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EXECUTIVE SUMMARY

Purpose

This document presents the findings of a Strategic Environmental Assessment (SEA) conducted for proposed developments of Rose Hall Developments Ltd. Based on the Environmental Permit # 2003-0817-EP00123 granted by the National Environment and Planning Agency (NEPA) for one phase of the development, Sector O, and Specific Condition Clause 14 therein, NEPA stipulated that a Strategic Environmental Assessment (SEA) for the entire development be prepared and submitted to the Agency. This SEA is intended to provide the framework for consideration of environmental permits for site specific works.

Background

The development of the Rose Hall Estate, east of Montego Bay in the Parish of St. James, was started several years ago with the completion of Spring Farm (housing) Estate, the Holiday Inn Hotel, the restoration of the Rose Hall Great House, The Palms (condominium), the Wyndham Hotel and the Wyndham Golf Course.

The second stage of the development included the construction of the Rose Hall Beach Club and The Highlands (housing) Estate. The third stage, which was concluded in 2000, saw the creation of the Resort Community which includes the flagship property, The Ritz Carlton Rose Hall Hotel and the eighteen hole White Witch international golf course.

The Proposed Development

Rose Hall Developments Ltd. entered into an agreement with the Government of Jamaica to implement a phased development plan with specific benchmarks. The company produced a Master Plan for the site, which includes a combination of uses – residential, recreational (including two golf courses), green areas and commercial functions.

The main North Coast artery – Montego Bay to Ocho Rios – divides the property, and the major components of the Master Plan lie on the landward side of the road, sloping toward the ridges. Covering an area of approximately 329 hectares, this landward side will accommodate 16 hectares of residential development, considerable green areas, a commercial area, and recreational activity. The seaward side of the Estate contains properties earmarked also for residential, resort and commercial use. There are about 28,300 lineal feet of beach frontage for the property.

The Master Plan incorporates several blocks designated “Sectors”, and Sectors G through V are planned as a private estate, thereby allowing the residences to maintain the entire Sector of land with minimal assistance from the local authority. The private estate will be designed as a low density golf resort with minimal volumes of pedestrian traffic. RDL is committed to creating a self-contained tropical resort community with high-income units in well-vegetated surroundings. With this in mind, and to engender a feeling of a lush tropical environment, it is proposed that the standard concrete side walks along the edge of the paved roads be abandoned in favour of grass verges. The compound will be gated and will not allow free access to the general public. Residents will receive membership status which will allow them to and their guests to use the facilities of the Ritz Carlton Rose Hall Hotel, which includes dining, spa, pool, beach, tennis and golf.

A permit for the development of Sector O was received in 2003. This parcel is an integral part of the Master Plan, borders on the Three Palms Ocean Golf Course, and will be incorporated into a private estate.

Individual sewage disposal systems in the form of tile fields are planned for each unit, and a water supply system capable of supporting the entire development has already been designed and constructed.

In addition to the two golf courses – white Witch and Three Palms - 110 hectares has been earmarked for Forest Reserves.

Policy, Legal and Administrative Framework

Under the Natural Resources Conservation Authority Act (1991), the Natural Resources Conservation Authority (NRCA) now the National Environment and Planning Agency (NEPA) is authorized to issue, suspend and revoke permits and licences. In discussions with NEPA (Rose Hall/ESL/NEPA) it was agreed that an SEA would be undertaken to provide the framework of data necessary to facilitate consideration of approval for the phased development of the varied components of the landholding. Requirement for the SEA was also stipulated in Clause 14 of the Special Conditions of the Environmental Permit for Sector O. Several legal instruments have been identified as being relevant to the project, including the Natural Resources Conservation Act, the Beach Control Authority Regulations, the Water Quality Act, the Town and Country Planning Act, the National Heritage Trust Act and the National Solid Waste Management Act.

Methodology and Approach

The multi-disciplinary team assembled to carry out the work, utilized the Charette-style approach to data gathering, analysis, and presentation whereby team members conducted the reconnaissance investigations together to determine the critical elements for analysis and the issues to be highlighted for the design and planning process. Team meetings were held to discuss the progress of investigations and analyses, and to facilitate integration of data toward an understanding of the systems at work in both the natural and built environment.

Baseline data for the study area was collected using the following methods:

- Windshield Survey
- Site Reconnaissance
- Aerial Survey
- Analysis of Maps and Plans
- Literature Review
- Desk Top Research
- Public Consultations

- Field Studies
- Laboratory Analyses
- Charette Style Consultations

Project Setting

The Rose Hall estate forms part of the Greater Montego Bay Area (GMBA) which was designated as a development area in 1994. A development plan was promulgated as the GMBA PLAN 2014, by the Greater Montego Bay Redevelopment Company (GMRC) in 1997. The GMBA is the residential and economic core of St. James and covers an area of 52,168 acres extending over a radius of 19 kilometers from Montego Bay to include 38 residential districts in 42 planning areas. The 2001 Census of Jamaica refers to the Montego Bay “*Special Area*”, which essentially incorporates the GMBA.

The project falls within planning district (D36) in the GMBA PLAN 2014 and includes the areas of Rose Hall and Spring Farm with a total area of 2675 acres that has been “*zoned for mixed resort commercial /residential (that) will be important for the expansion of the city needs for culture, housing, entertainment and amusements and expansion of the tourism product. It has the potential to develop into a cultural and historic node with the Rose Hall Great House property*”. The land use projections for the Rose Hall/Spring Farm planning district designated 542 acres for housing, 148 acres for public use and 61 acres for commercial development.

Key development plans within GMBA relate to expansion of the Freezone, Freeport and Donald Sangster International Airport (SIA). Tourism is posited as the growth industry and economic mainstay of the GMBA.

SIA is the larger of the island’s two international airports transporting most of the Jamaica’s tourists to the island. It serves as the hub of the national airline with direct flights to the Caribbean, North America and Europe. SIA has been privatized by the Government of Jamaica, and is undergoing extensive expansion and redevelopment.

The Montego Bay Freeport is a major transshipment container port associated with the Montego Bay Freezone. Cruise ship docking and handling facilities are also accommodated there.

Potable water is supplied to the GMBA from the Great River and Queen of Spain's Valley water treatment plants. The combined output capacity is 32 mgd, and current demand is estimated at 24 mgd.

The Bogue Sewage Treatment plant with a total capacity of 10.5 million gallons per day currently handles 4.5 million gallons per day. Treatment is effected through a combination of aerated ponds and mechanical treatment. The National Water Commission is currently expanding the sewerage network to include more buildings within the GMBA.

Montego Bay is the major transportation node for western Jamaica. Ground transportation for commuting non resident population, local residents and tourists is largely by privately owned taxis and mini buses. The Northern Coastal Highway Improvement Project involves the upgrade of Negril- Montego Bay – Ocho Rios - Port Antonio corridor. This highway improvement will greatly enhance movement of people, goods and services. Recent road improvements within the Montego Bay centre has improved traffic flow and eased traffic congestion.

Existing Environment

Physical Aspects

The climate of the Rose Hall area is tropical maritime that is typical of Jamaica's general climatic conditions. The long- term mean rainfall for the area is in the order of 150 cm with the Rose Hall area receiving an annual average of about 100 cm. The two months of maximum rainfall are October and May during which about 20 percent of the annual

rainfall occurs. Short duration, high intensity rainfall events are characteristic of the area ,and accelerated run off and erosion as well as ponding are significant considerations.

There are three distinct physiographical zones. To the north is a low-lying, relatively flat coastal strip which runs parallel to the coastline. Maximum elevation is about 10 meters. South of this area is a parallel zone consisting of north facing slopes that grade gradually upwards from the coastal strip. The land surface here is gently undulating with low relief except where they are dissected by north-south oriented drainage lines,which have produced steep sided gullies. This physiographical area makes up most of the area proposed for development. The third physiographic zone is found further south and consists of more highly dissected hills with less defined drainage lines.

The study area is well drained with well-defined steep sided gullies that drain northwards to the sea. The gullies channel mainly intermittent flow that occurs after heavy rainfall, except for the Little River, which is fed perennially by the Banana Spring.

Gibaltarr, Bonny Gate and Font Hill limestone formations underlie the hilly slopes which cover most of the study area. The Gibaltarr–Bonny Gate Limestone is a relatively permeable rock type and therefore most rainfall infiltrates downward to meet the subsurface water table at depths of between 170 and 250 feet above sea level. The underlying Font Hill Limestones are relatively impermeable and form an impermeable barrier at the base of the Gibaltarr –Bonny Gate Limestone.

The coastal strip comprises poorly consolidated alluvium and limestone marls found between the beach deposits along the coastline and the adjacent limestone deposits to the south. These coastal deposits were formed as a series of fans by sediment-laden runoff from streams and gullies. Over time these deposits have coalesced into a continuous apron that slopes gently to the sea.

Soils overlying the limestone are very thin where present, and consist of a light reddish brown gravely clay. On the slopes the soil is typically 6 to 12 inches deep but tends to be deeper in depressions where it can exceed five feet.

Terrestrial Ecological Aspects

The undeveloped areas of the Rose Hall property are mainly ruinate pastureland interspersed with areas of disturbed dry limestone forest. Two large triangular areas on the White Witch golf course constitute the dry limestone forest remaining on the property. The margins of the dry limestone forest generally show signs of disturbance, with mainly shrubs occupying the dense undergrowth. Along the coastal area of the property, one may find the dry limestone thicket, as well as open areas.

The property covers a range of ecological habitats, extending from the coast into the mountains. The land has previously been used for agriculture and subsequently cattle farming. The bird fauna found on the property are generally species common to Jamaica. At least 27 species of bird were identified, five of which are endemic to Jamaica, and one of which has become threatened throughout its range due to habitat destruction and hunting.

The Rose Hall property, with its dry limestone forests, is probably an important bird habitat due to the quantity of birds seen and heard, even in the middle of the day when most are inactive. A number of trees bearing fruits and berries constitute the disturbed and dry limestone forests, and provide sustenance for many bird species. The dense vegetation also provides suitable habitat for more reclusive species.

Marine Aspects

The marine area extending from the Wyndham Rose Hall Hotel to the Half Moon Hotel is quite uniform in its physical and biological characteristics. A fringing reef extends throughout the area, and is part of the north coast fringing reef system. It may be divided into two distinct areas – the back reef zone and the fore reef zone. These areas are not separated by an emergent reef crest; the back reef area slopes gently into the fore reef zone. The back reef zone is within 100 m of the shore, and is quite shallow.

The back reef is characterized by shallow, flat or gently sloping pavement covered by a thin layer of sand. Closer to shore the pavement is covered by a deeper layer of sand, which merges with the beach. The sand in the back reef zone is white and of fine to medium grain, and covers approximately 50% of the substrate.

Patch reefs and isolated coral heads characterize the coral of this area. Live hard coral cover is generally low, at less than 5%. Coral rubble is scattered throughout the area, and sediment- or algal-covered standing dead colonies are frequently seen.

The fish community is mainly composed of small reef fish, dominated by parrotfish, doctorfish, damselfish and wrasses. Fish are generally not very numerous in this zone. A large proportion of the community is composed of juveniles, with the remaining mature fish being small. Small patches of sparsely growing seagrass (*Thalassia testudinum*) were occasionally seen in the back reef area.

The fore reef zone is made up of well-developed spur and groove formations, oriented with their long axes parallel to the prevailing currents. This zone occurs at depths of 5 to 12 m. Live coral cover is approximately 20% on the fore reef, with colonies of approximately 20 to 40 cm diameter. A few colonies were seen which measured more than 1 m in diameter.

Socio-economic Aspects

The development area is bordered by Ironshore on the west and Lilliput on the east, two contrasting residential communities in terms of income levels, design, ownership and infrastructure. Other communities within the project's area of influence include Barrett Town, Spot Valley, Cornwall, Mount Zion, Rhyne Park, and Spring Farm Estate. Lilliput is a sprawling squatter community on the hills adjacent to the Rose Hall property. Ironshore is a higher income area with permanent and villa residential development.

Success Beach is situated on the coast immediately east of the project area and Sand Castles condominium complex is located east of Success Beach.

Land use and livelihoods in the other surrounding communities are dominated by residential and small-scale agricultural use. Employment is dominated by hotel-related work - mainly domestic services, hotel construction and to a lesser extent craft. Under-employment or outright unemployment is evident.

Several fishing beaches of varying sizes and activity lie along the shore from Montego Bay to the area east of Rose Hall. Success Beach lies immediately within the project area. The beach is licensed, accommodates approximately 20 boats and twenty fishermen. Other beaches from west to east include Whitehouse, Flankers, Harvey and Grange Pen. Fishermen report unsatisfactory infrastructure at the beaches (lack of water supply, sanitation, and electricity) and declining catch which they attribute mainly to effects of Hurricane Gilbert, dumping of construction material and garbage on the coast, and the removal of mangroves. They also acknowledge the problem of over fishing and point to their own inappropriate use of smaller than recommended wire gauge in making pots. Several fishers refer to "chemical contamination" of the coastal waters.

Potential Impacts, Cumulative Impacts and Mitigation Measures

Several potential impacts have been identified – positive and negative, and cumulative. Mitigation measures to minimise negative impacts and the parties responsible for implementing the mitigation measures, have been identified. The main impacts identified on the physical environment relate to hydrology and drainage, hazard vulnerability, air quality and noise.

Proposed mitigation measures include recommendations for drainage design for 100 year events, no obstruction of existing drainage lines, engineering of kerbs and channels to reduce the effects of sheet flow and ponding, and the channeling of water into retention ponds. Air quality mitigation measures include the phasing of vegetation removal to minimize the exposed surfaces, covering of stockpiles of earth materials, wetting of stripped surfaces, and landscaping to provide vegetative buffers.

Negative Impacts

Potential negative impacts on the marine environment could occur from increased sedimentation in terrestrial run-off, increased nutrient loading from the use of fertilizers, release of oil and grease and solid waste during construction and operation phases. Mitigation measures include proper storage of earth materials, oils and grease; appropriate collection and disposal of solid waste; use of portable chemical toilets during construction; use of retention ponds to reduce terrestrial run-off and to allow for settling of sediments; and regulations and public education for recreational/sport divers and snorkelers to minimize damage to coral heads. Lighting, beach design and beach activities should take account of reported turtle nesting on beaches within the project area.

Potential negative impacts on the terrestrial environment are mainly related to the removal of vegetation and loss of habitat for local and migratory bird species. Mitigation measures include:

- ‘red-flagging’ of identified trees to be retained;
- ‘construction monitoring’;
- golf course design to retain as much forested land as possible, as greens and fairways will have to be cleared;
- maintenance of feeding trees for birds, particularly sweetwoods, replanting of verges with trees and shrubs where appropriate, so as to maintain airshed purification functions and aesthetic appeal.

Traffic dislocation during construction is a potential negative impact. Mitigation measures include scheduling of construction work to minimise disruption to traffic flow along the main north coast artery and allow for the movement of material and heavy equipment; arrangements for parking and storage of material should be made on-site as is feasible for efficient operations; discussions with the National Works Agency regarding the current work on the Northern Coastal Highway Improvement Project to determine the construction schedule through the Rose Hall area and the provision of underpasses and exit ramps; and the use of properly trained flag persons and road side signs where the movement of heavy machinery and construction equipment may cross the main road.

The proper collection, removal and disposal of solid waste is essential during all phases. During the operation of the various components of the proposed development, sewage will be treated through a new facility to be established by the Rose Hall Utility Company. Details of the collection system, irrigation system and wastewater treatment system have been provided.

In the interest of public health and safety, the construction activities which will directly affect the movement of traffic and pedestrians, should be properly scheduled and standard construction techniques for sign-posting and flagging should be adhered to. Additionally, dust control by wetting is essential; unnecessary idling of construction related vehicles should be discouraged; and proper sign posting of speed limits and entrances and exits.

The site is in a known heritage area with the Rose Hall Great House being a listed site. The JNHT should be informed of the construction schedule and given an opportunity to conduct a Watching Brief during the construction phase and to perform Rescue Archaeology if any artifacts are discovered.

Cumulative Impacts

Cumulative impacts that have been identified include the potential for increased levels of eutrophication in the marine environment as a result of increased nutrient loading from terrestrial run-off, resulting from the use of fertilizers for golf courses associated with various developments. Mitigation measures have been proposed to minimize the potential run-off, through the use of retention ponds in the landscaping. Physical damage to coral reefs is another potential cumulative impact which can result from an increase in visitor arrivals to the Montego Bay area and other north coast spots, and a resulting increase in the number of recreational/sport snorkellers and divers.

The continued development along the north coast will result in an increase in the movement of heavy vehicles and machinery during the construction phases. Scheduling and timing of site preparation and construction activities should be co-ordinated so that the main north coast artery is not impeded. During the operational phase of the developments the upgraded Northern Coastal Highway should facilitate smooth flow of traffic between developments, other resort facilities and tours and the international gateway in Montego Bay.

Positive Impacts

In fulfilling the mandate of Rose Hall Developments Ltd. to develop the area with luxury accommodation, condominiums, golf courses and conference facilities, several positive impacts are anticipated from this project. These include:

The engineering of drains, kerbs and channels and the golf course, should channel storm water run-off to reduce potential ponding. Sedimentation control devices should reduce the levels of siltation in nearby coastal waters.

Fulfilment of setback requirements for shoreline facilities should minimize the risks due to storm surge and wave action.

The establishment of a sewage treatment plant to include recycling and irrigation use should also minimize nutrient loading and the effects of eutrophication in coastal waters.

The engineering for stormwater run-off will also have beneficial impacts on the coral reefs through the reduction of siltation. Additionally, engineering and landscaping of golf courses to include retention ponds should minimize the impacts associated with high nutrients in run-off.

