reef installations. Promoting low-impact tourism practices will help minimize ecological disturbance. By implementing these recommendations, the project can proceed in a manner that balances economic development with environmental sustainability, ensuring that Paradise Park Resort becomes a model for responsible coastal tourism development.

10.0 REFERENCES

Agarwal, S. K., 2009. Noise Pollution. New Delhi. In: s.l.:APH Publishing Corporation.

AGRRA Lang, J. &. M. K. (., 2016. *Baseline Assessment of Coral Conditions (Corals, Benthos and Fish) at Monitoring Sites across the CMBP Project Seascapes*, s.l.: s.n.

Authority, N. F., 2023. *Jamaica fisheries: Quarterly statistics report, volume 2, issue 3, October–December 2023*, s.l.: s.n.

Bayraktarov, L. e. a., n.d. *Coral gardening: a useful tool for coral reef restoration and management.* [Online] Available at: "Ct" https://doi.org/10.1016/j.marenvres.2018.02.003

Bennett, G., 2022. *Letter from Gregory Bennett (Director, Applications Management Division, NEPA) to Krishna Desai (Attorney-at-law, Myers, Fletcher & Gordon), c. CEO, Westmoreland Municipal Corporation, Re: DAC Facilitation— Proposed Hotel Development at Paradise Park, W.* Kingtson: National Environment and Planning Agency.

Bisset, R., 1996. *Environmental Impact Assessment: Issues, Trends and Practice.* 612 ed. s.l.:UNEP.

Bluefields Bay Fishermen's Friendly Society (BBFFS), n.d. *Management and Enforcement Plan for the "Bluefields Bay Fish Sanctuary".* Belmont Fishing Beach, Bluefields, Jamaica: s.n.

Bluefields Bay Fishermen's Friendly Society, 2013. *Bluefields Bay Fish Sanctuary: Now and Then.* s.l., Bluefields Bay Fishermen's Friendly Society.

Bluefields Bay Fishermen's Friendly Society, 2018. *Turtle Report July - BBFFS Sea Turtle Data for the 2018 Nesting Season*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2019. *Turtle Report BBFFS Sea Turtle Data for the 2019 Nesting Season*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2021. *Turtle Report 2021 BBFFS Sea Turtle Data for the 2021 Nesting Season*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2022. *Sanctuary Report April 2022*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2022. *Sanctuary Report April 2022*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2022. *Sanctuary Report December 2022*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2022. *Sanctuary Report January 2022*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2022. *Sanctuary Report September 2022*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, 2022. *Turtle Report 2022 BBFFS Sea Turtle Data for the 2022 Nesting Season*, s.l.: s.n.

Bluefields Bay Fishermen's Friendly Society, n.d. *Bluefields Bay Fishermen's Friendly Society.* [Online] Available at: http://bluefieldsbayfishers.wordpress.com/home-2/bluefields-bay-fish-sanctuary [Accessed 5 February 2014].

Bluefields Bay Special Fishery Conservation Area (Fish Sanctuary), 2022. *Operational Plan/ Performance Review, October - December 2022.* s.l.:Bluefields Bay Special Fishery Conservation Area (Fish Sanctuary).

Bluefields People Community Association, n.d. *Bluefields People Community Association – BPCA | bluefields bay ja,* s.l.: Bluefields People Community Association.

Brüel & Kjær, 1984. *"Measuring Sound.* [Online] Available at: http://www.bksv.com/doc/br0047.pdf [Accessed 17 July 2013].

Burrowes, R., 2013. *Stakeholder Questionnaire* [Interview] (28 November 2013).

Campbell, C. L., 2000. *The Phytoplankton Community as indictors of Water Quality in Discorvery Bay Jamaica.* s.l.:University of the West Indies, Mona.

Campbell, C. L., 2014. *Noise Influences Associated with the Operation of a Power Generation Facility Adjacent to Rural Communities, Old Harbour, Jamaica,* s.l.: s.n.

Carroll, J. D., 2013. *Physical Habitat Mapping and Assessment in Bluefields Bay Fish Sanctuary, Westmoreland, Jamaica (Master's thesis).*, s.l.: Missouri State University, Geography, Geology, and Planning Department, USA. .

Clegg, E., 2015. Sustainable Tourism Assessment for a Marine Protected Area in Southwest Jamaica. *Thesis, Masters of Science, Geospatial Sciences in Geography and Geology, Missouri State University*.

Consortium, C. R., 2017. *Coral Nurseries: A Guide to Design, Establishment, Operations and Maintenance.* s.l., s.n., p. .

Copernicus, 2024. *Copernicus: 2023 is the hottest year on record, with global temperatures close to the 1.50C limit.* [Online] Available at: https://climate.copernicus.eu/copernicus-2023-hottest-year-record [Accessed 9 July 2024].

Creed-Nelson, M., 2021. *Letter from Mrs. Michele Creed-Nelson (JNHT) to Mrs. Michelle Grant (NEPA), Re: 2021-10017 DAC00177 "Proposed Hotel Development- Paradise Park, Westmoreland".* Kingston: Jamaica National Heritage Trust.

Dahl M., D. D. G. S. A. M. E. L. L. D. K. V. S. R. B. M. G. M., 2016. *Sediment Properties as Important Predictors of Carbon Storage in Zostera marina Meadows: A Comparison of Four European Areas.* [Online].

Datastream, 2021. *A Monitors Guide to Water Quality.* Canada: DataStream, Datastream.org.

Day, O. E. N. M. M. L. S. a. G. N., 2015. *Community-based Live Fish (CLIF) Monitoring Results: Interim Report (2012-2014). The CARIBSAVE Partnership, West Indies.*, s.l.: s.n.

Day, O. et al., 2015. *Community-based Live Fish (CLIF) Monitoring Results: Interim Report (2012-2014).* West Indies: The CARIBSAVE Partnership.

Downer, A. & Sutton, R., 1990. *Birds of Jamaica: A Photographic Field Guide,* Cambridge: Cambridge University Press.

Ebert, J. E., 2010. Integrated Watershed Management in Bluefields Bay, Jamaica. *Masters Thesis, Degree of Master of Science, Geospatial Sciences in Geography and Geology, Missouri State University*.

Ebert, J. E., 2010. *Integrated Watershed Management in Bluefields Bay, Jamaica,* s.l.: Missouri State University.

EcoNexus Consulting Group LLC, 2025. *Ecosystem Service and Natural Resource Valuation Assessment for a Resort Development at Paradise Park, Smithfield, Westmoreland,* Kingston: EcoNexus Consulting Group LLC.

ECOST Project, 2007. *Case Study 2: Jamaica,* Mona, Jamaica: Centre for Marine Sciences (CMS), University of the West Indies.

Fath, K. L., 2014. Agricultural Livelihoods and Climate Change: Employing the Livelihood Vulnerability Index in Bluefields, Jamaica. *M.S. thesis in Agricultural Leadership, Education, and Communications, Texas A & M University*.

Fink, D. et al., 2018. *eBird Status and Trends, Version November 2018.* s.l.:s.n.

Forestry Department, 1998. *1998 1:100000 Landuse/Cover of the Island of Jamaica | JAD 2001.* s.l.:s.n.

Forestry Department, 2003. *Ecological Land Classification for Forest Management and Conservation in Jamaica.* s.l.:s.n.

Forestry Department, 2022. *National Mangrove & Swamp Forests Management Plan 2023-2033.* Kingston, Jamaica: Forestry Department, Government of Jamaica.

Forestry Deprtment, 2023. *LandUse_LandCover_Paradise_Park.shp.* Jamaica: Forestry Deprtment.

Fourqurean, J. W. D. C. M. K. H. M. N. H. M. M. &. S., 2012. Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience,* pp. 505-509..

Garffer, P., 1992. Enchanting rhythms from the other side. *Americas,* 44(4), p. 28.

Hartley, W., 2022. *Letter from Winston Hartley BH (M) and Patrick Rose (NWA) to the Government Town Planner (NEPA), Enquiry Re: DAC Application for Proposed Hotel Development Comprising 500 Suites Called Keys at Paradise Park, Westmoreland Reference No.: 2021-10017-DAC00177.* Kingston: National Works Agency.

Hydrology, C. I. f. M. a., 2024. *Heat Outlook for April to September 2024.* [Online] Available at: https://rcc.cimh.edu.bb/files/2024/03/heat_outlook_AMJ2024.pdf [Accessed 2025].

Jamaica National Heritage Trust, 2023. *Archaeological Impact Assessment for Paradise Park,* Kingston, Jamaica: Jamaica National Heritage Trust.

Jamaica Tourist Board, 2022. *JTB Annual Report 2021-2022,* Jamaica: Jamaica Tourist Board.

Kennedy, H. B. J. D. C. M. F. J. W. H. M. M. N. &. M. J. J., 210. Seagrass sediments as a global carbon sink: isotopic constraints. *Global Biogeochemical Cycles.*

Lavery, P. S. M. M. A. S. O. &. R. M., 2013. Lavery, P. S., Mateo, M. A. Variability in the carbon storage of seagrass habitats and its implications for global estimates of blue carbon ecosystem service. ..

Lillian R. Aoki, K. J., 2021. *Seagrass Recovery Following Marine Heat Wave Influences Sediment Carbon Stocks.* , s.l.: Frontiers in Marine Science..

Macreadie, P. I. A. A. R. J. A. B. N. C. R. M. F. D. A. &. S. O., 2019. The future of Blue Carbon science. *Nature Communications.*

McIntyre, K., 2015. Benthic mapping of the Bluefields Bay fish sanctuary, Jamaica. *Master's degree thesis, 30 credits in Geographical Information Sciences (GIS), Department of Physical Geography and Ecosystems Science, Lund University.*

Mines and Geology Division, 1984. *Jamaica-Geology.* s.l.:Mines and Geology Division.

Missouri State University, 2011. *Bluefields Bay, Jamaica Geotourism Evaluation.* s.l.:Missouri State University.

Mohamed, B., Barth, A. & Alvera-Azcárate, A., 2023. Extreme marine heatwaves and cold-spells events in the Southern North Sea: classifications, patterns, and trends. *Frontiers in Marine Science.*

National Environment and Planning Agency, n.d. *Protected Areas System Master Plan: Jamaica 2013 – 2017, Final Submission to the Protected Areas Committee*, s.l.: s.n.

National Fisheries Authority, 2023. *Email, Re: EIA for the Proposed Housing and Resort Development at Paradise Park, Westmoreland | Request for Information.* s.l.:s.n.

National Fisheries Authority, 2023. *Jamaica Fisheries: Quarterly Statistics Report, Volume 2: Issue 3, October – December 2023*, Jamaica: National Fisheries Authority.

Natural Resources Conservation Authority, 2000. *A Beach Policy for Jamaica, A Policy for the Managment of the Beach, Foreshore and Floor of the Sea.* s.l.:Natural Resources Conservation Authority.

NEPA, 2024. *Coral Reef StatusReport for Jamaica 2023*, s.l.: s.n.

NOAA, 2024. *NOAA Climate.gov.* [Online]
Available at: https://www.climate.gov/news-features/featured-images/2023-was-warmest-year-modern-temperature-record#:~:text=Details,decade%20(2014%E2%80%932023).
[Accessed 11 July 2024].

Norrman, J. et al., 1997. *Manual for Integrated Coastal Planning and Management in Jamaica,* Uppsala: s.n.

Novak M., B. F. J. I. C. B. S. M. J. C. F. V. L. B. E. P. M. A., 2020. Isotope composition of dissolved organic carbon in runoff and peat leachates from a Central European wetland: Temporal. *CATENA*, pp. 217-225.

Oreska M. P. J., M. K. J. P. J. H., 2017. *Oreska M. P. J., McGlatherSeagrass blue carbon spatial patterns at the meadow-scale.* [Online]
Available at: https://doi.org/10.1371/journal.pone.0176630

Oreska M. P. J., M. K. J. P. J. H., 2020. Seagrass blue carbon spatial patterns at the meadow-scale.

Planning and Investigations Section, Water Resources Authority, 2021. *WRA COMMENTS FOR DOCUMENT ASSISTANCE COMMITTEE: PROPOSED DEVELOPMENT AT PARADISE PARK, WESTMORELAND.* Kingtson: Water Resources Authority.

Premier Land & Water Development Ltd., 2023. *Site Visit Report, Proposed Devlopment at Paradise Park., Westmoreland,* Kingston: Premier Land & Water Development Ltd..

Premier Land & Water Development Ltd., 2024. *Paradise Park Hydrological Assessment Report,* Kingston: Premier Land & Water Development Ltd..

Prentice C., P. L. L. M. M. E. S. T. A. S. A. H. M. S. R. R. J. M. ,. J. ,. F. T. G. J. H. A. M. C. R. W. W. a. K. T. A., 2020. *Synthesis of Blue Carbon Stocks,Sources, and Accumilation Rates in Eel grass (Zostera marina) Meadows in the Northeast Pacific.* [Online].

Raffaele, J., Garrido, o., Keith, A. & Raffaele., J., 1998. *A Guide to the Birds of the West Indies.* s.l.:Princeton University Press..

Ricketts, C., 2022. *Letter from Canute Ricketts (Mr) (Director of Research and Mapping,Mines and Geology Division) to Miss Michelle Grant (Development Assistance Centre, NEPA), Re: Proposed Paradise Park Development, Westmoreland.* Kingston: Mines and Geology Division.

Röhr E., H. M. B. J. K. B. M. (. B. C. S. C. o. T. E. (. m. M. h., 2018. *Blue Carbon Storage Capacity of Temperate Eelgrass (Zostera marina) Meadows.* [Online] Available at: ttps://www.researchgate.net/publication/327757134_Blue_Carbon_Storage_Capacity_of_Temperate_Eelgrass_Zostera_marina_Meadows

Schill, S. R. et al., 2021. Regional high-resolution benthic habitat data from planet dove imagery for conservation decision-making and marine planning. *Remote Sensing,* 13(21).

Schwartz, A. & Henderson, Robert, . R. W., 1991. *Amphibians and reptiles of the West Indies : descriptions, distributions, and natural history.* s.l.:s.n.

Smith Warner International Limited, 2025. *Preliminary Engineering Design and Coastal Impact Assessment Report, Beach Development for Proposed Beach Works at Paradise Park, Westmoreland, Jamaica,* Kingston: Smith Warner International Limited.

Social Development Commission, 2010. *Community Profile (Smithfield, Westmoreland).* Kingston: Soical Development Commission (SDC).

Social Development Commission, 2017. *National Community Boundaries - Jamaica.* s.l.:s.n.

Social Development Commission, 2018. *Lucea Community Profile, Hanover,* Kingston: Social Development Commission.

Soical Development Commission, 2010. *Community Profile (Smithfield, Westmoreland).* Kingston: Soical Development Commission (SDC).

South East Regional Health Authority, n.d. *Health Centres,* s.l.: s.n.

The Nature Conservancy, 2024. *The Nature Conservancy's Blue Carbon Explorer,* s.l.: s.n.

Thorpe, C., 2015. Governance Analysis of Bluefields Bay Special Fisheries Conservation Area. *Master's thesis in Conservation, University College London*.

Transmodel, 2025. *Paradise Park Traffic Impact Assessment*, s.l.: Transmodel.

Triplehorn, C. A., Johnson, D. J. & Borror, D. J., 2005. *Borror and DeLong's introduction to the study of insects..* s.l.:s.n.

United Nations, 1952. *Manual I: Methods for estimating total population for current dates.* Sales No. 52.XIII.5 ed. s.l.:United Nations Publications.

United States Environmental Protection Agency, 2016. *National Aquatic Resource Survey - US EPA.* [Online]
Available at: https://www.epa.gov/national-aquatic-resource-surveys/indicators-dissolved-oxygen

Van Oppen, R. e. a., 2015. Assisted Evolutionary Intervention for Reef Corals: A Feasibility Study.

Warner, G. & Goodbody, I., 2005. Jamaica. In: P. Miloslavich & E. Klein , eds. *Caribbean Marine Biodiversity: The Known and the Unknown.* s.l.:DEStech Publications, Inc., pp. 57-70.

Wendy E.D Piniak, D. A. M. C. A. H. T. T. J. S. A. E., 2016. Hearing in the Juvenile Green Sea Turtle (Chelonia mydas): A comparison of Underwater and Aerial Hearing Using Auditory Evoked Potentials. *PLOS ONE*, Issue DOI:10.1371/journal.pone.0159711.

Western Regional Health Authority, 2023. *Infrastructure and Services Response - Environmental Impact Assessment (EIA) for the Proposed Housing and Resort Development at Paradise Park, Paradise Pen, Westmoreland* , s.l.: s.n.

Wood, C., n.d. Environmental Impact Assessment: A Comparative Review. In: s.l.:s.n., p. p. 2..

11.0 APPENDICES

Appendix 1 – Terms of Reference

APPLICATION
NOV 26 2024
ACCEPTED

APPLICATION SECRETARIAT OFFICE
NOV 26 2024
NEPA

TERMS OF REFERENCE FOR AN ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED RESORT DEVELOPMENT AT PARADISE PARK, PARADISE PEN, WESTMORELAND

DATE | 5 September 2024
PREPARED BY | C.L. Environmental Company Limited

Table of Contents

Project Description

The proposed Paradise Park resort development is located along the south coast of Westmoreland, Jamaica, 3 km east of Savanna-La-Mar in in a community known as Smithfield (Figure 1). The project area is known as Paradise Pen and the proposed resort project boundary comprises the following land parcels: Vol.1146 Fol.944, Vol.1146 Fol.945, Vol.1146 Fol.946 and Vol. 1141 Fol.494.

The total land area of Paradise Park is 1,120 acres (453 hectares) and it contains several distinct ecosystems and natural environments including mangroves, wetlands, fields, beach, rivers, and grassed areas. The shoreline is approximately 4,572 m (≈15,000 feet) in length, including 680 m (≈2,230 feet) of white sand beach. Given the rich diversity of ecosystems and natural beauty, the proposed resort at Paradise Park is envisioned as a one of a kind hospitality development that will focus on conservation, restoration, and expansion of existing natural habitats. The proposed resort development comprises five (5) land use programmes (Table 1, Figure 2, Figure 3 and Figure 4):

1. **Resort** – This comprises the ultra-luxury resort with its many private villas configured as clusters having a common cluster pool and its and resort amenities. The resort offers a wide variety of villa sizes and experiences through their unique placement in various environments across the site including limited number of overwater villas. A main reception/lounge area will serve to the resort. All resort visitors have access to the many amenities scattered across the site and the resort-designated beach area to the east of the hotel. Resort will have its own Food and Beverage outlets as well as its main kitchen and satellite kitchens. A small Sushi Restaurant with no cooking will be built at the tip of land parcel Vol.1141. Fol.494.
2. **Hotel** - This ultra luxury hotel offers different room sizes and experiences throughout the various hotel room strips that are strategically placed across the site. Hotel visitors will have access to all the hotel amenities and the large, designated hotel beach. Hotel will have its own Food and Beverage outlets as well as its main kitchen and satellite kitchens
3. **Villas** – These luxury villas are privately owned by residents and managed by the resort management. The villas are positioned along the golf course and have various beautiful ecological features for enhanced variety and views for potential buyers.
4. **Golf** - A pro tour level golf course and club house with its own Food and beverage facility are situated within the villa land use to attract golfers from across the island and the world. The course integrates the existing natural environment into its hole design to have as little impact on the environment as possible.
5. **Beach** – The new white sand beach is being planned to be extended to have approximately 900 m (=2952 feet) in front of the land parcels Vol.1146.Fol.946 and Vol.1141. Fol.494
6. **Amenities** – There will be separate amenities for the Resort/Villas and the Hotel but there will also be some common amenities for all.
   a. **Amenities for the Resort/Villas**
      i. **Spa/Wellness Centre**
      ii. **Gym**

iii. **Tennis courts**
iv. **Farming School** (Guests will learn how to raise vegetables in general but specific to Jamaica also.)
v. **Cooking School** (Guests will learn how to cook Jamaican Cuisine as well as other unique cuisines from around the World
vi. **Equestrian Centre** (A complete equestrian centre with stalls and fields will be constructed)
vii. **Polo Club** (The site historically had the first Polo Club in Jamaica. This is a tribute to that)
viii. **Art School** (Guests will have the opportunity to learn various forms of Jamaican art, including painting and pottery)
ix. **Music Recording Studio** (This will accommodate musicians from around the world, allowing them to stay at the resort as guests and record their music))
x. **Fragrance School** (Guest will learn how fragrances are created)

b. **Amenities for the Hotel**
i. **Spa/Wellness Centre**
ii. **Gym**
iii. **Tennis Courts**
iv. **Pickle ball courts**

c. **Common Amenities**
i. **Children's Club**
ii. **Rum Bottling Facility** (Rum produced at an external third-party distillery will be stored in tanks and individually bottled for each guest with personalized labels)
iii. **Basketball court**

Table 1 Land use area summary for the Paradise Park resort development

	PROGRAM	KEYS/ UNITS	TOTAL BLDG FOOTPRINT (SQM)	GFA (SQM)	GFA (ACRES)
R	RESORT LANDUSE	120	40273	472,444	117
H	HOTEL LANDUSE	200	35355	180,758	45
G&V	GOLF COURSE & VILLA LANDUSE	100	75594	1,958,341	484
S	SERVICE/UTILITY LANDUSE	-	14819	114,962	28
U	UNDEVELOPED LANDUSE	-	-	1,731,664	428
	TOTAL AREA - PARADISE PARK			*4,458,169*	*1,102*

Figure 1 Location of the proposed resort development at Paradise Park, Paradise Pen, Westmoreland

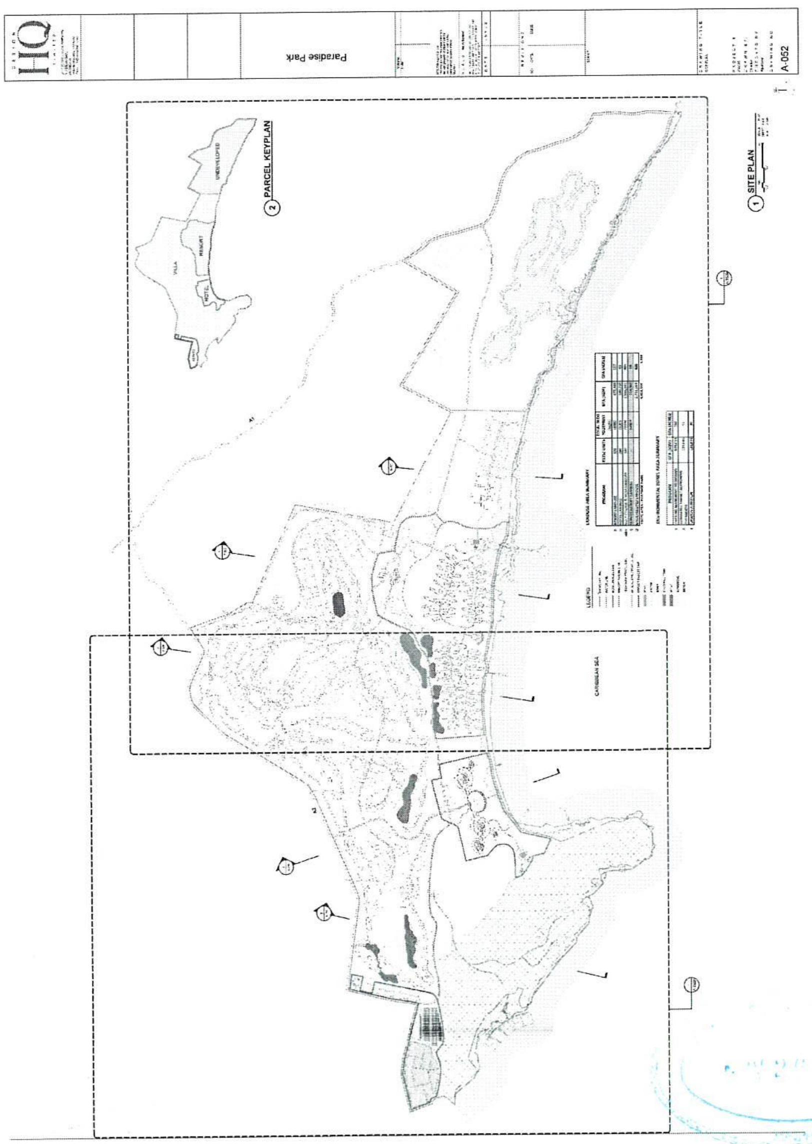


Figure 2 Resort master plan for the proposed development at Paradise Park, Paradise Pen, Westmoreland

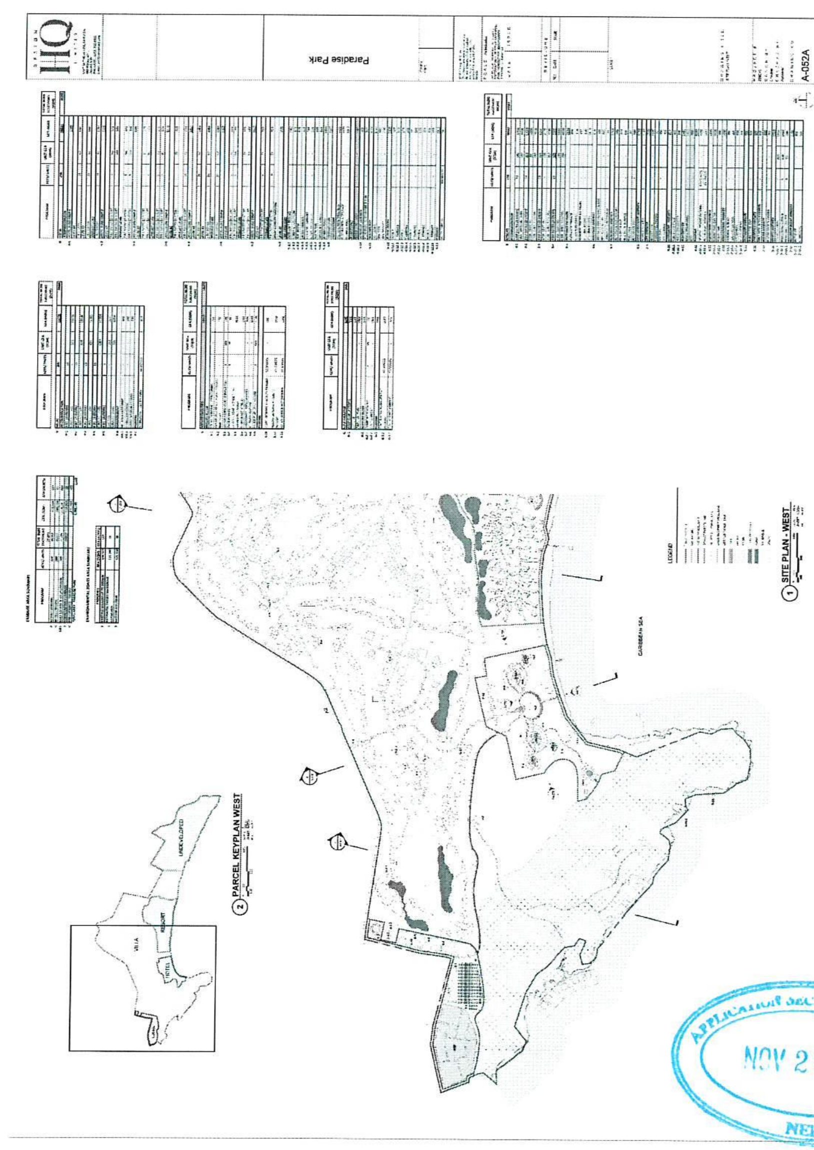


Figure 3 **Western section of resort master plan for the proposed development at Paradise Park, Paradise Pen, Westmoreland**

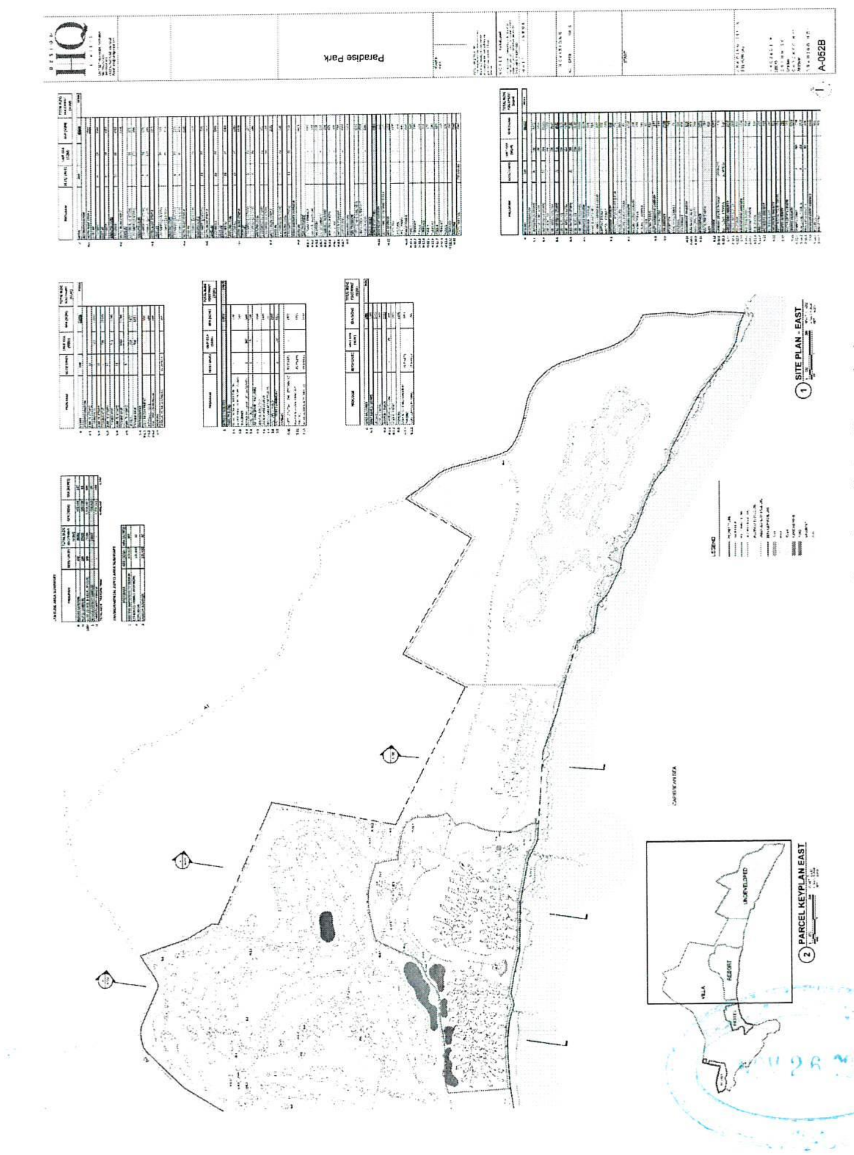


Figure 4 **Eastern section of resort master plan for the proposed development at Paradise Park, Paradise Pen, Westmoreland**

Foreword

The purpose of this document is to establish the **Terms of Reference for an Environmental Impact Assessment for the Proposed Resort Development at Paradise Park, Paradise Pen, Westmoreland**. An EIA seeks to identify the impacts the proposed project is likely to have on the area in which the physical development will be carried out as well as the impact of the environment on the proposed development. It also outlines mitigation measures necessary to reduce the negative impacts of the project.

