FINAL REPORT

ENVIRONMENTAL IMPACT ASSESSMENT OF

THE FAIRY HILL DEVELOPMENT PHASE 2

October 2006

PREPARED BY

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF PHOTOGRAPHS

LIST OF APPENDICES

EXECUTIVE SUMMARY

The Urban Development Corporation (UDC) proposes to develop Phase 2 of a four phase development plan in the Fairy Hill area of Portland, Jamaica. This second phase development "Fairy Hill Phase 2" is proposed to have three main features:

- Fairy Hill Beach Park
- Beach Cottages and
- Residential Lots

An Environmental Impact Assessment (EIA) is a requirement of the National Environment and Planning Agency (NEPA) in exercising their powers under the NRCA Act 1991. Technological and Environmental Management Network (TEMN) Limited has been engaged by The Urban Development Corporation (UDC) to carry out the EIA, and this report presents the findings thereof.

The Environmental Impact Assessment was carried out by a multidisciplinary team, and utilised skills in biological assessments, hydrogeology, environmental chemistry, socioeconomics and project management. A comprehensive evaluation of the study area was carried out and the environmental character of the area determined. This was related to the development plans and the potential impacts identified. Recommendations are made which are aimed at ensuring compliance with relevant environmental statutes, and ensuring the preservation or restoration of the ecological balance through the mitigation of anticipated impacts.

THE DEVELOPMENT

The beach park would feature at minimum, the following amenities: a ticket office, guard post, business offices, and family oriented recreational facilities, as well as sanitary conveniences. The main feature of this development will be the twenty-nine (29) residential lots ranging in size from 821m^2 -1505m^2. Beach cottages will also be constructed to provide temporary dwelling opportunities for beach patrons and other visitors to Portland who are desirous of extending their length of stay. There are also plans for development of ecotrail facilities as well as wetlands reserves and forest conservation areas. The entire Fairy Hill property is located approximately twelve kilometres (12km) east of Port Antonio and comprises approximately 110.72 hectares.

Pre-construction activities would include bushing to allow for surveyor to establish levels and the establishment of site office inclusive of temporary on site pit latrine. Construction method and works would be conventional i.e. Strip or raft foundation.

Duration of construction phase should not exceed 6 months for road and sewage. The construction of the Beach Cottages should not exceed 12 months. Both activities could go on simultaneously.

Water and electricity will be supplied in the usual manner. Solid waste disposal will be satisfied by the local Solid Waste Management Agency (SWMA). Sewage will be treated to a tertiary level using an anaerobic septic tank with sand filter, followed by a constructed wetland. The system will be sized to suit the number of people using the

system. Storm water flows will be calculated and dispersed to nearest gully/sinkhole using storm water pipes of the required size.

METHODOLOGY

All components of this EIA required that the following tasks be performed:

- Review of Literature
- Site Visits
- Data Collection and Sample Analyses
- Review of results, impact analysis and mitigation recommendations.

ENVIRONMENTAL IMPACTS

Environmental Chemistry

Present Impact

The data collected indicates that water quality at Winnifred Beach and in the bay, met or was better than the requirements for recreation. There are however, signs that could indicate deterioration in water quality since the 1997 assessment.

Most sites monitored had **dissolved oxygen** levels that were better than the USEPA marine standard at the time of sampling. This suggests no significant demand on dissolved oxygen from biodegradation of organic waste. The normal levels encountered also indicate the absence of eutrophic conditions. In a eutrophic situation daytime oxygen levels would tend to be very high due to the contribution of photosynthetic oxygen by the large population of algae associated with such conditions.

The presence of **faecal coliform** in the sample taken from the spring to the east of the beach suggests contamination from sewage or other mammalian faecal waste. As no sources were seen in the immediate area it is likely that this contamination is occurring up gradient of our sampling site. The absence of faecal coliform from all sea water samples including the bathing area suggests little if any impact from sewage or animal waste on water quality in the bay. The results suggest that though there was faecal coliform present in the pool exiting to the beach, the flow from the stream was so small that there was no measurable impact on water quality.

Nitrate levels in sea water were determined to be slightly higher than the proposed coral reef standard. This suggests some influence from land based sources. No fresh water outflows other than the springs were noted so the existence of subsurface inflows is possible. A comparison of nitrate levels from the 1997 assessment with the present assessment shows an apparent increase in nitrate both in the brackish water samples as well as the sea water samples. This fact along with the increased faecal coliform in the brackish pool formed from the spring water suggests an increase in impact from sewage and/or other mammalian waste on water quality since the 1997 assessment.

Phosphate levels were generally below the proposed coral reef standard for all sea water samples. The fact that the higher levels were determined for samples collected close to shore

near the eastern and western extremities (Station 4 and 7 respectively) could indicate some impact from land based sources.

Salinity levels at the surface were slightly lower than at the bottom of the water column for the sea water sites suggesting that there is some influence from fresh water inflows though small. The fact that salinity was uniform at the top and bottom for the control sites suggests that the fresh water influence is most likely confined to the nearshore sites.