The maintenance of large diameter trees and forest verges as part of the landscaping and engineering of golf courses, as well as to ensure the maintenance of a lush tropical environment for homeowners, should continue to provide habitats for avifauna.

During design, site preparation and construction employment will be generated for several categories of workers including engineers, casual labourers, skilled and unskilled workers, as well as suppliers of goods and services. During the operation phase supplies of good and services will be required.

A Public Hearing has been requested by NEPA for the establishment of the sewage treatment facilities by Rose Hall Utility company. This hearing will also incorporate information on the Master Plan and serve the purpose of information sharing for the local communities.

1.0 INTRODUCTION

Rose Hall Developments Ltd. (RDL) has entered into an agreement with the Government of Jamaica to implement a phased development plan of the Rose Hall Estate in the Parish of St. James (Figure 1.1) Specific benchmarks have been stated in the agreement. The company produced a Master Plan for the site, which includes a combination of uses – residential, recreational, green areas and commercial functions.

The property is divided by the main North coast road and the major components of the Master Plan lie on the landward side of the road, sloping toward the ridges. The seaward side of the Estate contains properties earmarked for residential, resort and commercial use. On the landward side the proposed development covers approximately 329 hectares, with 16 hectares of residential development, considerable green areas, a commercial area, and recreational activity. RDL is committed to creating a self-contained tropical resort community with high-income units in well-vegetated surroundings.

In the Environmental Permit # 2003-0817-EP00123 granted by the National Environment and Planning Agency (NEPA) for Sector O and Specific Condition Clause 14 therein, NEPA stipulated that the Terms of Reference for conducting a Strategic Environmental Assessment for the entire development be prepared and submitted to the Agency for approval. The TOR's were prepared by Environmental Solutions Ltd. on behalf of Rose Hall Developments Ltd., and submitted to NEPA for approval in March 2004. The TORs were subsequently approved with some specific emphases.

This document constitutes the final report on the Strategic Environmental Assessment of the proposed Rose Hall Development.

Figure 1.1: Site Location Map

1.1 Terms of reference

Based on research on the approach to SEAs, and adaptation of the NRCA's "Guidelines for Conducting EIA's", the Terms of Reference for conducting the SEA are as follows:

5.1 Introduction. Identification of the Rose Hall Master Plan to be assessed and explanation of the executing arrangements for conducting the Strategic Environmental Assessment.

5.2 Background Information. A brief description of the major components of the proposed Master Plan, a brief history, and its current status. This will include information on the existing developments and those currently under review for approval.

5.3 Study Area. Specification of the boundaries of the study area for assessment as well as any adjacent or remote areas, which should be considered with respect to the project, that is the sphere of influence of the project.

5.4 Scope of Work. Standard environmental assessment techniques will be used, including field investigation of the environmental parameters of the site and its situation, desktop research, data analysis and interviews with key stakeholders. Use will be made of existing information including previous studies for developments such as the Rose Hall Golf Course.

The following tasks will be performed:

Task 1: Description of the Proposed Project. Using maps and photographs as appropriate, provide a full description of the Master Plan and the setting into which the development will proceed (e.g. surrounding land use etc.) This is to include general layout, size, location, land use, infrastructure, water supply, waste disposal systems, and institutional setting. The proposed sphere of influence or project impact boundary will be suggested. Alternative development scenarios will be presented.

Task 2: Description of the Existing Environment. Assemble, evaluate and present data on the relevant characteristics of the study area. Information will be presented for:

- a. The coastal component – north of the main road to the coast
- b. The terrestrial component - south of the main road sloping inland

on the following parameters:

- ✓ **Physical environment:** geology, topography, soils, surface runoff characteristics, groundwater and water table levels, natural hazard risk, coastal processes.
- ✓ **Ambient Air quality:** particulates and noise levels
- ✓ **Water quality** for resources on the site
- ✓ **Biological environment:** forest/vegetation cover, existing wildlife (flora and fauna), rare or endangered species, sensitive habitats, species of commercial importance, nuisance species, pests and vectors
- ✓ **Socioeconomic setting:** land use and livelihoods, traffic patterns, public health issues, demographics, solid waste management, sewage disposal, water supply, community facilities/structures, institutional structures
- ✓ **Proposed Developments** for the area: North Coast Highway, other resort/residential plans, infrastructure, recreational uses, *et al.*

Task 3: Policy, Legal and Administrative Framework. A description will be given of the pertinent policy, legislation, regulations, and standards governing the development. The areas to be covered would include, but not necessarily be limited to

tourism investment, resort development, coastal management, environmental quality, health and safety, protection of biological diversity and endangered species, siting and development control, and sewage and solid waste treatment and disposal.

Task 4: Identify the salient issues related to each aspect of the proposed development, and list relevant sustainability issues and constraints. **Potential Impacts** of the Proposed Project will be determined, and these will be categorized as significant positive or negative, direct or indirect, short-term or long-term, unavoidable or irreversible. Potential cumulative impacts should be noted. Special emphasis will be placed on:

- ✓ Land use management on-site and compatibility with surrounding uses
- ✓ Other proposed developments
- ✓ Terrestrial ecology and change in vegetation cover
- ✓ Coastal ecology and water quality
- ✓ Natural drainage and stormwater runoff
- ✓ Slope stability and soil erosion
- ✓ Water resources and supply
- ✓ Fisheries
- ✓ Traffic patterns, entrance and exits and connection to the North Coast Highway
- ✓ Physical carrying capacity of proposed infrastructure and services
- ✓ Buffer zones and recreational areas
- ✓ Sewage treatment and disposal
- ✓ Solid waste management

Task 5: Mitigation and Management of Negative Impacts. Recommendations will be made for feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels.

Task 6: Recommendations for Development Guidelines and a Monitoring Framework. Development guidelines and a Monitoring Framework to ensure implementation of the mitigation measures and long-term minimization of negative environmental impacts will form part of the assessment report.

Task 7: Assist in Inter-Agency Coordination and Public Participation. As, and if required by the NRCA/NEPA, ESL will assist in the public participation/review process through meetings with relevant governmental agencies, and in obtaining the views of civil society.

Task 8: Report – The Strategic Environmental Assessment report will be concise and limited to the significant environmental issues. The main text will focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. The report will be organized according to, but not necessarily be limited by, the outline below:

- Executive Summary
- Description of the Proposed Project
- Policy, Legal and Administrative Framework
- Description of the Existing Environment
- Significant Impacts and Proposed Mitigation Measures
- Recommended Development Guidelines and Monitoring Framework

Task 9: NEPA Emphasis – NEPA approved the TORs indicating that special emphasis needed to be placed on several aspects of the physical, biological and social environment. These are detailed in Appendices I and II.

1.2 Description of the Proposed Development

The project area called the “Residences of Rose Hall” is registered at the Certificates of Title Vol. 1308 Fol.458 and Vol. 1143 Fol. 527. The subdivision will consist of sixteen housing clusters (Figure 1.2) woven around the fairways of two golf courses, which will be strategically placed to take advantage of the majestic views and open spaces offered by this area. This development plan to the Estate was preceded by several major developments on the larger Rose Hall Estate.

The first stage of the development of the entire estate was completed several years ago with the development of Spring Farm(housing) Estate, the Holiday Inn Hotel, the restoration of the Rose Hall Great House, The Palms (condominium), the Wyndham Hotel and the Wyndham Golf Course. The second stage of the development included the construction of the Rose Hall Beach Club and The Highlands (housing) Estate. The third stage, which was concluded in 2000, saw the creation of the Resort Community which includes the flagship property, The Ritz Carlton Rose Hall Hotel and the eighteen hole White Witch international golf course.

A permit for the development of Sector O was received in 2003. This parcel is an integral part of the master plan and borders on the Three Palms Ocean Golf Course. It is proposed that this residential area will be incorporated into a private estate for Sections G through V, thereby allowing the residences to maintain the entire development with minimal assistance from the local authority. The private estate will be designed as a low density golf resort with minimal volumes of pedestrian traffic.

In keeping with this vision, and to engender a feeling of a lush tropical environment, it is proposed that the standard concrete side walks along the edge of the paved roads be abandoned in favour of grass verges.

The compound will be gated and will not allow free access to the general public. Residents will receive membership status which will allow them and their guests to use

the facilities of the Ritz Carlton Rose Hall Hotel, which includes dining, spa, pool, beach, tennis and golf.

The utilities within Sector O will be run underground, and existing power and telephone lines at the Three Palms Ocean Golf Course will be relocated underground.

Individual sewage disposal systems in the form of tile fields are planned for each unit, and a water supply system capable of supporting the entire development has been built. In addition to the two golf courses, 110 hectares has been earmarked for Forest Reserves.

During the operation of the various components of the proposed development, sewage will be treated through a new facility to be established by the Rose Hall Utility Company. The treated effluent from the wastewater treatment facility would be pumped into an irrigation distribution system for beneficial reuse and sale to customers as irrigation water. It is estimated that the daily average flow from the existing hotels, resorts, and commercial establishments would be 350,000 gallons per day with a potential future flow of 1,000,000 gallons per day.

The wastewater treatment facility would be an extended aeration system which has benefits of ease of operation and maintenance, more capable handling of spikes in flow and contents and less generation of solids. The company would build operate and maintain a wastewater collection forcemain which would extend along the eight mile stretch of coastal highway. Details of the collection system, irrigation system and wastewater treatment system are given in Appendix IV. A Public Hearing for this facility has been requested by NEPA, and will be held by mid 2004.

The various sections of the development, with zone, description of use, size and percentage of total area, is given in Table 1.1.

FIGURE 1.2: ROSE HALL DEVELOPMENT MASTER PLAN

TABLE 1.1: ROSE HALL DEVELOPMENTS LAND USE

Section	Zone & Description of Use	Size of Parcel Hectares	Percentage of Total Area
White W	Golf Course, Recreational	78.21	23.8
F	Commercial, UDC Conference Centre	14.13	4.3
I	Residential Development	1.05	0.3
K	Residential Development	3.04	0.9
J	Residential Development	5.75	1.7
H	Residential Development	4.13	1.3
G	Residential Development	4.94	1.5
L	Residential Development	5.98	1.8
M	Residential Development	8.54	2.6
N	Residential Development	5.29	1.6
O	Residential Development	12.92	3.9
P	Residential Development	2.79	0.8
Q	Residential Development	5.54	1.7
R	Residential Development	1.94	0.6
S	Residential Development	9.10	2.8
T	Residential Development	3.24	1.0
U	Residential Development	5.83	1.0
V	Residential Development	0.81	1.8
Three P	Golf Course, Recreational	40.5	12.3
Ocean Great House	Attraction, Recreational	5.5	1.7
-	Forest (not included in any zones)	112.97	33.4
	TOTAL	329.07	100.0

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 PERMITTING

Under the Natural Resources Conservation Authority Act (1991), the Natural Resources Conservation Authority (NRCA now the National Environment and Planning Agency, NEPA) is authorized to issue, suspend and revoke permits and licences. The Permit and Licence System was established in 1997 to ensure compliance with Sections 9 & 12 of the NRCA Act, which gives the NRCA the right to issue permits for new developments and request EIA studies where necessary.

Prescribed categories of projects requiring a permit have been listed by the NRCA/NEPA and these include Development Projects. A Project Information Form (PIF) and a Permit Application (PA) must be completed and submitted to NRCA/NEPA with the requisite application fee. NRCA/NEPA will then determine if an EIA is required and request submission of the Terms of Reference for conducting the EIA. An EIA is usually required for housing developments over ten units.

In discussions with NEPA (Rose Hall/ESL/NEPA) it was agreed that an SEA would be undertaken to provide the framework of data necessary to facilitate consideration of approval for the phased development of the varied components of the landholding. Requirement for the SEA was also stipulated in Clause 14 of the Special Conditions of the Environmental Permit for Sector O.

ESL was contracted by RDL to develop the Terms of Reference for the SEA and to undertake the study, both for submission to NEPA. The Terms of Reference were submitted and approved by NEPA and this document constitutes the report of the SEA.

2.2 NATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS – NATURAL ENVIRONMENT

2.2.1 Natural Resources Conservation Act (1991)

The Natural Resources Conservation Act was passed in the Jamaican Parliament in 1991 and provided the basis for the establishment of the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development in Jamaica through the protection and management of Jamaica's natural resources and control of pollution. Sections 9 and 10 of the NRCA Act stipulate that an Environmental Impact Assessment (EIA) is required for new projects and existing projects undergoing expansion.

2.2.2 Wildlife Protection Act (1945)

The Wildlife Protection Act of 1945 prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams, and Authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act are six species of sea turtle, one land mammal, one butterfly, three reptiles and several species of birds including rare and endangered species and game birds.

Section 4.2 describes the fauna and habitats in the project area, while guidelines for development are given in the mitigation measures in Section 5.0.

2.2.3 The Endangered Species (Protection, Conservation And Regulation Of Trade) Act (1999)

This Act deals with restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement. Many species of reptile, amphibian and birds that are endemic to Jamaica but not previously listed under national protective legislation, or under international legislation, are listed in the Appendices of this Act.

2.2.4 The Natural Resources (Prescribed Areas)(Prohibition Of Categories Of Enterprise, Construction And Development) Order (1996)

The island of Jamaica and the Territorial Sea of Jamaica has been declared as a Prescribed Area. No person can undertake any enterprise, construction or development of a prescribed description of category except under and in accordance with a permit. The Natural Resources Conservation (Permits and Licenses) Regulations (1996) gives effect to the provisions of the Prescribed Areas Order.

2.2.5 Water Resources Act (1995)

The Water Resources Act of 1995 established the Water Resources Authority (WRA). This Authority is authorized to regulate, allocate, conserve and manage the water resources of the island. The Authority is also responsible for water quality control and is required under Section 4 of the Act to provide upon request to any department or agency of Government, technical assistance for any projects, programmes or activities relating to development, conservation and the use of water resources.

It is the responsibility of the WRA as outlined in Section 16 to prepare, for the approval of the Minister, a draft National Water Resources Master Plan for Jamaica. Areas to be covered in this Draft Master Plan of 1990 included objectives for the development, conservation and use of water resources in Jamaica with consideration being given to the protection and encouragement of economic activity, and the protection of the environment and the enhancement of environmental values.

Section 25 advises that the proposed user will still have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, Section 21 of the Act stipulates that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

With regard to underground water, Section 37 states that it is unlawful to allow this water to go to waste. However, if the underground water "interferes or threatens to interfere with the execution or operation of any underground works", it will not be unlawful to allow the water to go to waste in order to carry out the required works provided that there is no other reasonable method of disposing of the water. The Authority also has the power to determine the safe yield of aquifers. (Section 38).

2.2.6 The Beach Control Authority (Licensing) Regulations (1956)

The Beach Control Authority (Licensing) Regulations (1956) stipulates that a license is required for the modification of any beach/coastline and sets out requirements for the posting of public notices. Dredging works are included under these regulations. An application for a license was also submitted to the NRCA/NEPA (February 2002) with the requisite application fee of J\$ 1000.

This SEA Report forms a part of the application process.

2.2.7 Country Fires Act (1942)

Section 4 of the Country Fires Act of 1942 prohibits the setting of fire to trash without prior notice being given to the nearest police station and the occupiers of all adjoining lands. In addition, a space of at least fifteen feet in width must be cleared around all trash to be burnt and all inflammable material removed from the area. Section 6 of the Act empowers the Minister to prohibit, as may be necessary, the setting of fire to trash without a permit.

Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);
- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);

- Negligent use or management of a fire which could result in damage to property (Section 13a);
- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

2.2.8 Quarries Control Act (1983)

The Quarries Control Act of 1983 established the Quarries Advisory Committee, which advises the Minister on general policy relating to quarries as well as on applications for licenses. The Act provides for the establishment of quarry zones, and controls licensing and operations of all quarries. The Minister may on the recommendation of the Quarries Advisory Committee declare as a specified area any area, in which quarry zones are to be established and establish quarry zones within any such specified area.

Section 5 of the Act states that a licence is required for establishing or operating a quarry though this requirement may be waived by the Minister if the mineral to be extracted is less than 100 cubic metres. Application procedures are outlined in Section 8. The prescribed form is to be filed with the Minister along with the prescribed fee and relevant particulars. The applicant is also required to place a notice in a prominent place at the proposed site for a period of at least 21 days starting from the date on which it was filed.

No quarry zones are proposed for the project areas, but developers' guidelines should stipulate requirements for the use of material from licensed quarries and ensure the use of certified contractors.

2.3.9 The Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Section 11 states that the Authority is required to keep a register or record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture

pesticides. Under Section 16 of the Act, the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

- Aerial application of pesticides;
- Supervision required for the use of pesticides, the prescribed protective clothing to be worn and other precautionary measures;
- The permissible levels of pesticides to be used;
- The periods during which particular pesticides may or may not be used on certain agricultural crops;
- The disposal of pesticides and packages.

2.2.10 Air Quality Standards

The Federal Clean Air Acts which came into force in the United States in 1990 established air quality standards for six pollutants: ozone (O₃), carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), respirable particulate matter (PM₁₀) and lead (Pb). An allowable level for each of these pollutants has been set by the United States Environmental Protection Agency (US EPA) whose objective is to protect the public from exposure to dangerous levels. National standards, known as the National Ambient Air Quality Standards (NAAQS), were established and they were categorized into two groups. In one group, there are the primary standards, designed to protect human health and in the other, there are the secondary standards designed to protect the environment and limit property damage.

2.2.11 Noise Standards

To date, Jamaica has no National legislation for noise, but World Bank guidelines are often used for benchmarking purposes. The NRCA is currently preparing a draft document for national Noise Standards.

