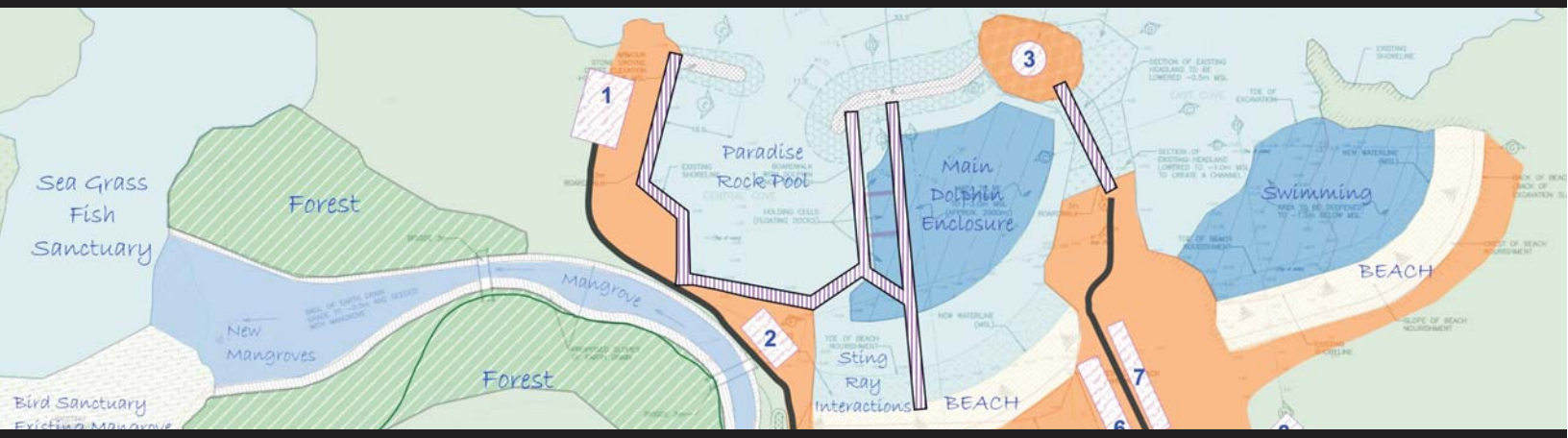
ENVIRONMENTAL IMPACT ASSESSMENT
For the Proposed Dolphin Park, Paradise, Hanover

Draft Report



Prepared for Dolphin Cove Ltd.

April 17th 2007

Environmental Management
Consultants (Caribbean) Ltd
61 Mansfield Meadows,
Ocho Rios St. Ann, Jamaica
876-974-7423
rburrowes@eiacaribbean.com

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED DOLPHIN PARK AT PARADISE, HANOVER.

April 17th 2007.

Table of Contents

List of Figures

List of Tables

List of Preparers and Acknowledgements

This EIA was prepared by Dr. Ravidya Burrowes with assistance from Mr. Osbourne Chin and Ms. Sheilah Forward of *emc*^{2}. Water and sediment sampling was conducted by Mr. Tyrone Rose.

Analytical water chemistry was conducted by the following laboratories:

- ETAS: BOD, TSS, Oil & Grease.
- SRC: Faecal Coliforms
- Mines and Geology: Nutrients.

Mines and Geology Laboratory also conducted heavy metal screening on sediment samples.

The following persons contributed to the environmental baseline assessments:

- Mr. Marlon Hibburt: Coastal Ecology
- Ms. Loureene Jones-Smith: Marine Ecology
- Ms. Beverline Brown: Socio-Economics.
- Smith Warner International Limited: Oceanography & oceanographic modeling.

The authors also wish to thank the NHT and JPSCo for their comments in response to our letter seeking stakeholder input. We also thank all other persons who commented on the Draft TORs to improve the quality of this assessment process, and those who will comment on the EIA Report to ensure the environmental sustainability of development in Jamaica.

Executive Summary

Pursuant to the Natural Resources Conservation Authority (NRCA) Act, Phase 1 of the proposed development may be categorized as having involving two Prescribed Categories (modification of wetlands and development and operation of a theme park) and will therefore require the relevant Environmental Permits. An application for an Environmental License is required in respect of the proposed sewage treatment plant (STP). In addition, beach licenses (under the Beach Control Act) are required for any works to be done in the foreshore, inclusive of any dredging and excavation, and encroachments such as breakwaters and pilings for boardwalks. This EIA has been prepared in compliance with the approved Terms of Reference (TOR) which are included as Appendix 1. The objective of this EIA as stated in the TOR is to "*provide a comprehensive and integrated evaluation of the proposed development, in terms of predicted environmental impacts, needed mitigation strategies, potentially viable alternatives to the project and all related legislation*".

The proposed development site is located on a 20-acre parcel of coastal land referred to as "*Paradise*" on the Ordinance Survey map (Sheet 1, 1:50,000 Metric Series). It is bound in the south by the North Coast Highway, in the north by the sea, in the east by a gully course, and in the west by a property boundary (Figure 1). The Lucea Harbour is less than 3 km west of the site, and the Mosquito Cove is ~2.25 km to its east.

1. Excavation/Dredging in bays 2 and 3
2. Construction of two boulder breakwaters in Bay 2.
3. Fill and beach nourishment in Bays 2 and 3
4. Construction of sub-marine fence, boardwalks and floating docks in Bay 2.
5. Diversion of the gully that presently empties into Bay 2.

The following buildings will be constructed. Final architectural drawings and elevations of these buildings are not yet available. Once they are available, building permission will be sought from the Hanover Parish Council.

1. A restaurant will be located on the western side of Bay 2 overlooking the dolphin bay.
2. The dolphin building shall provide accommodations for dolphin staff, and offices for the resident and consulting veterinarian.
3. A circular Snack Bar shall be located on the western side of Bay 2.
4. The staff building will provide space for storage, general support, staff facilities and additional rest rooms.
5. Reception will be located opposite the parking lot and main entrance to the facility.
6. Western Shops (20' x 150') and astern Shops (15' x 100')..
7. A building near the recreational beach will provide changing rooms and toilets.
8. Sewage treatment Plant (STP).
9. Parking and access roads

Approximately 300 visitors are expected to visit the attraction on an average cruise ship day. Like the Ocho Rios Facility, the Paradise Dolphin Cove will be open to the public from 8:00 am to 5:00 pm, 365 days a year except during periods of inclement weather. Operational aspects of the facility will include the following core areas:

1. Dolphin Programmes (Bay 2).
2. Paradise Rock Pool (Bay 2).
3. Paradise Sting Ray Experience (Bay 2).
4. Paradise Shore Trail Experience.
5. Paradise Beach Experience (Bay 3)
6. Restaurants and shopping.
7. Community Linkages.
8. Maintenance

The main benchmarks for this EIA process (past and projected) are given in below.

Benchmark	Completion Date
Submission of applications to NEPA	*July 17th 2006*
Receipt of the Generic TOR from NEPA	*October 26th 2006*
Submission of application for the Sewage Treatment system	*November 7th 2006*
Submission of the Draft TOR to NEPA for review	*November 7th 2006*
Public Notice of availability of TOR for review	*November 15th 2006*
Submission of responses to comments on the TOR	*January 12th 2007* *February 5th 2007*
Acceptance of the revised TOR by NEPA	*February 23rd 2007*
Field surveys	*Nov 2006 to Jan 2007*
Completion of the EIA	*April 17th 2007*
Posting of the 2nd Public Notice (availability of the EIA for review).	April 20th 2007
Public Meeting.	May 11th 2007
Submission of Verbatim Report	May 18th 2007
Review Report (estimated date)	June 30th 2007
Addendum Report	July 6th 2007
Review of Addendum Report	July 30th 2007
Submission of application to the NRCA Board for decision.	August 2007
Notice to the Applicant of the Board's decision.	August 2007

All EIA documentation shall be placed online at nrca.org and at eiacaribbean.com/DCL. After the submission of the EIA for review, neither the applicant nor consultant shall contact NEPA until the review report has been submitted to the consultant for formal response.

The main objective of the EIA process is to determine whether there are any environmental considerations that need to be taken into account in reviewing the applications for environmental permits and beach licenses, and whether there is any environmental why the project should not proceed as proposed. This would be tantamount to a finding of significant negative impact, where the project itself or project-related cause:

- Is located in proximity to any sensitive or protected areas and has been determined to impact negatively on these.
- Is extensive over space or time (scales must be appropriately defined)
- Is intensive in concentration (i.e. exceeding recommended criteria) or in relation to assimilative capacity (as appropriated to the affected receptor).
- Is not consistent with national plans for the general use of the area.
- Contributes to the endangerment of threatened species.
- Reduces the stocks of commercially important species.
- Permanently damages habitat quality or creates ecological barriers.
- Threatens cultural or heritage resources.
- Alters community lifestyles or requires long-term adjustments of local people in respect of traditional values and resource use.
- Represents a long-term nuisance or significant safety risk to other users.

A secondary objective of this section is to outline the relative importance of the causative elements along with the potential for cost-effective mitigation of negative impacts (including design modification). This should facilitate development of specific environmental conditionalities that would to be outlined if the project application is permitted.

The assessment of impacts found a total of 14 site development related negative impacts and 7 operations related negative impacts (see Table below for summary). The highest ranked negative impact was the possible effect on coastal water quality during the operational phase, which can be cost effectively managed and monitored. It also is an impact that would occur with most other changes in land use from the *status quo*. The second highest ranked negative impact (importation of dolphins into Jamaica) scored 3.0. This particular impact scored relatively higher than expected because of the uncertainties involved in making the assessment. All of the other negative impacts were scored below 3.0 in terms of their effect level.

There were a total of six positive impacts (2 in the site development phase and 4 in the operational phase). The most significant impacts were found to be the effects on tourism and the creation of a nature preserve (both scoring 4.0). The next most important positive effect was related to the creation of jobs and earning opportunities (3.3) as expected by the majority of stakeholders that have been interviewed. The impacts of modification of the natural vegetative cover scored 2.9, and land use change scored 2.2.

Summary of Impacts

Score	Classification	Negative`	Positive
>4	Significant		*Effects on Regional Tourism* *Creation of the Nature Preserve*
3.0 to 4.0	Higher Moderate	*Decreased coastal water quality* Importation of dolphins into Jamaica	*Creation of Jobs & Opportunities*
		Decreased coastal water quality Change to the oceanography Consumption of land fill Deepening the sea floor in bays 2 and 3 Increased vehicular traffic	Modification of natural vegetation
2.0 to 3.0	Low Moderate	*Potential for Pests and Vectors* Modification of drainage patterns Demand for quarry products and sand Increased site vulnerability to storms Change to the configuration of Bay 2 *Loss of amenity to fishermen* Nuisance Noise Change to air quality Consumption of lumber	Construction employment *Land Use Change*
1 to 1.9	Minor	Lowering of the headland *Change in air quality* *Harvesting or collection of other animals* *Change in micro-climate*	
<1	Negligible	*Increased day time noise levels*	

Operational impacts are shown in blue italics.

It is the finding of this assessment that there are no ***significant*** negative impacts associated with the project, according to the definition of significance described at the beginning of this section, and the pre-set criteria for determination of the effect level of impacts. The negative impacts that have been found can be cost effectively mitigated as given in the fore-going tables. Provision is made in the Environmental Management Plan (this EIA) for the monitoring of these proposed mitigation measures, and the validity of the predicted impacts.

Based on the range of impacts, the following objectives have been developed. They are intended to focus on optimization of opportunities for environmental enhancement in all aspects of the project.

During the construction phase:

- To ensure that contractors implement the proposed mitigation measures as described below.
- To ensure that the design and layout of all structures are consistent best practices and codes for minimization of risk from natural hazards.
- To purchase goods such as sand, stone, and lumber from suppliers that have implemented environmentally sustainable practices.
- To import dolphins for the attractions from suppliers who (a) have conducted the necessary stock assessments of the wild populations, and limit their collection to sustainable numbers and (b) practice humane methods of collection of specimens from the wild.

During the operational phase:

- To operate the attraction in accordance with the highest international standards for marine aquaria, and optimize the benefits nature based tourism as far as possible.
- To develop a sustainable breeding programme that minimizes the need to import dolphins.
- To monitor water quality and ensure that the water quality in both bays is suitable for human swimming.
- To promote biodiversity by maintaining the sanctuaries as proposed, and by monitoring the effects of nutrient loading associated with dolphins on adjacent benthic communities.
- To foster community tourism in Hanover.

1 PREAMBLE

Pursuant to the Natural Resources Conservation Authority (NRCA) Act, Phase 1 of the proposed development may be categorized as having involving two Prescribed Categories (modification of wetlands and development and operation of a theme park) and will therefore require the relevant Environmental Permits. An application for an Environmental License is required in respect of the proposed sewage treatment plant (STP). In addition, beach licenses (under the Beach Control Act) are required for any works to be done in the foreshore, inclusive of any dredging and excavation, and encroachments such as breakwaters and pilings for boardwalks.

This EIA has been prepared in compliance with the approved Terms of Reference (TOR) which are included as Appendix 1. The objective of this EIA as stated in the TOR is to "*provide a comprehensive and integrated evaluation of the proposed development, in terms of predicted environmental impacts, needed mitigation strategies, potentially viable alternatives to the project and all related legislation*".

More specific objectives of this EIA process include:

1. Compliance with the environmental laws and regulations of Jamaica, specifically Sections 9 and 10 of the NRCA Act of 1991.
2. Assurance of all concerned stakeholders that environmental considerations have been taken into account in project planning, particularly in respect of minimization of environmental disturbance, optimization of resource consumption and effective management of waste streams. The success of this may be measured against environmental standards, policies and plans.
3. Evaluation of the potential for environmental impacts that could arise during the project life-cycle (site preparation, construction, operations and decommissioning phases). This shall include evaluation of the ecological footprint of the project both on-site and off-site (such as downstream, along supply corridors and upon material sources etc.). The document will give a clear statement as to whether there are any significant negative environmental impacts that cannot be cost-effectively managed by implementation of mitigation measures or design modification.
4. Determination of whether wider societal benefits of the project and the cost-effectiveness of proposed mitigation measures are sufficient to justify environmental costs or trade-offs. This is normally done in the Analysis of Alternatives Section of the EIA.

5. Preparation of an EIA document to support the granting of the Environmental Permits and Beach Licenses, which:
    a. Is fully compliant with the approved terms of reference (TOR) for the study;
    b. Is technically accurate and meets international standards in terms of methodologies and approaches;
    c. Has followed prescribed procedures and is transparent enough to withstand public scrutiny;
    d. Highlights opportunities for enhancing operational performance/efficiency or modifying design so that the project will be better aligned with environmental objectives; and
    e. Is professionally produced in a style and format that is consistent with international standards for EIA reporting.

2 PROJECT DESCRIPTION

2.1 SECTION OVERVIEW

The aim of this section of the EIA is to provide comprehensive information about the proposed development, which can be used to assist in the assessment of the potential environmental impacts of the project.

2.2 PROJECT OVERVIEW

2.2.1 Justification

Since 1999 Dolphin Cove Ltd. has been operating one of the most successful tourism attractions in the Ocho Rios area. Phase 1 of the Ocho Rios facility includes a natural seawater lagoon with eight dolphins. The recently developed Phase 2 (Dolphin Cove at Treasure Reef) is also a natural seawater lagoon, and houses an additional six dolphins. Aside from dolphin tours, the Ocho Rios facilities also offer a wide range of recreational activities including: the beach, snorkelling, kayaking, jungle trail, pirate village, and shark and sting ray tours. The company also operates a much smaller facility (with 2 dolphins) with very restricted public access at the Half Moon Hotel in Montego Bay.

The Phase 2 expansion (completed in 2005) was in response to a growing demand for attractions from the cruise ships and hotels. This demand is fuelled by the continued growth in cruise arrivals, and the rapid development of hotels on the north coast: according to JAMPRO (http://www.investjamaica.com/sectors/tourism/stats.php), the combined number of cruise and hotel arrivals increased by almost 1 million between 2001 and 2006 (from 2.1 million in 2002 to 3.0 million in 2006).

The need to develop a site on the western side of the island is justified by the increasing numbers of cruise arrivals to Montego Bay, who presently have to travel 2 hours between the pier and Dolphin Cove. Although Ocho Rios typically receives more cruise ship visitors, the number of arrivals to Montego Bay has steadily been increasing. Between 2001 and 2004 cruise arrivals to Montego Bay grew by 75% (140,300 visitors), in contrast to the 18% (116,570 visitors) growth in Ocho Rios cruise arrivals for the same period (JTB, 2005).

The demand for attractions in the west is also being driven by increasing numbers of hotel stop-overs in that part of the island. According to the Jamaica Tourist Board (JTB, 2005) in 2004 ~60% (10,555 rooms) of all hotel rooms in Jamaica were located in Montego Bay and Negril. This capacity is expected to increase by another 3400 rooms with 2000 planned for Fiesta, 700 planned for RIU Montego Bay, and another 700 planned for Seawind, Montego Bay.

With the projected increase in overall visitors, the increase in demand for dolphin tours remains high as this tour remains one of the most popular tours.

2.2.2 Project Location

2.2.2.1 Setting & Situation

The proposed development site is located on a 20-acre parcel of coastal land referred to as "*Paradise*" on the Ordinance Survey map (Sheet 1, 1:50,000 Metric Series). It is bound in the south by the North Coast Highway, in the north by the sea, in the east by a gully course, and in the west by a property boundary (Figure 1). The Lucea Harbour is less than 3 km west of the site, and the Mosquito Cove is ~2.25 km to its east.

The 2000-room Fiesta Hotel (now under construction) is located approximately 2.5 km west of the site at Point District. The nearest town is Lucea, which is the parish capital. The town centre is located ~4.5 km from the site. Settlements in proximity include Elgin Town and Hopewell.

The project site is situated equidistance from Negril and Montego Bay, both of which are major tourist centres in western Jamaica, and are also national marine parks. The aptly named Dolphin Head protected area is located in the hinterlands approximately 11 km south-southwest of the site.

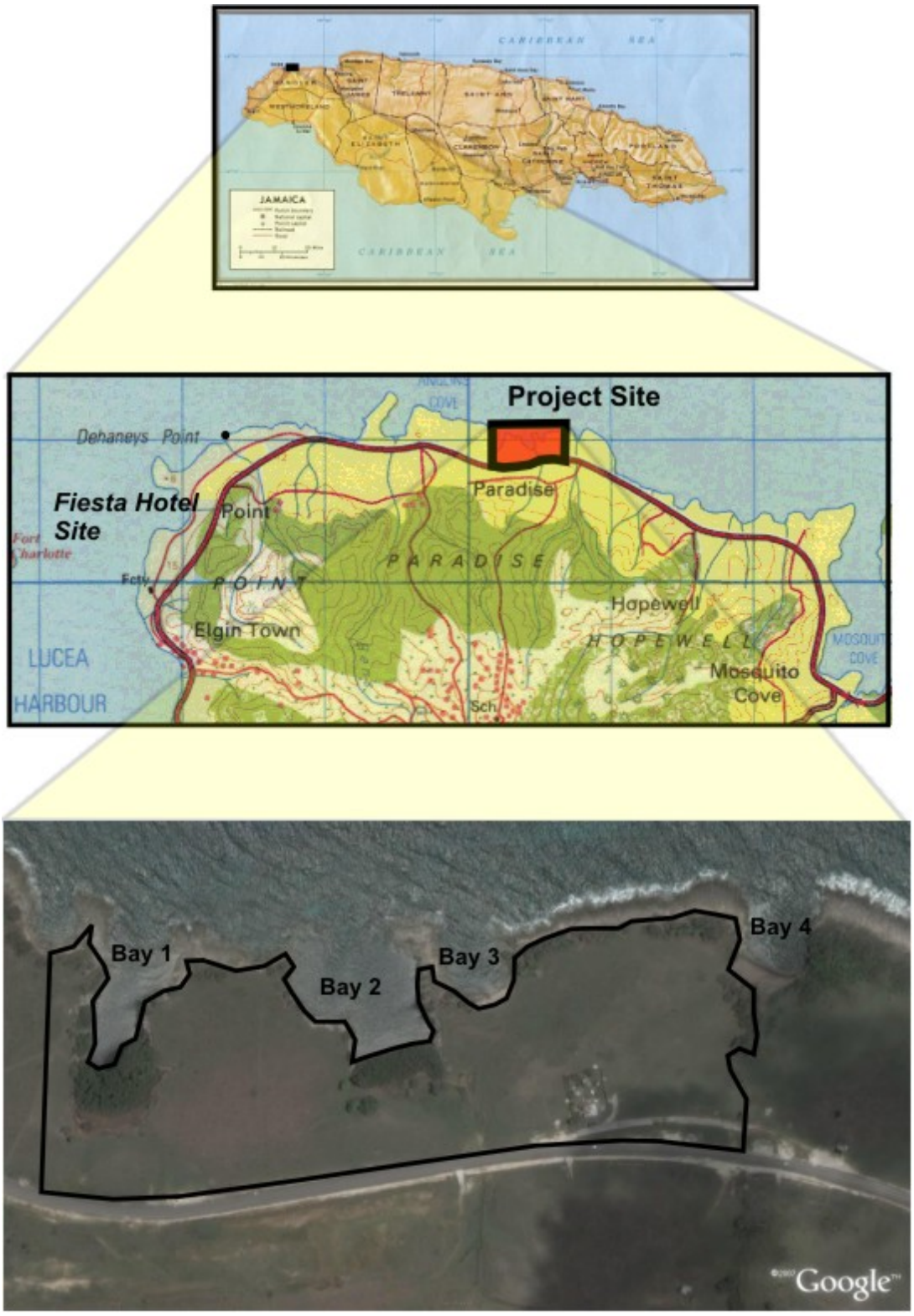
2.2.2.2 Siting criteria

The following criteria were considered in selecting the optimal location for the new Dolphin Park.

Availability of suitable land: Suitable land would be located on the coast, and in proximity to the highway. The adjacent uses should not be in conflict with recreational land uses or tourism.

1. Proximity to the tourist centres: Paradise is situated approximately 25 km from both Montego Bay and Negril. Along the North Coast Highway, this is less than half-hour driving time. The convenience of the journey between the hotel/pier and the attraction is recognized as an important factor in the viability of tours. A related factor is therefore location along the North Coast Highway.
2. Relatively clean waters: as dolphins will be housed in natural bays, it was important that the water and sediment quality be of sufficiently high standard. This particular site is located in an area that is predominantly agricultural, with no major residential or industrial land uses in the hinterland. The developers have carefully selected a site with no historic contamination in respect of heavy metals, sewage, pesticides or other contaminants of concerns that could impact the health of the marine mammals.
3. Conductive oceanographic conditions: the proposed lagoon must be sufficiently large for housing six to twelve dolphins, and relatively well-protected to allow for recreational use for a good portion of the year. The depth of the bay should also be ~3 m or comprised of a substrate that could be excavated/dredged to the required depth. There should also be adequate capacity for flushing waters from the bay.

Figure 1 Proposed Location of Dolphin Cove, Hanover


JAMAICA
CARIBBEAN SEA
Project Site
Dehaneys Point
Fiesta Hotel Site
Point
Paradise
PARADISE
POINT
Elgin Town
Hopewell
HOPEWELL
Mosquito Cove
LUCEA HARBOUR
Bay 1
Bay 2
Bay 3
Bay 4
Google

2.3 PROJECT FOOTPRINT & SITE PLAN

The site boundaries are shown in Figure 1 above. The proposed layout of the site is given in Figure 2. It outlines the physical footprint of the project, and as specified in the TORs, it shows the location of buildings, access roads, parking lots, sewage treatment, and all proposed site modifications, as well as areas to be left as open space.

However, with any project, the footprint extends beyond the physical development area (onsite) as outlined by the design specifications. It includes offsite linkages in both the site development and operational phases (under both normal and upset conditions), as well as intangible aspects such as energy consumption, emissions etc. The wider definition of the footprint includes activities (including technology & equipment usage), consumption of resources/subsidiary inputs, and all associated waste streams. These are described below.

2.3.1 Site Development

2.3.1.1 Coastal Modification, Earthworks & Landscaping

a/ Specifications & Outline of the Plan

Although ideally located (see Section 2.2.2.2 above), the site will require modification and development before the dolphin attraction can be located there. The plans are the subject of the detailed engineering design report prepared by Smith Warner International (2006), which was submitted to NEPA along with the applications for beach licenses.

The coastal works are guided by two main principles: (1) the dolphin pens that are created must allow for optimal environmental conditions for the dolphins (discussed in detail below) (2) the overall facility must be of an aesthetic standard that is consistent with the intended recreational land use.

In taking the environmental aspect into consideration safety and environmental quality are the two most over-riding concerns, as the developers' experience in respect of minimizing the environmental effects outside the lagoon has been to maintain good water quality inside the lagoon, which is also essential for the health and well-being of both the dolphins and human swimmers in the water. Dolphin Cove Ltd. has always had a policy of ensuring that the water quality criteria that are maintained are within human criteria as these are considerably more stringent than those established for dolphins.

Maintaining the water quality in the dolphin lagoon is dependent on the following factors (1) land based sources of pollution (2) the number of dolphins in the facility (carrying capacity of the water body) (3) flushing rates within the lagoon. In respect of run-offs, it has been decided that there should be no freshwater drains or flows directly into the dolphin lagoon. For this reason, the idea of drainage diversion has been integrated into the plan.

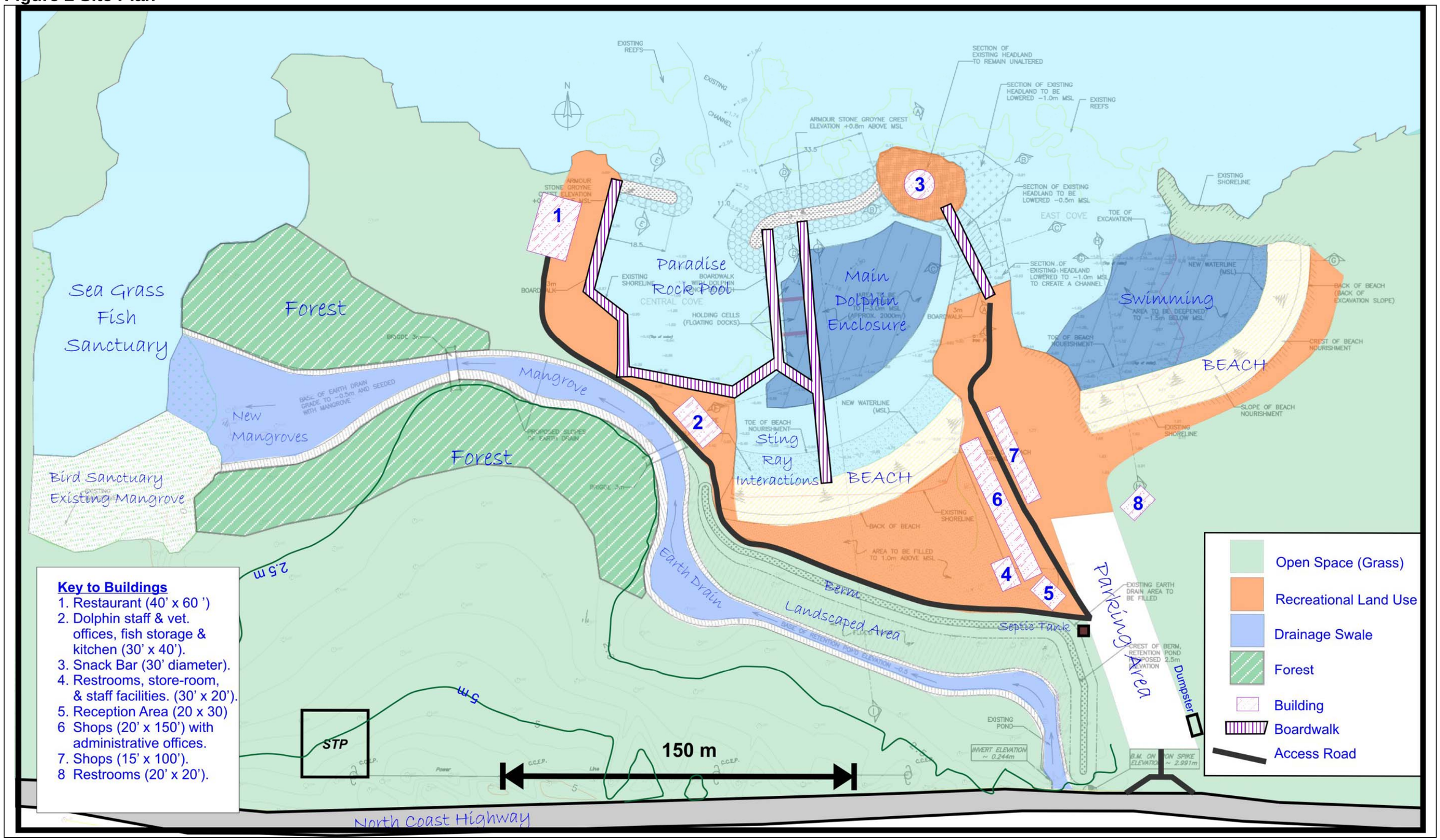
Secondly (in respect of the carrying capacity of the bay), the National Standards and Guidelines for Operating Dolphin Facilities in Jamaica set by the NRCA has established the following the minimum surface area requirement of 110 m^2 for the first 3 dolphins, and an additional provision of 25 m^2 for each dolphin over the first three. These numbers are based on the *The Animal Welfare Act of the United States of America: Subpart E- Specifications for the Humane Handling, Care, Treatment and Transportation of Marine Mammals" issued by the US Department of Agriculture's Animal and Plant Health Inspection Service (USDA/APHIS) (January 2003 version),* the relevant section of which has been suspended in the US. Using the NEPA criteria, it may be calculated that 12 dolphins will require a surface area of 335 m^2. In addition, Dolphin Cove will seek to provide this space allocation for the main interaction area, the sanctuary area, and a transition zone, which gives a total requirement of 1005 m^2. The developers have opted to have a ~100% over-design capacity so that the area that will be dredged to the 3 m depth is 2000 m^2.

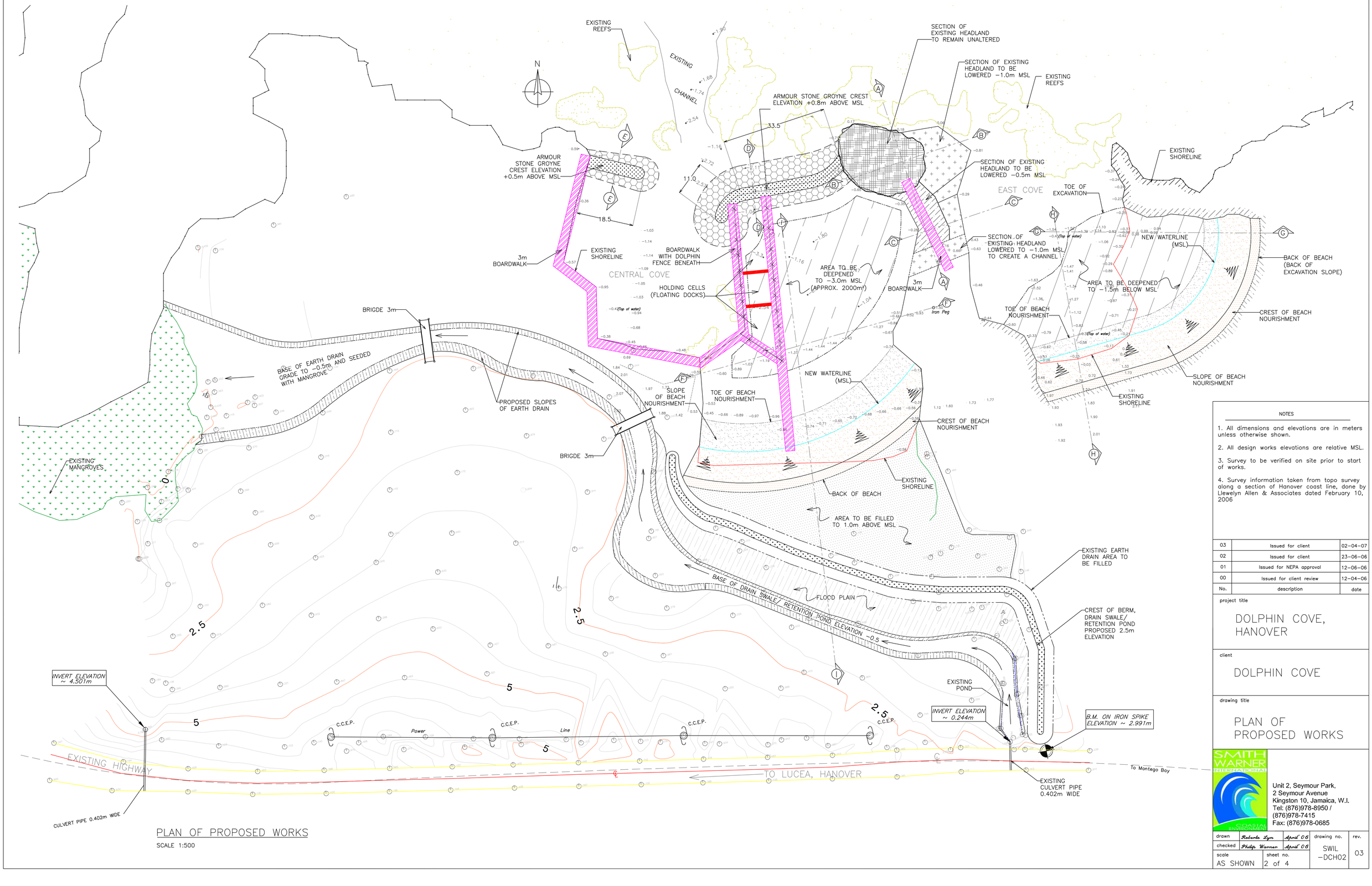
The other industry standard document used by the marine parks in respect of spatial requirements for marine mammals is issued by the Alliance of Marine Mammal Parks and Aquaria (AMMPA). The Alliance standards establish volume criteria for bottlenose dolphins as follows based on a required depth of the Average Adult Length of 2.55 m: 290 m^3 for the first 4 dolphins, plus an additional 125 m^3 for every 2 additional dolphins. Using these criteria, 12 dolphins would require a minimum volume in the main pool of 374 m^3. The Hanover facility will be excavated to a low tide depth of 3 m (to ensure that 2.55 m depth occurs during low tide). Assuming that 3 times the required volume is available for the dolphins, the AMMPA total volume requirement is 2861 m^3. In this case, the developers still have an over-design capacity of 75%.

The third main design consideration in respect of water quality was balancing the need for maintaining calm conditions in the lagoon (though establishment of boulder barriers) with the need for circulation. One of the main tasks of the Coastal Engineering Design undertaken by Smith Warner International, therefore was to maximize flushing through their design, which was modelled (finite element) using data collected from the bay. Based on the modelling exercise, it was suggested that circulation in both Bay 2 and 3 would be greatly improved by opening a channel between them.

These plans for primarily foreshore modification are described below, and are shown in figures 2 to 4 on the following pages. The following discussion is based on the Coastal Engineering Design Report prepared by Smith Warner International Ltd. (2006).