The EIA will be prepared using a participatory approach involving key stakeholders. The EIA report must be produced in accordance with the agreed TOR issued by the National Environment and Planning Agency (NEPA) to Paradise Park Development Corporation Limited.

Where the need arises to modify the TOR, the required amendments/modifications are to be made and submitted to the Agency. Approval for the TOR must be obtained from the Agency, in writing, prior to the commencement of the EIA study.

The National Environment and Planning Agency and the Natural Resources Conservation Authority (NRCA) reserves the right to reproduce, transfer and disclose any and all contents contained in the submitted environmental impact assessment report without the written consent of the proponent, consultants and/or its agents.

Terms of Reference

The Terms of Reference to conduct the Environmental Impact Assessment (EIA) are as follows:

1.0 EXECUTIVE SUMMARY

Provide a brief statement on the content of the EIA report. The executive summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project, etc. In addition, it should include relevant background information and provide a summary of the main findings, including but not limited to main impacts and mitigation measures, analyses, and conclusions in the report. A summary of the environmental monitoring and management plans, as well as alternatives should also be included.

The study area shall include at least the area within a 5 km radius of the property boundaries (and must capture the Bluefields Bay Special Fishery Conservation Area).

2.0 INTRODUCTION

The introduction should provide a background and seek to explain the need for and the context of the project and the EIA. It should also provide the delineation and justification of the boundary of the study area, general methodology, assumptions, and constraints of the study. Additionally, a profile of the project proponent, implementing organization, project consultants, etc. should also be provided.

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3.0 LEGISLATION AND REGULATORY CONSIDERATION

This section should provide details of the pertinent regulations, standards, policies, and legislations governing environmental quality, safety and health, cultural significant finds, protection of sensitive areas, protection of endangered species, tourism enterprises, siting, and land use control at the local and national levels. The examination of the legislation should include at a minimum the Natural Resources Conservation Authority Act 1991, Natural Resources Conservation Regulations 1996, amended 2015, Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, Beach Control Act, Jamaica National Heritage Trust Act, Wild Life Protection Act, Fisheries Act 2018, Pesticides Act, National Solid Waste Management Authority Act, the Town and Country Planning Act, Town and Country Planning (Westmoreland Area) Development Order, 2018, Building Act and Codes and Standards promulgated there under and Planning Guidelines - Overwater Structures, and all appropriate international convention/protocol/treaty where applicable. Describe traditional land use and advise of any prescriptive rights including public access rights.

4.0 PROJECT DESCRIPTION

The report should provide a comprehensive description of all proposed terrestrial and marine project component, including information necessary to identify and assess the potential environmental impacts of the project. This should include but not be limited to:

Location and Background

- Location map and total site area.
- An overall master plan of the site including current, proposed, and future use of the lands showing the various components and design elements of the proposed development. Site maps illustrating areas to be impacted and areas to be preserved in their existing state.
- Objectives and information on, rationale for the project.
- History and project background, the nature, location/existing setting, timing, duration, frequency, general layout, as well as the impact on the carbon footprint of the energy sector are to be discussed.
- Existing site and its characteristics (landward & seaward).
- The study area should be clearly delineated and referenced. Considering the types of resources located in the area and the magnitude of the associated impacts, the study area should be large enough to include all valued resources that might be significantly affected by the project.

Project Features and Design

- For each major project component, that is, resort, hotel, villas, golf course, overwater features, beach works and lagoon, where applicable:
    - Detailed description of the project, project objectives and phases (where applicable), including all applicable timelines for the various aspects of the project (from pre to post development). The description should also provide details of the design concept, design components, material(s) to be used, total number, size, and types of guest rooms/suites, boardwalk or means of access to the overwater rooms; design height of structures above sea level; and supporting services such as administrative, "back-of-house" facilities, power generation, laundry facilities and amenities to serve the proposed development

such as pools, restaurants, helipad, etc. This should be supported using maps, diagrams, and other visual aids where appropriate.
  - Detailed description of all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to mangrove removal, seagrass and/or coral relocation and shading; collection, beach works, transfer, and disposal of waste (solid waste and sewage); provision of potable water and electricity; and dredging/excavation.
  - Details of the methods, equipment, and machinery to be employed to undertake each aspect of the project including coral/seagrass relocation, dredging/excavation, transportation of material, disposal of spoils (if applicable), storage of material, installation of pylons, construction of units, installation of required infrastructure and secondary activities such as refuelling of vessels, proposed location(s) for equipment storage (staging area) and establishment of a site office.
  - Source and characteristic of fill sediment for beach nourishment and the impact on coastal morpho-dynamics should be include.
  - A detailed landscape plan highlighting grading and proposed changes in topography. The landscape plan should emphasize the retention of mature trees and use of native species in landscaping activities.
  - Details of all chemicals including pesticides and herbicides.
- Construction methodology, works, duration and maintenance schedule, which must include methodology for the proposed cutting/trenching, beach nourishment, coastal protection works and overwater suites. Coastal works should be supported by modelling data to demonstrate impact on adjacent shorelines to the west and east of project site.
- Details regarding access points and accessibility during pre-construction, construction, and post-construction, to the proposed work site(s).
- Details of any required decommissioning of the works and/or facilities.

Wastewater Treatment Plant

Detailed description of Wastewater Treatment Plant details to include but not be limited to:

- Treatment system and design criteria
- Maintenance and operation plan
- Septage and sludge
- Projected daily flows (average and peak)
- Effluent discharge details (including projected water quality)
- Treatment processes
- WWTP components

Drainage

Detailed drainage report which should be designed for a 1 in 100-year event.

Batching Plant (Construction Phase ONLY)

Details of the proposed batching plant to be used during construction phase, should be clearly outlined in the EIA report. These details should include but not be limited to:

- Concrete generation rate per hour
- Raw materials to be used and where they will be bought/sourced from
- Raw material storage details
- Amount of water to be used and source of water
- Dust generation mitigation details
- Washdown activities and treatment of wastewater
- Maintenance and operations
- Emergency Response

5.0 DESCRIPTION OF ENVIRONMENT

This section should include a detailed description of the proposed sites (marine and terrestrial) and surrounding environment. Baseline data should be generated to give an overall evaluation of the existing environmental conditions. The study area should be large enough to include all valued resources that might be significantly affected by the project. This information will form the basis upon which impacts of the project will be assessed. The following aspects should be described in this section, broken down into the following:

- Physical Environment
- Biological Environment
- Natural Hazards
- Socio-economic and Cultural/Heritage

Physical Environment

- Topography, soils, climate/meteorology, geology (including but not limited to rock type and formation, susceptibility to erosion, seismicity, and faults), geomorphology of the site and impacts on current landscape, aesthetic appeal and hydrology should be examined. Special emphasis should be placed on storm water runoff and drainage patterns within and outside of the mangrove swamp.
- A geotechnical study should also be conducted within the proposed project area.
- A detailed hydrological assessment of the proposed project area should be conducted to:
  - Identify and clearly map locations of natural and manmade drainage features within the project area. These are to include sinkholes, rivers, gullies, and drainage infrastructure;
  - Estimation of peak flows under the 10-, 25-, 50- and 100-year Return Periods;
  - Flushing/circulation analysis of immediate coastal area against generated stormwater runoff.
  - Consultations should be had with the National Works Agency (NWA) regarding the drainage plan for the development.
- Hydrodynamics, including but not limited to bathymetry, waves (hurricane, operational and swell), currents, tides, baseline sediment transport, circulation patterns, dredge plume modelling and associated impacts. Scenarios for hurricane should consider 50- and 100-year return periods.
- Water quality of the marine and freshwater environment (Figure 5). Baseline water quality should include study areas and associated environs and control sites. These should be accurately mapped, and a spatial comparison of the data should be done to determine any possible source(s) of pollutants.

- Water quality should include but not be limited to the following parameters:
  - Physical parameters: Temperature, salinity, conductivity, pH, dissolved oxygen, turbidity, Total Suspended Solids and Total Dissolved Solids.
  - Chemical Parameters: Nitrate, Phosphate.
  - Biological Parameters: Biochemical Oxygen Demand, Faecal Coliform.
- Water quality data (primary) shall be collected at the sampling sites identified (Figure 5), during the wet and dry seasons. A minimum of six (6) months data shall be presented and analysed. Water quality sampling events will be conducted, each at least one month apart. Sampling should include at least 3 samples for the wet season and 3 for the dry season. Where there is heavy rainfall during the six months data collection, at least one sample should be collected.
- Where secondary data is used to supplement (not replace) the primary data, it should not be older than five years.
- Results from the water quality sampling should be compared to NRCA water quality standards.

- Analysis of marine sediments (Figure 6) should include but not be limited to the following parameters:
  - Arsenic
  - Cadmium
  - Mercury
  - Lead
  - Total Petroleum Hydrocarbons
- Dry sieve analysis of sediments in project area.
- Analysis of sediment loading in project area (Figure 7).
- Noise and vibration levels of undeveloped site and the ambient noise in the area of influence (Figure 8).
- Particulate Matter (PM10 and PM2.5) of the undeveloped site and in the area of influence (Figure 8). Data is to be compared with the NRCA daily ambient air quality standard limit for PM10, and the USEPA daily limit for PM2.5 since a PM2.5 standard has not yet been promulgated for Jamaica. Ambient air quality sampling will be conducted at eight (8) locations for 24 hours each, using Airmetrics Minivol Tactical Air Samplers. Measurements of PM 10 (particles of sizes between 2.5 – 10 mm) and PM 2.5 (2.5 micrometres and smaller) will be taken. PM10 sampling will be conducting on select days according to the US EPA 6-day schedule, while PM2.5 sampling will be conducted on select days according to the US EPA 3-day schedule, for a total of six (6) months.
- Sources of existing pollution (coastal, surface and groundwater) and extent of contamination.

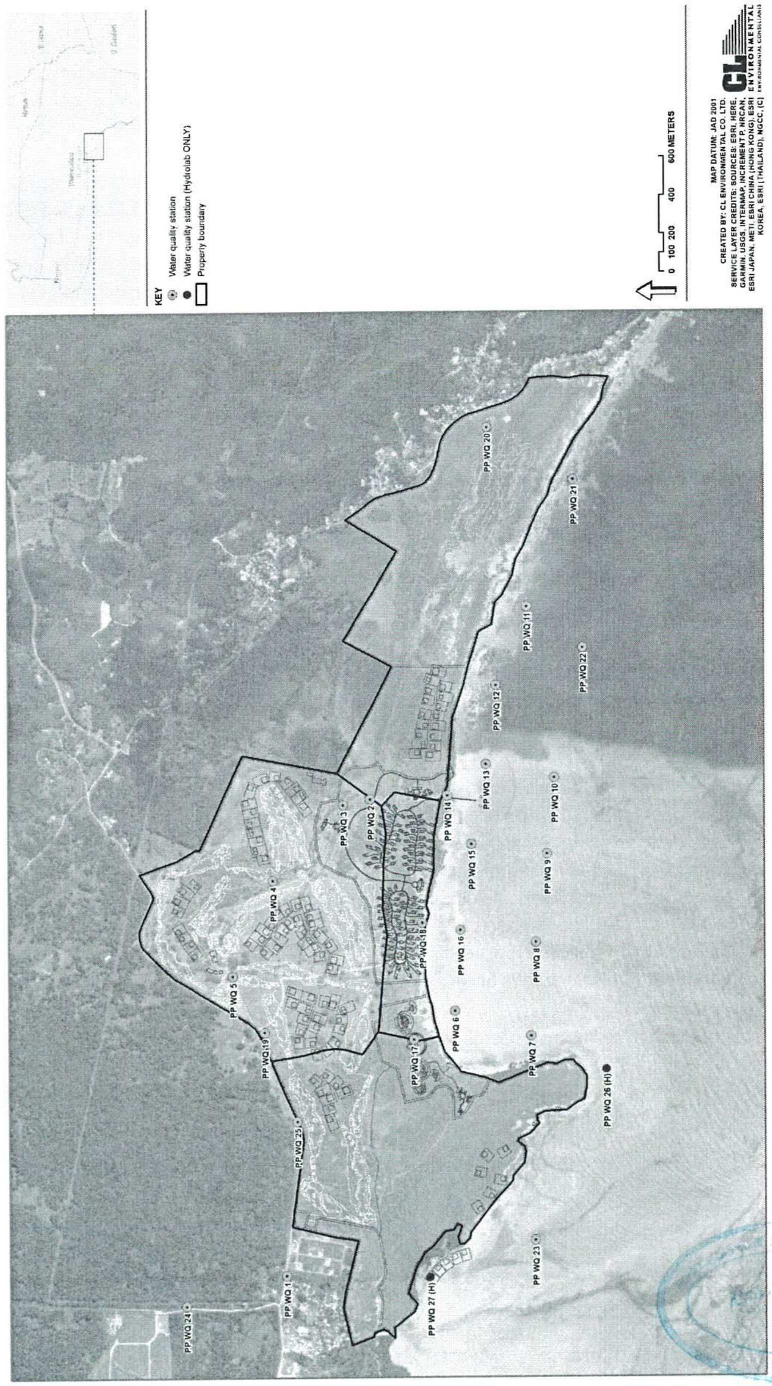

Figure 5 Water quality station locations at the proposed development site, Paradise Park, Paradise Pen, Westmoreland

TERMS OF REFERENCE FOR AN ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED RESORT DEVELOPMENT AT PARADISE PARK, PARADISE PEN, WESTMORELAND | 13

Figure 6 Sediment sample locations at the proposed development site, Paradise Park, Paradise Pen, Westmoreland

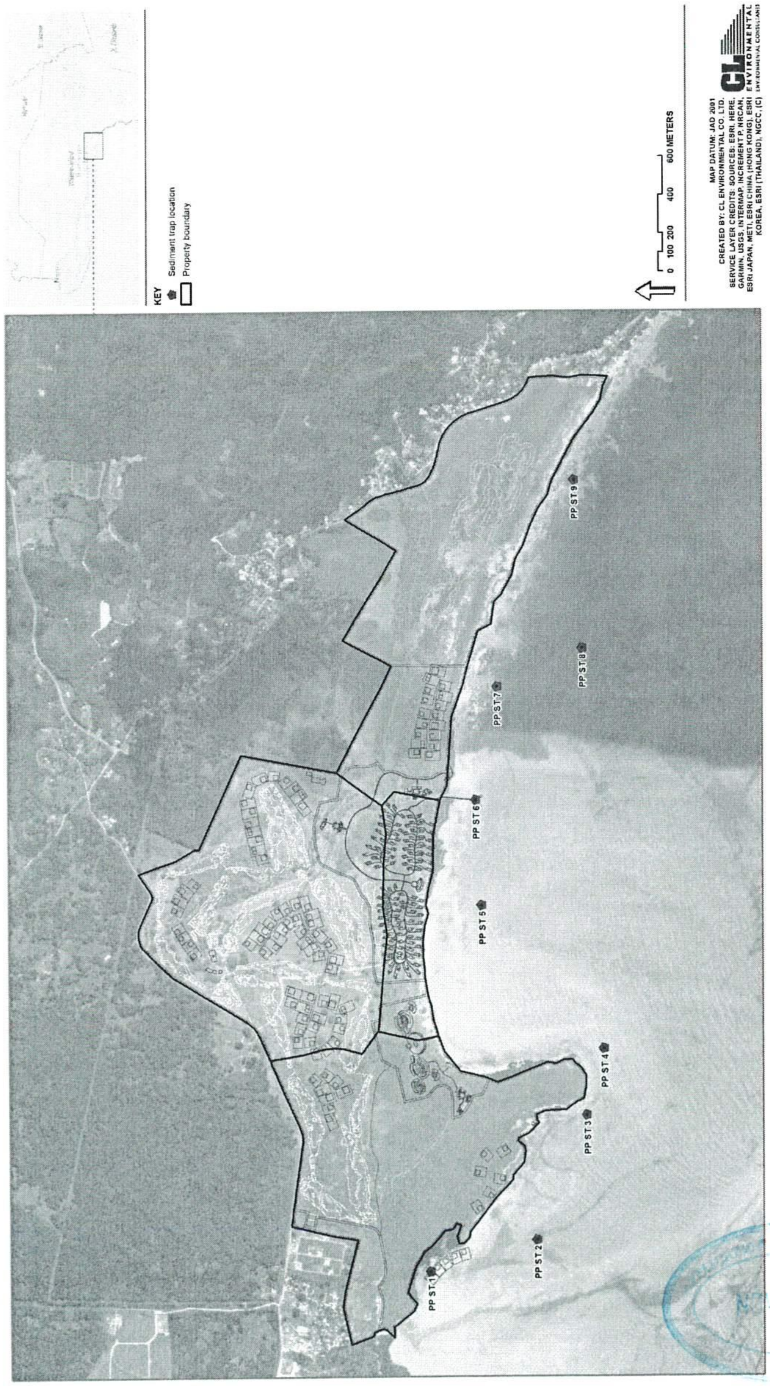

Figure 7 Sediment trap locations at the proposed development site, Paradise Park, Paradise Pen, Westmoreland

TERMS OF REFERENCE FOR AN ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED RESORT DEVELOPMENT AT PARADISE PARK, PARADISE PEN, WESTMORELAND | 15

Figure 8 Noise and particulate station locations at the proposed development site, Paradise Park, Paradise Pen, Westmoreland

Biological Environment

Detailed description of terrestrial and marine habitats, existing vegetation type, detailed floral and faunal surveys inclusive of a species list; commentary on the biodiversity, ecological health and function in the project area, threats and conservation and significance. This should include:

- A qualitative and quantitative assessment of ecologically sensitive terrestrial and marine habitats in and around the proposed project sites and the areas of impact.
- Habitat Map of area.
- Benthic surveys should be conducted with emphasis placed on the working footprint (seafloor) inclusive of temporary access points and buffer zones, which will be impacted by the proposed project structures/features such as coastal protection works, overwater structures, beach nourishment and dredging/excavation.
    - Where practical, the benthic survey should include the size, number and species name of coral colonies within the project footprint.
    - Carbon storage and above and below ground biomass should be calculated for seagrasses in the project area, in suitable sediment types.
- A species list of terrestrial and marine flora and fauna (including but not limited to marine mammals, herpetofauna, avifauna, invertebrates, and bats) should be generated with special emphasis on those species considered rare, threatened, endangered, endemic, protected, invasive and economically or nationally important. Migratory and seasonal species variation should also be assessed/considered.
- Identification and description of the different ecosystem types and structure including species dominance, possible biological loss or habitat fragmentation ought to be considered.
- A detailed assessment of the forested areas should be conducted to include:
    - Tree species and diameter at breast height (DBH) of flora species within the sample area.
    - Vegetation profile.
    - Inventory of epiphytes, of bromeliads and orchids.
- Any crocodile, sea turtle or bird nests observed in or around the project area should be recorded and mapped. This should be supported by information including but not limited to the following; existing sea turtle and bird nesting sites and seasons and habitat usage by migratory species.
- Classification of forested wetland types.
- A detailed assessment of the mangrove ecosystem should be conducted to include:
    - Tree species and numbers within sample area
    - Tree heights(m) for up to 10 of each species present
    - Diameter at breast height (DBH) in cm, for up to 10 of each species present
    - Density of mangrove seedlings within 1 m^2
    - Visible fauna
    - Visible hydrology, including salinity and water level assessment
    - Possible impact of wetland modification activities on surrounding areas
    - Determination of amount of mangrove to be impacted
    - Overall health and appearance and signs of human disturbance. The location of each transect will be recorded using a GPS
    - Carbon storage and above and below ground biomass should be calculated
    - Provision of options suitable to compensate for the unavoidable loss of mangrove trees, including a mangrove monitoring and rehabilitation plan

- Special emphasis must be placed on the hydrology within the mangrove swamp as well as investigating the existing mangrove mortality within the swamp and possible steps to rehabilitate.

- A freshwater assessment should be conducted to include:
  - Baseline assessments of freshwater habitats – streams and rivers- to determine the underlying conditions for the habitat and the surrounding riparian watershed.
  - Assessment of aquatic resources include habitat quality, macroinvertebrate communities, and riparian and in stream vegetation.
  - Ambient water quality including physical and chemical parameters: dissolved oxygen, temperature, TDS, pH, salinity, and conductivity, nitrate, phosphate, Biochemical Oxygen Demand.
  - Identify potential impacts and mitigation for various freshwater habitats in and around the project area.
- Natural Resource Valuation: An Ecosystem Service valuation (ESV) and Natural Resource Valuation (NRV) shall be conducted of the marine and coastal resources within the study site for the proposed development. This should include wetland areas for proposed hotel expansion, site of beach enhancement works and overwater suites.

  There shall be an identification of in situ ecosystem services and where feasible monetary values assigned to them. The study will include but not limited to the following:

  - Economic Valuation of Ecosystem Services using the benefit transfer method
  - Economic Value of Carbon
  - Damage Cost Avoided Approaches
  - Market Based Approaches

  The following tasks shall be conducted:

  - Conduct policy analysis and review of supporting studies for the site and study area (proposed project)
  - Conduct a comprehensive review of the relevant economic valuation literature
  - Based on literature review conduct benefit or value transfer analysis and where possible provide economic value for the key ecosystems (mangroves, seagrasses, coral reefs) associated with the site
  - Provide a discussion of the likely loss in economic value based on negative impacts of development (irreversible habitat loss) associated with proposed activities and suggestions for possible mitigation of the economic costs of the development action

Natural Hazards

Natural Hazards and Disaster Risk Reduction for Climate Change, in relation to:

- Earthquakes
- Hurricane
- Storm surges (coastal flooding)
- Flooding
- Beach Stability
- Karstic Hazards

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The natural hazard risk assessment should take in account climate change projections for return periods of 25, 50 and 100 years.

Socioeconomic Environment

This section should provide details on demography, regional setting, current and potential land-use patterns; description of existing infrastructure such as transportation, electricity, water and telecommunications, and public health and, educational and social services, amenities; should be explored and other material assets of the area should also be examined. This will be done within 10 km of the proposed site.

Traffic Impact Assessment

A Traffic Impact Assessment must also be undertaken. The objectives are to investigate the potential impact of the traffic during construction and during operations on the existing and future main road traffic. For resort development, two signalized intersections to the south of A2 (one main entrance in the centre of the development and a service entrance to the west), and one widened intersection to the south of A2 with road markings for a service entrance in the east. The assessment will involve:

- Meeting with the respective Westmoreland Municipal Corporation and National Works Agency to discuss the project parameters and assumptions that will be made to refine the scope of works required for approval.
- Background Data Collection
    - Existing traffic count data on main road and associated intersection
    - Field/road conditions parameters will be collected for all the relevant roads and intersections.
    - Other developments currently planned within the area.

The data collected will be used to describe the existing conditions at all the selected locations. Comparisons will also be drawn to show what the existing conditions are as opposed to what the standards recommend. Analysis will be conducted to determine the existing Level of Service (LOS) at each intersection as well as on the roads.

The potential impact of project construction and operations on LOS will be determined and recommended mitigation measures provided.

Cultural/Heritage

An assessment of artefacts, archaeological, and paleontological features of the site must be undertaken. The historical importance of the area should also be examined including identification of culturally significant features e.g., archaeological finds. Where there is a need, this should be conducted in collaboration with the Jamaica National Heritage Trust.

6.0 PUBLIC PARTICIPATION

A socio-economic survey to determine public perceptions of the project (both negative and positive) should be completed and this should include but not be limited to potential impacts on social, physical, biological, and historical/cultural values. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires. The methodology for conducting the survey should be included as part of the EIA report. This will be done within 5 km of the proposed site.

Stakeholders to be consulted shall include but not be limited to: Westmoreland Municipal Corporation, National Fisheries Authority, Water Resources Authority, National Works Agency, Ministry of Health and Wellness - Environmental Health Unit, Bluefields Bay Friendly Fisherman Society and any special interest groups.

Describe the public participation methods, timing, type of information provided and collected from public and stakeholder target groups meetings. The instrument used to collect the information must be included in the appendix. It may be useful and necessary to hold stakeholder meetings to inform the public of the proposed development and the possible impacts. This will also gauge the feeling/response of the public toward the development.

The issues identified during the public participation process should be summarized and public input that has been incorporated or addressed in the EIA should be outlined.

Public Meetings should be held in accordance with the Guidelines for Conducting Public Presentation at a time and location signed off by the National Environment and Planning Agency (NEPA). A public meeting will be held to present the findings of the EIA once the EIA is completed and submitted for consideration. All relevant documents are required to be made available to the public. In addition, any material change to the design of the project will require a further public meeting to be undertaken by the developer and all changes made to the document should be clearly outlined to the public.

7.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

Impacts

A detailed analysis of the project components should be done in order to: identify the major potential environmental and public health impacts of the project; distinguish between levels of impact, significance of impact (a ranking from major to minor/significant to insignificant should be developed), positive and negative impacts, duration of impacts (long term or short term or immediate), direct and indirect and impacts, reversible or irreversible, long term and immediate impacts and identify avoidable impacts.

Cumulative impacts should also be evaluated considering previous developments and any proposed development immediately adjacent to the subject development within the area. The identified impacts should be profiled to assess the magnitude of the impacts. The major concerns surrounding environmental and public health issues should be noted and their relative importance to the design of the project and the intended activities indicated.

The extent and quality of the available data should be characterized, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should then be ranked as major, moderate and minor and presented in separate matrices for all the phases of the project (i.e. preconstruction, construction, operational and decommissioning/closure). The potential impacts may be subdivided into Physical Impacts, Biological Impacts and Socio-economic/Cultural Impacts. All impacts should be listed, ranked and assessed, preferably in a single table.

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

Physical Impacts

- Construction activities such as site clearance, earthworks and spoil disposal
- Sediment plume dispersal
- Modification of waves and current patterns
- Water quality
- Geotechnical and engineering requirements
- Spoil Disposal
- Impacts of potential spills (such as oil and chemical spills)
- Drainage
- Solid Waste
- Noise and vibration impacts
- Operation and maintenance – provision of and demand requirements for potable water and electricity, waste disposal, sewage treatment and disposal, communication and other utility requirements
- Water supply and consumption (primarily during the operational phase for maintenance of the golf course)
- Water contamination (with special emphasis on the impacts of herbicides and pesticides primarily during the operational phase for maintenance of the golf course)
- Impacts on aesthetics, landscape and seascape

Biological Impacts

This should include an assessment of the direct and indirect impacts of the project on the ecology of ecologically sensitive coastal marine ecosystems with emphasis being placed on rare, endemic, threatened, protected, endangered, invasive, and economically important species, migratory and seasonal species and the ecological integrity of the adjacent special fisheries conversation area. Other impacts should include:

- Coastal modification and shoreline modification including but not limited sandy and rocky shore ecosystem. The impact of the coastline to the east and west of the project area should be assessed for risk of adverse impacts associated with proposed coastal modification works.
- Removal of seagrass and corals, relocation of seagrass and corals, shading which should be supported by the criterion for relocation site(s) and an assessment of the sites to determine suitability.
- Reef modification
- Assessment on impacts on other marine resources including but not limited to corals and seagrass

An assessment of the direct and indirect impacts of the project on the sensitive ecosystems and communities should also be conducted. This should include but not be limited to:

- Provision of options suitable to compensate for the unavoidable loss, including monitoring and rehabilitation plan
- Determination the total impact area and or number of individuals
- Potential rehabilitation sites and/or other compensation measures

Project impact (land clearance, noise, dust) on other floral and faunal species (birds, herpetofauna, bats etc.) should be explored, with emphasis on impacts on species of importance.

Natural Hazards

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

Socioeconomic/Cultural/Heritage Impacts

Effects on the socio-economic status such as changes to public access and recreational use; impacts on existing and potential economic activities; increased pressure on infrastructure, with special emphasis on the demand for water; traffic impacts; contribution of the development to the national economy; and development of surrounding communities should be examined. Socio-economic and cultural impacts to include prescriptive rights, land use/resource effects, health and safety of the potential workers as well as the residents of the surrounding environs should be described. Public perception as it relates to loss of property value, loss of aesthetic enjoyment among other things should be explored, as well as loss of and damage to artefacts, archaeological and paleontological features.

Mitigation

The mitigation measures should endeavour to avoid, reduce and remedy the potential negative effects while at the same time enhancing the positive impacts projected. Mitigation and abatement measures should be developed for each potential negative impact identified. Full details of the methods proposed to be employed in the implementation of these measures should be provided, including details on the scheduling/timelines, source of materials, location and responsible parties, where appropriate. Maps and diagrams should also be used to illustrate areas where mitigation measures are proposed to be implemented.

This should be represented in a table/matrix outlining the identified impacts and the proposed mitigation measures.

8.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

Alternatives to the proposed development/project including the no-action alternative should be examined. These should be assessed according to the physical, biological and socio-economic parameters of the site. This examination of alternatives should incorporate the use of the history of the overall area in which the site is located and previous uses of the site itself. Alternatives should also address specific aspects of the project such as methods proposed in the execution of the project (works) that have been identified as being causes of major impacts. A rationale for the selection/rejection of any project alternative should be provided.

This section should include at least three (3) alternatives including the No-Action alternative.

9.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Environmental Management Plan

An Environmental Management Plan should be developed which will detail the requirements for the construction and operational phases of the project. This should include, but not be limited to methodology, training for construction and operation staff, recommendations to ensure that the implementation of mitigation measures and long-term minimization of negative impacts. Special emphasis should be placed on the preparation of an outline Coral Management Plan, Seagrass Management and Wetland Management Plan.

Environmental Monitoring Plan

An outline Environmental Monitoring Plan should be included in the EIA. At the minimum the outline monitoring plan should include:

- Introduction outlining the need for a monitoring programme
- The locations selected for monitoring
- The mitigation measures to be implemented and the parameters and activities which will be monitored for each activity
- The proposed methodology to be employed for the monitoring of the various parameter.
- The frequency of the monitoring
- The proposed format that the monitoring reports should take
- The frequency of the submission of the monitoring reports
- The responsible parties for the monitoring

10.0 CONCLUSION AND RECOMMENDATIONS

11.0 LIST OF REFERENCES

12.0 APPENDICES

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

- Composition of the consulting team, team that undertook the study/assessment, including name, qualification and roles of team members
- Reference documents
- Photographs/ maps
- Data Tables
- Terms of Reference
- Notes of Public Consultation sessions
- Instruments used in community surveys

All findings must be presented in the EIA report and must reflect the headings in the body of the TORs, as well as references. GIS references should be provided where applicable.