2.2.12 Water Quality - NRCA Act (1990)

The NRCA has primary responsibility for control of pollution in Jamaica's environment, including pollution of water. National Standards exist for industrial and sewage

discharge into rivers and streams. WHO Standards for drinking water are used and these are regulated by the National Water Commission. There are no national standards for ambient water quality of riverine systems.

2.2.13 The Beach Control Authority (Licensing) Regulations (1956)

The Beach Control Regulations require a permit for any works on the beach, coastline or foreshore. Application must be made to the Applications Secretariat at the National Environment and Planning Agency (NEPA). Requirements include a Notice of Application to be posted on the landward and seaward sides of the property and said Notice should be served on adjoining neighbours.

2.3 NATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS – HUMAN, CULTURAL AND SOCIAL ENVIRONMENT

2.3.1 Town And Country Planning Act (1958)

Section 5 of the Town and Country Planning Act authorizes the Town and Country Planning Authority to prepare, after consultation with any local authority, the provisional development orders required for any land in the urban or rural areas, so as to control the development of land in the prescribed area. In this manner, the Authority will be able to coordinate the development of roads and public services and conserve and develop the resources in the area.

Any person may, under Section 6 of the Act, object to any development order on the grounds that it is:

- impractical and unnecessary;
- against the interests of the economic welfare of the locality.

However, if the Minister is satisfied that the implementation of the provisional development order is likely to be in the public interest, he may, under Section 7 (2) of the Act, confirm it with or without modification by publishing a notice in the Gazette. Section 8 of the Act also gives the Minister the authority to amend a confirmed

development order.

Section 10 of the Act states that a development order must include:

- clearly defined details of the area to be developed;
- regulations regarding the development of the land in the area specified;
- formal granting of permission for the development of land in the area.

If the provisions of section 9A of the Natural Resources Conservation Authority (NRCA) Act apply to the development, the application can only be approved by the Planning Authority after the NRCA has granted a permit for the development. (Section 11 (1A)). The Authority may impose a "tree preservation order" under Section 25 of the Act if it considers it important to make provision for the preservation of trees and woodlands in the area of the development. This order may:

- prohibit the cutting down, topping, lopping or wilful destruction of trees;
- secure the replanting of any Sector of the woodland area in which trees were felled during the forestry operations permitted under the order.

The tree preservation order is not applicable to the cutting down of trees which were already dead, dying or had become dangerous and the order can take effect only after it has been confirmed by the Minister.

The Minister can, under Section 26 of the Act, make regulations to restrict and regulate the display of advertisements in any area to be developed if he considers this to be in the interest of public safety. Section 28 of the Act empowers the local authority to require the owner or occupier of land in the development area to take the steps necessary to ensure its proper maintenance.

2.3.2 Land Development and Utilization Act (1966)

Under Section 3 of the of the Land Development and Utilization Act (1966), the Land Development and Utilization Commission is authorized to designate as agricultural land,

any land which because of its "situation, character and other relevant circumstances" should be brought into use for agriculture. However, this order is not applicable to land, which has been approved under the Town and Country Planning Act for development purposes other than that of agriculture. Among the duties of the Commission outlined in Section 14 of the Act is its responsibility to ensure that agricultural land is "as far as possible, properly developed and utilized".

2.3.3 The National Solid Waste Management Authority Act (2001)

The National Solid Waste Management Authority Act (2001) is “an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto”. The Solid Waste Management Authority (SWMA) is to take all steps as necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that waste is collected, sorted, transported, recycled, reused or disposed of, in an environmentally sound manner and to promote safety standards in relation to such waste. The SWMA also has responsibility for the promotion of public awareness of the importance of efficient solid waste management, to advise the Minister on matters of general policy and to perform other functions pertaining to solid waste management.

2.3.4 Jamaica National Heritage Trust Act (1985)

The Jamaica National Heritage Trust Act of 1985 established the Jamaica National Heritage Trust (JNHT). The Trust's functions outlined in Section 4 include the following responsibilities:

- To promote the preservation of national monuments and anything designated as protected national heritage for the benefit of the Island;
- To carry out such development as it considers necessary for the preservation of any national monument or anything designated as protected national heritage;
- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected.

Section 17 further states that it is an offence for any individual to:

- wilfully deface, damage or destroy any national monument or protected national heritage or to deface, damage, destroy, conceal or remove any mark affixed to a national monument or protected national heritage;
- alter any national monument or mark without the written permission of the Trust;
- remove or cause to be removed any national monument or protected national heritage to a place outside of Jamaica.

2.3.5 Land Acquisition Act (1947)

Section 3 of the Land Acquisition Act (1947) empowers any officer authorized by the Minister to enter and survey land in any locality that may be needed for any public purpose. This may also involve:

- Digging or boring into the sub-soil;
- Cutting down and clearing away any standing crop, fence, bush or woodland;
- Carrying out other acts necessary to ascertain that the land is suitable for the required purpose.

The Minister is authorized under Section 5 of the Act to make a public declaration under his signature if land is required for a public purpose provided that the compensation to be awarded for the land is to be paid out of the:

- Consolidated Fund or loan funds of the Government;
- Funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

Once the Commissioner enters into possession of any land under the provisions of this Act, the land is vested in the Commissioner of Lands and is held in trust for the Government of Jamaica in keeping with the details outlined in Section 16. The Commissioner shall provide the Registrar of Titles with a copy of every notice published as well as a plan of the land. The Commissioner will also make an application to the Registrar of Titles in order to bring the title of the land under the operation of the Registration of Titles Act.

2.3.6 Registration of Titles Act (1989)

The Registration of Titles Act of 1989 is the legal basis for land registration in Jamaica, which is carried out using a modified Torrens System (Centre for Property Studies, 1998). Under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.

2.3.7 Involuntary Resettlement Policy

Jamaica's experience in resettlement has come mainly as a result of urban renewal and bauxite mining but documentation of the process has been limited. Proposed policy guidelines for involuntary resettlement were outlined in a draft report McHardy (1997). The following measures were recommended as the principles and objectives of the policy:

- Avoid unnecessary displacement
- Give the population the option of selecting their choice among possible alternatives
- Prepare Rehabilitation Action Plans which will ensure that the project-affected people regain at least their "former standard of living and earning capacity after a reasonable transition period"
- All project-affected people should be entitled to benefit from the rehabilitation measures even if they are not holders of legal property titles
- Compensation money due to the persons being displaced should be paid well in advance of the date of their removal

Rehabilitation measures should include:

- Cost of moving to the new site
- Compensation for losses to be incurred
- Subsistence/maintenance allowance during the transition period
- Development programme to assist those resettled in regaining or improving on their previous living standards
- Considerations geared to minimize disruption during rehabilitation

2.3.8 Mining Act (1947)

It is the responsibility of the Commissioner of Mines to exercise general supervision over all prospecting and mining operations in the Island. Section 8 of the Act identifies lands excluded from prospecting or mining. These include:

- Land to be used for any public purpose (other than mining), for a burial ground or within 100 yards of such places;
- Any area located within any town or village;
- Land reserved for the purpose of a railway or situated within 100 yards of any railway (unless the railway is constructed by the mining lessee for use during operations);
- Any area which is the site or is within 100 yards of any building, works, reservoir or dam or occupied by the Government or a public authority;
- Any street road or highway or any land within 50 yards of the centre line of a street, road or highway other than one constructed on the mining lease by the mining lessee;
- Land within 100 yards of any building.
- Prospecting may proceed in these areas only with the consent of the Commissioner, or in the case of a building, the consent of its occupier.

According to Section 9 of the Act, the Minister may at any time declare an area closed to prospecting and mining. This excludes any lands to which a lessee has rights under a license or mining lease.

2.3.9 Toll Roads Act (2002)

The Toll Roads Act was tabled in the House of Representatives in February 2002. The Act was passed into law by the end of the legislative year on March 31, 2002, but there will be some reprieve for motorists for at least two years. This is an Act to provide for the designation of specified roads as toll roads, the establishment of the Toll Authority, the operation and maintenance of toll roads, the collection and retention of toll, and for other connected matters. (1) The Minister may, by order - (a) subject to subsection (2)

designate any road as a toll road for purposes of this Act; and (b) authorize any person, in return for undertaking such obligations as may be specified in an agreement with respect to the design, construction, maintenance, operation, improvement or financing of a toll road, to enjoy the rights conferred in the order, including the right to levy, collect and retain toll in respect of the use of the toll road. (2) No road shall be designated as a toll road under subsection (1) (a) unless in the area in which the toll road is to be established there is an alternative route accessible to the public by ferry, vehicular or other traffic.

2.4 INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

2.4.1 Cartagena Convention (Convention for the Protection And Development of the Marine Environment of the Wider Caribbean Region) (1983)

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, also known as the Cartagena Convention, is the only legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating governments to protect, develop and manage their common waters individually and jointly.

Ratified by twenty countries, the Cartagena Convention is a framework agreement which sets out the political and legal foundations for actions to be developed. The operational Protocols, which direct these actions, are designed to address special issues and to initiate concrete actions. The Convention is currently supported by three Protocols. These are:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;
- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the

text in January, 1990 and its Annexes in June, 1991. The Protocol entered into force in 2000;

- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October, 1999.

2.4.2 Biodiversity Convention

The objectives of the Convention on Biological Diversity are "the conservation of biological diversity, sustainable use of its components and the fair equitable sharing of the benefits arising out of the utilization of genetic resources". This is the first global, comprehensive agreement which has as its focus all aspects of biological diversity: genetic resources, species and ecosystems. The Convention acknowledges that the "conservation of biological diversity is a common concern of humankind and an integral part of the development process". In order to achieve its goals, the signatories are required to:

- Develop plans for protecting habitat and species.
- Provide funds and technology to help developing countries provide protection.
- Ensure commercial access to biological resources for development.
- Share revenues fairly among source countries and developers.
- Establish safe regulations and liability for risks associated with biotechnology development.

Jamaica's Green Paper Number 3/01, entitled *Towards a National Strategy and Action Plan on Biological Diversity in Jamaica*, speaks to Jamaica's continuing commitment to its obligations as a signatory to the Convention.

3.0 METHODOLOGY AND APPROACH

3.1 General Approach

A multi-disciplinary team of experienced scientists and environmental professionals was assembled to carry out the required resource assessment, generation of baseline data, determination of potential impacts and recommendation of mitigation measures. An iterative approach among the environmental team members and other project professionals was adopted.

The team utilized the Charette-style approach to data gathering, analysis, and presentation whereby team members conducted the reconnaissance investigations together to determine the critical elements for analysis and the issues to be highlighted for the design and planning process. Team meetings were held to discuss the progress of investigations and analyses and facilitate integration of data toward an understanding of the systems at work in both the natural and built environment.

Baseline data for the study area was collected using a combination of :

- Windshield Survey
- Site Reconnaissance
- Aerial Survey
- Desk Top Research
- Analysis of Maps and Plans
- Review of Reports and background documents
- Public Consultations
- Field Studies
- Laboratory Analyses
- Charette Style Consultations

3.2 Physical Environment

Information was gathered on the existing physical environment, particularly as related to geology, topography, soils, hydrology and drainage, water quality, air quality and noise.

3.2.1 Geology, Topography, Soils

Information on the climate, geology, topography, soils, was obtained by compiling existing data from reports as well as from source agencies. Aerial photos, satellite imagery and other published maps were also examined.

Field work was carried out to augment and verify existing information relating to geology and soils and to obtain first hand knowledge of the topography.

3.2.2 Hydrology and Drainage

Surface and ground water characteristics and flows were assessed using field investigation as well as maps, aerial photographs and data from previous reports.

3.2.3 Air Quality

Particulate measurements (PM 10 - non settleable dust smaller than 10 microns in diameter) were taken at three stations for one day. Sensidyne BDX 530^{CFT} personal high flow portable vacuum pumps were used to collect the respirable particulates. These pumps were calibrated to a suction rate of approximately 2.5 litres/minute using Sensidyne EZ Cal 1 Primary Flow Calibrator. The calibrated pumps were attached to pre-weighed filters fitted to cyclones. The cyclones separate the respirable from the non-respirable particulate by centrifugal forces. Air drawn into the cyclone is accelerated by a circular motion allowing the lighter particles to separate from the heavier ones, which are then collected unto the filters. The pumps with the cyclones were placed at the respiratory height of pedestrians for approximately six hours running time after which the pumps were turned off, the filters removed, stabilized and re-weighed to determine a

Time Weighted Average (TWA) value for the particulates. Respiratory height is the approximate height at which someone conducting his normal daily activity breathes. Weighing of the filters was done at the Jamaica Bureau of Standards, Kingston.

3.2.4 Noise

Noise level readings, wind direction and any unusual local noise sources were recorded. Measurements were taken using Quest Electronics sound level meters, which conform to ANSI S1.4 - 1983, TYPE 2 and IEC 651 - 1979, TYPE 2 standards. The meter was calibrated before and after each set of readings.

3.2.5 Water Quality

The objective of the baseline water quality programme was to determine pre-construction water quality conditions in the coastal environment at an average depth of 0.5m. All samples collected were stored in pre-cleaned 2 L polyethylene and 250/500 ml glass bottles (transparent and opaque). Bacterial samples were collected at the water surface in sterilized 100 ml glass bottles. Dissolved oxygen and conductivity measurements were taken *in situ* at all sampling stations. Laboratory Analyses were performed at the Environmental Solutions Laboratory Division using certified methodology from Standard Methods for Water and Wastewater Analyses (Eaton *et al*, 1995).

3.3 Biological Environment

The status of the flora and fauna of the study area was determined by a review of literature relevant to the area and field investigations for both the terrestrial and marine environments.

3.3.1 Flora

The vegetative communities were identified using the method of Grossman *et al* (1991) and classified into community types. Identification was carried out of dominant tree

species, assessment of stage of growth (mature or sapling) and assessment of canopy cover. The vegetation was identified and described for seven sites along the property

3.3.2 Fauna

Information on avifauna was gathered from existing literature on reported species as well as observations in the field. At the seven sites for vegetation analysis, the avifauna was surveyed by fifteen (15) minute point counts. Birds were identified by both sight and call.

3.3.3 Marine Environment

The marine environment was investigated by SCUBA diving and snorkeling at six sites along the property. Three of these sites were in the back reef area and the remaining three in the fore reef zone. A qualitative assessment of each site was conducted to provide a species list and an abundance (DAFOR) rating for each species. The DAFOR is a subjective rating which provides an indication of whether an organism is Dominant, Abundant, Frequent, Occasional or Rare in the environment. Quantitative data on coral cover and size were collected along 10 m long transects. Data on macroalgal cover and coral recruit densities were collected using 0.25 cm² quadrats.

3.4 Socio-economic Environment

Rapid field appraisal techniques in conjunction with desk research were employed to investigations of the socio economic considerations within the project area, viz:

- typology (urban, rural, unplanned residential, housing scheme, etc.)
- land uses and livelihoods
- developments underway
- community facilities
- water supply and other utilities
- waste management practices
- recreational activities

4.0 DESCRIPTION OF EXISTING ENVIRONMENT

4.1 Physical Environment

4.1.2 Climate

The climate of the Rose Hall area is tropical maritime that is typical of Jamaica's general climatic conditions. The long term mean rainfall for the area is in the order of 150 cm, with the Rose Hall area receiving an annual average of about 100 cm of rainfall. The two months of maximum rainfall are October and May during which about 20 percent of the annual rainfall occurs.

The Montego Bay/ Rose Hall area receives high-intensity short duration rainfall associated mainly with cold fronts that approach Jamaica from North America as well rainfall generated by tropical weather systems. Rainfall intensity estimated at stations at the Sangster International Airport and the Rose Hall property is shown in Table 4.1 indicating the Maximum 24 Hour Rainfall with four return periods of 2, 5, 10 and 25 years.

Table 4.1: Maximum 24 Hour Rainfall for selected return periods

Return Period	Maximum 24 hour rainfall (mm)			
	T2	T5	T10	T25
Rose Hall Station	104	136	166	204
Sangster International Airport	84	147	188	239

(Source: Estimates of Maximum 24 hour rainfall for selected Return Period and for 343 Rain gauge Locations Jamaica.)

The Water Resources Authority estimates that short term rainfall intensity of 85 mm in 30 minutes is possible at the Sangster International Airport.

Humidity ranges between 66% and 87% with a significant diurnal variation resulting in high morning humidity dropping off significantly in the afternoon. Temperatures vary from a monthly daily mean of 23°C in January to about 28°C in July.

Winds approach the area primarily from the east and north east. Annual averages of evaporation from free water surfaces is in the order of 183 cm with the highest rates occurring in May and October.

4.1.3 Topography & Drainage

The study area can be divided into three distinct physiographical areas. The northern most area is a low lying relatively flat coastal strip which runs parallel to the coastline with very low relief and maximum elevation in the order of 10 metres (Figure 4.1).

South of this strip is an area running parallel to the coast consisting of north facing slopes that grade gradually upwards from the coastal strip. The land surface here is gently undulating with low relief except where they are dissected by north-south oriented drainage lines which have produced steep sided gullies.

These slopes attain altitudes in the order of 120-190 meters at the southern edge of this area. Generally this area becomes more dissected with increasing relief moving southward. This physiographical zone makes up most of the area proposed for development.

A third physiographic area is found to the south consisting of more highly dissected hills with less defined drainage lines.

The study area is generally well drained with well defined-drainage channels comprising steep-sided gullies that drain northwards to the sea. The gullies channel mainly intermittent flow that occurs after heavy rainfall except for the Little River that is fed perennially by the Banana Spring.

FIGURE 4.1: TOPOGRAPHY AND DRAINAGE

The long term degradation of the limestone forest together with the thin soil cover and impermeable underlying limestone results in most rainfall flowing over the surface as surface runoff. This surface flow concentrates rapidly and creates significant discharge through all the drainage channels very soon after heavy rainfall. Along the coastline where these drainage channels enter the sea there is considerable build-up of rubble deposited during these storm run-off events.