Figure 2 Site Plan





PLAN OF PROPOSED WORKS

SCALE 1:500

NOTES

1. All dimensions and elevations are in meters unless otherwise shown.
2. All design works elevations are relative MSL.
3. Survey to be verified on site prior to start of works.
4. Survey information taken from topo survey along a section of Hanover coast line, done by Llewelyn Allen & Associates dated February 10, 2006

No.	description	date
03	Issued for client	02–04–07
02	Issued for client	23–06–06
01	Issued for NEPA approval	12–06–06
00	Issued for client review	12–04–06

project title

DOLPHIN COVE, HANOVER

client

DOLPHIN COVE

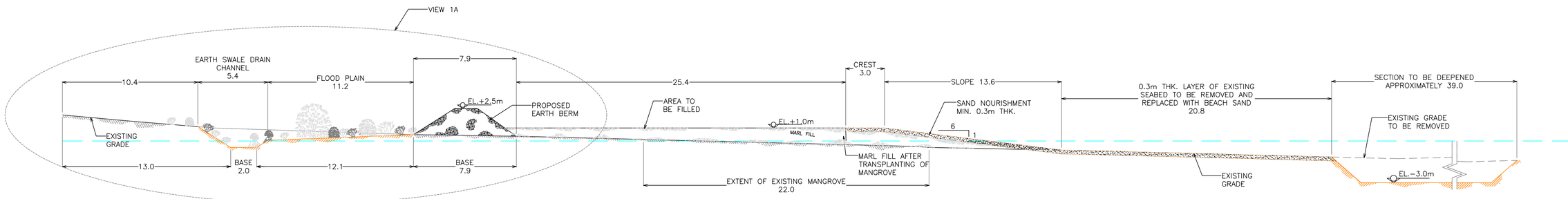
drawing title

PLAN OF PROPOSED WORKS

SMITH WARNER INTERNATIONAL CARIBBEAN ENGINEERING

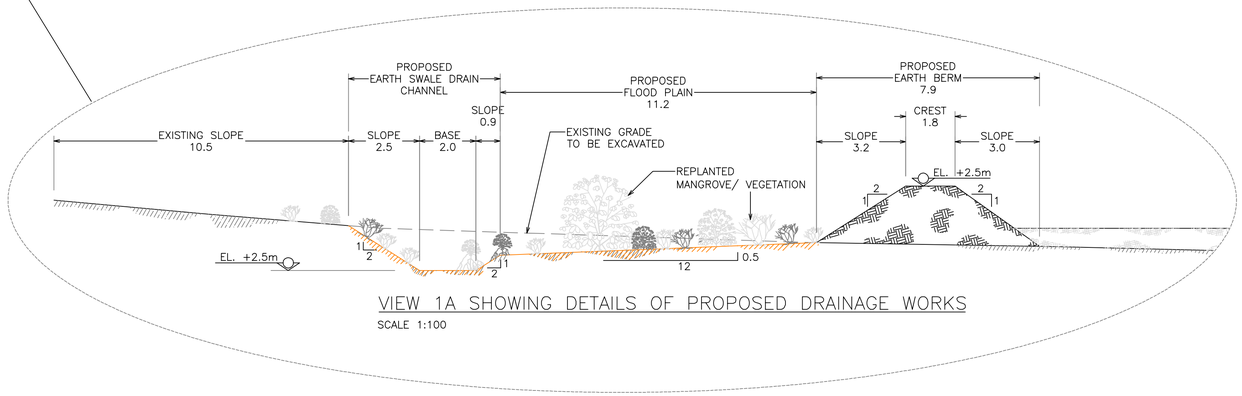
Unit 2, Seymour Park,
2 Seymour Avenue
Kingston 10, Jamaica, W.I.
Tel: (876)978-8950 /
(876)978-7415
Fax: (876)978-0685

drawn	Roberto Lyn	April 06	drawing no.	rev.
checked	Philip Warner	April 06	SWIL –DCH02	03
scale	AS SHOWN	sheet no.	2 of 4	



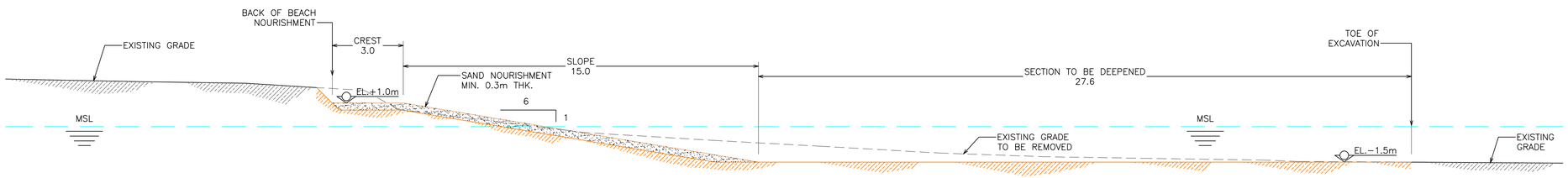
CROSS SECTION I–I SHOWING PROPOSED WORKS

SCALE 1:150



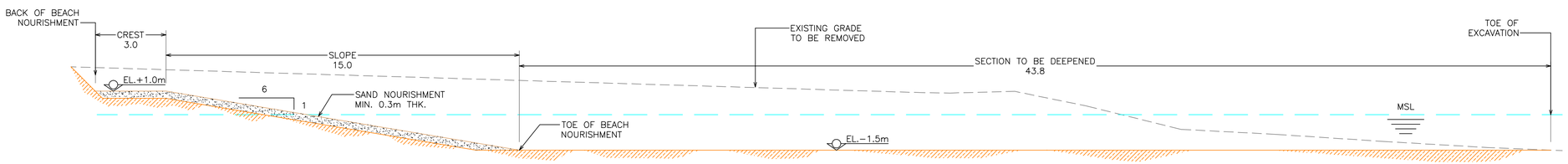
VIEW 1A SHOWING DETAILS OF PROPOSED DRAINAGE WORKS

SCALE 1:100



CROSS SECTION H–H SHOWING PROPOSED WORKS

SCALE 1:100



CROSS SECTION G–G SHOWING PROPOSED WORKS

SCALE 1:100

NOTES

1. All dimensions and elevations are in meters unless otherwise shown.
2. All design works elevations are relative MSL.
3. Survey to be verified on site prior to start of works.
4. Survey information taken from topo survey along a section of Hanover coast line, done by Llewelyn Allen & Associates dated February 10, 2006

No.	description	date
02	Revised and issued for client	02–04–07
01	Issued for NEPA approval	12–06–06
00	Issued for client review	12–04–06

project title

DOLPHIN COVE, HANOVER

client

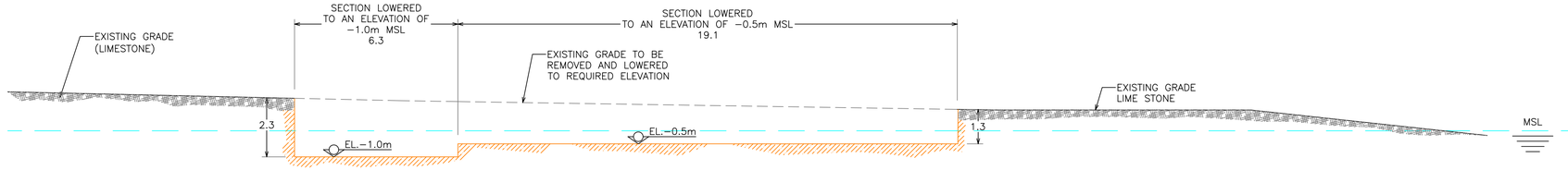
DOLPHIN COVE

drawing title

CROSS SECTIONS PROPOSED WORKS (02)

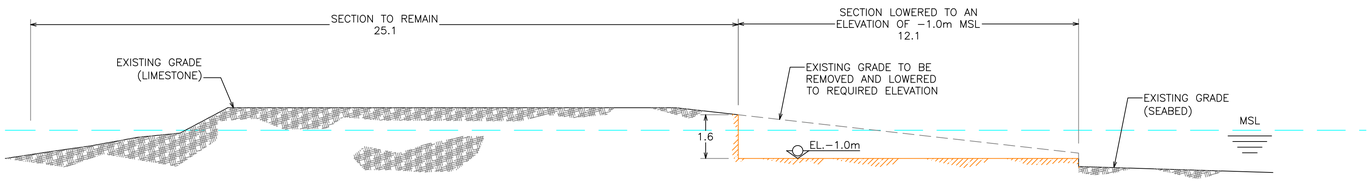
SMITH WARNER INTERNATIONAL COASTAL ENVIRONMENT
Unit 2, Seymour Park,
2 Seymour Avenue
Kingston 10, Jamaica, W.I.
Tel: (876)978-8950 /
(876)978-7415
Fax: (876)978-0685

drawn	Roberto Lyn	April '06	drawing no.	rev.
checked	Philip Warner	April '06	SWIL DCH04	03
scale	AS SHOWN	sheet no.	4 of 4	



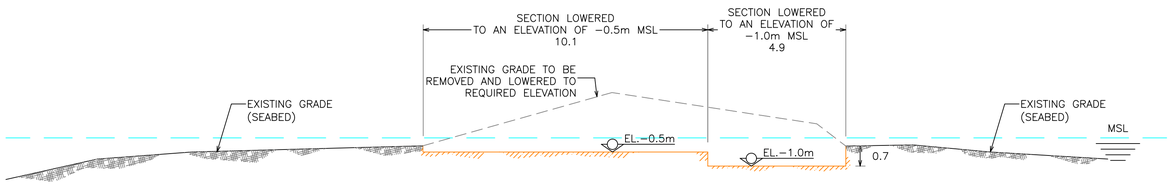
SECTION A−A SHOWING PROPOSED WORKS

SCALE 1:100



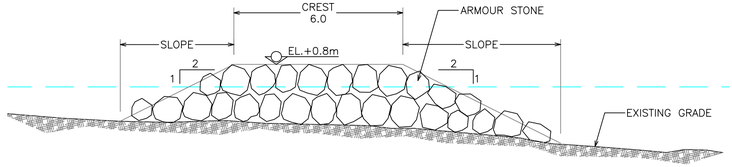
CROSS SECTION B−B SHOWING PROPOSED WORKS

SCALE 1:100



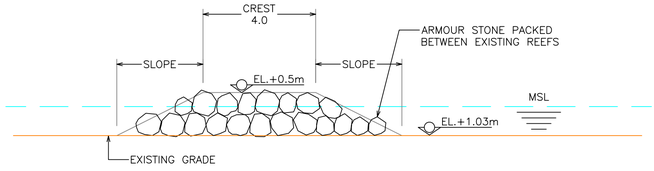
CROSS SECTION C−C SHOWING PROPOSED WORKS

SCALE 1:100



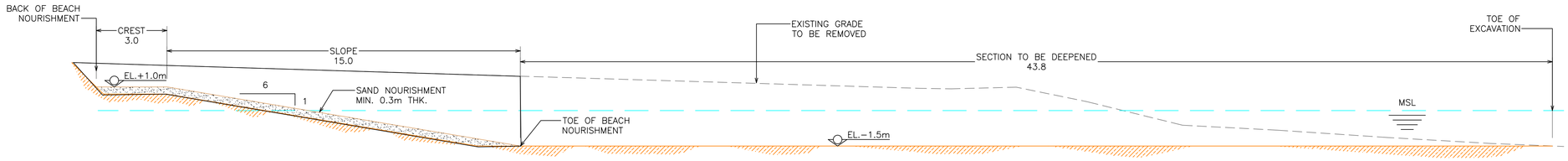
CROSS SECTION D SHOWING PROPOSED WORKS

SCALE 1:100



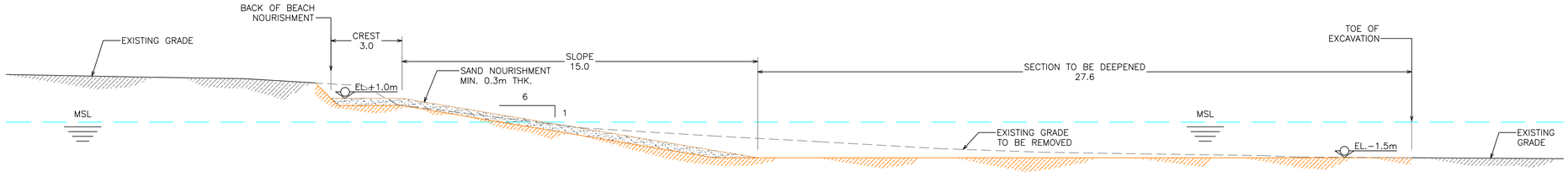
CROSS SECTION E SHOWING PROPOSED WORKS

SCALE 1:100



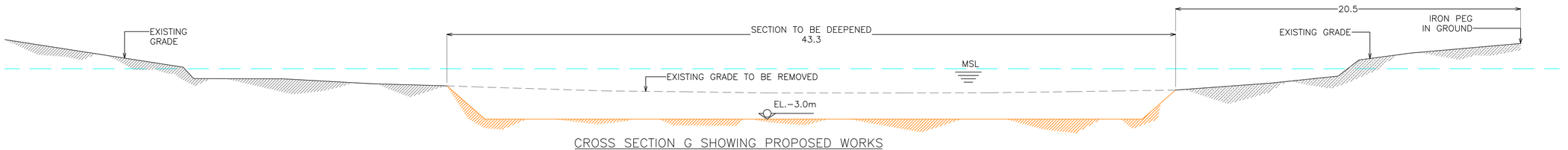
CROSS SECTION F SHOWING PROPOSED WORKS

SCALE 1:100



CROSS SECTION G SHOWING PROPOSED WORKS

SCALE 1:100



CROSS SECTION G SHOWING PROPOSED WORKS

SCALE 1:100

NOTES

1. All dimensions and elevations are in meters unless otherwise shown.
2. All design works elevations are relative MSL.
3. Survey to be verified on site prior to start of works.
4. Survey information taken from topo survey along a section of Hanover coast line, done by Llewelyn Allen & Associates dated February 10, 2006

No.	description	date
01	Issued for client review	12−04−06

project title

DOLPHIN COVE, HANOVER

client

DOLPHIN COVE

drawing title

PROPOSED WORKS CROSS SECTIONS

SMITH WARNER INTERNATIONAL
COASTAL ENVIRONMENT

Unit 2, Seymour Park,
2 Seymour Avenue
Kingston 10, Jamaica, W.I.
Tel: (876)978-8950 /
(876)978-7415
Fax: (876)978-0685

drawn	Roberta Lyn	April 06	drawing no.	rev.
checked	Philip Warner	April 06	SWIL DCH03	01
scale	AS SHOWN	sheet no.	3 of 3	

6. **Excavation/Dredging**:

    i. Excavation of the headland between bays 2 and 3 to enhance circulation and flushing of Bay 2. This excavation will involve lowering of ~200 m^2 of the headland to a depth of -0.5, and lowering 485 m^2 to a depth of -1.0 m. It is estimated that ~1270 m^3 of excavated rock will be produced.

    ii. Excavation of 2000 m^2 of foreshore to a depth of 3 m. This is expected to produce 1500 m^3 of excavated rock and sediments.

    iii. There will be some dredging along the shoreline, where approximately 190 m^3 of fine organic sediment will be removed for two reasons: (a) to change the shape of the shoreline so that an area of slack water is removed (b) to be able to create a sandy beach that can be integrated into the proposed tourism usage. This will necessitate relocation of ~ ½ -acre of mangroves to the distal end of the drainage swale and Bay 1. Guidelines for the post-permit mangrove transplantation plan is given in the environmental management plan of this EIA.

    iv. It is proposed that an area of 1150 m^2 will be excavated to create a safe swimming area of suitable depth. This is estimated to produce 575m^3 of excavated material**.** A narrow strip of the cliff line on the eastern side of Bay 3 will be left in place to function as a natural breakwater, and will leave the inter-tidal community on the seaward margin of that strip unaffected.

7. **Construction of two boulder breakwaters in Bay 2** to protect the bay from wave action, and maintain good recreational swimming conditions for as much of the time as possible. The breakwaters will also serve to protect the dolphin fencing and floating docks. These breakwaters are designed to provide the necessary wave protection, while avoiding being visually intrusive and obstructive to the natural flushing of the lagoon. The western breakwater is 20 m long, and will require 220 m^3 of stone, while the eastern breakwater is 50 m long and will require 1350 m^3 of stone. The footprints of these breakwaters have been calculated to be 11 m^2 and 28 m^2 respectively.

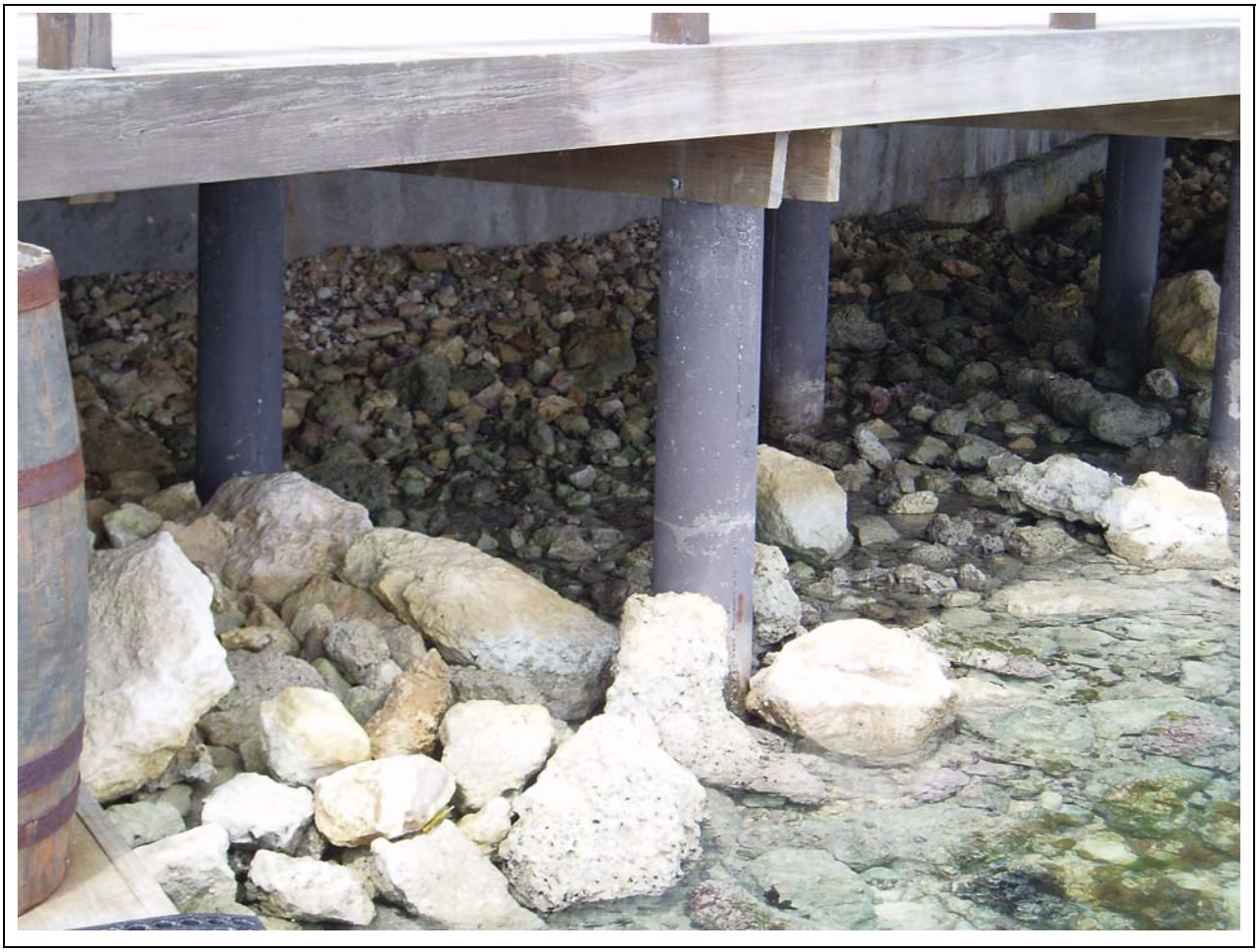
8. **Fill and beach nourishment**:

    i. An area approximately 2130 m^2 along the shoreline in Bay 2 will be filled with ~1065 m3 of suitable fill material to a depth of 0.5 m. The beach area will require an estimated 1210 m^3 of sand over the fill to create a recreational beach.

    ii. Completion of the plan for Bay 3 (creation of a recreational beach), calls for the placement of 1508 m^2 of suitable sand along the created beach area as shown in Figure 2.

9. **Construction of sub-marine fence, boardwalks and floating docks in Bay 2**. These elements are a necessary part of the operations, allowing human access to the dolphinarium. The fence serves to ensure that the park dolphins stay within the lagoon area. The total length of the 3-m wide boardwalk will be 280 m. This consists of ~100 m along the western perimeter of Bay 2 (up to the beach area), another 150 m running between the shoreline and the eastern breakwater, and another 30 m bridging the excavated area between Bay 2 and Bay 3. The boardwalk will be supported by concrete pilings into the sea floor. Pilings are created by filling suitable lengths of 8"-pvc pipes (20 cm) with concrete, and are spaced one every 2.5 m (Figure 5).

Figure 5 Photo of boardwalk showing pvc pilings



10. **Diversion of the gully that presently empties into Bay 2**. This ephemeral stream presently empties to the back of the mangrove area in Bay 2, and appears to contribute mainly fine sediments and periodic freshwater storm flows to the bay. In order to prevent land based pollution in the dolphin bay (Bay 2) this will be diverted to Bay 1 along an earthen drainage swale that will roughly run along the 2 m contour line, and will be excavated to a depth of -0.5 m.

A berm will be created along the swale to ensure that run-off from the catchment of this gully does not enter Bay 2. This swale is estimated to be ~ 350 m long from the culvert at the highway to the exit to Bay 1, and will be constructed within a width range of 12 m to 30 m. Associated with the swale is an earthen berm that will follow the swale along the length of Bay 2. This berm will be approximately 180 m long, with a basal width of 7.9 m and crest elevation of 2.5 m above mean sea level (Figure 4).

b/ Project Implementation Schedule and Activities

For the purpose of estimating the implementation schedule of the project, assumptions about the permitting process have to be made. Assuming this EIA is available for review by relevant stakeholders by April 16th, and that a public meeting will be held by May 6th 2007, it is expected that the review process of the EIA can be completed by June 6th, 2007. It is therefore estimated that a decision from the NRCA Board in respect of the various applications made in respect of this development may be expected by August 2007. Given this scenario, it is expected that coastal modification works (which require the beach licenses) can commence while the final construction drawings and architectural plans (for land side structures) are being finalized for submission to the Hanover Parish Council for building permission/planning approval. Coastal modification work is expected to commence in Bay 2 in September 2007, and is expected to proceed as outlined below.

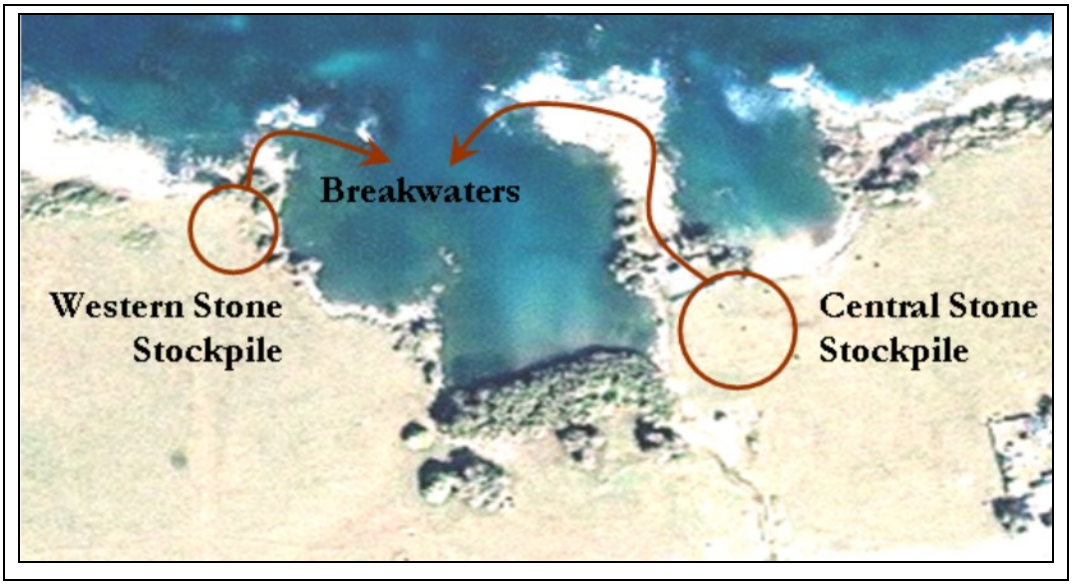
By September 2007

1. Operators of equipment such as loaders, excavators and cranes will be contracted. This equipment will be mobilized along the North Coast Highway from the premises of the contractor. Preference will be given in selection of a contractor to those in proximity to the site with competitive bids and a good performance and safety record.
2. Boulders for the construction of the breakwaters will be sourced at the nearest licensed quarry site that can generate suitably sized stones of the required specific density. These will be transported via truck to the site and stockpiled as shown in Figure 6 below.

4th Quarter 2007:

3. During the period when boulders are being stockpiled on site, the marine footprint of the breakwater and excavation areas will be physically marked out using buoys and rope. A marine biologist will dive this marked area, and create an inventory of all viable coral specimens and sea grass that can be successfully relocated to a site that will be agreed with NEPA prior to commencement. NEPA will be advised of the scheduling of the coral relocation exercises so that observers may be present during relocation. It is expected that a more detailed coral and sea grass relocation plan will be developed in conjunction with NEPA as a post permitting condition. This will be submitted for approval prior to commencement of construction at the site.

Figure 6 Locations of Stockpile/Staging Areas



Source: SWIL 2006 (Coastal Engineering Design Report)

4. Turbidity screens will be placed prior to commencement of the excavation and boulder placement in Bay 2. One will extend across the entire bay, and a second will extend along the western limit of the proposed excavation works.

5. Starting on the eastern side, loaders will transport the boulders to the landside margin of the breakwater and build the breakwater out (moving westwards) in accordance with the engineering designs. The design crest width is wide enough to allow the heavy vehicle to drive on its surface while building out.

6. While the eastern breakwater is being constructed the mangroves on the shoreline of Bay 2 can be removed to the designated transplantation areas in Bay 1. It may be necessary to begin excavation of the distal end of the drainage swale (where it empties into Bay 1) at this time in order to accommodate the extension of the mangrove area in Bay 1. Transplantation of mangroves will be done as outlined in the management plan (this document).

7. After the eastern breakwater is constructed, the excavation of the sea floor using the appropriate equipment will commence.

    a. Soft sediments from the sea floor and muddy shoreline will be dredged or removed by excavator. Dredged material will be pumped to shore, near the central stockpile area shown in Figure 6. The dredged spoil stockpile area will be bunded and developed so that the first cell acts as a settlement area for coarser materials, and fine suspended sediments can overflow to a second cell, where the fines can be settled out. Beneficial use of the dredge spoil will be considered (e.g. if suitable sand for the creation of the beach is found it will be so utilized). If

the dredged material cannot be used beneficially, it will be transported to the nearest dumpsite by an approved contractor for appropriate disposal.

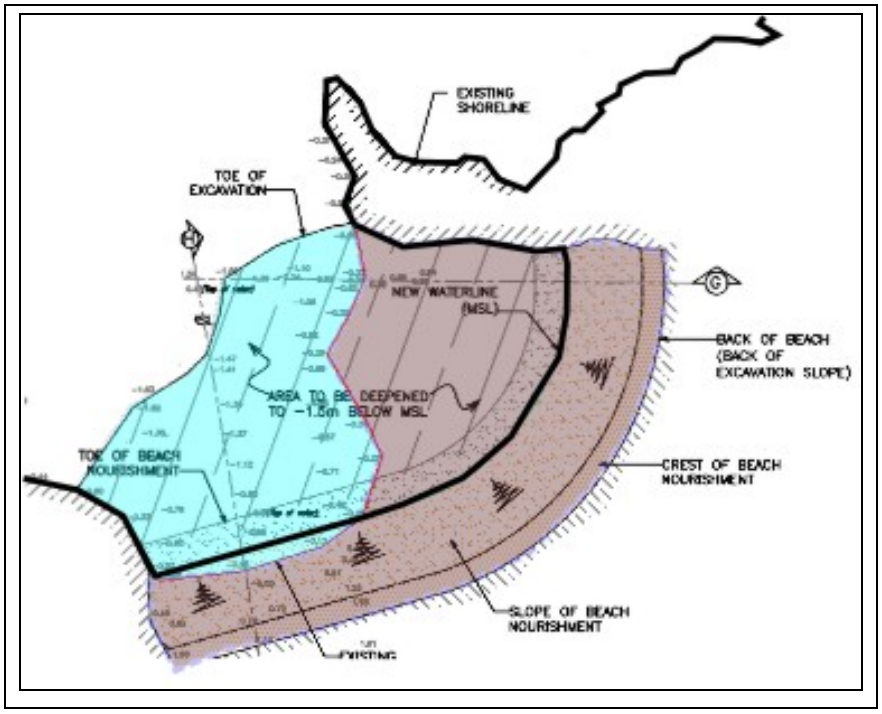
b. When rock is encountered below the mud line, an excavator working from the crest of the eastern breakwater or land side will be employed to achieve the design depth.

c. In respect of the main dolphin area, it may be necessary to temporarily widen the crest/footprint of the breakwater in order to access the excavation area. The breakwater will be returned to design specification upon completion of the excavation works in Bay 3. Excavated rock will be used as fill material for the berm and the back beach area in Bay 3.

8. The western breakwater will be constructed after the excavation of the main dolphin area in Bay 2 using the western stone stockpile area. This breakwater will be built out by the loaders moving out from the land in an easterly direction.

9. During or after the construction of the western breakwater, Bay 3 will be marked out to the extent of the marine excavation by ropes and buoys (shown in blue in Figure 7). This area will be surveyed by a marine biologist, and the viable coral specimens and sea grass will be relocated to the designated transplantation site in accordance with an approved plan, which will be submitted post-permit.

Figure 7 Proposed works in Bay 3



Key to Figure 7

Blue area: extent of marine excavation works.

Brown area: extent of land side excavation works.

Heavy black line shows the proposed shoreline after excavation.

10. A turbidity barrier will be erected on the seaward side of the marker buoys before any further work in Bay 3.
11. After relocation of sensitive benthic species, and placement of the turbidity barrier, excavation work in Bay 3 will proceed. The marine areas (shown in blue above) will be excavated using an excavator extending from the land areas around the site.
12. Excavation of land side areas (shown in brown above) will be accomplished using a front end loader, Vermeer and excavator with pneumatic hammer. The front end loader will be used to remove the upper layer (soil), which will be stockpiled for landscaping. The Vermeer will be used to cut a trench line along the area shown as "*back of beach (back of excavation slope)"* in Figure 7 above. A grid of NW and EW trenches with 7 m spacing will be cut between this line and the shoreline. The excavator and hammer will be used to break up the middle areas. Material will be removed with the front end loader. This material will be stockpiled in the central stockpile area, and will be used as fill if suitable or will be trucked off site for final disposal.
13. After excavation of is completed, it is expected that the excavation of the headland between bays 2 and 3 can commence. This will be accomplished using an excavator with pneumatic hammer. The excavated rock will be stockpiled in the central staging area, and used as fill material in the back beach area of Bay 3.

1st Quarter 2008

14. The back beach area of Bay 3 will be filled to the design elevation.
15. While the back beach area is being filled in Bay 3, the boardwalk can be constructed.
16. Immediately upon completion of filling the back beach of Bay 2, the drainage works (inclusive of creation of the swale and berm) between the back of Bay 2 and Bay 1 will be completed. Material removed to create the swale will be banked up along the berm.
17. After the drain has been successfully diverted from Bay 2, and the back beach area has been filled to design elevation, beach nourishment will commence in bays 2 and 3. It is estimated that approximately 3000 m^3 of sand is required for nourishment in both bays. According to the engineering design report (SWIL, 2006) sand for beach nourishment can be dredged from undetermined offshore sources or if this is not possible, sand will be imported to the site from a source approved by NEPA.
18. Upon completion of all earthworks on the site, the turbidity screens will be removed.
19. Landscaping of the earthen embankment of the swale can begin immediately upon completion of the embankment. Landscaping efforts will also extend to ensuring that the transplanted mangroves are tended within the designated areas, and that indigenous dry limestone forest sapling specimens are sourced and planted in the area intended for this use.

20. It is expected that the submarine fence and the floating docks will be placed just prior to introduction of the dolphins into the area.

c/ Resource Consumption & Waste Streams

1. Subsidiary Inputs

- Epoxy for coral transplantation.
- Containers for sea grass transplantation.
- Buoys and rope for marking out work areas.
- Diesel fuel for equipment.
- Concrete for pilings of boardwalk.
- 1570 m^3 boulders for breakwater.
- 3000 m^3 sand for beach nourishment.
- 1065 m^3 fill for back beach area in Bay 2.
- Lumber for the boardwalks (840 m^2).
- Construction camp amenities: portable lavatory, potable water.
- Turbidity barriers 80 m and 50 m in length for bays 2 and 3 respectively.
- Indigenous trees (dry limestone forest specimens) for creation of the forest area.
- Mangroves (transplanted from Bay 2) for building up the community at Bay 1.

2. Human resources inputs

- Site supervisor to ensure that construction proceeds according to the NRCA permits and licenses.
- Environmental compliance advisor to ensure implementation of mitigation measures, monitor environmental performance and prepare quarterly reports to NEPA.
- Suppliers of stone and sand.
- Haulage contractors.
- Contractors for the earthworks (excavation and dredging), and their team.
- A marine biologist to do the inventory and relocation.
- 4 divers to assist with the dredging works.
- 10 workmen to assist with stockpile management.
- 4 carpenters to construct the boardwalk.

3. Waste Streams

- Combustion emissions from diesel engines.
- Noise emissions: heavy equipment (excavator, dredger, pneumatic hammer, front end loader, trucks, pile drivers, hammers on boardwalk)
- Fugitive dust: from vehicles, stockpiles, bare soils (during creation of drainage swale).

- Storm water: in the event of rain during the major period of earthworks, there could be mobilization of sediments in site run-offs, and this could enter the marine environment.
- Suspended sediments (plume) during dredging, excavation and placement of boulders.
- Solid waste (domestic waste) and sewage from the construction camp. This will be collected on a weekly basis from the site by an approved contractor, and taken to an approved land fill site.
- The total estimated amount of excavated material is 2035 m^3. Assuming that the estimated 1065 m^3 material that is required for fill is available from the excavated material, there will be a surplus of 970 m^3. This material may either be used elsewhere on the site (e.g. creation of the berm) or will be hauled away from the site for disposal at a land fill.
- The total estimated amount of dredged material is 1500 m^3. This is about half of the sand that is required for beach nourishment. However, it is uncertain what proportion, if any, if this material is suitable. Dredge spoil will therefore either be used to nourish the beach or will be hauled away to a land fill by an approved contractor.

2.3.1.2 Structures

a/ Specifications & Outline of the Plan

A number of structures will have to be constructed to accommodate the proposed dolphin park operations. The design of Dolphin Cove Hanover is guided by the following principles:

1. The structural footprint of the facility should be as minimal as possible, and as much space as possible shall be left as green areas. Green areas such as the mangrove and forest preserve should be integral to the tourist experience.
2. The layout should assist in the management of visitor traffic through the site and its facilities. Wheel chair access to all areas of the site shall be provided.
3. The design of the facility should allow for emergency response and management of the dolphins in Bay 2.
4. Land based sources of pollution to the marine environment should be strictly controlled to minimize effects on the bays on property. Consequently, there shall be no discharge of treated sewage effluent into the marine environment. Treated sewage effluent shall be evaporated away through the use of a tile field.

The following buildings will be constructed (as shown on Figure 2). Final architectural drawings and elevations of these buildings are not yet available. Once they are available, building permission will be sought from the Hanover Parish Council.

1. A restaurant (40' x 60') will be located on the western side of Bay 2 overlooking the dolphin bay. A buffet lunch shall be served here. This will have covered dining accommodation for 100 persons (25 4-seater tables). The restaurant will have separate male and female toilets, and at least one of each shall be equipped for the disabled. There shall be 4 female toilets, 2 male toilets and 2 urinals. A restaurant kitchen and food storage area will be located in this building. All sinks will be equipped with grease traps. Grey water will not be routed to the STP, but a separate filtration system to remove oil and grease before re-use to irrigate forest and mangrove areas.
2. The dolphin building (30' x 40') shall provide accommodations for dolphin staff (Director of Animal Care, dolphin trainers and handlers), and offices for the resident and consulting veterinarian. In addition, this building will house the freezer in which fish (for dolphin food) is stored and the dolphin kitchen (in which the dolphin food is prepared according to the specifications of the veterinarian and Director of Animal Care).
3. A circular Snack Bar (30' wide) shall be located on the western side of Bay 2 (Figure 2). This is envisaged as a thatch covered open structure, with a central bar and jerk chicken and hamburger grills.
4. This building (30' x 20') will provide 600 square feet of space for storage, general support, staff facilities and additional rest rooms. It shall be located immediately adjacent to the western shops.
5. This 600 square foot building will be the main reception area and will be located opposite the parking lot and main entrance to the facility. Guests will be required to get their wrist bands and waiver forms at this location before proceeding to their tours. Restrooms will be provided in this building as well (6 female, 2 male and 4 urinals). A security station and nurse's station will be located in this building.
6. Western Shops (20' x 150'). This will be a 2–storey building with 3000 square feet on each floor. The upper floor will be used exclusively for administrative offices (of the General Manager, the Tour Sales Manager, and the Gift Shop Manager and their executive assistants). The Accounts Manager and the accounting staff will also be located here.
7. Eastern Shops (15' x 100'). This will be a single storey building with 1500 square feet of shop space, giving a combined total of 4500 square feet of street level commercial space.
8. A 400 square foot (20' x 20') building near the recreational beach (Bay 3) will provide changing rooms and toilets (6 female, 2 male and 4 urinals).
9. Sewage treatment Plant (STP). The Clear Stream Wastewater System will be used, which is a highly efficient "extended aeration" package sewage treatment plant (STP). Approximately 900 m^2 have been allocated to this STP on the south-western side of the property. Additional space is available for this if necessary. A 1500-GPD unit will be

installed, and will produce an effluent compliant with tertiary discharge standards. This effluent will be chlorinated, filtered and evaporated (tile field) out as the developers do not wish to have any discharge of effluents to the marine environment. As the system is electricity-powered, there will be a stand-by generator in the event of failure of the main grid. The process flow of the STP and schematics are given as Appendix 2. Design specifications for the system are given as Appendix 3.

10. There will be approximately 400 m of roadway constructed at a width of 6 m.
11. Approximately 1500 m^2 (0.4 acres) have been allocated as shown to accommodate parking for visitors. A smaller parking area is being considered near to the restaurant (building 1) at the end of the proposed road, but this parking area will be unpaved.

The proposed distribution of ground cover for the 20-acre parcel (not including beach and foreshore areas) is as given in Table 1 below. Approximately 92% of the site (or 18.4 acres) will either be left in its present condition (grass lands), or reserved for mangrove expansion and forest cover. Only 7.3 % (1.5 acres) will be built up with impervious surfaces as described in Table 2.

Table 1 Percentage Cover

	Area (m^2)	**% cover**
Built Area	5871	7.3%
Dry Limestone Forest	5000	6.2%
Mangrove preserve	2000	2.5%
Green areas (includes earth drain)	68069	84.1%
	80940	**100%**

Table 2 Built Up Space

	Area (Square meters)
Restaurant	223
Dolphin Offices etc	110
Admin offices	70
Reception area	50
West shops	279
East shops	209
Snack Bar	80
Beach facilities	50
Parking lot	1500
Roads	2400
Sewage Treatment Plant	900
TOTAL AREA	**5871 m2**

b/ Project Implementation Schedule and Activities

By end 2007

1. Removal of the two informal site users (one to the front and one near to Bay 2).
2. Applications will be made to NRCA to import 6 dolphins to introduce into the facility in time for September 2008. After the first year a second application will be made to import another 6 dolphins.
3. Applications for building approvals in respect of the proposed buildings, drainage, roads, parking and sewage design.

1st Quarter 2008

4. Construction of a temporary construction camp near the area shown as the central stockpile area in Figure 6 above. Changing rooms, storage facilities for construction materials, portable lavatories will be located here, along with the site office.
5. A carpentry shop will be established behind Building 4. This will store wood, tools and carpentry equipment necessary for board walk maintenance etc.
6. Commencement of construction. Much of the laying of foundations will be scheduled for this period.
7. Installation of the sewage treatment system will be scheduled for completion by September 2008.

2nd and 3rd Quarters 2008

8. Erection of buildings, casting of floors and roofing will be scheduled for this period. Concrete will be purchased from a ready mix facility as there is not sufficient demand for concrete to justify its batching onsite.
9. It is expected that TPDCo permits will be acquired at this time, with an aim to open in time for the winter season of 2008.
10. It is assumed that CITES export and import permits will be secured, and the dolphins will be imported and acclimatized by September 2008.
11. Commissioning of shops and restaurants.

4th Quarter 2008

12. Staff (operational phase) recruitment will commence in October 2008.
13. Final fittings and interior furnishings will be done in November 2008.

c/ Resource Consumption & Waste Streams

1. Subsidiary Inputs

- Construction camp materials: zinc, wood, portable lavatories, changing areas, potable water, staff canteen, storage facilities.
- Construction materials (bills of quantities not yet available): aggregate, construction water, cement, ceramic tiles, concrete blocks, electrical conduits, lumber and roofing materials, plumbing fixtures and pipes, paint etc.
- Potable water and electricity will be supplied from the mains (NWC and JPSCo respectively) at this time.
- Fixtures and furnishings: office and restaurant furniture, computers, telephones, tour related amenities (life vests, snorkel gear, towels, beach chairs etc.), air conditioning units for the offices,
- Floating docks.
- Generator for dolphin freezer.
- Freezer/cold storage facilities for dolphin food.
- Goods and supplies for shops and restaurants.
- The plan calls for the following species:
    i. Six Atlantic Bottlenose (*Tursiops truncatus)* dolphins in the first year, and possibly another 6 in the second year (depending on business). The facility has been designed to accommodate at least 12 dolphins. The main sources of dolphins are Cuba or the Ocho Rios facility. Dolphins are also available from a number of countries in the region including the United States. The Cuban authorities conduct stock assessments and collect coastal dolphins. Dolphins are not collected specifically for a particular buyer, and there is usually a long waiting list to acquire the animals. Cuban dolphins are usually sold in pairs (male and female), so if the animals are sourced from Cuba, there will probably be 6 males and 6 females. Typically animals imported from Cuba are 2 to 5 years old. Pregnant or lactating females or juveniles less than 2 years old will not be imported.
    ii. Other species: ~ 20 sting rays (*Dasyatis* sp.) will be caught from local waters once a fisheries license has been obtained to harvest them.

2. Human resources inputs (60 persons)

- 1 firm of architects
- 1 construction manager
- 10 skilled workers: 4 carpenters, 2 masons, 2 electricians, 2 plumbers
- 30 Laborers
- 2 Canteen staff: 1 chef and 1 assistant.
- 1 Human Resources Manager (permanent)
- 1 Director of Animal Care (permanent)

- 6 dolphin trainers and 6 dolphin handlers (permanent).

***** the resident veterinarian at the Ocho Rios facility and the consulting veterinarian will be on call to this facility.

3. Waste Streams

- Air emissions: emissions from any diesel powered equipment and vehicles (haulage of construction materials).
- Construction noise: drills, hammers, saws, etc.
- Fugitive dust: concrete dispensation (from trucks), and from heavy equipment, woodwork. Mixing of mortar (cement dust)
- Storm run-offs and suspended materials: from stockpiles of construction materials.
- Solid waste: construction camp (canteen/domestic waste, package materials)
- Sewage from ~ 60 persons on construction site.

2.3.1.3 Operational Phase Footprint

a/ Specifications & Outline of the Plans

Approximately 300 visitors are expected to visit the attraction on an average cruise ship day. Like the Ocho Rios Facility, the Paradise Dolphin Cove will be open to the public from 8:00 am to 5:00 pm, 365 days a year except during periods of inclement weather. Operational aspects of the facility will include the following main areas:

1. **Dolphin Programmes** (Bay 2). This will include the same programmes that are offered in the Ocho Rios Facility: the Swim-with programme (which includes the push and pull), the Encounter Programme (no direct contact, the animal swims around the participant) and the touch programme (designed for non-swimmers to have an opportunity to view the dolphins). The participant ratios used in the tours will be compliant with the NRCA standards and guidelines for operating dolphin facilities in Jamaica. All of the programmes will have an orientation component for the visitors, during which they are advised on how to behave around the dolphins. Additionally, the trainers and handlers take the opportunity to inform participants about dolphins' anatomy and physiology, as well as threats facing wild populations and their habitats.

   Dolphin Cove has previously discussed the possibility of offering Dolphin Human Therapy (DHT) at this facility with its main proponent, Dr. David Nathanson, who is based in Key Largo, Florida. However, these discussions are on hold until the facility is developed, at which time, if both parties still feel it is viable, the relevant permits will be sought from the regulatory authorities. No additional or dedicated dolphins will be required by the programme.

2. **Paradise Rock Pool**: This area is presently too rocky and shallow for recreational swimming, but can be integrated into the attraction as it is. It is envisaged that visitors will be able to view tropical fish such as parrot fish, jacks, tarpons, sting rays etc. from

the boardwalk that surrounds much of the perimeter of this section of the bay. At this time, the western part of Bay 2 will not be further developed, although the developers may choose to apply for permission to do so later on.

3. **Paradise Sting Ray Experience**: The shallow sandy area on the western side of the beach created in Bay 2 will be used as a sting ray interaction area. Sting rays will be de-barbed and kept in this area for interaction with visitors.