Projected Impact

Projected impacts from the development are associated with the need to dispose of sewage/grey water and storm water run off. Where the disposal of these is carried out without taking into consideration environmental imperatives the following can result:

- Increased oxygen demand in receiving waters resulting in lowering of dissolved oxygen possibly to critical levels particularly during the night.
- Increased levels of nutrients in receiving waters. This can result in the overgrowth of algae (eutrophic conditions). Eventual die off of these algae result in increased oxygen demand associated with their decay.
- Increased contamination of ground water and coastal water due to seepage of sewage into the aquifer.
- Contamination of receiving waters by fertilizers and pesticides used in the maintenance of green areas.
- Reduced salinity of nearshore water due to increased surface run off.
- Contamination of nearshore water with solid waste e.g. plastics etc.

Ecology

Anticipated Ecological impacts to the area resulting from Phase II of the Fairy Hill Development are expected to be:

Loss of Habitat and Biodiversity

An immediate and most adverse environmental impact to the area would occur during the preparatory phase which calls for clearing of the site for the proposed development. The removal of trees and shrubs would reduce the existing forest cover, resulting in irreversible loss of natural habitat for flora and fauna particular to the area. The proposed development will have negative effects on the composition of the bird community in the area. There will be obvious loss of species from the area, especially of the forest-based endemic species. The loss of habitat and negative impacts on the local biodiversity are obvious adverse consequences of the proposed development.

Loss or Alteration of Turtle Nesting Grounds

Hawksbill turtles favor nesting on remote, clean sandy beaches. Their nesting behavior can be very easily disturbed by beach development, noise and light pollution, litter and disease. Construction of buildings and other structures near or on beaches used by hawksbills can alter the beach and destroy the vegetation and other conditions needed for successful reproduction.

Airborne and Noise Pollution

The increased traffic to the area, use of heavy equipment during the clearing of the site and transportation of building materials will create noise and raise dust which could further disturb the habitat of the existing fauna, in particular the birds nesting in the area, as well as the plants and insects they feed on. Dust and emissions from the construction vehicles and heavy machinery are inevitable both during the site clearing as well as during construction phases. Airborne pollution, in particularly dust resulting from clearing of the land and from exposed piles of building materials (e.g. sand, cement, etc.) may further stress the local flora and fauna, and may also pose a health risk to construction workers and residents in the vicinity who suffer from asthma or other respiratory ailments.

Soil Erosion and Change in Drainage Patterns

Removal of vegetative cover and the subsequent excavation activities required for infrastructure installation (paving of roads, laying of water/sewage pipes, electrical cables, etc.) will impact the existing drainage patterns in the area. Loss of topsoil due to soil erosion as well as excessive runoff into the bay, are causes for concern which must be addressed prior to the clearing phase. Soil erosion will remain a problem during the clearing as well as during the construction phases of the project. Lack of proper drainage ways could result in localized pooling and flooding, providing ideal conditions for the proliferation of nuisance pests such as mosquitoes. Excessive runoff, especially during heavy rains, could also lead to elevated nutrient loading into the bay, directly or via the stream. The resulting turbidity and sedimentation could negatively impact the inshore water quality and the marine ecosystem in the bay, especially the corals which do not tolerate prolonged exposure to high concentrations of particulate matter in the water column.

Beach Erosion and Sand Mining

Small scale illegal sand-mining from the beach has been reported in the area. On the west side of the beach, there are exposed hard surface areas in the swash zone of the beach which have presumably been exposed because of the removal of sand from this section of the beach. The lack of vigorous enforcement of the Quarries act, which controls sand mining, would contribute to the degradation of the beach area.

Transportation and Storage of Construction Materials

Transportation of heavy machinery and building supplies/materials implies heavy traffic on the roads leading to the site with possible negative impacts to the surrounding area (dust, spillage, emissions and noise). Use of uncovered trucks for transporting building materials as well as improper storage of building materials, especially gravel, sand and cement on the construction site could lead to inadvertent dispersal of materials during heavy rains or high

winds during dry periods. This could have a negative impact on the coastal waters. Improper storage or handling of hazardous or flammable materials, including fuel, paints and solvents) could result in soil contamination.

Disposal of Construction Debris

Each phase of the development will produce solid waste, the disposal of which, if not managed properly could have negative impacts to the site and the surrounding area. Cut vegetation resulting from the clearing of the area could pose a fire hazard and affect air quality if burned on location. Other construction materials including concrete waste, wood, steel, and packaging plastics could be dispersed and could end up blocking drainage channels if not disposed of at approved disposal sites.

Sewage and Garbage Disposal

Inadequate provision of portable restrooms and garbage dumpsters at the construction site could lead to unsanitary conditions. Resulting impacts could vary from unsightly littering of the site, fly and vermin infestations to increased nutrient levels in the stream leading into the bay. Reliable sewage treatment systems are a long term concern for the area. It is essential for the villas, cottages and the nearby beach recreation area to have proper sewage treatment systems capable of handling increases in capacity while ensuring that there is no direct discharge of untreated effluent into the porous substrate which drains directly into inshore marine waters.