The surface flow that naturally moves overland northwards from the north facing foot hills has been interrupted by the east west trending roadway and causes ponding on the south side of the road.

4.1.4 Geology & Soils

The main rock type exposed on the Rose Hall site consists of limestone that makes up the hillslopes comprising most of the study area, Figure 4.2. The coastal strip comprises mainly poorly consolidated alluvium and limestone marls found between the beach deposits along the coastline and the adjacent limestone deposits to the south. These deposits formed as a series of fans deposited by sediment laden runoff from streams and gullies. Over time these deposits have coalesced into a continuous apron that slopes gently to the sea.

The coastal zone is underlain by rocks belonging to the Falmouth Formation that is part of the coastal Group of recent reef rock limestones. This formation consists of well bedded to massive, hard, and highly fractured limestone that is exposed close to and just offshore the coastline. Along some sections of the coastline these rocks are exposed as elevated reef rock that form the rugged karst solution features known as ironshore. The shoreline characteristics vary greatly from gently sloping sand pebble and cobble beaches, to rocky coastline consisting of exposed raised reef rock that forms a platform that extends offshore.

FIGURE 4.2: GEOLOGY & SOILS

In general the inshore currents move from east to west but shifts to the opposite direction in June and during storm systems that approach from the west. Highly eroded shoreline with scoured berm heights up to ten feet indicate that the shoreline is subjected to significant wave action. The shoreline is protected by nearshore patch reefs that extend along most of the shoreline of the project area.

The limestone deposits that underlie more than two thirds of the site belong to the Font Hill Formation which is part of the Yellow Limestone Group of rocks (Figure 4.2). This limestone formation occurs in the project area as a yellowish brown marl with a hard rubbly limestone unit and mudstone. The Font Hill limestone has a relatively high clay content and the internal structure of the rock produces poor primary porosity and therefore low permeability. This rocktype occurs as massive deposits and as well bedded outcrops. Plate 1 shows the typical characteristics of the massive, rubbly variety of the Font Hill limestone.

The eastern third of the project area is underlain by the Gibraltar-Bonny Gate Formation that is a member of the White Limestone Group. This limestone is stratigraphically younger and therefore overlies the Font Hill limestones. The Gibraltar-Bonny Gate limestone occurs in the project area as a range of relatively clean limestones varying from massive chalky deposits to well bedded hard recrystallised rocks. There is considerable variation in the characteristics of the both formations sometimes over relatively short distances.

Structurally the area is not complex, with bedding typically gently dipping at angles in the order of 15 to 20 degrees. The major fracture zones that transect the site are found in sets with three dominant orientations. There is an east-west set that is parallel to the coast, a north-south set one of which defines the course of the Running Gut, and a northwest southeast trending set. None of these fracture lineaments are active faults.

Soils overlying the limestone are very thin where present and consists of a light reddish brown gravelly clay. The soil is typically 6 to 12 inches deep on slopes but tends to be deeper in depressions where it can exceed five feet. There is a relatively sharp contact

between the underlying limestone and the soil cover which usually includes abundant limestone gravel (Plate 2).

Soils overlying alluvium along the coast consist of interbedded gravels, sands, silts and clays with marls and shelly limestone soils overlying the Coastal Group rocks.

4.1.5 Surface and Ground Water

Surface Runoff

The Gibraltar–Bonny Gate Limestone is a relatively permeable rock type and therefore most rainfall infiltrates downward to meet the subsurface water table at depths of between 170 and 250 feet above sea level. The underlying Font Hill Limestones are relatively impermeable and form an impermeable barrier at the base of the Gibraltar – Bonny Gate Limestone. Where this contact intersects with the land surface springs such as the Banana Spring occur and flow over the impermeable Font Hill as surface runoff (Figure 4.2). The discharge from the five main springs in the vicinity of the site are shown in Table 4.1.

Table 4.1: Discharge from Five main Springs in the Project Area

SPRING NAME	DISCHARGE (mgd)
Banana Spring	0.13
Riverhead Spring	0.02
Upper Tryall Spring	0.03
Brother Bush Spring	0.01
Doctors Dam Spring	0.12

After heavy rainfall overland runoff from the watershed concentrates and flows through the well defined drainage channels that have developed within the Font Hill Limestone. Significant surface runoff takes place through the gullies that transect the site, the largest of which are the Little River, White Gut and Boyce Gully (Figure 4.3). These channels therefore act as intermittent streams carrying storm runoff to the sea where significant quantities of sediment is deposited. The Little River flows mostly over the more permeable Font Hill limestone but receives its supply from the Banana Spring and therefore the flow is less determined by direct rainfall. The estimated surface runoff from

the Little River, White Gut and Boyce Gully is shown in Table 4.2 indicating the 10 and 50 return period discharge.

Table 4.3: Estimated surface runoff in the Little River, White Gut and Boyce Gully. (Source ETAS 1998)

RETURN PERIOD (YEARS.)	SURFACE RUNOFF (M3/SEC)		
	BOYCE GULLY	LITTLE RIVER	WHITE GUT
10	33	65	15
50	51	100	24
100	61	1212	29

The flow characteristics and configuration of the main drainage channels traversing the site have been modified by the various developments including the construction of dams, collection ponds, golf courses and the construction of concrete channels along the coastal zone. These modifications have not impeded the flow of storm water into the natural drainage channels. A number of ponds naturally occur on the site within depressions in the impermeable limestone that is typically lined by clay soil deposits. Natural ponds have been expanded and artificial ponds created to form water retention ponds. These include the Nursery Lake and Doctors dam in the south east and the Spring Lake in the west. These have a holding capacity of 33, 7.3 and 33 million gallons of water respectively.

Ground water resources on the site are limited because the underlying Font Hill limestone formation acts as an aquiclude and therefore does not yield appreciable water from production wells. The only productive well within the project area is the Banana Spring well that is located at the contact between the two limestone types and forms a natural spring. Extraction from this well has significantly reduced the flow through the Little River channel. The Gibraltar–Bonny Gate Limestone that underlies the eastern third of the project area forms a fairly productive aquifer and production wells yield significant quantities of good quality potable water (Figure 4.2).

4.1.6 Natural Hazards

The location of the project area within Jamaica and the Caribbean basin makes it susceptible to a range of natural hazards including the effects of hurricanes and other tropical systems, earthquakes and to a lesser extent slope instability. Jamaica lies in the path of hurricanes and other tropical weather systems that typically develop and move through the Caribbean basin between June and November.

The location of the project area along the northern coastline of Jamaica makes the coastal zone highly susceptible to the effects of storm surge associated with hurricanes. Low lying areas along the coast are susceptible to inundation and accelerated erosion from increased wave action. Estimates of storm surge along this section of the northern coastline of Jamaica suggest an elevated water height of between 1.5 and 2.5 meters above mean sea level. Intense rainfall associated with these weather systems can cause flooding of low lying areas in the coastal zone.

High velocity winds generated by hurricanes have the capacity to cause significant damage. No significant acceleration of wind velocity is expected over the low lying hills of the project site although structures located on ridges and spurs are susceptible to higher wind speeds.

The study area experienced a magnitude 6.5 earthquake in 1957 with an epicentre 20 kilometers north west off Montego Bay. Analysis of historic seismic events and the tectonic setting of Jamaica by Pereira (1987) has produced seismic zonation maps. These maps (Figure 4.2a) indicate that the project area is located in a zone that is more susceptible to low magnitude earthquakes. These low magnitude earthquakes do have the potential to cause significant damage especially where buildings are founded on alluvium and poorly consolidated sediment along the coastal zone.

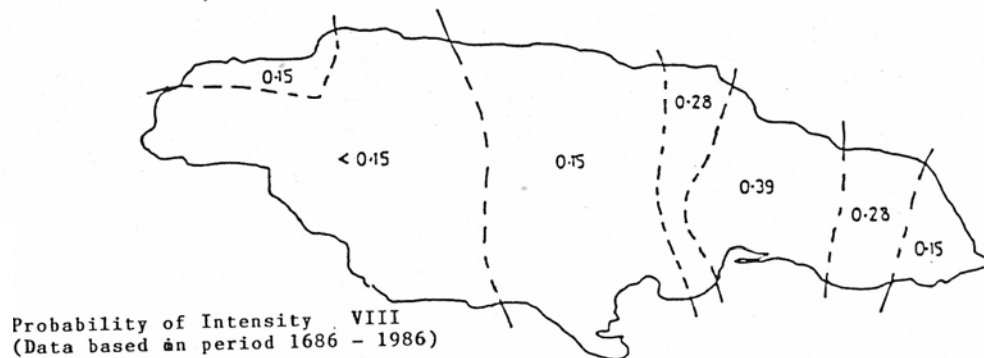
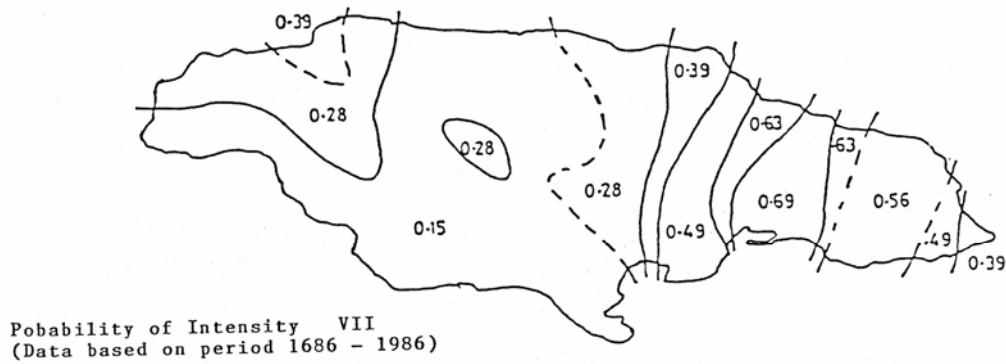
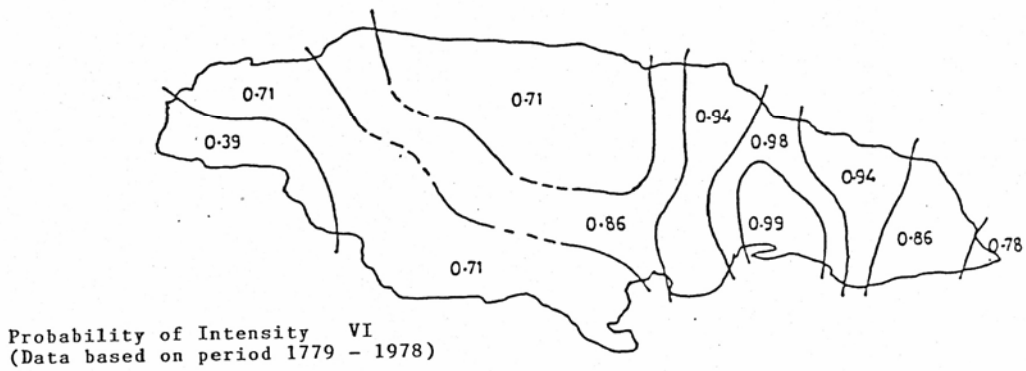
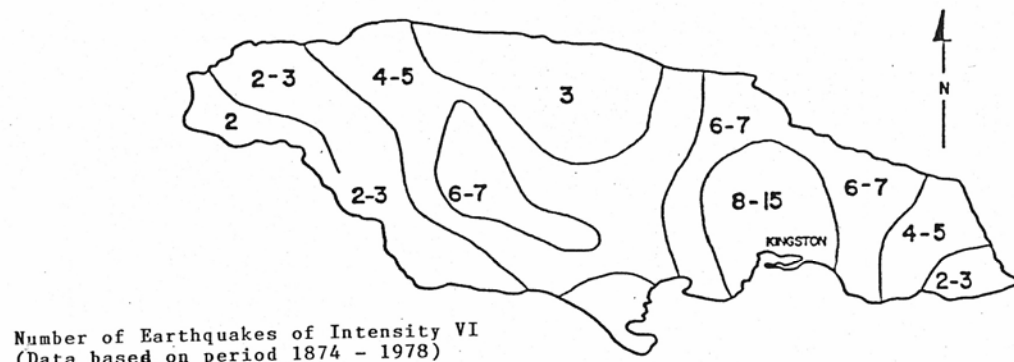


Figure 4.2.a: Earthquake magnitude distribution and probabilities for Jamaica
(Source: Pereira, 1982, 1987)

The stability of natural slopes in the project area is good with no evidence of substantial earth movement. High angle to vertical cuts in the underlying limestone for road placement appear to be stable up to heights of up to 15 feet. Where cuts are made into the well bedded form of the Font Hill limestone a greater degree of instability can be expected along steep cuts where beds slope downwards into the cut.

4.1.7 Coastal Water Quality

The following discussion is based on the analysis of one sample set and thus no conclusive statements can be made about the general water quality of the stations sampled. Sampling stations are shown in Figure 4.3.

The results for the sampling exercise showed that the water at all the stations sampled was well oxygenated with low bacterial levels. Phosphate levels were variable. High phosphate levels were recorded at the mouth of the Boyce Gully and Little River, significantly exceeding the National Environment and Planning Agency's (NEPA) interim ambient marine water quality standard. Lower levels were measured at the other three stations. Nitrate, biochemical oxygen demand and total suspended solids were high at all stations sampled.

These readings indicate high nutrient loading and high levels of sedimentation, possibly due to terrestrial run-off which carries fertilisers from agricultural practices and golf courses, as well as loose soil.

FIGURE 4.3: WATER QUALITY STATIONS

Table 4.3: Water Quality

PARAMETERS	NEPA Ambient Interim Water Standards	STATIONS				
		White Gut River WQ1	Little River Reef front WQ2	Little River Mouth WQ 4	Boyle Gully Reef front WQ3	Boyle Gully Channel WQ5
pH	6.5-8.5	7.9	7.9	7.9	7.9	7.9
Dissolved Oxygen (mg/L)	>4	6.7	6.5	6.4	6.4	6.7
Salinity (ppt)	-	35.5	35.4	35.4	35.4	35.4
Temperature (°C)	-	27.9	27.7	28.2	27.7	27.9
BOD (mg/L)	2	30	30	24	19	18
TSS (mg/L)	10	75	51	14.7	48	45
Nitrate (as nitrogen) (mg/L)	0.001 – 0.081	2.0	2.3	2.4	1.1	2.0
Phosphate (mg/L)	0.001 - 0.055	0.01	0.01	1.43	0.01	1.43
Total Coliform (MPN/100ml)	<500	<3	<3	<3	<3	<3
Feacal Coliform (MPN/100ml)	<100	<3	<3	<3	<3	<3
Oil & Grease (mg/L)	10	2.4	10.3	<2.0	4.13	9.0

4.1.7 Air Quality

Particulate matter (PM) refers to discrete particles in ambient air that exist either as solid particles, or as liquid droplets. The sources of PM are: natural, e.g. pollen; a combination of natural and man-made in variable proportions, e.g. dust in a park, roadside dust, smoke from vegetation and wood burning; and wholly man-made, either: - naturally, e.g. household dust from skin shedding; or - activity-related, e.g. smoking, cooking and barbecuing, vehicle use, industrial activities, etc.

The sizes of PMs cover a very wide range: from the tiniest in smokes and aerosols (e.g. perfumes), through the maximum respirable size 10 microns (μm) up to ‘grit in the eye’ sizes of 100 μm and upwards. Many particles do not maintain a constant form during their lifetimes in the atmosphere: many agglomerate to become fewer, larger particles whilst others react chemically to become something different altogether. The normal fate

of PM is deposition. The rate of deposition depends upon the size and density of the particle. The deposition rate in still air approaches 90 to 100 per cent for particles that are, larger than 0.5 μm (*fraction measured in this assessment*), whilst particles smaller than 0.5 μm will tend increasingly to remain suspended in the air. Atmospheric turbulence is an important factor and can have opposite effects. On the one hand, ventilation disperses concentrations of PM, while on the other hand turbulence reduces the rate of deposition. Hence, the PMs' size distributions, their other physical and chemical properties and their concentrations in ambient air are highly variable, depending on the particular characteristics of the biosphere at issue (e.g. urban or rural) and the ecosystem involved (e.g. indoor, outdoor, roadside, etc.).

Atmospheric particulate matter concentrations in ambient air can influence both human health, and flora and fauna. It is the effects however, on human health that evokes the greatest concern. Exposure to fine airborne particulates has been linked to increased respiratory illness, decreased lung function, and premature death. The lower sized particles are of most concern because they are directly respired into lung tissue. In recent times health issues have been related to the chemical nature of the particle, for example the particulates from diesel vehicle exhausts carry certain chemicals (called polycyclic aromatic hydrocarbons, PAH) similar to those found in cigarette tars. Low levels of ambient particulate matter have been cited as a contributory cause of particular diseases, such as asthma.

Sulfate and nitrate particles contribute to acid rain, which can damage forests and reduce fish populations. Particulates may be instrumental in interfering with biological processes, for instance, soot on leaves, which can interfere with photosynthesis.

Crustal material is very similar to dust. It enters the air from dirt roads, fields, and other open spaces from wind, traffic, and other surface activities. Whereas other types of particles form from the condensation and growth of microscopic particles and gasses, crustal material results from the crushing and grinding of larger, earth-born material. Because it is difficult to reduce this material to microscopic sizes, crustal material tends

to be larger than other particles and tends to fall from the air sooner, contributing less to the overall effect of haze, but contributes significantly to respirable particulate levels.

Respirable particulates are therefore an important element of any tourist destination, as most recreational activities are likely to be outdoors.

The results of the ambient respirable sampling exercise conducted (Figure 4.3) will be submitted as a separate report.