4. **Paradise Shore Trail Experience**: Visitors will be able to learn about tropical sea grass eco-systems through an observation deck, and interpretive signage. There will be a trail going through the forested area and part of the mangrove swamp which will include at least two wood-and-rope bridges across the drainage swale. Visitors will have the opportunity to learn about the mangrove-sea grass and dry limestone forest eco-systems through interpretive signage and trained tour guides. This protected area will be marked off on the ocean side by marker buoys and rope at the bay entrance.

5. **Paradise Beach Experience** (Bay 3): This tour is a simple sun-sand-sea experience that most tourists expect when they choose a Jamaican vacation. With the exception of accessible public beaches in Negril and Montego Bay, there are no public beaches with proper user amenities between these two resort areas. Visitors will be able to park their vehicles in a secure parking lot within walking distance to the beach. No vehicles will be permitted on the beach. The beach will have changing facilities and restroom facilities as well as a life guard and grounds maintenance. There will also be lounge chairs and towels available for rental. The beach itself will be equipped with marker buoys to indicate the six-foot depth. The water quality at the beach will also be routinely monitored to ensure compliance with the Blue Flag faecal coliform criterion. This beach will be completely man-made with imported sand and excavated swimming area, which had been designed and modeled for optimal swimming conditions and shoreline stability.

   The developers reserve the right to apply for (Jamaica Tourist Board) Watersports licenses to operate non-motorized boating such as ocean kayaking and sailing. Jet skis will not be allowed in this area.

6. **Restaurants and shopping concepts**. Dolphin Cove Ltd. has realized the importance of having food, beverage and shopping available to tourists in order to enhance the quality of their experience at the park, and to encourage them to stay longer. The restaurant will be a simple beach buffet, and their will be an additional snack bar selling jerked chicken and hamburgers. Shopping will be available in buildings 6 and 7. The design concept for the dining and shopping areas is still being developed, but it has been decided that the experience should be evocative of the typical Jamaican town with a central clock tower, and non-uniform facades.

7. **Community Linkages.** Although the dolphin park cannot be classified as an eco-tourism venture in the strictest sense of the word, the company recognizes the benefits

of bundling their tours with off-site tours. These community-based tours generally serve enhance the overall experience of the Dolphin Cove guest. Therefore, Paradise Dolphin Cove will seek to develop (in partnership with community stakeholders) bundled tours to:

a. The historic town of Lucea (including a visit to the 18th Century Haughton Court.
b. The community of Blenheim (birthplace of National Hero Alexander Bustamante).
c. Historic sugar plantations in the area.
d. Kenilworth Ruins (near Mosquito Cove).
e. The Dolphin Head Protected Area/Askenish Community.

The Tourism Master Plan to develop of community tourism as one of its five main objectives will be fully supported by Dolphin Cove Ltd. in this parish as these types of experiences complement the tours offered at the park.

8. **Maintenance** is also considered a core function of the park operations as it is important to maintaining the visual aesthetic for tourism as well as the necessary environmental quality for the dolphin lagoon and swimming beach, and pest management in the restaurants and dining areas.

- Detergents are not used in proximity to the dolphin lagoon, and all cleaning of boardwalks and floating docks are done by manual scrubbing. The grassy areas will be mowed.
- Landscaping in the forest and mangrove areas will be kept to a minimum to ensure the natural succession of the vegetation community. Maintenance in these areas will consist mainly of trimming trees along the trail for visitor safety.
- The use of indigenous ornamental vegetation for landscaping will be restricted to the areas marked for recreational land use on Figure 2.

b/ Resource Consumption & Waste Streams

1. Subsidiary Inputs

- Food for dolphins (frozen fish)
- Restaurant supplies: meat, vegetables, seasonings, rice, bean etc,
- Consumables: toilet paper, detergents, office supplies (stationary etc.)
- Merchandise: craft and souvenir items etc.
- Electricity: this will be purchased from JPSCo. It is estimated that 15,000 units will be required on a monthly basis.
- Potable water: Approximately 6000 gallons of potable water are estimated to be required per day during the operational phase. Permission to connect to the NWC mains will be sought.
- Telecommunications: At least 4 telephone lines (including ADSL connection) will be required. This will be sought from Cable and Wireless.

2. Human resources inputs

The final staff complement will consist of 8 managers and 82 support staff, giving a total of 90 permanent staff at the facility (Table 3). As far as possible, the company's hiring policy will be to give preference to Hanover residents, and to promote local skills development for the tourism industry. Staff that is shared with the other facilities include: Internal auditor, veterinarians, environmental compliance advisor, marketing representatives. As with the Ocho Rios facility operations at this park will be overseen by a competent board of directors that meets on a monthly basis.

Table 3 Breakdown of Permanent Staff

Management	Support Staff
1 General Manager	1 administrative assistant
	4 life guards
	4 parking lot attendants/security
	20 Tour Guides
	6 grounds and housekeeping staff
1 HR Manager	1 administrative assistant
	1 nurse
1 Director of Animal Care	6 trainers and 6 handlers
1 Food and Beverage Manager	1 administrative assistant
	10 restaurant staff
1 Tour Sales Manager	1 administrative assistant
	4 reception/reservations staff
1 Gift Shop Manager	1 administrative assistant
	8 Gift shop staff
1 Chief Accountant/Financial Controller	2 accountants
1 Video Manager	1 administrative assistant
	6 videographers

In addition to these jobs that will be created by the park, it is expected that there will be an number of other earning opportunities associated with the community tours, taxis services, entertainment (musicians etc) and general supply of goods to the park.

3. Waste Streams

a. Air emissions: emissions from vehicular traffic.

b. Operational noise: music played at 70 dBA during daylight hours in the shopping and beach areas.

c. Dust: from routine maintenance of the facilities.

d. Storm run-offs and grey water wash basins, showers and kitchens. These will be filtered to remove oil and grease and routed to the drainage swale. Run-offs from these areas are expected to have a phosphate detergents and very diluted quantities of chlorine bleach.

e. Solid waste collection: Approximately 16 cubic meters of solid waste is expected to be generated by the facility per week. Solid waste is expected to include office waste, restaurant waste (organic waste, plastic bottles, tin cans) and shop packaging materials etc. A collection facility will be located on the south-eastern side of the parking lot. It will be constructed of concrete to allow for easy cleaning, and will be designed to facilitate truck access. If the local authorities are not able to offer collection services, an approved contractor will be contracted to take the solid waste to the nearest land fill.

f. Sewage from a maximum of 500 persons per day: this will be routed to a sewage treatment plant. There will be no discharge of sewage effluent.

2.3.1.4 Upset Conditions

An **Emergency Response Plan** will be developed post-permit, and will be implemented after approval from the Office of Disaster Preparedness and Emergency Management, the Coast Guard and NEPA. This plan will cover the procedures for hurricanes, earthquakes, oil spills and fires, and medical emergencies. The plan will include at a minimum:

- Implementation procedures (responsibilities, activation/deactivation)
- Specific hazards at the facility and general vulnerability assessment.
- Response procedures for each hazard identified, inclusive of checklists of emergency equipment (and where kept), personnel, responses, reporting procedures etc.

The site plan allows for vehicular road access directly to the dolphin area in the event that dolphins have to be moved. Typically dolphins are moved to a secure prepared pool in the event of a hurricane. The emergency response plan will identify a suitably sized pool to which the dolphins can be relocated in the event of an emergency. The pool that is used will be located within 30 minutes drive from the facility, and will not be vulnerable to storm surges.

3 REGULATORY FRAMEWORK

3.1 SECTION OVERVIEW

The objective of this task is to outline the relevant environmental regulations, policies and standards/guidelines governing the construction and operation of a dolphin park as proposed. In all cases the roles of agencies with responsibility for implementing legal mechanisms are described. Where Jamaican standards or policy are insufficient, international standards and policies are. This section summarizes (thematically) the key regulatory controls on the project (including environmental quality criteria, physical planning restrictions, building codes etc.). The degree of compliance with these regulatory controls (general acceptability) is used in the impact assessment section a key criterion used in determining of the relative significance of environmental impacts.

3.2 DEVELOPMENT & OPERATIONAL CONTROLS

3.2.1 Development Control

3.2.1.1 Permitting

The National Environment and Planning Agency (NEPA) is in charge of land use and development and natural resource conservation under the **Natural Resources Conservation Authority** (NRCA) Act, (1991) which makes stipulations for Environmental Impact Assessments (EIA) in addition to the requirements of the Permit and Licensing System (PLS) for a development proposal. Theme parks require an environmental permit under the NRCA schedule. A license is also required for the construction of any works, such as, a sewage treatment plant. Encroachments onto the foreshore (e.g. dredging, reclamation or establishment of permanent structures on the foreshore) require a Beach Licence under the **Beach Control Act**, which is administered by the NRCA. Under the NEPA PLS, applications have been submitted for the following project elements:

- Operation of a dolphin theme park (environmental permit)
- Wetlands modification (environmental permit)
- Operation of a sewage treatment plant (environmental license)
- Coastal modifications to facilitate the development of the proposed dolphin facility (beach license). Specifically, the application was made to: (a) construct 2 boulder breakwaters (b) excavation of 1935 m^3 material from coastal land (c) dredging of 1500 m^3 in the foreshore (d) placement of 3783 m^3 of sand and fill. A separate application will have to be made for the construction of docks.

For developments with significant subsidiary inputs (concrete or asphalt batching), separate applications are needed for these temporary activities. The small scale of construction of this project will not necessitate batching plants.

The Ministry of Tourism, Entertainment & Culture is responsible for recreational attractions in Jamaica through the Tourism Product Development Corporation (TPDCo) and the Jamaica Tourist Board. Section 8 of the **Fishing Industries Act** prescribes that registration and licensing under the act is required for recreational and sport fishing. The regulatory framework governing dolphin operations is addressed in Section 3.4.1.

The Town Planning Authority (through the Planning Branch within the Integrated Planning and Environment Division NEPA) administers the Town Planning Act, which covers the development and use of land. All development projects must have planning and building permission (which considers planning constraints such as zonation, parking, availability of municipal services) from the Local Planning Authority and TPA.

3.2.1.2 Approvals for Utilities, Civil Works and Infrastructure

Roads: **The National Works Agency (NWA)** operates under the **Main Roads Act (1932)** as it relates to maintenance of roads and road construction. The Act regulates the detailed procedures and requirements for major roads, inclusive of the laying out, making, repairing, widening, altering, deviating, maintaining, superintending and managing of main roads. The North Coast Highway Project management team at the NWA will have to ensure that the proposed design of the entrance and exit to the North Coast Highway is safe and integrates properly with the highway alignment.

Drainage: **The National Works Agency (NWA)** administers the **Flood Water Control Act** which regulates the management of watercourses concerning flood regulation, specifically, terms of surveys, civil works or clearance. The NWA reviews and approves the development proposal of any road or drainage works particularly as they connect to municipal roads or drainage systems.

Water Supply: The National Water Commission (NWC) Act (1980) regulates public water supply systems and public sewerage and sewage treatment. **National Water Commission (NWC)** provides potable water and sewage services for proposed development. All water supply and sewage disposal plans must be granted approval by the NWC. This is done in conjunction with the **Water Resources Authority**, which administers the Water Resources Act and is thereby mandated to regulate ground and surface water resources, specifically, supply, flood risk and water quality and has a representative on NEPA's Technical Review Committee (TRC), which reviews development proposals.

The **Environmental Health Unit** (Ministry of Health) also reviews the application and makes comments in terms of the potential of the proposed sewage disposal to impact on human health.

The **Office of Disaster Preparedness and Emergency Management** (ODPEM) is an advisory body with responsibility to implement pro-active and timely procedures to prevent or reduce the impact of hazards on Jamaica. The ODPEM provides recommendations to NEPA and the **Hanover Parish Council** with regards to vulnerability to hazards for proposed development.

3.2.1.3 Operation of a Restaurant

Restaurants have to be inspected by the Hanover Health Department and have a Public Health Certificate. Persons involved in preparing food are required to have a Food Handler's Permit, issued by the Ministry of Health (Comprehensive Health Centre). The operation of restaurants must comply with the **Public Health Act**, which gives the local health board the right to inspect the sanitary conditions of restaurants and eating establishments. Restaurants must be inspected by the Health Department and must hold a Public Health Certificate. Individuals involved in food preparation are required to have a Food Handler's Permit, issued by the Ministry of Health. The **Food Storage and Prevention of Infestation Act** provides for inspection in order to prevent infestation by pests such as rodents, insects or fungi.

3.2.2 National Planning Context

3.2.2.1 Physical Planning: Hanover Coast Development Order (1959)

The proposed tourism development at the site is not inconsistent with the resort land use for which the area is zoned under the Hanover Coast Development Order (1959).

3.2.2.2 National Forest Management and Conservation Plan (2001)

With the exception of two relatively small mangrove stands, the area is not presently under forest. According to the National Forest Management and Conservation Plan (Forestry Department, 2001), the estimate of total area under mangroves and swamps in Jamaica is of the order of 12,000 ha. This plan proposes to remove 0.2 ha of mangrove forest and has identified an area fore replanting and expanding the mangrove resources on the property.

The development proposal also calls for establishment of a coastal forest along the banks of the proposed drainage swale. The coastal area near Lucea was not specifically identified as having reforestation potential in the National Forest Management and Conservation Plan (NFMCP). This aspect of the development proposal is consistent with the idea of forestry development as a means of conserving biodiversity and carbon sequestration, which are specifically mentioned in the NFMCP.

The most important forest reserve in the proximity to the site is Dolphin Head.

3.2.2.3 Tourism Master Plan (2002)

The Tourism Master Plan is most relevant Master Plan in evaluating tourism related development proposals. The plan sets out five main objectives:

1. Growth based on a sustainable market position.
2. Enhancing the visitor experience.
3. Community based development.
4. An inclusive industry.
5. Environmental sustainability.

The applicants are presently involved in the tourism industry, already operating a major tourism attraction in Jamaica, and through this project will continue to support these national tourism objectives.

Heritage sites in proximity to the site that have been specifically named in the Tourism Master Plan as having "National Heritage Significance and Primary Tourism Potential" include Fort Charlotte in Lucea and the birthplace of Sir Alexander Bustamante, Blenheim. Lucea was named as a town that could serve as a heritage centre (*the Breadfruit Port of Captain Bligh"*)

The Master Plan also identified endangered species ("*such as alligators* (?) *and manatees*"), birds and flora as focal tourism themes that could be developed.

3.2.2.4 Other Plans

- Water Resources Master Plan: As a coastal site not in proximity to any major rivers, the site is not regarded as having significant ground or surface water resources that would fall under the ambit of the Water Resources Master Plan. The area does not fall within any important recharge areas or protected watershed.
- NRCA System of National Parks and Protected Areas: The site is not located within the boundaries of the two nearest protected marine areas the Negril Marine Park and the Montego Bay Marine Park.

3.3 ENVIRONMENTAL CONSERVATION

3.3.1.1 Coastal Areas

Ownership of the foreshore is vested in the Crown except where rights are acquired under express license from the Crown (before 1956). Therefore lands above the foreshore may be private property. **The Beach Control Act (1956)** is administered by the **Natural Resources Conservation Authority (NRCA)** which regulates coastal and marine resources by administering licensing of activities on within 25 m of the shoreline, the foreshore and the floor of the sea for specific purposes. Section 4 of the Beach Control Act sets a requirement for for commercial use of the foreshore by owners of the adjoining lands.

Section 5 prohibits encroachments on the foreshore unless under licence. These include the construction of defence structures such as breakwaters and groynes, as well as activities such as dredging/excavation or land reclamation. In addition, Section 8 stipulates that the construction of jetties and docks also require a license.

The **National Beach Policy (2000)** outlines the Government's policy in respect of use of the coastal area. The objectives of the policy revolved around equitable access, expansion of recreational opportunities (tourism), public health issues (pollution control), traditional fishing rights, wild life conservation and vilnerability to climate change and natural disasters.

According to the National Beach Policy, "In common law, the public has no general rights of access to the foreshore or the floor of the sea or to beaches. There is no general right of bathing. There are no general common law rights over the foreshore except to pass over it for the purpose of navigation or fishing. In Jamaica there is no statute that conveys any general rights over the foreshore or the floor of the sea save and except the provisions in the Beach Control Act. Rights of fishing and bathing may however be acquired by custom and such customary rights are addressed in Section 14 of the Beach Control Act and Sections 4 and 9 of the Prescription Act." Prescriptive rights have to be specifically declared by the Court.

3.3.1.2 Water Resources

The Water Resources Authority (WRA) administers the Water Resources Act (1995), which regulates the use of water resources in Jamaica, including any activities that impact on the quality of freshwater resources. WRA manages the water resources of Jamaica by issuing 5-year licenses for the abstraction of groundwater and surface waters. WRA also implements the Water Sector Policy Strategy/Action Plan (Ministry of Water, 1999), which addresses water resource management, urban water and sewerage, rural water and sanitation, urban drainage and irrigation.

3.3.1.3 Heritage Resources

Jamaica National Heritage Trust (JNHT) is a branch of the Ministry of Youth and Culture. It enforces its mandate under the Jamaica National Heritage Trust Act (1985) which serves to identify and preserve anything that can be designated as part of the national heritage, including physical structures and objects, underground, above ground and beneath the sea. In the event of the discovery of archaeological artifacts during construction, the JNHT will be notified as it is responsible for declaring all national monuments.

3.3.1.4 Wetlands, Coral Reefs and Seagrasses

The NRCA has issued a **Draft Mangrove and Coastal Wetlands Protection Policy** and Regulation document, which is to be administered by the Integrated Branch of NEPA. This Draft policy seeks to designate wetlands as protected areas, and protect them from pollution (including sedimentation) and dredging, filling and other development. It further seeks to ensure that all development proposals planned for wetlands are subject to an EIA. The policy is concerned with establishment of guidelines and planning for sustainable wetland development and use, and conservation of wetlands biodiversity and ecological functions. It specifically states that "*If properly managed, mangrove wetlands can be important in generating ecotourism. Wetlands offer recreational opportunities such as sight-seeing, boating, swimming, and sport fishing. Boat excursions into wetlands are gaining increasing popularity as a tourist attraction*".

The project seeks to relocate, rehabilitate and expand the wetland resources at the site, and to develop them in a sustainable manner that will be consistent with the national policy, preserving their ecological functions (through the establishment of bird and fish sanctuaries in the wetland preserve, and engineered storm water management), whilst facilitating their productive use as part of a viable nature tourism theme park.

The Policy for the **National System of Protected Areas** (1997) suggested in Goal 1 (Economic Development) that Jamaica's economy was natural resources based, and that the policy should ensure that the Protected Area System (PAS) contributed "*significantly to the sustainability of the critical tourism sector by protecting beaches, coastal waters, coral reefs …..".* The policy concluded that "*representative habitats of coastal and marine ecosystems, habitats, and associated ecosystems of adequate size to ensure their long term viability and to maintain biological and genetic diversity".* The specific area is not included as a protected area by name, but falls within the system as a coastal area. The nearest protected areas are the Negril Marine Park and the Montego Bay Marine Park.

3.3.1.5 Biodiversity & Capture of Wild Dolphins

Jamaica is signatory to the Convention on Biological Diversity, which requires *inter alia,* the establishment of regulatory provisions to protect threatened species and populations. The NRCA through its **Biodiversity Branch** (NEPA) has the responsibility of administering the Wildlife Protection Act (1945). This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. Section 6 of the Act prohibits the hunting of protected species (listed under the 3rd Schedule of the Wildlife Protection Act – Table 4) The development does not include proposals for hunting or harming protected species.

Table 4 Third Schedule of the Wild Life Protection Act

	Terrestrial	Marine
Invertebrates:	Jamaican Kite Swallowtail, Giant Swallowtail Butterfly	Black Coral, Reid Seahorse,
Reptiles:	Crocodile Iguana	Green, Hawksbill, Loggerhead, Atlantic Ridlye, Atlantic Leatherback
Mammals:	Coney	Manatee, Pedro Seal, bottlenose dolphin, sperm whale, pantropical spotted dolphin, Baird's beaked whale, short-finned pilot whale, humpback whale,

The international conservation status of relevance to this project as unregulated captures from wild populations for trade could be deleterious to both biodiversity and the stability of the population in areas where this is a problem. The **Cetacean Specialist Group of the IUCN** has also listed the bottlenose dolphin under the classification of DD (data deficient or insufficiently known)[1]. The IUCN list the following areas as known or suspected to have conservation problems: (a) the Mediterranean and Black Seas, (b) Sri Lanka (c) Peru and Chile, (d) Taiwan and (e) Japan. The IUCN notes a live-capture management regime in the south-eastern United States, and warns that "*Unregulated live-capture fisheries can contribute to the depletion of wild populations".*

Jamaica signed the **Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean (SPAW)** on January 18, 1990. *Inter alia* the Protocol requires signatories to establish specially protected areas to conserve rare and fragile ecosystems, and threatened or endangered species.

[1] Accessed on March 16th 2007: http://www.iucnredlist.org/search/details.php/22563/all

All cetacean species are included in Annex II of the SPAW Protocol, which requires signatory states to:

- Prohibit non-selective means of capture, killing, hunting and fishing;
- Institute closed hunting and fishing seasons and other measures for maintaining their populations;
- Consult with range states on their efforts to manage and protect endangered or threatened migratory species; and
- Regulate and, where appropriate, prohibit the taking, possession or killing of protected species of fauna.

UNEP's **Marine Mammal 2001 Action Plan for the Caribbean**[2] indicated that Bottlenose Dolphins "*are considered to be the most common inshore cetacean species in parts of the Caribbean as noted by the following researchers: in Colombia (Palacios et al. 1995), near Grand Bahama Island (Rossbach and Herzing 1999), Puerto Rico and the Virgin Islands (Erdman 1970; Mignucci-Giannoni 1989), and the Lesser Antilles and Venezuela (Schmidly 1981). Erdman (1970) indicated that bottlenose dolphins are seen in greater numbers around Puerto Rico and the Virgin Islands in the summer, and that they occasionally come near to shore in very shallow channels amongst mangroves. Rodríguez-Ferrer et al. (2000) reported on the status of the bottlenose dolphin in Puerto Rico; the species is characterised as common throughout the year and ranked second in the number of strandings in the area*". In the Caribbean, the species is not regarded as endangered.

The **Fishing Industry Act** (1975) established a Licensing Authority to issue a fishing licence for fishing activities. The Act defines a fish to include shell fish, crustaceans and marine or freshwater animal life. A new Fisheries Bill has been drafted and is presently under review.

The **National Strategy and Action Plan on Biological Diversity** (2003) stipulated in respect to collection of wild faunas: "*Given the potential threat of harvesting and collecting to species survival, a programme must be developed to regulate and monitor all aspects of species trade. Specific activities include the development and implementation of guidelines for the ecologically sustainable use of species and genetic resources; application of the precautionary approach to harvesting and collection of biological resources; formulation of a policy and regulations to facilitate controlled access to biological resources; increased enforcement efforts and monitoring of collection; and the launch of a public education campaign".*

In July 2004, the Biodiversity Branch issued a **Draft Dolphin Conservation Policy** for Jamaica for public comment. That document focused heavily on issues pertaining to dolphins in captivity rather than wild populations, extensively citing anti-captivity animal rights activists.

[2] Ward, N., Moscrop, A and Carlson, C. 2001. Elements for the Development of a Marine Mammal Action Plan for the Wider Caribbean: A Review of Marine Mammal Distribution. UNEP(DEC)/CAR IG.20/INF.3. United Nations Environment Programme, Regional Office for Latin America and the Caribbean, Mexico City, Mexico.

The Draft Policy called for the formulation of Draft Dolphin Management Plan (DMP) for Jamaica, which would include establishment of best practices methods in respect of the capture and transport of wild dolphins, and catch quotas in terms of overall numbers of individuals to be taken per licensee, or number of particular age/sex classes based on results of scientific surveys. This policy is still under review.

The development proposal does not include any plan for capturing of wild dolphins from Jamaican waters, but seeks to import captive-bred dolphins as a first option.

3.3.1.6 International Trade of Dolphins

The **Endangered Species (Protection, Conservation and Regulation of Trade) Act** was promulgated in 2000 as a means of establishing a national framework to ensure codification of Jamaica's obligations under the **Convention on the International Trade in Endangered Specis of Wild Fauna and Flora (CITES)**. Under this Act, the NRCA was designated as the Management Authority (as per Article IV of CITES), with responsibility to *inter alia*:

- Protect and manage endangered species from overexploitation through trade.
- Grant permits and certificates in respect of trade in endangered species
- Determine national quotas
- Determine methods of shipment.

The Scientific Authority's role *inter alia* primarily includes advising the Management Authority in respect of species vulnerability and policy, and the likely effect of a proposed import, export re-export or introduction from the sea of any species. There are four schedules to the Act, which are essentially the four CITES appendices.

Bottlenose dolphins fall under Appendix II of CITES, which pertains to "*all species which although not now threatened with extinction, may become so if trade in specimens of such species is not subject to strict regulations in order to avoid utilization which may be detrimental to their survival".*

Second Schedule Import Permits are granted only if the Management Authority is satisfied that the specimen will not be used for purposes detrimental to its survival, and if the recipient is suitably equipped to house and care for the specimens. Dolphin Cove Ltd. will be required to apply for a permit to import dolphins in accordance with the provisions of this Act, and will be required to demonstrate a capacity to care for and house the animals. The Act does not apply to animals bred in captivity. Applicants who are denied CITES permits by the Management Authority may appeal in writing to the Minister within 28 days of the date of notification of the decision. NRCA (as the Management Authority) then has 7 days to submit all relevant documents to Minister for a hearing of the appeal.

The **Animals (Diseases and Importation) Act 1948** mandates the Veterinary Services Division of the Ministry of Agriculture require a Health Certificate from the appropriate authority in the exporting country before issuing an import permit. This certificate normally provides information in respect of the general health of the specimens, and the diseases for which they have been tested.

The **Draft Dolphin Conservation Policy** (July 2004) sets the management of dolphin importation into Jamaica as on of its strategic goals. It seeks to ensure that imported specimens be accompanied by CITES import and export permits, scientific study and health certificate. It also recommended the establishment of an importation quota on number of dolphins that may be imported on a phased basis to achieve goals set out in sustainable captive breeding programmes.

3.3.1.7 Transportation of Dolphins

The NRCA has established **Guidelines for the Transportation of Dolphins** (May 2004). These guidelines cover:

i) The optimal design for the transportation containers and labeling of containers.

ii) Essential personnel to be present during the transportation of the dolphins.

iii) Handling and general care of dolphins during transportation. This includes stipulations for the comfort and well-being of the dolphins such as moisturizing, temperature, freedom of movement, and avoidance of weight pressure points. This section stipulates that dolphins should not be moved again unless medical attention is required or if they are being re-exported.

iv) Feeding during transport.

v) Documentation. The importation/transportation of dolphins from the port of entry must be accompanied by copies of the CITES import permit from Jamaica and the CITES export permit and the Health Certificate from the exporting country,

3.3.1.8 Husbandry of Dolphins & Public Display

The NRCA **Draft Policy and Regulation for Mariculture** (1998) is considered relevant, as the project involves the cultivation of marine organisms in their natural habitats for commercial purposes[3], although the 1998 policy document limited its definition to food production. The draft policy outlines that the government should be guided by the following principles: use of local species (or controlled introduction of exotic species), coordination of functions of government agencies and collaboration with the operators and communities, and public awareness of the

role of mariculture in preservation of marine species, and the improvement of environmental quality. The policy identified the mangrove or cup oyster, mussel, tilapia, sea moss, shrimp and cage culture of fin fish options. The specific policy goals focused on sustainable mariculture, controlling impacts, and recognition of mariculture as an option for the sustainable use of coastal resources.

According to the policy, areas designated for mariculture should not be subject to harmful levels of pollution, conflict with other users, or is needed as a nursery area. The policy recommended the requirement of a permit or lease from NRCA or the Fisheries Division to specifically address the area extent, type of operation, use of the water column and floor of the sea, time frame, performance, fees and termination. NRCA would maintain jurisdiction over mariculture under the Beach Control Act except within declared fish sanctuaries, in which case the Fisheries Division would also have to grant approval.

One of the strategic goals of the policy was to "*enact and enforce regulations to protect the rights of those engaged in mariculture…."* by specifically preventing discharges of pollutants to waters leased or licensed for mariculture and setting up a system of settling compensatory claims as a result of pollution incidents (e.g. oil spills). A second relevant strategic goal of the policy was to establish standards to prevent the adverse impacts of mariculture activities on coastal areas and marine eco-systems, and included allowable levels of total Nitrogen and total Phosphorus in the water column and BOD in sediment. The policy specifically mentions the Lucea Harbour and Mosquito Cove areas as suitable for cage culture of fin fish.

The NRCA has established the **General Standards and Guidelines for the Operation of Dolphin Facilities in Jamaica** (1999). A revision was proposed in 2005, but has not been finalized as yet. The 1999 guidelines cover the following aspects of dolphin tour operations:

- Importation of dolphins
- Facilities and enclosures
- Staff Requirements
- Public Contact with Dolphins
- Rescued dolphins
- Records and Reporting
- Food and Health
- Tour standards

Through the Standards and Guidelines NEPA has made provision for monitoring of water quality in the dolphin lagoons, and stipulated the monitoring of faecal coliform (fortnightly), nitrates, phosphates, Biological Oxygen Demand (monthly), pesticides (quarterly) and oil and grease (in the event of an incident). Operators of dolphin facilities in Jamaica are required to comply with these standards and guidelines as part of the environmental permit issued for the operation of the facility.

[3] A standard definition of mariculture as defined by the American Heritage® Dictionary of the English Language, 4th Edition. Retrieved March 16, 2007, from Dictionary.com website: http://dictionary.reference.com/browse/Mariculture

The NRCA **Draft Dolphin Conservation Policy** (July 2004) recommended *inter alia* the following:

- Determining the carrying capacity for dolphinaria and explore the feasibility of dolphin watching facilities as opposed to dolphinaria.
- Conducting surveys (market and ecosystem) to determine the number of dolphinaria to be established in Jamaica.
- Establishing best practice methods for the development and operation of dolphinaria.
- Developing guidelines for captive breeding programmes.
- Requiring that the dolphins for the captive breeding programme, outside of Jamaica, are purchased outright (not leased) from sources which have conducted proper population surveys.
- Conducting independent water quality and veterinary tests.

However, this document is still under review.

In addition to the national Standards and Guidelines, the proponents also operate in accordance with international standards such as the Standards and Guidelines established by the Alliance of Marine Mammal Parks and Aquaria, which give guidance in respect of:

- Acquisition and disposition
- Animal Training
- Public Education
- Husbandry
- Spatial Requirements
- Transportation
- In-water interactive programmes
- Propagation
- Quarantine
- Record Keeping
- Water and Environmental Quality
- Scientific Research

Other international guidance on marine mammal husbandry is given by the International Marine Animal Trainers Association (IMATA). IMATA sets a code of professional ethics for dolphin trainers who are members. Members are expected to be committed to:

1. The highest levels of respect and humaneness for all animals;
2. Professional integrity;
3. Respect, understanding, and cooperation among fellow members and others associated with the zoological community in general and the marine animal community in particular;
4. The promotion of public and professional interest in IMATA and accepting the obligations of membership.

3.4 WASTE MANAGEMENT

3.4.1.1 Air Quality

NEPA is responsible for matters related to air quality and noise emissions under its general environment and planning mandate. **The Clean Air Act (1964)** regulates air emissions of any noxious or offensive gases which include alumina, cement, lime and sulphur resulting from petroleum, gypsum and sugar processing as well as electrical generation stations. The proposed development is not expected to generate any of the above listed activities in either its construction or operational phases.

3.4.1.2 Noise Emissions

The Noise Abatement Act (1997) regulates "public peace" in terms of the generation of nuisance noise audible beyond 100 m from the source in day or night time, and night time noise. Under the act, a person who wishes to operate equipment providing music for entertainment in a public area in which such music is capable of disturbance to any persons residing in private premises, is required to make a written application to the Superintendent of Police in charge of the division for permission to do so, no later than ten clear days before the date on which it is proposed to hold such activity.

The **Noise Pollution Rules of the Environment Management Act (2000) of Trinidad and Tobago** use three zones in which a sound may originate: industrial, environmentally sensitive areas and general. The maximum sound pressure level (SPL) must not exceed 75 dBA, 60 dBA and 65 dBA respectively in these zones. Similarly, the **World Bank Health Organization** and the **World Health Organization Noise Standards** apply to three major categories – residential, commercial and industrial. This zone may best be classified as commercial as there are adjacent commercial activities but no residential or industrial land use. The proposed development is not expected to increase ambient levels of noise during its operational phases.

3.4.1.3 Solid Waste Disposal

The National Solid Waste Management Act (2001) regulates solid waste management in Jamaica. This includes the regulation of environmentally sound waste collection, transportation, re-use and re-cycling, and the development of a licensing system for operators of solid waste management and collection facilities. The **National Solid Waste Management Authority (NSWMA)** is the governing body in charge of solid waste management in Jamaica.

3.4.1.4 Pollution Control & Public Health

The Pollution and Prevention Control Branch of the **National Environment and Planning Agency (NEPA**) regulates the control of groundwater contamination under Sections 15 and 16 of the NRCA Act. Section 12 of the NRCA Act stipulates that licenses are required for the discharge of sewage or any polluting matter. Section 17 allows for the periodic performance reporting from the owner or operator of any sewage treatment plant, industrial waste treatment facility or any facility for the disposal of solid waste or any other facility for controlling pollution.

This can include information pertaining to the performance of the facility; the quantity and condition of effluent discharged and the area affected by the discharge of effluents. Table 5 summarizes the effluent criteria for Jamaica (NRCA standards).

Table 5 Jamaican Water Quality Standards (Key Parameters)

Parameter	Freshwater	Sewage Effluent	Trade Effluent	Dolphin Facilities
Nitrates mg/L	0.10 - 7.5	10 (Nitrogen)	10	0.14
Phosphates mg/L	0.01 - 0.8	4	5	0.003
Biological Oxygen Demand mg/L	0.8 - 1.7	20	<30	1.16
Total Suspended Solids mg/L	-	20	<150	-
Faecal Coliform - MPN/100 ml	-	1000	100	200*

* *Blue Flag criterion for recreational marine waters.*

The **Public Health Act (1985)** makes provision for the establishment of the **Central Health Committee (appointed by the Minister chaired by the Chief Medical Officer).** The Public Health Act under Section 7 makes provision for the local health boards (Parish Council) to regulate *inter alia* such areas as public sanitary conveniences, lodging houses and camps, swimming pools, restaurants, public nuisances, garbage and waste. This is done in conjunction with the Central Health Committee. The **Environmental Health Unit (EHU)** of the Ministry of Health has responsibility for administering the act, including the review of designs for sewage treatment. The **Public Health Regulations** (First Schedule, paragraph 10) prohibit the discharge of sewage into the sea.

4 DESCRIPTION OF THE ENVIRONMENT

4.1 SECTION OVERVIEW

The purpose of this section of the EIA is to describe Valued Environmental Components (VECs) within an area that could be impacted should the project be implemented. It is therefore not limited to a description of the site. The level of study given to any one VEC in this baseline is commensurate with the degree of change to baseline condition that may be expected as a result of project implementation.

Information presented in this section allows for:

1. Evaluation of existing trends in environmental systems if the project were not implemented and the carrying capacity of the environment in respect of specific stresses.

2. Determination of existing environmental effect levels to which the project may contribute.

3. Establishment of a baseline against which future monitoring data can be compared to determine whether and how a project is actually impacting specific receptors.

This section is organized according to the broad classification of physical environment, biological environment and human and built environment. Methodologies and data sources with respect to each sub-section are given at the start of that sub-section.

4.2 PHYSICAL BASELINE

4.2.1 Climate

The site is located at latitude ~18.5° N on the northwest coast of Jamaica. As such it possesses a tropical climate, characterised by pronounced wet and dry seasons. Climate data for the Sangster International Airport (National Meteorological Service), located 23 km ENE of the site is regarded as representative of climate conditions at the site as it occurs at similar latitude (4 km south) on the northwest coast of Jamaica, and is also a coastal location.

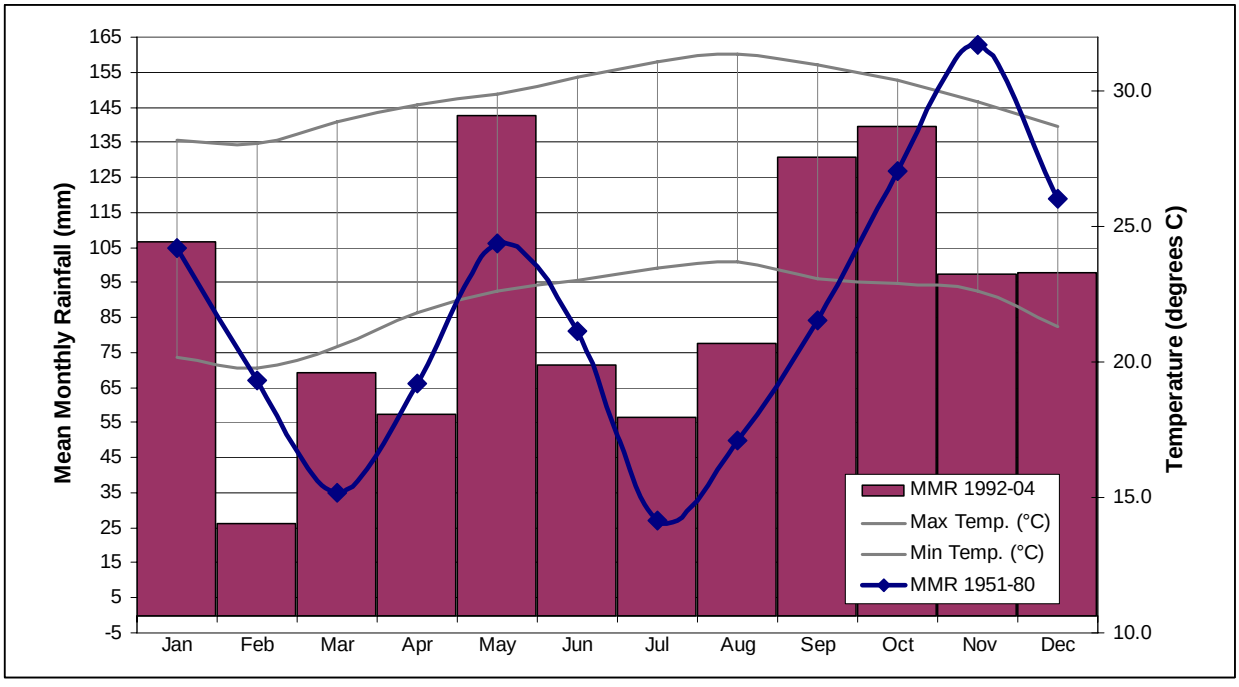
4.2.1.1 Rainfall

Mean total annual rainfall for Sangster's International Airport (SIA) for the period 1992 to 2004 (13 years) is 1073 mm, with a minimum of 636 mm (1997) and a maximum of 1472 mm (2001). The highest mean monthly rainfall recorded in this period was January 2001 (~400 mm). Individual mean monthly rainfall (MMR) records exceeding 200 mm have occurred in January (2001 and 2003), May (1993, 1994 and 2001), September (2002 and 2004), October (1993, 1997, 1999), and December (2000).

On average (for 1992 to 2004) there are between 5 and 14 rain-days per month. The months between August and January and May and June all have more than 8 rain-days per month. The mean monthly distribution of rainfall (Figure 8) for this period is compared with the 30-year mean monthly rainfall distribution available for 1951 to 1980 for the SIA. In general, the area is characterized by three rainfall peaks: December-January (98-107 mm), May (143 mm) and September October (131-139 mm). The dry seasons (when rainfall depths are below 80 mm per month) occur in February – April and June to August.

The more recent data trends (1992-2004) show the following when compared to the 30-year mean for 1951-1980: (1) a drier February and a wetter March (2) a more pronounced rainfall peak in May, which is now on par with the later peak and (3) a shift in the occurrence of the later peak from November to September-October, with a drier November in general.

Figure 8 Mean Monthly Rainfall and Temperature Distributions (SIA, Montego Bay).



4.2.1.2 Temperature and Humidity

Mean monthly temperature data for 1951 – 1980 for the Sangster International Airport (Figure 8, above) shows summer highs with a peak in June – September (when maximum temperatures exceed 30 degrees C) and winter lows (when minimum temperatures are around 21 degrees C).