Two hard copies and an electronic copy must be submitted to NEPA for review after which the Agency will indicate the number of hard copies along with an electronic copy of the report to be submitted. One copy of the document should be perfect bound.

The report should include appendices with items such as maps, site plans, the study team and their individual qualifications, photographs, and other relevant information. All the foregoing should be properly sourced and credited.

Appendix 2 – Study Team

Environmental Consultant

C.L. Environmental Company Limited

- Carlton Campbell, PhD, CIEC (Project Coordinator)
- Matthew Lee, MSc (Noise, Air Quality)
- Rachel D'Silva, BSc (Marine and Benthic Studies)
- Karen McIntyre, MSc, GISP (GIS, Socioeconomics)
- Alec Silvera, B Sc (Water Quality, Marine and Benthic Studies, Marine Benthic Sediments)
- Glen Patrick (Field Technician – Noise, Particulates and Weather)
- Patrick Litchmore (Field Technician – Noise, Particulates and Weather)

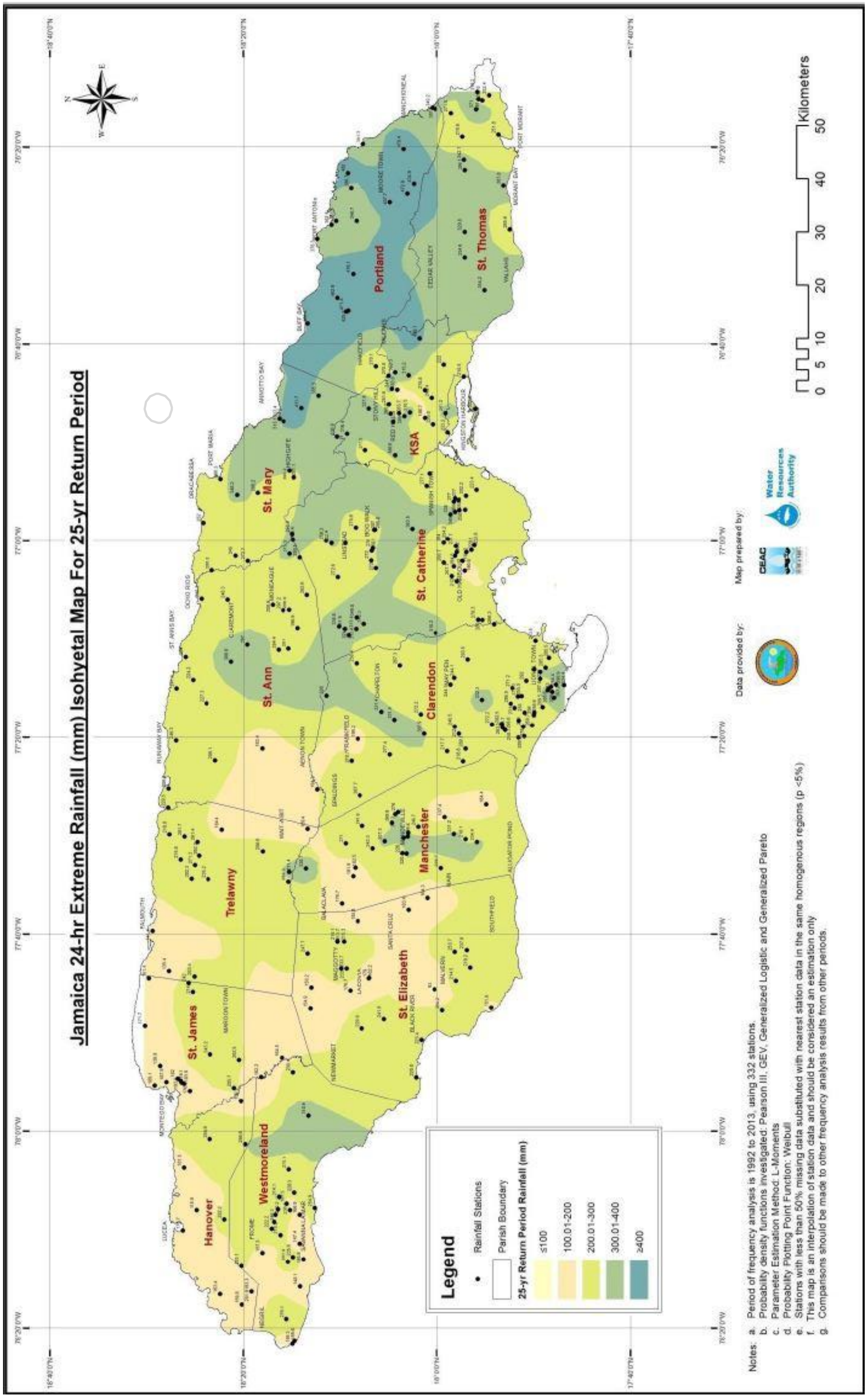
Associate Consultants

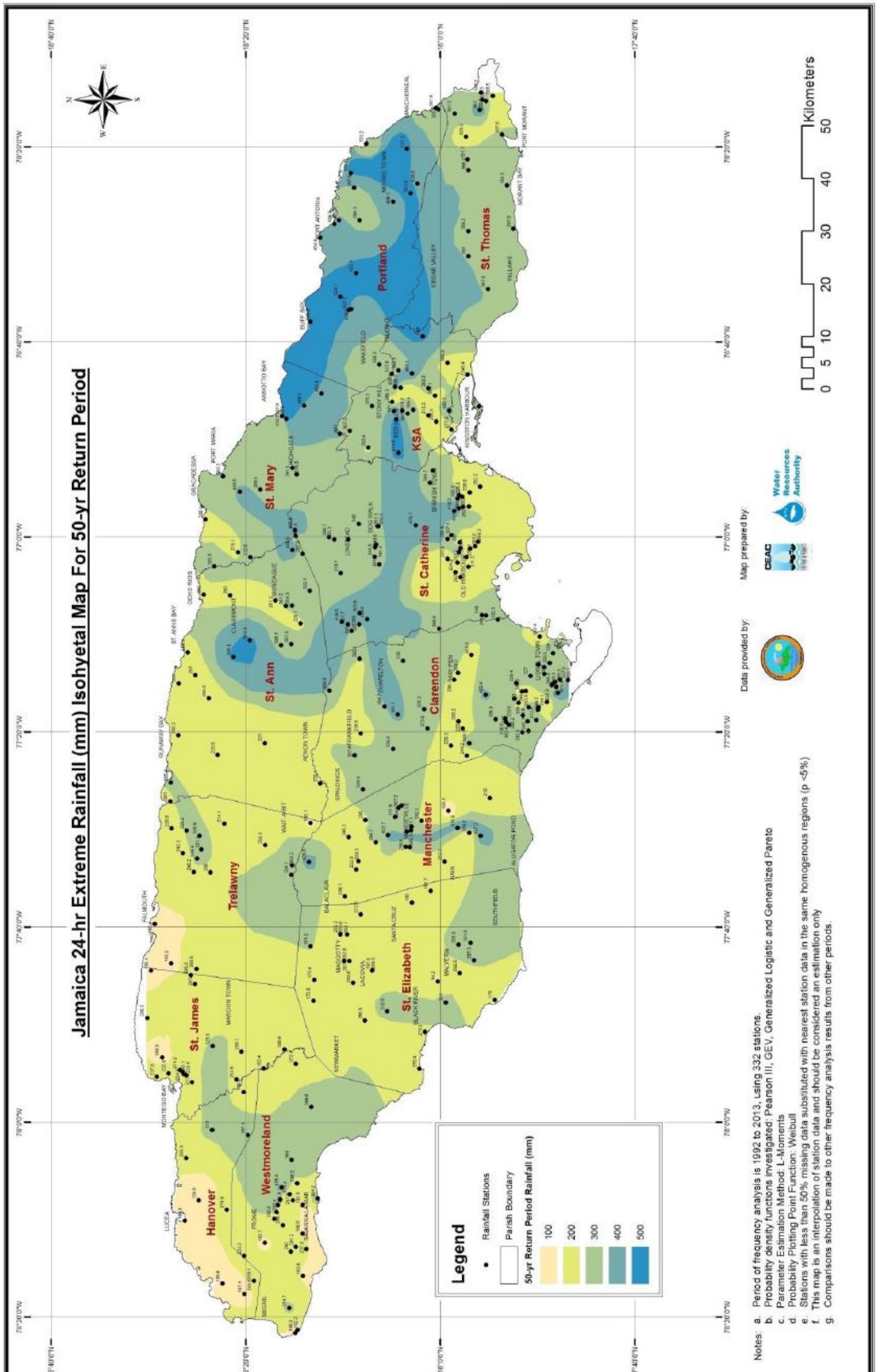
- Marc Rammelaere, MSc (Geomorphology)
- Damion Whyte, PhD candidate (Terrestrial Fauna)
- Adrian Thomas, BSc, MSc (pending) (Terrestrial Flora)
- Keron Campbell, MSc, PhD pending (Terrestrial Flora)
- Camilo Trench, PhD candidate (Wetlands and Mangroves)
- Sacha-Renée Todd, PhD (Freshwater Habitats)
- Gavin Campbell, PhD (Freshwater Habitats)
- Christine Lawson, MPhil (Freshwater Habitats)
- Chauntelle Parkins, BSc, MPhil (pending) (Coral and Fish)
- Le'Anne Green, MSc (Seagrass)
- EcoNexus Consulting Group LLC (Natural Resource Valuation)
- Jannette Manning, MSc (Public Perception Survey)
- Jamaica National Heritage Trust (Archaeological Impact Assessment)

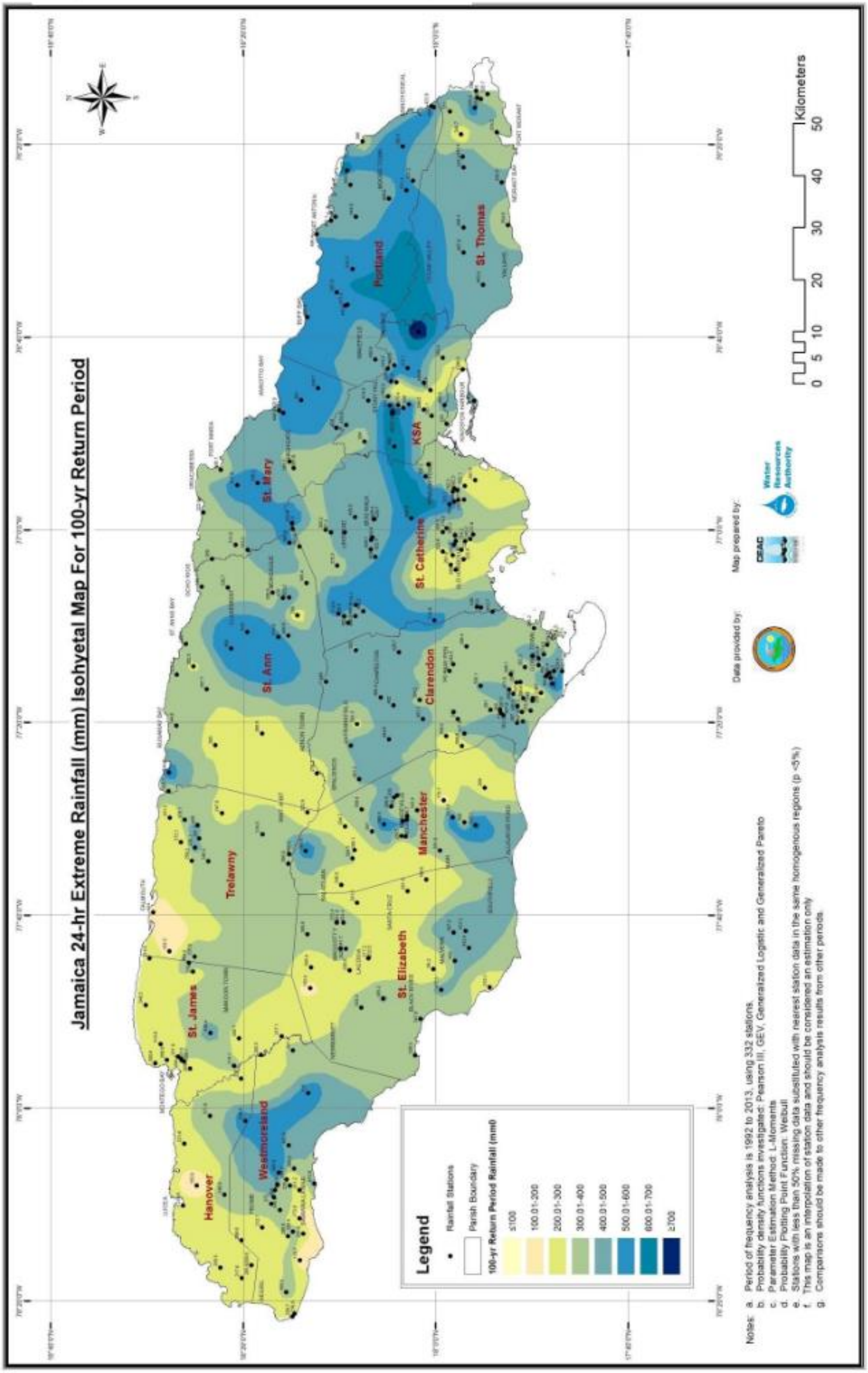
Other Project Consultants

- Design H.Q. Ltd. (Architecture)
- Smith Warner International Limited (Oceanography and Hydrodynamics)
- Premier Land & Water Development Ltd (Drainage and Hydrology)
- Golden Business Consortium and Development Company Limited (GBCD) (Mechanical, Electrical, & Plumbing)
- DCK (Construction Methodology)
- Transmodel (Traffic Impact Assessment)

Appendix 3 – Isohyet Maps (Jamaica)




Jamaica 24-hr Extreme Rainfall (mm) Isohyetal Map For 50-yr Return Period
Legend
Rainfall Stations
Parish Boundary
50-yr Return Period Rainfall (mm)
100
200
300
400
500
Hanover
Westmoreland
St. James
Trelawny
St. Elizabeth
Manchester
St. Ann
Clarendon
St. Catherine
St. Mary
KSA
Portland
St. Thomas
Kilometers
0 5 10 20 30 40 50
Data provided by:
Map prepared by:
Water Resources Authority
Notes: a. Period of frequency analysis is 1992 to 2013, using 332 stations.
b. Probability density functions investigated: Pearson III, GEV, Generalized Logistic and Generalized Pareto
c. Parameter Estimation Method: L-Moments
d. Probability Plotting Point Function: Weibull
e. Stations with less than 50% missing data substituted with nearest station data in the same homogenous regions (p <5%)
f. This map is an interpolation of station data and should be considered an estimation only
g. Comparisons should be made to other frequency analysis results from other periods.


Jamaica 24-hr Extreme Rainfall (mm) Isohyetal Map For 100-yr Return Period
Hanover
Westmoreland
St. James
Trelawny
St. Elizabeth
Manchester
St. Ann
Clarendon
St. Catherine
St. Mary
KSA
Portland
St. Thomas
Legend
Rainfall Stations
Parish Boundary
100-yr Return Period Rainfall (mm)
≤100
100.01-200
200.01-300
300.01-400
400.01-500
500.01-600
600.01-700
≥700
Data provided by:
Map prepared by:
Water Resources Authority
0 5 10 20 30 40 50
Kilometers
Notes:
a. Period of frequency analysis is 1992 to 2013, using 332 stations.
b. Probability density functions investigated: Pearson III, GEV, Generalized Logistic and Generalized Pareto
c. Parameter Estimation Method: L-Moments
d. Probability Plotting Point Function: Weibull
e. Stations with less than 50% missing data substituted with nearest station data in the same homogenous regions (p <5%)
f. This map is an interpolation of station data and should be considered an estimation only
g. Comparisons should be made to other frequency analysis results from other periods.

Appendix 4 – Hydrolab Calibration Certificates

2023-2024

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OTT HydroMet

Section A: **Series 5, and 5x Sonde Functional Test Data Sheet**

Work Order # WO-01261722	Customer CL Environmental	Date Started 05/06/22
Housing Serial # 100100048757	Embedded Serial# 48757	Additional Driver Firmware:
Technician Phillip Druyor	Model: **Datasonde** ✓ 5 ✓ **Minisonde** 5x	Depth100 2.13 PAR 1.02 Turbidity 3.21 LDO 3.07

Customer Display Information

I/D N/A	DOM 011510	Baud Rate 19200	Security 2	SDI N/A	TTY
Parameter	Time	Temp	pH	SpCond	ORP
Units	HH:MM:SS	°C	Units	mS/cm	mV
Parameter	Dep100	PAR	TurbSC	LDO%	LDO
Units	meters	µE/s/m²	NTU	Sat	mg/l

For Sonde with Depth – Coefficients

A: -4230.0	B: 14300.0	C: 16.8	D: -16000.0
E: -0.0101	F: -6.03	G: 6000.0	H: 3.44E-05
I: 0.008519	J: 3.37	SER: 0.0	

FLUOROMETER OFFSETS

1ST N/A	X10: N/A	X1: N/A
2ND N/A	X10: N/A	X1: N/A

For Sonde with TDG or PAR – Coefficients

A: -220.98	**B:** -220.98	**C:** N/A	**D:** N/A
Local: N/A	Ref: N/A		

Performance, Test and Evaluation

Current MPL Rev-- 5.44 Upgrade to MPL Rev--	pH Electrolyte & Teflon Junction Replaced- Yes ✓ No NA	DO membrane Replaced Yes No NA ✓
Sensors cleaned –Yes ✓	RTC Battery Replaced Yes ✓ No	Desiccant Replaced –Yes ✓ No

Section B:

	Submission 1 Day 1	Submission Day
Customer Observations Verified / Customer Request	Y ✓ N N/A PT&E ✓ Upgrade	Y N N/A PT&E Upgrade
Set Time and Date	Yes ✓	Yes
Verified all hardware updates as current	Yes ✓	Yes
Total current draw. (Check all that apply) MPL PCB 40mA ✓ SC Turbidity 20mA ✓ LDO 80mA ✓ 4Beam Turbidity 10mA Flourometers: 1st 30mA 2nd 30mA 3rd 30mA PAR 10mA ✓ (Optimal Values not to exceed +20mA overall.)	140	
Current draw of circulator. (20 mA max. beyond previous values.)	N/A	
Operation of self-cleaning motor verified—	P ✓ F NA	P F NA
Audio functions correctly	P ✓ F	P F
RTC sleep/wake-up test.	P ✓ F	P F

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Additional Notes:

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Temp probe test at room temperature. 20.00 ° C (+/- 0.1)	Sonde Temp : 20.01 ° C	Sonde Temp : ° C
DO 100% sat integrity window verified at +50 mmHg over current bp. (Clark Cell only)	P F NA ✓	P F NA
DO 100% saturation calibration verified - local BP (+/- 0.2 mg/L Clark Cell) (+/- 0.1mg/L LDO)	Temp : 21.90 BP : 630.25 mg/L : 7.22 Drift +/- :	Temp : BP : mg/L : Drift +/- :
Scale Factor (0.7 -- 1.3) LDO Only	1.11066	
Conductivity zero (air) calibration verified - (+/-.005mS)	0.0000	
Conductivity calibration verified – ✓ 1.412 mS/cm (± .04 mS) 12.856 mS/cm (± .2 mS) 47.6 mS/cm (± .2 mS)	1.412	
Conductivity linearity verified – .100 mS/cm (± .005 mS) ✓ .500 mS/cm (± .025 mS)	.505	
pH 7 buffer calibration verified– (+/- .2 pH)	7.00	
pH slope calibration verified at 10.01 units.	10.02	
ORP calibration verified at 21.63 ° C (+/- 20 mV)	435	
Turbidity - Calibration accepted & verified with DI Water (0.0 +/- 0.7 NTU)	0.0	
Turbidity - Calibration accepted & verified at (100.0 +/- 1 NTU) with Hach StablCal	99.9	
Turbidity - Linearity verified with 40 NTU Hach StablCal – (+/- 4 NTU)	40.3	
Depth zero calibration verified – (.02 meters)	0.00	
Depth Check verified – (+/- 0.03 meters) Tank depth: 0.685	0.69	

Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A

N03- calibration verified	P F NA ✓	P F NA
NH4+ calibration verified	P F NA ✓	P F NA
Cl- calibration verified	P F NA ✓	P F NA
Chlorophyll 'a' calibration verified	P F NA ✓	P F NA
Rhodamine 'wt' calibration verified	P F NA ✓	P F NA
Blue-green Algae calibration verified	P F NA ✓	P F NA
PAR calibration verified	P ✓ F NA	P F NA
TDG calibration verified (+/- 2 mmHg)	P F NA ✓	P F NA
Logging/Sensor Stability Test	P ✓ F	P F
pH linearity verified at 4.01 units. (+/- 0.20 units)	4.02	
Battery pack setup and checked	P ✓ F NA	P F NA

Display, Baud Rate, Communications mode settings returned as received.	Yes ✓ No

Calibrated Test Equipment Used – Description **X-number**

Power Supply BK Precision 1617A	X- 8954
Fluke 1524 -- Reference Thermometer	X- 8244
DVM Digital Multimeter	X- 001765

Section C. Final Check-off Prior to Submitting for Estimate

Exterior is clean ✓ **Clear** pH 4 Buffer in storage cup ✓	Hach Business System updated ✓ Date Completed 05/09/22

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2024-2025

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OTT HydroMet

Section A: **Series 5, and 5x Sonde Functional Test Data Sheet**

Work Order # WO-01546549	Customer CL Environmental	Date Started 7/31/24
Housing Serial # 100100048757	Embedded Serial# 48757	Additional Driver Firmware:
Technician Phillip Druyor	Model: **Datasonde** ✓ **Minisonde** 5 ✓ 5x	Depth100 2.13, PAR 1.02, Turbidity 3.21, LDO 3.73

Customer Display Information

I/D N/A	DOM 011010	Baud Rate 19200	Security 2	SDI N/A	TTY
Parameter	Time	Temp	pH	SpCond	ORP
Units	HH:SS:MM	°C	Units	mS/cm	mV
Parameter	LDO%	LDO	TurbSC	PAR	
Units	Sat	mg/l	NTU	µE/s/m²	

For Sonde with Depth – Coefficients

A: -4230.0	B: 14300.0	C: 16.8	D: -16000.0
E: -0.0101	F: -6.03	G: 6000.0	H: 3.44E-05
I: 0.008519	J: 3.37	SER: 0.0	

FLUOROMETER OFFSETS

1ST N/A	X10: N/A	X1: N/A
2ND N/A	X10: N/A	X1: N/A

For Sonde with TDG or PAR – Coefficients

A: -220.98	**B:** -220.98	**C:** N/A	**D:** N/A
Local: N/A	Ref: N/A		

Performance, Test and Evaluation

Current MPL Rev-- 5.44 Upgrade to MPL Rev--	pH Electrolyte & Teflon Junction Replaced- Yes ✓ No NA	DO membrane Replaced Yes No NA ✓
Sensors cleaned –Yes ✓	RTC Battery Replaced Yes ✓ No	Desiccant Replaced –Yes ✓ No

Section B:

	Submission 1 Day 1	Submission Day
Customer Observations Verified / Customer Request	Y ✓ N N/A PT&E ✓ Upgrade	Y N N/A PT&E Upgrade
Set Time and Date	Yes ✓	Yes
Verified all hardware updates as current	Yes ✓	Yes
Total current draw. (Check all that apply) MPL PCB 40mA ✓ SC Turbidity 20mA ✓ LDO 80mA ✓ 4Beam Turbidity 10mA Flourometers: 1st 30mA 2nd 30mA 3rd 30mA PAR 10mA ✓ (Optimal Values not to exceed +20mA overall.)	140	
Current draw of circulator. (20 mA max. beyond previous values.)	N/A	
Operation of self-cleaning motor verified—	P ✓ F NA	P F NA
Audio functions correctly	P ✓ F	P F
RTC sleep/wake-up test.	P ✓ F	P F

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Additional Notes:

DATE: 10-2-12	DOCUMENT #: 19005-00-Tech_Series5_Instruc
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Temp probe test at room temperature. 20.00 ° C (+/- 0.1)	Sonde Temp : 20.03 ° C	Sonde Temp : ° C
DO 100% sat integrity window verified at +50 mmHg over current bp. (Clark Cell only)	P F NA ✓	P F NA
DO 100% saturation calibration verified - local BP (+/- 0.2 mg/L Clark Cell) (+/- 0.1mg/L LDO)	Temp : 20.69 BP : 635.10 mg/L : 7.45 Drift +/- :	Temp : BP : mg/L : Drift +/- :
Scale Factor (0.7 -- 1.3) LDO Only	1.137811	
Conductivity zero (air) calibration verified - (+/-.005mS)	0.0000	
Conductivity calibration verified – ✓ 1.412 mS/cm (± .04 mS) 12.856 mS/cm (± .2 mS) 47.6 mS/cm (± .2 mS)	1.413	
Conductivity linearity verified – .100 mS/cm (± .005 mS) ✓ .500 mS/cm (± .025 mS)	.498	
pH 7 buffer calibration verified– (+/- .2 pH)	7.00	
pH slope calibration verified at 10.01 units.	10.01	
ORP calibration verified at 21.26 ° C (+/- 20 mV)	436	
Turbidity - Calibration accepted & verified with DI Water (0.0 +/- 0.7 NTU)	0.0	
Turbidity - Calibration accepted & verified at (100.0 +/- 1 NTU) with Hach StablCal	99.8	
Turbidity - Linearity verified with 40 NTU Hach StablCal – (+/- 4 NTU)	39.7	
Depth zero calibration verified – (.02 meters)	0.0	
Depth Check verified – (+/- 0.03 meters) Tank depth: 0.685	0.68	

Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A	Specific Ion N/A Low C N/A High C N/A mV N/A mV N/A

N03- calibration verified	P F NA ✓	P F NA
NH4+ calibration verified	P F NA ✓	P F NA
Cl- calibration verified	P F NA ✓	P F NA
Chlorophyll 'a' calibration verified	P F NA ✓	P F NA
Rhodamine 'wt' calibration verified	P F NA ✓	P F NA
Blue-green Algae calibration verified	P F NA ✓	P F NA
PAR calibration verified	P ✓ F NA	P F NA
TDG calibration verified (+/- 2 mmHg)	P F NA ✓	P F NA
Logging/Sensor Stability Test	P ✓ F	P F
pH linearity verified at 4.01 units. (+/- 0.20 units)	3.97	
Battery pack setup and checked	P ✓ F NA	P F NA

Display, Baud Rate, Communications mode settings returned as received.	Yes ✓ No

Calibrated Test Equipment Used – Description	X-number
Power Supply BK Precision 1617A	X- 8954
Fluke 1524 -- Reference Thermometer	X- 8244
DVM Digital Multimeter	X- 001765

Section C. Final Check-off Prior to Submitting for Estimate

Exterior is clean ✓	Hach Business System updated ✓
Clear pH 4 Buffer in storage cup ✓	Date Completed 8/15/24

DATE: 4/1	DOCUMENT #: 19005-00-Tech_Series5_Instruc
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OTT HydroMet

Section A: **Series 5, and 5x Sonde Functional Test Data Sheet**

Work Order # 01608041	Customer CL ENVIRONMENTAL	Date Started 12/19/2024
Housing Serial # 100100048757	Embedded Serial# 48757	Additional Driver Firmware:
Technician Ross Bruner	Model: Datasonde ✔ 5 ✔ / Minisonde 5x	Depth100 2.13; PAR 1.02; Turbidity 3.21; LDO 3.73

Customer Display Information

I/D n/a	DOM 1/10/2010	Baud Rate 19200	Security 2	SDI 0	TTY
Parameter	Time	Temp	pH	SpCond	ORP
Units	HH:MM:SS	°C	Units	mS/cm	mV
Parameter	LDO%	LDO	TurbSC	PAR	Dep100
Units	Sat	mg/l	NTU	µE/s/m²	meters

For Sonde with Depth – Coefficients

A:	-4.23E3	B:	1.43E4	C:	16.799999	D:	-1.6E4
E:	-0.0101	F:	-6.03	G:	6E3	H:	3.44E-5
I:	0.008519	J:	3.37	SER:	0		

FLUOROMETER OFFSETS

1ST	N/A	X10:	N/A	X1:	N/A
2ND	N/A	X10:	N/A	X1:	N/A

For Sonde with TDG or PAR – Coefficients

A:	-220.979996	B:	-220.979996	C:		D:	
Local:		Ref:					

Performance, Test and Evaluation

Current MPL Rev-- 5.44 Upgrade to MPL Rev-- N/A	pH Electrolyte & Teflon Junction Replaced- Yes ✔ No NA	DO membrane Replaced Yes No NA ✔
Sensors cleaned –Yes ✔	RTC Battery Replaced Yes ✔ No	Desiccant Replaced –Yes ✔ No

Section B:

	Submission 1 Day 1	Submission Day
Customer Observations Verified / Customer Request	Y ✔ N N/A PT&E ✔ Upgrade ✔	Y N N/A PT&E Upgrade
Set Time and Date	Yes ✔	Yes
Verified all hardware updates as current	Yes ✔	Yes
Total current draw. (Check all that apply) MPL PCB 40mA SC Turbidity 20mA LDO 80mA 4Beam Turbidity 10mA Flourometers: 1st 30mA 2nd 30mA 3rd 30mA PAR 10mA (Optimal Values not to exceed +20mA overall.)	140mA	
Current draw of circulator. (20 mA max. beyond previous values.)	N/A	
Operation of self-cleaning motor verified—	P ✔ F NA	P F NA
Audio functions correctly	P ✔ F	P F
RTC sleep/wake-up test.	P ✔ F	P F

1
19005-00-Tech_Series5_Instruc
Rev 1

Additional Notes:

DATE: 10-2-12	DOCUMENT #: 19005-00-Tech_Series5_Instruc
PAGE: 2 OF 2	REVISION: 1

Temp probe test at room temperature. 20.00 ° C (+/- 0.1)	Sonde Temp : 20.01 ° C	Sonde Temp : ° C
DO 100% sat integrity window verified at +50 mmHg over current bp. (Clark Cell only)	P F NA ✔	P F NA
DO 100% saturation calibration verified - local BP (+/- 0.2 mg/L Clark Cell) (+/- 0.1mg/L LDO)	Temp : 21.19 BP : 640 mg/L : 7.4 Drift +/- : .002	Temp : BP : mg/L : Drift +/- :
Scale Factor (0.7 -- 1.3) LDO Only	1.163157	
Conductivity zero (air) calibration verified - (+/-.005mS)	.0000	
Conductivity calibration verified – ✔ 1.412 mS/cm (± .04 mS) 12.856 mS/cm (± .2 mS) 47.6 mS/cm (± .2 mS)	1.412	
Conductivity linearity verified – .100 mS/cm (± .005 mS) ✔ .500 mS/cm (± .025 mS)	.508	
pH 7 buffer calibration verified– (+/- .2 pH)	7.00	
pH slope calibration verified at 10.01 units.	10.02	
ORP calibration verified at 21.36 ° C (+/- 20 mV)	436	
Turbidity - Calibration accepted & verified with DI Water (0.0 +/- 0.7 NTU)	0.0	
Turbidity - Calibration accepted & verified at (100.0 +/- 1 NTU) with Hach StablCal	100.0	
Turbidity - Linearity verified with 40 NTU Hach StablCal – (+/- 4 NTU)	40.2	
Depth zero calibration verified – (.02 meters)	0.00	
Depth Check verified – (+/- 0.03 meters) Tank depth: 0.685	0.68	

Specific Ion N/A Low C mV N/A N/A High C mV N/A N/A	Specific Ion N/A Low C mV N/A N/A High C mV N/A N/A	Specific Ion N/A Low C mV N/A N/A High C mV N/A N/A

N03- calibration verified	P F NA ✔	P F NA
NH4+ calibration verified	P F NA ✔	P F NA
Cl- calibration verified	P F NA ✔	P F NA
Chlorophyll 'a' calibration verified	P F NA ✔	P F NA
Rhodamine 'wt' calibration verified	P F NA ✔	P F NA
Blue-green Algae calibration verified	P F NA ✔	P F NA
PAR calibration verified	P ✔ F NA	P F NA
TDG calibration verified (+/- 2 mmHg)	P F NA ✔	P F NA
Logging/Sensor Stability Test	P ✔ F	P F
pH linearity verified at 4.01 units. (+/- 0.20 units)	3.96	
Battery pack setup and checked	P ✔ F NA	P F NA
Display, Baud Rate, Communications mode settings returned as received.	Yes ✔ No	

Calibrated Test Equipment Used – Description	X-number
Power Supply BK Precision 1617A	X- 8954
Fluke 1524 -- Reference Thermometer	X- 8244
DVM Digital Multimeter	X- 001765

Section C. Final Check-off Prior to Submitting for Estimate

Exterior is clean ✔	Hach Business System updated ✔
Clear pH 4 Buffer in storage cup ✔	Date Completed 12/30/2024

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19005-00-Tech_Series5_Instruc
Rev 1

Appendix 5 – Laboratory Water Quality Results

1 - June 2023

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-06-22

July 06, 2023

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: June 22, 2023

Date Received: June 22, 2023

Number of Samples: 22

Type of Material: Marine

Date Tested: June 22-July 03, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	3.84	15.64	11.76	14.76	10.62	10.84	9.57	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	0.3	1.0	1.0	0.7	0.4	2.1	0.7	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.11	0.16	0.13	0.19	0.20	0.14	0.05	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	8	14	11	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.8	5400	1300	3500	1700	2200	9200	11	<2-13

1

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-06-22

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	12.74	12.18	11.46	7.20	5.88	9.30	13.02	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.4	2.1	2.1	2.2	2.4	1.5	1.2	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.19	0.07	0.04	0.05	0.05	0.05	0.17	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	11	37	61	18	490	210	330	<2-13

2

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-06-22

Parameters	Unit	Method	Detection Limit	PP 16	PP 17	PP 18	PP 21	PP 22	PP 23	PP 24	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	8.52	18.70	9.30	8.49	4.92	8.46	16.54	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.5	0.5	0.6	2.3	1.7	2.3	0.3	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.06	0.69	0.91	0.04	0.05	0.03	0.12	0.001-0.003
TSS	mg/L	HACH 8006	5.0	6	553	569	<5	<5	<5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	3500	16000	5400	11	11	18	2400	<2-13

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

CETMS Ltd. does not accept responsibility for any deviations in results if:
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ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested
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3

2 - August 2023

PP 2023-08-10

August 30, 2023

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: August 10, 2023

Date Received: August 10, 2023

Number of Samples: 25

Type of Material: Marine

Date Tested: August 10-22, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	3.94	4.38	5.97	5.19	5.20	5.46	5.38	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	0.50	1.0	1.0	3.3	0.9	1.5	2.9	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	1.21	0.23	0.19	0.21	0.11	0.04	0.19	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	17	<5	<5	<5	17	6	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.8	3500	1100	2800	1400	2100	5400	36	<2-13

1

PP 2023-08-10

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	PP 15	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	5.25	6.60	2.55	4.90	5.43	4.65	5.58	4.53	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.3	2.6	2.3	2.6	1.8	2.0	0.4	2.4	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.05	0.03	0.04	0.05	0.04	0.02	0.07	0.07	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	<5	<5	5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	11	36	40	18	470	170	260	480	<2-13

2

PP 2023-08-10

Parameters	Unit	Method	Detection Limit	PP 16	PP 17	PP 18	PP 19	PP 20	PP 21	PP 22	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	4.74	8.61	9.30	7.47	4.92	4.74	5.85	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.7	0.4	0.1	2.9	0.8	3.1	1.7	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.07	1.32	0.79	0.19	0.35	0.09	0.12	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	18	19	<5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	3500	9200	3500	36	37	18	2300	<2-13

3

PP 2023-08-10

Parameters	Unit	Method	Detection Limit	PP 23	PP 24	PP 25	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	5.13	5.61	6.27	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	1.8	0.8	1.6	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.04	0.12	0.18	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	2800	5400	4300	<2-13

4

PP 2023-08-10

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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3 - October 2023

CLE 2310ET1467_etc,shr (completed) PP1-25

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Hope Gardens, P.O. Box 28, Kingston 6
Telephone: (876) 927-1944 Email: etaslimited1093@gmail.com

Water and Wastewater Report Sheet, Page 1 of 3

REF. #:2310ET1467-1490 **ATTENTION:** Mr. Matthew Lee

COMPANY	C. L. Environmental Co. Ltd.		MEANS OF CONTRACT	Written
DATE RECEIVED	October 19, 2023		DATE REPORTED	October 27, 2023
NO. OF SAMPLES	Twenty-Four (24)		SAMPLE VOLUME	Approx. 2L
STARTED	October 19, 2023		SAMPLE TYPE	Marine, Brackish, Fresh, River& Gulley Water

Reference Number	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2310ET1467	PP1	1.2	
2310ET1468	PP2	1.0	
2310ET1469	PP3	0.9	
2310ET1470	PP4	0.8	
2310ET1471	PP5	0.8	
2310ET1472	PP6	0.9	
2310ET1473	PP7	1.1	
2310ET1474	PP8	0.5	
2310ET1475	PP9	0.5	
2310ET1476	PP10	0.7	
2310ET1477	PP11	0.8	
2310ET1478	PP12	0.5	

CLE 2310ET1467_etc,shr (completed) PP1-25

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Water and Wastewater Report Sheet, Page 2 of 3

REF. #: 2310ET1467-1490 **ATTENTION:** Mr. Matthew Lee

Reference Number	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2310ET1479	PP13	0.2	
2310ET1480	PP14	0.9	
2310ET1481	PP15	0.6	
2310ET1482	PP16	0.6	
2310ET1483	PP17	16.8	
2310ET1484	PP18	15.0	
2310ET1485	PP20	5.6	
2310ET1486	PP21	0.4	
2310ET1487	PP22	0.4	
2310ET1488	PP23	0.6	
2310ET1489	PP24	1.0	
2310ET1490	PP25	0.5	

R11	DATE SAMPLED	October 19, 2023		TIME SAMPLED	7:30 AM – 10:30 AM
R11	DATE RECEIVED	October 19, 2023		TIME RECEIVED	4:50 PM
R11	DATE STARTED	October 19, 2023		TIME STARTED	4:50 PM

CLE 2310ET1467_etc,shr (completed) PP1-25

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Water and Wastewater Report Sheet, Page 3 of 3

REF. #: 2310ET1467-1490 **ATTENTION:** Mr. Matthew Lee

Parameter	Test Method	Detection Limit	Range
BOD_5, mg/L D. O.	Dilution Method adapted from HACH Method 8043 **and** Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005 (SMEWW) Method 5210.	(Method 1a) Sample unseeded & diluted: 2 mg/L **X** Dilution Factor [NOTE: Dilution Factor = "Total Volume" divided by "Sample Volume."] (Method 1b) Sample unseeded & undiluted: Approx 0.1 mg/L	

Certified By: ....
Kamara Beckford, Quality Manager

Certified By: ....
Chinell Francis, Laboratory Analyst

Form ET2

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-10-19

November 7, 2023

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: October 19, 2023

Date Received: October 19, 2023

Number of Samples: 24

Type of Material: Marine

Date Tested: October 19-31, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	1.1	1.8	1.2	1.4	1.1	2.2	2.6	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.67	0.50	0.86	0.21	0.16	0.06	0.65	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	29	12	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.8	2800	1200	2200	1400	1700	3500	56	<2-13

1

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-10-19

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	PP 15	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	2.6	1.7	1.9	2.4	2.5	2.7	1.1	2.5	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.16	0.26	0.04	0.05	0.16	0.31	0.56	0.14	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	<5	8	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	22	56	60	40	480	210	260	480	<2-13

Parameters	Unit	Method	Detection Limit	PP 16	PP 17	PP 18	PP 20	PP 21	PP 22	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	3.4	0.8	0.9	0.7	2.1	1.9	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.26	1.42	0.13	0.37	0.26	0.07	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	9	104	52	<5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	3500	5400	3500	40	36	2200	<2-13

2

caribbean environmental TESTING & MONITORING SERVICES LTD.

PP 2023-10-19

Parameters	Unit	Method	Detection Limit	PP 23	PP 24	PP 25	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	2.1	0.5	1.2	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.08	0.39	0.21	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	42	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	2800	4300	3500	<2-13

3

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-10-19

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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i. Samples are not collected and handled in accordance with the Ministry of Health, Environmental Health Unit, Sampling and Field Measurements Protocol (January 2015)
ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested

4 – November 2023

CLE 2311ET1661_etc,slr (completed) PP1-25

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Hope Gardens, P.O. Box 28, Kingston 6
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Water and Wastewater Report Sheet, Page 1 of 3

REF. #:2311ET1661-1685 **ATTENTION:** Mr. Matthew Lee

COMPANY	C. L. Environmental Co. Ltd.	MEANS OF CONTRACT	Written
DATE RECEIVED	November 24, 2023	DATE REPORTED	December 6, 2023
NO. OF SAMPLES	Twenty-Five (25)	SAMPLE VOLUME	Approx. 2L
STARTED	November 24, 2023	SAMPLE TYPE	Marine, Brackish, Fresh Water

NOTE: -	Please see R11

Reference Number	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2311ET1661	PP1	0.5	
2311ET1662	PP2	0.3	
2311ET1663	PP3	0.2	
2311ET1664	PP4	0.3	
2311ET1665	PP5	0.5	
2311ET1666	PP6	0.5	
2311ET1667	PP7	0.5	
2311ET1668	PP8	0.2	
2311ET1669	PP9	0.5	
2311ET1670	PP10	0.4	
2311ET1671	PP11	1.1	
2311ET1672	PP12	0.7	

CLE 2311ET1661_etc,shr (completed) PP1-25

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Water and Wastewater Report Sheet, Page 2 of 3

REF. #: 2311ET1661-1685 **ATTENTION:** Mr. Matthew Lee

Reference Number	Sample Name	Parameter	Remarks
- - -	- - -	BOD_5, mg/L D. O.	- - -
2311ET1673	PP13	0.4	
2311ET1674	PP14	2.2	
2311ET1675	PP15	<0.0	
2311ET1676	PP16	0.4	
2311ET1677	PP17	15.3	
2311ET1678	PP18	6.6	
2311ET1679	PP19	1.1	
2311ET1680	PP20	2.0	
2311ET1681	PP21	0.5	
2311ET1682	PP22	1.0	
2311ET1683	PP23	0.7	
2311ET1684	PP24	1.1	
2311ET1685	PP25	0.8	

CLE 2311ET1661 _etc,shr (completed) PP1-25

ENVIRONMENTAL, TECHNICAL AND ANALYTICAL SERVICES LIMITED
Hope Gardens, P.O. Box 28, Kingston 6
Telephone: (876) 876927-1944 / 876-616-2723
Email: etaslimited1093@gmail.com

Water and Wastewater Report Sheet, Page 3 of 3

REF. #:2311ET1661-1685 **ATTENTION:** Mr. Matthew Lee

R11	DATE SAMPLED	November 24, 2023		TIME SAMPLED	-----
R11	DATE RECEIVED	November 24, 2023		TIME RECEIVED	4:53 PM
R11	DATE STARTED	November 24, 2023		TIME STARTED	4:53 PM

Parameter	Test Method	Detection Limit	Range
BOD_5, mg/L D. O.	Dilution Method adapted from HACH Method 8043 **and** Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005 (SMEWW) Method 5210.	(Method 1b) Sample unseeded & undiluted: Approx 0.1 mg/L (Method 1d) Sample Seeded and Undiluted: 0 mg/L	

Certified By: .... Kamara Beckford, Quality Manager

Certified By: .... Chinell Francis, Laboratory Analyst

Form ET2

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-11-24

December 15, 2023

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: November 24, 2023

Date Received: November 24, 2023

Number of Samples: 25

Type of Material: Marine

Date Tested: November 24- December 01, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	0.8	2.5	1.0	0.7	0.8	1.2	1.6	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.71	0.88	0.22	0.21	0.22	0.03	0.06	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	<5	<5	30	20	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.8	2800	1200	2200	1100	1700	3500	36	<2-13

1

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TESTING & MONITORING SERVICES LTD.

PP 2023-11-24

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	PP 15	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	2.7	1.6	2.3	1.9	2.1	2.0	1.1	2.2	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.33	0.04	2.30	0.26	1.13	0.96	0.39	1.13	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	5	<5	<5	8	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	11	22	36	11	320	110	260	270	<2-13

Parameters	Unit	Method	Detection Limit	PP 16	PP 17	PP 18	PP 19	PP 20	PP 21	PP 22	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	1.4	0.5	0.6	3.9	0.8	1.8	2.1	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.96	0.39	0.13	0.25	0.22	0.40	0.06	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	12	73	41	32	<5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	2800	5400	2800	36	22	18	1700	<2-13

2

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-11-24

Parameters	Unit	Method	Detection Limit	PP 23	PP 24	PP 25	NRCA Standard
Nitrates	Mg/L	HACH 8039	0.03	2.0	0.6	1.0	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.25	0.41	0.19	0.001-0.003
TSS	mg/L	HACH 8006	5.0	<5	<5	<5	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	1700	3500	3500	<2-13

3

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2023-11-24

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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4

5 - September 2024

PP 2024-09-27

October 11, 2024

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: September 27, 2024

Date Received: September 27, 2024

Number of Samples: 25

Type of Material: Marine

Date Tested: September 27-October 08, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	2.93	1.95	2.85	2.88	2.85	2.55	2.43	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	0.6	1.0	1.5	1.0	1.1	1.6	1.9	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.23	0.28	0.22	0.23	0.26	0.03	0.03	0.001-0.003
TSS	mg/L	HACH 8006	5.0	1	3	2	2	3	39	11	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	130	170	490	230	78	<1.1	<1.1	<2-13

1

PP 2024-09-27

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	2.46	2.58	0.12	2.94	1.95	0.34	0.18	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.3	2.1	1.3	1.5	1.0	1.4	1.4	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.02	0.02	0.07	0.05	0.02	0.06	0.53	0.001-0.003
TSS	mg/L	HACH 8006	5.0	5	2	2	4	4	2	1	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	51	<1.1	<1.1	45	20	330	<2-13

2

PP 2024-09-27

Parameters	Unit	Method	Detection Limit	PP 15	PP 16	PP 17	PP 18	PP 19	PP 20	PP 21	PP 22	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.15	0.18	0.60	0.63	1.12	1.89	0.15	0.39	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.0	1.8	0.4	1.4	0.6	1.8	2.0	1.4	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.23	0.08	0.05	0.04	0.18	0.17	0.05	0.02	0.001-0.003
TSS	mg/L	HACH 8006	5.0	0	3	4	5	3	9	2	0	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	<1.1	130	170	220	330	1.1	51	<2-13

3

PP 2024-09-27

Parameters	Unit	Method	Detection Limit	PP 23	PP 24	PP 25	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.15	0.60	0.57	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	1.7	0.6	1.5	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.04	0.16	0.21	0.001-0.003
TSS	mg/L	HACH 8006	5.0	2	1	0	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	1.1	120	<2-13

4

PP 2024-09-27

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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6 - October 2024

PP 2024-10-24

November 06, 2024

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: October 24, 2024

Date Received: October 24, 2024

Number of Samples: 25

Type of Material: Marine

Date Tested: October 24-November 01, 2024

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	1.71	0.66	1.29	1.20	1.53	1.44	0.96	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	0.6	0.8	1.0	1.0	0.8	1.8	1.6	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.21	0.22	0.14	0.17	0.18	0.04	0.04	0.001-0.003
TSS	mg/L	HACH 8006	5.0	1	2	2	2	5	11	16	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	120	140	390	160	51	<1.1	<1.1	<2-13
Dissolved Oxygen	Mg/l	HACH 10360	0.01	7.15	8.49	8.59	8.40	7.88	6.61	8.70	

1

PP 2024-10-24

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.60	0.40	0.39	1.20	0.30	0.30	0.72	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.2	1.2	1.9	1.8	2.3	2.0	1.0	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.06	0.04	0.03	0.04	0.05	0.03	0.51	0.001-0.003
TSS	mg/L	HACH 8006	5.0	1	1	1	1	2	3	4	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	36	<1.1	<1.1	51	11	230	<2-13
Dissolved Oxygen	Mg/l	HACH 10360	0.01	8.83	8.59	9.20	7.81	6.85	8.12	8.28	

2

PP 2024-10-24

Parameters	Unit	Method	Detection Limit	PP 15	PP 16	PP 17	PP 18	PP 19	PP 20	PP 21	PP 22	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.66	1.11	6.95	0.72	1.77	3.78	0.75	0.60	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.1	1.7	0.6	0.6	0.7	0.8	1.6	1.7	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.11	0.06	0.20	0.21	0.24	0.24	0.07	0.03	0.001-0.003
TSS	mg/L	HACH 8006	5.0	0	0	5	8	23	21	1	0	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	<1.1	92	120	160	230	1.1	36	<2-13
Dissolved Oxygen	Mg/l	HACH 10360	0.01	7.50	6.75	4.43	5.51	4.36	6.57	7.24	7.91	

3

PP 2024-10-24

Parameters	Unit	Method	Detection Limit	PP 23	PP 24	PP 25	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.48	0.39	1.29	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.0	0.7	1.1	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.03	0.14	0.21	0.001-0.003
TSS	mg/L	HACH 8006	5.0	1	0	1	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	<1.1	92	<2-13
Dissolved Oxygen	Mg/l	HACH 10360	0.01	8.50	6.69	7.99	

4

PP 2024-10-24

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested

7 – March 27 , 2025

caribbean environmental
TESTING & MONITORING SERVICES LTD.

PP 2025-03-27

April 03, 2025

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: March 27, 2025

Date Received: March 27, 2025

Number of Samples: 25

Type of Material: Marine

Date Tested: March 27-April 02, 2025

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 2	PP 3	PP4	PP 5	PP 6	PP 7	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	1.49	2.13	1.52	1.50	0.54	0.63	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	0.9	1.1	1.1	2.2	1.8	2.0	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	H ACH 8048	0.02	0.89	0.34	0.27	0.14	0.28	0.06	0.001-0.003
TSS	mg/L	HACH 8006	5.0	2	3	1	1	13	11	NA
Faecal Coliform	MPN/100ml	SMEWW 9221 E	1.1	92	120	140	36	<1.1	<1.1	<2-13

1

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TESTING & MONITORING SERVICES LTD.

PP 2025-03-27

Parameters	Unit	Method	Detection Limit	PP 8	PP 9	PP 10	PP 11	PP 12	PP 13	PP 14	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.82	0.66	0.42	0.36	0.32	0.09	0.73	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	1.9	2.2	1.7	2.4	1.7	2.0	1.9	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.42	0.04	0.06	0.03	0.11	0.06	0.08	0.001-0.003
TSS	mg/L	HACH 8006	5.0	3	1	1	1	1	4	39	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	22	<1.1	<1.1	36	11	160	<2-13

2

CARIBBEAN ENVIRONMENTAL TESTING & MONITORING SERVICES LTD.

PP 2025-03-27

Parameters	Unit	Method	Detection Limit	PP 15	PP 16	PP 17	PP 18	PP 21	PP 22	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.10	0.69	31.49	0.51	1.05	0.63	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	2.2	2.0	1.5	0.6	2.2	1.5	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.09	0.10	0.10	0.12	0.30	0.15	0.001-0.003
TSS	mg/L	HACH 8006	5.0	2	6	72	5	2	2	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	<1.1	<1.1	160	92	1.1	22	<2-13

3

caribbean ENVIRONMENTAL
TESTING & MONITORING SERVICES LTD.

PP 2025-03-27

Parameters	Unit	Method	Detection Limit	PP 23	PP 25	NRCA Standard
BOD	Mg/L	HACH 8043	0.01	0.84	0.96	0.0-1.16
Nitrates	Mg/L	HACH 8039	0.03	1.6	1.1	0.007-0.014
Phosphates	Mg/L PO_4^{3-}	HACH 8048	0.02	0.05	0.84	0.001-0.003
TSS	mg/L	HACH 8006	5.0	7	1	NA
Total Coliform	MPN/100ml	SMEWW 9221 E	1.8	11	69	<2-13

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005

Reported by: Odian Barrett
Analyst

Approved by: Prof. Nilza Aples
Director of Analytical Testing and Monitoring

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PP 2025-03-27

Protocol (January 2015)

ii. Samples are not delivered to the lab within the maximum holding time for each respective analysis requested

Appendix 6 – In-situ Water Quality Results

1 - June 21, 2023

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
PP1	27.80	0.52	0.26	7.52	4.40	0.00	0.3320	-	-
PP2	26.09	0.46	0.23	7.91	7.80	0.00	0.2926	-	-
PP3	26.05	0.47	0.24	7.97	8.29	0.00	0.3023	-	-
PP4	27.69	0.55	0.28	7.92	8.14	0.00	0.3479	-	-
PP5	28.44	0.45	0.23	8.02	6.61	0.00	0.2884	-	-
PP6	30.17	52.80	34.89	8.05	4.85	17.70	33.81	-	-
PP7	29.89	53.25	34.80	8.04	4.86	28.54	25.74	-	-
PP8	30.39	52.82	34.90	8.11	5.64	2.56	33.81	-	-
PP9	30.60	52.65	34.78	8.09	5.54	1.02	33.71	-	-
PP10	30.42	50.04	33.15	8.09	5.84	0.02	34.02	-	-
PP11	30.53	52.96	35.01	8.01	4.07	1.23	33.90	-	-
PP12	30.46	52.49	34.66	8.06	5.15	1.57	33.76	-	-
PP13	30.89	52.91	34.94	8.10	5.46	4.90	33.82	-	-
PP14	26.89	13.05	7.92	7.96	6.80	60.65	7.28	-	-
PP15	30.77	52.81	34.89	7.90	4.03	23.75	33.80	-	-
PP16	30.37	52.88	34.95	8.05	4.91	9.37	33.85	-	-
PP17	31.20	15.22	8.85	7.39	0.93	18.30	9.7510	-	-
PP18	27.68	0.81	0.42	7.28	0.84	31.30	0.5198	-	-
PP19	-	-	-	-	-	-	-	-	-
PP20	-	-	-	-	-	-	-	-	-
PP21	30.59	52.88	34.94	8.03	4.99	2.27	33.8400	-	-
PP22	30.60	52.95	34.99	8.10	5.49	0.16	33.8880	-	-
PP23	29.38	52.37	34.61	8.07	4.45	4.40	33.1833	-	-
PP24	28.01	0.50	0.25	7.79	6.04	0.00	0.3197	-	-
PP25	-	-	-	-	-	-	-	-	-
PP26	30.25	52.78	34.87	8.10	5.51	4.84	33.7780	-	-
PP27	29.42	52.43	34.59	7.98	4.28	219.95	33.5350	-	-

2 - August 10, 2023

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
PP1	28.13	0.58	0.29	7.59	4.87	-	0.37	-	-
PP2	25.57	0.48	0.24	7.83	7.03	-	0.31	-	-
PP3	25.50	0.48	0.24	7.85	7.66	-	0.31	-	-
PP4	26.28	0.48	0.24	7.94	7.75	-	0.31	-	-
PP5	28.27	0.45	0.22	7.91	6.65	-	0.29	-	-
PP6	30.91	54.59	36.22	8.02	5.62	-	34.95	708.50	1.1096352
PP7	31.11	54.71	36.31	8.06	6.35	-	35.01	684.67	0.6978675
PP8	30.96	54.76	36.34	8.03	5.70	-	35.05	542.00	0.4109641
PP9	30.89	54.71	36.31	8.03	5.76	-	35.02	631.25	0.3872215
PP10	31.07	54.67	36.34	8.01	5.42	-	34.96	647.75	0.3900653
PP11	31.38	54.73	36.30	7.92	4.07	-	34.69	841.00	0.2826851
PP12	31.46	54.80	36.26	7.92	4.09	-	35.07	868.50	0.2672603
PP13	31.41	54.61	36.33	7.93	3.67	-	35.08	848.50	0.1474204
PP14	27.12	16.50	11.50	7.81	3.84	-	14.56	745.00	1.8748471
PP15	31.61	54.57	36.19	7.90	3.72	-	34.99	1040.00	0.1907484
PP16	30.98	54.44	36.13	7.87	3.00	-	34.88	695.50	0.3942499
PP17	28.84	0.65	0.33	7.54	1.33	-	0.41	-	-
PP18	27.83	0.69	0.36	7.40	1.85	-	0.44	-	-
PP19	29.32	0.62	0.32	7.12	3.37	-	0.40	-	-
PP20	30.92	0.83	0.43	7.33	3.28	-	0.53	-	-
PP21	31.47	54.64	36.24	7.87	3.42	-	34.97	915.50	0.266704
PP22	31.11	54.80	36.37	7.99	4.95	-	35.08	881.00	0.4504299
PP23	30.74	53.96	35.75	7.90	4.12	-	34.56	366.67	0.3851995
PP24	28.03	0.49	0.25	7.70	5.88	-	0.31	-	-
PP25	26.95	0.49	0.25	7.47	7.67	-	0.31	-	-
PP26	30.98	54.90	36.44	7.94	4.29	-	35.12	409.25	0.455701
PP27	31.04	53.57	35.50	7.87	4.43	-	34.35	507.50	0.279946

3 - October 19, 2023

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
PP1	30.05	0.46	0.23	7.93	5.76	0.00	0.2966	-	-
PP2	25.58	0.46	0.23	7.87	7.58	0.00	0.2905	-	-
PP3	25.52	0.45	0.23	7.88	7.77	0.00	0.2889	-	-
PP4	26.98	0.46	0.23	7.78	7.61	0.00	0.2924	-	-
PP5	26.94	0.45	0.23	7.92	6.57	0.00	0.2913	-	-
PP6	30.59	52.21	34.47	8.00	4.27	37.40	33.44	-	-
PP7	31.14	52.56	34.71	8.07	5.25	36.13	33.64	-	-
PP8	31.43	52.69	34.80	8.13	5.20	0.00	33.72	-	-
PP9	31.64	52.53	34.68	8.11	4.78	0.00	33.66	-	-
PP10	31.35	52.09	34.54	8.13	5.14	0.00	33.24	-	-
PP11	31.26	52.54	35.03	8.01	3.46	0.00	33.63	-	-
PP12	31.25	52.41	34.59	7.97	2.98	0.00	33.54	-	-
PP13	31.99	51.47	33.85	8.12	5.09	0.00	31.73	-	-
PP14	25.32	3.85	2.28	7.90	6.75	17.35	1.98	-	-
PP15	31.97	49.70	32.50	8.06	4.87	0.00	31.66	-	-
PP16	31.31	52.40	34.59	8.07	4.75	2.55	33.53	-	-
PP17	30.68	1.67	0.89	7.86	2.78	0.00	1.0730	-	-
PP18	29.09	0.51	0.26	7.58	8.62	6.40	0.3286	-	-
PP19	-	-	-	-	-	-	-	-	-
PP20	34.11	0.61	0.31	7.68	7.87	41.40	0.3926	-	-
PP21	31.60	52.79	34.88	8.07	4.55	0.00	33.7900	-	-
PP22	31.54	52.69	34.81	8.13	5.22	0.00	33.7125	-	-
PP23	30.97	51.98	34.28	8.05	4.12	4.87	33.9300	-	-
PP24	27.91	0.46	0.23	7.89	5.85	0.00	0.2914	-	-
PP25	26.15	0.45	0.23	7.46	7.18	0.00	0.2904	-	-
PP26	31.34	52.73	34.84	8.09	4.80	0.48	33.7400	-	-
PP27	31.58	52.23	34.48	8.02	3.36	21.90	33.5200	-	-