4.2 Biological Environment

4.2.1 Vegetation

The undeveloped areas of the Rose Hall property are mainly ruinate pastureland interspersed with areas of disturbed dry limestone forest. Two large triangular areas on the White Witch Golf Course constitute the dry limestone forest remaining on the property. The margins of the dry limestone forest generally show signs of disturbance, with mainly shrubs occupying the dense undergrowth. Along the coastal area of the property, one may find the dry limestone thicket, as well as open areas.

The property covers a range of ecological habitats, extending from the coast into the mountains. The land has previously been used for agriculture and subsequently cattle farming. The remains of old pastureland are found throughout the property. Data from the vegetation survey is given in Appendix V.

Site 1

This site is located at the eastern end of the Rose Hall property, across the main road south of the Wyndham Rose Hall hotel. This area is ruinate pasture land, and is mainly open with scattered trees and low-growing grasses and herbs. The substrate is mainly limestone with a thin layer or a few pockets of soil.

The southern side of the site is bordered by degraded dry limestone forest. The forest canopy slopes from approximately 3 m high bordering the pastureland, to 5.5 m high further to the south. The forest is densely vegetated at all levels, and the forest floor is covered in leaf litter. The trees are mainly saplings with a trunk diameter of less than 10 cm, and often less than 5 cm. Larger diameter trees are few and scattered throughout the area.

The pastureland appears to have been cleared some months ago as suggested by piles of dried vegetation such as *Acacia sp.* Some evidence of soil erosion was also noted. Garbage was also frequently noted throughout this site.

Further south, moving towards the mountains, the degraded forest is bordered by dry limestone thicket. This is dominated by densely-growing *Acacia sp.* and is approximately 1.5 to 2 m high.

Vegetation present at this site includes Seymour, Guinea and Crab grass in the pastureland, as well as Spanish Elm, *Bursera simaruba* (Red birch), Naseberry, Trumpet tree, Taliandra, Cockroach Poison, Devil's Horsewhip, Pussclaw Macka, Cow-itch and *Tillandsia sp.* throughout the remainder of the site. A variety of sweetwoods and trees bearing berries also occur. At least seven species of butterflies were seen, as well as eight species of birds.

Site 2

This site is located further south, following the road across from the Wyndham Rose Hall hotel. A dam is located adjacent to the road, the banks of which are covered in grasses and herbs. At the time of the survey the banks were being sprayed, possibly with pesticides. The surrounding vegetation is characterized by scattered short *Acacia sp.* plants (< 2 m tall), as well as isolated *Samanea saman* (Guango), Red Birch, Trumpet tree, *Psidium guajava* (Guava), *Musa sp.* (Banana) and Bamboo. A few water-birds were seen in and around the dam.

Site 3

This site is located just northeast of the Mount Zion community, overlooking another dam, close to an old marl pit. The dam is overgrown with bulrushes and some *Nymphaea sp.* and hosts numerous moorhens. The water level was low at the time of observation, but citizens of the area report that it has been known to overflow its banks.

The vegetation is mainly composed of *Acacia sp.* and Hops bush in ruinate pastureland, with scattered clumps of trees such as Guango, *Spathodea campanulata* (African tulip tree), Red birch and Trumpet tree. Bamboo, Guava, Susumba, *Ranunculus sp.*, a number of ferns and a species of palm tree also occur.

Further to the west the vegetation is of the degraded or disturbed dry limestone forest. A number of large fruit trees are present, and were probably introduced by members of the nearby community. These include *Blighia sapida* (Ackee), *Artocarpus incisus* (Breadfruit), *Mangifera indica* (Mango), Naseberry and *Tamarindus indica* (Tamarind). *Terminalia catappa* (Almond), *Delonix regia* (Poinciana), Pimento, Spanish elm, *Haematoxylum campechianum* (Logwood), Red birch and Molina also occur.

Site 4

This site is located near the southern border of the property, west of Mount Zion. Due to the elevation at this site, the greater part of the Rose Hall property is visible, from the golf courses to the ocean. Grasses, *Acacia sp.* and Hops bush dominate the vegetation, with scattered forest trees of the aforementioned types. The scrub canopy here generally does not exceed 2 m in height. Large termite nests were occasionally seen in some of the forest trees. Eight bird species were seen at this site.

Site 5

This site is near the western boundary of the property, east of Spring Farm Drive. The vegetation may be categorized as a disturbed dry limestone forest. The canopy is approximately 6 m tall with no distinct tiers. The under-canopy region is densely vegetated at all levels, with a number of shrubs as well as saplings. The trees are mainly less than 10 cm in trunk diameter. The larger trees include Poinciana, Guango, Logwood, Red birch and Mango. A number of sweetwoods were seen, as well as trees bearing pods and berries. Some of the forest trees also supported cactus epiphytes. Bamboo, *Leucaena glauca* (Wild Tamarind) and *Thrinax sp.* (Thatch palm) were present in small numbers amongst the *Acacia sp.* thicket which occurred at the margins of the forest.

Site 6

This site is located on the golf course to the west of Cinnamon Hill. To the east the golf course is bounded by *Acacia sp.* thicket and to the west by a stand of hardwood trees. Amongst the *Acacia sp.* thicket one may also find Guinea grass, Trumpet tree and *Ranunculus sp.* In the forest, amongst the various hardwood trees, one may also see Guango, African tulip tree, sweetwoods, Spanish elm, Red birch, *Adenanthera pavonina* (John crow bead) and Logwood. Also visible from this point are Breadfruit, *Ficus sp.* (Banyan) and bamboo, as well as ornamental vegetation such as *Cycas sp.*, *Ravenala madagascariensis* (Traveller's Palm) and *Cybistax donnell-smithii* (Poui) trees.

Site 7

This site is along the main road between the coastal side and land side of the western region of the property. The vegetation is mainly low grasses and succulent herbs, with a scattered assortment of shrubs and trees. The plants seen include coastal plants as well as ornamentals. Species identified are as follows: *Coccoloba uvifera* (Sea grape), *Acacia sp.*, *Thrinax sp.* (Thatch palm), *Roystonea elata* (Royal Palm), Almond, *Casuarina equisetifolia* (Willow), *Araucaria excelsa* (Norfolk Island Pine), *Cocos nucifera* (Coconut), Poinciana, Guango, Guinea grass, *Tecoma stans* (Yellow elder), *Cassia sp.*, *Bougainvillea sp.*, Bottlebrush, *Bauhinia variegata* (Poor man's orchid), Oleander, Black olive and *Ficus sp.* The area is very open, without a definite canopy due to the dispersed nature of the trees and shrubs.

4.2.2 Fauna

A field survey and literature research were conducted to identify existing avifauna on the site. Historical information was also used from previous studies on the Rose Hall property. Information on marine turtles is also given as they are reported from the sandy beaches on the property. Data generated from field investigations is given in Appendix V.

4.2.2.1 Historical Data

A study by ETAS (1998) for the Ritz Carlton Golf Course, recorded 45 species of birds, with 368 individuals, indicating that the area retained sufficiently stable and diverse vegetation to attract a diverse bird community. No endangered or threatened species were observed in that study. More than half of the endemic bird species in the project area occurred in areas with mature trees. During that study, which occurred during the over wintering period for North American migrants, 10 migrant species were reported and one migrant shore bird the Bleck-bellied Plover. All the migratory species were considered to be common within the area and the Palm Warbler, restricted to open grassy areas, was expected to increase in numbers with the construction of the Ritz Carlton Golf Course.

4.2.2.2 Birds

The avifauna found on the property are generally species common to Jamaica. At least 27 species of bird were identified, five of which are endemic to Jamaica, and one of which has become threatened throughout its range due to habitat destruction and hunting. Previous studies (EIA: Rose Hall Irrigation Earth Dams, 1999) done on this property have identified a further seven bird species, three of which are endemic to Jamaica. This brings the total number of bird species seen on the property to at least 34, with 8 endemic species. The ETAS (1998) survey reported that a total of 45 species, 11 of which are endemic, are present on the Rose Hall property. The smaller number of species observed during the present survey as compared to the ETAS survey is probably due to the fact that observations were carried out during the afternoon and evening, rather than at dawn when birds are most active.

During this survey, at least 6 of the bird species seen are those usually found in association with freshwater bodies. These species were generally seen in the vicinity of the dams, which add diversity to the ecological habitats on the property. The birds most commonly seen at all sites include the Northern Mockingbird, Loggerhead Kingbird,

Zenaida Dove and Common Ground Dove. These birds are ubiquitous, are common in disturbed areas, and often inhabit urban areas or developed areas.

The Rose Hall property, with its dry limestone forests, is probably an important bird habitat due to the quantity of birds seen and heard, even in the middle of the day when most are inactive. A number of trees bearing fruits and berries constitute the disturbed and dry limestone forests, and provide sustenance for many bird species. The dense vegetation also provides suitable habitat for more reclusive species.

4.2.2.3 Sea Turtles

Turtle nesting has been reported to occur on the sandy beaches from Half Moon Resorts east to The Palms. Sea turtles are a migratory species which are known to return to the same nesting beach. There are five species of sea turtles that occur in Jamaica the two most common species being the Hawksbill turtle (*Eretmochelys imbricata*) and the Green turtle (*Chelonia mydas*). Sea turtles are protected by both national and international legislation. The modification of beaches for recreational use, high level of human activity and night lighting have been known to impact on turtle nesting sites.

4.2.3 Marine Environment

The marine area extending from the Wyndham Rose Hall Hotel to the Half Moon Hotel is quite uniform in its physical and biological characteristics. A fringing reef extends throughout the area, and is part of the north coast fringing reef system. It may be divided into two distinct areas – the back reef zone and the fore reef zone. These areas are not separated by an emergent reef crest; the back reef area slopes gently into the fore reef zone. The back reef zone is within 100 m of the shore, and is quite shallow.

4.2.3.1 Back reef zone

The back reef is characterized by shallow (1.5 to 4 m), flat or gently sloping pavement covered by a thin layer of sand. Closer to shore the pavement is covered by a deeper layer of sand which merges with the beach. The sand in the back reef zone is white and of fine to medium grain, and covers approximately 50% of the substrate. The sand appears to contain fine limestone sediments carried by run-off water from further inland.

This zone is dominated by fleshy brown algae and filamentous turf algae. Macroalgal cover is approximately 30%. *Sargassum*, *Turbinaria* and *Dictyota* are the most commonly seen. Calcareous green algae such as *Halimeda*, *Penicillus* and *Udotea* also occur in smaller quantities, as well as the red alga *Jania*. Crustose coralline algae is infrequently seen, mainly because of sedimentation throughout the area. Fleshy macroalgae were relatively tall, with heights of 15 to 25 cm. Calcareous macroalgae were generally less than 10 cm in height.

Patch reefs and isolated coral heads characterize the coral of this area. Live hard coral cover is generally low, at less than 5%. The most commonly occurring scleractinians are *Siderastrea radians*, *Montastraea annularis* and *Porites astreoides*. Isolated small heads of *Montastraea cavernosa*, *Siderastrea siderea* and *Diploria strigosa* are also present. Coral rubble is scattered throughout the area, and sediment- or algal-covered standing dead colonies are frequently seen. The gorgonian coral *Pterogorgia guadalupensis* is common in this zone, as well as *Eunicea mammosa* and *Pseudopterogorgia sp.*

The fish community is mainly composed of small reef fish, and is dominated by parrotfish, doctorfish, damselfish and wrasses. Fish are generally not very numerous in this zone. A large proportion of the community is composed of juveniles, with the remaining mature fish being small, at an average length of ≤ 20 cm.

Small patches of sparsely growing seagrass (*Thalassia testudinum*) were occasionally seen in the back reef area, as well as a few urchins (*Diadema sp.* and *Tripneustes sp.*).

Encrusting sponges were seen occasionally on dead coral heads, and numerous mounds of sand created by *Arenicola sp.* were distributed throughout the deeper sand patches.

4.2.3.2 Fore reef zone

The fore reef zone is made up of well-developed spur and groove formations, oriented with their long axes parallel to the prevailing currents. This zone occurs at depths of 5 to 12 m, with the tops of the spurs at depths ≥ 2 m. Large sand channels separate the spurs, the sand being coarse, and made up of disintegrating *Halimeda* fragments.

Macroalgal cover on the fore reef is relatively low, at approximately 30%. Crustose coralline algae occur in patches covering dead coral substrate, with an overall cover of 10%. Turf algae are common on exposed hard substrate. The macroalgal community is mainly composed of brown algae such as *Dictyota*, *Sargassum*, *Styopodium*, *Lobophora* and *Turbinaria*, and green algae such as *Halimeda*, *Ventricaria* and *Caulerpa*. Calcareous macroalgae were generally short, with heights of 3 to 8 cm. Fleshy macroalgae were taller, with an average height of 15 cm.

Live coral cover is approximately 20% on the fore reef, with colonies of approximately 20 to 40 cm diameter. A few colonies were seen which measured more than 1 m in diameter. *Montastraea annularis*, *Porites astreoides*, *Millepora sp.*, *Agaricia agaricites* and *Siderastrea sp.* are the most commonly seen. Coral recruits (colonies < 2 cm in diameter) were occasionally seen. Old coral rubble occurs throughout the site, indicating that this area suffered severe damage from storms. At site 2, (Wyndham Hotel), a large stand of *Acropora cervicornis* was found. The majority of the stand appeared to have died a long time ago, but small areas were still healthy.

Fish were numerous at the fore reef sites, and were mainly scarids (parrotfish), acanthurids (doctorfish), pomacentrids (damselfish) and labrids (wrasses). Mixed schools of grunts and snappers were occasionally seen. The parrotfish present were juveniles as well as initial and terminal phases. The mature fish were not very large, most being less than 20 cm long. Other commercially important fish were present in small numbers, such

as hogfish, spanish hogfish, bar jacks, graysbys and goatfish. The area shows signs of over-fishing due to the relatively small numbers of fish seen, and the predominance of juvenile and small mature fish. A few fishermen were seen in the area, as well as the occasional fish pot.

Numerous *Diadema* were present on the reef, with densities of 4 m⁻². The presence of these herbivorous echinoderms aids in the suppression of macroalgal growth, providing clear hard substrate on which coral larvae may settle. These urchins are important in this area due to the relatively low numbers of herbivorous fish present.

Mounds belonging to the lugworm *Arenicola sp.* were frequently seen throughout the sandy grooves. A few species of sponge were also seen, particularly the encrusting form of the brown variable sponge. Gorgonians are fairly common in this zone, with four species occurring frequently. The corky sea fingers and the grooved-blade sea whip were seen most regularly.

4.2.3.3 Specific site descriptions

Site 1 – Wyndham Rose Hall Hotel

This site is at a depth of 4.5 m, and is part of the back reef zone. Approximately 30% of the substrate is covered in sand. Live scleractinian coral cover ranges from 5 to 10%, and gorgonian cover is approximately 5%. Macroalgae covers the remaining 55 to 60% of the substrate. The area is mainly flat pavement with scattered shallow depressions. The coral heads are generally isolated rather than occurring in an organized structure. The majority of the coral heads seen are long dead, probably due to storms or anthropogenic effects such as over-fishing and nutrient pollution.

Site 2 – Wyndham Rose Hall Hotel

This site is in the fore reef zone. It ranges in depth from 6 to 9 m, and is made up of well-developed spurs and grooves. The tops of the spurs rise to depths of 1.5 m. Live hard coral cover increases to approximately 20%, and sand cover decreases to approximately 20%. Crustose coralline algae occupy 10% of the substrate, while macroalgae covers 25

to 30%. The remaining 20 to 25% is covered by gorgonians, sponges and other benthic cnidarians. *Diadema* are common at this site.

Site 3 – Three Palm Restaurant

This site is located between the Wyndham Rose Hall Hotel and the Ritz-Carlton Hotel, where the main road is visible through a gap in the coastal vegetation. This is a part of the fore reef zone, and is approximately 7.5 m deep. This site also displays the spur and groove formation with the long axes oriented in a south-west to north-east direction. The sand channels or grooves are particularly wide in this area, and coral rubble is quite abundant.

Site 4 – Ritz-Carlton Hotel

This is a back reef site which slopes gently from 1.5 to 4.5 m depths. Sand cover is high, at 40 to 50%, and is interspersed with sparsely growing seagrass blades. Macroalgal cover averages 30% cover at this site, and turf algae is abundant. A number of gorgonians occur here, but live hard coral cover is low. The dominant scleractinian at this site is the small *Siderastrea radians*.

Site 5 – Half Moon Hotel

This is a fore reef site and again shows the spurs and grooves characteristic of the study area. This area ranges in depth from 6 to 9 m. Although *Diadema sp.* were frequently seen at this site, it seemed to be quite degraded, as greater macroalgal growth was observed here. The sand channels in this area were quite wide.

Site 6 – Half Moon Hotel

This back reef area showed a large degree of overgrowth by macroalgae, with cover reaching up to 70%. Live hard coral cover was less than 5%, and gorgonian cover was also 5%. Approximately 2% of the substrate was covered by sponges, and the remaining 18% was covered by sand. This site is at a depth of approximately 3 m, and slopes gently down toward the fore reef zone.