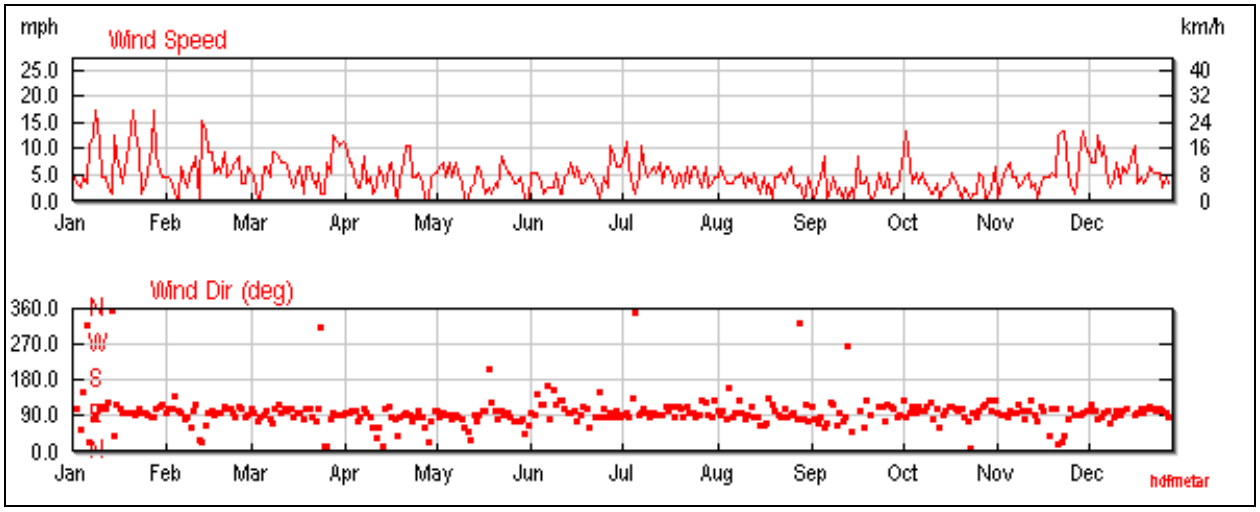
The high summer temperatures coincide with the driest months. In general, relative humidity ranges from 82% (in the dry summer months) to 89% in the wet winter months at 7 am. Mean relative humidity at 1 pm ranges between 68% in March-April and April to 75% in October.

4.2.1.3 Winds

Coastal sites in Jamaica are affected primarily by the prevalence of the North East Trade Winds and the daily fluctuations between day time onshore breezes and night time offshore breezes. Figure 9 shows the prevalence of winds from the east and north east into Montego Bay.

Higher wind speeds (>16 kph) occur between December and mid February, probably reflecting the fact that the trade winds are at also at their strongest during the cooler winter months and to a lesser extent, the effects of winter storm fronts from the north. July to mid-November generally marks a period of relatively calmer conditions.

Figure 9 Mean Wind Speed (mph/kph) and Direction (degrees) for Montego Bay (2006)



Source: wunderground.com

4.2.2 Ambient Air & Noise

The major source of air and noise emissions in the area comes from vehicular traffic along the North Coast Highway, which forms the southern boundary of the site.

4.2.3 Topography & Drainage

The proposed site occurs at elevations between ~6 m above sea level near its southern boundary (the North Coast Highway) and sea level on its northern boundary. The site is characterized by very gently sloping to flat terrain (Figure 10).

Figure 10 Typical Site Terrain

The site has ~800 m of sea frontage on its northern side. This shoreline in this area is predominantly rocky, periodically indented with small, shallow lagoons that are sheltered by small barrier and fringing reef structures. There are three bays within the limits of the 20-acre parcel.

The Bay 1 (mangrove reserve) is the most deeply incised bay. The innermost areas of the latter two bays are areas of net sediment accretion, due to the presence of slack water. The maximum tidal range in this area is of the order of about 30 cm.

Bay 2 is the central and largest bay (dolphin bay). The western side of this bay is very shallow and rocky. The offshore reef structures of this the bay occur at depths of -2 m+, and are broken by a marine channel with a south-easterly orientation. It is encircled by two natural headlands in a pincer-like array with a third submerged ridge extending into the mid-western part of the bay (Figure 11).

Bay 3 immediately east of the proposed dolphin enclosure bay is the smallest of the three bays on the property (Figure 12). It is significantly less indented than the central bay and possesses a sandy shore (pocket beach) with no mangrove development, and a small beach. This beach is less than 5 m in width between the high water mark and the vegetation/rock line.

A fourth bay (Bay 4) on the far eastern side receives drainage from a storm gully that forms the eastern property boundary.

Bays 1, 2 and 4 have small ephemeral streams emptying into them. The largest of these is the stream that empties into Bay 4, which has incised the bedrock to a depth of ~1.5 m along its lower course. Small concrete culverts (1 m diameter) have been constructed with the highway to facilitate these seasonal flows.

Figure 11 Bay 2 (Dolphin Bay)

Figure 12 Bay 3 (Beach Bay)

Very small wetlands occur in association with the gullies draining into bays 1 and 2. Both of these wetlands occur in depressions (Figure 13) and show evidence of slack water (accumulation of muds), which cause water ponding. Aside from the beaches, low cliffs (~0.5 m to 2 m) and rocky inter-tidal benches characterize the shoreline (Figure 14).

Figure 13 Mangrove Areas

Figure 14 Site Terrain

4.2.4 Geology

Seven boreholes were drilled on the site by Civil Works Jamaica Ltd. in January 2006. Three were done to a depth of 6 m and the other four were drilled to a depth of 3 m below ground level. Based on these boreholes, it was found that the upper 1.6 m consisted of brown silty clay. A middle layer (1.6 m to ~3 m) consisted of a very dense limestone, approximately 1.3 m thick. Below this the bedrock consisted of a medium density cream-yellow limestone. The limestone bedrock in this area is likely to be a Pleistocene coralline limestone (Coastal Group), which onlapped onto the older (Cretaceous) calcareous shales. The Coastal Group underlies the clay soil onsite and outcrops extensively at the shoreline (Figure 15). This limestone is case hardened by the salt spray.

Figure 15 Rock outcrops on the site

4.2.5 Soils & Surficial Sediments

Based on borehole data from the site, the soil layer is about 1.67 m (5.5 feet) thick. The soil is characterised as a brown silty clay, which is consistent with the Rural Physical Planning soil classification. The soil on site is likely to be largely a transported colluvial soil, derived mainly from the Cretaceous shales that occur in the hinterland of the site, and to a lesser extent from residual weathering of the impure coastal limestone. This clay soil has a low fertility (presently under grass), and low permeability. The gentle slopes and compact nature of the clays on site do not present an erosion hazard.

According to investigations carried out by Smith Warner International Ltd (SWIL) as part of their site investigations, the seabed in the area is characterized by a sandy bottom. Probing conducted in Bays 2 and 3 (which are expected to be impacted by the project) shows a pattern of softer sediment near to the mangroves and harder rocky substrates nearer to the cliffs as expected.

Sediment samples (grab) were collected from each of the water quality stations as well as the beach in Bay 3 to determine the percentage carbonate. This was found to range between 28% (offshore west) and 38% (offshore east). In general, percentage carbonate inside bays 2 and 3 was about 21%, which was lower than the percentage carbonate found in Bay 1. The beach sand in Bay 3 was 34% carbonate. The carbonate fraction of the sediment is expected to be largely derived from the benthic communities, whereas the non-carbonate fraction would be terrigenous clastic material derived from the hinterlands.

4.2.6 Hydrology

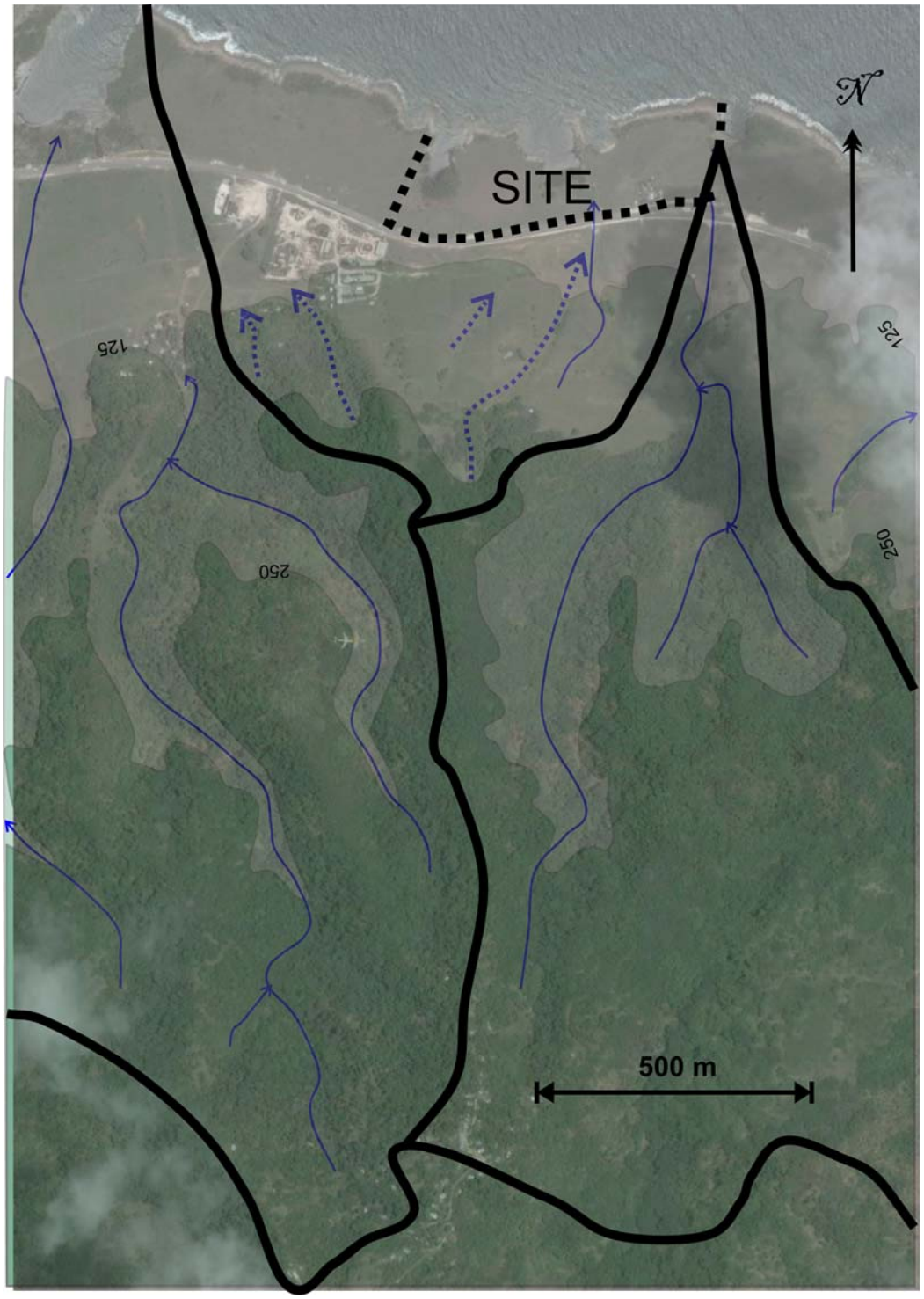
4.2.6.1 Water Management

The proposed site is located within the Lucea Watershed (#2) and much of the hinterland of this catchment is underlain by Basal Aquiclude (Cretaceous shales). The Coastal limestone found at the site would also be classified as a Coastal Aquiclude. Consequently, the importance of surface hydrology is very significant in this region.

Figure 16 shows the drainage basins adjacent to the site, and the one in which the site is contained. This shows that the catchment draining into the coastal area adjacent to the site is relatively small compared to the two adjacent ones, which would explain why the gullies draining the property are poorly developed ephemeral streams. The Google satellite image shows the land cover in the study area catchment is predominantly under vegetative cover as relatively poor road access and steep slopes have limited settlement in this area. Therefore, although the bedrock may consist of shales (general impermeable), the run-off co-efficient may be relatively low due to vegetation and soil cover. The small streams transmitting storm water outflows from the catchment flow into the small mangrove lagoons, which show evidence of sediment (muds) accretion from material brought in by the streams.

Streams cross the road via small 1m diameter culverts (Figure 18). Some ponding of water has been observed at the culvert draining into Bay 3 (Dolphin Bay).

Figure 16 Surface Hydrology (Regional)



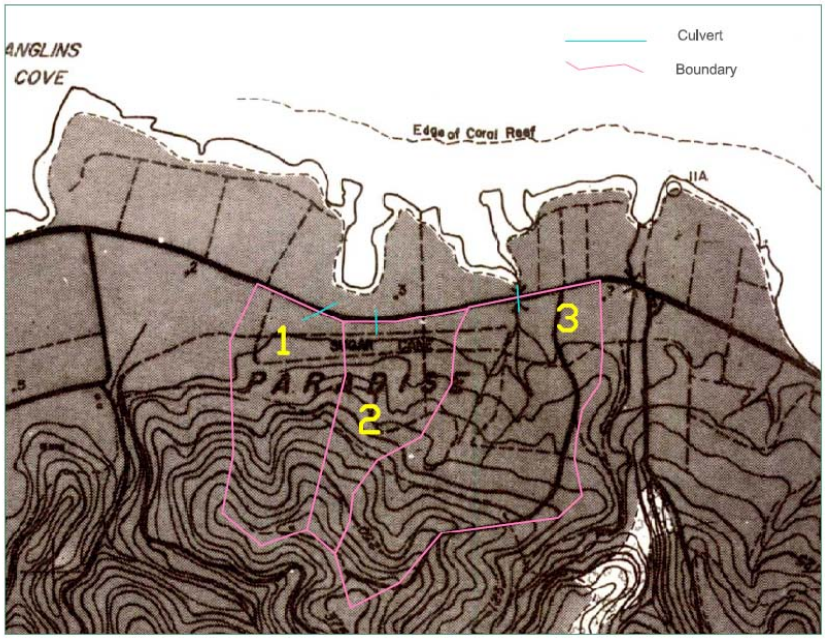
Sub-Basin boundaries shown in solid black. Land above 250 feet is shown in dark green shading; land above 125 feet is shown in lighter green shading. Streams are shown in blue arrows. Dashed represents ephemeral streams

Figure 17 Culvert on property

Groundwater was encountered in the seven boreholes drilled at the site in January 2006 and was measured to be ~ 2 m below ground level. Boreholes were drilled at 2 m to 2.5 m above mean sea level. It is likely that groundwater levels at this location do not varying significantly between wet and dry season, and are influenced by tidal fluctuations.

A detailed drainage report was prepared by Smith Warner International Limited. This is included as Appendix 4. That study used the hinterland watershed boundaries as showing in Figure 17 below, based on the 1:12, 500 OS map.

Figure 18 Hinterland Watershed Boundaries



The Rational Method was used to compute expected flows (Table 4). This method requires determination of the soil and ground cover characteristics. According to Drainage Study, the soil

types in the hinterland include the Hall's Delight Channery Clay Loam in the upper reaches, and the Highgate Clay in the lower sections closer to the highway. The Clay Loam experiences rapid internal drainage, while Highgate Clay has very slow internal drainage. The existing soil characteristics and vegetative cover lead to a composite Curve Number (CN) of 58 Antecedent Moisture Condition II. This curve number is used with the Jamaica II method for determining the time of concentration. Based on the small watershed area, the Rational Method is used with the Sangster International Airport intensity-duration frequency curves to determine the peak discharge through each culvert.

Table 4 Rational Method Flow Computations

Sub-Watershed	Area	Time of Concentration	Discharge (m^3/s) for varying recurrence intervals			
	(Hectares)	(min)	5	10	25	50
1	8.34	36	0.86	1.03	1.2	1.35
2	6.68	35	0.72	0.84	1.0	1.09
3	16.81	39	1.67	1.99	2.36	2.6

The Soil Conservation Service Technical Release 20 method (SCS TR-20) was also applied to the same sub-basins using the curve number lag time for Time of Concentration and Type II rainfall distribution curves. Hydrographs were produced for each of the design storms, and the peak discharges are listed in Table 5 using this latter method.

Table 5 SCS TR-20 - Flow computations

Sub-Watershed	Area	Time of Concentration	Discharge (m^3/s) for varying recurrence intervals			
	(Hectares)	(min)	5	10	25	50
1	8.34	27	0.76	1.14	1.67	2.1
2	6.68	24.7	0.65	0.97	1.42	1.78
3	16.81	29.9	1.44	2.15	3.15	3.95

The times of concentration predicted by the CN lag time method are shorter than those predicted by the Jamaica II method and the peak discharges predicted by both methods for the five year (5 yr) and ten year (10 yr) events are within twenty percent (20%) of each other. The SCS method yields a higher peak discharge for the larger storm events (25 and 50 yr).

The outlet for sub-basin 1 is a 600 mm diameter reinforced concrete pipe (RCP) with headwall. The culvert inlet is approximately 3 m below the road and discharges into the Bay 1. This culvert

was calculated to convey 1.22 m^3/s without overtopping the road. If the discharge is larger than the culvert can handle, some runoff flow along the ditches then the east towards the other culverts. The outlet for sub-basin 2 also flows directly into Bay 1. This RCP culvert is approximately 20 m long and 600 mm in diameter. The inlet elevation is estimated at 5.93 m and was calculated to convey 0.90 m^3/s without overtopping the road. Any discharge in excess of this will likely flow towards culvert 3 before overtopping the road. The outlet for sub-basin 3 is ~ 11 m long and 900 mm in diameter. The outlet was partially submerged during the field visit. This culvert is expected to convey ~ 2.32 m^3/s without overtopping the road.

The drainage study concluded that culverts 2 and 3 are expected to convey the 25 year peak discharges predicted by the rational method computations. The road elevation does not provide the head water requirements to prevent overtopping of the road during the 50-yr storm.

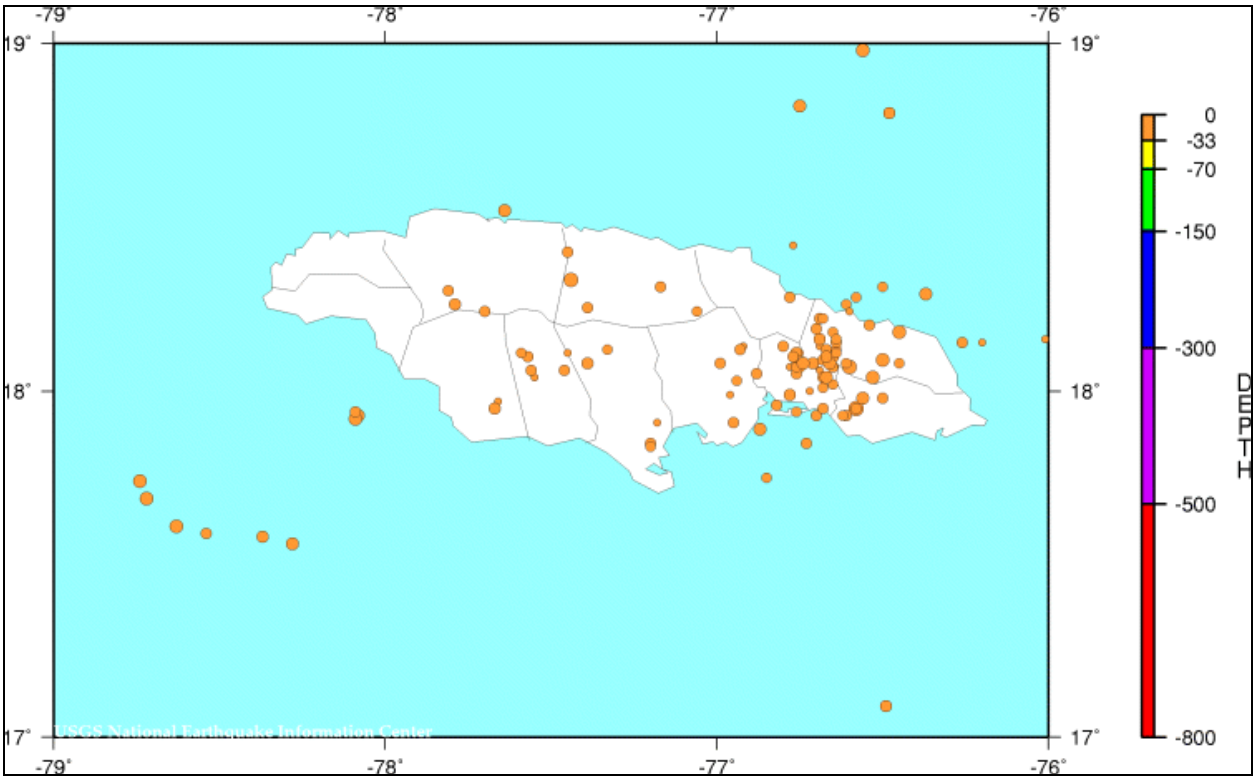
4.2.7 Natural Hazards

4.2.7.1 Earthquakes

The earthquake risk at this site is affected by the presence of a major transform boundary associated with the Duanvale Fault. Over the last 326 years, Jamaica has experienced thirteen earthquakes with intensities of magnitude greater than 7 (Wiggins-Grandison, 1996). Most of these (10 of 13) have affected the eastern part of the island more severely than the western section (Wiggins-Grandison, 1996). Earthquakes of high magnitude occurring elsewhere on the island or island shelf may still be felt in this area.

Figure 19 shows a map generated from a search at the USGS NEIC database for 1977 to 2005 (Appendix 5). All of these events are very shallow. Most of these larger events are clustered in the eastern part of the island. The largest event occurred in June 2005 (central Jamaica) and was magnitude 5.1. According to more recent data from the Jamaica Seismograph Network (Wiggins-Grandison, 2006) earthquakes in the region are concentrated near Quick Step Trelawney with magnitudes up to 4.2, which would be felt in this area.

Figure 19 Earthquake Events Affecting Jamaica (1977 – 2005)



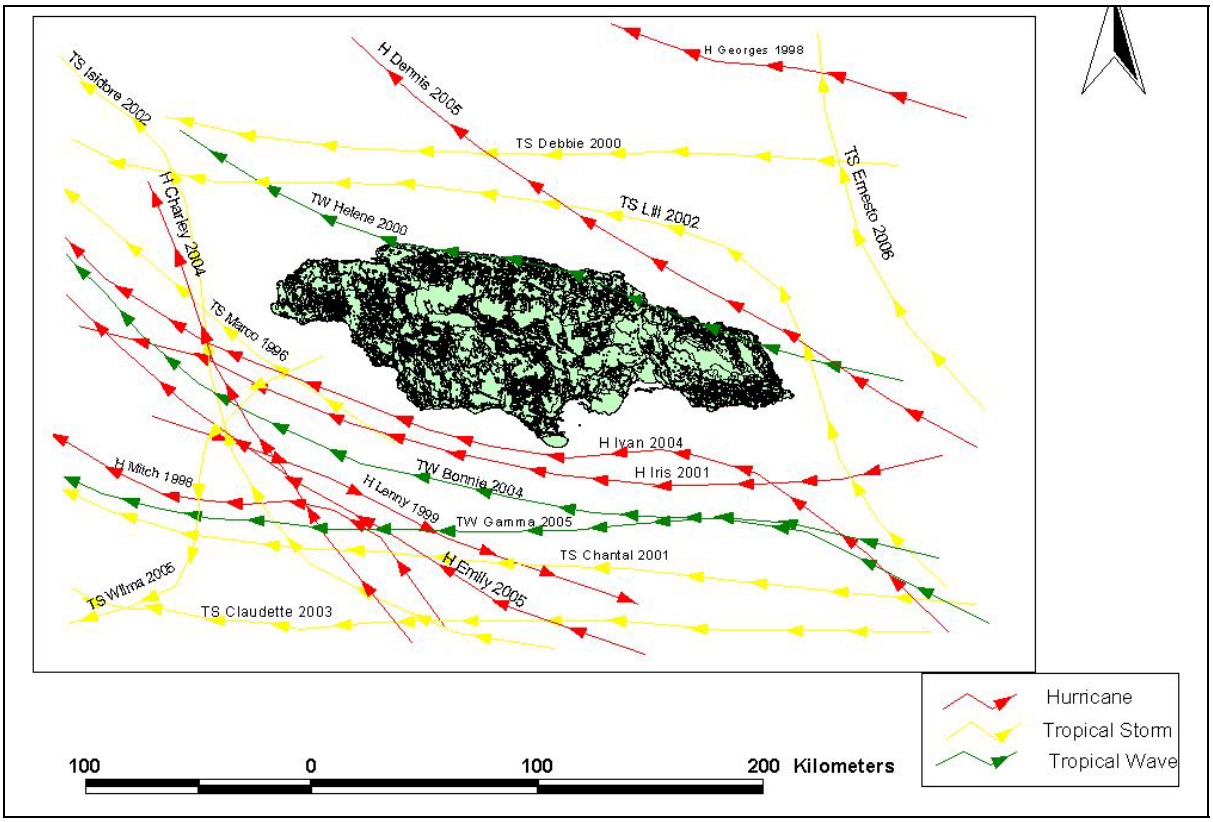
Source: NEIC (rectangular grid search): http://neic.usgs.gov/neis/epic/epic_rect.html

4.2.7.2 Hurricanes

Jamaica lies within the Caribbean hurricane belt and has been directly affected by numerous hurricanes. During the hurricane season (June to November) these low-pressure systems form in the mid-Atlantic off the African west coast between latitudes 5 to 25 N, and move northwesterly into the Caribbean basin. Detailed storm data are available from the US National Hurricane Center archives for the period 1995 to present. Nineteen (19) cyclones have affected Jamaica in the past 12 years (extracted to Table 6 and Figure 20).

The location of this particular site on the north-western side of the island makes it vulnerable to most hurricanes affecting the island, including those tracking to the south, across the island, and to the north,

Figure 20Tracks of Hurricanes Affecting Jamaica between 1995 and 2006



Source: National Hurricane Centre Map Created using ARCView GIS 3.1

Table 6 Cyclonic Activity near to Jamaica 1995-2006

	Name	Date	Class
1	Marco	24-Nov-96	TS
2	**Georges**	**24-Sep-98**	**H**
3	**Mitch**	**25-Oct-98**	**H**
4	**Lenny**	**15-Nov-99**	**H**
5	Debby	4-Aug-00	TS
6	Helene	19-Sep-00	TW
7	Chantal	19-Aug-01	TS
8	**Iris**	**7-Oct-01**	**H**
9	Isidore	18-Sep-02	TS
10	Lili	29-Sep-02	TS

	Name	Date	Class
Table cont'd			
11	Claudette	9-Jul-03	TS
12	Bonnie	11-Aug-04	TW
13	**Charley**	**11-Aug-04**	**H**
14	**Ivan**	**11-Sep-04**	**H**
15	**Dennis**	**7-Jul-05**	**H**
16	**Emily**	**16-Jul-05**	**H**
17	Wilma	16-Oct-05	TS
18	Gamma	16-Nov-05	TD
19	Ernesto	28-Aug-06	TS

Source: National Hurricane Centre (http://www.nhc.noaa.gov/)

Compared to the two previous years (2004 and 2005), the last (2006) hurricane season was relatively calm. The intensity and frequency of storms vary with various global meteorological conditions from year to year, and it is suggested that it may be influenced by the occurrence of the El Nino/La Nina phenomena and the development of high pressure cells, mid-Atlantic sea surface temperatures and the amount of Sahara dust in the upper atmosphere.

These systems normally steadily progress from a tropical wave, to a tropical depression, to a tropical storm, then to a hurricane. The hurricane itself has five categories according to the Saffir-Simpson Hurricane scale with a category one having the lowest wind speeds and the category five with the highest (Table 7). Although the category of the hurricane indicates its intensity and subsequently its damage potential, the impacts of the hurricane depend on when and where the storm strikes. There have been instances where a category one hurricane has caused more damage than a category three or four hurricane.

Table 7 Saffir-Simpson Hurricane Scale

Category	Wind Speeds km/hr	Storm Surge (m)	Possible Damage on the North Coast
One	119-153	1.5	Tree limbs and signs affected. Landslides and some flooding. No real damage to building structures.
Two	154-177	2.5	Roofs, doors, window damage. Small trees and shrubs. High tension wires and overhead cables blown down. Some coastal flooding.
Three	178-209	3.6	Minor structural damage. Large trees damaged. Coastal roads flooded.
Four	210-249	5.5	More extensive structural damage, doors and windows; loss of roofs. Vegetation and signs blown down. Low-lying terrain and roads flooded. Beach erosion.
Five	>249	>5.5	Some complete building failures. Trees and signs blown down. Severe damage to windows doors and roofs.

During a hurricane, a major coastal hazard is coastal flooding arising from the combination of storm surge (low atmospheric pressure), high wind speeds and large wave set ups. The 100-year storm surge for the area was determined using the SWAN (Simulating Waves Nearshore), which predicted a maximum surge of 2.0 m relative to mean sea level (SWIL 2006).

As part of the coastal engineering design study, Smith Warner International used a computer model to hindcast storms affecting the area. This program (HurWave) was developed to calculate design wave heights and peak wave periods for different return periods and locations within the Caribbean.

The program has a complete database of all storms and hurricanes occurring in the North Atlantic and the Caribbean from 1900 to present, with data taken from the National Oceanic and Atmospheric Administration (NOAA). HurWave recognized a total of 100 storm events within a 300 km radius of the site since 1900. More than half of the 100 events (56%) were classified as tropical storms. In 105 years, 26 systems were classified as hurricanes of greater than Category 2. Included this list are hurricanes such as Ivan (2004), Gilbert (1988), Allen (1980), Janet (1955) and Cleo (1964). This software was also able to predict that storm waves approach from an easterly direction, and that waves between 6 and 8 m are most dominant, although extreme heights of 12 m can occur.

Nearshore wave conditions were determined using the SWAN software, which uses bathymetry and wave data to predict coastal wave heights in different scenarios (SWIL 2006). This model predicted that the 5-year storm wave height at the shoreline (for design purposes) would be 2.25 to 2.75 m. For the 50-year hurricane event, the maximum wave height at the shoreline was predicted to be 3 to 4 m.

The main effects of hurricanes include:

1. Damage to property or loss of life or injury from sustained high winds and flooding.
2. Loss of amenity due to disruptions along access roads (floods or debris).
3. Disruption of life lines (water, power and communication utilities).
4. Public health risk associated with contaminated or insufficient water supply, and unsanitary conditions.
5. Loss of time during and after the event.

4.2.7.3 Flooding

Low-lying areas of the site in proximity to the storm water gullies may be prone to flooding associated with extreme rainfall events in western Jamaica. The most extreme of these events on record occurred in June 1979. This area was estimated to have received more than 250 mm of rain in a 24-hour period, which approximated the 150-year event based on previous rainfall data. There is no specific documentation of flooding in this area at this time, but given the hydro-geology of the area, it is expected there would have been considerable flooding along the road and along gully courses. Extreme rainfall events such as these can also occur in relation to hurricane systems. There is no evidence of remedial action taken in relation to flood risk.

4.2.7.4 Erosion

The soil in the area is not particularly prone to erosion as it is clayey and well vegetated on very gentle slopes. Some evidence of vertical incision has been noted along the gully course marking the eastern border of the site. There is no evidence of remedial action taken in relation to soil erosion.

There is no evidence of previous action taken to protect the shoreline as the shoreline appears to be very stable and protected.

4.2.8 Oceanography

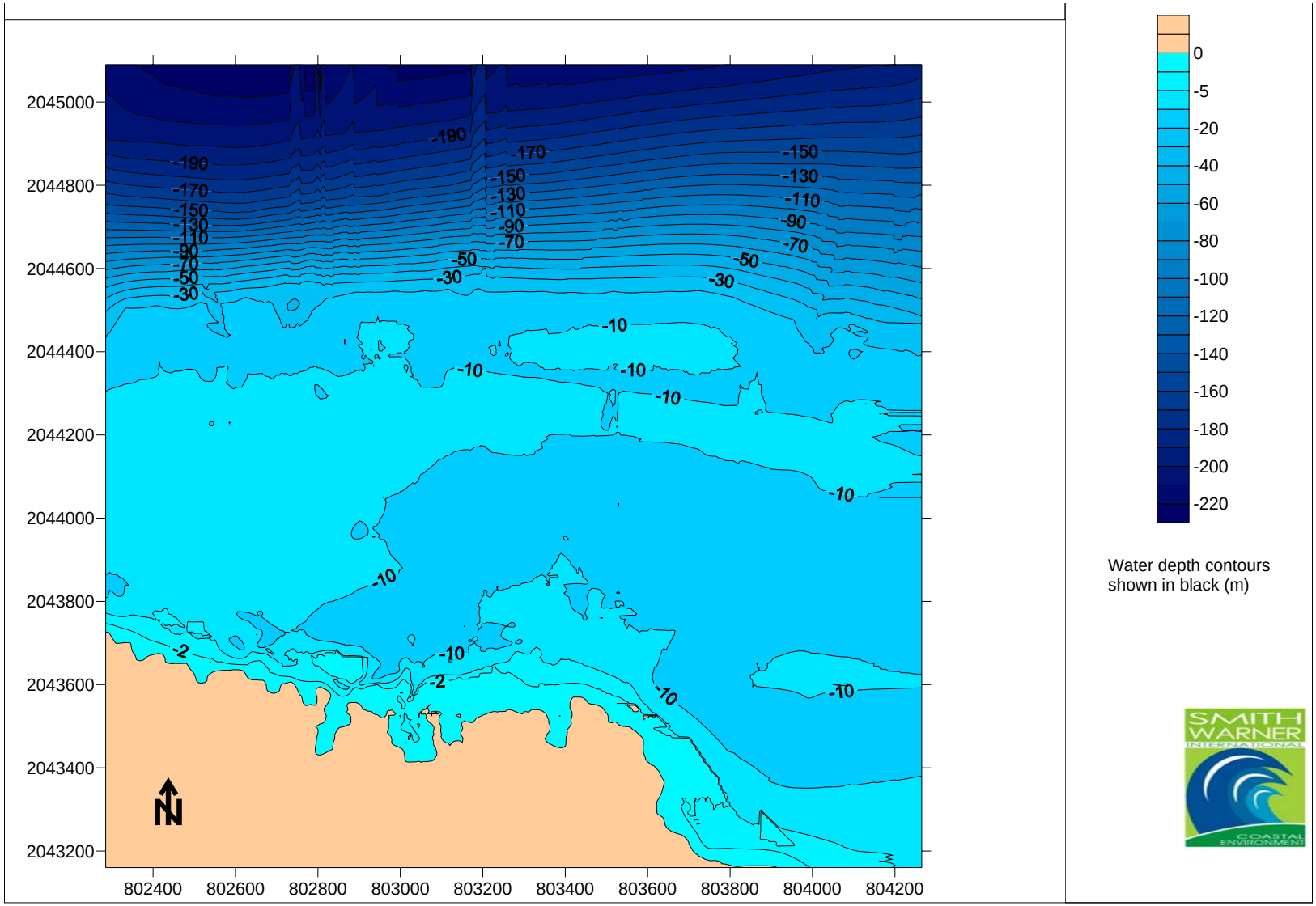
Smith Warner International conducted an investigation into the oceanographic conditions at the site for input into the coastal engineering design during January – February 2006.

4.2.8.1 Bathymetry

A bathymetric survey of the two central bays and adjacent sea was conducted to a depth of 20 m. Nearshore reefs made it difficult to carry out the bathymetry surveys. Therefore a topographic survey was carried out to enhance the bathymetric data inside the bay and to map the coastline of the project site more accurately. The topographic survey shows elevations up to 2.1 m above MSL 15 m away from the shoreline. Bay 3 (Beach Bay) also had to be surveyed via a topographic survey because reefs prevented the boat from entering that bay to carry out the bathymetric survey inside it. Five profiles were measured inside this bay to a depth of 1.5 m. Three profiles were carried out inside the Bay 2 (Dolphin Bay) to augment the data within the bay. The nearshore and offshore seabed bathymetry was defined by compiling the results of the bathymetric survey and topographic shoreline surveys performed in February 2006 in the nearshore surveyed areas, and marine chart data obtained from MapSource from further offshore.

The bathymetric survey covered an area of about 173 Ha (428 acres), up to the 20 meter contour line (Figure 21). The island shelf occurs just past the 20 iso-bath with a relatively steep slope. The shelf itself is wide (~1 km) with two notable outer barrier reef features close to the break of slope, which occur at depths of 10 m below mean sea level.

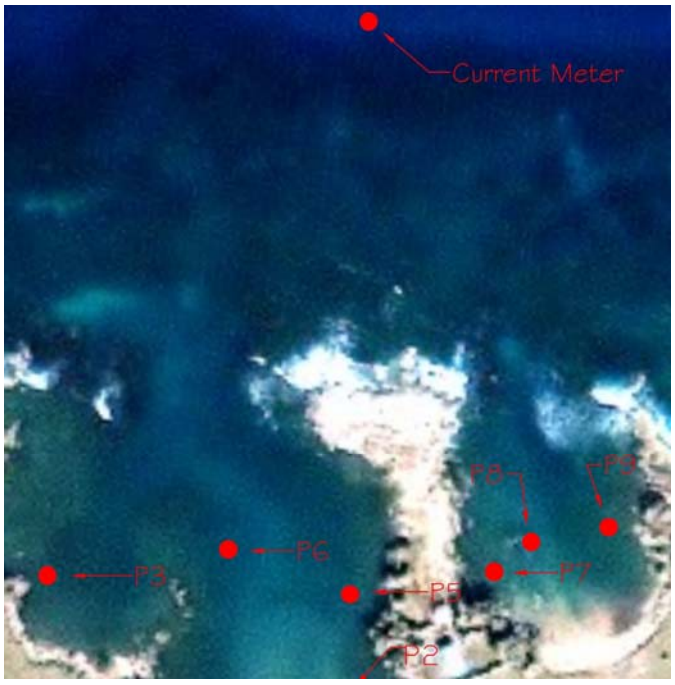
Figure 21 Bathymetry off Point District Hanover



4.2.8.2 Tides, Waves and Currents

Tides, waves and currents were measured at a water depth of 7.5 m below msl, using an InterOcean S4ADW bottom-mounted oceanographic current meter located off the headland separating bays 2 and 3 as shown in Figure 22. The current meter was deployed approximately 3 weeks. Over this period the meter recorded readings every 3 hours.

Figure 22 Location of the Current Meter



Source: SWIL 2006

Recorded wave heights were of the order of 0.55 m, with 2 exceptions on January 27th 2006, which roughly corresponded with higher winds speeds. Waves approached from directions between north-north west and east-north-east. The measured tidal range during the 3-week period was 0.3 m with two highs and lows per day. In general currents at this point appear to move in a north-westerly direction with speeds ranging between 5 to 20 mm/sec.

4.2.8.3 Chemical Oceanography

Basic water variables include pH, salinity, temperature and dissolved oxygen, which were measured during the rainy season (December 7th 2007) at the five water quality stations (Figure 23) using a YSI meter. These data are presented in Table 8. These data represent a single sampling event and can only be used to characterize conditions at the time of sampling (December 7th 2006). They are insufficient to properly characterize the long term trends in the chemical oceanography at the site, which will require a monitoring programme.

Figure 23 Location of Water and Sediment Sample Stations

Table 8 In Situ Meter Readings

Measured Parameter	Offshore East	Station 2 Bay 1	Station 3 Bay 2	Station 4 Bay 3	Offshore West
pH	8.4	8.3	nd	8.4	8.4
Electrical Conductivity/Salinity mS/cm	37	38	33	37	37
Temperature ^{o}C	30.1	30.0	32.6	30.1	30.1
Dissolved Oxygen (DO) %	3.8	5.5	1.2	3.8	3.8

Based on the data presented conditions at Bay 2 appear to be different from the ambient conditions obtaining at the other 4 stations.

pH values for all stations were very similar (8.3 to 8.4) and fell on the high side of the ambient range for marine waters (7.5 to 8.5).

Salinity is measured by the YSI meter in milli-Seimens per cm which is a measure of electrical conductivity. Salinity ranged between 37 to 38 for stations 1, 2, 4 and 5. It was a bit lower (33) at Bay 2, probably reflecting higher freshwater inflows to this bay.

Temperatures were generally around 30 degrees Celsius (December 2006). Bay 2 was slightly warmer (32.6 degrees C).

Dissolved oxygen readings ranged between a high of 5.5 % at Bay 1 and a low of 1.2 % at Bay 2. The other stations all had an ambient DO of 3.8%. The USEPA[4] recommends that saltwater DO levels above 4.8 mg/L for the protection of aquatic life. DO levels below 2.3 mg/L are considered insufficient for aquatic life. Using these limiting criteria, only Bay 1 was had a sufficiently high DO. The DO level at Bay 2 was below acceptable levels.