4 - November 24, 2023

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
PP1	25.98	0.50	0.25	7.87	6.69	0.00	0.3063	-	-
PP2	25.61	0.48	0.24	7.76	7.86	0.00	0.3035	-	-
PP3	25.67	0.48	0.24	7.76	8.01	0.00	0.3052	-	-
PP4	26.21	0.48	0.24	7.68	7.77	0.00	0.3090	-	-
PP5	26.39	0.48	0.24	7.80	6.69	0.00	0.3063	-	-
PP6	28.89	53.65	35.51	7.93	5.28	48.05	34.34	977.00	0.8226031
PP7	29.12	53.65	35.52	7.97	5.82	21.87	34.35	715.67	1.476674
PP8	29.55	53.82	35.65	7.98	5.70	0.00	34.44	428.75	0.4018888
PP9	29.63	53.56	35.46	7.99	5.78	0.00	34.11	509.00	0.3731379
PP10	29.73	53.66	35.61	8.00	6.09	1.28	34.30	450.25	0.3792671
PP11	29.41	53.62	35.51	7.92	5.53	0.40	34.33	679.00	0.2307854
PP12	29.36	53.61	35.50	7.92	4.97	0.00	34.32	821.00	0.3563724
PP13	29.90	53.33	35.60	7.97	5.80	0.00	33.90	790.50	0.255829
PP14	27.20	27.89	19.14	7.86	6.13	19.80	18.69	1004.50	0.3529336
PP15	29.71	53.71	35.60	7.93	4.87	0.00	34.45	936.50	0.5552523
PP16	29.19	53.77	35.60	8.00	5.98	3.10	34.41	958.50	0.0865505
PP17	27.21	2.85	1.54	7.59	1.53	0.00	1.8030	-	-
PP18	26.25	0.56	0.28	7.62	2.94	0.00	0.3557	-	-
PP19	26.57	0.68	0.35	7.50	3.33	0.00	0.4354	-	-
PP20	30.72	0.73	0.38	7.48	7.99	10.70	0.4671	-	-
PP21	29.63	53.82	35.62	7.87	4.54	0.00	34.4300	777.00	0.2283312
PP22	29.51	53.81	35.64	7.98	5.98	0.85	34.4350	531.50	0.2691835
PP23	29.11	53.60	35.48	7.99	6.01	1.63	34.3100	418.00	0.4160637
PP24	25.12	0.49	0.25	7.84	6.14	0.10	0.3134	-	-
PP25	25.95	0.48	0.24	7.36	7.15	0.00	0.3074	-	-
PP26	29.25	53.70	35.55	8.01	6.23	5.78	34.3700	345.75	1.0204281
PP27	29.02	53.67	35.53	7.93	5.29	14.85	34.3450	411.00	0.9302677

5 - September 27, 2024

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
PP1	27.69	0.61	0.31	7.58	5.25	0.00	0.3923	-	-
PP2	28.20	0.54	0.27	7.69	7.60	0.00	0.3500	-	-
PP3	27.01	0.54	0.27	7.65	7.71	0.00	0.3492	-	-
PP4	26.66	0.54	0.27	7.62	7.48	0.00	0.3497	-	-
PP5	26.88	0.52	0.26	7.73	6.48	0.00	0.3357	-	-
PP6	29.03	53.33	35.32	7.70	4.36	61.15	34.07	1355.00	2.6031625
PP7	29.01	53.79	35.63	7.80	4.60	8.97	34.35	738.00	0.7143676
PP8	29.17	54.09	35.86	7.84	4.72	4.78	34.54	632.25	0.4816176
PP9	29.13	53.97	35.81	7.83	4.72	2.05	34.49	660.25	0.319258
PP10	29.29	54.18	35.94	7.85	4.73	2.76	34.60	738.00	0.2653333
PP11	29.02	53.67	35.58	7.77	4.25	2.00	34.29	1059.00	0.3740264
PP12	29.02	53.65	35.55	7.75	4.26	1.30	34.27	1379.50	0.2894713
PP13	29.16	53.77	35.65	7.76	4.45	1.35	34.35	1326.00	0.2728728
PP14	25.53	0.70	0.32	7.46	6.75	27.10	0.44	1328.00	0.4380028
PP15	29.30	53.68	35.53	7.79	5.20	2.45	34.29	1385.50	0.4211461
PP16	29.25	53.57	35.50	7.78	5.03	6.25	34.24	1387.50	0.7353007
PP17	28.46	0.99	0.52	7.54	5.03	0.00	0.6443	-	-
PP18	27.30	0.69	0.35	7.46	3.50	0.00	0.4444	-	-
PP19	27.10	0.64	0.33	7.42	3.63	0.00	0.4148	-	-
PP20	28.77	0.86	0.45	7.32	4.60	2.80	0.5546	-	-
PP21	29.10	53.56	35.46	7.75	4.09	7.65	34.1981	959.00	0.874781
PP22	29.27	54.21	35.93	7.83	4.71	2.03	34.5806	846.25	0.276521
PP23	28.85	53.32	35.29	7.72	3.61	2.20	34.1397	678.33	0.2679455
PP24	27.63	0.53	0.27	7.55	4.67	0.00	0.3444	-	-
PP25	26.90	0.55	0.28	7.36	6.94	0.00	0.3518	-	-
PP26	29.12	54.09	35.81	7.84	4.68	3.63	34.5656	692.50	0.48433
PP27	28.76	52.10	34.50	7.65	3.42	14.55	33.8531	654.00	0.522248

6 - October 24, 2024

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
PP1	28.05	0.52	0.26	8.04	7.15	0.00	0.3337	-	-
PP2	28.60	0.47	0.24	8.12	8.49	0.00	0.3017	-	-
PP3	27.28	0.47	0.24	8.10	8.59	0.00	0.3031	-	-
PP4	26.93	0.47	0.24	7.49	8.40	0.00	0.3015	-	-
PP5	27.28	0.49	0.25	8.19	7.88	0.00	0.3132	-	-
PP6	31.00	53.38	35.32	8.17	6.61	44.80	34.17	-	-
PP7	30.99	53.64	35.48	8.37	8.70	15.50	34.31	-	-
PP8	31.14	53.72	35.56	8.34	8.83	0.00	34.38	-	-
PP9	31.14	53.58	35.47	8.34	8.59	0.00	34.31	-	-
PP10	31.26	53.69	35.56	8.34	9.20	0.00	34.40	-	-
PP11	31.40	53.66	35.52	8.25	7.81	0.00	34.34	-	-
PP12	31.61	53.61	35.60	8.26	6.85	0.00	34.42	-	-
PP13	31.52	53.75	35.59	8.34	8.12	0.00	34.40	-	-
PP14	25.82	0.48	0.25	8.21	8.28	4.00	0.31	-	-
PP15	31.75	53.73	35.59	8.24	7.50	0.45	34.37	-	-
PP16	31.18	53.63	35.32	8.19	6.75	0.00	34.16	-	-
PP17	30.17	1.22	0.64	7.84	4.43	0.00	0.7718	-	-
PP18	28.00	0.54	0.28	8.03	5.51	0.00	0.3485	-	-
PP19	28.00	0.64	0.33	7.75	4.36	0.00	0.4102	-	-
PP20	31.16	0.71	0.36	7.64	6.57	10.30	0.4498	-	-
PP21	31.47	53.64	35.51	8.23	7.24	1.60	34.3200	-	-
PP22	31.22	53.78	35.62	8.29	7.91	0.00	34.4200	-	-
PP23	30.80	53.81	35.63	8.35	8.50	0.80	34.4367	-	-
PP24	28.34	0.49	0.25	8.00	6.69	0.00	0.3135	-	-
PP25	27.51	0.47	0.24	7.76	7.99	0.00	0.3032	-	-
PP26	31.01	53.61	35.58	8.28	-	0.00	34.3867	-	-
PP27	30.62	53.64	35.50	8.15	-	61.00	34.3400	-	-

7 – March 27, 2025

STN.	TEMP. °C	COND (mS/cm)	SAL (ppt)	pH	D.O. (mg/l)	Turb (NTU)	TDS (g/l)	PAR (uE/cm/s)	EC
WQ1	-	-	-	-	-	-	-	-	-
WQ2	26.11	0.47	0.24	8.26	9.71	0.00	0.31	-	-
WQ3	26.51	0.48	0.24	8.25	9.59	0.00	0.51	-	-
WQ4	27.97	0.48	0.24	8.19	8.83	0.00	0.31	-	-
WQ5	27.67	0.48	0.24	8.03	6.93	0.00	0.31	-	-
WQ6	27.77	54.15	35.89	8.07	5.28	32.65	34.66	-	-
WQ7	28.05	55.91	37.21	8.27	5.42	47.00	35.79	377	1.7069
WQ8	28.29	55.82	37.14	8.31	5.49	3.68	35.73	254	0.4480
WQ9	28.49	55.76	37.06	8.33	5.55	2.75	35.69	244	0.3624
WQ10	28.51	55.98	37.25	8.31	5.36	2.33	35.82	310	0.2694
WQ11	28.17	55.82	37.12	8.25	4.90	0.00	35.72	385	0.2904
WQ12	28.18	55.87	37.18	8.26	4.77	0.00	35.77	451	0.1732
WQ13	28.60	54.06	35.85	8.09	4.87	0.00	34.65	-	-
WQ14	26.96	27.94	18.27	8.02	5.20	115.60	19.35	-	-
WQ15	28.77	54.21	35.93	8.16	5.70	0.00	34.70	-	-
WQ16	28.27	54.25	35.98	8.18	5.90	22.75	34.72	-	-
WQ17	32.54	37.92	24.09	8.03	13.48	34.80	24.24	-	-
WQ18	28.33	0.50	0.25	7.83	5.27	12.30	0.32	-	-
WQ19	-	-	-	-	-	-	-	-	-
WQ20	-	-	-	-	-	-	-	-	-
WQ21	28.49	55.82	37.13	8.24	4.92	0.30	35.74	308	0.4254
WQ22	28.37	55.88	37.17	8.32	5.62	1.03	35.76	253	0.3281
WQ23	28.14	56.19	37.40	8.36	6.14	6.23	35.96	314	0.6257
WQ24	-	-	-	-	-	-	-	-	-
WQ25	26.92	0.48	0.24	7.81	9.10	0.00	0.31	-	-
WQ26	28.19	55.90	37.19	8.24	4.71	26.23	35.77	132	1.4472
WQ27	27.99	56.41	37.55	8.12	4.30	3.45	36.09	228	0.6182

Appendix 7 – Sediment Loading Laboratory Results

Waste Management Group & Laboratory Services

PP1-8 2023-10 -25

November 7, 2023

Name of Company: CL Environmental

Contact Person(s): Matthew Lee

Address: 20 Windsor Ave, Kingston 5, Jamaica

Telephone: 876-439-9584

Email: mlee@clenvironmental.com

Sample Date: October 25 , 2023

Date Received: October, 2023

Number of Samples:

Type of Material: Marine

Date Tested: October 25-31, 2023

RESULTS FOR SAMPLES SUBMITTED

Parameters	Unit	Method	Detection Limit	PP 1	PP 2	PP 3	PP 4	PP 5	PP 6	PP 7	PP 8
Settleable Solids	Mg/L	SMEWW 2540 F	0.1	240	64	960	180	90	170	54	42

Methods: HACH Water Analysis Handbook 7th Edition
SMEWW Standard Methods for the Examination of Water and Wastewater, 21st Ed 2005
N/A Dry

Reported by: Odian Barrett, Analyst

Appendix 8 – Benthic Sediment Chemistry Results

INTERNATIONAL ANALYTICAL GROUP

REVIEW OF ANALYTICAL REPORT

JOB NUMBER: 400-243987-1

Paradise Park

International Analytical Group, Inc. (IAG) has conducted an independent, third party review of the above referenced analytical report. The samples were analyzed by Eurofins Testamerica Pensacola, a NELAC certified laboratory in Pensacola, Florida.

If you have any questions regarding this analytical report, please contact Marino Fernandez at marino@iagenvironmental.com

INTERNATIONAL ANALYTICAL GROUP 1998 "Excellence since 1998"

791 SKIVIEW ROAD, SEVEN DEVILS, NC 28604

eurofins | Environment Testing

1 2 3 4 5 6 7 8 9 10 11

ANALYTICAL REPORT

PREPARED FOR

Attn: Matthew Lee
CL Environmental
22 Fort George Heights
Stony Hill,
Kingston 8, Jamaica

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JOB DESCRIPTION

Paradise Park

JOB NUMBER

400-243987-1

Eurofins Pensacola
3355 McLemore Drive
Pensacola FL 32514

See page two for job notes and contact information.

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Eurofins Pensacola

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Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Environment Testing Southeast, LLC Project Manager.

Authorization

Mark Swafford

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Authorized for release by
Mark Swafford, Project Manager II
Mark.Swafford@et.eurofinsus.com
(850)471-6207

Table of Contents

Definitions/Glossary

Client: CL Environmental Job ID: 400-243987-1
Project/Site: Paradise Park

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Job ID: 400-243987-1

Laboratory: Eurofins Pensacola

Narrative

Job Narrative
400-243987-1

Analytical test results meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page unless otherwise noted under the individual analysis. Data qualifiers are applied to indicate exceptions. Noncompliant quality control (QC) is further explained in narrative comments.

Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD may be performed, unless otherwise specified in the method.
Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Receipt
The samples were received on 9/25/2023 9:20 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 12.3°C

GC Semi VOA
Method FL_PRO: Two surrogates are used for this analysis. The laboratory's SOP allows one of these surrogates to be outside acceptance criteria without performing re-extraction/re-analysis. The following samples contained an allowable number of surrogate compounds outside limits: (LCS 400-642768/2-A) and (MB 400-642768/1-A). These results have been reported and qualified.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Metals
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Sample Summary

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
400-243987-1	PP1	Solid	09/13/23 09:00	09/25/23 09:20
400-243987-2	PP2	Solid	09/13/23 09:20	09/25/23 09:20
400-243987-3	PP3	Solid	09/13/23 10:00	09/25/23 09:20
400-243987-4	PP4	Solid	09/13/23 10:20	09/25/23 09:20
400-243987-5	PP5	Solid	09/13/23 10:40	09/25/23 09:20
400-243987-6	PP6	Solid	09/13/23 10:54	09/25/23 09:20
400-243987-7	PP7	Solid	09/13/23 11:10	09/25/23 09:20
400-243987-8	PP8	Solid	09/13/23 11:28	09/25/23 09:20
400-243987-9	PP9	Solid	09/13/23 11:50	09/25/23 09:20
400-243987-10	PP10	Solid	09/13/23 12:30	09/25/23 09:20

Client Sample Results

Client: CL Environmental　　Job ID: 400-243987-1
Project/Site: Paradise Park

Client Sample ID: PP1　　**Lab Sample ID: 400-243987-1**
Date Collected: 09/13/23 09:00　　**Matrix: Solid**
Date Received: 09/25/23 09:20　　**Percent Solids: 49.3**

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		40		mg/Kg	☼	09/26/23 13:35	09/28/23 09:58	1
C8-C10	ND		40		mg/Kg	☼	09/26/23 13:35	09/28/23 09:58	1
C10-C28	ND		40		mg/Kg	☼	09/26/23 13:35	09/28/23 09:58	1
C28-C40	ND		40		mg/Kg	☼	09/26/23 13:35	09/28/23 09:58	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*80*		*36 - 132*	*09/26/23 13:35*	*09/28/23 09:58*	*1*
o-Terphenyl	*88*		*66 - 136*	*09/26/23 13:35*	*09/28/23 09:58*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	4.2		1.9		mg/Kg	☼	10/03/23 12:47	10/04/23 12:35	1
Cadmium	ND		0.95		mg/Kg	☼	10/03/23 12:47	10/04/23 12:35	1
Lead	3.3		1.9		mg/Kg	☼	10/03/23 12:47	10/04/23 12:35	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.030		mg/Kg	☼	09/27/23 09:09	09/27/23 15:07	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	50.7		0.01		%			09/29/23 14:33	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP2
Date Collected: 09/13/23 09:20
Date Received: 09/25/23 09:20

Lab Sample ID: 400-243987-2
Matrix: Solid
Percent Solids: 54.8

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		36		mg/Kg	☼	09/26/23 13:35	09/28/23 10:32	1
C8-C10	ND		36		mg/Kg	☼	09/26/23 13:35	09/28/23 10:32	1
C10-C28	ND		36		mg/Kg	☼	09/26/23 13:35	09/28/23 10:32	1
C28-C40	ND		36		mg/Kg	☼	09/26/23 13:35	09/28/23 10:32	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*95*		*36 - 132*	*09/26/23 13:35*	*09/28/23 10:32*	*1*
o-Terphenyl	*89*		*66 - 136*	*09/26/23 13:35*	*09/28/23 10:32*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	3.6		1.7		mg/Kg	☼	10/03/23 12:47	10/04/23 12:39	1
Cadmium	ND		0.86		mg/Kg	☼	10/03/23 12:47	10/04/23 12:39	1
Lead	2.9		1.7		mg/Kg	☼	10/03/23 12:47	10/04/23 12:39	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.027		mg/Kg	☼	09/27/23 09:09	09/27/23 15:08	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	45.2		0.01		%			09/29/23 14:33	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental | Job ID: 400-243987-1
Project/Site: Paradise Park

Client Sample ID: PP3 | **Lab Sample ID: 400-243987-3**
Date Collected: 09/13/23 10:00 | **Matrix: Solid**
Date Received: 09/25/23 09:20 | **Percent Solids: 61.2**

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		31		mg/Kg	☼	09/26/23 13:35	09/28/23 10:49	1
C8-C10	ND		31		mg/Kg	☼	09/26/23 13:35	09/28/23 10:49	1
C10-C28	ND		31		mg/Kg	☼	09/26/23 13:35	09/28/23 10:49	1
C28-C40	ND		31		mg/Kg	☼	09/26/23 13:35	09/28/23 10:49	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*71*		*36 - 132*	*09/26/23 13:35*	*09/28/23 10:49*	*1*
o-Terphenyl	*86*		*66 - 136*	*09/26/23 13:35*	*09/28/23 10:49*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	3.4		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 12:43	1
Cadmium	ND		0.78		mg/Kg	☼	10/03/23 12:47	10/04/23 12:43	1
Lead	2.9		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 12:43	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.025		mg/Kg	☼	09/27/23 09:09	09/27/23 15:09	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	38.8		0.01		%			09/29/23 14:33	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP4
Date Collected: 09/13/23 10:20
Date Received: 09/25/23 09:20

Lab Sample ID: 400-243987-4
Matrix: Solid
Percent Solids: 61.4

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		32	mg/Kg	☼	09/26/23 13:35	09/28/23 11:05	1
C8-C10	ND		32	mg/Kg	☼	09/26/23 13:35	09/28/23 11:05	1
C10-C28	ND		32	mg/Kg	☼	09/26/23 13:35	09/28/23 11:05	1
C28-C40	ND		32	mg/Kg	☼	09/26/23 13:35	09/28/23 11:05	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*79*		*36 - 132*	*09/26/23 13:35*	*09/28/23 11:05*	*1*
o-Terphenyl	*92*		*66 - 136*	*09/26/23 13:35*	*09/28/23 11:05*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	3.4		1.5	mg/Kg	☼	10/03/23 12:47	10/04/23 12:47	1
Cadmium	ND		0.77	mg/Kg	☼	10/03/23 12:47	10/04/23 12:47	1
Lead	2.7		1.5	mg/Kg	☼	10/03/23 12:47	10/04/23 12:47	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.025	mg/Kg	☼	09/27/23 09:09	09/27/23 15:11	1

General Chemistry

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	38.6		0.01	%			09/29/23 14:33	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Job ID: 400-243987-1
Project/Site: Paradise Park

Client Sample ID: PP5
Lab Sample ID: 400-243987-5

Date Collected: 09/13/23 10:40
Matrix: Solid
Date Received: 09/25/23 09:20
Percent Solids: 57.0

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		35		mg/Kg	☼	09/26/23 13:35	09/28/23 11:22	1
C8-C10	ND		35		mg/Kg	☼	09/26/23 13:35	09/28/23 11:22	1
C10-C28	ND		35		mg/Kg	☼	09/26/23 13:35	09/28/23 11:22	1
C28-C40	ND		35		mg/Kg	☼	09/26/23 13:35	09/28/23 11:22	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*89*		*36 - 132*	*09/26/23 13:35*	*09/28/23 11:22*	*1*
o-Terphenyl	*101*		*66 - 136*	*09/26/23 13:35*	*09/28/23 11:22*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	4.0		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 12:51	1
Cadmium	ND		0.81		mg/Kg	☼	10/03/23 12:47	10/04/23 12:51	1
Lead	3.0		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 12:51	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.027		mg/Kg	☼	09/27/23 09:09	09/27/23 15:12	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	43.0		0.01		%			09/29/23 14:33	1

Client Sample Results

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP6
Date Collected: 09/13/23 10:54
Date Received: 09/25/23 09:20

Lab Sample ID: 400-243987-6
Matrix: Solid
Percent Solids: 58.5

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 11:42	1
C8-C10	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 11:42	1
C10-C28	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 11:42	1
C28-C40	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 11:42	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*94*		*36 - 132*	*09/26/23 13:35*	*09/28/23 11:42*	*1*
o-Terphenyl	*92*		*66 - 136*	*09/26/23 13:35*	*09/28/23 11:42*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	3.0		1.7		mg/Kg	☼	10/03/23 12:47	10/04/23 13:03	1
Cadmium	ND		0.83		mg/Kg	☼	10/03/23 12:47	10/04/23 13:03	1
Lead	2.9		1.7		mg/Kg	☼	10/03/23 12:47	10/04/23 13:03	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.027		mg/Kg	☼	09/27/23 09:09	09/27/23 15:16	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	41.5		0.01		%			09/29/23 14:33	1

Client Sample Results

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP7
Date Collected: 09/13/23 11:10
Date Received: 09/25/23 09:20

Lab Sample ID: 400-243987-7
Matrix: Solid
Percent Solids: 61.9

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		32		mg/Kg	☼	09/26/23 13:35	09/28/23 11:59	1
C8-C10	ND		32		mg/Kg	☼	09/26/23 13:35	09/28/23 11:59	1
C10-C28	ND		32		mg/Kg	☼	09/26/23 13:35	09/28/23 11:59	1
C28-C40	ND		32		mg/Kg	☼	09/26/23 13:35	09/28/23 11:59	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*85*		*36 - 132*	*09/26/23 13:35*	*09/28/23 11:59*	*1*
o-Terphenyl	*100*		*66 - 136*	*09/26/23 13:35*	*09/28/23 11:59*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	2.7		1.5		mg/Kg	☼	10/03/23 12:47	10/04/23 13:07	1
Cadmium	ND		0.75		mg/Kg	☼	10/03/23 12:47	10/04/23 13:07	1
Lead	2.2		1.5		mg/Kg	☼	10/03/23 12:47	10/04/23 13:07	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.024		mg/Kg	☼	09/27/23 09:09	09/27/23 15:17	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	38.1		0.01		%			09/29/23 14:33	1

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Client Sample Results

Client: CL Environmental — Job ID: 400-243987-1
Project/Site: Paradise Park

Client Sample ID: PP8 — **Lab Sample ID: 400-243987-8**
Date Collected: 09/13/23 11:28 — **Matrix: Solid**
Date Received: 09/25/23 09:20 — **Percent Solids: 59.3**

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 12:16	1
C8-C10	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 12:16	1
C10-C28	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 12:16	1
C28-C40	ND		33		mg/Kg	☼	09/26/23 13:35	09/28/23 12:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*68*		*36 - 132*	*09/26/23 13:35*	*09/28/23 12:16*	*1*
o-Terphenyl	*76*		*66 - 136*	*09/26/23 13:35*	*09/28/23 12:16*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	2.6		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 13:12	1
Cadmium	ND		0.82		mg/Kg	☼	10/03/23 12:47	10/04/23 13:12	1
Lead	2.8		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 13:12	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.026		mg/Kg	☼	09/27/23 09:09	09/27/23 15:18	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	40.7		0.01		%			09/29/23 14:33	1

Eurofins Pensacola

Client Sample Results

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP9
Date Collected: 09/13/23 11:50
Date Received: 09/25/23 09:20

Lab Sample ID: 400-243987-9
Matrix: Solid
Percent Solids: 60.0

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		33		mg/Kg	☼	09/26/23 13:53	09/28/23 12:50	1
C8-C10	ND		33		mg/Kg	☼	09/26/23 13:53	09/28/23 12:50	1
C10-C28	ND		33		mg/Kg	☼	09/26/23 13:53	09/28/23 12:50	1
C28-C40	ND		33		mg/Kg	☼	09/26/23 13:53	09/28/23 12:50	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*87*		*36 - 132*	*09/26/23 13:53*	*09/28/23 12:50*	*1*
o-Terphenyl	*83*		*66 - 136*	*09/26/23 13:53*	*09/28/23 12:50*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**2.7**		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 13:16	1
Cadmium	ND		0.82		mg/Kg	☼	10/03/23 12:47	10/04/23 13:16	1
Lead	**3.0**		1.6		mg/Kg	☼	10/03/23 12:47	10/04/23 13:16	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.025		mg/Kg	☼	09/27/23 09:09	09/27/23 15:19	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**40.0**		0.01		%			09/29/23 14:33	1

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10/5/2023

Client Sample Results

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP10
Date Collected: 09/13/23 12:30
Date Received: 09/25/23 09:20

Lab Sample ID: 400-243987-10
Matrix: Solid
Percent Solids: 50.3

Method: FL-DEP FL-PRO - Florida - Petroleum Range Organics (GC)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
C8-C40	ND		40		mg/Kg	☼	09/26/23 13:53	09/28/23 13:09	1
C8-C10	ND		40		mg/Kg	☼	09/26/23 13:53	09/28/23 13:09	1
C10-C28	ND		40		mg/Kg	☼	09/26/23 13:53	09/28/23 13:09	1
C28-C40	ND		40		mg/Kg	☼	09/26/23 13:53	09/28/23 13:09	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
n-C39	*86*		*36 - 132*	*09/26/23 13:53*	*09/28/23 13:09*	*1*
o-Terphenyl	*95*		*66 - 136*	*09/26/23 13:53*	*09/28/23 13:09*	*1*

Method: SW846 6010D - Metals (ICP)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	**3.5**		1.9		mg/Kg	☼	10/03/23 12:47	10/04/23 13:20	1
Cadmium	ND		0.96		mg/Kg	☼	10/03/23 12:47	10/04/23 13:20	1
Lead	**3.5**		1.9		mg/Kg	☼	10/03/23 12:47	10/04/23 13:20	1

Method: SW846 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.031		mg/Kg	☼	09/27/23 09:09	09/27/23 15:20	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	**49.7**		0.01		%			09/29/23 14:33	1

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10/5/2023

Lab Chronicle

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Client Sample ID: PP1 — **Lab Sample ID: 400-243987-1**
Date Collected: 09/13/23 09:00 — **Matrix: Solid**
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP1 — **Lab Sample ID: 400-243987-1**
Date Collected: 09/13/23 09:00 — **Matrix: Solid**
Date Received: 09/25/23 09:20 — **Percent Solids: 49.3**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 09:58
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 12:35
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:07

Client Sample ID: PP2 — **Lab Sample ID: 400-243987-2**
Date Collected: 09/13/23 09:20 — **Matrix: Solid**
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP2 — **Lab Sample ID: 400-243987-2**
Date Collected: 09/13/23 09:20 — **Matrix: Solid**
Date Received: 09/25/23 09:20 — **Percent Solids: 54.8**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 10:32
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 12:39
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:08

Client Sample ID: PP3 — **Lab Sample ID: 400-243987-3**
Date Collected: 09/13/23 10:00 — **Matrix: Solid**
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

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Lab Chronicle

Client: CL Environmental — Job ID: 400-243987-1
Project/Site: Paradise Park

Client Sample ID: PP3 — **Lab Sample ID: 400-243987-3**
Date Collected: 09/13/23 10:00 — Matrix: Solid
Date Received: 09/25/23 09:20 — Percent Solids: 61.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 10:49
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 12:43
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:09

Client Sample ID: PP4 — **Lab Sample ID: 400-243987-4**
Date Collected: 09/13/23 10:20 — Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP4 — **Lab Sample ID: 400-243987-4**
Date Collected: 09/13/23 10:20 — Matrix: Solid
Date Received: 09/25/23 09:20 — Percent Solids: 61.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 11:05
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 12:47
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:11

Client Sample ID: PP5 — **Lab Sample ID: 400-243987-5**
Date Collected: 09/13/23 10:40 — Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP5 — **Lab Sample ID: 400-243987-5**
Date Collected: 09/13/23 10:40 — Matrix: Solid
Date Received: 09/25/23 09:20 — Percent Solids: 57.0

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 11:22
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 12:51
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:12

Eurofins Pensacola

Lab Chronicle

Client: CL Environmental
Job ID: 400-243987-1
Project/Site: Paradise Park

Client Sample ID: PP6
Lab Sample ID: 400-243987-6
Date Collected: 09/13/23 10:54
Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP6
Lab Sample ID: 400-243987-6
Date Collected: 09/13/23 10:54
Matrix: Solid
Date Received: 09/25/23 09:20
Percent Solids: 58.5

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 11:42
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 13:03
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:16

Client Sample ID: PP7
Lab Sample ID: 400-243987-7
Date Collected: 09/13/23 11:10
Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP7
Lab Sample ID: 400-243987-7
Date Collected: 09/13/23 11:10
Matrix: Solid
Date Received: 09/25/23 09:20
Percent Solids: 61.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 11:59
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 13:07
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:17

Client Sample ID: PP8
Lab Sample ID: 400-243987-8
Date Collected: 09/13/23 11:28
Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Lab Chronicle

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

1 2 3 4 5 6 7 8 9 10 11

Client Sample ID: PP8

Lab Sample ID: 400-243987-8
Date Collected: 09/13/23 11:28
Matrix: Solid
Date Received: 09/25/23 09:20
Percent Solids: 59.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:35
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 12:16
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 13:12
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:18

Client Sample ID: PP9

Lab Sample ID: 400-243987-9
Date Collected: 09/13/23 11:50
Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP9

Lab Sample ID: 400-243987-9
Date Collected: 09/13/23 11:50
Matrix: Solid
Date Received: 09/25/23 09:20
Percent Solids: 60.0

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:53
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 12:50
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 13:16
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:19

Client Sample ID: PP10

Lab Sample ID: 400-243987-10
Date Collected: 09/13/23 12:30
Matrix: Solid
Date Received: 09/25/23 09:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	643491	TMP	EET PEN	09/29/23 14:33

Client Sample ID: PP10

Lab Sample ID: 400-243987-10
Date Collected: 09/13/23 12:30
Matrix: Solid
Date Received: 09/25/23 09:20
Percent Solids: 50.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	3546			642768	LH	EET PEN	09/26/23 13:53
Total/NA	Analysis	FL-PRO		1	643074	MP	EET PEN	09/28/23 13:09
Total/NA	Prep	3050B			643876	KWN	EET PEN	10/03/23 12:47 - 10/03/23 15:58 [1]
Total/NA	Analysis	6010D		1	644168	LSS	EET PEN	10/04/23 13:20
Total/NA	Prep	7471B			642901	JR	EET PEN	09/27/23 09:09 - 09/27/23 11:49 [1]
Total/NA	Analysis	7471B		1	643003	NET	EET PEN	09/27/23 15:20

[1] This procedure uses a method stipulated length of time for the process. Both start and end times are displayed.