Impact on Winnifred Beach

Currently the beach is well maintained by local vendors however there are already signs of stress on the local ecology. The stream on the East side of the beach which is used for washing is overgrown with fleshy algae and the waters in the bay display characteristics of localized eutrophication. The potential increase in runoff from the nearby construction site would compound the nutrient loading into the stream and in the bay, affecting the inshore water quality and the marine life in the area. Increased tourist traffic to the beach if not controlled, could result in trampling of the Turtlegrass in the shallow waters. The beach itself is currently accessible by cars which in addition to compacting the sand, contributes to the pollution through emissions, noise, as well as potential oil and gas spills, all of which are hazardous to terrestrial and marine life. In the absence of facilities such as proper sanitation, garbage collection, offsite parking and maintenance to support the increased tourist traffic, the state of the beach will deteriorate quickly.

The beach and the surrounding area is small and confined and as such, the proposed construction of the bar and grill would further limit the space available for free movement by patrons of the beach and more importantly, it would destroy the pristine nature of the setting as it now exists. A bar and grill enterprise (with its attendant need for support services) would further increase the pressure on the fragile ecology of the area (seagrass beds, coral reef, turtle

nesting grounds, etc). As such, construction of any kind directly on the beach is NOT recommended as it is not consistent with "reserve/conservation area" concept proposed for the beach and its environs. All of the impacts discussed above represent substantial threats to ecology of the Winnifred beach area and could result in the degradation of this environment to a point where both its commercial value and ecological appeal are compromised.

Socio-economics Impacts

Socioeconomic impacts include construction and post-construction impacts. These are summarized in the Impact Matrix Table in Appendix 4.

Construction Impacts

The construction impacts of the proposed development include land use, employment and income, transportation and community development.

Land Use

The proposed development would impact land use in a negative way as between fourteen and sixteen vendors currently operating on the beach area of the study site would be displaced during the construction phase of the development.

Employment and Income

Employment and income would be impacted both negatively and positively by the proposed development. The positive impact is represented by the creation of jobs during the construction phase of the development. The negative impact is the loss of income by the on-site vendors.

Transportation

Transportation impacts are limited to the lack of access routes to the beach during construction. As no major roads within the community will be affected, the impact is short-term and not very significant.

Community Development

The construction impact on the community will be a short-term negative impact. This is as a result of the loss of access to the beach for residents and visitors.

Post-Construction

The post-construction impacts of the proposed development include national/regional impacts, land use, employment, community development and recreational impacts.

National/regional Development

The proposed development of includes the development of a residential estate. This will contribute to the overall housing development and increase housing stock nationwide.

The proposed development includes the development of a beach park. The beach park site also includes a wetland area, which will be preserved and incorporated into the development as a part of an "eco-trail and wetland reserve." In light of the aspirations of the local community and the nation towards developing a tourism product with low environmental and cultural impacts while attempting to help generate income, employment and the conservation of local ecosystems, the proposed development will have a significant positive impact in the long-term.

Further, the proposed development will have a significant and long-term positive impact on regional and national employment. After construction, the proposed development will generate employment for management, security and maintenance personnel as well as concessionary personnel on the beach. The residential estate also has the potential to generate employment for management, domestics and maintenance personnel. This will contribute to lowering unemployment rates on a regional and national scale.

Land Use

The post-construction land use impact includes the potential for the regularization of the vendors currently operating on site. The development would provide proper facilities for the vendors in the form of shops, concessionary stands, sanitary facilities and adequate parking for visitors to the beach, thus improving working conditions and improving the service/product the vendors are providing.

Employment

As mentioned above in the national/regional impacts, the post-construction phase of the proposed development will provide employment for the local, regional and national scale.

Community Development/Recreational

The post-construction impacts on the community/community development and recreation are both positive and negative. The positive impact includes improved recreational facilities and infrastructure for the community. Currently, the beach area of the site is characterized by poor access roads, improper sanitary facilities and lack of security among others. The proposed development would improve and upgrade the access roads, provide clean sanitary and safe environment for the community members and visitor to enjoy while visiting the beach park. However, there may be a charge for utilizing the facilities. This is perceived as a significant and long-term impact as currently access to the beach is largely unrestricted and free.

The proposed development has the potential for increasing employment, housing stock and therefore has the potential for increasing the population of the area. Additionally, it is assumed the beach park with its improved facilities will attract more visitors (local, national and tourists). There will be increased vehicular traffic and the need for services (for example, banks and ATMs) will increase. The existing social services and infrastructure may not be able to facilitate the increased activities anticipated in the SIA study area.

Coastal Dynamics

One of the most important features of the entire development is the existence of the high-quality beach, as it adds great value for aesthetic and recreational purposes.

However the existence of this beach should not be taken for granted, as its presence is the result of a fine balance of coastal processes including wave-climate, current regimes, storm water and river discharges, and also sediment supply.

Any significant disturbance to any one of these parameters will result in destabilization and erosion of the foreshore. As such, all attempts should be made to preserve the natural forces at work here. Probably the most significant factor in this equation is the wave-attenuation properties of the existing barrier reef. This feature modifies incoming deep-water ocean swells, and causes them to shoal and accrete sand in its lee

The health of this reef is directly linked to good water quality, and as such any discharges of effluent whether by natural storm water runoff, planned drainage schemes, or discharges into the local streams must be carefully controlled in order to maintain the integrity of the entire coastal system. This reef also offers major protection from storm-surges associated with tropical storms.

Hydrogeology

Short term supply may be inadequate for the proposed development due to the unreliability of the Zion Hill mains supply because of water quality issues. Long term the proposed mains supply improvement, scheduled to commence in 2008/2009, will substantially alleviate this problem.