4.2.9 Coastal Water Quality

Figure 23 shows the location points for the water and sediment stations. Water samples were collected during the wet season (December 7th 2006) and during the dry season (January 31st 2007) from these stations in triplicate. Samples were transported on ice to the laboratories indicated in Table 9.

Table 9 Water Quality Test Methods and Laboratories Used

Parameter	Test Method	Laboratory
Biochemical Oxygen Demand	HACH method	ETAS
Total Suspended Solids	Gravimetry	ETAS
Faecal Coliform	Membrane Filtration	Scientific Research Council
Nitrates & Phosphates	Colorimetry	Mines and Geology
Total N and Total P	Colorimetry	Mines and Geology
Oil and grease	Gravimetry/Partition	ETAS

4.2.9.1 BOD

BOD is a measure of the amount of oxygen required to decompose sewage and other organic matter present in a water sample. NRCA has established BOD criteria (0.8 to 1.7 mg/l) for freshwater, which may also be applied to saltwater systems. Table 10 shows that the mean BOD concentration for the five stations. The main observations of the data set are:

- The maximum recorded concentration of BOD was 1.4 mg/L, which was found at Station 4 in the wet season. Dry season data for this station averaged 0.13 mg/L.
- All recorded concentrations of BOD were within NRCA standards.
- In all but one case (Offshore West), mean dry season BOD concentrations were lower than the mean wet season concentration.

[4] http://www.epa.gov/waterscience/criteria/dissolved/dofacts.html

Table 10 BOD Concentrations (Wet and Dry Seasons)

	Offshore E		Bay 1		Bay 2		Bay 3		Offshore W	
Replicates	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
a	0.95	0.20	0.45	0.15	0.70	0.75	**1.40**	0.10	0.70	0.50
b	0.65	0.15	0.50	0.45	0.75	0.35	0.85	0.15	0.40	**1.30**
c	**1.10**	0.00	0.60	0.00	0.85	0.20	0.25	0.15	0.40	0.70
Average	0.90	0.12	0.52	0.20	0.77	0.43	0.83	0.13	0.50	0.83
Std Dev	0.23	0.10	0.08	0.23	0.08	0.28	0.58	0.03	0.17	0.42

4.2.9.2 Total Suspended Solids

Total Suspended Solids (TSS) is an indicator of the amount of suspended solids in the water, and is usually indicative of run-off from land, or high levels of nutrients in the water, as well as the energy conditions. Higher levels of TSS can produce very turbid conditions, affecting the availability of light in the photic zone. Typical un-impacted marine waters have TSS concentrations below 10 mg/l, which was the case at this site (Table 11). There was no significant difference in TSS during the wet and dry season, suggesting low levels of soil erosion in the catchment and low levels of sediment transport.

Table 11 TSS Concentrations (Wet and Dry Seasons)

	Offshore E		Bay 1		Bay 2		Bay 3		Offshore W	
Replicates	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
a	2	2	BDL	BDL	BDL	BDL	2	2	2	2
b	1	1	1	1	BDL	BDL	3	3	3	3
c	1	1	2	2	BDL	BDL	2	2	3	3

4.2.9.3 Faecal Coliform

All samples taken in both wet and dry seasons for all five stations showed very little faecal contamination with values being below detectible limits in most cases (Table 12). The few readings that were above detection were below 10 MPN per 100 ml, which is very good recreational quality marine water.

Table 12 Faecal Coliform Concentrations (Wet and Dry Seasons)

	Offshore E		Bay 1		Bay 2		Bay 3		Offshore W	
Replicates	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
a	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4	BDL
b	BDL	BDL	BDL	4	BDL	BDL	BDL	4	BDL	BDL
c	BDL	BDL	BDL	9	BDL	BDL	4	4	BDL	BDL

4.2.9.4 Nutrients

For all 30 samples taken (five stations, three replicates, two seasons), nitrate concentrations were below detectable levels. Similarly, for all 30 samples (Table 13), phosphate concentrations were below 0.1 mg/l, which is significantly lower than the NRCA criteria for freshwater (0.8 mg/l). These data suggest very little contamination from nutrient sources.

Table 13 Mean Phosphate Concentrations (Wet and Dry Seasons)

	Offshore E		Bay 1		Bay 2		Bay 3		Offshore W	
Replicates	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
a	0.1	0	BDL	BDL	0	BDL	BDL	0.1	BDL	BDL
b	0.1	0.1	BDL	0	BDL	BDL	0.1	0	0.1	BDL
c	BDL	0	BDL	0	0	0	BDL	0	BDL	ND

Total N and Total P were measured on January 31st 2007 only, in triplicate for all five stations (giving a total of 15 samples). Looking at the standard deviations of the data it can be seen that for Total N there is considerable variability in the nitrogen and phosphorus concentrations in the samples taken at each station (Table 14). Total nitrogen in this area ranged between 1.1 mg/l to 9.6 mg/l. Total phosphorus levels ranged between 0.04 mg/l and 0.94 mg/l. Both of these loads appear to be higher than would be expected in this area, where human influences are limited. Natural sources of nutrients in marine waters include ammonia (from fish and other marine organism) and decay of organic material.

Table 14 Total Nitrogen and Total Phosphorus

	TOTAL N					TOTAL P				
STATIONS	**OE**	**B1**	**B2**	**B3**	**OW**	**OE**	**B1**	**B2**	**B3**	**OW**
a	6.9	BDL	1.2	1.8	6.7	0.94	0.07	0.18	0.3	0.27
b	1.1	6.1	6.5	1.2	9.6	0.07	0.04	0.06	0.21	0.72
c	5.6	BDL	6.4	3.0	ND	0.09	0.40	0.07	0.05	ND
Average	**4.53**		**4.70**	**2.00**		**0.37**	**0.17**	**0.10**	**0.19**	
Std Dev	**3.04**		**3.03**	**0.92**		**0.50**	**0.20**	**0.07**	**0.13**	

It is recommended that Total N and Total P be monitored on a monthly basis for at least 3 months prior to the introduction of the dolphins to better establish baseline conditions so that the actual contributions of the dolphins to the total N and P load can be monitored.

4.2.9.5 Oil and Grease

Oil and Grease levels ranged between 0.13 mg/l to 12.6 mg/l (Table 15). In general there was a marked increase in the amount of oil and grease present in the waters between the wet and dry seasons. The USEPA recommends that levels should be below 0.01 mg/l. The levels found at this location are therefore regarded as very elevated and may be due to boating in the area (possibly related to fishing vessels). It is recommended that additional monitoring of oil and grease, and total petroleum hydrocarbons (TPH) be done to better establish baseline conditions at the site.

Table 15 Mean Oil and Grease Concentrations (Wet and Dry Seasons)

	Offshore E		**Bay 1**		**Bay 2**		**Bay 3**		**Offshore W**	
Replicates	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**
a	0.9	7.4	0.1	7	1.6	8.9	0.8	6.7	1.1	7.5
b	1.8	8.9	0.8	1.6	0.8	2.9	2.1	2.3	0.9	1.8
c	2.8	1.9	0.8	2.4	2.9	1.9	1.9	13.0	0.3	3.3
Average	**1.81**	**6.06**	**0.54**	**3.67**	**1.77**	**4.56**	**1.59**	**7.19**	**0.75**	**4.19**
Std Dev	**0.96**	**3.68**	**0.36**	**2.91**	**1.05**	**3.82**	**0.74**	**5.15**	**0.45**	**2.97**

4.2.9.6 Floatables (Solid Waste)

No anthropogenic solid waste was observed either in the water or along the shoreline.

4.2.10 Foreshore Sediments

Sediment samples from the five stations (water quality) were screened for heavy metals (cadmium, copper, lead, nickel, zinc) that are of concern. These were tested at the Mines and Geology Laboratory using a flame photometer. The results of the sediment tests are given in Table 16.

Table 16 Sediment Quality

Parameter (mg/kg)	**Cadmium**	**Copper**	**Nickel**	**Lead**	**Zinc**
Station 1	<2.0	8.8	30.0	36.2	17.8
Station 2	<2.0	6.7	33.7	40.2	12.4
Station 3	<2.0	5.3	32.0	22.5	14.5
Station 4	<2.0	5.7	37.6	29.3	14.0
Station 5	<2.0	7.6	33.8	26.1	17.0
Station 6	<2.0	9.4	33.1	29.9	18.5
ISQG*	**0.7**	**18.7**	**50.0**	**30.2**	**124.0**

*Canadian Sediment Quality Guideline for the Protection of Aquatic Life **(2002)**

Concentrations of Cadmium, Copper, Nickel and Zinc were all within the Canadian Interim Sediment Quality Guidelines (ISGGs). The lead levels are considered high although they are still well within the Canadian Probable Effect Level (PEL) for aquatic life of 112 mg/kg.

4.3 BIOLOGICAL BASELINE

4.3.1Terrestrial Eco-Systems

4.3.1.1 Vegetation Cover

The coastal flora and fauna at the proposed Dolphin Cove Hanover site was assessed over a period of two days in December 2006. The assessment was conducted in two ways, based upon aerial photographs and ground-truthing. A walk-through was conducted during which the species of plants encountered was recorded and those unrecognizable were collected and tagged appropriately. Three belt transects were conducted, each transect was 100 m long and data was collected from a 2 m x 2 m belt along the line every 10 m (Figure 24). Data recorded was used to give a picture of the percentage cover of each vegetative type or particular species. Data recorded yielded the dominant species within the proposed site.

Figure 24 Transect Lines for Terrestrial Floral Survey

Jamaican coastal communities have been classified as being strand- beach, strand-dune, strand-scrub and strand- woodland associations. (Asprey and Robbins 1953). Previous work done in the area (ESTECH 2004) reported three main types of communities present in this area: (1) a beach community comprising mainly *Coccoloba* , *Ipome*a and *Sesuvium* species (2) an *Acacia* plant community located landward of the beach community and (3) a ravine/drainage canal community consisting of primarily fruit trees.

Only one type described in that study was observed at the proposed Dolphin Cove site: the beach community herein described as coastal scrub. Thirty three (33) plant species were identified. The detailed list of species recorded at the proposed development site is given in Table 17 below. The three species of mangrove identified at the site are protected. No species were found that were considered rare or endemic to Jamaica. Although the mangroves are considered to be ecologically important, the site does not contain any commercially important species.

Table 17 Vegetation Species at the Site

Scientific name	Common name	Scientific name	Common name
Alysicarpus vaginalis	Medina	***(List cont'd)***	
Ammannia baccifera		*Laguncualaria racemosa*	White mangrove
Caesalpinia bonduc	Grey nickol	*Mimosa sp.*	Shame lady
Caperonia sp		*Rhizophora mangle*	Red mangrove
Centrosema pubescens		*Rhynchosia sp*	
Coccoloba uvifera	Seagrape	*Ruella tuberose*	Duppy gun
Conocarpus erectus	Button mangrove	*Samanea saman*	Guango
Cordia laevigata		*Sesuvium portulacastrum*	Seaside purslane
Dalbergia brownie		*Sida jamaicenis*	
Desmanthus depressus		*Sida spinosa*	
Desmodium barbatum		*Spilanthes urens*	Pigeon coop
Desmodium scorpiurus		*Sporobulus virginicus*	
Desmodium sp		*Tephrosia sp*	
Euphorbia hyssopfolia		*Teramnus volubilis*	
Guazuma ulmifolia	Bastard cedar	*Terminalia cattapa*	WI Almond
Hewitta sublobata		*Themeda arguens*	Piano grass
Ipomoea pes-caprae	Beach morning glory	*Thespesia poplunea*	Seaside mahoe

Coastal Scrub: This is confined to the area directly adjacent to the existing coastline. The coastline is rugged and is subject to high wave energy and a far reaching splash zone, species encountered here were limited to the pioneer such as *Sesuvium* and *Ipomea*, *Coccoloba Uvifera* (sea grape) was found further inland and was interspersed with button mangrove trees *Conocarpus erectus* and West Indian Almond *Terminalia cattap*a (Figure 25). Tree height in this community was limited to an average 4m and almost all trees encountered were mature.

Though lacking any sand dunes usually typifying a coastal environment, the coastal vegetation present at the site provides anchorage to the surrounding soils. The vegetation has slowing effect on the surface runoff into the nearshore marine environment. The plants species here also provides some refuge and food sources for varying insects, reptiles and birds.

Figure 25 Coastal Scrub Vegetation

Pioneers species in the foreground and sea grape Coccoloba uvifera in the background.

Conocarpus (Button mangrove), Sesuvium, Ipomea and Coccoloba (seagrape) all existing on the rocky shore

<u>Grasses</u>: Directly behind and in some cases merging with the coastal scrub were grasses, these were very extensive and extended 100 m south to the asphalted road (Figure 28). The grasses *Cynodon dactylon* (Bermuda grass) and *Themeda arguen*s ('Piano grass") were intermixed with other herbaceous species including, *Mimosa pudica (*Shame lady), *Alysicarpus vaginalis* (Medina). Combined the grasses accounted for 100 percent coverage to the surrounding area being superseded only by the stands of mangrove and a few large trees of West Indian Almond and Bastard Cedar.

Figure 26 Grassed Area

Grasses were the dominant vegetative type recorded at the proposed site. The extensive coverage recorded at the proposed site, provides the important function of preventing substantive amounts of runoff from entering the nearshore waters. The extensive coverage of the grasses also provides food sources and habitats for birds, insects and reptiles.

Mangroves: Red mangrove stands occur in Bays 1 and 2. These stands were exclusively *Rhizophora* mangle with no other species present; abundant seedlings are observed in Bay 2 (Figure 27). The mangroves were found to be maintained by a healthy tidal influence and an intermittent flow of fresh water from run off from the hinterland. To the eastern-most boundary of the property a few mature trees of white mangrove were observed existing on the bank of the drainage ditch leading from the culvert. Button mangrove was found on the rocky shoreline.

Figure 27 Mangroves behind Bay 2

a/Seedlings

b/Tidal influence

Mangroves worldwide wide are considered to be important plant species. Their functions range from being natural biological filters at the land/sea interface to providing shoreline stability, acting as windbreaks and acting as a habitat above and below the water line. The forest provides a breeding, nursery and feeding ground for various species, enabling complex interactions and food chains, many directly or indirectly affecting human populations**.** Almost 75% of commercially caught fish (including shellfish) spend time in the mangrove ecosystems once in their lives, whether seeking shelter, food, or mating grounds (Robertson 1992).

Many mangrove trees were observed to have nests of the common duck ants. There were also the mangrove tree crabs *Aratus pisonii*, on the floor of the forest and in the salinas behind the forest were numerous crab holes of the genus *Uca.*

Figure 28 Mangrove Forest in Bay 1

4.3.1.2 Coastal Faunas

The coastal fauna was recorded in two ways. On the walk through, each animal was identified if possible and a count taken to determine their DAFOR rating. Bird assessments were conducted during the early morning, using point count methods during which bird calls and visual confirmation along with the use of field guides (Bond, 1990: Downer *et al*, 1990) was used to identify each bird as far as possible.

Avifauna: A total of 32 birds were observed over the two days representing 8 families (Table 18). There were no endemic species recorded during these observations. Overall the diversity could be regarded as low, this may be as a direct result of the lack of favorable nesting, roosting sites available. However that the area to the north supports a more diverse forest, the visiting birds may use the extensive grass areas as a feeding ground. The most common sitings were the egrets and the West Indian Brown Pelicans (Figure 29).

Table 18 Avifauna observed at the Site

			Recorded Numbers		
Family	**Species Name**	**Common Name**	**Day 1**	**Day 2**	**Status***
Ardeidae	*Bubucus ibis*	Cattle egret	3	2	VCR
Ardeidae	*Egretta thula*	Snowy egret	4	4	CR
	Pelicanus occidentalis	WI Brown Pelican	3	2	CR
		Sea Gull	2		CR
Fregatidae		Grey Heron	1	1	CR
Emberizidae	*Tiaris bicolor*	Grass quit	2	2	CR
Laridae	*Sterna maxima*	Royal tern	1	1	CR
Emberizidae	*Quiscalus niger*	Greater Antillean Grackle	2	2	CR

Day 1: Dec 9th 2006 Day 2: Dec 10th 2006

***Based on Downer & Sutton , 1990:** CR-Common Resident VCWR-Very Common Widespread Resident

Figure 29 West Indian Brown Pelicans in Bay 1

4.3.1.3 Other Fauna

One single rocky shore transect was conducted extending landward from the shoreline for 10 m the results are shown in Table 19. Numbers were recorded at 1 m, 5 m and 10 m intervals.

Table 19 Census of Species on Rocky Shore

Scientific Name	Common Name	Numbers/m^3
Nerita peloranta	Bleeding tooth	7
Nerita versicolor	Four toothed nerite	15
Puperita pupa	Zebra nerite	10
Nerita tesselleta	Tessellate nerite	8
Tectarius muricatus	Beaded periwinkle	46
Acanthopleura granulata	Fuzzy chiton	7

The other fauna observed at the proposed site are listed below in Table 20. The most common species encountered were the crabs numbering as many as 86/m^3. This was observed in the salina behind the Bay 1 and were determined to be holes of the *Uca sp* of crab.

Table 20 Other Coastal Fauna Observed at the Site

	Scientific Name	Common Name	DAFOR Rating
Reptiles	*Anolis grahami*	Common lizard	O
	Anolis lineatopus	Common lizard	O
Butterflies	*Danaus pleippus*	Monarch Butterfly	O
	Heliconius chantonius simulator	Zebra Butterfly	O
	Euptoieta hegesia hegesia	Tropical Fritallary	O
Crustaceans	*Geacarcinus lateralis*	Black land crab	F
	Ocypode sp	Ghost crab	O
	Cardisoma guanhumi	Great land crab	F
	Uca rapax	Fiddler crab	A
	Uca thayeri	Fiddler crab	A
	Aratus pisonii	Mangrove tree crab	F
Miscellaneous	*Crematogaster sp*	Duckants	O
	Austrolestes sp	Duckants	F
		Love Bug	F
	Apitasia	Sea anemone (mangrove lagoon)	F

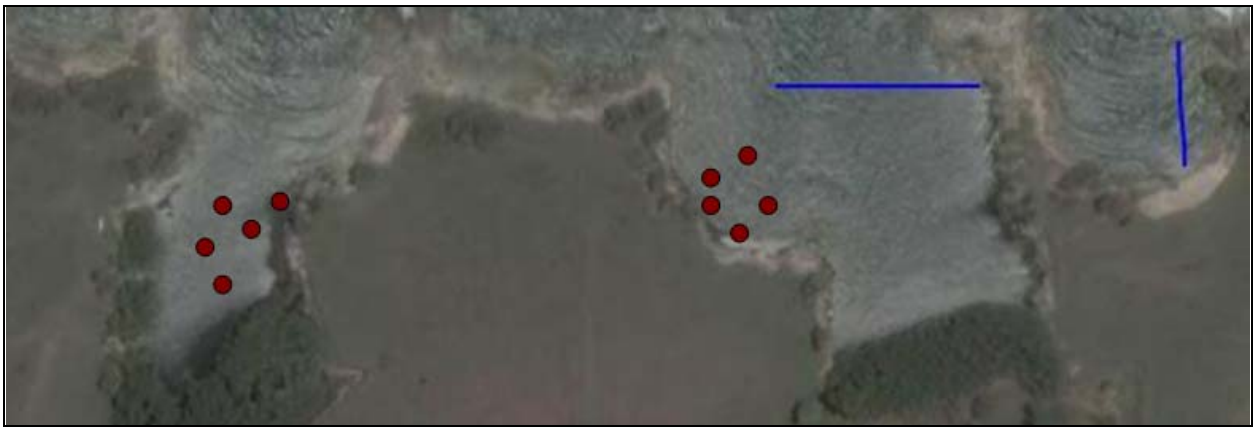
The physical characteristics of the proposed site determine the flora and fauna existing in the area. With grasses being the dominant species, ground cover for large birds and animals is limited, so fauna is restricted to those species that can successfully exploit these conditions (small birds and insects). The coastal areas are linked directly to the nearshore marine environments; none more so than mangrove forests stands. These mangrove stands provide shoreline stabilization and provide a buffer for runoff into the surrounding sea grass beds and ultimately coral reefs offshore. Presently the three systems described are in equilibrium as there are no obvious sources of disturbance to the system. The only observed anthropogenic inputs to the system may come from the drainage structures that drain the roadway. These drains are however impeded by overgrowth of vegetation that significantly reduces the water flows to the adjacent waters.

4.3.2 Marine Eco-Systems

4.3.2.1 Benthic Cover

A marine survey was conducted in December 2006 to provide baseline information on the current status of the three bays expected to be impacted by the project (Bays 1 to 3). These bays cover approximately 350 m of the shoreline. The survey utilized snorkeling and SCUBA of the bays and still photography to document the condition of the structures and marine life in the study area. Transects and random quadrat sampling methods were utilized to determine the health and composition of the benthos. In the Bay 3 a 50 m transect was laid perpendicular to the shoreline (starting at 18^{o} 27.589 N 78^{o} 07.792 W). For the assessment of the Bay 2 both random quadrats and a 50 m transect were used (starting at 18^{o} 27.605 N 78^{o} 07.828 W). The transect was laid parallel to the shore in the proposed footprint of the breakwater while quadrats were scattered randomly to the west of the bay. In Bay 1 only random quadrats were used (Figure 30).

Figure 30 Transects and Random Quadrat Locations



Sea grass Beds: Sea grass beds have several uses such as acting as a nursery for juvenile fish species, sediment retention, and acting as a silt barrier for surrounding areas. In the Bay 3 observations of the typical progression from shore to reef included: sandy shore, to extensive and healthy sea grass beds interspersed with sand and algae particularly *Penicillus* and *Halimeda* spp. A fringing coral reef system is also present offshore of this area (ESTECH 2005) which is indicative of a highly productive marine environment. In the Bays 1 and 2, the progression was from mangrove forests to sea grass beds interspersed with sand and low percentages of algae.

The beds in all three bays were very extensive and consisted of turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) in a ratio of approximately 95% to 5% with *Thalassia* being the dominant species. Average blade length in the bays range from 14 cm to 30 cm for *Thalassia* and 26 cm to 35 cm for *Syringodium*. No major epiphytic growth was noted on the blades however there was some evidence of grazing. Unlike the adjoining property (Fiesta site) no evidence of turtles was detected. The sea grass beds within the bays were very extensive and overall appeared to be very productive (Figure 31). Variable substrate types were encountered in the bays and included sand and silty/muddy conditions. The latter was experienced in the bays 1 and 2 in the areas immediately adjoining the mangroves.

Figure 31 Sketch map: approximate extent of sea grass within the bays

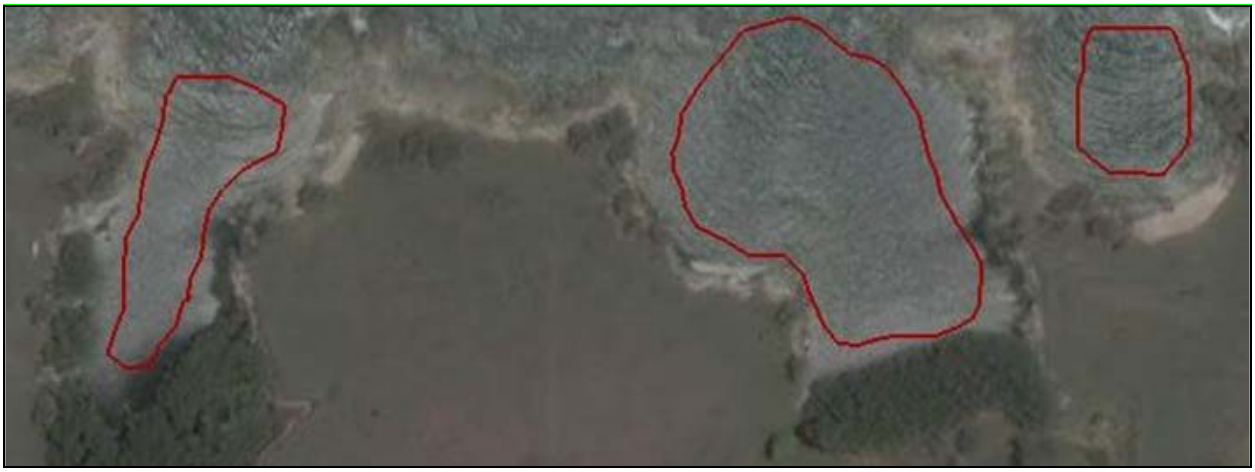


Figure 32 Sea grass blade density in Bay 3

Table 21 Average substrate percentage cover along transects

Substrate	Bay 3	Bay 2	Bay 1
Sand	9	3.9	0
Coral	0	0	0
Rock	1.2	0.9	2.8
Algae	0.8	0.9	0.2
Sponge	0	0	0
Seagrass - Thalassia	85	91	95
Seagrass - Syringodium	4	3.3	2

Coral and Algae: Although no corals were observed along the transect, general during general reconnaissance of the area, several species of algae and few specimens of hard coral were encountered. Both *Siderastrea siderea* and *Gorgonia ventalina* were observed. Prior surveys also noted the presence of *Porites* sp., *Montastrea* sp., *Diploria* sp. and *Millepora* sp. in the bays. Overall 21 algal species were noted from the phyla Chlorophyta, Phaeophyta and Rhodophyta (Figure 33).

Figure 33 Coral Community

Siderastrea radians, *Halimeda* sp. *Avrainvillea* sp., *Thalassia testudinum* and Syringodium filiforme

Table 22 Coral and Algae species listing

Scientific name	Common Names	Bay 3	Bay 2	Bay 1
Halimeda *sp.*		*	*	*
Dictyota sp.	Y-branched algae	*	*	
Valonia macrophysa	Elongated sea pearls	*		*
Ventricaria ventricosa	Sea pearl	*	*	*
Sargassum sp.	Sargassum algae	*		
Amphiroa rigida	Y-twig algae	*	*	
Avrainvillea sp.		*	*	
Penicillus pyriformis	Flat-top bristle brush	*	*	*
Penicillus dumetosus	Bristle ball brush	*	*	*
Dasycladus vermicularis	Fuzzy finger algae	*		
Peyssonnelia sp.	Crustose coralline algae	*		*
Caulerpa sp.			*	
Udotea sp.			*	
Gracilaria blodgettii			*	
Turbinaria turbinata	Blistered saucer leaf algae		*	
Laurencia sp.			*	
Hypnea musciformis			*	
Galaxuara sp.			*	
Padina jamaicensis	White scroll algae		*	
Dictyosphaeria cavernosa	Green bubble weed		*	*
Codium isthmocladium	Dead man's fingers			
Siderastrea radians	Lesser starlet coral		*	*
Gorgonia ventalina	Sea Fan	*		

4.3.2.2 Marine Fauna

A species list was prepared for each bay with each individual/organism encountered assigned a DAFOR rating. The DAFOR rating lists an individual species as Dominant, Abundant, Frequent, Occasional and Rare. This method is useful to gain a snapshot of the area but is limited in that the observational rating of an individual species may change from day to day.

Table 23 Census of major taxonomic groups encountered along the transect (Bay 1)

DAFOR	Class	Scientific name	Common Names	Census
R	Ophiuroidea		Brittlestar	1
A			Juvenile fish	30

Table 24 Census of major taxonomic groups encountered along the transect (Bay 2)

DAFOR	**Class / Family**	**Scientific name**	**Common Names**	**Census**
R	Labridae	Thalassoma bifasciatum	Wrasse – Slippery Dick	4
R	Echinoidea	*Tripneustes ventricosus*	West Indian sea egg	4
O	Haemulidae		Grunt	7
R	Echinoidea	Echinometra *viridis*	Reef urchin	4
R	Lutjanidae		Snapper	1
R	Polychaeta	Hermodice carunculata	Bearded fireworm	1

Table 25 Census of major taxonomic groups encountered along the transect (Bay 3)

DAFOR	**Class / Family**	**Scientific name**	**Common Names**	**Census**
F	Echinoidea	*Tripneustes ventricosus*	West Indian sea egg	11
R	Anthozoa	*Stichodactyla helianthus*	Sun anemone	1
O	Labridae	*Halichores bivittatus*	Wrasse – Slippery Dick	5
R	Haemulidae		Grunt	3
R			Juvenile fish	3

During the study marine fauna was limited mainly to the fishes and a few echinoderms, which was consistent with the recent study done offshore of the Fiesta site (ESTECH 2005). Several fish species were observed including, juvenile wrasses, other juvenile fish, grunts and snappers but in very low numbers ranging from 21 to 31 organisms. Anemones and fireworms were also observed. A total of 75 organisms were recorded in the three bays with fish accounting for 53 individuals. The species present were not very diverse. No invasive species were observed during the assessment.

Figure 34 Fauna in the Bays

WI Sea egg - *Tripneustes ventricosus* in Thalassia bed

Bearded Fireworm - *Hermodice carunculata*

The shoreline of the bays range from sandy beach and rocky shore in the Bay 3 to mangrove forests and rocky shore in the bays 1 and 2. The property also has two drains which influence the conditions within the bays. At the time of the assessment both bays 1 and 2 displayed evidence of storm water input in the form of brown and murky low visibility water. This was mainly observed in the areas closest to the mangrove forests but dissipated closer to the mouth of the bays.

Invertebrates were well represented on the rocky shores in the intertidal zone. The gastropods observed were nerites, periwinkles and chitons (Figure 35). Nerites were found in large numbers; chitons were also fairly represented. The least abundant organisms were the periwinkles. Cyanobacteria (Figure 35) was observed in along the shoreline of the Bay 1.

Figure 35 Intertidal Zone Invertebrates

Nerites (*Nerita versicolor*) and Periwinkles (*Tectarius muricatus*)

Chiton (*Acanthopleura granulata*)

Cyanobacteria on the Bay 1 shore

4.3.2.3 Macro-Benthic Infauna

A characterization of macro-benthic communities inside and outside of the bays was conducted. The life stages of macro-benthic invertebrates are sensitive and therefore changes in the community structure can be detected if they are exposed to stress. Macro-invertebrates are long-term indicators of environmental quality as they often provide useful measures of anthropogenic impact. In accordance with USEPA methods (USEPA 2002) used to determine macro-faunal assemblages, benthic grab samples were collected; one in each bay and one each before and after the bays. Three replicates were recovered from each station using a modified 0.1 m^2 Ponar grab sampler. Samples were then washed through a 1.0 mm sieve. Organisms retained were preserved in a stain solution consisting of 0.1 g Rose Bengal powder dissolved in 2 litres of formalin.

All samples were grossly sorted into two groups; marine worms (Phylum Annelida) and all others. All organisms collected were counted and identified using the relevant taxonomic literature. Damaged or juvenile individuals that were unidentifiable were taken to the lowest possible identification level (lpil). The information obtained was used to calculate values for Shannon-Weiner Diversity Index.

Productivity and Relative Abundances: There was considerable variability in the relative abundance of benthic infauna in each of the bays (Table 26). The highest numbers of individuals were found in the samples located outside of the bays (east and west). Inside the bays, the highest faunal abundances were found in Bay 1 (mean of 53, with replicates yielding 55, 41 and 53 individuals). According to the development proposal, Bay 1 will receive additional storm run-offs now entering Bay 2, and will be preserved as a fish and bird sanctuary. Bays 2 and 3 contained relatively lower numbers of specimens (with averages of 14 and 5 respectively). These are the main bays that will be impacted by the project, with dredging proposed for both bays.

Table 26 Benthic Abundance

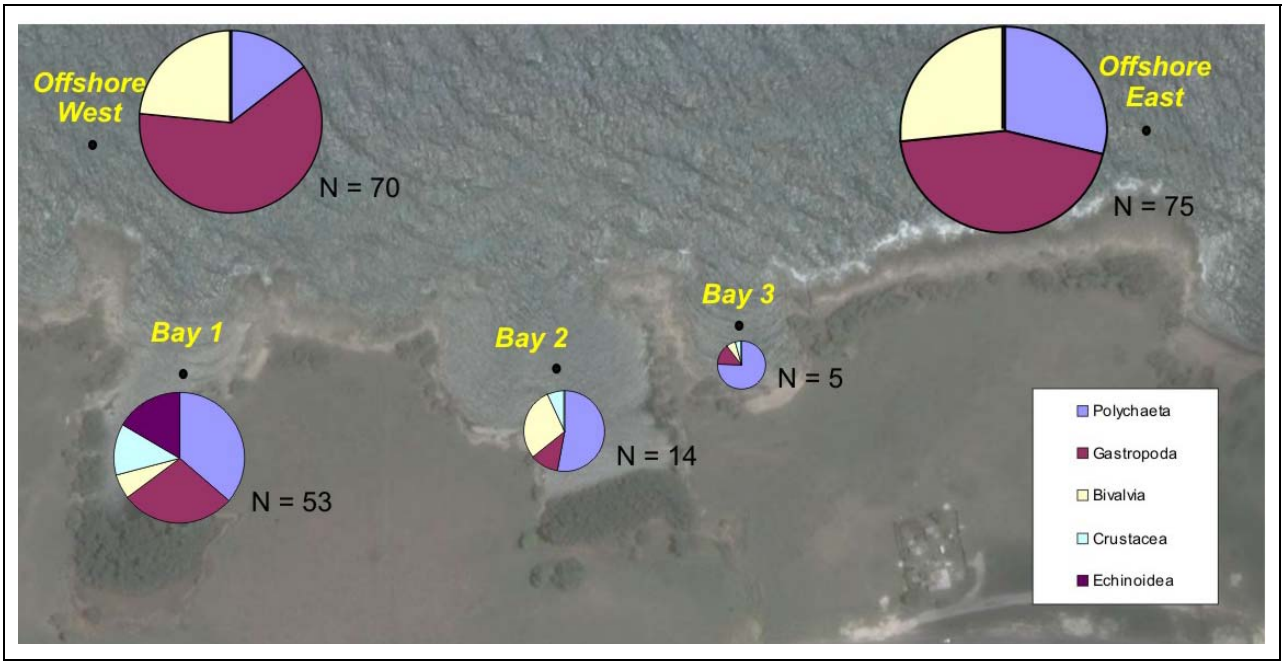
Location	Mean Number of Individuals (for 3 replicates)
Offshore East	75
Offshore West	70
Bay 1	53
Bay 2	14
Bay 3	5

Community Structure: The benthic communities at each of the sample locations are described in Table 25 and Figure 36.

Table 25 Mean Percentage Macro Benthic Infauna by Class

	Offshore W	Bay 1	Bay 2	Bay 3	Offshore E
Polychaeta	15%	39%	53%	75%	29%
Gastropoda	62%	30%	11%	14%	44%
Bivalvia	23%	7%	30%	6%	27%
Crustacea	0%	13%	7%	4%	0%
Echinoidea	0%	18%	0%	0%	0%

Figure 36 Macro-Benthic Faunal Communities



Nb the circle diameters are not directly proportion to n values, and are meant to be graphically representative of these differences only.

Offshore benthic macro infauna comprised mainly gastropods, bivalves and polychaetes. Gastropods were much more dominant in the west than they were offshore the river at Bay 4. The higher percentage of polychaetes at this site may be related to a higher percentage of fine sediments associated with this gully (however, no grain size analysis was done). Finer sediments (silts and muds) have been found to support polychaete-dominant associations in coastal areas whereas there is a tendency to for non-polychaete organisms to dominate coarse sandy substrates (Gray, 1974, Agard, 1984, Gobin 1988).

Polychaetes dominated the assemblages in the bay stations, but this was very variable, with more than 75% of the benthic macro fauna in Bay 3 being polychaetes (compared to 53% in Bay 2 and 39% in Bay 1). Again, this may be due to the higher presence of fine sediments in the substrates developing under the calmer conditions in the bays as well as run-offs from the land. Bivalves accounted for 30% the fauna in Bay 2, compared to 7% and 6% in bays 1 and 2. This may be attributable to the fact that there is no direct inflow of freshwater (and therefore fine sediment) into Bay 2. Echinoids were only found in Bay 1.

Table 27 shows the Shannon-Weiner Diversity indices calculated for each of the sample stations. These values indicate the spread of individuals per species, and are generally used to compare species diversity. In general, the biodiversity at the stations ranged 0.78 and 1.1 (see Appendix 6 for detailed data set), with a standard deviation 0.15 about a total mean of 0.971 for all 15 samples. There was insufficient data to determine whether there were any correlations with water depth, substrate type and sediment quality. These biodiversity indices may be used as a baseline against which future monitoring exercises may be compared.

Table 27 Biodiversity Index

Station	Shannon-Weiner Diversity Index
Offshore West	0.913
Bay 1	1.103
Bay 2	1.011
Bay 3	0.782
Offshore East	1.046

4.4 SOCIO-ECONOMIC BASELINE

4.4.1 Approach and Methodologies

Socio-economic data to support the EIA were collected through three primary means; analysis of existing document, interviews and a community survey conducted in the Point, Hanover area as described below:

1. Primary data: reconnaissance of the site and adjacent areas; interviews with and socio-economic survey among local stakeholders and telephone interviews with personnel of relevant government agencies and service providers.
2. Secondary data: Population 2001 Census Data, Government Reports and data (Ministry of Education, the Jamaica Tourist Board, the Social Development Commission and the Statistical Institute of Jamaica, National Works Agency)

The Quota Sampling method was used to arrive at the one hundred (100) individuals, eighteen and over who formed the population sample for the socio-economic survey. The 2001 population within the Enumeration Districts (EDs) in which the proposed development falls and also neighbouring EDs were the subjects of the survey as shown below in Table 28 and Figure 37. The relative percentage of each district was used to determine the number of survey

interviews to conduct in each ED, to ensure that the populations of each was adequately represented out of a survey total of 100.

Table 28 Population of Enumeration Districts

Enumeration District	Total Population	Percentage
East Rural 01 (Point)	431	19
East Rural 02 (Hopewell)	443	19
East Rural 03 (Kew)	712	31
West Rural 25 (Kew Estate)	732	31
	2318	100

4.4.2 Socio-economic Setting

The parish capital, Lucea, is located within 5 km of the proposed site. As described in section 2.1.2.1, the site is also located ~25 km (within 30 minutes) of both Montego Bay and Negril by the North Coast Highway. Smaller settlements that are located in proximity to the site include: Hopewell, Mosquito Cove and Claremont in the east and south, Elgin Town and Point in the west, Kew and Dundee in the southwest.

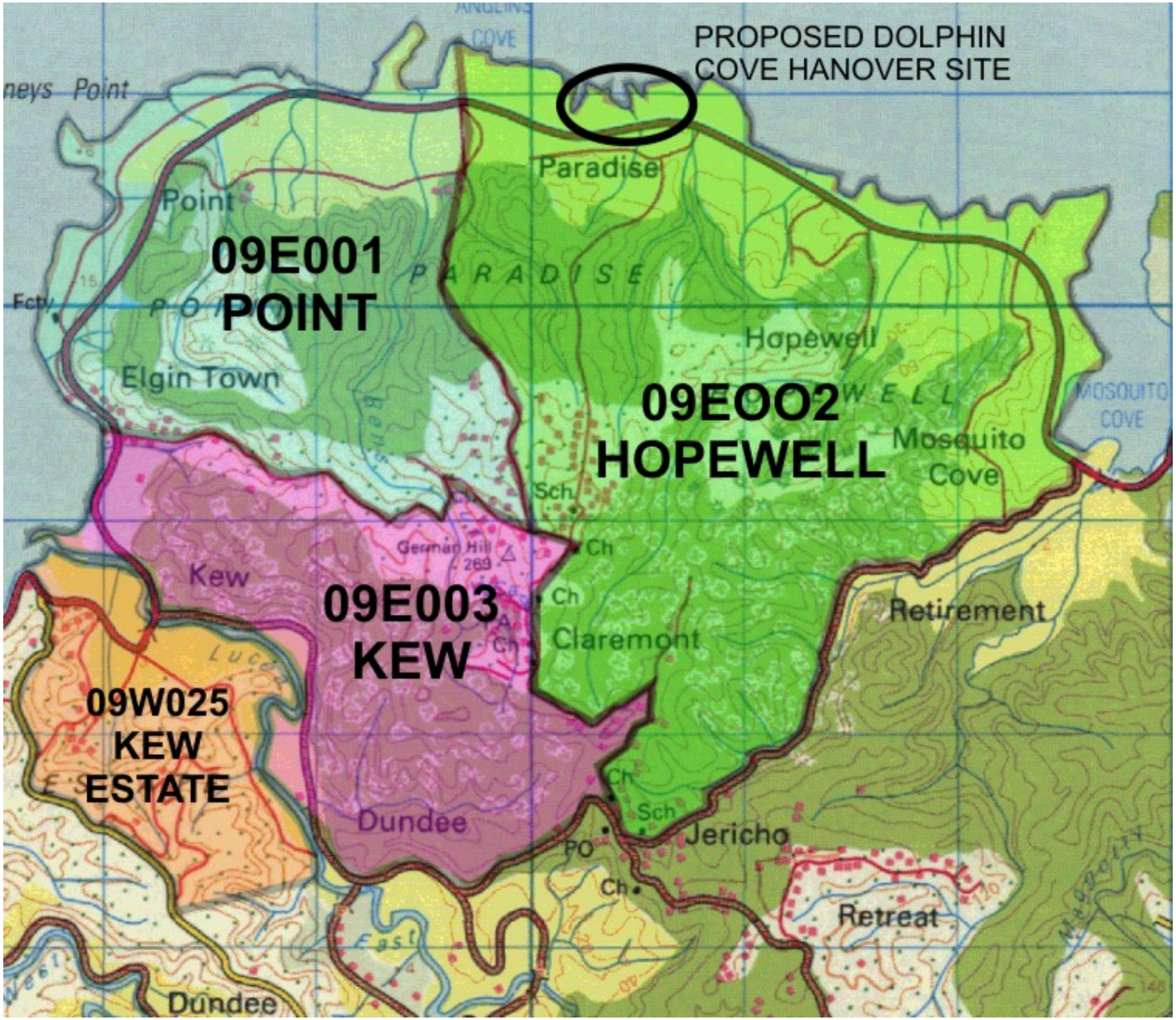
4.4.3 Economic Activities

Commerce and fishing are the main activities that form the economic base of Lucea. The fishing industry grew after the decline of the town's importance as port. Historically, the port served as a shipping wharf for the export of sugar, banana, dyewood and yam. Agriculture is important in hinterland communities such as Elgin Town and Kew. Tourism is emerging as important sector to the parish's economy.