Figure 4.4: Comparison of number and abundance of species between fore and back reef sites

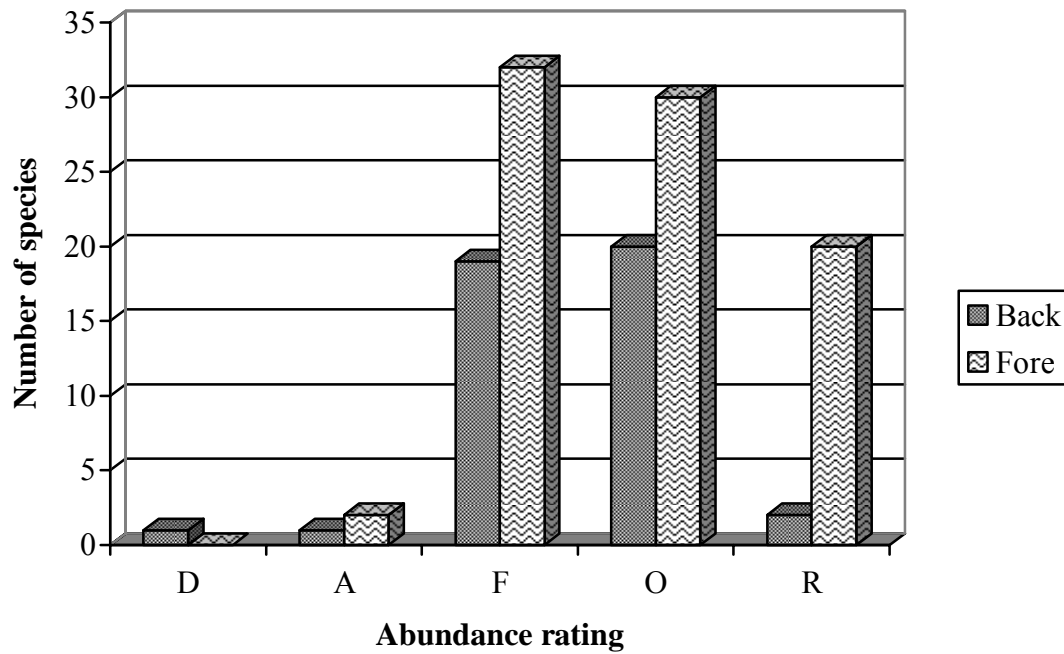


Table 4.5: Percent cover of the different algal types occurring at Site 1 (Quadrat data)

Quadrat	Algal type		
	Fleshy	Calcareous	Crustose coralline
1	15	1	5
2	5	10	80
3	15	5	5
4	20	20	30
Average	14	9	30

4.4 SOCIO ECONOMIC ENVIRONMENT

4.4.1 Regional Setting

The Rose Hall estate located east of the town centre of Montego Bay is a historic sugar plantation that sits amidst significant tourism development extending from Montego Bay through Falmouth and ultimately Ocho Rios. As indicated in Section 1.2 of this report conversion of the estate lands to urban/resort/residential uses has been occurring since the late 1960's when the Rose Hall Great House was restored as a major tourism attraction.

The estate forms part of the Greater Montego Bay Area (GMBA) for which a development plan to the year 2014 was drafted and eventually promulgated by the Greater Montego Bay Redevelopment co. (GMRC) in 1997. The GMBA is the residential and economic core of St. James and covers an area of 52,168 acres extending over a radius of 19 kilometers from Montego Bay to include 38 residential districts in 42 planning areas. The 2001 Census of Jamaica refers to the Montego Bay "*Special Area*", which essentially incorporates the GMBA.

The project falls within planning district (D36) in the GMBA PLAN 2014 and includes the areas of Rose Hall and Spring Farm with a total area of 2675 acres that has been "*zoned for mixed resort commercial /residential (that) will be important for the expansion of the city needs for culture, housing, entertainment and amusements and expansion of the tourism product. It has the potential to develop into a cultural and historic node with the Rose Hall Great House property*". The land use projections for the Rose Hall/Spring Farm planning district designated 542 acres for housing, 148 acres for public use and 61 acres for commercial development.

Key development plans within GMBA relate to expansion of the Freezone, Freeport and Donald Sangster International Airport (SIA). Tourism is posited as the growth industry and economic mainstay of the GMBA.

Figure 4.5 shows the Greater Montego Bay Area.

FIGURE 4.5: Greater Montego Bay Area

4.4.1.1 Population

The 2001 Census indicated a population of 174,120 for the parish of St James, and 55% (or 95,940 persons) is located in Montego Bay and its immediate environs (referred to collectively as the Montego Bay Special Area). The population of the GMBA was estimated at 98,000 in 1995 with an annual growth rate of 2.5%. About 80,000 workers are estimated to commute and work within the GMBA on a daily basis, and population numbers rise with the introduction of cruise ship and stop-over visitors. Unemployment rates in the GMBA are estimated at 17% with 65% of current economic activity consisting of family type businesses.

4.4.1.2 Land Use & Economy

Land use within the GMBA (Figure 4.6) is dominated by tourism/resort – related enterprises and residential development. Freezone, shipping, agriculture, and wooded areas add to the mix of uses.

The area has about fifty percent of Jamaica's tourism accommodation and accounts for approximately 35% of the national tourism earnings. The economy of the GMBA represents about 6% of national GDP.

Over the last 20 years the GMBA has developed into a major regional centre and the economy has been further diversified into light manufacturing, transshipment, information processing, and agribusiness.

Figure 4.6: Land Use

The tourism sector is the main economic activity employing about 29,000 persons within the GMBA. Expansion in the tourism sector will be the main area of economic growth. Currently the GMBA has about 4,200 tourist rooms with a mix of hotels, guest houses cottages and apartments. About 50% of available rooms are found in hotels with 200 or more rooms that represent about 13% of all accommodation types.

Cruise shipping has seen a steady increase over the last 20 years and also represents a distinct growth area within the sector. Currently the total number of cruise ship visitors is in the order of 200,000 per year with an average expenditure per passenger of about US\$90 per person. Cruise shipping activities with the GMBA accounts for about 35% of the total foreign exchange earnings from tourism.

Figures provided by the Jamaica Tourist Board indicate that the four main hotel properties lying within the Project area account for 37.4% of visitors to Montego Bay. The Project, must therefore be regarded as significantly positioned, in relation to Montego Bay's tourism product.

4.4.1.3 Infrastructure

Water Supply

Potable water is supplied to the GMBA from the Great River and Queen of Spain's Valley water treatment plants with a combined output capacity of 32 million gallons per day supplying current demand of an estimated 24 million gallons per day.

Sewage

The Bogue Sewage Treatment plant with a total capacity of 10.5 million gallons per day currently handles 4.5 million gallons per day. Treatment utilizes a combination of aerated ponds and mechanical treatment. The National Water Commission is currently expanding the sewerage network to include more buildings within the GMBA.

Solid Waste Disposal

Solid waste is currently disposed of at the Retirement Dump which is currently being upgraded to function as a landfill site. The site receives about 80 tonnes of solid waste per day and serves the parishes of St. James and Hanover.

Electricity and Telecommunications

The Jamaica Public Service Company supplies electricity to the GMBA., and recent improvements at the Bogue plant have greatly enhanced power supply to the GMBA.

The telecommunications services are provided to the GMBA by all the service providers in Jamaica, and data transfer services are provided by the Montego Bay Digiport facility.

Transportation

Montego Bay is the major transportation node for western Jamaica. Ground transportation for commuting non resident population, local residents and tourists is largely by privately owned taxis and mini buses. Larger minibuses and tour buses transport passengers out of the city. The North Coast Highway Improvement Project (NCHIP) includes as Segment II upgrading of the link between Montego Bay and Ocho Rios. This improvement includes development links that bypass the towns of Falmouth, Duncans and Rio Bueno, and will function as an improved transportation corridor.

Recent road improvements within the GMBA has improved traffic flow and eased traffic congestion, and NCHIP is expected to further improve traffic movement.

The Donald Sangster International airport serves as the hub of the national airline, Air Jamaica, and is the larger of two international airports serving the island, transporting most of the Jamaica's tourists to the island. The airport was recently privatized under a development agreement and an expansion and development plan is underway.

The Montego Bay Freeport is a major transshipment container port, and cruise berths are available. The Freeport lies adjacent to and serves the the Montego Bay Freezone.

4.4.2 THE PROJECT AREA

The development area is bordered by Ironshore on the west and Lilliput on the east, two contrasting residential communities in terms of income levels, design, ownership and infrastructure. Other communities within the project's area of influence include Barrett Town, Spot Valley, Cornwall, Mount Zion, Rhyne Park, and Spring Farm Estate. Lilliput is a sprawling squatter community on the hills adjacent to the Rose Hall property. (Figure 4.6) Ironshore is a higher income area with permanent and villa residential development.

4.4.2.1 Population

The Project area and its neighbouring communities have a combined population of 16,956 which together account for 8% of the population of the GMBA (Table 4.6). Flankers and Torado Heights/Coral Spring have been included in the community population figures although they are further removed from the immediate environs of the site. However, both communities are dominant in this particular section of the GMBA.

Table 4.6: Population Statistics

Communities	Population
Lilliput	4,865
Barrett Town	1,441
Spot Valley	531
Cornwall	405
Mount Zion	230
Half Moon/Spring Farm	246
Torado Heights & Coral Gardens*	1,351
Ironshore	676
Flankers*	7,211
TOTAL	16,956

* not in the immediate environs of Rose Hall

4.4.2.2 Land Use and Livelihoods

The Rose Hall property that makes up the project area consists of about 5,200 acres of former sugar estate lands, with approximately 28,300 feet of beach frontage. The property has been under development for some time as outlined in **Section 1**, and continues to be upgraded as a tourism resort area, including upscale housing development. The Spring Farm Estate and the Highlands Estate are two upscale residential developments located towards the centre and west of the property.

Land use and livelihoods are dominated by tourism/resort infrastructure – hotels, shopping, golf courses and other attractions. Several large upscale properties lie within the development area: Half Moon Resort, The Ritz Carlton Golf and Spa Hotel, and the Wyndham Rose Hall Resort and Country Club. Each of these properties has a golf course, and the Half Moon Resort has a medical facility and shopping centre. In addition to the phases already developed and described in Section 1, two additional golf courses have been completed and commissioned on the Rose Hall Estate– Three Palms and White Witch. Three sectors of residential villas – L, M and O have received permits for construction. A Conference Centre is proposed for the site as is another Great House attraction. Approximately 34% of the site will be retained in forest cover, in addition to the open green areas occupied by the golf courses (36%), making a total of about 70% of the Master Plan site not covered by residential and structural developments.

The heritage site and major tourism attraction - Rose Hall Great House - and the historic Mount Zion community are also found in the southern more hilly parts of the property.

The remainder of the lands along the coast consists of undeveloped coastal flatlands while the hilly area south of the main road consists mainly of undeveloped degraded secondary limestone forest and grass covered hills.

Several fishing beaches of varying sizes and activity lie along the shore from Montego Bay to the area east of Rose Hall. Success Beach lies immediately east of the project

area. The beach is licensed, accommodates approximately 20 boats and twenty fishermen. Other beaches from west to east include Whitehouse, Flankers, Harvey and Grange Pen. Fishermen report unsatisfactory infrastructure at the beaches (lack of water supply, sanitation, and electricity) and declining catch which they attribute mainly to effects of Hurricane Gilbert, dumping of construction material and garbage on the coast, and the removal of mangroves. They also acknowledge the problem of over fishing and point to their own inappropriate use of smaller than recommended wire gauge in making pots. Several fishers refer to “chemical contamination” of the coastal waters.

Surrounding communities are dominated by residential and small-scale agricultural use. Employment is dominated by hotel-related work - mainly domestic services, hotel construction and to a lesser extent craft. Under-employment or outright unemployment is evident.

The main characteristics of the surrounding communities are discussed in the following section.

4.4.3 SURROUNDING COMMUNITIES

Barrett Town

Barrett Town is a lower middle and low income, unplanned community with some squatter elements. The population of Barrett Town is in the order of 1,441 (STATIN 2001) having grown by 20% over the last 10 years. About 360 dwellings and 47 small business establishments are found in Barrett Town.

Barrett Town is largely a residential community with limited small scale trading activities mainly in food retail and household services. The main occupations of the residents are based on domestic and artisan skills supplied to the tourism sector outside of the community. The community is served by a health clinic, a police station, a playing field an all age school, and a primary school currently under construction.

The town receives metered piped water from the National Water Commission (NWC) and is supplied by an eight inch main. Several wells lie upland of the community, none of which is currently a source of water to NWC. Run off pits (30%) and pit latrines (70%) are the main sanitary conveniences used. Garbage disposal & collection is undertaken by Western Parks and Markets (WPM). Unauthorised dumping of household garbage also takes place in the Boyce Gully (the main storm water discharge route to the sea). The main mode of public transportation for community members is by route taxis.

Spot Valley

Spot Valley is a low income, unplanned community with squatter elements with about 55 dwellings and 5 small shops that is part of the old Spot Valley estate lands. The population of Spot Valley based is about 500 with a high proportion under age 35. Land use is mainly residential. Some small-scale back yard gardening is in evidence. Small businesses are mainly in food retail and household services. Main occupations involve domestic and artisan skills supplying services outside of the community.

The community is served by a church, a postal agency, a basic school and a sports field. The NWC provides metered water to the community. Run off toilets and pit latrines are the main sanitary conveniences used.. Garbage is collected by WPM. The main mode of public transportation for community members is by route taxis.

Important heritage elements are found on the surrounding former Spot Valley Estate lands including Taino middens and burial sites as well as Taino cave art. The ruins of the old Spot Valley estate sugar factory are also of heritage value.

Two large middle and upper income housing scheme developments are currently being planned on the western border of the community. One referred to as the Spot Valley Development will comprise 600 two bedroom single units. Also designed for are a shopping arcade, fire brigade station, police post, taxi stand, bus station and a public park (incorporating the ruins of an old sugar factory). A further 500 individual houses and 700 town house and apartment units are also to be built as part of this development. West

Indies Home Contractors, who are currently building a school in the community, are also planning a 560-600 two-bedroom lower middle income-housing scheme. These developments will significantly impact the growth and economic prospects of Spot Valley.

Cornwall

Cornwall is a lower middle and low income, unplanned community with about 200 residents, about 35 dwellings and 8 business establishments, mainly small food retail and other household services. No schools clinics or churches are present but there is a playing field.

The community is largely limited small-scale trading activities the most significant of which is a small hotel and guesthouse, catering to the tourist and local market. Water is supplied by the NWC. Run off toilets and pit latrines are the main sanitary conveniences used. Household garbage is mainly disposed of through burning and burying although the MPM collects garbage infrequently. The main mode of public transportation for community members is by route taxis.

Mount Zion

Mount Zion is a small, low income, unplanned community with some squatter elements with a population of just over 200 persons. The community consists of about 36 dwellings and 8 business establishments, mainly small food retail and other household services. Mount Zion lies at the end of a popular Bike Trail offered as an attraction by several hotels where tourists enjoy the view of the sea and tour the Mount Zion Church, dating from 1838.

The main land use is residential interspersed with the production of cash crops, mainly carrots and sweet peppers. The community is also served by an all age school, which provides a sports field for the community. Water supply is metered via the NWC. There are no health clinics in Mount Zion. Pit latrines are said to account for about 70% of the sanitary conveniences used with the remaining 30% being flush toilets. There is garbage

disposal system and therefore household garbage is either burnt or buried. The main mode of public transportation for community members is by route taxis.

Mount Zion was a free village. Its imposing Church and graveyard were established in the year of emancipation and the church bell is inscribed with the text preached on Emancipation Day

Rhyne Park

The Rhyne Park community is a recently developed residential area consisting of 80 homes. It is a middle class community with metered water supply, electricity supply and has its own sewage treatment plant. Solid waste disposal in the form of a centrally placed skip that is emptied periodically.

Spring Farm Estate

The Spring Farm Estate is located well within the project area towards the south eastern corner that is close to the main coastal road. This is an affluent residential area with about 60 houses and about 200 residents.

Ironshore

The Ironshore area and the adjacent Coral Gardens area located along the western boundary of the project area is an expansive residential area that extends from the main road inland. Significant commercial activity has developed within the Ironshore area along the main road which was formally a golf course.

4.4.4 INFRASTRUCTURE

4.4.4.1 Potable Water – Supply and Demand

The Montego Bay Special Area is served by two main water basins. The Great River Basin and the Martha Brae Basin. Collectively these basins are projected to comfortably meet demand projections for St. James through 2015, as reflected by data supplied by the Water Resources Authority.

Table 4.7: Water Resources Available to St. James

Millions of Cubic Meters per Year (MCM/Year)

Basins	Currently Supplying	Projected Demand 2015	Reliable Yield.
Great River	21.96	32.91	381.20
Martha Brae	1.17	3.34	89.0
Totals	23.13	36.25	470.20

The Project area is adequately served by available water resources. The Project’s future water requirements will be mainly for supplying its existing and planned residential and hotel components, and irrigation of its several golf courses. Based on projections supplied by Rose Hall Development Limited, at completion, water demand and use is given in Table 4.11.

Table 4.8: Estimated Project Peak Daily Water Demand and Use

Potable	Grey	Total
1.6 MG/D	1.4MG/D	3.0MG/D

Currently, peak daily demand for potable water is 1.1Mgd and use of Grey water is 1.0 Mgd. Over the next few years, the main consumers of water within the Project are expected to be the following facilities:

Table 4.9: Major Consumers within Project Area.

Major Water Consumers within The Project..	
<u>Existing</u>	Shopping Center (60-70 shops)
Holiday Inn hotel	Conference Center (10,000 capacity)
Half Moon hotel	Individual houses (1000 x 2 & 3 B/rooms)
The Ritz Carlton hotel	Seaside Villas (6)
Wyndham Rose Hall hotel	
Associated Golf Courses	
<u>Future (On the drawing boards)</u>	
The Iberostar Hotel	

The Project, at full roll out, is expected to be highly self- sufficient in meeting its water needs.

Table 4.10: Sources of Water Consumption.