Sewerage disposal can be a considerable impact if the appropriate sewerage systems are not implemented to protect coastal waters. However, this impact is completely mitigable.

The pre- and post-runoff calculations indicate that impact of the post-development runoff will not be significant, provided the implemented drainage systems are appropriately designed to cope with the predicted 25 year return storm runoff, both on and off site, whilst preventing unacceptable ponding.

RECOMMENDED MITIGATION AND MONITORING

Environmental Chemistry

In order to reduce the possible impact of the development on local water quality it is recommended that consideration be given to the following:

- Provision of adequate land area for water management.
- The containment and reuse of storm water as far as possible

- Prevention of seepage areas by using appropriately lined containment areas for treated sewage/storm water
- Treatment of sewage/grey water above ground
- Elimination of local sources of pollution especially those that are a threat to the aquifer
- The provision of adequate arrangements for the containment and disposal of solid waste

Ecology

Mitigation of Impacts on Ecology

Construction of a subdivision such as the one proposed by UDC at Winnifred Beach, Fairy Hill represents a permanent and irreversible commitment of land resources. The area in question which was previously used for agricultural purposes will no longer be available for such use. The loss of natural habitat as well as a loss of the option for alternative uses of the land is a considerable negative impact.

Loss of Habitat and Biodiversity Impact

Mitigation calls for protecting and restoring as much of the original condition on the development site as possible. The planned wetland reserve and forest conservation area partially address the loss of habitat and biodiversity by creating an ecological buffer zone. Additional measures must be considered to further minimize negative impacts on the terrestrial ecology in the area: Identified trees must be clearly marked and protected. This map can be used to adjust road construction plans as well as individual lots with the goal of minimizing tree removal. A landscape plan should be developed which would include action items corresponding to each phase of the project ensuring gradual, albeit partial, restoration of the site's ecological characteristics. A landscape plan would ensure that designated trees are protected and/or relocated and that areas suitable for replanting are identified and landscaped using only local tree and shrub species used for feeding by local bird species. Selecting appropriate plant species for replanting is essential in determining the types of birds, butterflies and other fauna that will re-inhabit the site upon completion of the project. An integral part of the landscape plan should also address means of protecting and monitoring the beach (turtle nesting areas), the wetland reserve and the forest conservation area during site clearing and construction phases to ensure that the ecological integrity of the area is maintained.

In an effort to preserve the existing biodiversity, naturally occurring plants such as those used primarily by the birds for food and shelter should be harvested during the site clearing phase and relocated to a nursery, to serve as a source of plants for replanting at a later date. This would ensure that only native plants are used as part of the landscape plan thus eliminating the use of imported or potentially invasive species. Using bird feeders may encourage the displaced avifauna to remain in or return to the general vicinity, thus maintaining the existing biodiversity. The building contractor should be subject to punitive penalties for removal or damage of ecologically valuable trees.

Airborne and Noise Pollution
The site clearing plan should provide for 10-15m wide green buffer zones along roadsides and drainage ways to dampen the noise and dust related to construction. Access roads and exposed terrain should be sprayed by water trucks to minimize the dust. Use of heavy machinery should be restricted to daylight hours in order to minimize the noise pollution arising from the construction site.

Soil Erosion and Change in Drainage Patterns
Site clearing activities should be conducted in stages to minimize the area of exposed soil at any given time. Exposed soil should be seeded with grass or other appropriate cover as soon as possible to minimize soil erosion. Monitoring and maintaining proper storm water drainage systems, and redirecting flows during periods of heavy rain are steps that can minimize erosion and surface runoff into the bay.

Beach Erosion and Illegal Sand Mining
The proposed development plan calls for controlling of access points to the area and restricting car access to the beach during and after the completion of the development. These measures would restrict if not eliminate illegal sand mining and mitigate degradation of the beach area caused by such activities.

Transportation and Storage of Construction Materials
Arrangements should be made with contractors and subcontractors to ensure that the vehicles used for transporting building materials to the site are appropriately sealed and covered to minimize dust. Dust producing building materials such as sand or cement should be stockpiled in low enclosures and covered, away from drainage areas where they could easily be washed away during rainfall.

Disposal of Construction Debris
A site waste management plan should be made the responsibility of the building contractor to provide for the designation of appropriate waste storage areas on the site and a schedule for the timely collection and removal of construction debris to an approved dump site. Organic waste produced during site clearing should be mechanically mulched and composted at the site and used for landscaping at a later date.

Sewage and Garbage Disposal
Providing adequate number of portable restrooms (chemical toilets or dry composting toilets) and waste baskets and dumpsters is essential to keeping the construction site clear. Arrangements should be made for regular garbage collection and removal of sewage from the site.

Impact on Winnifred Beach
The development of the area will result in increased number of visitors to the beach recreation area, providing appropriate sanitation facilities such as toilets and running water are available. Eliminating car access to the beach in favour of parking spaces at a nearby area, as well as ensuring regular garbage collection for the vendors are some measures that would help maintain the present quality of the beach area. Landscaping the

area near the stream may discourage use of the stream for washing purposes. The best mitigation for the beach area would be to avoid the development of infrastructure in this area other than that required for sanitation. The square footage currently being suggested, for the forest conservation and wetland reserve area should be maximized, if any significant habitat is to be conserved.