4.4.3.1 Tourism

In recent times the tourism sector has expanded rapidly and is now one of the Jamaica's leading foreign exchange earners. Tourism is second after remittances as it relates to foreign exchange earnings. Negril, shared between the parishes of Hanover and Westmoreland, is considered Jamaica's second most popular tourist destination. Tourism in Hanover, in general, is typical of the north coast in which tourists' attractions revolve around "sun, sand and sea". At the end of 2006 Negril had a total of 4,824 hotel rooms, including ~ 3,000 on the Hanover side (of which ~1,800 are licensed/ recommended by JTB). This is in comparison to just over 6000 rooms in Ocho Rios and ~5900 rooms in Montego Bay. Aside from hotels, there are 41 villas, and ~ 30 guest houses in the parish.

Figure 37 Enumeration Districts included in Survey Area



Outside of Negril, there is very little tourism in the parish. There is the West Palm Hotel in Lucea with 18 rooms and the Round Hill Hotel at Hopewell with 121 rooms. A major addition is the Fiesta Hotel which is now being constructed 2.5 km to the west of the site, on the eastern side of Lucea Harbour. The Fiesta Hotel is being constructed in phases, with the current phase consisting of four hundred (400) rooms. When completed the hotel will have one thousand six hundred (1,600) rooms and will provide approximately one thousand two hundred and eighty (1,280) permanent jobs (JAMPRO, 2007).

The main tourist attractions within the parish are:

- The Waterfalls located in Paradise, Kempshot and Dry Hill
- The Old Lucea Court House, which is situated in the centre of town. The court house is home to one of the only town clocks throughout the Island that still chimes.
- Blenheim, the birthplace of Sir Alexander Bustamante, one of Jamaica's National Heroes and a former Prime Minister of Jamaica.
- The Lucea Parish Church which dates back to the 1700s. Based on legend it is said that a tunnel leads from the Church to the nearby Fort Charlotte.
- Fort Charlotte, which stands on a peninsula overlooking the bay, was built in 1761 for the defense of the Lucea which, at that time, was in danger of attack by French raiders.
- The Tryall Waterwheel located on one of the 16 former sugar estates in Hanover.
- Belvedere Estate operated as an historic working plantation.

4.4.3.2 Manufacturing

According to the Ministry of Labour and Social Security there are 76 companies in Hanover including fifteen (15) manufacturing companies. The manufacturing industry within the parish is not large and, therefore, has not been a significant contributor to the economic base of the Parish. The major manufacturing activities within the parish include garment manufacturing, block manufacturing and concrete works. One such manufacturing establishment, Vidal Concrete Product (Block Making Factory & Hardware) is located in Elgin Town.

This is in addition to a Molasses Pier (now closed) and a Woodwork Shop also located in Elgin Town. There is a Block Factory in Lucea and a Jockey International Jamaica Limited Factory in Sandy Bay. From the survey conducted, it was revealed that eight persons were employed within the manufacturing industry; with two people specifically at Jockey, the others were all carpenters.

4.4.3.3 Fishing

The Fisheries Division (Ministry of Agriculture and Land) has on record 535 licensed fishermen and 172 registered fishing vessels in Hanover. This represents ~4% the total number of (14,014) registered number of fishermen and fishing vessels (4,154) reported in the Jamaica Marine Fisheries Statistical digest (1996).

As shown in Table 29 most fishers and vessels are located within Lucea, followed by Lance Bay where the Fisheries Division has an office. Paradise is specifically noted as a landing site and there 4 registered fishers and 1 fishing vessel indicated at this site. 1 vessel and 1 fisherman has been encountered near Bay 3 at the site.

Table 29 Registered Fishers and Vessels in Hanover

Landing Sites	Registered Fishers	Registered Vessels
1. Lucea	174	52
2. Orange Bay	75	31
3. Lances Bay	55	19
4. Hopewell	51	26
5. Sandy Bay	51	10
6. Cousin's Cove	30	4
7. Great River	29	5
8. Haughton Court	28	9
9. Johnson Town	15	9
10. Bloody Bay	9	2
11. Industry Cove	5	2
12. Elgin Town	4	1
13. Mosquito Cove	4	1
14. Paradise	4	1
15. Sawyers Beach	1	0
	535	**172**

Source: Ministry of Agriculture, Fisheries Division

The fisheries operating in this area may be classified as artisanal fisheries. The Caribbean Regional Fisheries Mechanism (CRFM) reports that "*coral reef finfish account for the catch category in Jamaica fisheries*" and is domestically consumed. This includes species such as snappers, parrot fish, and doctor fish. According to the FAO (Fisheries Country Profile), "*the nearshore reef resources are since many years in a state of severe over-exploitation, in particular on the North shelf. Fishing is an employment of the last resort, and solving the overfishing problem is therefore more a sociological problem than a fisheries management problem*."

4.4.3.4 Agriculture

With a rich history in sugar cane production and processing, agriculture is still considered one of the major sectors in the economy of Hanover. Since the Kew Estate Factory closed, there are no operational sugar factories in Hanover. Local cane is now processed at Frome Estate in Westmoreland. Yams, ginger, rice, pimento, turmeric, breadfruit and arrowroot are produced for the export market. Four of those surveyed were farmers who raised cattle, pigs and goats. It is likely that some subsistence farming also practiced.

4.4.4 Demographic Profile

4.4.4.1 Population

In the 2001 Population Census the enumerated population of Hanover stood at 67,037 in contrast to the 1991 population figure of 66,108. The parish is largely rural with less than 10% of the parish total being classified as urban dwellers (9.32%). Between the two census periods (1991 and 2001) Lucea had a population increase of only 95 persons, increasing from 5, 967 in 1991 to 6,062 in 2001 (Table 30). Over the period 1991-2001 the annual rate of population growth for Jamaica was 0.91 per cent, in contrast to the very low growth rates seen in Hanover and Lucea (0.14% and 0.16% respectively). The very low growth rate may be attributable to out migration from the parish to other parishes for jobs or other opportunities. Using this rate of growth, it may be projected that the population of Hanover may be close to 75,000 by the year 2015.

Table 30 Population changes 1991 – 2001

Source: STATIN

Location	1991	2001	Annual Growth Rate %
Hanover	66,108	67,037	0.14
Lucea	5,967	6,062	0.16
Hopewell	519	443	-1.7
Point	478	431	-1.09

4.4.4.2 Households

According to the census there were 20,283 households and 19,867 dwellings in Hanover in 2001, giving an average number of persons per household of 3.3. The average dwelling size was in the range of 1-3 bedrooms in Hanover. Roofing materials were predominantly metal sheeting (16,071) and concrete (1,788). Outer walls of the houses built were constructed of three main types of materials; (i) 57% wood (10,421), (ii) 33% concrete and blocks (6,037) and (iii) 10% wood and concrete (1,801). A survey conducted within Elgin Town (West of Point) by the Social Development Commission (SDC) in 2004 was consistent with the findings of the national 2001 census in terms of the use of wood, with their survey reporting 60% of the houses were constructed from board. However, SDC found that 30% of the houses were constructed from a combination of concrete and board and only 10% from blocks (converse of the census).

4.4.4.3 Employment

Hanover has higher rates of unemployment than the national average (24.4% compared to 15.1%) and has a larger dependency ratio than the national dependence ratio (82.1 compared to the national average of 72.1). The survey conducted as part of this study found an unemployment rate of almost 40% for the area surveyed.

Table 31 Total Labour force employed and unemployed

Location	Total	Employed	Unemployed	Percentage Unemployed
Hanover (2002)	29,500	22,300	7,200	24.4
Jamaica (2002)	1,124,500	954,300	170,200	15.1
Jamaica (October 2005)	1,225,000	1,091,700	133,300	10.9
Jamaica (April 2006)	1,251,300	1,117,7000	133,600	10.7
Survey – January 2007*	95	58	37	38.9

Source: STATIN & PIOJ/ This study*

This high rate of unemployment is despite the average age of the survey's population sample was 37.4 years. Only six individuals were over the age of 65. Half the labour force in the survey population were occupied as skilled laborers (carpenters, masons, and mechanics). The remainder were business persons, taxi drivers, vendors, farmers, cooks and teachers.

The population in the area showed a general lack of skills development that would be required for tourism related developments. More than 50% of the surveyed population (54%) reported that they had no skills. Small percentages (less than 5% each) indicated skills in swimming, hairdressing, woodwork, farming, sewing, etc. Based on the survey conducted within the study area, three (3) per cent are employed within the tourist sector, with six (6) individuals possessing skills/training relevant to the industry.

4.4.5 Municipal Resources

4.4.5.1 Emergency Services

Police: the Lucea Police Station is strategically located within the Central Business District (CBD) and is the main station within the parish. There is a second station in Sandy Bay. Monitoring of the area and surrounding communities is shared by both stations which report an adequate staff complement. Most criminal activity occurs in areas such as Kew. Most traffic accidents, occur in hot spot areas at Round Hill, Hopewell heading towards Tryall and along the Point Road. .

Fire Station: The Parish is served by the Lucea Fire Brigade Station. The station is manned over a 24 hour period with a staff complement of fifty eight (58). The station is adequately staffed with thirteen (13) persons on each shift, at least eight (8) for the fire unit and three (3) persons on each shift for emergency medical services.

There are two units (1 pumper & 1 ambulance), which can be supported by resources from Negril and Montego Bay. Other resources used in fire fighting and emergency response such as "Jaws of Life", were acquired last year. The fire engine at the station is able to access buildings up to three storeys. The superintendent at the station indicated that the station itself is currently being expanded and upgraded. The officers at the Lucea Fire Station indicated that they receive ~ 750 calls per year, of which about a third are false alarms. Most fires are bush fires occurring in the dry season. Most calls are received from the communities of Point, Green Island, Log Wood and Ginger Hill.

The Fire Prevention Team has the responsibility of ensuring that adequate fire prevention measures are in place for all developments. The Fire Prevention Division conducts Fire Drills and training of Fire Wardens from time to time (personal communication-Nembhard & Hibbert 2006 & 2007). Emergency Services providers and/or response teams include the Fire Brigade, The Jamaica Defense Force, the Jamaica Constabulary Force and various ambulance providers. Both the Fire Brigade and Constabulary Force are within relatively close proximity to the site. These are also available through the Western Regional Health Authority (WRHA) and companies such as Ambucare. Seven (7) new ambulances were added to the fleet early in 2007.

The Hanover Disaster Committee, which operates out of the Hanover Parish Council, is responsible for emergency management and disaster preparedness in the Parish.

4.4.5.2 Health Care

Nationally, hospitals are general and specialist facilities, administered through the boards of the four regional health authorities; Western, Northern, Southern and South-eastern. The Western Regional Health Authority (WRHA), is responsible for public health surveillance, enforcement, and delivery of health to the estimated 480,762 inhabitants of the parishes of Trelawny, St. James, Hanover and Westmoreland.

Hospitals are classified as A, B or C according to the level of service offered and the size of the population served. There are five (5) hospitals within the Western Regional Health Authority (WRHA), as shown in Table 32 with the Noel Holmes Hospital being the only hospital within, Hanover. The Type C Noel Holmes Hospital located in Lucea would serve the proposed development area. Type C Hospitals are basic district hospitals where in-patient and out-patient services are provided in general medicine, surgery, child and maternity care. Additionally basic x-ray and laboratory services are usually available. Their medical staff compliment includes Medical Officers and Consultants.

Table 32 Hospitals in the WRHA by type and bed complement

	Hospital	Address	Type	No. of Beds
Trelawney	Falmouth Hospital	Rodney Street	C Public	60
St. James	Cornwall Regional Hospital	Mount Salem	A Public	375
	Doctor's Hospital	Fairfield	Specialist Private	10
Hanover	Noel Holmes Hospital	Fort Charlotte Drive	C Public	38
Westmoreland	Savanna-La-Mar Hospital	Barracks Road	B Public	140

The services offered at the Hospital are listed below:

- Maternity
- Laboratory services
- Accident and Emergency
- General Medical
- Child Health
- Pharmaceutical
- Orthopaedic
- General Surgery
- Mental Health

With one hospital in the parish, the Cornwall Regional Hospital a Type A hospital and a final referral point for secondary and tertiary services would be within the sphere of influence of the development. The hospital is multi-disciplinary and provides in-patient and outpatient services as well as 24hr Emergency Room and Lab and blood banking.

Health centres are classified according to the services offered and the size of the population served and ranges from Type I to Type IV. Within the parish of Hanover there are approximately twenty (20) health centres inclusive of satellite locations, with the Lucea Health Centre being closest to the proposed development area. The Lucea Health Centre, a Type IV and a main health centre within the parish, serves Western Hanover and sections of Eastern Hanover (including the proposed project area). There are also health centres in areas such as Sandy Bay (Type 2), Hopewell (Type 3) and Montpelier (Type 1) within Eastern Hanover.

According the Lucea Health Centre staff, there are between thirty-five (35) and forty (40) persons on staff at the health centre inclusive of ancillary staff. These include four (4) Nurses (2 RN & 2 Public Health Nurse), six (6) Community Health Aids, a Dentist and five (5) Doctors. These five doctors serve the entire parish and are rotated throughout the parish. The dentist operates three times weekly with Dental Nurses working on other days, with special emphasis on children, while the doctors work daily.

The services offered at the health centre include:

- Child health (Pediatric services)
- Child Guidance Counseling
- Public health (food handling etc.)
- Medical
- Family Planning
- Dressing
- Pre-natal health
- Sexually Transmitted Infection Service
- Curative services
- Dental
- Social services

There is also a small laboratory at the centre that can test for Sexually Transmitted Infections (S.T.I.) and pregnancy. They also collect blood samples for analysis at the Cornwall Regional Hospital in Montego Bay, St. James.

4.4.5.3 Postal Services

According to the Post Mistress at the Lucea Post Office basic services of general mail delivery, receiving mail and selling stamps are offered. There is house-to-house delivery of mail within the Lucea town centre. Residents outside the town must make visits to the post office in order to receive mail. In addition to the basic postal services the post office offers a bill payment service through a branch of Paymaster. There are ten (10) members on staff at the post office and their opening hours are Monday to Friday 8am to 5pm. (Personal communication-Campbell, 2006).

4.4.5.4 Schools

Within the area there is one (1) Public Infant School (ages 3-5), three (3) Primary Schools (ages 6-12), three (3) All-Age Schools (ages 6-15) one (1) Primary and Junior High School and one (1) Secondary High. The Lucea Infant School is located within the capital town, Lucea. The school's enrollment exceeds its capacity. The Primary Schools include the Lucea, Esher and St. Simons Primary Schools.

The number of students enrolled (1,104) at Lucea Primary greatly exceeds its capacity (440) resulting in a high student-teacher ratio above the recommended standards set by the Ministry of Education. St. Simons Primary has a relatively high student-teacher ratio (45:1) although the number of students enrolled is below the school's capacity. This high ratio is a result of the limited number of teachers present at the school.

There are three All-Age schools within the development area; Claremont All-Age, Claremont; Hills Brook All-Age, Lucea and Jericho All-Age, Jericho. Both the enrollment figures and the student teacher ratio are in excess at Claremont. There is an excess of thirty six (36) students and student-teacher ratio is 4 above the acceptable ratio.

At the Hills Brook All-Age both enrollment figures and student-teacher ratios are below the capacity of the school and the standard set by the Ministry of Education. Jericho All-Age has enrollment figures below the schools capacity; in spite of this the student- teacher ratio (37:1) is above the standard set by the Ministry of Education. Similar to St. Simons Primary the high student-teacher ratio is an effect of the small number of teachers (7) present at the school. The Sandy Bay Primary and Junior High School, Sandy Bay is well in excess of its capacity (565) with 1, 053 students enrolled. The situation at the Bethel Primary & Junior High is similar to that at Sandy Bay, with enrollment exceeding capacity and a high student: teacher ratio. At the Rusea's High School the enrollment numbers greatly exceed the school's capacity, however the student teacher ratio falls below the standard set by the Ministry of Education.

There are few private schools in Hanover. The Ministry of Education 2005 estimates that there were approximately six (6) registered private schools, and possibly other unregistered ones (kindergartens) There is also a Joinery (carpentry) Training Centre located within the Elgin Town community.

4.4.6 Utilities and Infrastructure

4.4.6.1 Electricity

In 2001, electricity was the source of lighting for 81% of the households in Hanover compared to the national average of 87%. The Jamaica Public Service Company (JPSCo) supplies electricity to Point and neighbouring communities such as Lucea through a 24KV transmission line from its substation at Orange Bay. Information obtained from the JPS office in Lucea indicates plans are afoot to reroute the supply line that runs through the hills at Point/Mosquito Cove follow the highway route.

4.4.6.2 Telephone and the Internet

Cable and Wireless supplies land line and cellular services to residents in the area. Cellular service is also available through Mossel (Jamaica) Limited and Oceanic Digital Jamaica Limited. The extension of landline service to the proposed development is within the capability of Cable and Wireless. In 2001 telephone use by household in Hanover was ~ 46%. Approximately 5,768 households had landlines while 3,474 households had mobile phones. Since 2001, the use of mobile cellular phones has increased significantly and as such the number of households using mobile phones has also increased dramatically. The area is also provided with access to the World Wide Web (Internet) through Broadband and Dial-up services and Video Conferencing by the providers, such as, Cable and Wireless.

4.4.6.3 Potable Water Supply

According to the 2001 census, 5,490 (27%) households in the parish of Hanover had water piped in their dwellings, 4,401 (25%) received potable water from standpipe, 3,181 (16%) had water piped into their yard and 352 (1.7%) received water from catchments. Based on information ascertained from the National Water Commission's (NWC) Lucea office, Lucea and surrounding communities including Point, Elgin Town, Johnson Town, Kew and Haughton Court are served by the new Great River Plant.

4.4.6.4 Roads and Transportation

The road network and structure within the area is very simple, comprising a main Class A road, the Northern Coastal Highway and narrow Class C arterial roads off the Highway, which lead southerly into adjacent communities, such as, Kew Estate and hinterland communities, such as, Jericho. The main Class A road connects the resort areas of Montego Bay and Negril via Lucea.

4.4.6.5 Solid waste

Based on the 2001 Population Census, of a total of 20,283 households in Hanover 3,625 households (17.8%) had public collection of garbage while 13,215 households (65%) burn their garbage. According to a representative of the National Solid Waste Management Authority (NSWMA) there is no formal collection of solid waste within the Point as there is no significant residential development. Waste from the construction site for the Fiesta Hotel is collected by a private contractor. There is collection in the communities of Elgin Town and Kew Estate. Where formal collection is not done it is necessary to employ private collection/disposal contractors authorized by the NSWMA.

4.4.6.6 Waste Water

In 2001 water closets were the predominant means for sewage disposal for 58% of the population. In contrast, pit latrines were used by 38% of the population. There is no central sewage treatment system in the town of Lucea.

4.4.7 Land Use

4.4.7.1 On Site

The 20-acre parcel is essentially undeveloped, covered mainly by grass and coastal vegetation at the shoreline. The residents in the community graze cattle and goats in the lowland area opposite the site and several of these animals were observed at the site. Two (2) informal establishments occur on the site: a small informal banana plot and a hut on the coast where a small fishing vessel is kept.

4.4.7.2 Regional Land Use

Much of the surrounding coastal area is undeveloped, and under pasture or open fields. The density of vegetation appears to increase with distance from the coast. The lands directly opposite the site are being considered by the National Housing Trust (NHT) for residential development. Population within the vicinity is generally sparse. Small communities exist at Elgin Town, Kew and Mosquito Cove. Some farmers informally occupy parts of the grasslands to the south of the main road.

Within 2 km of the site in all directions the most extensive development at Point is the original Bosung Construction Company facility (see Figure 16), which formed a multifunctional enclave of activities dedicated to the implementation of this segment of the Northern Coastal Highway construction. A wide range of land uses were evident at the installation; these include an asphalt factory, a stone grinding mill, offices and residences. The facility is to be dismantled.

4.4.8 Traffic

Traffic counts were conducted by the National Works Agency (NWA) between 2007 January 24 and 30 (Appendix 7). This survey may therefore be affected by the occurrence of the Air Jamaica Jazz & Blues Festival which was been held in Montego Bay, and the fact that a cruise ship was in port on Thursday 2007, January 25. The location of the count station is given in Figure 39.

Figure 38 Location of Traffic Counters (NWA)

Location of Automatic Traffic Counters in Point, Hanover.

Source: National Works Agency (NWA)

4.4.8.1 Volumes

Table 33 shows the east and westbound traffic volumes near the site in the last week of January 2007. East and westbound volumes were roughly similar, except on the weekend, when there was more westbound traffic (in both 12 hour and 24 hour counts). There was a peak in the 24-hour volumes on Thursday.

Table 33 Traffic Volumes at Point, Hanover, 2007, January 24-30

	24-hours			12-hour		
	Westbound	**Eastbound**	**Difference**	**Westbound**	**Eastbound**	**Difference**
Weds				1620	1577	43
Thurs	3088	3128	-40	2412	2423	-11
Fri	3199	3187	12	2357	2370	-13
Sat	3033	2880	153	2150	2022	128
Sun	2373	2231	142	1661	1590	71
Mon	2783	2843	-60	2173	2171	2
Tue				943	1038	-95

4.4.8.2 Daily Peaks

Morning Peaks: For the survey period (Thursday to Tuesday), there were peaks as early as 7 to 8 am for east bound traffic (towards Montego Bay) on Thursday, Friday and Monday, which probably reflected normal commuter traffic. Peaks for westbound traffic (towards Negril) tended to occur later (8 to 9 on Friday and Tuesday, and 9 to 10 on Thursday and Monday). With the exception of eastbound traffic peak on Sunday at 9 to 10, the weekend morning peaks occurred after 10 am.

Afternoon Peaks: For the period Wednesday to Monday, there was an early afternoon peak on Wednesday (1 to 2 pm) for eastbound traffic. For Friday through to Sunday there were a westbound peaks occurring throughout the afternoon (1-2 on Friday, 2-3 on Saturday and 3-3 on Sunday). There was a late afternoon peak in both directions between 4 pm and 6 pm, probably reflecting normal commuter traffic. Late Saturday afternoon (6 to 7 pm) there was a peak in eastbound traffic (Appendix 7).

4.4.9 Heritage Resources

The parish of Hanover was established on November 12, 1723, and named after King George I who was from the House of Hanover. In the early colonial days, the parish capital, Lucea, was an even busier town than Montego Bay and by the mid-18th century, was the hub of an important sugar growing region, which led to the town prospering as a sugar port and market centre.

As the area prospered, Jews from Europe settled in the parish as merchants, store keepers, haberdashers, shoemakers and goldsmiths, and it became a free port. These Jews are credited

for some of the listed surnames within the parish such as DeLissers, Simmons, Browne and Sanflteben. There is a Jewish cemetery near to the Lucea Anglican Church, which is currently maintained by the Hanover Museum.

The clock atop the old court house, (Town Hall) was built in 1817. This clock is believed to have beeen destined for St. Lucia originally, and was delivered in error to the town of Lucea. A leading citizen, Mr. Sanflteben, is said to have donated the money to house the clock and insisted that it should be designed in the shape of a German helmet. The tower housing the clock has only three faces, the fourth face to the west is missing. The Town Hall is still the tallest building in Hanover.

After emancipation in 1834, the free people prospered and supplied produce to much of the rest of Jamaica. The harbour was used to export bananas until after the 1960s. A deep-water pier was built, but this was restricted to the shipping of molasses and is no longer in use. In 1983, the port was closed, but the old Fort Charlotte still stands at one side of the entrance to the harbour. It was never used.

The Hanover Beneficial Bank (now Jamaica National) and the Hanover Peoples Cooperative Bank were founded in Lucea, while in the 1940's, on public holidays, horse racing was a feature event in western Lucea and was staged at Copperwood horseracing track.

The remnants of an old sugar factory located near the entrance to the Point Property indicates that it dates back to the eighteenth century. It was during that period that sugar production using African slave labour was at its peak. Information obtained by the NHDC suggests that there is a cemetery for slaves within that location and this along with the old stonework structure will be conserved and incorporated in their development plans. Subsequently there have been varying land uses, for example, records at the National Library of Jamaica indicate that in 1930 the size of the property was 1030 acres (417 hectares). During that period the property was used both for coconut production and as a grazing pen. It is uncertain when the property reverted to sugarcane production, but this activity was halted again about ten years ago. The wind windmill near the old plant is listed along with the “community on the hill”; the community is a Taino site.

Apart from the Parish Council owned Watson Taylor Park, the recreational facilities in and around Lucea are the Elgin Town Cricket Pitch, the Ruseas Playing Field and a large playing field on the outskirts of the Town. There are fifteen (15) beaches within Hanover. Most (including Elgin Town and Lucea beaches) are both public as well as fishing beaches. The closest strictly public beach is located at Bulls Bay.

5 THE STAKEHOLDER CONSULTATION PROCESS

5.1 SECTION OVERVIEW

This section outlines the process for stakeholder consultation that applies to this EIA process and summarizes the key environmental concerns arising during the stakeholder consultations done prior to submission of the EIA. The degree of public concern with specific issues (and general acceptability of the impact given proposed mitigation) is a key criterion used in determining of the relative significance of environmental impacts.

5.2 CONDUCT OF THE EIA PROCESS

The main benchmarks for this EIA process (past and projected) are given in Table 34 below.

Table 34 EIA Project Benchmarks

Benchmark	Completion Date
Submission of applications to NEPA	*July 17th 2006*
Receipt of the Generic TOR from NEPA	*October 26th 2006*
Submission of application for the Sewage Treatment system	*November 7th 2006*
Submission of the Draft TOR to NEPA for review	*November 7th 2006*
Public Notice of availability of TOR for review	*November 15th 2006*
Submission of responses to comments on the TOR	*January 12th 2007* *February 5th 2007*
Acceptance of the revised TOR by NEPA	*February 23rd 2007*
Field surveys	*Nov 2006 to Jan 2007*
Completion of the EIA	*April 17th 2007*
Posting of the 2nd Public Notice (availability of the EIA for review).	April 20th 2007
Public Meeting.	May 11th 2007
Submission of Verbatim Report	May 18th 2007
Review Report (estimated date)	June 30th 2007
Addendum Report	July 6th 2007
Review of Addendum Report	July 30th 2007
Submission of application to the NRCA Board for decision.	August 2007
Notice to the Applicant of the Board's decision.	August 2007

All EIA documentation shall be placed online at nrca.org and at eiacaribbean.com/DCL. After the submission of the EIA for review, neither the applicant nor consultant shall contact NEPA until the review report has been submitted to the consultant for formal response.

5.2.1 Opportunities for Stakeholder Inclusion

The EIA process will only be considered valid if there are meaningful and valid opportunities for public scrutiny of the environmental effects of the project as proposed. The consultation mechanisms used in this EIA process included:

1. Availability for public comment of the Draft Terms of Reference (inclusive of detailed descriptions of the project and environmental setting).
2. Direct written communication from the EIA preparer to relevant public agencies, NGOs and adjacent land owners/occupiers advising them of the project, and seeking their concerns about it as they relate to potential environmental impacts. The letter given as Appendix 8 was sent to several public agencies (Appendix 9). Two responses were received, and these are given as Appendices 10 and 11.
3. A survey (Appendix 12) of the communities identified in Section 4.4.1 was administered to determine:
    a. General acceptability of the proposed project, with consideration of the community-based stakeholders' willingness to make trade-offs, given the potential benefits of the project to the local and national economies.
    b. Fears and expectations about the specific project, including any anticipated social conflict and crime.
    c. Perceptions and attitudes of present community-based resource users, e.g., fishermen, squatters, recreational beach users.
    d. General health, safety and environmental concerns related to the project.

Issues arising from these avenues are discussed in this section of the EIA. After the Draft EIA is completed, the following additional opportunities will be available for public comment:

4. Public Meeting held in Lucea three weeks after the EIA is made available for review. This meeting shall include presentations outlining the project, its possible environmental impacts, and proposed mitigations. The public shall be invited to ask the consultants about any environmental issues pertaining to the project at this time. The public shall be advised of the venue and time in a national newspaper.
5. All EIA documents shall be available for public review, inclusive of: (1) the Terms of Reference (2) the EIA inclusive of all supporting technical appendices (3) the Public Meeting Report (containing presentations, summary, verbatim report of question and answer session and the register of attendance) and (4) Addendum Report (i.e. written response to the official review report).

5.3 PROFILE OF SURVEY RESPONDENTS

The following profile has been interpreted based on data from the community survey. The average age of the respondent was 37 years. Fifty five percent (55%) of the respondents were male. Seventy-two percent (72%) of the respondents had been born in the area, and another 18% had been living in the area for at least 10 years. Fifty five percent (55%) of the respondents had completed at secondary school, and another 37% had completed primary school. The remaining 8% had tertiary education.

Of the 95 persons indicating a response, a relatively large number (37 persons or 39%) were unemployed. Of those employed, most (84%) were employed within the parish. Almost a third of the respondents (34%) indicated that they had no skills.

Respondents were reasonably satisfied with the provision of the following services and amenities to the area: transportation (91%) fire (83%), electricity (88%), telephone (82%), water supply (83%), recreational facilities (74%), garbage collection (78%) and police (76%). More than half (56%) indicated that the health services could be improved.

5.4 CULTURAL ASPECTS

5.4.1 Community Values

5.4.1.1 Sense of Place and Community

Most (97%) respondents indicated that they liked living in the area. More than half (52%) indicated they liked living in the area because it is peaceful and quiet (crime free). Others (20%) suggested that it was because they were born there and considered it home. The 3% who indicated that they did not like living in the area were all from Kew Estate.

5.4.1.2 Recreation

The majority (63%) of respondents indicated outdoor recreation as the main form of recreation, with most citing the beach (41%) and picnics (23%). Other forms included night clubs and slot machines.

A third (31%) of those who answered the question in respect of where they went for entertainment indicated that they went either to Montego Bay or Negril. Only 21% indicated that they go to either Lucea or Sandy Bay.

Without knowing the details of the facility other than it will offer dolphin tours, persons were asked about the price they would be willing to pay to enter the facility. A third (33%) indicated that they would pay between 500 and 1000 Jamaican dollars to enter. Most (64%) said they would (could) pay less than 500 Jamaican dollars. It is important to note that 98% of the respondents indicated that they would actually pay to visit the facility, suggesting overwhelming support for the development.

5.4.2 Attitudes toward the Project

5.4.2.1 Awareness

When asked whether they had prior knowledge of the project, 98 persons responded. Of these only 19 indicated that they did.

The respondents were then asked how important the project was to them and their community. An overwhelming 85% indicated that it was “very important”, and another 12% indicated it was “important”. Only 3% indicated that they did not regard Dolphin Cove as important.

5.4.2.2 Expectations

Respondents were asked if they though the proposed development would have any environment effects. These responses are summarized in Table 35. In general less than 40% of the respondents felt there would be negative environmental effects (crime, social conflict, loss of biodiversity). Most people had the expectation that jobs would be created and that there would be general improvement in the community in terms of resources and amenities as a result of the development be implemented.

Table 35 Expected Environmental Effects (Responses)

Option	% Positive Answer
Job creation	99%
Improved utility services (e.g. waste disposal, water, electricity etc.)	75%
Improved security (policing), thus decreased crime rate	92%
Improved living standard	94%
Improved community resources	97%
Conflict/competition between locals and newcomers for jobs	59%
Increase in crime rate	35%
Exclusion of person who currently use the property	34%
Loss of biodiversity (e.g. plants, marine life)	39%

5.5 ISSUES RAISED

The issues raised from the consultation process (including letters, survey, interviews, comments on Terms of Reference) are summarized below.

5.5.1 EIA Process

Comment/Requirement for inclusion	Section
Location of the site relative to protected areas	2.2.2.1
Siting criteria	2.2.2.2
Complete designs including a site layout plan	2.3
Whether Dolphin Human Therapy will be included.	2.3.1.3
Endangered Species Act and the Wildlife Act	3.3.1.5 and 3.3.1.6
Relevant guidelines, international conventions etc	3.3.1.5, 3.3.1.6, 3.3.1.8
Hanover Coast Development Order (1962)	3.2.1.1
Baseline Total N and Total P	4.2.9.4
Methods used in respect of stakeholder consultation	5.2.1
Off-site impacts, indirect and secondary effects	6.2.2.
Relocation of sensitive or protected species	8.4
Emergency response plan	8.5.1
Environmental monitoring plan (including reefs)	8.5.2

5.5.2 Sustainable Development Issues

The Terms of Reference (developed by the EIA consultant in discussion with technical staff at NEPA) identified the following impacts for further investigation:

1. Environmental effects arising from the proposed physical changes and design footprint of the facility:
    a. Changes to hydrological conditions and flood potential arising from the proposed drainage modifications and site run-offs.
    b. Changes to natural features and visual aesthetics (landscape) arising from drainage and excavation works.
    c. Modification of natural habitats, and niches, including changes to the benthic environment in the bays (from foreshore encroachments, dredging and beach nourishment).

d. Off-site impacts arising from sourcing of sand for nourishment.
e. Increased vulnerability of the lagoons and facilities to (a) storm surges given design life of structures and coastal set-back (b) seismicity (c) coastal erosion.

2. Potential for pollution of coastal or ground water, particularly in relation to:
    a. Dredging and excavation works (plumes).
    b. Disposal of dredge spoil if material is not suitable for on site beneficial use options (beach nourishment or land fill).
    c. The capacity and design parameters of proposed sewage treatment facility.
    d. Presence of marine mammals given predicted flushing rates and patterns (arising from the combination of tidal currents and waves).

3. Impacts on the biological community: Disturbance/use of protected species and other species: Mangroves, sea grasses, corals, dolphins and other species of interest to the project: scientific names, sources, numbers, age and sex. In addition the specific effects of creation of a "dry limestone forest" in this area was identified.

4. Potential impacts on the human environment:
    a. Earning opportunities for Hanover residents including provision of new jobs.
    b. Effects on regional tourism: numbers of tourists, foreign exchange revenues, recreational opportunity diversification
    c. Alignment with regional land uses (e.g. Fiesta hotel) and physical planning objectives for the area.
    d. Effects on municipal services: solid waste disposal capacity and emergency services.
5. The EIA will describe off-site and on-site effects on the environment caused by any foreseeable developments engendered by the implementation of this project.

6 ASSESSMENT OF IMPACTS

6.1 SECTION OVERVIEW

The purpose of this task is to identify the major environmental and public health issues of concern that could arise from implementation of the project as described in Section 2. The main objective is to determine whether there are any environmental considerations that need to be taken into account in reviewing the applications for environmental permits and beach licenses, and whether there is any environmental why the project should not proceed as proposed. This would be tantamount to a finding of significant negative impact, where the project itself or project-related cause:

- Is located in proximity to any sensitive or protected areas and has been determined to impact negatively on these.
- Is extensive over space or time (scales must be appropriately defined)
- Is intensive in concentration (i.e. exceeding recommended criteria) or in relation to assimilative capacity (as appropriated to the affected receptor).
- Is not consistent with national plans for the general use of the area.
- Contributes to the endangerment of threatened species.
- Reduces the stocks of commercially important species.
- Permanently damages habitat quality or creates ecological barriers.
- Threatens cultural or heritage resources.
- Alters community lifestyles or requires long-term adjustments of local people in respect of traditional values and resource use.
- Represents a long-term nuisance or significant safety risk to other users.

A secondary objective of this section is to outline the relative importance of the causative elements along with the potential for cost-effective mitigation of negative impacts (including design modification). This should facilitate development of specific environmental conditionalities that would to be outlined if the project application is permitted.

6.2 METHODOLOGIES

6.2.1 Impact Identification

Both positive and negative project impacts were identified using the following methods:

1. Stakeholder consultation.
2. Technical inputs from environmental specialists on the EIA team.
3. Review of the possible impact-causing aspects of the project.
4. Review of impact assessments done for similar projects.
5. Regulatory criteria governing aspects of the environment likely to be impacted.
6. The sensitivity of valued environmental components (VECs) likely to be impacted.
7. Review of the risks arising from the project and the range of environmental consequences that could arise under upset conditions.

6.2.2 Impact Assessment

Each identified impact is classified according to the assessed effect level (no impact, minor, moderate or major). Each identified impact shall be assessed using the following criteria:

1. Scale: this refers to the magnitude of the adverse effect in terms of the geographic extent of influence arising from frequency and magnitude of the causative action. This allows higher assessment of impacts with a wider sphere of influence.

2. Affected Numbers: this considers the numbers of individuals (organisms, people etc.) from a valued population that stand to be impacted. This parameter can refer to indicator species or general receptor populations.

3. Secondary Effects: This parameter looks at the impact as a trigger mechanism for other effects, particularly those manifesting downstream of a pathway emanating from a project component, latent effects that could occur in the future, such as bioaccumulation of heavy metals in the food chain, or effects on future generations.

4. Resilience: This criterion examines ecological resilience/sensitivity (ability of a population to cope with effect). Existing stresses and variability of sensitivity (spatial or seasonal) shall be considered. Resilience/sensitivity can be determined by eco-toxicological response, dose/response relationships and exposure of the population given effect pathways.

5. Persistence: This addresses the frequency and duration of effects in the environment. In general, chronic (persistent) or acute (short-term but severe) effects are regarded as more significant.

6. Reversibility. This criterion evaluates the extent to which an effected receptor can be returned to its pre-project state.

7. Baseline change: This relates to any model or prediction of the extent of change that can be expected. This shall compare predicted levels of change with normal fluctuations as well as trends in the parameter without the effect of the project.
8. Extent to which the impact can be mitigated: This addresses the feasibility (ease of implementation and cost-effectiveness) of measures to prevent or reduce environmental costs. It shall also consider the benefits or moderating circumstances given these environmental costs.
9. Uncertainty: This allows for disclosure of the level of scientific confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts.
10. Acceptability to stakeholders: This examines the willingness to make trade-offs and the degree of objection, given potential benefits of the project. This also includes planning constraints and scientific criteria (maximum allowable limits).

The criteria given above are used in a simple rating scale, which further defines each of the criteria, according to the four basic effect levels commonly used in EIA practice (No Impact, Minor, Moderate and Significant). These are defined in Tables 36 and 37 and are consistently applied to each of the impacts identified.

Each impact is evaluated against each of the set criteria, with the assignment of a score (based as far as possible on the available scientific data presented in the EIA), and given a score between 0 and 5. The scores ranges from less than 1 (no impact to negligible), 1 to 1.9 (minor), 2 to 3.9 (low to high moderate), and more than 4 (low to high significant). Total score is averaged out of the scores in respect of the criteria to determine the overall averaged effect level for the impact. Where a criterion is not relevant, no score is assigned, and the average calculated only on the number of relevant and scored criteria.