TYPE	ROSE HALL	NWC	TOTA L
Potable	80%	20%	100%
Grey	100%	Nil	100%
Overall Totals	90%	10%	100%

The main water resources available to Rose Hall Development Ltd, derive from its control of several wells and springs linked into supporting distribution infrastructure. These currently include:

Table 4.11: Rose Hall's Wells and Springs

Name	Flow (MGD)
Cornwall Well 1	0.16
Banana Springs Well 1	0.13
Rhyne Park Well 1	0.22
Ryne Park Well 2	0.29
Riverhead Spring	0.02
Upper Tryall Spring	0.03
Brother Bush Spring	0.00
Doctors Dam Spring	0.12
Total	0.95

To meet anticipated demand, two of these wells not currently fully serviced, will be brought on line.

The water available from these sources is marshalled though a collection and distribution system comprising both tanks, dams and reservoirs. All of the tanks have automatic

chlorination plants. Currently water quality testing is done at all sources of potable water, (wells and dams).

Table 4.12: Rose Hall Tanks

Tank	Volume at capacity (gallons)
1	40,000
2	300,000
3	625,000
4	300,000
5	250,000
6	1,400,000
7	300,000
8 (transfer pending to NWC)	500,000
Total	3,715,000

Table 4.13: Rose Hall Dams & Reservoirs.

Dam	Full Volume (M.Gals)	Drainage Area (acres)
Nursery Dam	33	474
Spring Dam	33	328
Stable Dam	25	1,008
Doctors Dam	7.3	-
Totals	9.83	

In an agreement being finalized with the NWC, it is expected that by the completion of the Project, all residential water supply sources and infrastructure will be transferred to NWC while those, for commercial water, will be retained by Rose Hall.

4.4.4.2 Sewage Treatment

Rose Hall Utility Co. Ltd proposes to build a wastewater collection, treatment and irrigation distribution in Rose Hall. The treated effluent from the wastewater treatment facility would be pumped into an irrigation distribution system for beneficial reuse and sale to customers as irrigation water. It is estimated that the daily average flow from the existing hotels, resorts, and commercial establishments would be 350,000 gallons per day

with a potential future flow of 1,000,000 gallons per day. More details of this facility are given in Appendix IV.

It is estimated by Rose Hall Developments Ltd., that about 70% of water used will be recycled, and the effluent from the sewage plant will be utilized in this way.

Currently water quality testing is done at all the existing sewage treatment plants of the respective hotel properties.

4.4.5 TRANSPORTATION

The main transportation corridor serving the Project area is the Montego Bay to Falmouth main road. As indicated above, this is part of Segment 2 of the Northern Coastal Highway Improvement Project, which is currently underway.

Three roads lead into the southern section from the main road. In the vicinity of the Holiday Inn hotel, a road serves the residents of Spring Farm Estates. Access is also gained via the main entrance to the Half Moon Golf course and Club House. A third entrance serves the Rose Hall Great House and Cinnamon Hill. A new road, constructed by Rose Hall Developers Ltd, serves the eastern boundary area of the Project, connecting the main road with Cornwall and Mount Zion.

These roads only cover a relatively small proportion of the land to be developed. However, since the design concept targets low density traffic, and golf carts will be the vehicles of choice, additional road construction will not assume major significance. A public main road, links the coast road with the communities of Barrett Town, Spot Valley, Cornwall and Mount Zion where it terminates. The three former communities all lie beyond the eastern boundary of the Project area. The latter, Mount Zion is bounded on three sides by the Project area.

The design concept calls for a single main entrance to the main Project area, through what is currently identified as “the enhanced entrance”. An underground tunnel will link the coastal side of the Property, with the southern section.

A challenge for the Project will be the interchange arrangements with the main road, as the flow of traffic is consistently heavy. After consultations with the appropriate traffic authorities, a twelve hour traffic count was undertaken on Friday 16th April 2004 between the hours of 6AM and 6PM, representing a peak day in a typical week. The traffic count was conducted just opposite the staff entrance to the Ritz Carlton Hotel, an accepted proxy, for the ‘enhanced entrance’ a short distance away. The results of the traffic count are presented in the following tables.

Table 4.14: Traffic Count by Time Period

Summary Of Vehicles By Time Period				
TYPE OF	INBOUND TOWARDS MOBAY	OUTWARD BOUND TOWARDS FALMOUTH	TOTAL	% OF TOTAL
6:00-7:59	1,136	769	1,905	17
8:00-10:00	973	1,116	2,089	18
10:01-2:00	1,564	1,814	3,378	30
2:01-4:00	527	1,089	1,616	14
4:00-6:00	1,135	1,300	2,435	21
TOTALS	5,335	6,088	11,423	100%

During the period, 11,423 vehicles carrying 31,622 passengers were recorded. Close inspection of the data, and the four hour average between 10AM to 2PM, indicates that traffic is consistently heavy throughout a peak day. The average rate of flow can be expressed as one vehicle, carrying 2.78 passengers, passing a fixed point every 3.75 seconds.

Table 4.15: Summary of Traffic by Type of Vehicles

CATEGORY	INBOUND TOWARDS MOBAY	OUTWARD BOUND TOWARDS FALMOUTH	TOTAL	% OF TOTAL
Motor Car	3,490	4,272	7,762	68
Van	474	539	1,013	9
Truck	373	342	715	6
Trailer	63	120	183	2
Large Bus	331	327	658	5.7
Mini Bus	591	480	1,071	9
Motorbike	13	8	21	0.3
TOTALS	5,335	6,088	11,423	100%

Rose Hall Development Ltd, has indicated that based on consultations with the North Coast Highway, it is planned that the traffic interchange at “the enhanced entrance” will comprise a central island and stop lights, with a filter lane exiting to Montego Bay. NCHIP will be using traffic lights at all such interchanges along the route.

Rose Hall Developments Ltd., tentatively estimates that the total incremental traffic due to the Project, moving through the interchange, will be about 4,000 vehicles during a 12 hour period. This is a very preliminary estimate, before the final design work on the respective project elements has been completed, It is based mainly on estimates of likely commercial traffic bringing cruise ship and other visitors to the various Project attractions. However, to the extent that this estimate proves true, and even allowing the unlikely assumption of zero incremental traffic, further consideration of the design of the interchange is highly recommended.

Taxi operators sampled, report that 20 minutes is the average time taken from Barrett Town into Montego Bay during peak traffic periods. This, they admit translates into about 30 minutes for 'less practiced' private vehicle drivers (figures confirmed by officers at the Barrett Town police station). Since the distance traveled is 11KMs, traffic flows at an average speed of 22 KMs/ per hour for these slower vehicles. Since this speed is just under half the permitted speed limit of 50 KMs per hour, it provides a measure of confirmation for the observed traffic congestion that builds up approaching Montego Bay. Between Flankers and Montego Bay, traffic is more often than not, reduced to a crawl.

4.4.6 PROPOSED DEVELOPMENTS

There are several major developments proposed for the north coast from Montego Bay to Ocho Rios. These include major resort facilities such as the Iberostar Resort at Rose Hall, Harmony Cove in Trelawny and the Royal Georgian Resort, Spa and Golf Course at Llandoverly in St. Ann. These facilities are expected to significantly increase the visitor arrivals to the north coast and generate more foreign exchange. Additionally, housing subdivisions and smaller tourism related developments have also been proposed, and these will not only serve the tourism market but also provide some housing solutions for residents.

5.0 POTENTIAL IMPACTS, CUMULATIVE IMPACTS AND MITIGATION MEASURES

This section identifies the potential impacts, particularly cumulative, and suggested mitigation measures, as related to the proposed developments at Rose Hall. Findings of the assessment are presented according to site preparation, construction and operation phases. The impacts have been determined as significant positive or negative, direct or indirect, long term or short term. The Impact Matrix presented in Table 6.1 identifies the inter-relationships between the project activities and the physical, biological and social environmental factors.

Based on written communication from the National Environment and Planning Agency (NEPA) (Appendix I and Appendix II), the following aspects have been included for consideration:

- Erosion mitigation with respect to proximity of the development site to a coastal/marine environment and reefs
- Drainage, especially with respect to existing natural drainage channels and the cumulative impact of increased drainage in the area
- The proposed method, level and location of any sewage treatment option and the impacts and cumulative impacts of its disposal on the environment.
- The impact of the proposed developments on the historical, cultural and archaeological sites in the area
- The SEA document must identify the parties to be responsible for the implementation of the mitigation plan, environmental monitoring and management plan aspects of the project
- The SEA should clearly identify alternatives to the proposed development activities as a Specific Task in the document.
- The SEA should clearly define the Environmental Objectives for the area and identify how the planned development will fit into these objectives

- The SEA should identify how the proposed development activity will dovetail with the Greater Montego Bay Redevelopment Plan (GMBA 2014).
- In Task 1 of the SEA mention must be made of the proposed Sewage Works Project that is currently the subject of an application by Rose Hall Development Limited.
- In Task 4 of the SEA special emphasis should be placed on the potential cumulative impacts of the proposed development as it relates to the construction, operation and maintenance of the golf course and in particular the application of chemicals/fertilizers and irrigation in these areas.
- The SEA document should also include a non-technical summary.

Table5.1 Impact Matrix

Table 5.1 Impact matrix page 2

Table 5.2: Natural Environment – Potential Impacts, Cumulative Impacts and Mitigation Measures

Environmental Aspect	Potential Impacts	Mitigation Measures
Hydrology and Drainage	Impacts on hydrology and drainage are both direct and indirect. They relate to all phases of the development and to high volume events (major drainage) as well as to drainage requirements for run-off from more frequent events (minor drainage).	<ol style="list-style-type: none"> 1. The engineering design for each component of the development should use the 100-yr. event as design criterion for drainage structures, to accommodate flash floods and catastrophic events. 2. Storm water runoff (more frequent events) will be handled by curbs, channels, catch basin inlets, storm sewers, minor swales and roadside ditches. These must be designed to prevent ponding and flooding of the highway and adjacent properties. 3. All existing drainage lines must be kept open and no obstructions must be built within these lines. Culverts and drains should be designed to channel surface run-off into existing drainage lines. 4. Surface drainage from the development at Sector O will be channelled into two retention ponds that will be built to the north eastern section of the area. The flood waters will be released in a controlled manner and will be channelled into existing lakes on

		<p>the adjoining golf course.</p> <ol style="list-style-type: none"> 5. Siltation control devices are required for run-off. 6. The standard concrete sidewalks along the edge of the paved roads will be abandoned in favour of grass verges. These will facilitate percolation <p>These mitigation measures are the responsibility of the developer.</p> <ol style="list-style-type: none"> 7. The gullies that currently run under the main road must be maintained, and design must ensure that there is no blockage of the existing channels. <p>This is the responsibility of the National Works Agency (NWA).</p> <p>Operation Phase</p> <p>During the operation phase the mitigation measures incorporated in the engineering design should prevent problems of ponding, and facilitate surface run-off. Scheduled inspections and maintenance of drainage channels is critical.</p>
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<p>Hazard Vulnerability</p>	<p>Impacts during site preparation or construction relate to the effect of flood events and stormwater run-off in the project area. Flooding is a major natural hazard to be considered and the major impact is derived from the effect of extreme runoff on the site and the topographical features.</p> <p>With respect to man-made/technological hazards, accidents can occur as a result of construction activities directly on-site and as a result of activities off-site, such as transportation of equipment and materials.</p> <p>Health and safety aspects must be considered with respect to workers existing residents on the site and the motoring public during both the Construction and the Operation Phases.</p>	<ol style="list-style-type: none"> 1. Shoreline protection must be engineered for all developments on the north side of the existing road. 2. Site preparation and construction schedules should take account of the traditional rainy season between May and October, and of the hurricane season from June to November, during which tropical systems sometimes cause flood rains. Extraordinary tropical systems have also caused problems of supersaturated soils, so that schedules should factor this eventuality. 3. A safety management plan including traffic handling and equipment management procedures should be developed as part of the construction scheduling. <p>These mitigation measures are the responsibility of the developer.</p>
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	<p><i>Operation Phase</i></p> <p>During the operation phase the mitigation measures incorporated in the engineering design should prevent problems associated with hazards.</p>	
<p>Air Quality</p>	<p><i>Site Preparation and Construction Phase</i></p> <p>Movement of trucks and heavy-duty equipment to and from the project area, as well as construction work and stockpiling of earth material, will contribute to dust emissions. Construction activities will also result in the removal of vegetation that will expose and loosen soil which can become airborne with medium to strong winds. This would add fugitive dust to the area, which is already dust prone because of previous land clearance. The transport of aggregate for road and drainage culvert construction will also contribute to the fugitive dust levels. Construction vehicles will emit air contaminants such as nitrogen and sulphur oxides as well as particulates.</p>	<ol style="list-style-type: none"> 1. Watering of un-vegetated areas and stripped road surfaces along which construction vehicles and trucks travel will control dust emissions by up to 70%. A full-time watering truck should be maintained on site for watering road surfaces as needed to minimize fugitive dust emissions. Over-saturated conditions, which would cause outgoing trucks to track mud onto public streets, should be avoided. Watering would not be necessary on days when rainfall exceeds 2.5 mm (0.01 inch). 2. Stock piling of earth materials for construction should be carried out within temporarily constructed enclosures to limit fugitive dust. Vehicles transporting earth materials should be covered en route. Mixing equipment should be sealed properly and vibrating equipment should be equipped with

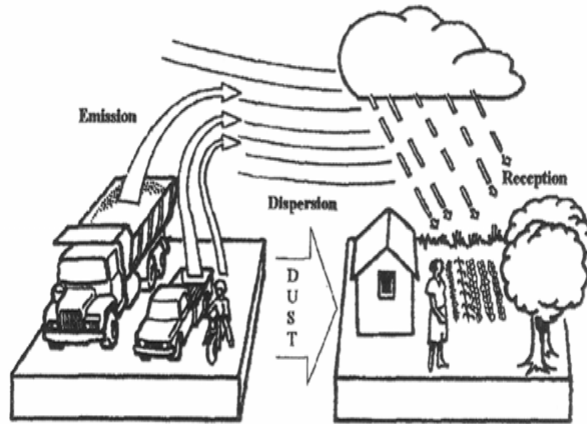


Figure 9.2: Illustration of Dispersion of Dust Emissions

Operation Phase

The main air impacts during the operational phase will be from vehicular emissions. These are not expected to be high as off-shore winds will move

dust removing devices. Stockpiles of fines should be covered on windy days.

3. A monitoring program for dust is recommended to assess the effectiveness of control measures in meeting ambient air quality standards.
4. Provide dust masks to operators in order to protect them from dust impacts.
5. Take account of prevailing wind direction and plant tall leafy and dense vegetation between roads and human settlements to filter pollutants. Vegetation should also be planted on the Dyke Road to prevent erosion.

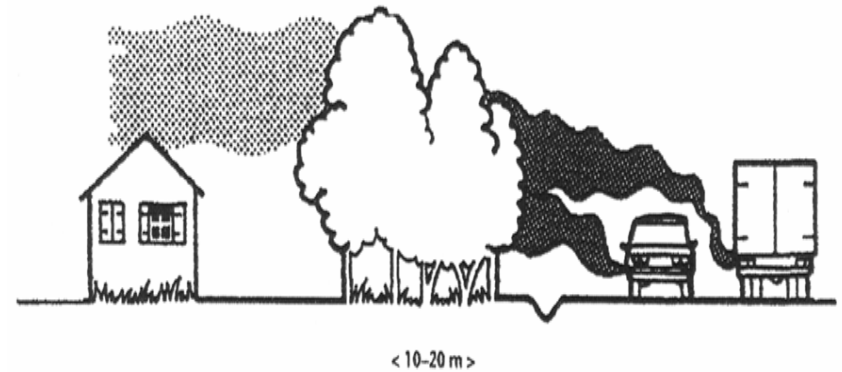


Figure 9.3: Illustration of the Effect of Vegetative Barriers on Vehicle Emissions