Lab Chronicle

Client: CL Environmental
Job ID: 400-243987-1
Project/Site: Paradise Park

1 2 3 4 5 6 7 8 9 10 11

Laboratory References:

EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001

Accreditation/Certification Summary

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Laboratory: Eurofins Pensacola

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
ANAB	ISO/IEC 17025	L2471	02-22-26

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
FL-PRO	3546	Solid	C10-C28
FL-PRO	3546	Solid	C28-C40
FL-PRO	3546	Solid	C8-C10
FL-PRO	3546	Solid	C8-C40
Moisture		Solid	Percent Moisture

Method Summary

Client: CL Environmental
Project/Site: Paradise Park

Job ID: 400-243987-1

Method	Method Description	Protocol	Laboratory
FL-PRO	Florida - Petroleum Range Organics (GC)	FL-DEP	EET PEN
6010D	Metals (ICP)	SW846	EET PEN
7471B	Mercury (CVAA)	SW846	EET PEN
Moisture	Percent Moisture	EPA	EET PEN
3050B	Preparation, Metals	SW846	EET PEN
3546	Microwave Extraction	SW846	EET PEN
7471B	Preparation, Mercury	SW846	EET PEN

Protocol References:

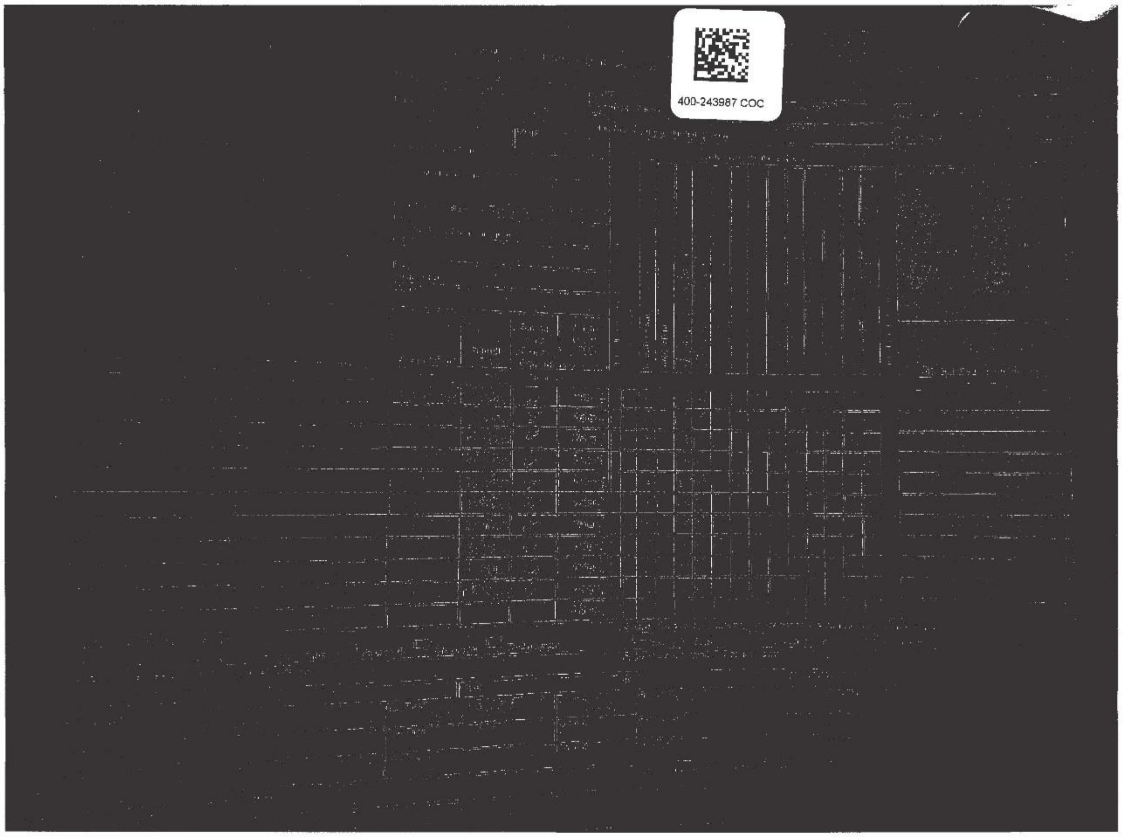
EPA = US Environmental Protection Agency

FL-DEP = State Of Florida Department Of Environmental Protection, Florida Administrative Code.

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET PEN = Eurofins Pensacola, 3355 McLemore Drive, Pensacola, FL 32514, TEL (850)474-1001



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10/5/2023


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Custody Seal
DATE 21/9/23
SIGNATURE
eurofins Environment Testing TestAmerica
2341930
FedEx
TRK# 0402 8177 1178 0732
XH PNSA
AA
IP EXP
32514
FL-US
BFM
10/5/2023

... McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001 Fax: 850-478-2671

Chain of Custody Record

eurofins | Environment Testing

Client Information

Client Contact: Matthew Lee	Sampler: Alec Silen	Lab PM: Swafford, Mark H	400-243987 COC
Company: CL Environmental	Phone: 876 817 0108	E-Mail: Mark.Swafford@et.eurofinsus.com	Carrier Tracking No(s):
Address: 22 Fort George Heights Stony Hill,	PWSID:	State of Origin:	COC No: 400-121057-41555.2
City: Kingston 8	Due Date Requested:		Page: Page 2 of 5
State, Zip: JA,	TAT Requested (days):		Job #:
Phone: 954-966-2454(Tel)	Compliance Project: Δ Yes Δ No		
Email: mlee@clenvironmental.com	PO #: Purchase Order not required		
Project Name: [redacted] Paradise Park	WO #:		
Site:	Project #: 40001109		
	SSOW#:		

Analysis Requested

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	FL_PRO - FLPRO	6010D, 7471B	Arsenic, Cadmium	Mercury, Lead	Total Number of containers	Special Instructions/Note
[redacted]			Preservation Code:				N	N				
PP1	Sep 13 2023	9:[illegible]am	G	Water S			✓		✓	✓		
PP2	"	9:20am	G	Water S			✓		✓	✓		
PP3	"	10:00am	G	Water S			✓		✓	✓		
PP4	"	10:20am	G	Water S			✓		✓	✓		
PP5	"	10:40am	G	Water S			✓		✓	✓		
PP6	"	10:54am	G	Water S			✓		✓	✓		
PP7	"	11:10am	G	Water S			✓		✓	✓		
PP8	"	11:28am	G	Water S			✓		✓	✓		
PP9	"	11:50am	G	Water S			✓		✓	✓		
PP10	"	12:30pm	G	Water S			✓		✓	✓		
				Water S								

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:		Method of Shipment:	
Relinquished by: Alec Silen	Date/Time: 21/9/23	Company: CLE	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Ver: 06/08/2021

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10/5/2023

Login Sample Receipt Checklist

Client: CL Environmental   Job Number: 400-243987-1

Login Number: 243987   **List Source: Eurofins Pensacola**
List Number: 1
Creator: Earnest, Tamantha

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	N/A	
Cooler Temperature is recorded.	True	12.3°C IR10
COC is present.	False	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Appendix 9 – Bruel & Kjaer Noise Calibration Certificates

HBK HOTTINGER BRÜEL & KJÆR

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION No.: 184963-601 Page 1 of 2

CALIBRATION OF:

Calibrator:	Brüel & Kjær	Type 4231 IEC Class: 1	Serial No.: 3008614

CUSTOMER:

CL Environmental
20 Windsor Avenue
Kingston 5, Jamaica

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23	°C
	Air pressure:	98.26	kPa
	Relative Humidity:	44.22	%RH

SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Bruel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Hottinger Brüel & Kjær Inc. acoustic calibrator calibration application
Software version 2.3.4 Type 7794 using calibration procedure4231 Complete

RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: May 30, 2024

Certificate issued: May 30, 2024

John Avitabile

Aundra Welch
Calibration Technician

John Avitabile
Quality Representative

CERTIFICATE OF CALIBRATION

No.: 184963-601

Type: 4231 Serial No.: 3008614 Page 2 of 2

Sound Pressure Levels

All stated values are valid at environmental reference conditions

Nominal Level [dB]	Accept Limit Lower [dB]	Accept Limit Upper [dB]	Measured Level [dB]	Measurement Uncertainty [dB]
94	93.80	94.20	93.98	0.12
114	113.80	114.20	113.95	0.12

Frequency

Nominal Frequency [Hz]	Accept Limit Lower [Hz]	Accept Limit Upper [Hz]	Measured Frequency [Hz]	Measurement Uncertainty [Hz]
1000	999.00	1001.00	999.98	0.10

Total Distortion*

Distortion mode: ☒ **TD*** ☐ **THD***

Calibration Level [dB]*	Accept Limit [%]*	Measured Distortion [%]*	Measurement Uncertainty [%]*
94	1.00	0.36	0.13
114	1.00	0.09	0.13

Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

Instrument List

Type	Description	Serial no	Cal. date	Due date	Calibrated by	Trace number
3560	PULSE Analyzer	2723320	2023-10-19	2024-10-18	GK	CAS-664166-V3L2K7-801
9545	Transfer Microphone	3	2023-10-31	2024-10-30	MH	CAS-664166-V3L2K7-403
4228	Reference Sound Source	1618502	2023-04-19	2025-04-30	WS	CAS-632564-L2S0L9-708

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 mm^3 . For all other types the result is valid with the actual load volume.

Transfer Microphone Type	Fulfils standard IEC 61094-1 LS	Fulfils standard IEC 61094-4 WS	Load Volume 1" (1/2" mic including DP-0776)	Load Volume 1/2"
4180	yes	yes	1126 mm^3	43 mm^3
4192	-	yes	1273 mm^3	190 mm^3
9545	-	-	1333 mm^3	-

Condition "As Received": Good

Comments

Appendix 10 – Airmetrics Calibration Certificates

NIST Traceable Transfer Standard Calibration

Calibration Date: 12/08/2023
Ambient Temp, °K: 298.2
Amb Press, mmHg: 765.0

Orifice # MNF1829-
Pri Std # LFE786620
Manometer # DIG1829

By: ________

Chk: ________

Std ΔH (inH_2O)	Manometer ΔH (inH_2O)	Actual Flow (alpm)	Calc Flow (alpm)	Difference* (%diff)
4.63	4.57	7.797	7.798	-0.01
3.77	3.72	7.045	7.036	0.13
3.00	2.97	6.285	6.287	-0.03
2.32	2.29	5.518	5.520	-0.04
1.74	1.71	4.745	4.771	-0.54
1.35	1.33	4.226	4.207	0.44
1.05	1.03	3.705	3.703	0.06
0.78	0.76	3.181	3.181	0.01

Manometer ΔH vs Act Flow
Linear Regression Results:
m_{flo} = **5.8423**
b_{flo} = **0.0011**
r^2 = **0.9999**

* all points must be within ± 2%

The MiniFlo calibration is performed with an NIST-traceable standard. Each unit has a unique pair of calibration constants derived from the calibration which are used to calculate the actual air flow rate at all ambient conditions. The unit's calibration should be recertified annually.

The actual flow rate is a function of the pressure drop across the device, the ambient temperature, and the ambient pressure. The relationship of these variables and the unique calibration constants ("m" and "b") for each device is presented in the following equation (Eq.A):

$$Q_{act} = m_{flo} \times \sqrt{\frac{\Delta H \times T_{act}}{P_{act}}} + b_{flo}$$

Q_{act} = actual flowrate, liters per min
ΔH = manometer reading, inches of water
T_{act} = ambient temperature, °K
P_{act} = ambient pressure, millimeters of mercury

CAUTION: The weather service, most airports, etc, reduce the atmospheric pressure to a common reference (sea level). The equation above requires the atmospheric pressure at the location where the MiniFlo is being used.

The equation below may be used to estimate the ambient atmospheric pressure at any elevation if the sea level pressure is known.

$$P_{act} = P_{sea} \times \left(1 - \frac{E}{145300}\right)^{5.25}$$

P_{act} = Ambient Atmospheric Pressure
P_{sea} = Sea Level Atmospheric Pressure
E = Site elevation, feet

Airmetrics
1940 Don St., Suite 300
Springfield, OR 97477
(541) 683-5420

NIST Traceable Transfer Standard Calibration

Calibration Date: 12/08/2023
Ambient Temp, °K: 298.2
Amb Press, mmHg: 765.0

Orifice # MNF1829-
Pri Std # LFE786620
Manometer # DIG1829

Std ΔH (inH_2O)	Manometer ΔH (inH_2O)	Actual Flow (alpm)	Calc Flow (alpm)	Difference* (%diff)
4.63	4.57	7.797	7.798	-0.01
3.77	3.72	7.045	7.036	0.13
3.00	2.97	6.285	6.287	-0.03
2.32	2.29	5.518	5.520	-0.04
1.74	1.71	4.745	4.771	-0.54
1.35	1.33	4.226	4.207	0.44
1.05	1.03	3.705	3.703	0.06
0.78	0.76	3.181	3.181	0.01

Manometer ΔH vs Act Flow
Linear Regression Results:
m_{flo} = 5.8423
b_{flo} = 0.0011
r^2 = 0.9999

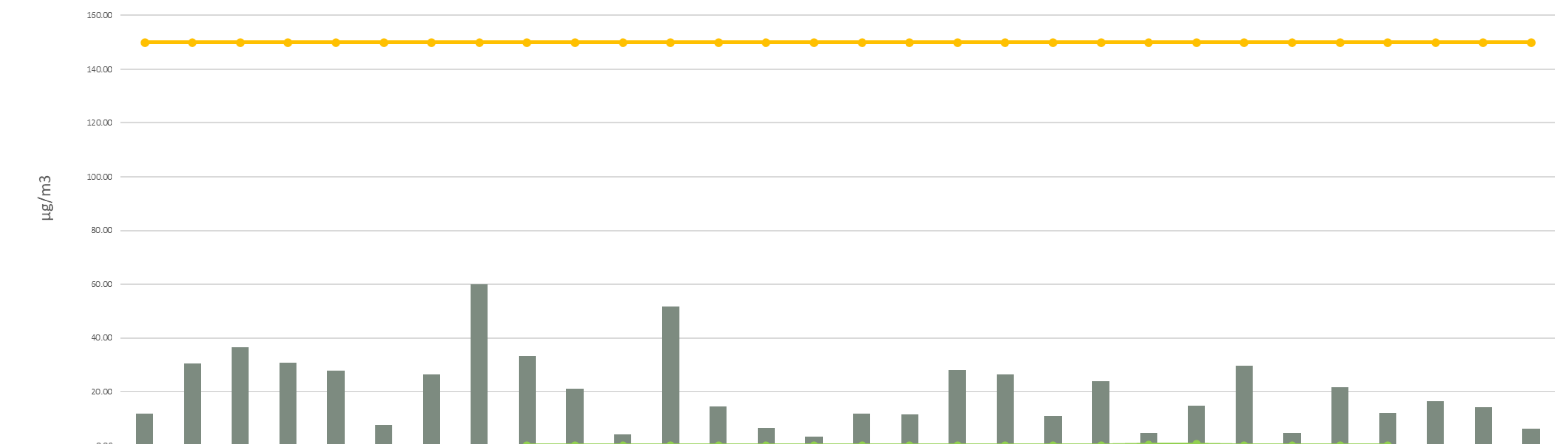
* all points must be within ± 2%

$$Q_{act} = m_{flo} \times \sqrt{\frac{\Delta H \times T_{act}}{P_{act}}} + b_{flo}$$

Q_{act} = actual flowrate, liters per min
ΔH = manometer reading, inches of water
T_{act} = ambient temperature, °K
P_{act} = ambient pressure, millimeters of mercury

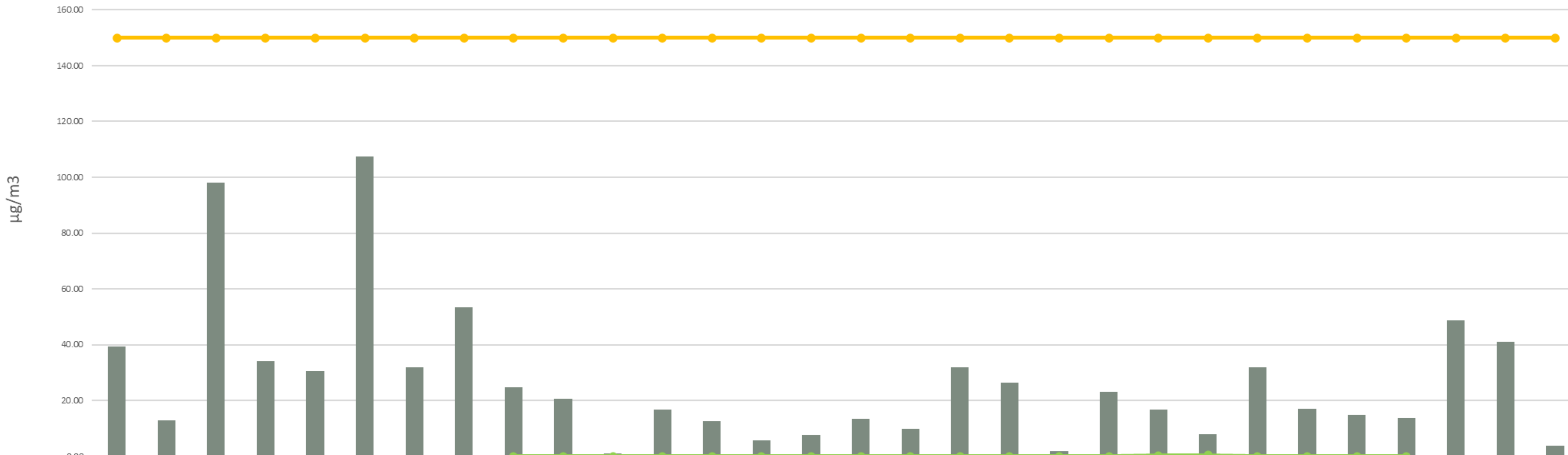
Appendix 11 – Particulate Data

Detailed particulate data over the assessment period with corresponding rainfall days.



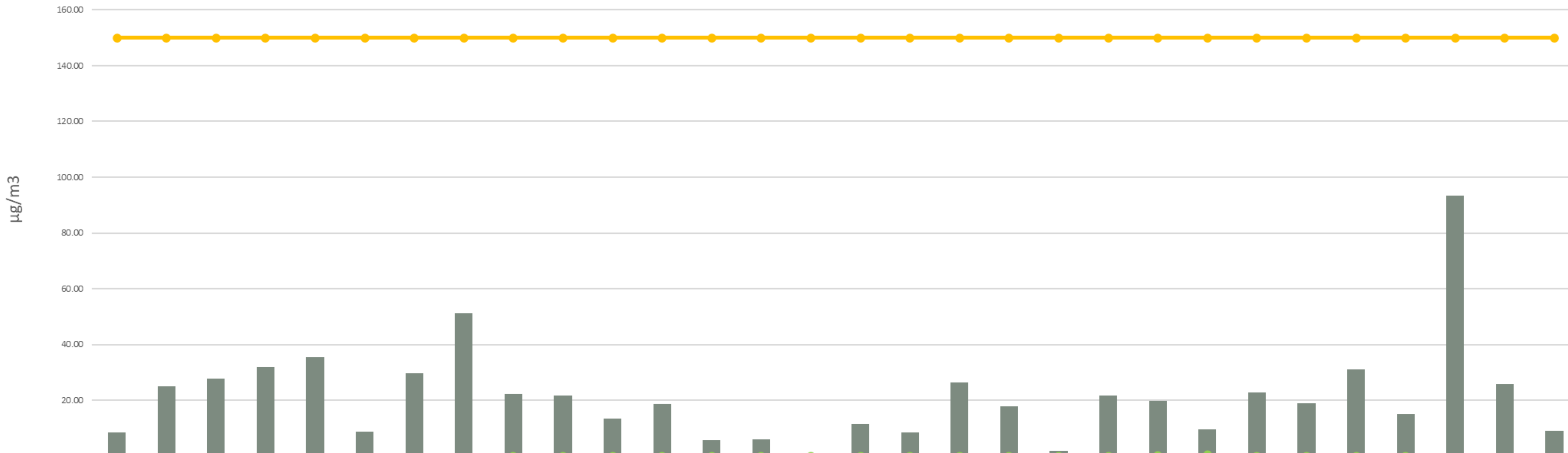
	17-Jun-23	29-Jun-23	2-Jul-23	8-Jul-23	11-Jul-23	14-Jul-23	17-Jul-23	16-Aug-23	22-Aug-23	3-Sep-23	21-Sep-23	9-Oct-23	15-Oct-23	21-Oct-23	27-Oct-23
STN. 1 (PM10)	11.94	30.42	36.53	30.69	27.78	7.78	26.39	60.14	33.33	21.25	4.17	51.81	14.44	6.67	3.33
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 1 (PM10)	11.94	11.67	28.19	26.53	10.97	23.89	4.72	14.72	29.72	4.58	21.81	12.22	16.39	14.17	6.25
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



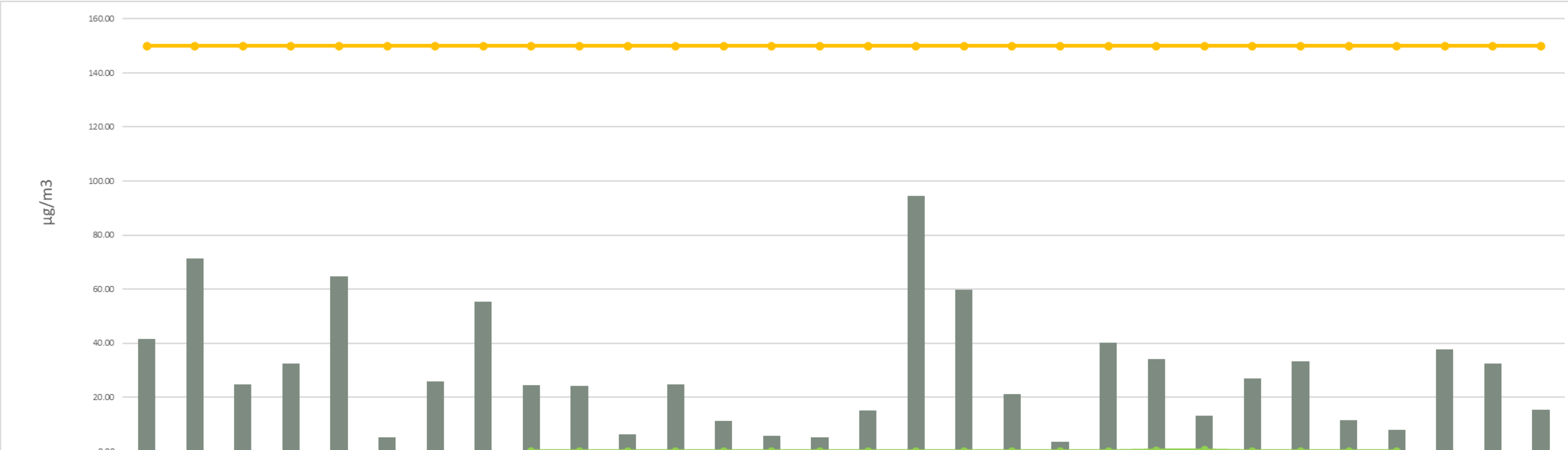
	17-Jun-23	29-Jun-23	2-Jul-23	8-Jul-23	11-Jul-23	14-Jul-23	17-Jul-23	16-Aug-23	22-Aug-23	3-Sep-23	21-Sep-23	9-Oct-23	15-Oct-23	21-Oct-23	27-Oct-23
STN. 2 (PM10)	39.31	12.78	98.19	34.17	30.56	107.50	31.94	53.33	24.72	20.69	0.97	16.81	12.50	5.69	7.67
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 2 (PM10)	13.47	10.00	31.81	26.53	1.94	23.19	16.67	7.92	31.94	16.94	14.72	13.61	48.61	41.11	3.75
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



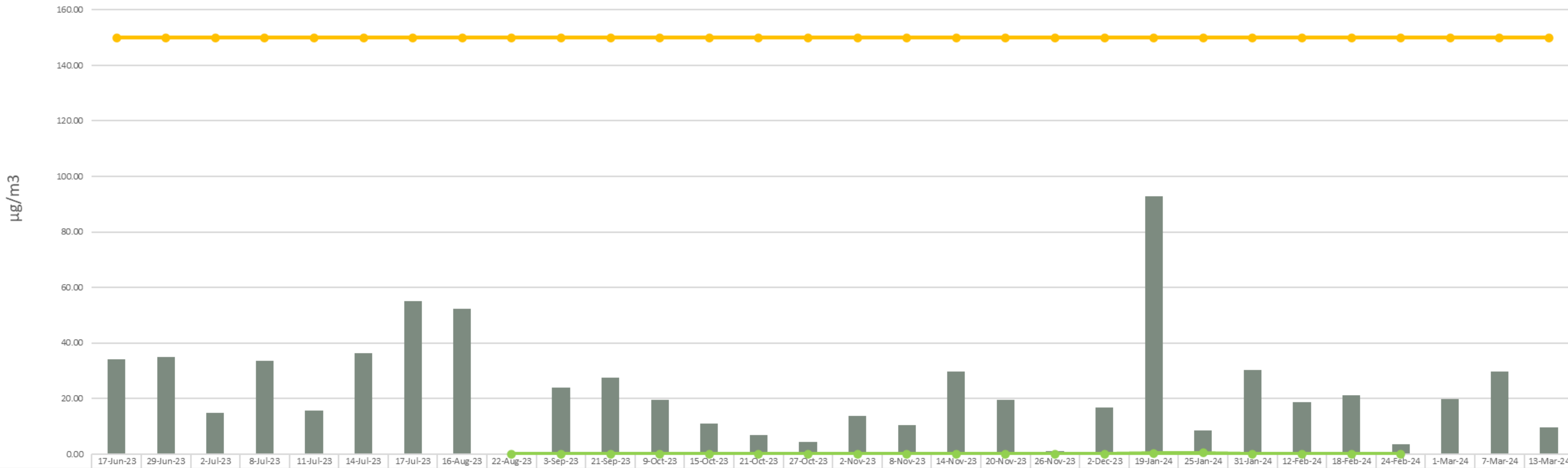
	17-Jun-23	29-Jun-23	2-Jul-23	8-Jul-23	11-Jul-23	14-Jul-23	17-Jul-23	16-Aug-23	22-Aug-23	3-Sep-23	21-Sep-23	9-Oct-23	15-Oct-23	21-Oct-23	27-Oct-23
STN. 3 (PM10)	8.47	25.14	27.92	31.94	35.42	8.75	29.86	51.11	22.38	21.81	13.47	18.75	5.69	6.11	
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 3 (PM10)	11.67	8.61	26.39	17.92	1.94	21.67	19.86	9.72	22.78	19.03	30.98	15.14	93.33	25.97	9.17
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



	17-Jun-23	29-Jun-23	2-Jul-23	8-Jul-23	11-Jul-23	14-Jul-23	17-Jul-23	16-Aug-23	22-Aug-23	3-Sep-23	21-Sep-23	9-Oct-23	15-Oct-23	21-Oct-23	27-Oct-23
STN. 4 (PM10)	41.67	71.39	24.72	32.50	64.72	5.14	25.97	55.42	24.59	24.31	6.25	24.86	11.25	5.83	5.28
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 4 (PM10)	15.00	94.58	59.86	21.11	3.47	40.14	34.17	13.06	27.08	33.33	11.53	7.92	37.64	32.50	15.28
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



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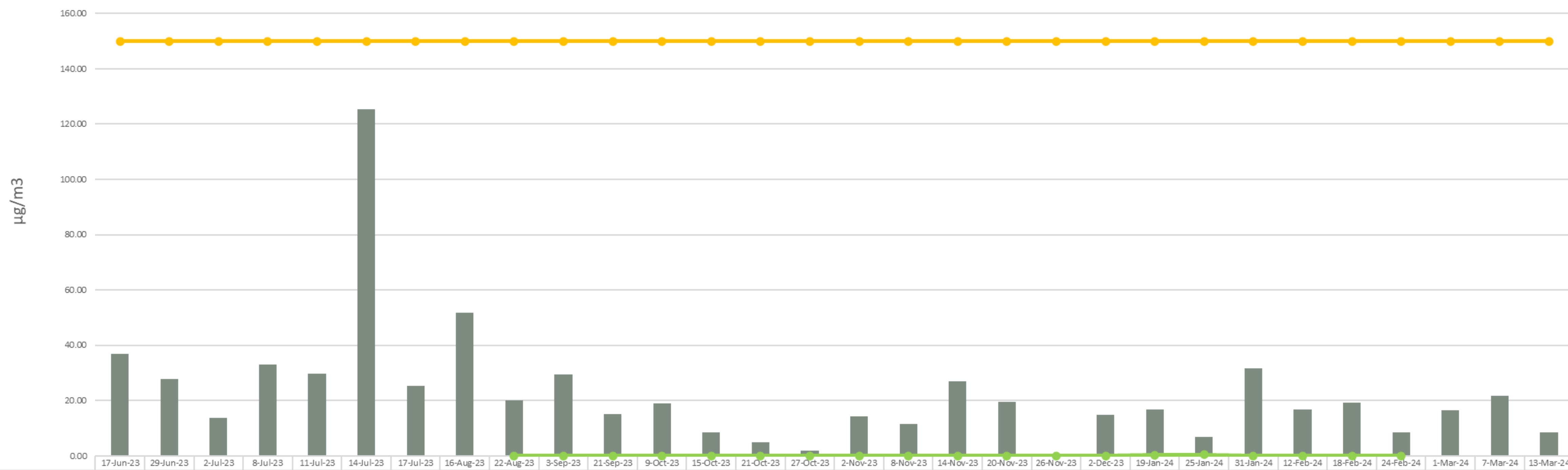
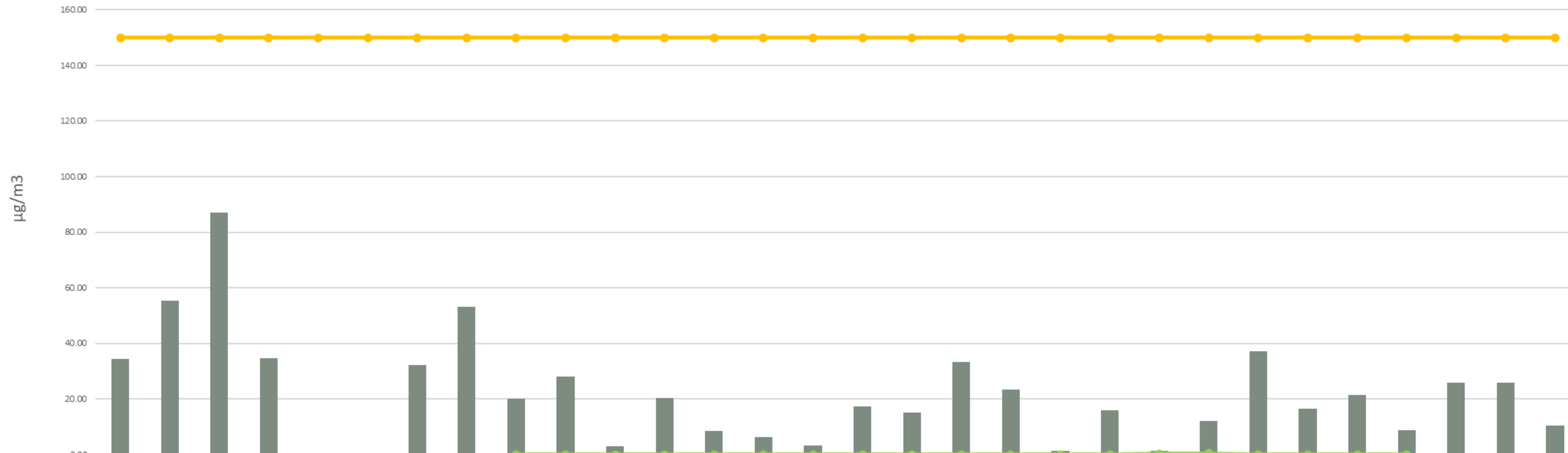
STN. 5 (PM10)	34.17	35.00	14.86	33.47	15.56	36.25	55.21	52.22		23.89	27.64	19.44	11.11	6.81	4.43
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 5 (PM10)	13.75	10.42	29.72	19.44	1.11	16.67	92.92	8.61	30.14	18.75	21.11	3.47	19.86	29.72	9.72
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