Table 36 Negative Impact Assessment Criteria

	0	0.1 1.9	2 3.9	4 4.9
CRITERIA	**No impact**	**Minor**	**Moderate**	**Significant**
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.	Widespread: offsite regional effects
Affected Numbers:		<1% population or habitat area is directly exposed.	1% to 10% population or habitat directly exposed.	> 10% population or habitat area is directly exposed.
Secondary Effects		Few indirect effects.	Many indirect negative affects. One trophic level within one generation affected.	Many indirect negative affects. > 1 generation affected. Several trophic levels involved.
Resilience:		Receptors are resilient. Nuisance but no real loss of revenue or amenity. Impact does not occur at a time when receptors are vulnerable	Morbidity or health concern. Temporary loss of revenue or amenity. Impact occurs at the start or end of a period when receptor is particularly vulnerable.	Receptors unable to cope. Mortality or trauma in populations. Loss of revenue or amenity is sustained after remedial action is taken. Impact occurs at the peak time when receptor is vulnerable.
Persistence:		Lasting less than a few months before recovery occurs with no observable residual effects. Related to duration of event.	Lasting from a few months to two years before signs of recovery.	Impact persistent after 2 years. Impacts on a biological population over a number of recruitment cycles.
Reversibility:	Can be returned to original state completely with removal of structural elements.		Can be returned to a productive state with removal or change of use of structural elements.	Cannot be easily or cost-effectively returned to previous state or be re-used for any other productive purpose.
Baseline change:		Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.	Moderate deviation from baseline conditions. Within 2 standard deviation of the mean.	Major deviation from baseline conditions: > 2 standard deviations of the mean.
Manageability:	No mitigation necessary	Very easily and cost-effectively mitigated. Significant opportunities for environmental enhancement or benefits in the short to medium term (arising within a few months).	Cost-effectively mitigated. Long term environmental benefit as a result of the short-term negative impact associated with project (arising within 2 years)	Cannot be easily mitigated or requires major design change to causative activities. No mitigation possible. No opportunity for environmental enhancement or no perceptible environmental benefit.
Scientific Uncertainties	>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set.	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied.

Acceptability:		Impacts are acceptable to affected community. Complies with legal thresholds and /or best practice or wise use of resource, physical plans and land use policies.	Acceptable with mitigation. Affected stakeholders willing to make trade off. Approaches legal limits or criteria or maximum allowable levels.	Public outcry. Prohibitive legislation, plans or policies. Exceeds legal thresholds, limits or criteria or maximum allowable levels.

Table 37 Positive Impact Assessment Criteria

	0	1	2	3	4	5
CRITERIA	**No impact**	**Minor**	**Moderate**		**Significant**	
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.		Widespread: offsite regional effects	
Affected Numbers:		Less than 1% population or habitat affected.	1-10% population or habitat affected.		More than 10% population or habitat affected	
Secondary Effects		Few indirect positive effects.	Many indirect positive affects. One trophic level within one generation affected.		Many indirect positive affects. > 1 generation affected. Several trophic levels involved.	
Resilience:	Receptors are not able to take full benefit or benefit indirectly. Minor advantage but no real increase in revenue or amenity. Impact does not occur at a time when receptors are receptive.		Medium term increase of revenue or amenity. Impact occurs at the start or end of a period when receptor is able to benefit.		Receptors benefit directly. Revenue or amenity is sustained in the long term. Benefits are accessible at best time for receptor.	
Persistence:	Lasting less than a few months before recovery occurs with no observable residual effects.		Lasting from a few months to two years before signs of recovery.		Impact persistent after 2 years. Impacts on a biological population over several recruitment cycles.	
Baseline change:	Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.		Moderate deviation: 1-2 standard deviations		Major deviation: >2 standard deviations	
Scientific Uncertainties	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied. Numerous conditions that are likely to occur that would affect impact of benefits.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set. A number of conditions that could off-set benefits.		>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable. Few conditions that could off-set benefits.	

6.3 ENVIRONMENTAL IMPACTS

6.3.1 Site Development and Construction Phase (Negative)

6.3.1.1 Change to Air Quality

Air quality is expected to be impacted during the construction of the site as a result of:

1. **Diesel emissions**:
    - The use of heavy vehicles and equipment fuelled mainly by diesel. Diesel emissions contain hundreds of different components, over 40 of which are considered toxic (American Lung Association[5]) carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), and hydrocarbon particulates. NOx can contribute to the development of photochemical smog, and fine (breathable) particulates. Exposure to high concentrations of these chemicals can produce serious health risks. The release of carbon from fossil fuels contributes to global warming.

2. **Fugitive dust**:
    - Although the present status of the site calls for very little vegetation clearance, considerable earthworks are planned for the site, including excavation of approximately half an acre (1900 m^2) of land behind Bay 3 (for creation of the beach). The excavation of the drainage swale will also create bare earth and temporary stockpiling.
    - The movement of heavy vehicles hauling construction materials such as concrete blocks or cement or haulage of solid waste (included excavated and dredged material).
    - There might also be fugitive dust associated with stockpiles of earth and fill materials.

[5] http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=36089

CRITERIA	ASSESSMENT	Score
Scale:	Although the highest concentrations of emissions and dust will be limited to the construction areas on site and are expected to be rapidly dispersed, it is expected that the corridor between the site and the supply areas or land fill will be impacted by very small amounts of dust and emissions. Day time sea breezes are expected to move dust toward the main road.	3
Affected Numbers:	The nearest communities are not expected to be affected by nuisance levels. Construction workers (~20) may have higher levels of exposure. Communities along transportation corridor may be affected. Cars along the highway are unlikely to be too vulnerable to localized dusty conditions during construction period.	1
Secondary Effects	Local climate effects: dust traps heat. Health: particulates could affect workers Decline in visual aesthetic of the area	1
Resilience	Communities along major road arteries such as the North Coast Highway have been exposed to heavy vehicular traffic and haulage operations. Workers will be protected by dust masks. Higher wind speeds between December and mid-February and relatively drier conditions could be conducive to increased dustiness, but more rapid dispersal of emissions.	1
Persistence:	The major earthworks are expected to be completed in the last quarter of 2007 (3 month period).	1
Reversibility:	Dust will eventually be rained out of the atmosphere. Emissions will be dispersed.	1
Baseline change	No baseline survey was done because this is a usual impact of construction sites, and there are no major environmental receptors close by. However, the local change to baseline is expected to be moderate as there are no major sources of air pollution (other than the highway).	3
Manageability	Ensure that contractors maintain the vehicles properly. Smoky vehicles should not be allowed to operate. Provide workers with dust masks. Wetting of stockpiles. Cover haulage vehicles. Landscaping as soon as possible. Minimizing periods of work stoppage during earth works.	1
Uncertainty	Worst case scenario has to be applied in the absence of data. Earth works planned for a windy period.	4
Acceptability:	Dustiness not expected to reach unacceptable levels, and is expected to be within normal range for construction sites with significant amount of earth works. Not expected to exceed air quality criteria.	2
Classification:	**Minor**	1.8

6.3.1.2 Nuisance Noise

During the entire construction period (15 months) it is expected that there would be above ambient noise arising from the operation of heavy equipment, hammers, etc.

Foreshore works (dredging, excavation, boulder and sand placement) are also expected to produce underwater vibrations.

CRITERIA	ASSESSMENT	Score
Scale:	The noise levels will be limited to the construction areas on site.	1
Affected Numbers:	The nearest communities are not expected to be affected by nuisance levels. Construction workers (~20) will be exposed to the highest levels of noise. Marine communities in Bays 1 and 2 are expected to be exposed intermittently to underwater vibrations.	2
Secondary Effects	Coastal faunas (birds in particularly) and marine pelagic species are likely to demonstrate avoidance behaviour until the operations ceases. This would temporarily reduce local populations.	2
Resilience	Construction workers can wear ear muffs to reduce the impact. Coastal birds and marine pelagics will flee to avoid detrimental effects, and are expected to return when conditions return to normal. There are no noise sensitive human receptors within 2.5 km radius of the site (schools, hospitals, churches, parks, residential areas)	2
Persistence:	15 months	3
Reversibility:	Faunas expected to return upon cessation of noise	1
Baseline change	No baseline survey was done because this is a usual impact of construction sites, and there are no major environmental receptors close by. However, the local change to baseline is expected to be moderate as there are no major sources of noise pollution (other than the highway).	3
Manageability	Ensure that contractors maintain equipment properly. Provide workers with ear muffs. Construction activities should be limited to daylight hours (6 to 6)	1
Uncertainty	The noisiest equipment that may be used is a jackhammer, which is rated at ~115 dBa. It is expected that if this is used near the coast, it is expected that by 2.5 km this will be reduced to less than 67 dbA (making no provisions for terrain or wind directions). Uncertainty as to the extent of use required for jack hammer. All other equipment expected to be significantly lower in noise ratings.	2
Acceptability:	Noise is not expected to reach unacceptable levels, and is expected to be within normal range for construction sites. Not expected to exceed recommended criteria.	2
Classification:	**Minor**	1.9

6.3.1.3 Decreased Coastal Water Quality

With the extent of planned foreshore works, earthworks, and stockpiling described in Section (Section 2) it is likely that there might be an increased in the TSS load in the coastal waters, which has been found to be generally below 5 mg/l in both wet and dry season in the 3 bays, and offshore areas. In addition, there might be minor inputs of nutrients from the construction camp (e.g. ammonia from urine, phosphates from detergents). If construction camp solid waste is not properly managed, there could also be increased levels of floatables. Oil and grease levels may also increase due to the presence of heavy equipment in proximity to the coastal waters.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Although generally localized currents could take a plume beyond the project site, this is expected to disperse rapidly in open waters.	3
Affected Numbers:	If impact is managed less than 10% of the benthic eco-systems could be impacted. Pelagics are expected to exhibit avoidance behaviour.	3
Secondary Effects	Decline in visual aesthetic Morbidity in benthic communities from TSS and oil and grease loads Temporarily depletion of mobile species that are intolerant of elevated TSS levels.	2
Resilience	Minor increases in nutrient load are expected to be assimilated by the sea grass communities. Benthic communities in the highest impact area will be relocated. Silt screens are expected to be effective in protecting the outer reefs.	3
Persistence:	15 months	3
Reversibility:	Minor secondary effects are reversible.	2
Baseline change	Minor to moderate change to baseline if impact is managed properly.	3
Manageability	Use and maintenance of silt screens. Bunding of stock piles. Use of portable lavatories for construction workers. Relocation of sensitive benthic organisms in high impact areas. Coastal water outside of the bays need to be monitored to ensure that levels remain below 30 mg/l	2
Uncertainty	The occurrence of upset conditions is uncertain, and can result in a larger number of receptors being impacted. Oceanographic conditions at the time will control the extent of the dispersion.	4
Acceptability:	Generally acceptable with the implementation of mitigation measures.	3
Classification:	**Moderate**	2.8

6.3.1.4 Consumption of Landfill for Dredged Spoil and Excavated Rock

It is estimated that there may be as much as 970 m^3 of excavated rock plus up to 1500 m^3 of dredged material. This material will have to be taken to the nearest landfill or approved dumpsite. Preliminary tests on the quality of sediments in the area confirm that they are not contaminated, as would be expected from an area where there is no major industrial activity. The main effects of interior disposal of these materials at a dump or land fill would be salt associated with the sediments and possibly fine sediments that could be mobilized in a water course and cause increased turbidity.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Although offsite, it is limited to the disposal site, which if properly managed should not allow for dispersal off site. It is hoped that much of the dredged and excavated material can be beneficially used on site.	2
Affected Numbers:	It is not expected that the land fill will be a significant habitat for vegetation or faunas that are likely to be impacted by the salt load.	1
Secondary Effects	Minor increase in salt load of the land fill's soils. Occupation of land fill space	2
Resilience	It is estimated that there is sufficient land fill capacity in Montego Bay to receive these wastes.	1
Persistence:	Consumption of land fill space is permanent. Localized salt loading will be leached over time.	5
Reversibility:	Not reversible.	5
Baseline change	Localized salt loading with be above ambient levels, although there would be other non-marine sources of salts in land fill leachate.	3
Manageability	Once the spoil is disposed of at an approved site that is properly situated and managed, potential secondary or indirect effects such as turbidity in surface water or leachate getting into groundwater systems should be avoided. In the event that there is inadequate land fill space, ocean disposal should be considered.	2
Uncertainty	The exact quantity of spoil to be disposed of is unknown. The availability of land fill space is also uncertain.	4
Acceptability:	This form of disposal is consistent with common practice and is generally acceptable.	2
Classification:	**Moderate**	2.7

Deepening of the seafloor of Bays 2 and 3

The development brief calls for extensive dredging of the foreshore to deepen 2000 m^2 to the desired 3 m depth in Bay 2, and to deepen 1150 m^2 in Bay 2 to create a swimming area of ~1.5 m in depth. The sandy bottom likely to occur in Bay 2 will be temporarily changed to a rocky bottom, then replaced with sand from the nourishment exercise. The bottom in Bay 2 appears to be more variable with softer sediments towards the centre, with rocky shallow areas in places. This area will be excavated to rocky substrate, which may eventually accumulate a thin layer of fine carbonate sediments. Both bays will be deeper than they are now.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Isolated effects within bays 2 and 3	1
Affected Numbers:	More than 50% of the benthic community in both bays will be impacted by excavation works.	4
Secondary Effects	- Impacts on benthic eco-systems within footprint. A major secondary impact of this effect is removal of ~3152 m2 of sea grass beds. The main species impacted (*Thalassia* and to a lesser extent *Syringodium*), are very common in this area, and are present in all the bays. Corals found in the footprint will also be disturbed. - Increased suspended solids. This could have effects on outer reefs and sea grass areas within the bays that are not being excavated. - Reduced efficiency of tidal flushing - mitigated.	3
Resilience	Benthic eco-systems in the area comprise mainly sea grass beds, algae with very sparse corals (*Sideratrea radians, Porites sp., Montastrea sp., Diploria sp. and Millepora sp).* Corals that are replanted in similar conditions have a good chance of success. Sea grasses may have ~30% chance of successful transplantation (based on the author's experience transplanting sea grasses). It is also expected that sea grasses will re-colonize the area if a soft substrate is restored after deepening. Other marine specimens will not be negatively impacted by the depth change.	2
Persistence:	The effects of deepening the bay will be very long term.	5
Reversibility:	Possible to fill the area again, but the sites cannot be fully restored.	4
Baseline change	The average depth in Bay 2 excavation area is presently ~1.5 m. The excavation area in Bay 3 is on average < 1.5. The depth change in Bay 2 will be greater than in Bay 3.	3

Manageability	The impacts on benthic eco-systems can be mitigated by the relocation of sensitive or protected species. Sea grasses will be transplanted to adjacent areas within the same bay (outside the silt screen) and possibly to Bay 1 which will remain undisturbed. Corals will be relocated to an area to which NEPA has agreed. Increased suspended solids during excavation can be contained by pumping of soft sediments prior to excavation, and by silt screens. Tidal flushing in the bays can be augmented by the creation of a channel between the two bays to force currents from Bay 3 through to Bay 2.	2
Uncertainty	The resolution on the bathymetric survey of the bays presented in the Coastal Engineering Design Report is reasonably detailed over specific transect lines. The model used can accurately predict flushing scenarios given the ambient currents and tidal regime in the area (calibrated using data collected from the area).	1
Acceptability:	There are many legal precedents for deepening of the foreshore, and relocation of benthic species such as corals and sea grasses in Jamaica. - The negative effects need to be evaluated against the benefits. - Increase in the overall volume of water in the bay (lower concentrations of nutrients). - Production of dredged spoil which could be used beneficially. - Enhancing the bay for productive use (dolphins and recreational swimming).	1
Classification:	**Moderate**	2.6

6.3.1.5 Change to Shoreline Configuration in Bay 2

The plan proposed to change the shoreline configuration of Bay 2. This involves replacement of the soft muddy irregular shoreline with a more uniform beach and foreshore. The south-eastern corner of this bay is much incised (in plan view) due to the outfall of the gully at this location. This presently produced slack water conditions (stagnant) and bad odours. The sediments found in this area are generally very fine, dark organic muds.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Isolated effects within project site	1
Affected Numbers:	Approximately half an acre (0.2 ha) of mangrove will be impacted. This is less than 1% of the mangroves in north-western Jamaica, and many of the mangroves will be relocated elsewhere on the property. Crabs and other species within the eco-system will be affected by the removal of the mangroves and replacement of soft organic sediment with fill and sand. These are likely to represent less than 1% of the total numbers as well.	1

Secondary Effects	- Disturbance of mangrove eco-system (discussed elsewhere) – mitigated. - Disposal required for the organic sediment beneath the mangroves. This is likely to be brackish and nutrient rich.	1
Resilience	The impacted eco-system is expected to be successfully relocated. Birds and crustaceans are expected to migrate to Bay 1, where the sanctuary is located.	1
Persistence:	Long term	4
Reversibility:	This change can be easily returned to previous state with the restoration of drainage conditions.	2
Baseline change	Major deviation from existing conditions.	4
Manageability	Mangroves will be replanted. Organic sediment will be disposed of at an approved landfill. Positive impacts do not require mitigation.	2
Uncertainty	Elimination of slack water has been modelled. The area of impact is known.	1
Acceptability:	Generally, disturbance of mangrove eco-systems is not encouraged as they are considered important for many reasons. - They are important habitats and carbon sinks that are diminishing globally. However, Jamaica, and the north-west coast in particular has an abundance of mangroves. In addition, this acreage will not be lost, but will be actually relocated to a sanctuary area. - Their functions in respect of coastal water quality, sea grass and coral ecosystems. In this case, these functions will be greatly reduced as the sea grasses and corals will be relocated, and the coastal water quality will be managed by prevention of outfall. - The site does not fall within a protected Ramsar site. The negative effects need to be evaluated against the benefits of this project element: - elimination of slack water conditions and odours; - opportunity to use the area for tourism (beach creation); and - need to prevent the problem associated with organic sub-strata mixing with sands.	3
Classification:	**Moderate**	2

6.3.1.6 Change to the Oceanography (Boulder Breakwaters and Boardwalk Pilings)

The footprint of the two breakwaters is 38 m^2 in Bay 2. This will consist of large boulders being placed on the sea floor and built up to the design elevation above sea level. In addition, there will be 280 m of board walk, supported by pilings placed on either side every 2.5 m (224 pilings). Each piling is expected to be 20 cm in diameter, giving an area of 314 cm^2. The total impact area of the pilings is therefore expected to be of the order of ~7 m^2 spread over the area shown. The boardwalk will also have a footprint in terms of blocking of light from the sea bed. The impact area of this is expected to be the total length (280 m) by 3 m (width), which is 840 m^2. At least 100 m^2 of this will overhang onto the cliff line.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Very localized in the project area	1
Affected Numbers:	The main receptors are expected to be benthic species (sea grass, algae, corals etc.) and benthic invertebrate fauna (gastropods, polychaetes, bivalves, crustaceans, echinoids etc.). Sea grass beds are not expected to be dominant in the footprint areas, which are expected to be rocky (Figure 31) as the sea bed in this area is an underwater extension of the headland feature. There may be a range of hard corals in this area. Compared to the Bays 1 and 4 and outer marine areas, Bay 1 was found to have relatively sparser populations of infauna, dominated by polychaetes. This is thought to be related to the presence of finer sediments. It is likely that more intense sampling in the bay, particularly the outer areas might show less dominance of polychaetes. It is unlikely that the populations in this area will represent more than 10% of the population in the Bay.	3
Secondary Effects	- The breakwaters cause calmer conditions within the Bay 2. - This will reduce the rate of flushing of Bay 2 as it is less open to the sea. Pilings are not expected to have a significant effect on the flushing rate. - The physical presence of the breakwaters and pilings will result in the loss of benthic organisms in the footprint area. Local loss of biomass will not impact regional biodiversity. - These will also create additional substrate for encrusting organisms. The breakwaters over time are expected to provide a range of niches for fish and other species (reef effect) because of the spaces between the boulders. - The boardwalk itself will reduce the sunlight getting to the <840 m^2 of the sea floor. This will further reduce the area available for sea grass.	5
Resilience	There will be mortality (crushing) of benthic infauna, and species that	4

	are not physically removed from the footprint area.	
Persistence:	Long term	4
Reversibility:	Completely with the removal of the breakwaters and pilings	2
Baseline change	The footprint of the breakwaters as rocky extensions of the headland is expected to be a similar rocky substrate to the breakwaters. The presence of pilings would also be similar to storm boulders that are commonly found in Bay 2. The presence of the boardwalks would represent a major change, but over a relatively small area.	3
Manageability	- Corals should be removed from the footprint of the breakwaters and boardwalk areas. - Circulation in the bay needs to be enhanced by the creation of the channel in the headland between Bay 2 and 3 as indicated in the Engineering Design Report.	2
Uncertainty	Actual affected numbers uncertain (impact area used as an indicator)	2
Acceptability:	There are precedents for these types of foreshore encroachments in Jamaica. There is a trade-off in that that the structures are all serve critical functions in the proposed use. The boardwalks are important for creating access, and the breakwaters are important for protecting the bay from wave action.	2
Classification:	**Moderate**	2.8

6.3.1.7 Lowering of the Headland between Bays 2 and 3

This element of the plan is proposed based on the need to increase the flushing in Bay 2. An estimated 200 m^2 of the headland will be lowered to 0.5 m below sea level, separating the headland from the rest of the area, and creating an island. The submarine section of the headland (another 485 m^2) will be lowered to a depth of -1 m.

CRITERIA	ASSESSMENT	Score
Scale:	Very localized.	1
Affected Numbers:	The main receptors are expected to be the inter-tidal communities encrusting on the rocky shoreline around the headland. The area to be lowered to below 50 cm will essentially eliminate the inter-tidal habitat in the affected area. The impacted area estimated to be less than 5% the total available inter-tidal habitat in the two bays.	2
Secondary Effects	This headland area is colonized presently only by halophytic vines and a gastropods due to the extensive salt spray so it is not expected that the excavation will represent a severe ecological barrier. This “island” will be reconnected to the mainland by way of a wooden boardwalk. Birds, gastropods and crustaceans will still be able to colonize the site, as will halophytes. Loss of inter-tidal habitat along the excavated areas	2
Resilience	Encrusting organisms in the affected area will be lost. However, if the available habitat and regional biodiversity is considered, then the ability of the system to cope with this change is very high.	1
Persistence:	The change is expected to be persistent over the long term, The areas around the excavated channel (on the headland and mainland) that are within +.2 m to -.3 m will probably be recolonized by inter-tidal organisms within a few months. Encrusting marine species will probably colonize the areas lower to between 0.5 m and 1m.	3
Reversibility:	The excavated area can be refilled with boulders to its previous elevations.	2
Baseline change	Changes to habitat availability and biodiversity in the intertidal eco-system in the area will be barely measurable.	1
Manageability	No mitigation necessary.	0
Uncertainty	-	0
Acceptability:	The negative effects are relatively small in comparison to the major benefit of this project element: Improved flushing between bays 2 and 3, and improved water quality for the dolphins and human swimmers (public health trade-off). The design element also adds interest to the attraction (bridge, and snack bar).	1
Classification:	**Minor**	1.3

6.3.1.8 Modification of Drainage Patterns

The project plan proposes a diversion to Bay 1c of site run-offs and flows normally exiting to Bay 2. The diversion consists of (a) filling of the back beach area in Bay 2 to a higher elevation, (b) creation of a berm along the back beach area of Bay along the alignment of the drainage swale (c) creation of an earthen drainage swale to transmit storm flows entering the property from the culvert above Bay 2 to Bay 3. The base of the swale is designed to an elevation 50 cm below mean sea level so it is expected to also act as a tidal inlet, allowing for brackish conditions conducive to mangrove growth.

The only other impact on site drainage is expected to arise from the creation of impervious surfaces: roads, buildings, parking lot etc. This has been estimated to represent less than 8% of the site.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	On site (affects Bays 1 and 2).	2
Affected Numbers:	The mangrove and sea grass eco-system of Bay 1 will be affected.	5
Secondary Effects	Increased freshwater, nutrient load and sediment to Bay 1. The Drainage Report (Appendix 4) concluded that the proposed swale should be able to accommodate discharges calculated for the 50-year storm event under present catchment hydrologic conditions. The drainage swale essentially will not retain water but facilitate its transmission to the sea. The fact that the swale will function also as a tidal inlet will serve to control mosquito vectors, and promote mangrove growth on the tidal end. The effect of creation of impermeable surfaces in this area is considered negligible for the following reasons. - The existing permeability in the area is low because of clayey soils and case hardening of the limestone into a concrete like surface in places exposed to salt spray. - < 8% of the site will be used. The remainder will allow for percolation where possible. Only one major car park is planned.	2
Resilience	Much of the sediment being transmitted by the drain is expected to settle in the drain before the discharge exits to the sea grass beds. The mangroves that will be planted on the distal end of the swale will serve the function of trapping sediments. Present nutrient loads from the periodic discharges is expected to be very low as the coastal water nutrient load was found to be very low and there are no obvious sources of nutrient loading in the catchment. The drain is expected to transmit storm water only periodically during high rainfall events. It is expected that due to the length and width of	1

	the swale, much of the freshwater may pond behind the mangrove system (unless there is very high discharge), and be used in processes of evapo-transpiration (the banks of the swale will be landscaped with grass and riparian vegetation). The mangrove and sea grass eco-systems are therefore expected to be very resilient.	
Persistence:	Expected to persist for more than 25 years (lifetime of project)	5
Reversibility:	Completely with removal of structural elements (berm and earthen swale)	2
Baseline change	Very moderate deviation. It is proposed that salinity in Bay 1 be monitored.	2
Manageability	Detention or slowing of freshwater in the swale can be enhanced by creating slight variation in the bottom topography (roughness).	2
Uncertainty	Discharge has been modelled based on existing data sets.	2
Acceptability:	The effect of increased storm discharge to Bay 1 should be evaluated against the need to eliminate freshwater inflow to Bay 2 and the protection of the marine mammals being housed there.	1
Classification:	**Moderate**	2.4

6.3.1.9 Potential increased vulnerability to Storm Winds, Storm Surges

The breakwaters in Bay 2 are designed to protect the created beaches from at least the 50-year storm event. The natural vulnerability of the strip of land that will be left in place behind the excavation area in Bay 3 will be unaltered. These structures are designed to actually reduce the vulnerability of the area to storm waves, so the main vulnerability will be in respect of storm surges, hurricane force winds and earthquakes.

Based on SWAN model outputs, the Coastal Engineering Design Report (SWIL, 2006) found that the maximum surge that could be associated with the 100-year event (1% chance of occurring in any given year) was of the order of 2 m above mean sea level. On the western side of the property the land south of the drainage swale will be generally below 2 m in elevation. Much of the proposed development area around Bay 2 will be built up to the required elevation using fill.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Localized	1
Affected Numbers:	More than 50% of the site occurs below 2 m. Wet, sandy and filled areas (like the back beach area of Bay 2) may be more vulnerable to damage during an earthquake.	4
Secondary Effects	Damage to property Closure of operations during and following a storm Recovery costs	2
Resilience	Serious damage is only expected to be incurred to temporary structures that may not be designed to withstand hurricane force winds. Vegetation is also expected to be damaged during hurricanes.	2
Persistence:	Duration of building and operational life.	4
Reversibility:	Completely with removal of vulnerable elements.	1
Baseline change	Presently the site is vulnerable to these hazards. The breakwaters will actually reduce the risk. However, placement of the buildings will increase the at risk elements. These risks are manageable.	1
Manageability	The permanent buildings that are being constructed (not including Building 3 – the snack bar on the island) will be designed: - in accordance with national codes in respect of hurricane force winds and earthquakes; - with a floor level above the 2 m above mean sea level; and - within Parish Council recommended set backs.	2
Uncertainty	The actual occurrence of natural disasters and the extent of loss that would be incurred.	3
Acceptability:	This risk applies to every coastal site in Jamaica within the storm surge area. Nothing about this site or development makes the risk greater.	1
Classification:	**Moderate**	2.1

6.3.1.10 Increased Heavy Vehicular Traffic Between Montego Bay and Site

During the proposed 15-month construction period there will be an increase in the number of vehicles moving between the site and supply area (probably Montego Bay). This will be cumulative unless the Fiesta Hotel is completed before construction at Dolphin Cove Paradise starts up. There may also be an increase in commuter traffic associated with workers coming to the site.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	The effect of this will be felt along the transportation corridor (regional).	4
Affected Numbers:	The main receptors will be communities located along the corridor. It is expected that less than 10% population in the area in general will be impacted.	3
Secondary Effects	- Wear and tear on the roads. - Congestion in built up areas, particularly during peak hours - delays - Road safety issues - Nuisance noise, vehicular emissions and fugitive dust	3
Resilience	Communities living along major road ways become used to the vehicular traffic nuisances. The wear and tear on the roads is within the normal range that will be addressed by municipal maintenance.	2
Persistence:	15 months	3
Reversibility:	Complete with cessation of activities.	1
Baseline change	Moderate increase that will be noticeable because it is cumulative with the effects of the Fiesta development.	2
Manageability	Haulage contractors will be required to: - have the necessary axel fittings to spread the load; - operate within the off-peak times as much as possible; - observe road safety and speed limits in built areas; - maintain their vehicles to avoid excessive smokiness; and - wash vehicles and cover loads to reduce fugitive dust.	2
Uncertainty	The actual number of trucks and haulage trips that will be made during the period.	3
Acceptability:	This is a normally accepted impact associated with any major development. With the suggested mitigation measures it is generally acceptable to most stakeholders.	2
Classification:	**Moderate**	2.5

6.3.1.11 Demand for Quarry Products

It has been estimated by the engineering design team that 1570 m^3 of armor stones will be needed. In addition, 3000 m^3 sand will be needed for nourishing the beaches. Fine aggregate (undetermined quantity) will also be needed for any concrete and masonry work.

CRITERIA	ASSESSMENT		Score
Scale:	The demand will impact the availability of the resource as well as the source area.		4
Affected Numbers:	Stone and aggregate will be sourced from existing quarries, with proven yields. Stone is not in short supply in Jamaica. The sand in the area is not white sand, but a mixed clastic carbonate sand with less than 40% carbonate. Carbonate sands may exist offshore of other areas where there are carbonate beaches. In general carbonate sand bodies offshore do not support dense marine populations as they are highly mobile. Therefore the receptors associated with dredging offshore sands may be relatively small. If the sand is sourced from on land (crushed stone, river or relict dune sands), it will be sourced from an area where quarrying is permitted, and therefore, adequate controls will be in place to minimize impacted receptors.		2
Secondary Effects	<u>Offshore Effects</u> - Vibration in the water column - Some burrowing organisms may be taken up. - Potential for increased TSS. - If done too close to shore (within closure depth) there could be potential for beach erosion.	<u>Onshore Effects:</u> - Noise associated with use of the back hoe and front end loaders. - Dust near quarry. - Possible need to remove vegetation over deposits	3
Resilience	In the case of offshore sources, biodiversity will not be impacted by the removal of 3000 m^3 of sand. This sand is being produced continually in the marine environment, and is considered a renewable resource. In the case of onshore effects: receptors around quarries are expected to be able to cope with the effects.		2
Persistence:	The demand and associated indirect effects are expected to last for a short period.		1
Reversibility:	n/a		
Baseline change	The demand for these resources is cumulative as there are many other on-going and proposed developments with similar or greater requirements.		2
Manageability	Sustainable sourcing of stone and sand can be easily managed with the implementation of standard best quarrying and dredging practices.		2
Uncertainty	Specific sources are as yet undetermined.		5

Acceptability:	Any offshore dredging proposal will require a separate Beach License under the Beach Control Act. An application will be submitted once a plan has been formulated, if this option is to be taken. Licensed quarries will be used to supply stone, aggregate and possibly sand.		1
Classification:	**Moderate**		2.4

6.3.1.12 Consumption of Lumber

The development proposal calls for a considerable amount of lumber to be used in the boardwalk (840 m^2). In addition an undetermined quantity of lumber will be needed in the construction of buildings and scaffoldings. This lumber will be sourced from an approved supplier of cut lumber, and is most likely to be imported.

CRITERIA	**ASSESSMENT**		**Score**
Scale:	Onsite and offsite (at source)		3
Affected Numbers:	n/a		
Secondary Effects	Carbon footprint of the site is increased by the consumption of wood. Trees used to create lumber (assumed to be from an approved forestry area).		2
Resilience	n/a		-
Persistence:	Renewable sources.		3
Reversibility:	The carbon footprint of the project is to a large extent offset by the acres of trees and grasses that are going to be preserved.		1
Baseline change	Barely measurable.		1
Manageability	The source of the lumber should be checked to ensure that the supply is sustainable.		1
Uncertainty	-		
Acceptability:	This is a normally accepted effect of development.		1
Classification:	**Minor**		1.5

6.3.1.13 Importation of Dolphins into Jamaica

Dolphin Cove intends to apply for a CITES import permit initially to import 6 dolphins from Cuba, and later on to possibly import another 6 (and/or relocate some of the animals at the Ocho Rios facility). Importation and transportation of the dolphins will be done in accordance with the laws of Jamaica and best available international practices, and under the careful supervision of an experienced marine mammal veterinarian, and trained dolphin handlers.

It is important to bear in mind that this EIA is not required to return a judgement on the morality or even sustainability of the practice of collecting dolphins from the wild. The dolphins that are imported from Cuba are not collected specifically for Dolphin Cove in Jamaica, and will be sold to other buyers if Dolphin Cove does not get an opportunity to purchase them. These other buyers compete directly with Jamaica in terms of attracting hotel guests and cruise ships with alternative swim with dolphins programmes being set up in several Caribbean islands that depend heavily on tourism.

The importation of bottlenose dolphins is neither illegal in Jamaica, nor banned by CITES. Bottlenose dolphins fall under Appendix II of CITES, which pertains to "*all species which although not now threatened with extinction, may become so if trade in specimens of such species is not subject to strict regulations in order to avoid utilization which may be detrimental to their survival".* Provided that the Management Authority (NEPA) is satisfied that the imported specimen will not be used for purposes detrimental to its survival, and that the applicant is suitably equipped to house and care for the specimens, an import permit may be issued. CITES does not make any provision for consideration of animal rights issues. In the scientific community, animal rights issues are not related to environmental impact issues.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Importation of dolphins into Jamaica affects source populations and the viability of the international supply of dolphins.	4
Affected Numbers:	The main receptor of this impact is the viability of the source population. The Cuban authorities routinely conduct stock assessments (which Dolphin Cove has previously submitted to NEPA) to ensure that the collection of dolphins from the wild does not result in depletion of stocks, or in the viability of the population (in terms of the age and sex of the specimens that are ultimately collected). The US uses the Potential Biological Removal (PBR) index to determine the viability of harvesting (NOAA, 2003). PBR is calculated as the product of the minimum population size, one half of the maximum net productivity and a "recovery factor". The latter accounts for endangered, depleted or threatened stocks and uncertainties. Using a minimum population size of 20,414 and a default maximum net productivity rate for cetaceans of 0.04 (4%) and a recovery factor of 0.5, the PBR of 204 is calculated for the bottlenose dolphin population in the northern Gulf of Mexico. The PBR for cetaceans works out to be 1% of the population.	2

	Cuban scientific authorities (CITES) use a similar method to determine the maximum number of dolphins that can be collected, and this is assumed to be less than 1% of the population.	
Secondary Effects	Importation of 12 dolphins by Dolphin Cove for the Hanover Project will not result in the depletion of coastal stocks in Cuba. These animals will be sold to competing buyers if Dolphin Cove does not buy. However, by being in the market for dolphins, Dolphin Cove contributes to the viability of the practice of harvesting wild dolphins in general.	3
Resilience	It is assumed that once less than 1% of the population is harvested annually, the viability of the population will not be compromised. However, there can be no real guarantee of this as there are many uncertainties with the methods now used internationally in respect of stock assessments.	3
Persistence:	Dolphin Cove's involvement in the international trade in dolphins as it relates to the Hanover project may last as long as the company is not able to develop a sustainable captive breeding programme in Jamaica. Dolphin Cove submitted such a proposal to NEPA for consideration in 2001. To date there has been no decision on this matter.	4
Reversibility:	Cetaceans removed from the wild are not easily reintroduced. Once dolphins are imported into Jamaica from other countries, national policy and standards require that they be kept in enclosed facilities and not mix with local populations. If the attraction is closed, the dolphins will either be relocated to Ocho Rios or re-exported to another country.	2
Baseline change	Dolphin Cove has a population of 14 dolphins plus 2 in Montego Bay (Half Moon). Importation of 12 dolphins will almost double the number of animals under their care.	3
Manageability	CITES has 2 requirements: 1. That the imported specimens are not used in a manner that threatens their survival, and 2. That the applicant can adequately house the specimens (in accordance with existing standards and guidelines). If the importation of dolphins is permitted, Dolphin Cove will be required to demonstrate that both these conditions are satisfied through a Quarterly Reporting process which involves declarations on the health and well-being of the specimens, environmental quality of the dolphins' living space, and general compliance with the national standards and guidelines for operating dolphin facilities in Jamaica. Representatives of the CITES management and scientific authorities, and representatives of NRCA are also given the authority to inspect the operations at any time to ensure that the conditions are being satisfied.	2

Uncertainty	There is uncertainty in terms of the actual number of dolphins that will be required to sustain operations over the lifetime of the project if no breeding programme is adopted. After the initial 12 are imported, further importation will depend on the rate of birth and mortality in that population. These dolphins represent major investments and are given the best available living environment, care and veterinary treatment. However, dolphins, like other living things, have finite life spans (~50 years), and get old or sick. There is no scientifically valid way to predict the turn over of dolphins.		5
Acceptability:	Although there is a minority that brings animal rights issues into play, the following realities must be taken into consideration. - No laws are being broken. Importation will be done in accordance with established internationally sanctioned protocols. - The operations can be managed to ensure that the animals are properly accommodated and cared for. Marine mammal parks are operated in many developed countries, including the USA. They are generally acknowledged for the role they play in increasing public awareness about cetaceans and creating opportunities for studying the pathology of these animals. Both of these ultimately benefit conservation efforts in respect to wild populations. - The overwhelming majority (97%) of the community in which the facility is being proposed think it is important for it to be implemented. - If Jamaica does not continue to be viable and offer the range of tourism attractions offered in other Caribbean destinations, the country will not be positioned to compete effectively in the market.		2
Classification:	**Moderate**		3.0

Site Development and Construction Phase (Positive)

6.3.1.14 Modification of Natural Vegetation

Much of the site vegetation will remain completely unaltered. The basic landscaping concepts include the following.

1. Landscaping only in recreational use areas. This will involve planting of ornamental coastal plants that are indigenous to the region. There shall be no addition of fertilizer or pesticides.
2. Mangroves will be planted behind the existing mangrove stand in Bay 1 and along the distal end of the drainage swale. This may need to be thinned out from time to time to ensure the swale is functioning properly and flooding does not become a problem.

3. A dry limestone forest species will be planted as shown in Figure 2. These will be sourced from coastal areas in St. Ann and Trelawney where these ancient forests are rapidly being replaced by resort land use. To some extent, there is a relic of this immediately west of Bay 2. No soil or irrigation will be needed (see Figure 39 below). There shall be no addition of fertilizer or pesticides. It is proposed that there will be no landscaping of this area except in respect of trail maintenance.

   The site is actually underlain by limestone, and has a typical coastal annual rainfall. The present vegetation at the site represents a disturbance and deviation from what would have been there before humans colonized the area. It is conceivable that the areas now under grass may have been originally under forest, and thin limestones in dry coastal areas in northern Jamaica tend to develop this type of succession. The vegetation in the forest is expected to take 10 to 15 years to reach a secondary level of maturity.

This is interpreted as a positive impact.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Limited to project site	1
Affected Numbers	The main receptors will be biodiversity, birds and insects. Visitors (estimated to be 400 per day)	2
Secondary Effects	Preservation of 1.2 to 1.5 acres of dry limestone forest – creation of habitat, reinstatement of biodiversity and carbon sequestration. Creation of an opportunity to increase visitor awareness of the eco-system. Expected to affect several trophic levels and generations.	4
Resilience	Receptivity of the visitors will be enhanced by signage and trained tour guides. Full benefit will not be possible for a few years until the forest is more mature.	3
Persistence:	Long term effect	4
Baseline change	Major improvement to existing conditions as much of the shoreline in this area has lost its natural vegetation structure.	4
Uncertainty	Uncertainty in respect of specific source of saplings.	2
Classification:	**Moderate**	2.9

Figure 39 Examples of the Dry Limestone Forest

a/ A cave in foreground with tree species to the back – note absence of significant soil substrate.

b/ mature trees growing on limestone – natural forest (no irrigation or fertilizer) – photos taken along the highway in Trelawny.