Socioeconomics

Mitigative measures for the socio-economic impacts are summarized in the Impact Matrix Table in Appendix 4. Mitigative measures are recommended to off-set the negative impacts of the proposed development.

Land Use

The negative land use impact is a short-term construction impact, which includes the displacement of the vendors currently operating on the beach. It is recommended that the development plan for demolition, land preparation and construction activities on site be geared towards creating minimal displacement. The community and especially those persons who will be displaced should be included in the development activities whether by providing jobs or through compensation for loss income.

Employment

Negative employment impacts are also short-term though significant. It is recommended that the persons whose sources of income are disrupted by the proposed development be compensated through employment opportunities during and after construction or by monetary compensation.

Community Development/Recreation

Mitigative measures for the negative impacts on community development include the upgrading of infrastructure and the increased provision of social services for current and future residents as well as visitors to the Socioeconomic Impact Assessment (SIA) study area. Additionally, community participation in the proposed development may increase community pride and understanding, which would possibly increase the willingness of community members to pay for access to the beach. The community and the developers/manager may also work together in deciding on a mutually acceptable rate.

Hydrogeology

The proposed drains should be designed to accommodate a rainfall event that has a 4% chance of occurring in any one year.

The proposed drains should incorporate upgraded natural drainage routes to avoid blockages and potential flooding. Sinkholes and depression, should not be backfilled or used as drainage outfalls but maintained as green spaces within the development.

Swales and or retention ponds can be incorporated into the overall drainage design to provide areas of temporary storage and percolation. Areas for locating retention ponds could be within

kerb-side green spaces or other landscaped ponds as well as infiltration devices along walkways in order to improve amenity value.

All storm drain outlets should have strategically placed oil/water interceptors to prevent deleterious substances discharging to the sea. Surface water run-off can contain contaminants such as oil, organic matter and toxic metals. Although often at low levels, cumulatively they can result in poor water quality in rivers and groundwater, affecting biodiversity and amenity value. After heavy rain, the first flush is often highly polluting. Given the proposed site end-use, incorporating oil/water interceptors within the drainage system should be a primary design criterion. This will allow effective management of the contamination risks associated with storm runoffs. Storm water should NOT be allowed to discharge to the on-site wastewater treatment system as this effectively reduces the design capacity and can cause solids to be flushed out of the treatment system.

Source control techniques such as harvesting roof runoff, permeable pavements and infiltration devices are proven techniques in a complete and comprehensive and sustainable drainage plan. Dealing with the water locally not only reduces the quantity that has to be managed at any one point, but also reduces the need for conveying the water off the site.

Environmental Monitoring Plan

The aqueous environment should be monitored both during and post construction to ensure that national water quality objectives for beaches and freshwater are achieved and demonstrated to be achieved. Sites for monitoring shall include *both* coastal springs and the sea.

During the Construction Phase: precautionary engineering measures (such as cut-off trenches, etc) should be implemented to reduce run-off and prevent it from reaching, existing drains, natural gullies, springs and sea. Nothing which could cause pollution, including silty water, should enter any such watercourse.

All temporary fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Storage at or above roof level should be avoided.

Leaking or empty oil drums must be removed from the site immediately and disposed of via a licensed waste disposal contractor.

Washings from concrete mixers, paint or paint utensils should not be allowed to flow into any drain or watercourse.

Post construction: The costal springs and beach should be monitored at least twice yearly and the analysis shall include faecal and total coliforms, BOD_5, turbidity, nitrates, sulphur, pH, oils and grease.

ASSESSMENT OF ALTERNATIVES TO PROJECT

Alternative 1: Without Project Scenario
The without project scenario from a socioeconomic perspective would mean that the use of the site continues in a marginal manner with substantial underutilisation of resources. Without the proposed development project, the site would continue to be a public beach with no proper sanitary facilities, no security, no proper parking facilities, poor access roads and improper waste disposal practices. Additionally, potential for employment during and after construction of the proposed development would also be lost. The illegal use of the site for commercial purposes would continue and the residential lots would not be available. This alternative was the least favourable.

Alternative 2: Nature Reserve
The most environmentally friendly alternative to the current proposal would be to declare the area a Nature Reserve to be used primarily for eco-tourism (snorkelling, diving and bird-watching), research and education. The extent of infrastructure near the beach area would be limited to sanitation, garbage disposal and off-site parking facilities. Car access to the beach would not be permitted and would be restricted to pedestrian traffic only. Access to the beach area would be fee-based to support a beach maintenance crew as well as environmental wardens monitoring the conservation area. This scenario would protect the current state of the marine and terrestrial ecology, and maintain the integrity of the site for use by endemic resident and migrant species of avifauna. This scenario would stop the conversion of forested lands to pasture or agricultural use and offer long-term protection from future development initiatives. This scenario is attractive but would preclude the establishment of the villas in the area outside the beach, with its attendant economic opportunities for the community.

Alternative 3: With Project Scenario - Mixed Development
The "With Project" scenario contributes toward a national goal to expand the opportunities for tourism development, add to housing stock, provide for a diversified recreational product, and a foreign exchange earner. This development would also be compatible with the existing and future planned land uses. Significant forward and backward linkages associated with the local sourcing of construction material and employment opportunities during construction would be created. Other advantages include the maintenance of and woodlands by the creation of forest conservation areas and wetland reserves. This alternative was the most favourable.