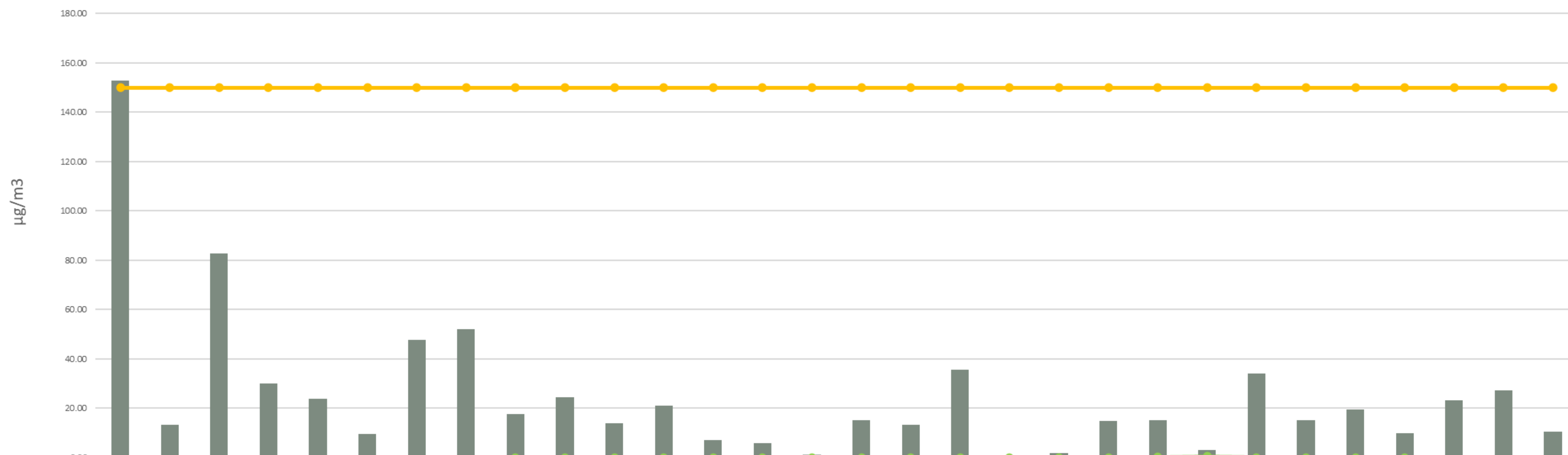
	17-Jun-23	29-Jun-23	2-Jul-23	8-Jul-23	11-Jul-23	14-Jul-23	17-Jul-23	16-Aug-23	22-Aug-23	3-Sep-23	21-Sep-23	9-Oct-23	15-Oct-23	21-Oct-23	27-Oct-23
STN. 6 (PM10)	36.81	27.78	13.75	33.06	29.72	125.42	25.28	51.81	20.07	29.44	15.14	18.89	8.47	4.86	1.99
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 6 (PM10)	14.31	11.67	27.08	19.44	0.42	14.86	16.81	6.94	31.53	16.67	19.31	8.47	16.39	21.81	8.61
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



	17-Jun-23	29-Jun-23	2-Jul-23	8-Jul-23	11-Jul-23	14-Jul-23	17-Jul-23	16-Aug-23	22-Aug-23	3-Sep-23	21-Sep-23	9-Oct-23	15-Oct-23	21-Oct-23
STN. 7 (PM10)	34.44	55.28	87.08	34.58			32.22	53.19	20.00	28.06	2.92	20.28	8.47	6.39
Rainfall (mm)									0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	27-Oct-23	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 7 (PM10)	3.33	17.22	15.14	33.19	23.47	1.39	15.97	1.39	12.08	37.08	16.53	21.53	8.89	25.83	25.83	10.56
Rainfall (mm)	0	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



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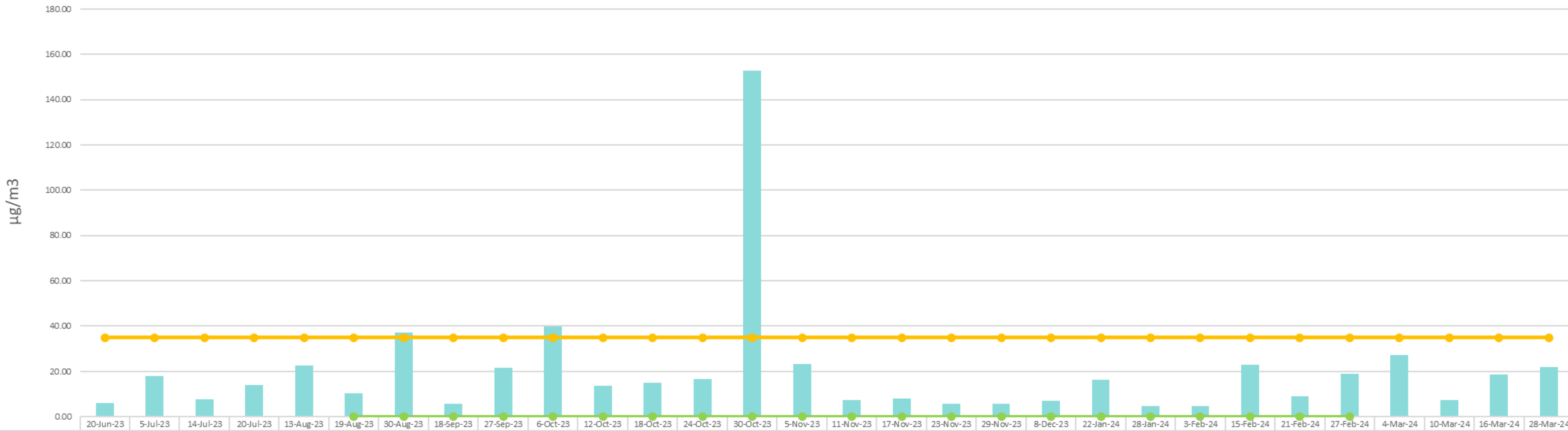
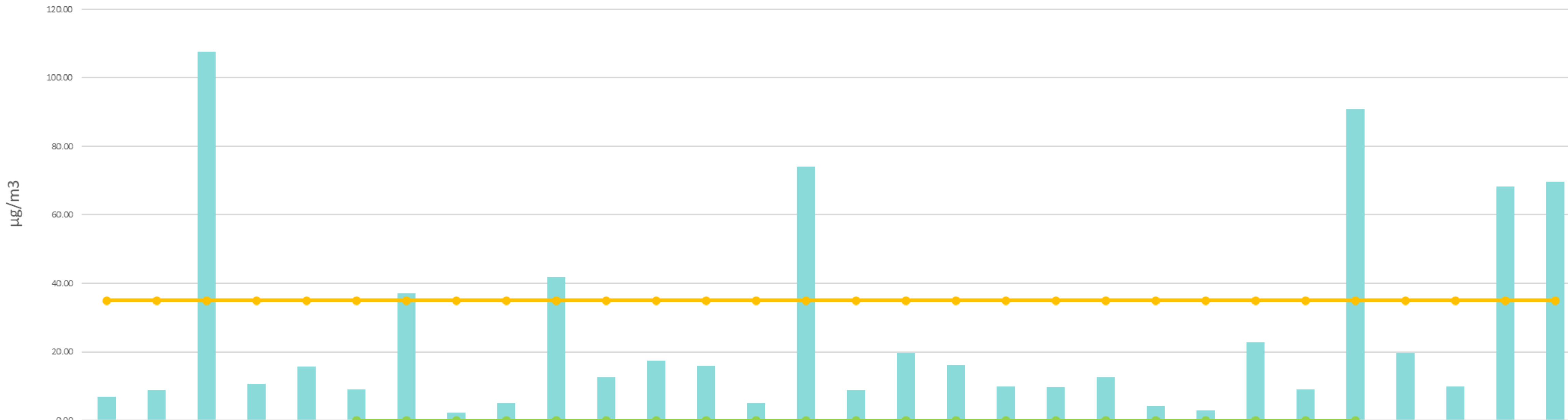
STN. 8 (PM10)	152.92	13.33	82.78	30.00	23.89	9.44	47.66	51.94	17.48	24.31	13.89	21.11	7.08	5.69	1.25
Rainfall (mm)									0	0	0	0	0	0	0
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

	2-Nov-23	8-Nov-23	14-Nov-23	20-Nov-23	26-Nov-23	2-Dec-23	19-Jan-24	25-Jan-24	31-Jan-24	12-Feb-24	18-Feb-24	24-Feb-24	1-Mar-24	7-Mar-24	13-Mar-24
STN. 8 (PM10)	15.28	13.19	35.69		1.81	14.86	15.00	3.19	34.17	15.28	19.58	9.88	23.33	27.22	10.56
Rainfall (mm)	0	0	0	0	0	0	0.25	0.51	0	0	0	0			
NRCA Std.	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150



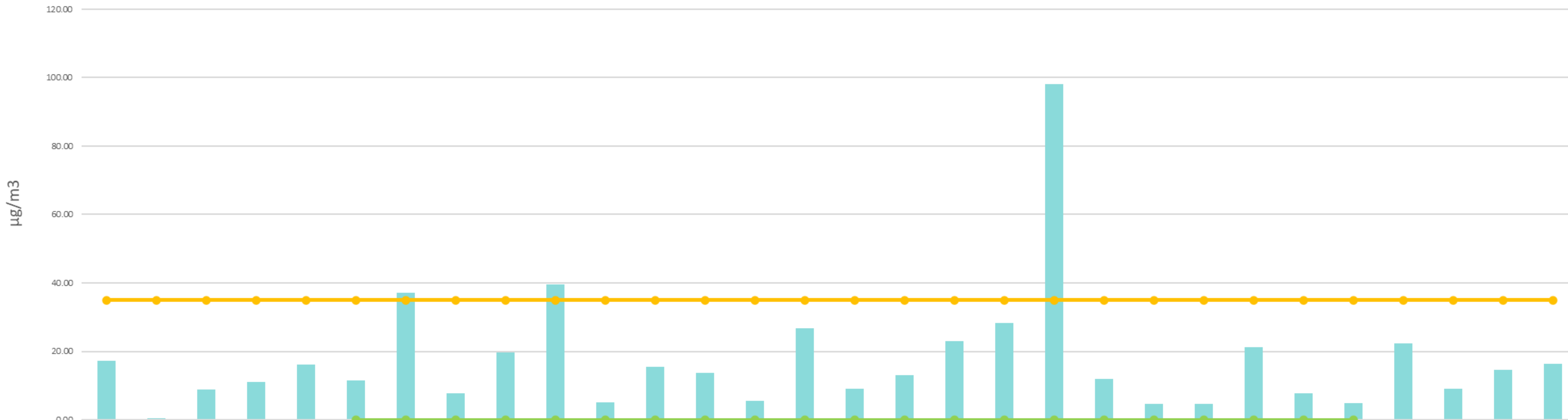
	20-Jun-23	5-Jul-23	14-Jul-23	20-Jul-23	13-Aug-23	19-Aug-23	30-Aug-23	18-Sep-23	27-Sep-23	6-Oct-23	12-Oct-23	18-Oct-23	24-Oct-23	30-Oct-23
STN. 1 (PM2.5)	5.97	18.06	7.78	13.89	22.50	10.42	37.08	5.83	21.67	39.86	13.75	14.86	16.53	152.64
Rainfall (mm)						0	0	0	0	0	0	0	0	0
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35

	5-Nov-23	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 1 (PM2.5)	23.19	7.50	8.06	5.83	5.83	6.94	16.39	4.72	4.86	22.92	8.89	18.89	27.08	7.36	18.75	22.08
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35



	20-Jun-23	5-Jul-23	14-Jul-23	20-Jul-23	13-Aug-23	19-Aug-23	30-Aug-23	18-Sep-23	27-Sep-23	6-Oct-23	12-Oct-23	18-Oct-23	24-Oct-23	30-Oct-23	5-Nov-23
STN. 2 (PM2.5)	6.81	8.89	107.50	10.56	15.69	9.03	37.22	2.22	5.14	41.67	12.50	17.50	15.97	5.00	73.96
Rainfall (mm)						0	0	0	0	0	0	0	0	0	0
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35

	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 2 (PM2.5)	8.75	19.58	16.15	10.00	9.72	12.50	4.31	2.92	22.78	9.03	90.83	19.58	9.86	68.33	69.58
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35



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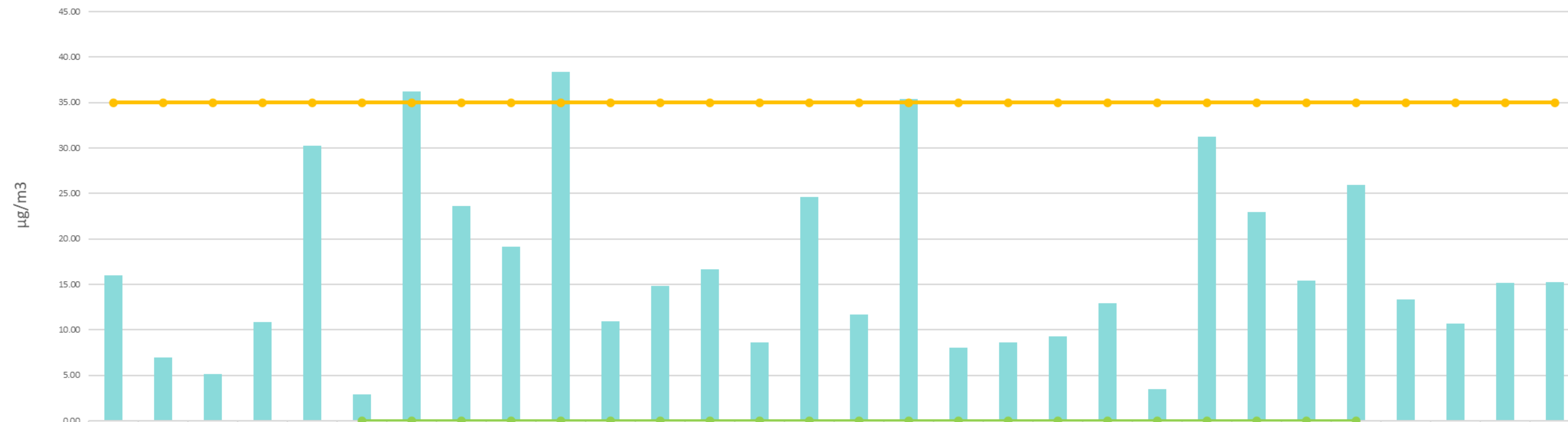
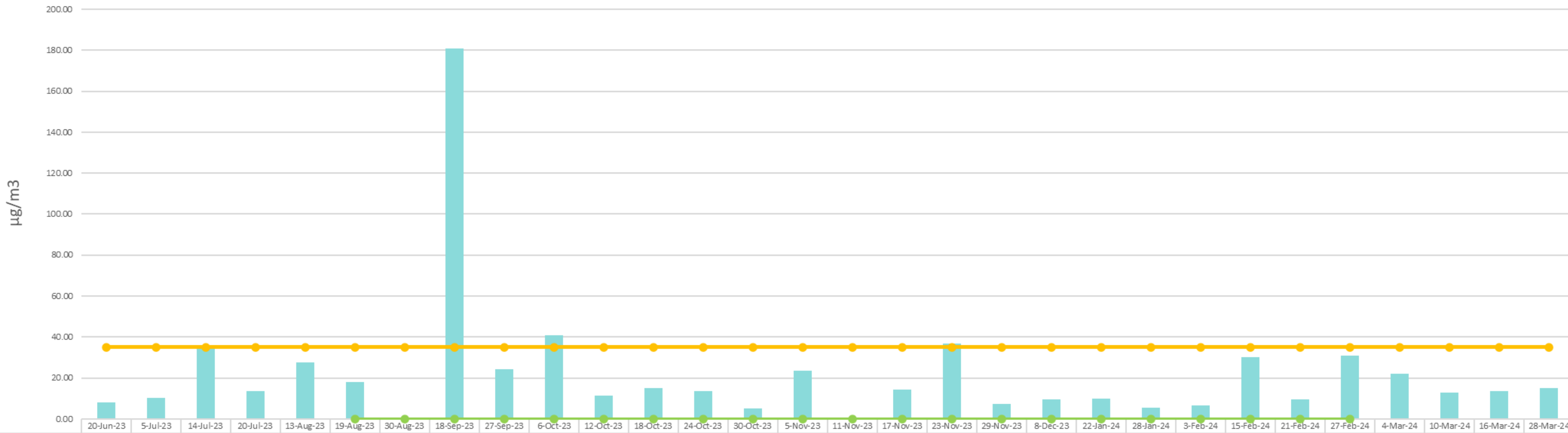
STN. 3 (PM2.5)	17.22	0.42	8.75	10.97	16.12	11.53	37.08	7.64	19.72	39.58	5.00	15.42	13.75	5.56	26.81	9.17	13.06	22.92	28.19	98.19	11.94	4.58	4.72	21.25	7.78	4.86	22.36	9.03	14.58	16.25
Rainfall (mm)						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35



	20-Jun-23	5-Jul-23	14-Jul-23	20-Jul-23	13-Aug-23	19-Aug-23	30-Aug-23	18-Sep-23	27-Sep-23	6-Oct-23	12-Oct-23	18-Oct-23	24-Oct-23	30-Oct-23
STN. 4 (PM2.5)	15.97	6.94	5.14	10.83	30.28	2.92	36.25	23.61	19.17	38.33	10.97	14.86	16.67	8.61
Rainfall (mm)						0	0	0	0	0	0	0	0	0
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35

	5-Nov-23	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 4 (PM2.5)	24.58	11.67	35.42	8.06	8.61	9.31	12.92	3.47	31.25	22.92	15.41	25.97	13.33	10.69	15.14	15.28
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35



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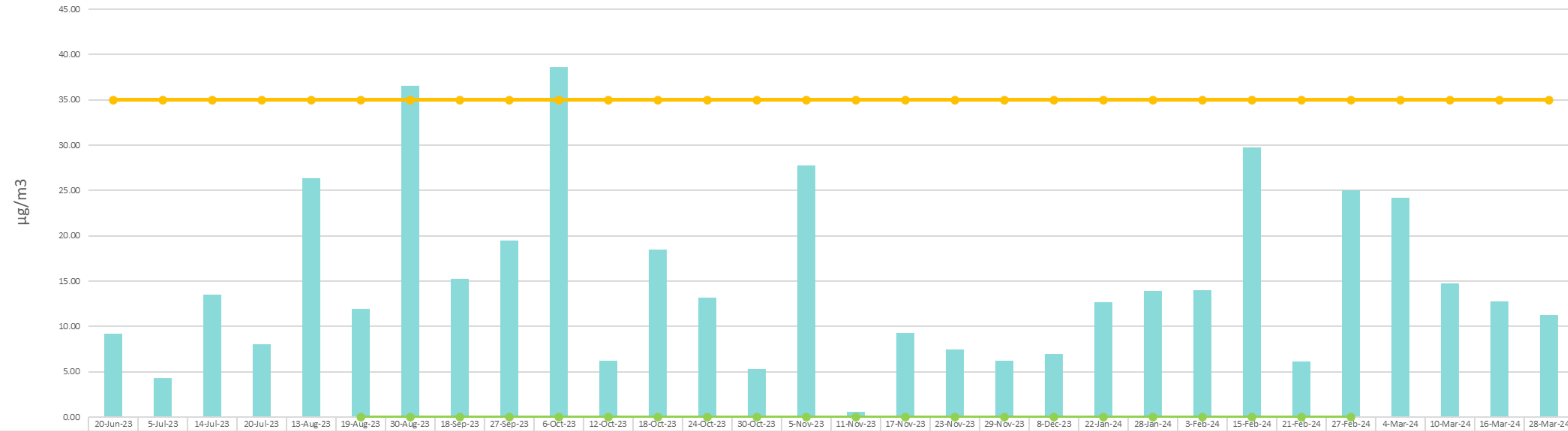
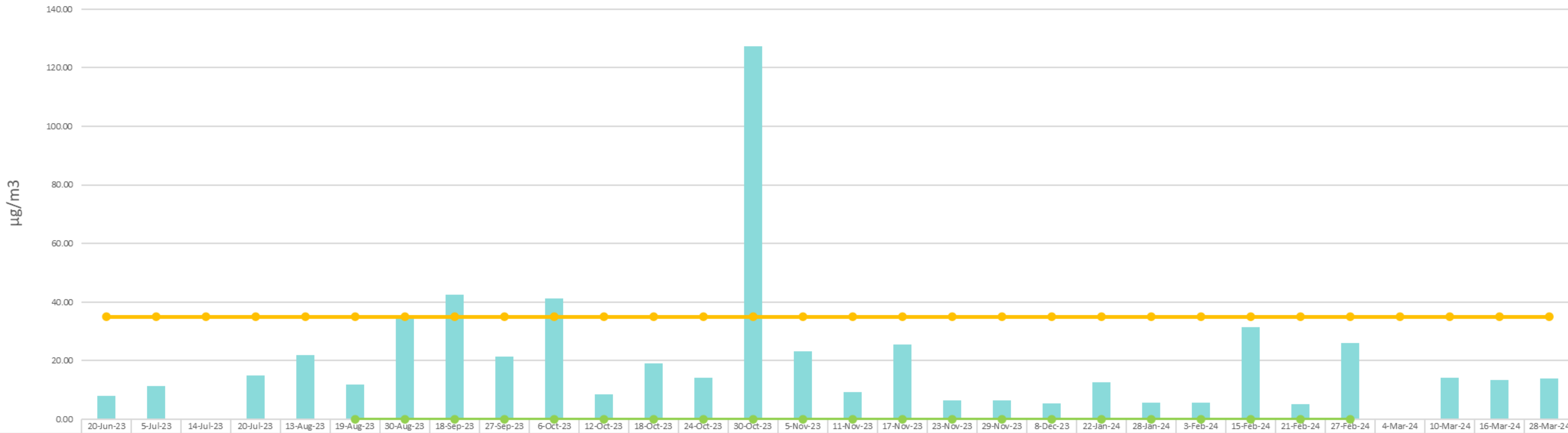
STN. 5 (PM2.5)	8.19	10.28	36.25	13.47	27.64	18.19		180.83	24.44	40.97	11.39	15.14	13.75	5.28	23.75
Rainfall (mm)						0	0	0	0	0	0	0	0	0	0
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35

	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 5 (PM2.5)	0.42	14.44	36.67	7.22	9.72	9.86	5.42	6.67	30.28	9.70	30.97	21.94	12.92	13.47	15.14
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35

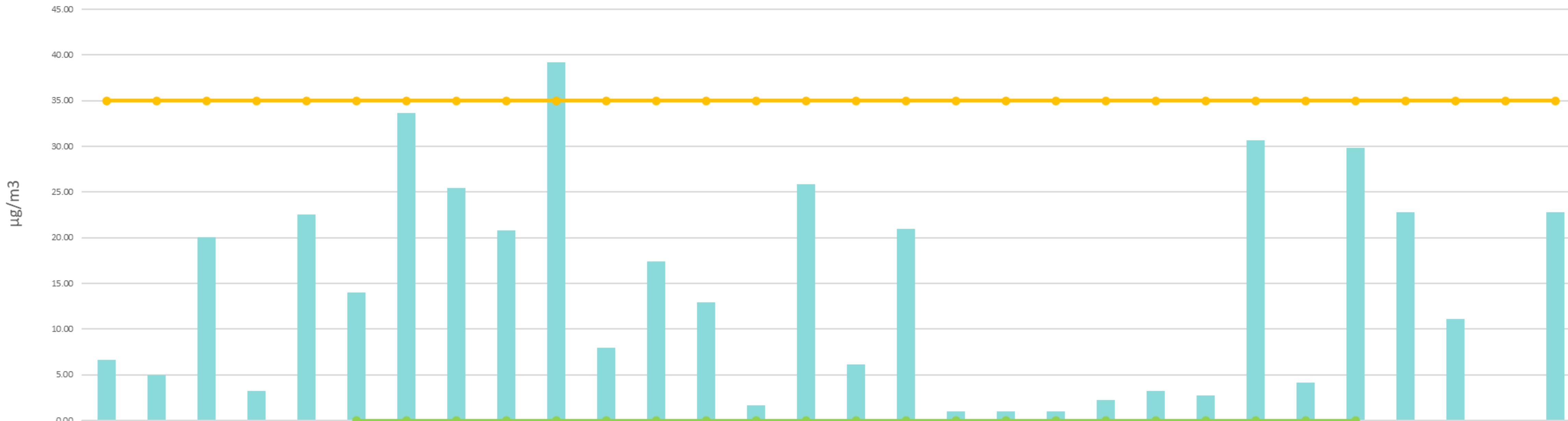


	20-Jun-23	5-Jul-23	14-Jul-23	20-Jul-23	13-Aug-23	19-Aug-23	30-Aug-23	18-Sep-23	27-Sep-23	6-Oct-23	12-Oct-23	18-Oct-23	24-Oct-23	30-Oct-23	5-Nov-23	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 6 (PM2.5)	9.17	4.31	13.47	8.06	26.39	11.94	36.53	15.28	19.44	38.61	6.25	18.47	13.19	5.28	27.78	0.56	9.31	7.50	6.25	6.94	12.64	13.89	14.03	29.72	6.11	25.00	24.17	14.72	12.78	11.25
Rainfall (mm)						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35



	20-Jun-23	5-Jul-23	14-Jul-23	20-Jul-23	13-Aug-23	19-Aug-23	30-Aug-23	18-Sep-23	27-Sep-23	6-Oct-23	12-Oct-23	18-Oct-23	24-Oct-23	30-Oct-23
STN. 7 (PM2.5)	8.06	11.25		14.86	21.94	11.94	34.58	42.50	21.39	41.25	8.61	19.03	14.31	127.36
Rainfall (mm)						0	0	0	0	0	0	0	0	0
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35

	5-Nov-23	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 7 (PM2.5)	23.33	9.31	25.56	6.53	6.53	5.42	12.64	5.69	5.69	31.39	5.28	26.11		14.17	13.47	14.03
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35



	20-Jun-23	5-Jul-23	14-Jul-23	20-Jul-23	13-Aug-23	19-Aug-23	30-Aug-23	18-Sep-23	27-Sep-23	6-Oct-23	12-Oct-23	18-Oct-23	24-Oct-23	30-Oct-23	5-Nov-23	11-Nov-23	17-Nov-23	23-Nov-23	29-Nov-23	8-Dec-23	22-Jan-24	28-Jan-24	3-Feb-24	15-Feb-24	21-Feb-24	27-Feb-24	4-Mar-24	10-Mar-24	16-Mar-24	28-Mar-24
STN. 8 (PM2.5)	6.67	5.00	20.06	3.19	22.50	14.03	33.61	25.42	20.83	39.17	7.92	17.36	12.92	1.67	25.83	6.11	20.97	0.97	0.97	0.97	2.22	3.19	2.78	30.69	4.17	29.86	22.78	11.11		22.78
Rainfall (mm)						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
US EPA Std.	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35

Appendix 12 – Infrastructure and Services Response (Western Regional Health Authority)

Environmental Impact Assessment (EIA) for the Proposed Housing and Resort Development at Paradise Park, Paradise Pen, Westmoreland
Infrastructure and Services Response

Hospitals, health centres and other facilities, and the population/areas they serve.

Westmoreland is situated at the most westerly end of the island bordered by Hanover to the North, St. James to the northeast and St. Elizabeth to the east. The parish covers an area of eight hundred and twenty nine square kilometers with an estimated population of one hundred and forty four thousand six hundred and twenty one (144,621)[1] persons with approximately one third of the population under 15 years of age and 10.8 % of the population over 59 years of age. Savanna la Mar, is the capital town, and is located on flat lands. The community of Savanna la Mar consists of three thousand nine hundred and eighty (3,980) households, with an estimated population of thirteen thousand nine hundred and thirty (13,930) individuals.[2] (SDC Survey, 2018).

In Savanna la Mar, health services are offered from both public and private health care facilities. The public sector offering consists of three health centres within the Savanna la Mar Health District, supported by one hospital: the Type B Savanna la Mar Public General Hospital.

The Savanna la mar Health Centre is a Type IV health centre, offering the highest level of care and the widest range of services in the parish. It is designated as a Type IV as the administrative block is adjacent to it. It acts as headquarters of the health district and parish health centre, accepting referral within the Savanna la Mar Health District, while it cushions the demands from the other four health districts in the parish. This health centre serves a population of over 65,000. In 1984, three years after being built, the population served by the facility was 19, 559, and over the years, this population has increased exponentially, inclusive of several housing schemes in the health district. Under Primary Care Reform, further infrastructure upgrade is planned, as the current physical facility has outgrown the services offered and the population served.

The Type 2 facility, Petersfield Health Centre, and the Type 1 facility, Williamsfield Health Centre, assist clients in this populous health district, serving 12,00 – 15,000 (STATIN) and 4,000 (Primary Care Survey, June 2023) persons, respectively. Ideally, more severe cases should be referred from these two facilities to the Savanna la Mar Health Centre.