6.3.1.15 Construction Employment

During the construction phase it is expected that there could be as many as 90 persons employed in the short term on the project. These persons will range from very skilled professionals (e.g. site supervisor, carpenters, electricians, divers etc.) to unskilled persons (laborers). This is interpreted as a positive impact. In addition, there will be demands for the supply of food and beverages to support the construction camp.

There are also going to be undetermined earning opportunities for suppliers of goods such as lumber, stone, ready mixed concrete and other construction materials.

This is interpreted as a positive impact.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Off site	3
Affected Numbers:	The 2001 Census estimated that there are 7200 unemployed persons in the parish, which was about a quarter of the labour force for Hanover. Temporary employment of ~90 persons will impact directly on 1.3% of the unemployed labour force in Hanover.	2
Secondary Effects	Minor stimulation of the local economy.	1
Resilience	Unemployed persons will benefit directly, but for less than 15 months.	4
Persistence:	Less than 15 months.	3
Baseline change	Barely measurable change.	1
Uncertainty	Some workers may come from outside of the parish.	4
Classification:	**Moderate**	2.5

Operational Phase Impacts (Negative)

6.3.1.16 Change in Air Quality

With the estimate of ~400 persons per day, it can be estimated that there could be as many as 20 20-seater buses traveling between Montego Bay and the site, and Negril and the site. In addition, with 90 to 100 staff members, there could be as many as 20 to 30 commuting vehicles along the main corridors. These vehicles will contribute to combustion emissions along the transportation corridor that include carbon monoxide, SOx, NOx and particulates.

CRITERIA	ASSESSMENT		Score
Scale:	Off site.		3
Affected Numbers:	It is unlikely that specific receptors will be impacted by air quality changes arising as the concentrations will be too low.		0
Secondary Effects	Contribution to cumulative emissions that affect the pH of rain, particulates in the air and global temperatures.		1
Resilience	No specific receiving population.		0
Persistence:	These emissions are widely dispersed but persist in the atmosphere.		3
Reversibility:	Not possible.		4
Baseline change	Not measurable.		1
Manageability	Use of unleaded fuels. Car pooling or provision of a commuter bus for staff.		2
Uncertainty	Actual quantities cannot be determined.		3
Acceptability:	Generally acceptable effect.		
Classification:	**Minor**		1.7

6.3.1.17 Changes to Micro-climate

Generally when there is development of previously un-used lands, there are micro-climate changes. These changes arise as a result of the increase in surfaces that retain heat such as paved areas. In addition, there will be heat associated with air conditioning units, and restaurant kitchens.

CRITERIA	ASSESSMENT		Score
Scale:	On site		1
Affected Numbers:	No specific populations affected		0
Secondary Effects	Increased humidity.		1
Resilience	-		0
Persistence:	As long as structures are in place and air conditioners operate.		4
Reversibility:	Complete with removal of structures.		1
Baseline change	Barely measurable in the vicinity of structures.		1
Manageability	Not really necessary.		1
Uncertainty	Actual increase in temperature and humidity is uncertain.		4
Acceptability:	Generally acceptable, especially given the prevalence of strong day-time breezes in this area.		1
Classification:	**Minor**		1.4

6.3.1.18 Increases in Daytime Noise Levels

It can be expected that music will be played in the beach areas of the attraction and a public address system (to advise participants about their programmes), at maximum level of ~85 dBA, which should reduce to ~67 dBA in 80 m of the source. The berm should also serve to reduce some of the noise. The forest area should also act a buffer between the recreational area and the bird sanctuary. No motorized water sports will be done at the site.

CRITERIA	ASSESSMENT	Score
Scale:	On site	1
Affected Numbers:	This music is unlikely to be considered nuisance noise by persons at the attraction. Persons in passing vehicles are unlikely to hear it. Bird populations in the mangrove swamp will be unaffected as the sanctuary is located >200 m from the likely location of the music source and public address system. There are no adjacent noise sensitive receptors.	0
Secondary Effects	-	0
Resilience	-	0
Persistence:	Operational hours only.	1
Reversibility:	-	0
Baseline change	Significant at the site as vehicular noise is relatively minor in the coastal area.	4
Manageability	None necessary.	0
Uncertainty	-	0
Acceptability:	Generally acceptable for attractions.	0
Classification:	**No Impact/Negligible**	0.6

6.3.1.19 Coastal Water Quality

BOD (associated with excreta from the dolphins) is expected to increase marginally. Baseline levels were generally below 1 mg/l. NEPA has set a limit of 1.4 mg/l for the dolphin facilities elsewhere.

Faecal coliforms from human bathers and dolphins. The development does not propose to discharge any sewage effluent into the marine environment so this will not be a contributing factor. In general faecal bacteria die off in sunlight and saline conditions. Baseline levels were very low (less than 10 mg/l). A bather standard of 200 MPN should be maintained.

Phosphates are not expected to impact on the coastal area as grey water and site run-offs will be routed through the drainage swale, which is expected to allow for vegetation uptake of nutrients. Phosphate levels were relatively low (less than 0.1 mg/l).

Oil and grease are not expected to impact on the coastal area as grey water will be routed through grease traps, Baseline oil and grease levels were as high as 9 mg/l in Bay 2.

Nitrogen from the urine and excreta from dolphins in Bay 2. Urine from kept fish such as sharks and sting rays would also tend to increase the nitrogen loading. Smith Warner International Ltd. estimated that 12 dolphins are likely to produce a maximum of 540 g of Nitrogen. Taking a very conservative approach, and only using the volume of water in the dolphin area (2000 m^2 by 3 m), there would be a daily loading of 540 000 mg of nitrogen in 6,000,000 liters of water (6000 cubic meters). This gives an initial concentration of 0.09 mg/l of total N. In reality there would be much more water in this bay as the water outside the dolphin area is in continuity with it. This concentration should be compared to the measured baseline concentration of 6.5 mg/l found in Bay 2 during this study.

The addition of nitrogen would be cumulative and variable. There would also be significant flushing of the bay from tides (with at least a 30 cm tidal exchange). The tidal exchange effect in the dolphin area would account for 0.3 m by 2000 m or 600 m^3 (600,000 liters). Tidal exchange is therefore expected to affect 10% of the water in the dolphin area. The coastal engineering design report predicts that the excavation of a channel between bays 3 and 2 will produce greatly enhanced flushing in Bay 2. The model (SWIL, 2006) predicts near complete flushing within 12 days. It is expected that sea grasses in the western side of the bay (Rock Pool) and any that recolonized the dolphin area itself will assimilate some of the nitrogen that is produced.

CRITERIA	ASSESSMENT	Score
Scale:	Mainly limited to bays 1 and 2, but could affect a wider area due to currents and flushing of the lagoons.	3
Affected Numbers:	The marine communities in bays 1 and 2 would be most directly impacted. Offshore areas would experience lower concentrations and the impact may not be measurable.	4
Secondary Effects	Increases in BOD would impact on the availability of oxygen in the bay for aquatic life. Increases in total nitrogen could have the following secondary impacts. - Increased turbidity from increased concentrations of chlorophyll. - Changes in the structure of the sea grasses and algae community. - Possible increases in the amount of fleshy algae on corals. - Possible reduction of available oxygen for aquatic life.	5
Resilience	The dominance of sea grasses and the density of sea grasses in this area is expected to result in significant assimilation of nitrogen. Corals are relatively sparse in these bays. Nitrogen loading in the open marine areas offshore is expected to be greatly diluted so that offshore reefs and macro-infauna are not expected to be impacted. Reefs offshore the Ocho Rios facility have been monitored over the past few years, and no major shifts towards fleshy algae (over calcareous) have been noted. However, it is recommended that annual surveys of the status of offshore reefs in respect of invasive fleshy algae be undertaken.	4
Persistence:	Life time of the project (25 years)	5
Reversibility:	Effects on water quality can be rapidly reversed. However, effects on aquatic community structure may be much less likely to be reversed.	4
Baseline change	Nitrogen loading in the bay is already relatively high. Addition of dolphin nitrogen may lead to a measurable change in total nitrogen and possibly BOD. Change in faecal coliform may be detectible as well depending on the time of day of sampling.	4
Manageability	Monitoring activities should establish the effects with 6 dolphins in the first year, and should allow for better decision making in respect of additional animals in this system.	3
Uncertainty	Actual changes unknown so worst case scenarios have been used to estimate changes.	3
Acceptability:	Nitrogen loading in coastal waters is generally expected to be within limits, as the dolphins are not likely to release more nitrogen than a coastal golf course.	3
Classification:	**Moderate**	3.8

6.3.1.20 Harvesting or Keeping of other Animal Species (Not protected or endangered)

The Ocho Rios facility keeps parrots (macaws and yellow billed parrots), snakes and iguanas for public display. In addition, there is a shark feeding programme and sting ray interaction programme. Other marine animals may also be on display. At this stage of the development of the concept, final decisions have not been made in respect of what other animal species will be on public display at the Paradise attraction. There has been some indication from the developer that this park will be more focused on the marine aspect, with the exception of the nature preserve on the western side. Sting rays are the most likely to be harvested for display purposes. Sting rays will be de-barbed and kept in a fenced enclosure near to the western part of the beach in Bay 2.

CRITERIA	ASSESSMENT	Score
Scale:	Regional effect on the population of sting rays.	4
Affected Numbers:	Approximately 20 sting rays will be collected from the wild. This is expected to be less than 1% the total population on the north coast.	1
Secondary Effects	Sting rays in the enclosure may add to the total nitrogen loading in the waters.	2
Resilience	It is uncertain what effect this will have on the population but as sting rays are not endangered, it is unlikely it will affect the viability of the population.	1
Persistence:	Short term	1
Reversibility:	Completely with the release of the rays.	1
Baseline change	Barely measurable.	2
Manageability	None necessary.	0
Uncertainty	Stocks of sting rays on the north coast.	3
Acceptability:	A fisheries permit is required to harvest sting rays from the sea.	1
Classification:	**Minor**	1.6

6.3.1.21 Potential for Pests and Vectors

The storage of food and garbage associated with kitchens and restaurants creates the potential for public health pests such as rodents and cockroaches.

CRITERIA	ASSESSMENT	Score
Scale:	On site.	1
Affected Numbers:	Pests such as these could affect consumers of food on property, which may be ~50% persons coming on a daily basis.	4
Secondary Effects	Illness related to food contamination. Decline in visual aesthetics.	2
Resilience	Variable depending on the contamination and the persons consuming contaminated food.	3
Persistence:	Potential exists during operations.	4
Reversibility:	Completely with removal of conducive conditions.	1
Baseline change	May be moderately measurable.	2
Manageability	Easily managed with the implementation of proper food storage measures and hygienic garbage collection and storage until collection and disposal. Food handlers should have the required permits to avoid contamination.	2
Uncertainty	The actual incidence of pests is unknown.	4
Acceptability:	Generally acceptable risk with implementation of the appropriate mitigation measures.	2
Classification:	**Moderate.**	2.5

6.3.1.22 Loss of Amenity to Fishermen at Paradise

According to the Fisheries Department records, Paradise, Hanover is a fish landing beach, and there are 4 registered fishermen and 1 registered fishing vessel associated with the area. The proposal will vastly change the land use at Bays 2 and 3, and is seeking to take measures to prevent disturbance of the sanctuary in Bay 1. The proposed land uses at Bays 2 and 3 are generally incompatible with fish landing, so this activity will be discouraged by the owners of the property above the high water mark. Landing at Bay 4 will be unaffected.

CRITERIA	ASSESSMENT	Score
Scale:	Localized to the bays on the property	1
Affected Numbers:	One to four out of a population of 186 fishermen registered to operate between Lucea and Mosquito Cove. This is 2%.	2
Secondary Effects	Loss of amenity will result in the fishers at Paradise having to move to another landing site in the area, and adjust to working out of the new area. They may move to Bay 4, or to one of the nearby landing sites (Lucea, Elgin Town, Mosquito Cove).	1
Resilience	No real loss of revenue is predicted although the loss of amenity may represent a nuisance as the fishermen are used to this area.	1
Persistence:	Over the duration of the project	4
Reversibility:	Completely with cessation of activities	1
Baseline change	The fishermen in the areas around the site have generally been undisturbed by development activities. The loss of this one site will not represent a significant loss as there are several other suitable landing sites in the area, that are easily accessible.	2
Manageability	The developers may wish to consider offering alternative employment to the fishermen who may be displaced by the development at Paradise. The FAO reports that fishing is a last resort job, so there might be an option for discussing alternatives, and a benefit to the developers to employ persons who know the sea conditions and fisheries in the area very well (e.g. to collect sting rays and to help attract fish to the proposed rock pool). The collection of sting rays will require that persons involved in this activity be registered as well as their vessel for fishing.	2
Uncertainty	It is uncertain how many fishermen actually use the beach at Bay 3. Only one has been observed on several visits to the site. Only 4 are registered.	3
Acceptability:	Although displacement of persons using the beach is not something that is happily done, the following must be considered. - There is a very good chance for mutual benefit through alternative employment of these persons so that there is no loss of income, and probably an increase of such. This will not require a significant adjustment in the skills set of the fishermen as it is a marine based attraction. - Artisanal fisheries in the Jamaican are based on exploitation of coral reef finfish, which are reported to be in a state of severe over-exploitation according to the FAO. Employment of fishermen in alternative activities that do not deplete stocks of coral reef fish such as the parrot fish will be of benefit to the environment. - There are alternative sites very close by if the fishermen choose not to make the change.	3
Classification:	**Moderate**	2.0

Operational Phase Impacts (Positive)

6.3.1.23 Creation of Jobs & Earning Opportunities

In its operational phase, Dolphin Cove Paradise will offer approximately 90 jobs, plus other opportunities to provide services and goods related to tourism (such as entertainment, drivers, tour companies, craft makers etc.).

CRITERIA	ASSESSMENT	Score
Scale:	Widespread effects into communities in the hinterlands of the parish and beyond.	5
Affected Numbers:	More than 1% of the unemployed labour force may be impacted.	3
Secondary Effects	Long term improvement in the earning potential of employed persons, and general quality of life. Increased revenues to the government from payment of taxes by formal employer.	3
Resilience	Although people may be unemployed, there is a need to develop the required skills. Until this can be done, there may be a need to fill vacancies with persons from outside of the parish.	2
Persistence:	Over the lifetime of the project	4
Baseline change	Measurable effect.	3
Classification:	**Moderate**	3.3

6.3.1.24 Effects on Regional Tourism Development

Creation of a major tourism attraction in Hanover is regarded as a positive socio-economic impact of regional and national importance.

CRITERIA	ASSESSMENT	Score
Scale:	Regional to national	4
Affected Numbers:	More than 1% of the population may benefit.	3
Secondary Effects	Stimulation of the Lucea economy by attraction of visitors, and development of tourism related activities. Creation of alternative recreational opportunity (diversification) for visitors and locals alike. Dolphin Cove has an inclusive policy that encourages locals to experience the facilities at a greatly reduced rate. Fostering of community based tourism. Encouragement of cruise lines to come to Montego Bay as a port of call because of the availability of a highly sought attraction. Encourage of other attractions and hotels around this area. Increased taxes to local government for the development.	5
Resilience	Things will have to be put in place to optimize the benefits.	2
Persistence:	Duration of the project	4

Baseline change	Moderate changes. No study has been done on the effect of Dolphin Cove in Ocho Rios in stimulating tourism but it has been suggested that the effects have been significant. It is suggested that Dolphin Cove in Paradise has the potential to act a tourism growth pole in the region along with the Fiesta Hotel, and proposed community and heritage developments in the Tourism Master Plan (for Lucea).		3
Uncertainty	Actual effects are unknown		3
Classification:	**Significant**		4

6.3.1.25 Land Use Change

The site is presently under grass. There is no evidence of recreational use at the beach. A single fishing shack is located near to the beach at Bay 3, and there is an informal banana plot near the road side. The proposed use will be a dramatic change of use from the present uses.

Physical planning objectives for this area are defined in the Hanover Coastal Development Order, which zones this area for resort use. The first major resort usage in the area is the proposed 2000-room Fiesta Hotel, located at Point District. The NHT owns the Paradise lands as well as the lands on the other side of the road, so it is possible that the area may be further developed for residential usage. The proposed development will consistent with these uses.

CRITERIA	**ASSESSMENT**		**Score**
Scale:	Site land use change		1
Affected Numbers:	n/a		-
Secondary Effects	Increases in land values in the area due to adjacent tourism usage. Provides additional recreational opportunities for locals and visitors.		2
Resilience	n/a		-
Persistence:	Long term		4
Baseline change	Over 80% of the land will remain under its present cover.		2
Uncertainty	Changes to land values in the area.		2
Classification:	**Moderate**		2.2

6.3.1.26 Creation of the Nature Preserve

The development proposes to create a nature preserve on the western side of the property which consists of a reforestation project on 1.5 acres, a mangrove preserve that will function as a bird sanctuary, and a sea grass preserve that will function as a fish sanctuary/nursery. It is proposed that some replanting of mangroves will be done in the distal end of the swale, and of suitable forestry species. The sea grasses will be protected by the placement of buoys and rope across the entrance of Bay 1. This preserve will be the first of its kind in Jamaica, as it will be integrated into the proposed development.

CRITERIA	ASSESSMENT	Score
Scale:	On site, but will have effects in the wider marine eco-systems	3
Affected Numbers:	~ 10% of the overall area available to the developers is being used for this purpose.	3
Secondary Effects	Increased biodiversity in the forested area Carbon sequestration in the mangroves, sea grasses and trees Safe habitat for shore birds and other coastal faunas Nursery for fish Preservation of protected species: sea grasses and mangroves Opportunity for increasing public awareness of the importance of these eco systems	4
Resilience	Time will be required to reach full potential. The project will also require a sustained level of commitment from the developers.	3
Persistence:	Long term	4
Baseline change	There is already a healthy mangrove and sea grass system there. Very little coastal forest remains in this area.	2
Uncertainty	99% confidence in the validity of the predicted outcomes	5
Classification:	**Significant**	4

The fore-going assessment of impacts found a total of 14 site development related negative impacts and 7 operations related negative impacts (see Table 38 for summary). The highest ranked negative impact was the possible effect on coastal water quality during the operational phase, which can be cost effectively managed and monitored. It also is an impact that would occur with most other changes in land use from the *status quo* (discussed in the next section). The second highest ranked negative impact (importation of dolphins into Jamaica) scored 3.0. This particular impact scored relatively higher than expected because of the uncertainties involved in making the assessment. All of the other negative impacts were scored below 3.0 in terms of their effect level.

There were a total of six positive impacts (2 in the site development phase and 4 in the operational phase). The most significant impacts were found to be the effects on tourism and the creation of a nature preserve (both scoring 4.0). The next most important positive effect was related to the creation of jobs and earning opportunities (3.3) as expected by the majority of stakeholders that have been interviewed. The impacts of modification of the natural vegetative cover scored 2.9, and land use change scored 2.2.

Table 38 Summary of Impacts

Score	Classification	Negative`	Positive
>4	Significant		*Effects on Regional Tourism* *Creation of the Nature Preserve*
3.0 to 4.0	Higher Moderate	*Decreased coastal water quality* Importation of dolphins into Jamaica Decreased coastal water quality Change to the oceanography Consumption of land fill Deepening the sea floor in bays 2 and 3 Increased vehicular traffic	*Creation of Jobs & Opportunities* Modification of natural vegetation
2.0 to 3.0	Low Moderate	*Potential for Pests and Vectors* Modification of drainage patterns Demand for quarry products and sand Increased site vulnerability to storms Change to the configuration of Bay 2 *Loss of amenity to fishermen* Nuisance Noise Change to air quality Consumption of lumber	Construction employment *Land Use Change*
1 to 1.9	Minor	Lowering of the headland *Change in air quality* *Harvesting or collection of other animals* *Change in micro-climate*	
<1	Negligible	*Increased day time noise levels*	

Operational impacts are shown in blue italics.

It is the finding of this assessment that there are no ***significant*** negative impacts associated with the project, according to the definition of significance described at the beginning of this section, and the pre-set criteria for determination of the effect level of impacts. The negative impacts that have been found can be cost effectively mitigated as given in the fore-going tables. Provision is made in the Environmental Management Plan (this EIA) for the monitoring of these proposed mitigation measures, and the validity of the predicted impacts.

7 ANALYSIS OF ALTERNATIVES

7.1 EIA OBJECTIVE

The purpose of this section of the EIA is to examine feasible alternatives to the project and highlight the benefits of and general rationale for the project that need to be considered against any potential environmental cost. It outlines in a balanced way, the wider societal benefits of the development proposal that could arise if the environmental permit is granted.

7.2 LAND USE ALTERNATIVES

Feasible land use options are compared below in terms of lowest costs and most benefits criteria which include environmental aspects, social acceptability, economics and engineering feasibility. The following land use options are considered: (1) leaving the land as it is (*status quo*); (2) the proposed tourism attraction; (3) golf course; and (4) housing development.

1. **The No-Action or Status Quo Alternative**: Under this alternative, the 20-acre property will be left in its current state without any development. The main benefits of leaving the land in this state include maintenance of good coastal water quality, and not disturbing the benthic eco-systems in the bay. However, this selection of this option would result in an opportunity cost that could be significant, given the advantages of developing the site.
2. **Tourism Attraction (Proposed)**: Although there are a number of negative impacts (described in the previous section) none has been found to be significant or unmanageable. The benefits of the project include: creation of earning opportunities, tourism development, and creation of the proposed nature preserve, which have been ranked as relatively more significant than the negative environmental impacts of the project.
3. **Golf Course**: Given the expanse of gently sloping land and its zoning for resort usage, it is conceivable that this area could be developed in part or whole as a golf course. Construction impacts would involve considerable earthworks to reshape the topography. The natural grass would be replaced with a more suitable species. There would be massive demands on irrigation water, and inputs of fertilizer and pesticides to maintain the golf course, with minimal earning opportunities being created. Although there would be no direct impacts on the marine eco-systems, the impact on water quality would be probably much more significant than the housing of 12 dolphins in Bay 2. A golf course in Jamaica uses of the order 3400 kg of fertilizer per month (USAID, 2005), which averages more than 100 kg per day. A low nitrogen fertilizer would have a ration of Nitrogen-Phosphorus-Potassium (N:P:K) distribution of 1-1-2, although it is more typically 2:1:3. This means that there would be at least 25000 g per day of Nitrogen added. Although most of this would be assimilated by the grass, it can be expected that

there would be some leachate to the marine environment, and this would be greater than 540 g expected to be generated by the dolphins each day. There would also be a loss of amenity to the fishermen who use the area.

4. **Housing Development**: The site is presently owned by the NHT, and is located within 30 minutes of Montego Bay along the North Coast Highway, with easy access to water and electricity. Therefore the side would be suitable for development for residential purposes. Assuming the same 20 acres are developed, with medium to low density housing (1/3 acre lots), there could be between 50 to 60 lots, depending on how much space central services occupied (sewage treatment, landscaping, access roads and parking areas). The estimated percentage of built area would move from less than 8% to close to 30% of the site under this scenario. It is expected that evaporative tile field would also be used for this type of development. Creation of earning opportunities is not expected to be significant in a residential community.

The land use options outlined above are compared in terms of potential benefits and costs using a range of desirable scenarios or normative criteria. A rank of number 1 indicates that the option is best suited to satisfying the criterion, and a rank of 4 indicates that the option is least suited to satisfying the criterion. The option scoring the lowest total score may be regarded as the most suited overall. Although the scores are un-weighted (assuming all to be of equal importance), ten sets of costs and ten sets of benefits were included to ensure a balance. Additionally, as it is a ranking system, each option must be given a score of at least one, although two options could tie with the same rank.

Table 39 Comparison of Alternative Land Uses (Most Benefits)

Normative Criteria (Most Benefits)	RANK			
	Status Quo	**Dolphins**	**Golf**	**Housing**
1. Most productive land use (value)	4	1	2	3
2. Most earning opportunities	4	1	3	2
3. Best alignment with national plans/zones	4	1	1	1
4. Best scenario for regional biodiversity	2	1	3	3
5. Most preservation of green space	1	3	2	4
6. Most socio-economically needed	4	1	3	2
7. Most feasible use for existing conditions	1	3	3	2
8. Most cost effective mitigation potential	1	2	4	3
9. Best diversification of sustainable tourism	3	1	2	3
10. Best opportunity for social development	4	1	3	2
	28	15	26	25
Overall Ranking	4th	1st	3rd	2nd

Table 40 Comparison of Alternative Land Uses (Least Costs)

Normative Criteria (Least Costs)	RANK			
	Status Quo	**Dolphins**	**Golf**	**Housing**
1. Least development cost	1	2	2	4
2. Least opportunity cost	4	1	3	2
3. Least impact on air and climate	1	2	2	4
4. Least impact on water quality	1	3	4	2
5. Least direct impact on marine communities	1	4	2	3
6. Least impact on informal users of land/sea	1	2	2	2
7. Least carbon footprint	1	3	2	4
8. Least fuel consumption	1	3	3	4
9. Least pressure on municipal resources	1	2	3	4
10. Least vulnerability to natural disasters	1	3	2	4
Total	13	25	25	33
Overall Rank	**1st**	**2nd**	**2nd**	**4th**

In terms of most benefits (Table 39) the proposed option was ranked highest overall. The other three options were clustered. In terms of least costs (Table 40), the proposed option was ranked second, after the status quo option, and is therefore considered the best option for change of use.

7.3 DOLPHIN RELATED ALTERNATIVES

7.3.1 Alternative Scales

Given the concern with nitrogen loading and its potential impacts on the structure of marine aquatic communities, having 6 dolphins would be better than 12. However, the bay can easily accommodate 12 dolphins with a 100% over-design capacity. In addition, the return on investment, supply of tours, and job creation potential would be much greater with the 12 dolphins, making it a more financially sustainable operation.

7.3.2 Alternative Types

There are several models for dolphin related tourism. In several countries (such as Anguilla, the US and Mexico) the dolphin facility typically consists of a completely constructed concrete tank with a water treatment system, which may involve chlorination. These facilities are normally very costly to operate, and cannot cost-effectively allow the dolphins a lot of space. They do allow better control on environmental impacts as water is re-circulated and treated. The model being proposed is very similar to the Ocho Rios facility where a natural marine environment is modified to make it better suited for the design purpose. This system depends on natural flushing mechanisms, and can allow the animals much more space than the tanks.

The concern with both these options is that the demand for cetaceans in marine parks contributes to the practice of live capture. It is estimated that ~1500 dolphins were removed from the wild between 1938 and 1980 for public display purposes in the United States. The US National Marine Fisheries Services authorized the collection of 530 dolphins from the southeastern US after the passage of the Marine Mammal Protection Act in 1972. However, since 1989 no bottlenose dolphins have been collected in the US for public display (Reynolds *et al.*, 2000). Successful breeding programmes in the US have virtually eliminated the need for collection from the wild. According to Reynolds *et al.* (2000) since 1995, more than 45% of all dolphins in marine aquaria (oceanaria) in North America (US and Canada) were born there.

According Dr. Sam Dover (marine mammal veterinary specialist – personal communication, 2006), one of the main advantages of oceanaria has been the opportunity to study cetaceans closely, and thereby develop better approaches treating stranded individuals. The types of facilities also offer the tremendous benefit of allowing people an opportunity to learn about dolphins first hand. The effect of this has been very important in establishing public support and awareness for conservation of wild habitats, and lobbying against threats to wild populations such as tuna fishing (dolphin-free tuna).

A third option involves cetaceans in the wild. Commercial tours of this kind are practices in Australia, the Azores, the Bahamas, the Canary Islands, Dominica, Grenada, Japan, New Zealand and the United States. This type of activity ranges from watching the dolphins at a distance, to feeding and swimming with them. Some argue that this is more sustainable than dolphin enclosures as it does not involve actually collecting and enclosing the animals. However, because this activity occurs in open waters it is very hard to control or regulate. In an effort to ensure that they always find some dolphins, tour operators may resort to feeding the wild pods, which is very damaging to their natural behavior patterns. Encouraging them to approach motorized vessels also increases the risk of dolphins approaching a boat and suffering an injury. Encouraging human interactions with wild dolphins has a high risk factor, as these dolphins have not been screened on the basis of their friendliness to humans (Samuels *et al.*, 2000). According to the IUCN, *(*Reeves *et al* 2002) "*Intensive, persistent and unregulated vessel traffic that focuses on animals while they are resting, feeding, nursing their young or socializing can disrupt those activities, and possibly cause long-term problems for populations."*

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 SECTION OVERVIEW

In compliance with the TOR, this Environmental Management Plan (EMP) outlines:

- Environmental performance objectives for the project based on the specific impacts identified during site preparation, construction and operational stages of the proposed development.
- Proposed mitigation measures, identifying the best timing for implementation, responsibilities.
- Plans for: (a) mangrove replanting (2) sea grass relocation (3) coral relocation.
- Requirements for post-permit plans and approvals.
- A monitoring plan.

8.2 ENVIRONMENTAL PERFORMANCE OBJECTIVES

Based on the range of impacts, the following objectives have been developed. They are intended to focus on optimization of opportunities for environmental enhancement in all aspects of the project.

During the construction phase:

- To ensure that contractors implement the proposed mitigation measures as described below.
- To ensure that the design and layout of all structures are consistent best practices and codes for minimization of risk from natural hazards.
- To purchase goods such as sand, stone, and lumber from suppliers that have implemented environmentally sustainable practices.
- To import dolphins for the attractions from suppliers who (a) have conducted the necessary stock assessments of the wild populations, and limit their collection to sustainable numbers and (b) practice humane methods of collection of specimens from the wild.

During the operational phase:

- To operate the attraction in accordance with the highest international standards for marine aquaria, and optimize the benefits nature based tourism as far as possible.
- To develop a sustainable breeding programme that minimizes the need to import dolphins.
- To monitor water quality and ensure that the water quality in both bays is suitable for human swimming.
- To promote biodiversity by maintaining the sanctuaries as proposed, and by monitoring the effects of nutrient loading associated with dolphins on adjacent benthic communities.
- To foster community tourism in Hanover.

8.3 MITIGATION SCHEDULE

8.3.1 Construction Mitigation Schedule

Table 41 Construction Mitigation Schedule

Mitigation	Best Timing	Responsibility
Provide workers with protective gear	At start of works	Equipment contractors
Manage stockpiles (wet and bund)	Daily	Contractors in general
Landscape	As soon as possible.	Developers
Minimizing periods of work stoppage	During earth works	Equipment contractors
Limit construction activities	To daylight hours (6 to 6)	Equipment & Haulage contractors
Use and maintain of silt screens.	Before foreshore works	Developers
Make portable lavatories available	At start of works	Developers
Relocate sea grass, corals, mangroves	Before the start of works	Developers
Dispose solid waste at approved sites	Always	Developers
Pump fines ashore before excavation.	Before foreshore works	Excavation contractor
Increase surface roughness in swale.	Before landscaping swale	Contractor
Maintain equipment and vehicles	Routinely	Equipment & Haulage contractors
Fit axel to spread the load.	Before haulage	Haulage contractors
Limit haulage operations	To off-peak times	Haulage contractors
Observe road safety & speed limits.	Always	Equipment & Haulage contractors
Avoid excessive smokiness.	Always	Equipment & Haulage contractors
Wash vehicles & cover loads	Daily	Haulage contractors

8.3.2 Operational Mitigation Schedule

The developers should have the responsibility to implement these measures.

Table 42 Operation Mitigation Schedule

Mitigation	Best Timing
Promote the use unleaded fuels.	Always
Promote car pooling or provide of a commuter bus for staff	Always
Implement hygienic food and garbage storage.	Always
Ensure that food handlers all have permits	Always
Consider offering alternative employment to fishermen in the operations	As soon as possible

8.4 GUIDANCE FOR CONSERVING SENSITIVE SPECIES

The following guidelines are intended to establish the basic principles to be observed during the construction period. It is anticipated that detailed plans will be required a post-permit conditions to be observed before starting works.

1. The developer should contract a marine ecology specialist to assist with the identification of suitable relocation sites for the corals and sea grasses. NEPA should be involved in the final selection of the relocation site.
2. The most viable and appropriate methodologies should be used. In the case of corals, they should be fastened in place with the use of marine epoxy. In the case of sea grasses, the plant should be removed along with the root mass intact (mat method). Mangroves seedlings should be replanted using pvc pipe (encased method).
3. Marine specimens should not be taken out of the water at any time.
4. As far as possible, specimens being relocated should be taken directly to the relocation site from their original site.
5. An inventory of corals should be done while relocating them.
6. NEPA should be advised of the time of relocation so that a representative could be present to observe the works.
7. There should be follow up monitoring of the success of the relocation activities.
8. After dredging is completed in the two bays, if sea grasses recolonized the basins, there should be no cosmetic removal of sea grasses.

8.5 RECOMMENDED POST-PERMIT DOCUMENTATION

8.5.1 Emergency Response Plan

An Emergency Response Plan should be developed post-permit, and implemented after approval from the Office of Disaster Preparedness and Emergency Management, the Coast Guard and NEPA. This plan shall cover the procedures for hurricanes, earthquakes, oil spills and fires, and medical emergencies. The plan will include at a minimum:

- Implementation procedures (responsibilities, activation/deactivation)
- Specific hazards at the facility and general vulnerability assessment.
- Response procedures for each hazard identified, inclusive of checklists of emergency equipment (and where kept), personnel, responses, reporting procedures etc.

8.5.2 Environmental Monitoring Plan

8.5.2.1 Implementation of Construction Mitigation & Monitoring

It is recommended that the following parameters should be monitored as indicated below.

- Implementation of construction-related mitigation measures should be monitored. A quarterly status report on the status of construction should be submitted to NEPA.
- Relocation of sensitive species in accordance with approved plans to the designated sites should be done by a qualified marine ecologist. Reports on the relocations should be submitted for review upon completion, with an inventory of the species, sizes and numbers relocated.
- TSS and TPH should be monitored in Bay 2 and 3. It is recommended that the stations be located near the mouth of the bay, and samples should be taken monthly for the 15 months of construction.

8.5.2.2 Water Quality Monitoring (Operational Phase)

It is recommended that the following water quality parameters be monitored as indicated

Table 43 Operation Water Quality Monitoring

Sampling Regime	Recommendation
Parameters	Total Suspended Solids, Total Nitrogen, Total Phosphorus, BOD, Salinity, Dissolved Oxygen,
Number of stations	3 stations
Frequency	Monthly
Location of stations	Bays 1, 2 and 3

In addition, it is recommended that the two swimming areas be tested fortnightly for *Enterococci* or faecal coliforms. Samples should be collected from wading depth (between ankles and knees).

8.5.2.3 Benthic Eco-systems (Operational Phase)

Coral reefs offshore of the Bay 2 should be monitored annually to determine whether there are any shifts in the community structure and change in percentage of fleshy corals. Transect lines should be established.

8.5.2.4 Nature Preserve (Operational Phase)

There should be some monitoring of the sea grasses, mangroves and proposed reforestation area on an annual basis. Sea grasses should be monitored in terms of percentage cover, density, blade length and species. Mangroves should be monitored in terms of general health, density and species. In the forested area, Saplings should be monitored to ensure they are successful, and should be replaced if they are not. In all cases, associated faunas should be documented.

9 REFERENCES

Adams, C.D. (1992) Flowering plants of Jamaica. University Press, UWI Mona Jamaica.

Agard, J.B. 1984. A baseline study of the effects of pollution on the benthos of the nearshore Diego-Martin to Port of Spain coastal area. IMA Technical Report. Institute of Marine Affairs, Chaguaramas , Trinidad, West Indies.

Asprey, G.F. and Robbins R.G. 1955. The Vegetation of Jamaica. Ecological Monographs 23, 359-412.

Bond, James, 1985. Birds of the West Indies. 5th Edition . London Great Britain.Collins

Clarke, Anne et al. 2002. Mangrove nurseries; construction, propagation and planting. Queensland Fisheries Service.

Davies, T. and Cahill, S. 2000. Environmental Implications of the Tourism Industry. Discussion Paper 00-14. Resources of the Future. www.rff.org. 40p.

Downer, Audrey and R. Sutton ,1990. Birds of Jamaica (APphotographic Field Guide) Cambridge, Great Britain. Cambridge University Press.

Eagles, P. F.J. McCool, S.F. and Haynes, C.D. 2002. Sustainable Tourism in Protected Areas Guidelines for Planning and Management. World Commission on Protected Areas (WCPA). The World Conservation Union IUCN Best Practice Protected Area Guidelines Series No. 8. 191 p.

ESTECH (2005) Environmental Impact Assessment for Grand Palladium Lady Hamilton Resort and Spa at Point, Hanover

FAO, 1994, Report to the Government of Jamaica on an evaluation of the possibilities for marine cage fish-culture and other alternative technologies. Marine Cage Fish Farming (Phase II). TCP/JAM/2251 (based on the work of P. Espeut, Y.Harache, J.M. Ricard).

Gobin, J.F. 1988. The polychaete macrofauna near a large industrial complex at Point Lisas, Gulf of Paria, Trinidad. MPhil. Thesis. University of the West Indies, St. Augustine.

Gray, J.S. 1974. Animal sediment relationships. Oceanogr. Mar. Biol., 12: 223-261.

http://en.wikipedia.org/wiki/Hanover_Parish,_Jamaica 29/01/2007

http://hawaiiislandjournal.com/2006/1230c.html29/01/2007

http://sxmprivateeye.com/node/650 29/01/2007

http://www.csc.noaa.gov/beachnourishment/html/geo/sand.htm, March 2007

http://www.jamentrust.org/News/dolphintherapy.html29/01/2007

http://www.marineconnection.org/news/general/jamaicadat.htm29/01/2007

http://www.oceansatlas.com/unatlas/uses/uneptextsph/settleph/2552seagrassbcd.html

http://www.talawah.com/lucea/luceasa.htm29/01/2007

Jamaica Tourist Board, 2005. Annual Travel Statistics, 2004.

Lewis R.R. (1982a) “Mangrove Forests” Creation and Restoration of Coastal plant communities. R.R. Lewis ed. CRC Press Boca Raton Fl. 153-172

LG406. Revision 07, March 2002. Office of Marine and Estuarine Protection.

NOAA 2003. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. Technical Memorandum

NOAA, 2001. Sand Resources for Beach Nourishment, NOAA Coastal Services Center, Ocean Planning Information System.

NOAA, 2007. Methods of Investigation to Identify Sources of Suitable Sand for Nourishment, NOAA Coastal Services Center.

Planning Institute of Jamaica's (PIOJ) ***Economic & Social Survey Jamaica 2005.*** Kingston

Planning Institute of Jamaica's (PIOJ) ***Review of Economic Performance, July to September 2006.*** November 2006.

Reeves, R.R., Smith, B.D. Crespo, E.A. and di Sciara, G.N. Dolphins, Whales and Porpoises. 2002-2010 Conservation Action Plan for the World's Cetaceans. IUCN/SSC Cetacean Specialist Group.

Reynolds, J. Wells, R.S. and Eide, S. 2000. The Bottlenose Dolphin. University Press of Florida.

Rabinowitz, Deborah.1978. Early growth of mangrove seedlings in Panama; and a hypothesis concerning the relationship of dispersal and zonation. Journal of Biogeography vol.5 no 2. 113-133

Robertson, A.J, D.M. Alongi.1992. Tropical Mangrove Ecosystems. American Geo-Physical Union.

Roovers, P. 2005. Impact of outdoor recreation on ecosystems: towards an integrated approach. Doctoraatsproefschrift nr. 650 aan de faculteit Bio-ingenieurswetenschappen van de K.U.Leuven. 200p.

Samuels, A., Bejdar, L. and Heinrich, S. 2000. A review of the Literature Pertaining to Swimming with Wild Dolphins. Prepared for the Marine Mammal Commission.

Social Development Commission (SDC) ***Community Profile***: *Elgin Town*. Hanover

Special Advisory Services Division, Commonwealth Secretariat, for the Government of Jamaica, Ministry of Tourism and Sport. 2002. Master Plan for Sustainable Tourism Development.

The Statistical Institute of Jamaica (STATIN) ***Population Census 2001.*** Kingston

USAID, 2005. The Integrated Watershed Management Plan for the White River Basin, Final Report. 116p.

USEPA (United States Environmental Protection Agency). (2002). Standard Operating Procedure for Benthic Invertebrate Field Sampling. EPA Document

www.csc.noaa.gov/opic, March 2007.