Alternative 4: Agriculture
Another alternative use of the site would be agricultural. However, the land is characterised by thin, clayey soil in patches between extensive limestone outcrops. This would not support any major agricultural endeavour. Some small stock rearing takes place on a subsistence level. This alternative was not as favourable.

Conclusion: Despite the use of the area in the past for certain agricultural ventures, this was not regarded as a viable alternative for use of the site primarily because of the instability of much of the land found in the area. The housing/resort development option

would provide significant employment and earn foreign exchange while maintaining significant conservation areas and with recommended mitigation of negative impacts, this would appear to be the most practical use of the area.

1.0 INTRODUCTION

The Urban Development Corporation (UDC) proposes to develop Phase 2 of a four phase development plan in the Fairy Hill area of Portland, Jamaica. This second phase development "Fairy Hill Phase 2" is proposed to have three main features:

- Fairy Hill Beach Park
- Beach Cottages and
- Residential Lots

An Environmental Impact Assessment (EIA) is a requirement of the National Environment and Planning Agency (NEPA) in exercising their powers under the NRCA Act 1991. Technological and Environmental Management Network (TEMN) Limited has been engaged by The Urban Development Corporation (UDC) to carry out the EIA, and this report presents the findings thereof.

1.1 Terms of Reference

The Terms of Reference as approved by the national Environment and Planning Agency is located in Appendix 1.

1.2 Scope of Work

The Environmental Impact Assessment was carried out by a multidisciplinary team, and utilised skills in biological assessments, hydrogeology, environmental chemistry, socioeconomics and project management. A comprehensive evaluation of the study area was carried out and the environmental character of the area determined. This was related to the development plans and the potential impacts identified. Recommendations are made which are aimed at ensuring compliance with relevant environmental statutes, and ensuring the preservation or restoration of the ecological balance through the mitigation of anticipated impacts.

2.0 DESCRIPTION OF PROJECT

The beach park should boast at minimum, the following amenities: a ticket office, guard post, business offices, and family oriented recreational facilities, as well as sanitary conveniences. The premiere attraction of this development will be the twenty-nine (29) residential lots ranging in size from 821m^2 -1505m^2. Beach cottages will also be constructed to provide temporary dwelling opportunities for beach patrons and other visitors to Portland who are desirous of extending their length of stay. There are also plans for development of ecotrail facilities as well as wetlands reserves and forest conservation areas. (See Appendix 5) The entire Fairy Hill property is located approximately twelve kilometres (12km) east of Port Antonio and comprises approximately 110.72 hectares. (Appendix, 6 Figure1)

Pre-construction activities would include bushing to allow for surveyor to establish levels and the establishment of site office inclusive of temporary on site pit latrine. Construction method and works would be conventional i.e. Strip or raft foundation.

Duration of construction phase should not exceed 6 months for road and sewage. The construction of the Beach Cottages should not exceed 12 months. Both activities could go on simultaneously.

Water and electricity will be supplied in the usual manner. Solid waste disposal will be satisfied by the local Solid Waste Management Agency.

Sewage will be treated to a tertiary level using an anaerobic septic tank with sand filter, followed by a constructed wetland. The system will be sized to suit the number of people using the system.

Storm water flows will be calculated and dispersed to nearest gully/sinkhole using storm water pipes of the required size.

3.0 METHODOLOGY

All components of this EIA required that the following tasks be performed:

- Review of Literature
- Site Visits
- Data Collection and Sample Analyses
- Review of results, impact analysis and mitigation recommendations.