	<p>particulates away from the development. There are currently no vehicular emissions standards for Jamaica. However, vegetative buffers which are proposed for the development will help to reduce negative impacts of vehicular emissions on the development.</p>	<p>The above mitigation measures are the ultimate responsibility of the developer, working with contractors and subcontractors.</p>
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<p>Noise</p>	<p><i>Site Preparation and Construction Phase</i> The noise level is expected to increase during site preparation and construction with the use of heavy machinery and earth moving equipment.</p>	<p><i>Site Preparation and Construction Phase</i></p> <ol style="list-style-type: none"> 1. Although not expected to create a significant negative impact, noise impacting on the existing components of the development from construction activities can be minimized by limiting noisy construction activities to the hours between 7 am and 6 pm, where construction is in close proximity to residential areas. Construction machinery and vehicles should be serviced at regular intervals in order to keep noise to a minimum. <p><i>Operation Phase</i></p> <ol style="list-style-type: none"> 2. The use of vegetative barriers, defined as a series of narrow and dense trees and shrubs planted near the roadside can significantly reduce roadside noise. Vegetative barriers have been shown to reduce noise by 1-3 dB. <p>Responsibility of the developer as determined.</p>
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<p>Marine Water Quality and Reefs</p>	<p>Construction Phase</p> <p>The marine survey indicates a degraded reef system. Impacts from construction activities could include untreated sewage effluent, deposition of human waste, commercial effluent, contaminated storm water runoff. The major water quality impacts likely during construction work are listed below:</p> <ul style="list-style-type: none"> • Increased suspended solid loading (sediments and garbage) to the coastal waters (from earth moving activities and terrestrial run-off) • Increased bacterial levels due to indiscriminate disposal of human waste (particularly construction camp activities). • Oil and grease from heavy equipment and trucks. 	<p>Construction Phase</p> <ol style="list-style-type: none"> 1. Measures to control or limit sedimentation in drainage channels during the construction phase will include storage of earth materials within containment berms 2. The deployment of sediment traps during any approved filling in the coastal environment. 3. The engineering design must incorporate measures for slope stabilization and reinforcement to prevent slope failure on steep slopes. 4. The proper removal and disposal of construction spoil, so as not to block drains and gullies. 5. Take all necessary measures to prevent refuse (solid waste) and wastewater produced in construction camps from entering into drains and water bodies. 6. Provision of portable chemical toilets at work sites, with appropriate sanitary arrangements for disposal of the contents. 7. Oil and grease which may be generated from construction equipment should not be allowed to run into the sea and should be properly stored and disposed of, off site, to prevent
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	<p>Operation Phase</p> <p>The most important impacts relate to increased nutrient loading in the coastal environment from the use of fertilisers and contaminated storm drainage.</p> <p>Assessment of the reef indicates a partially degraded reef structure resulting from high nutrient loading, possibly from surface run-off, and reduction of grazers, possibly due to over-fishing. An increase in</p>	<p>washdown in terrestrial run-off during rainfall events.</p> <p>The above mitigation measures are the ultimate responsibility of the developer, working with contractors and subcontractors.</p> <p>8. During the operation phase proper receptacles for the collection of solid waste must be installed.</p> <p>9. The services of a reliable, certified contractor must be engaged for the timely and efficient removal of solid waste to an approved site.</p> <p>These mitigation measures are the responsibility of the management entity for each component of the development.</p> <p>10. In order to reduce the run-off from the golf courses, golf course designs should integrate more lakes for the retention of water. Contamination of the aquifer or the coastal environment through percolation and leaching will not occur as the aquifer is further south and a coastal aquiclude is to the north.</p> <p>11. The lakes would also improve aesthetic appeal, and provide opportunities for reuse and recycling of water, particularly for irrigation purposes. An Integrated Water</p>
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	<p>the number of golf courses, combined with the existing golf courses, will result in an increase in the use of fertilizers, which could increase the nutrient loading to the coastal environment.</p> <p>The increase in number of snorkelers and recreational SCUBA divers may lead to physical damage of the reef due to trampling, breaking corals or removal of organisms for souvenirs.</p>	<p>Management Strategy should be adopted.</p> <p>12. Investigations should be conducted into the use of alternative fertilisation methods to reduce the nutrient loading on the coastal environment.</p> <p>13. Monitoring of the coastal environment should be conducted against baseline data and to assess cumulative impacts on water quality.</p> <p>14. Establish regulations and promote environmental awareness amongst visitors and residents e.g. using posters or signs, giving talks in hotels/communities.</p> <p>The requirements and implementation of coastal water quality monitoring to determine the impacts of all coastal developments is the responsibility of NEPA. Water quality monitoring may be the responsibility of the developer if specified by NEPA in any permit issued. Other mitigation measures are the responsibility of the developer.</p>
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<p>Vegetation</p>	<p><i>Site Preparation and Construction Phase</i></p> <p>Site preparation and construction activities will remove several acres of vegetation, removing the airshed purification function and habitat for birds. Loss of vegetation will also increase surface run-off and sheet flow after heavy rainfall events. Percolation into the limestone can be increased with the removal of vegetation and the creation of golf courses.</p>	<ol style="list-style-type: none"> 1. Vegetation will have to be cleared to provide land for the development works. Clearing of the vegetative stands should be carried out on a phased basis to reduce the amount of exposed top soil that can be washed down in rainfall events. 2. Clearance of vegetation should be done in accordance with the Terms and Conditions specified in any permit from NEPA. 3. Trees to be retained should be ‘red-flagged’ to alert contractors. 4. Construction monitoring is recommended. 5. Golf course design should retain as much forested land as possible, as greens and fairways will have to be cleared. 6. Feeding trees for birds, particularly sweetwoods, should be maintained. 7. To continue to provide airshed functions of purification it is recommended that verges be replanted with trees and shrubs where appropriate. 8. Additionally, tree planting should be carried out to form shelter belts, windbreaks, noise buffers, slope stabilization
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		<p>bands, erosion control and for aesthetic appeal, as appropriate.</p> <p>9. Selection of plants for landscaping should consider the following: habitat suitability, feeding trees, trees of national interest, flowering trees and shrubs.</p> <p>10. Vegetation planted for landscaping buffers and for aesthetic appeal should be maintained, and a maintenance programme should be established and implemented.</p> <p>11. Maintain an undisturbed core in the forest area if possible, which could be designated a Conservation Zone.</p> <p>The requirement for construction monitoring and the establishment of Permit Conditions are the responsibility of NEPA. Other mitigation measures are ultimately the responsibility of the developer and any contractors or subcontractors.</p>
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<p>Birds</p>	<p>Site Preparation and Construction</p> <p>Vegetation clearance will result in loss of habitat for both endemic and migratory bird species. Fragmentation of the forest, such as can occur on the golf courses, can result in fragmentation of the habitat, a decrease in the numbers and abundance of the forest bird species, and can impede feeding for birds reluctant to cross open areas. Birds that prefer open spaces will increase provided feeding trees remain.</p>	<ol style="list-style-type: none"> 1. Design of golf courses should ensure that feeding trees (particularly sweetwoods) are connected by vegetation corridors. 2. Efforts should be made to retain forest strips along gully slopes. 3. Landscaping and vegetation buffers, will result in the replacement of some habitat for selected species. 4. Selective vegetation clearance should be exercised to ensure that feeding, nesting and roosting sites are maintained in suitable numbers. 5. It is not expected that poachers will be a threat, as the development is secure and access is limited. <p>These mitigation measures are the responsibility of the developer and the design engineers.</p>
<p>Sea Turtles</p>	<p>Turtle nesting has been reported in the sandy areas along the shore. Sea turtles are protected by both national and international legislation and are an endangered species.</p>	<ol style="list-style-type: none"> 1. Design of shoreline facilities should take into account the effects of light pollution which can disorient turtles and disrupt nesting activities and safe emergence of hatchlings. 2. Strategies to facilitate turtle nesting on the sandy beaches should be integrated within any management plan. <p>These mitigation measures are the responsibility of the developer.</p>

Table 5.3: Social Environment – Potential Impacts, Cumulative Impacts and Mitigation Measures

Environmental Aspect	Potential Impacts	Mitigation Measures
<p>Traffic, Transportation and Access Roads</p>	<p><i>Site Preparation and Construction Phase</i></p> <p>Site preparation and construction activities will see an increase in the movement of heavy vehicles and construction equipment.</p> <p><i>Operation Phase</i></p> <p>Disruption to traffic is not anticipated during the operation phase. However, consideration should be given to the creation of underpasses for pedestrian traffic, golf carts and horse back riders. Exit ramps from the main road to access property on both the north and the south side of the property should be considered.</p>	<p><i>Site Preparation and Construction Phase</i></p> <ol style="list-style-type: none"> 1. Scheduling of construction work should seek to minimise disruption to traffic flow along the main north coast artery and allow for the movement of material and heavy equipment. 2. Arrangements for parking and storage of material should be made on-site as is feasible for efficient operations. 3. Discussions should be held early with the National Works Agency regarding the current work on the Northern Coastal Highway Improvement Project to determine the construction schedule through the Rose Hall area. 4. Discussion should be had with the National Works Agency regarding the provision of

		<p>underpasses and exit ramps.</p> <p>5. Properly trained flag persons and road side signs should be used where the movement of heavy machinery and construction equipment may cross the main road.</p> <p>These mitigation measures are the responsibility of the developer and the contractors in consultation with the National Solid Waste Management Authority, as required.</p>
Business Enterprises	<p><i>Construction Phase</i></p> <p>No business enterprises will be disrupted.</p>	<p>No mitigation measures are required.</p>
Employment	<p><i>Site Preparation and Construction Phase</i></p> <p>Employment opportunities will be created during the site preparation and construction phases. This will mostly be unskilled labour for the duration of the construction activities. Additionally, economic opportunities will involve the sourcing of construction material and linkages created with</p>	<p><i>Site Preparation and Construction Phase</i></p> <ol style="list-style-type: none"> 1. Casual labour will find employment and this is expected to be a positive impact for the surrounding communities. 2. Workers should be briefed on traffic management, solid and liquid waste disposal, dust management, parking, idling of equipment and oil

	<p>local and regional suppliers and industries.</p>	<p>spill control.</p> <p>3. The “politicization” of employment opportunities often poses some challenge to contractors, and the need for security and relevant dialogue have to be factored into construction planning.</p> <p>These mitigation measures are the responsibility of the developer.</p>
<p>Solid Waste Management</p>	<p><i>Site Preparation and Construction Phase</i></p> <p>Solid waste generated from the site preparation and construction activities will include construction debris, vegetation, solid waste from beaches, the demolished bridge and solid waste generated from the construction camp.</p>	<p><i>Site Preparation and Construction Phase</i></p> <p>1. Construction sites generate considerable waste and provision must be made for suitable separation and storage of waste in designated and labelled areas throughout the site and at the site camp.</p> <p>2. Collection of waste by certified contractors and disposal at an approved site, as recommended and approved by the National Solid Waste Management Authority.</p> <p>3. Any hazardous waste should be separated and stored in areas clearly designated and labelled, for future entombing and disposal as directed by the</p>

		<p>National Solid Waste Management Authority.</p> <ol style="list-style-type: none"> 4. Worker training should include instructions on how to dispose of food and drink containers emphasizing the need to protect the coastal environment. 5. Construction camps and work areas along the proposed alignment must be adequately equipped with portable chemical toilets. 6. Portable chemical toilets must be provided, maintained and removed by a certified contractor. 7. Consideration should be given to the establishment of an Integrated Solid Waste Management Plan. <p>These mitigation measures are the responsibility of the developer.</p>
<p>Proposed Developments</p>	<p>Major developments within the areas include the Iberostar Hotel at Rose Hall and Harmony Cove Developments at Harmony Hall, Trelawny.</p>	<p>These developments are not expected to impact on the proposed development by way of affecting the market share. However, the developments include golf courses, vegetation clearance, and coastal</p>

		<p>developments, which will add to the cumulative impacts as described under the natural environment. Cumulative impacts related to traffic management may occur if construction schedules overlap. The mitigation measures as described under traffic management would need to be applied by other developers.</p>
<p>Public Health and Safety</p>	<p>Site Preparation and Construction Phase</p> <p>Site preparation and construction will involve, transportation and storage of significant volumes of construction material, and proper disposal of construction spoil and any hazardous waste.</p> <p>Increased levels of fugitive dust and construction noise are also public health issues as the air quality is already deteriorated in this region and noise and activity levels are high.</p>	<p>Mitigation Measures</p> <ol style="list-style-type: none"> 1. To minimise risk to the public the construction activities which will directly affect the movement of traffic and pedestrians, should be properly scheduled and standard construction techniques for sign-posting and flagging should be adhered to. 2. Dust control by wetting is essential. 3. Unnecessary idling of construction related vehicles should be discouraged. 4. Proper sign posting of speed limits and entrances and exits.

		These mitigation measures are the responsibility of the developer.
Zoning	Some types of recreational water sports are incompatible, such as snorkeling and jet skiing. Some areas of the reef are in shallow water, and accidents could occur.	<ol style="list-style-type: none"> 1. Zoning of areas for swimming/snorkeling and for other sports such as jet skiing. 2. Placing markers to identify shallow parts of reef which may be hazardous to jet skiers. <p>These mitigation measures are the responsibility of the developer.</p>
Archaeological and Cultural Heritage	<p><i>Site Preparation and Construction Phase</i></p> <p>Rose Hall is a listed site under the Jamaica National Heritage Trust Act. The Rose Hall Great House has been renovated by Rose Hall Developments Ltd. and is a major tourist attraction.</p> <p>Site preparation and construction could result in the unearthing and discovery of artefacts.</p>	<ol style="list-style-type: none"> 1. The JNHT should be informed of the construction schedule and given an opportunity to conduct a Watching Brief during the construction phase and to perform Rescue Archaeology if any artifacts are discovered. <p>These mitigation measures are the responsibility of the developer in association with the JNHT.</p>
	<p><i>Operation Phase</i></p> <p>Damage to artifacts and heritage sites can occur if</p>	<p><i>Mitigation Measures</i></p> <ol style="list-style-type: none"> 1. Any sites discovered should be properly secured

	<p>open access is maintained.</p>	<p>to reduce public access and interference.</p> <p>2. Heritage sites should be demarcated with interpretive signs.</p> <p>These mitigation measures are the responsibility of the developer in association with the JNHT.</p>
<p>Sewage Treatment</p>	<p><i>Operation Phase</i></p> <p>Sewage will be generated during the operation of the various components of the proposed development.</p>	<p><i>Operation Phase</i></p> <p>During the operation of the various components of the proposed development, sewage will be treated through a new facility to be established by the Rose Hall Utility Company. Details of the collection system, irrigation system and wastewater treatment system are given in Appendix IV. A Public Hearing for this facility has been requested by NEPA.</p> <p>This mitigation measure is the responsibility of the developer on approval by NEPA.</p>

5.0 POSITIVE IMPACTS

The mandate of Rose Hall Developments Ltd. is to develop the project area with luxury accommodation, condominiums, golf courses and conference facilities. Several positive impacts are anticipated from the fulfillment of these objectives.

Physical Environment

The engineering of drains, kerbs and channels, should channel storm water run-off to reduce potential ponding and sheetwash. Sedimentation control devices should reduce the levels of siltation in nearby coastal waters. The golf course will facilitate absorption of rainwater through grass cover, and that together with the uneven surface form will further retard storm water runoff. Grassy verges will also enhance surface percolation.

Fulfilment of setback requirements for shoreline facilities should minimize the risks due to storm surge and wave action.

An integrated water management approach will facilitate consideration of water consumption, sewage disposal, recycling and reuse as part of water use efficiency and pollution prevention in the project area. The proposed sewage treatment plant to be built and operated by Rose Hall Utility company will constitute a major facility in the area and it is expected that wastewater management throughout that section of the north coast will be greatly enhanced, thus reducing the potential pollution to the coastal waters. It is expected that nutrient loading and the effects of eutrophication in coastal waters will be minimized.

Biological Environment

Engineering for stormwater run-off will also have beneficial impacts on the coral reefs through the reduction of siltation. Additionally, engineering and landscaping of golf courses to include retention ponds should minimize the impacts associated with high nutrients in run-off.

The maintenance of large diameter trees and forest to ensure the maintenance of a lush tropical environment for homeowners, should continue to provide habitats for avifauna.

Socioeconomic Environment

The Rose Hall development will make a significant contribution to the tourism product in Jamaica in terms of investment opportunity for resort style accommodation, recreational facilities and support services. The evidence of squatting/informal settlements in the surrounding areas is a major cause for concern with respect to environmental integrity of some of Jamaica's major natural and built assets. Controlled and well-designed development with the attendant infrastructure to facilitate positive environmental impact is a positive impact of this proposed development.

During design, site preparation and construction employment will be generated for several categories of workers including engineers, casual labourers, skilled and unskilled workers, as well as suppliers of goods and services. During the operation phase supplies of good and services will be required.

A Public Hearing has been requested by NEPA for the establishment of the sewage treatment facilities by Rose Hall Utility company. This hearing will also incorporate information on the Master Plan and serve the purpose of information sharing for the local communities.

6.0 CONSIDERATION OF ALTERNATIVES

The land purchased by Rose Hall Developments Ltd. from the Government of Jamaica was earmarked for high end tourism development to include luxury homes, condominiums, recreational areas including golf courses and meeting facilities. Rose Hall Developments Ltd. is meeting that mandate in the conceptual master plan presented. Alternative types of development would be outside the prescribed mandate.

However, alternatives in layout and design have been considered, and the Master Plan as presented gives the maximum use of space, facilities, identification of best suitable land for golf courses, retention of trees and forested areas, provision of ocean views for homeowners, maintenance of aesthetic appeal and integration of an internal transportation network.

7.0 ENVIRONMENTAL QUALITY OBJECTIVES

Environmental Quality Objectives have been identified for the proposed development to highlight the following aspects:

Integrated Water Resource Management

The use of potable water, treatment of waste water and irrigation systems have been proposed for integration to encourage reuse and recycling, as detailed in the proposed sewage treatment facility (Appendix IV and Section 5.0). The use of retention ponds on the golf course will also facilitate this approach.

Stormwater Run-off Control

Stormwater run-off to the main road must be controlled so as to prevent flooding and deposition of sand and gravel on the roadway. Runoff also has the potential to carry large volumes of sediment and agricultural chemicals (particularly fertilizers) to the coastal waters. Recommendations have been made for the reduction of stormwater run-off through engineering of the retention ponds (Section 5.0). These ponds will also be a part of the integrated water resource management programme. Additionally, the use of grassy verges instead of paved sidewalks should allow for percolation, and so reduce runoff, ponding, and accelerated erosion.

Energy Efficiency

Energy efficiency is essential to sustainable development and to operating cost management. The integration of energy efficient systems should be part of all aspects of the development. Home owners should also be “encouraged” to install energy efficient equipment, including fluorescent bulbs, timers and energy efficient household appliances.

Minimization of Pollution

Pollution of the coastal environment may be exacerbated by poor solid waste management practices which can result in the wash down of material during rainfall events. Proper solid waste management practices are to be incorporated in the development including the provision and installation of trash receptacles, collection and removal of trash by a certified contractor for disposal at an approved site.

Appropriate and effective sewage treatment and disposal is essential to the quality of the coastal environment.

Aesthetic Appeal

Recommendations have been made and the developers are including the retention of maximum number of trees and forested areas to ensure the maintenance of a lush tropical environment. The use of grassy verges has been incorporated into the design to enhance this effect. These measures will enhance aesthetic appeal by ensuring maximum green areas, but will also help to protect the habitat of species of birds, and reptiles.

The development has incorporated in the Master Plan the submergence of utility lines as a means of improving aesthetic appeal.