Private health services are offered by a private hospital, Royale Medical Hospital, Clinics and Imaging Centre. Several general practitioners conduct private practices/ medical centres in the health district, some offering imaging, blood collection and pharmacy services. Two private medical centres in Savanna la Mar offer 24-hour service: Dr. Reddy Medical Centre and Urgent Care Centre. Many private pharmacies operate in the town centre and in the suburban areas. Home visits are done by the public health team and private practitioners.

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[1] Mid Year Population for Westmoreland. STATIN Jamaica available at: www//statinja.gov.jm/Demo_SocialStats/populationbyparish.aspx update March 2013 accessed on 21/3/2014
2. Community Profile and Livelihood Baseline Assesment. Donovan and Marc James, Department of Geography(UWI). https://www.caribank.org/sites/default/files/publication-resources/LBA_Savanna-La-Mar_Mar2.pdf

Several private laboratories operate in the town of Savanna la Mar, with sample collection sites in some private practices.

Paradise Development is located less than 2.5km from the Savanna la Mar Public General Hospital, which is the nearest hospital, and the Savanna la Mar Health Centre which is adjacent to the hospital. The Royale Medical Hospital, Clinics and Imaging Centre (private health facility) is also less than 2.5km away, while the Omega Medical Hospital (private health facility) in Negril is located 40km away. The Black River Type C Hospital in St. Elizabeth is 47km away, and the Cornwall Regional Hospital Type A facility in Montego Bay is 50.4km from the Paradise Development.

Ambulance or other services provided

The Type B Savanna la Mar Public General Hospital offers 24-hour services, 7 days per week, inclusive of the following departments: Accident & Emergency, Internal Medicine, Paediatrics, General Surgery, Orthopaedics, and Obstetrics & Gynaecology. These are supported by Operating Theatre, Laboratory, Radiology, and Pharmacy services, among others. This hospital has outgrown its current bed complement and is scheduled for significant expansion in infrastructure and staffing.

The Savanna la Mar Health Centre offers services Monday- Thursday from 8:30am - 5:00pm and on Fridays from 8:30am - 4:00pm. That health centre has extended hours on Mondays – Thursdays from 5:00pm - 9:00pm and Fridays from 4:00pm – 8:00pm. On Saturdays, the operating hours are 8:00 am - 4:00pm. Services offered during regular weekday operating hours are Maternal and Child Health and Family Planning Services, General Curative and Treatment Services (routine medicals and well visits, management of acute disorders and chronic diseases, management of injuries, wound care, minor surgical, gynaecological and orthopaedic injuries), Environmental Health Services, Nutrition services, Adolescent Health, Oral Health services, Diagnostic services (laboratory) and Dermatology services.
Pharmacy services are offered by the National Health Fund Pharmacy at the Savanna la Mar Public General Hospital.
Mental Health clinics are held at the Savanna la Mar Public General Hospital, staffed by the Community Mental Health Team, who also provide routine maintenance visits in community, as well as respond to crisis calls.

There are seven ambulances assigned to the Westmoreland Public Health Services, with most of them based at the Savanna la Mar Public General Hospital. This is an aged fleet, but we recently benefited from 2 new ambulances, which improve the overall operational time.
The Emergency Medical Services (EMS) operates one ambulance out of the Negril Fire Department which responds to emergency situations. They are trying the replace the ambulance assigned to the Savanna la Mar Fire Department, as that is inoperable due to an accident earlier this year.
Private ambulance services support the hospital fleet, as needed.
Regarding fire services, one fire station is located in the town of Savanna la Mar.

Prevalent sicknesses and health issues residents suffer from.

For the year 2022, the greatest number of visits to the health centres was for Curative services (47%), with the most common diagnoses being due to Non Communicable Diseases (NCDs).

Among cardiovascular diseases, Hypertension was the leading cause for visits at the health centres, followed by the combined conditions of Diabetes Mellitus and Hypertension. The lowest number of visits was for Oral Health services (4%).

At the Savanna la Mar Public General Hospital, the leading cause of death was due to Cardiovascular Diseases such as Hypertension, Coronary Heart Disease and Cerebrovascular Accidents (stroke), as well as respiratory diseases, including Respiratory Failure and COVID-19 Pneumonia. Other communicable diseases, road traffic crashes and violence-related injuries add to the demands made on this Type B hospital.

Appendix 13 – Services and Response Support (Jamaica Fire Brigade)

JAMAICA FIRE BRIGADE
WESTMORELAND DIVISION
71 DALLING STREET
SAVANNA-LA-MAR P.O.
Tel. (876) 955-9682 Cell 564-1176
Email: dhwestmoreland.jfb@cwjamaica.com

14th **August, 2023**

Jamaica Fire Brigade Divisions and Services

The role of the Jamaica Fire Brigade is to protect life and property from fire or other disasters within the Island and its territorial seas. For operational management the Fire Brigade is divided into four areas: Area 1, Area 2, Area 3, and Area 4. The Westmoreland Division along with St. James and St. Elizabeth and Hanover Divisions comprise Area 4. (Westmoreland Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

The Westmoreland Division has a staff complement of over one hundred twenty-eight (128) firefighters, which includes Operational/Suppression teams, Emergency Medical Services teams and Fire Prevention and Investigation team. The Operation/Suppression teams respond to fires and other emergencies, while the Fire Prevention and Investigation team is comprised of firefighters trained as Fire Prevention Inspectors and Investigators. These Inspectors and investigators are trained to review building plans, inspect building to ensure that they are fire and structurally safe, conduct fire and life safety educational exercises with schools, communities, hospitals, and other groups and to conduct fire cause determination. Emergency Medical Service (EMS), this service will involve firefighters, trained as Emergency Medical Technician (EMT), responding to incidents in an ambulance to offer pre- hospital care to victims, package same and transport to the nearest health facility for further medical care. (Westmoreland Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

Response Support in the Project Area

Responses to fire and other emergencies are actioned from two (2) fire stations in the parish: Savanna-la-mar and Negril. The closest fire station to the project is found in Savanna-la-mar, approximately 7km southwest of the proposed site. This station, as well as the Negril Fire Station within the Westmoreland Division, are equipped with first responding units (Pumper/Fire Engine). There is also Ambulances and a Water Tanker assigned to the Savanna-la-mar Fire Station. (Westmoreland Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

The primary response team to incidents in the Paradise Area would be dispatched from Savanna-la-mar fire station. Support if required can be obtained from the Negril Fire Station. Further support can also be acquired from the Montego Bay and Black River Fire Stations, which has the capacity to provide firefighting and rescue response as well as Emergency Medical Service (EMS) response. (Westmoreland Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

Incident Responses 2020 - 2023

According to the Statistical Data, between January 2020 and July 2023, the Westmoreland Division of the Jamaica Fire Brigade has responded to a total seventy (70) incident call in the Smithfield, Paradise Penn and Ferris areas. This includes forty-two (10) Structural Fires thirty-nine (39) Bush/ Rubbish Fires, eighteen (18) Motor Vehicle Accidents and three (3) Special Service Calls (Non-Emergency) (Westmoreland Division, Jamaica Fire Brigade Divisional Headquarters, 2023).

JAMAICA FIRE BRIGADE
SUPERINTENDENT
16/08/23
DATE
WESTMORELAND DIVISION

Rudolph Seaton
Superintendent
Divisional Head (Acting)
Westmoreland Division

Appendix 14 – Perception Survey Questionnaires

Community

PROPOSED RESORT DEVELOPMENT AT PARADISE PARK, SMITHFIELD, WESTMORELAND

COMMUNITY QUESTIONNAIRE

DATE:________________________ **INTERVIEWER:**____

Purpose and Objectives

In compliance with the requirements set out by the National Environment & Planning Agency (NEPA), CL Environmental Co. Ltd. is conducting a community survey as part of the Environmental Impact Assessment (EIA) for the resort development at Paradise Park. The responses will provide insight into the community and gather opinions and concerns of residents regarding the proposed project.

Participation and Data Protection

Participation is voluntary and respondents are free to decline or withdraw at any time without consequence. Information provided will aid in assessing potential impacts and ensure that community perspectives are thoroughly considered throughout the EIA process. All responses will be treated confidentially and utilized solely for the EIA.

Location

The proposed development is situated on the south coast of Westmoreland 3 km east of Savanna-La-Mar, at Paradise Park in the community of Smithfield. The project site runs alongside the Bluefields Bay Fish Sanctuary and some proposed coastal features are located within the sanctuary.

Project Synopsis

Paradise Park Development Corporation Limited is proposing to develop a total land area of 1,120 acres (453 hectares) at Paradise Park, which features a variety of distinct ecosystems, including mangroves, wetlands, fields, beach, rivers, and grassy areas. The shoreline spans approximately 4,572 meters (about 15,000 feet), including 680 meters (approximately 2,230 feet) of white sand beach. Given the rich natural diversity and beauty, the proposed resort is envisioned as a one of a kind hospitality development that will focus on conservation, restoration, and expansion of existing natural habitats.

The proposed resort development comprises five (5) land use programmes:

1. **Resort**: 120 resort suites with access to resort amenities and designated beach area. This includes land villas, as well as overwater and mangrove villas, accessible by elevated boardwalks.
2. **Hotel**: 200 rooms spread across 7 building strips, with access to all hotel amenities and a spacious, designated beach.
3. **Villas**: 100 villas positioned along the golf course, and privately owned by residents.
4. **Golf**: Pro tour level golf course and club house, with its own Food and Beverage facility, situated within the villa land use.
5. **Service Facilities**:
    - Solar farm
    - Water treatment plant
    - Water tanks
    - Gate houses
    - Staff facilities and service buildings
    - Horse stables
    - Military station
    - Helicopter landing pad
    - Parking

There will be separate amenities for the Resort, Villas and Hotel, as well as some shared for all guests. Amenities include:

- Spa/Wellness Centre
- Gym
- Tennis, Basketball & Pickle Ball Courts
- Music Recording Studio
- Farming School
- Cooking School
- Equestrian Centre
- Polo Club
- Art School
- Fragrance School
- Children's Club
- Rum Bottling Facility

Key proposed coastal features:

- Rock Groynes
- Sandy Wading/Swimming Area
- Sill
- Sediment Sink
- Dock and River Training Structure
- Land Reclamation

Additionally, 428 acres of land will remain undeveloped for conservation purpose. Ecological zones, including existing mangrove, mangrove expansion and lagoon addition, will be preserved for ecological preservation, appreciation, recreation, and leisure.

COHORT DESCRIPTION

1. What is the name of this/your community? ____
2. Gender (i) male (ii) female (iii) do not wish to disclose
3. Age group (i) 18- 24 yrs (ii) 25 - 34 yrs (iii) 35 – 44 yrs (iv) 45 – 54 yrs (v) 55 - 64 yrs (vi) older than 65 yrs
4. Are you the head of your household (i) yes (ii) no (iii) do not wish to disclose
5. What is your current employment status? (i) self-employed (ii) employed full time (iii) employed part-time (iv) unemployed (v) retired (vi) other
6. Including yourself, how many people live in your household? _____

    (i) # adults ____ (ii) # children under 18 yrs ___ (ii) elders older than 65 yrs ___

1

7. How long have you lived in your community? (i) < 1 yr (ii) 1-5 yrs (iii) 5- 10 yrs (iv)10-15 yrs (v) >15 yrs
8. What is your average weekly income? (i) no income (ii) under $15,000 per week (iii) $15,000 per week (iv) $15,001 - $18,000 per week (v) $18,001 - $20,000 per week (vi) over $20,000 per week (vii) do not wish to disclose
9. What was the last school you attended? (i) None (ii) Primary/All Age (iii) High School (iv) College (v) University (vi) HEART/Vocational training institute (vii) Other
10. Is there anyone in your household attending school at this time? (i) yes (ii) no

    If yes, what school(s) do they attend (i) infant/basic (ii) primary/all age (iii) high school (iv) college (v) university (vi) HEART/ Vocational Training Institute (vii) home schooled
11. Are there any recreational centres/spaces in your community? (i) yes (ii) no (iii) not sure
    a. **If yes,** please give name and type ____
    b. **If yes,** is this facility accessible to all age groups and persons with special needs (i) yes (ii) no (iii) not sure
    c. **If yes,** is this facility maintained and in "good condition"? (i) yes (ii) no (iii) not sure

PERCEPTION

12. Before this interview, had you ever heard of a company called Paradise Park Development Corporation Limited? (i) yes (ii) no
13. Before this interview, did you know that Paradise Park Development Corporation Limited is proposing to develop land at Paradise Park, Smithfield, Westmoreland? (i) yes (ii) no

    If yes:
    a. How were you made aware? (i) newspaper (ii) television (iii) radio (iv) community meeting (v) word of mouth (vi) social media (vii) other____
    b. Are you aware of the details? (i) yes (ii) no

If yes to b, were aware of the following details (mark with X):		YES	NO
i.	120 Resort suites, comprising land, overwater and mangrove villas		
ii.	200 Hotel rooms spread across 7 building strips		
iii.	100 privately owned Villas		
iv.	Pro tour level golf course and club house		
v.	Solar farm		
vi.	Water treatment plant		
vii.	Equestrian Centre with horse stables		
viii.	Polo Club		
ix.	Helicopter landing pad		
x.	Music Recording Studio		
xi.	Schools (Farming, Cooking, Art and Fragrance)		
xii.	Rum Bottling Facility		
xiii.	Rock Groynes		
xiv.	Sandy Wading/Swimming Area		
xv.	Dock and River Training Structure		
xvi.	Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)		

14. Have there been any problems/issues (environmental, social, or other) on the proposed project site? (i) yes (ii) no (iii) don't know
    a. **If yes** what were/are the issues

    ____
15. Do you have any concerns about the project as proposed? (i) yes (ii) no (iii) not sure/don't know

If yes, any concerns specific to the following (mark with X):	YES	NO	If YES, list concerns	Suggested ways to resolve
i. Resort suites (land, overwater and mangrove) ** Overwater suites are outside Bluefields Bay Fish Sanctuary*				
ii. Hotel rooms spread across 7 building strips				

2

If yes, any concerns specific to the following (mark with X):	**YES**	**NO**	**If YES, list concerns**	**Suggested ways to resolve**
iii. 100 privately owned Villas				
iv. Pro tour level golf course and club house				
v. Solar farm				
vi. Water treatment plant				
vii. Equestrian Centre with horse stables				
viii. Polo Club				
ix. Helicopter landing pad				
x. Music Recording Studio				
xi. Schools (Farming, Cooking, Art and Fragrance)				
xii. Rum Bottling Facility				
xiii. Rock Groynes * *Within Bluefields Bay Fish Sanctuary*				
xiv. Sandy Wading/Swimming Area * *Within Bluefields Bay Fish Sanctuary*				
xv. Dock (*within Bluefields Bay Fish Sanctuary*) and River Training Structure				
xvi. Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)				

16. At this time, do you use the proposed site for any type of activity? (i) yes (ii) no

	NO	**YES**	**If YES, for what purpose**
Land			
Beach			
Sea			

17. In the past did you use the proposed site for any type of activity? (i) yes (ii) no

	NO	**YES**	**If YES, for how long?** (i) less than a yr (ii) 1-5 yrs (iii) 6-10 yrs (iv) 11-15 yrs (v) 16-19 yrs (vi) 20 or more yrs	**If YES, for what purpose**
Land				
Beach				
Sea				

3

18. Do you know of anyone who depends/uses the proposed site for any type of activity? (i) yes (ii) no

	NO	YES	If YES, for what purpose
Land			
Beach			
Sea			

19. Do you think this project will affect your Life/livelihood, Community or Environment? (i) yes (ii) no (iii) not sure

If yes, how:	Life/livelihood	Community	Environment
(i) Positively			
If positive, how so?			
(ii) Negatively			
If negative, how so?			
How do you think can be resolved?			
(iii) not at all			
(iv) not sure/don't know			

HOUSING, HEALTH AND SOCIAL SERVICES

20. What is the ownership status of the house you live in? (i) Own (ii) Lease (iii) Rent (iv)Government Own (v) Informal (vi) Family own (vii) Other, please specify ________________

21. What is the ownership status of the land on which your house is located? (i) Own (ii) Lease (iii) Squat on (iv) Family Owned (v) Government Owned (vi) Other, please specify ________________

22. What type of construction material is your residence made from?
    a. **Walls:** (i) Concrete and blocks (ii) Wood/Board (iii) Zinc (iv) Other specify________________
    b. **Roof:** (i) Metal sheeting (zinc) (ii) Concrete (iii) Wood (iv) Other specify________________

23. What type of toilet facility do you have? (i) Water Closet (ii) Pit Latrine (iii) None (iv) Other, specify ____________

24. What does your household use for lighting? (i) Electricity (ii) Kerosene oil (iii) Gas (iv) Solar (v) Other, specify

    ____

    If (i), do you have any problems with electivity supply (i) yes (ii) no

    If yes, what is the problem? (i) irregular supply/ outages (ii) no lines run to the area (iii) other, please specify

    ____

25. What (type of fuel does the household) do you **use most** for cooking? (i) Gas (ii) Electricity (iii) Wood (iv) Coal (v) Other, specify ________________

26. What is the main source of household domestic water supply? (i) Public piped water into dwelling (ii) Community Tank (iii) Government Water Trucks (free) (iv) Public Standpipe (vi). Private Water Trucks (paid) (vi) Spring or River (vii) Rainwater harvesting (ix) Other, please specify________________

27. Do you have any problems with domestic/household water supply (i) yes (ii) no

    If yes, what is the problem? (i) no water at all (ii) no pipes run to the area (iii) irregular water supply (iv) low water pressure (v) other, please specify ________________

28. What type of telephone service do you use (i) fixed/land line (ii) mobile/cellular telephone (iii) none (iv) other, please specify ________________

29. Does your community have fixed line (residential) telephone (land line) service? (i) yes (ii) no (iii) don't know

30. What is the main method of garbage disposal for your household? (i) Public Garbage Truck (ii) Private Collection (iii) Burn (iv) Other, please specify ________________

31. Do you have any problems with garbage disposal (i) yes (ii) no

    If yes, what is the problem? (i) irregular collection (ii) illegal dumping (iii) burning (iv) other, please specify

    ____

4

32. Do you recycle? (i) yes (ii) no (iii) sometimes

33. A times when you are sick, where do you mainly seek health care (**write in name and location**)?

(i) Public Clinic/Community Health Centre ______________________

(ii) Public Hospital ______________________

(iii) Private Doctor ______________________

(iv) Private Hospital ______________________

(v) Other ______________________

NATURAL HAZARDS

34. Are there frequent flooding problems in your community? (i) yes (ii) no (iii) don't know
    a. **If yes,** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes (iv) not sure
    b. **If yes,** how often does flooding occur? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year (vi) not sure
    c. **If yes** where are the affected areas? ______________________
    d. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft (iv) don't know

35. Are there frequent flooding problems at or near the proposed area? (i) yes (ii) no (iii) don't know
    a. **If yes** when does flooding occur (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes (iv) not sure
    b. **If yes** how often does flooding occur? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year (vi) not sure
    c. **If yes** where are the affected areas? ______________________
    d. **If yes** how high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft (iv) don't know

36. Is the proposed area affected by storm surge or sea level rise? (i) yes (ii) no (iii) not sure/don't know

37. Is the project and surrounding area affected by fires? (i) yes (ii) no (iii) not sure/don't know

PROTECTED AREAS AND SPECIES

38. Do you know of any site nearby considered to be protected or important (environmental/historical/cultural) (i) yes (ii) no (iii) don't know

    If yes, please give us as much detail as you can on this area ______________________

    ____

39. Please answer the questions for each species.

	Birds	Turtles (Sea turkey)	Crocodiles	Manatees (Sea cow)
Did you know that they are protected by law? (circle answer)	YES / NO	YES / NO	YES / NO	YES / NO
Have you ever seen any?	YES / NO	YES / NO	YES / NO	YES / NO
If yes, please give location (s)				
Do you know anyone who eats them?	YES / NO	YES / NO	YES / NO	YES / NO

40. Is there any other relevant information that you would like to share ?

____

____

____

Thank you for your time in participating in this survey.

Occasionally, NEPA may need to contact survey participants for verification or follow-up purposes. Are you willing to share your name and contact information for this purpose only? (i) yes (**insert complete given name and telephone/email below, and verify spelling**) (ii) no

____

Signature of Interviewer: ______________________

Fishers

PROPOSED RESORT DEVELOPMENT AT PARADISE PARK, SMITHFIELD, WESTMORELAND

FISHERS QUESTIONNAIRE

DATE:________________________ **INTERVIEWER:**____

Purpose and Objectives

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Participation and Data Protection

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Location

The proposed development is situated on the south coast of Westmoreland 3 km east of Savanna-La-Mar, at Paradise Park in the community of Smithfield. The project site runs alongside the Bluefields Bay Fish Sanctuary and some proposed coastal features are located within the sanctuary.

Project Synopsis

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3. **Villas**: 100 villas positioned along the golf course, and privately owned by residents.
4. **Golf**: Pro tour level golf course and club house, with its own Food and Beverage facility, situated within the villa land use.
5. **Service Facilities**:
   - Solar farm
   - Water treatment plant
   - Water tanks
   - Gate houses
   - Staff facilities and service buildings
   - Horse stables
   - Military station
   - Helicopter landing pad
   - Parking

There will be separate amenities for the Resort, Villas and Hotel, as well as some shared for all guests. Amenities include:

- Spa/Wellness Centre
- Gym
- Tennis, Basketball & Pickle Ball Courts
- Music Recording Studio
- Farming School
- Cooking School
- Equestrian Centre
- Polo Club
- Art School
- Fragrance School
- Children's Club
- Rum Bottling Facility

Key proposed coastal features:

- Rock Groynes
- Sandy Wading/Swimming Area
- Sill
- Sediment Sink
- Dock and River Training Structure
- Land Reclamation

Additionally, 428 acres of land will remain undeveloped for conservation purpose. Ecological zones, including existing mangrove, mangrove expansion and lagoon addition, will be preserved for ecological preservation, appreciation, recreation, and leisure.

COHORT DESCRIPTION

1. What is the name of this Fishing Beach/community? ____________________________________
2. Do you live in this community? (i) yes (ii) no. If **no**, which community do you live in? ____________________
3. Gender (i) male (ii) female (iii) do not wish to disclose
4. Age group (i) 18- 24 yrs (ii) 25 - 34 yrs (iii) 35 – 44 yrs (iv) 45 – 54 yrs (v) 55 - 64 yrs (vi) older than 65 yrs
5. Are you involved in fishing/the fishing industry? (i) yes (ii) no

If yes, which of these statements best describes you (mark with X):	
I am a fisher - I catch fish and sell directly to customers	
I am a fisher - I catch fish, but I do not sell directly to customers	
I am a vendor - I have a boat that goes to sea, and I sell the catch	

1

If yes, which of these statements best describes you (mark with X):	
I am a vendor - I buy directly from local fishermen	
I am a vendor I buy from outside the community	
I am a fish scaler/cleaner - I gut and scale fish after customers make their purchase	

Questions 6 - 14 for fishers who "catch fish/go to sea" and for vendors who "have a boat that goes to sea"

6. Are you a registered fisher with the National Fisheries Authority (i) yes (ii) no (iii) do not wish to disclose
7. Are you a member of Bluefields Bay Fisherman's Friendly Society (i) yes (ii) no (iii) do not wish to disclose
8. What do you use for fishing (select all that apply)? (i) line (ii) spear (iii) net (iv) fish pot (v) canoe without engine (vi) canoe with engine (vii) large boat with net (trawler) (viii) other, please specify ______________________________
9. What is the name(s) of the area(s) where you dock/beach and launch your boat, or swim from to go fishing? ______________________________
10. Where do you fish predominantly? (i) nearshore (ii) deep sea 1-5 miles from shore (iii) deep sea more than 5 miles from shore (iv) other, please specify ______________________________
11. What are the names of the areas that you mainly fish? ______________________________
12. How many times per week do you go fishing? (i) one (ii) two (iii) three (iv) four (v) five (vi) more than 5
13. Each time you go fishing on average how many pounds of fish do you usually catch? (i) less than 10lbs (ii) 11 – 20 lbs (iii) 21 -50lbs (iv) 51-100 lbs (v) more than 100 lbs
14. **Please look at the attached map**. Can you indicate any area (i) that you fish (mark with red) (ii) that is a turtle nesting area (mark with black) (iii) that is an area for juvenile fish (mark with blue).

ALL to answer

15. Is anyone else in your household involved in fishing? (i) yes (ii) no
16. Is your fishing related job your full-time job (i) yes (ii) no
    If no, are you otherwise employed (i) yes full time (ii) yes part time (iii) unemployed
17. What was the last school you attended? (i) None (ii) Primary/All Age (iii) High School (iv) College (v) University (vi) HEART/Vocational training institute (vii) Other
18. How long have you been working in the fishing industry? (i) 0 - 5 yrs. (ii) 6 - 11 yrs. (iii) 12 - 17 yrs. (iv) 18 - 24 yrs. (v) 25 - 30yrs. (vi) Over 30 yrs.
19. Over time have you noticed a change in the earning from/ size/ type of fish you catch or sell? (i) yes (ii) no (iii) no change (iv) not sure
    a. **If yes,** what change have you noticed (i) increase (ii) decrease
    b. **If yes,** what do you think is the reason (s)? ______________________________
20. What is the average weekly income of fish sales/fishing related activities? (i) Below $2000 (ii) $2001 - $4000 (iii) $4001 - $6000 (iv) $6001 - $8000 (v) $8001 - $10000 (vi) over $10000 (vii) do not wish to disclose

PERCEPTION

21. Before this interview, had you ever heard of a company called Paradise Park Development Corporation Limited? (i) yes (ii) no
22. Before this interview, did you know that Paradise Park Development Corporation Limited is proposing to develop land at Paradise Park, Smithfield, Westmoreland? (i) yes (ii) no

    If yes:
    a. How were you made aware? (i) newspaper (ii) television (iii) radio (iv) community meeting (v) word of mouth (vi) social media (vii) other______________________________
    b. Are you aware of the details? (i) yes (ii) no

If yes to b, were you aware of the following details (mark with X):		**YES**	**NO**
i.	120 Resort suites, comprising land, overwater and mangrove villas		
ii.	200 Hotel rooms spread across 7 building strips		
iii.	100 privately owned Villas		
iv.	Pro tour level golf course and club house		
v.	Solar farm		
vi.	Water treatment plant		
vii.	Equestrian Centre with horse stables		
viii.	Polo Club		

If yes to b, were you aware of the following details (mark with X):	**YES**	**NO**
ix. Helicopter landing pad		
x. Music Recording Studio		
xi. Schools (Farming, Cooking, Art and Fragrance)		
xii. Rum Bottling Facility		
xiii. Rock Groynes		
xiv. Sandy Wading/Swimming Area		
xv. Dock and River Training Structure		
xvi. Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)		

23. Have there been any problems/issues (environmental, social, or other) on the proposed project site? (i) yes (ii) no (iii) don't know
    a. **If yes** what were/are the issues

    ____

24. Do you have any concerns about the project as proposed? (i) yes (ii) no (iii) not sure/don't know

If yes, any concerns specific to the following (mark with X):	**YES**	**NO**	**If YES, list concerns**	**Suggested ways to resolve**
i. Resort suites (land, overwater and mangrove) ** Overwater suites are outside Bluefields Bay Fish Sanctuary*				
ii. Hotel rooms spread across 7 building strips				
iii. 100 privately owned Villas				
iv. Pro tour level golf course and club house				
v. Solar farm				
vi. Water treatment plant				
vii. Equestrian Centre with horse stables				
viii. Polo Club				
ix. Helicopter landing pad				
x. Music Recording Studio				
xi. Schools (Farming, Cooking, Art and Fragrance)				
xii. Rum Bottling Facility				
xiii. Rock Groynes ** Within Bluefields Bay Fish Sanctuary*				
xiv. Sandy Wading/Swimming Area ** Within Bluefields Bay Fish Sanctuary*				

If yes, any concerns specific to the following (mark with X):	**YES**	**NO**	**If YES, list concerns**	**Suggested ways to resolve**
xv. Dock (*within Bluefields Bay Fish Sanctuary*) and River Training Structure				
xvi. Ecological Zones (existing mangrove, mangrove expansion and lagoon addition)				

25. At this time, do you use the proposed site for any type of activity? (i) yes (ii) no

	NO	**YES**	**If YES, for what purpose**
Land			
Beach			
Sea			

26. In the past did you use the proposed site for any type of activity? (i) yes (ii) no

	NO	**YES**	**If YES, for how long?** (i) less than a yr (ii) 1-5 yrs (iii) 6-10 yrs (iv) 11-15 yrs (v) 16-19 yrs (vi) 20 or more yrs	**If YES, for what purpose**
Land				
Beach				
Sea				

27. Do you know of anyone who depends/uses the proposed site for any type of activity? (i) yes (ii) no

	NO	**YES**	**If YES, for what purpose**
Land			
Beach			
Sea			

28. Do you think this project will affect your Life/livelihood, Community or Environment? (i) yes (ii) no (iii) not sure

If yes, how:	**Life/livelihood**	**Community**	**Environment**
(i) Positively			
If positive, how so?			
(ii) Negatively			
If negative, how so?			
How do you think can be resolved?			
(iii) not at all			
(iv) not sure/don't know			

PROTECTED AREAS AND SPECIES

29. Do you know of any site nearby considered to be protected or important (environmental/historical/cultural) (i) yes (ii) no (iii) don't know

    If yes, please give us as much detail as you can on this area ____

    ____

30. How do you think the Bluefields Bay Fish Sanctuary has impacted the:
    a. Fishing industry (e.g. change in fish catch, quantity, type etc.)

    ____

    ____

    b. Marine environment (e.g. health/ quality)

    ____

    ____

31. Please answer the questions for each species.

	Birds	Turtles (Sea turkey)	Crocodiles	Manatees (Sea cow)
Did you know that they are protected by law? (circle answer)	YES / NO	YES / NO	YES / NO	YES / NO
Have you ever seen any?	YES / NO	YES / NO	YES / NO	YES / NO
If yes, please give location (s)				
Do you know anyone who eats them?	YES / NO	YES / NO	YES / NO	YES / NO

32. Is there any other relevant information that you would like to share ?

____

____

____

Thank you for your time in participating in this survey.

Occasionally, NEPA may need to contact survey participants for verification or follow-up purposes. Are you willing to share your name and contact information for this purpose only? (i) yes (**insert complete given name and telephone/email below, and verify spelling**) (ii) no

____

Signature of Interviewer: ______________________