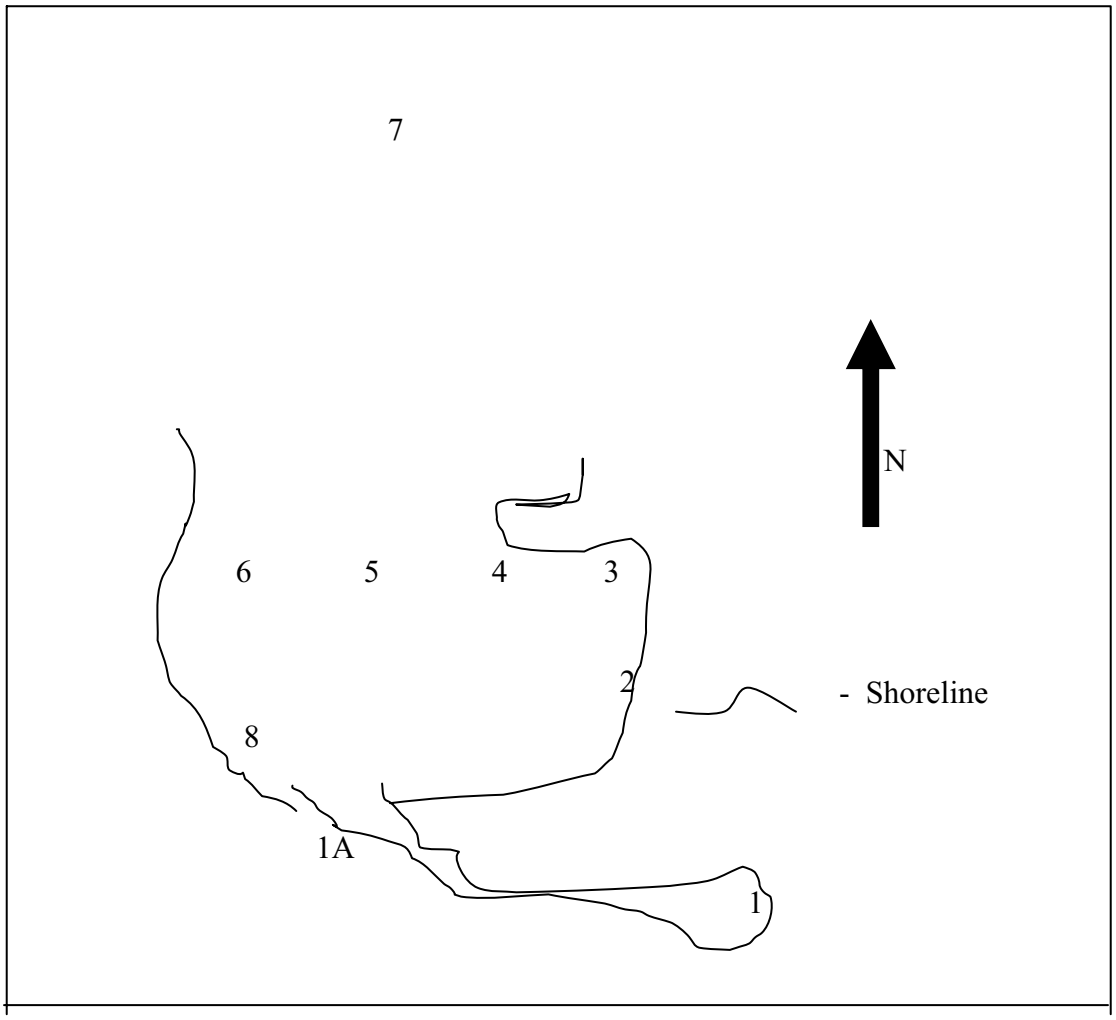
3.1 ENVIRONMENTAL CHEMISTRY

A statement on water quality is required to review background levels of critical indicators as well as to identify and quantify actual and/or potential impacts associated with the implementation of Phase 2 of the Fairy Hill Development.

A study carried out in August 1997 included the collection of spot samples at the popular Winnifred Beach referred to as Fairy Hill Beach in the 1997 report (TEMN 1997). A schematic of the sampling grid used for the 1997 exercise is shown in Figure 3.1.1.

Figure 3.1.1

Fairy Hill, Schematic of Sampling Grid (1997)



KEY: 1. Large pool near beach

1A. Outflow from pool

2. Second pool approximately 100m east of 1A

3. Grid station – near east shore

4. Grid station - approximately 5Om west of station 3

5. Grid station - approximately 5Om west of station 4

6. Grid station - near west shore

7. Background sampling site

8. Fairy Hill bathing area

Data from the 1997 exercise determined that levels of critical water quality parameters (TSS, N and P) in the bay off Winnifred Beach were well within the local standards interim and proposed standards for recreation waters and marine life (Table 3.1.1).

Table 3.1.1, Fairy Hill - Spot Water Quality Monitoring - Wednesday July 2, 1997

ID	Time	Cond. ms	T.S.S. mg/l	Turb. (FTU)	D.O. mg/l	Sal (ppt) $^{o}/_{oo}$	PO_4	NO_3	TC/100ml	FC/100ml	T (^{o}C)
1	10:00	11.89	22	5	5.2	6.8	0	0.9	170	0	25.1
1A	10:10	11.9	-	-	5.7	6.7	0	-	-	-	25.5
2	10:30	8.19	20	2	4.7	4.5	0.02	1	<20	0	25.4
3T	13:30	55	2	0	6.8	34.0	0.1	0.002	-	-	28
4T	13:15	55.3	2	0	6.9	34.1	0.1	0.01	<20	0	28.1
5T	13:10	55.5	6	0	7.6	34.1	0.04	0.01	-	-	29.5
6T	13:05	55.9	0	2	8.6	33.7	0.02	0.1	<20	0	29.5
7T	12:50	55.7	0	0	5.7	34.4	0.1	0.01	<20	0	29
8 (Beach)	13:40	0	2	0	-	-	0	0.04	<20	0	0
STD			**10**		**4.8**		**0.055**	**0.08**		**200**	

The spring stations had very low nutrients for fresh water as well as low faecal coliform indicating no detectable influence from sewage contamination at the time of sampling.

Based on the nature of the proposed development the parameters for this assessment are the same as those used in the 1997 study. These are:

- Coliform bacteria (total and faecal);
- Salinity
- Conductivity
- Nutrients (nitrate and phosphate)
- Dissolved oxygen
- Temperature
- Suspended solids
- Turbidity

Some international and local draft standards are presented in Table 3.1.2.

Table 3.1.2, Ambient Standards for Marine Waters

Parameter	Draft Standard
Nitrogen as NO_3	0.001 -0.081 mg/l
Phosphorous as o-PO_4	0.001-0.055 mg/l
BOD	0.57-1.16 mg/l
Dissolved Oxygen	4.8 mg/l*
Suspended Solids	<10mg/l**
Total Coliform	48-256 MPN/100 ml***
Faecal Coliform	<200

(**Source: USEPA Water Quality Criteria September 1999*)
***Proposed Coral Reef Criteria Value – (Draft NRCA Coral Reef Policy)*
**** Recreation Standard*

The present coastal and ground water quality has been assessed by the collection of water samples as well as a review of available data relevant to the study area. Standards used were from the National Environment and Planning Agency (NEPA) and the United States Environment Protection Agency (USEPA).

3.1.1 Field Work

Site investigation was conducted on Wednesday May 10 and June 19, 2006 for the purpose of making field observations, field measurements, and collecting samples for carrying out laboratory analyses.

Water samples were carried out at the eight sites established for the 1997 investigation. In addition, a sample was taken from the public water supply (NWC) at Zion Hill which is fed by the NWC well at Zion Hill and the Turtle Crawle River. GPS references are given in Table 3.1.3.

Table 3.1.3: Fairy Hill/Winnifred Beach Sampling Stations June 20, 2006

Station	Description	18°N	76°W
1	Spring - Winnifred Beach	10.208	22.432
1A	Spring - Outlet to Sea	10.212	22.441
2	Spring Just East of Station 1 - Emerges Along The Coastline		
3T	Bay - East	10.340	22.367
3B			
4T	Bay - Approx 15m W of 3T	10.342	22.459
4B			
5T	Bay - Approx 15m W of 4T	10.375	22.555
5B			
6T	Bay - W Shore	10.360	22.607
6B			
7T	Background	10.498	22.743
7B			
8 (Beach)	Winnifred Beach - Bathing Area	10.218	22.343
SF Well	Residence At Zion Hill	9.668	22.794

Samples were collected at the surface (wrist depth - within the upper 300cm) for laboratory analyses while portable instrumentation was used to determine selected water quality indicators in the field, at surface and depth.

3.1.2 Sample Analysis

Through the analysis of samples, as well as field measurements the levels of the following parameters were determined: coliform, salinity, nutrients (nitrates, phosphates), dissolved oxygen, temperature, suspended solids, and turbidity. Methods are summarized in Table 3.1.4.

Table 3.1.4: Summary of Analytical Methods

Parameter	Method
Total Suspended Solids (TSS)	Filtration and Gravimetry
Turbidity	Photometry
Nitrate	Cadmium Reduction/Colorimetry
Phosphate (o-PO4)	Molybdenum Method/Colorimetry
Dissolved Oxygen (DO), Salinity, Temperature (°C)	YSI Model 85 Oxygen, Conductivity, Salinity, Temperature Meter
Coliform	Multiple Tube Fermentation

3.2 ECOLOGY

The proposed development site is located in the town of Fairy Hill, on the ridge located immediately East of Winnifred Beach and includes the immediate beach area and adjacent foreshore. The area assessed in this study corresponds to the area indicated on the Fairy Hill Development Phase 2 - Master Plan supplied by the UDC, outlining the boundaries of the proposed development site and the specific areas of concern.

The primary objective of this study was to provide an overview of the biological status of terrestrial and marine areas in and around the proposed development site. The assessment focuses on identifying any existing (or potential) impacts to the ecology of the area which may occur as a result of the proposed development activities.

Photo 1: Aerial survey documents the current state of the area to provide a general overview of the terrain, vegetation and marine features of the site

An aerial survey of the proposed development site and surrounding areas was conducted on May 8th, 2006. Photographs were taken from an altitude of approximately 1,500 feet and documented

the current state of the area to provide a general overview of the terrain and vegetation. The photos were ground truthed by a series of passes through the site.

An assessment and classification of the terrestrial community was conducted on 13th May and subsequently on 21st July 2006. A "walk-through" terrestrial survey was conducted to determine the presence of ecologically or commercially important species of flora/fauna at or immediately adjacent to the site. Species of flora and fauna were identified on location and selected samples photographed for further verification at the lab.

Faunal community composition was recorded under the following headings:
MACROFAUNA; INSECTS; AVIFAUNA;
Avifauna identified was ranked according to the following criteria:

R = resident
E = endemic
I = introduced
W = winter migrant
S = summer migrant

The Fixed Radius Point Count Census Method was used to conduct the avifaunal census to determine the species composition in the area. Advantages of this method include:

- Ease of observation of the birds and their habitats from a stationary position
- More time available to identify contacts
- Greater opportunity to identify cryptic and skulking species
- Easier to relate bird occurrence to habitat features

This method was used to identify birds at twenty (20) survey points during a single day, along the parochial access road, as well as other paths within the area. Species observed between survey points were noted and added to the species list.

An assessment of the marine environment was conducted on 10th & 13th May 2006. Towline swims were carried out to evaluate the general features of the area. Line transects were carried out from the beach area toward the main reef buttress located approximately 200m from shore.

Four random 10 X 2m transects were selected and photographed at 10m and another three transects at 15m.

Substrate composition was determined by random dot analysis of the photographed transects using the Coral Point Count with Excel extensions (CPCe v3.1). A random distribution of twenty reference points was superimposed on each image allowing for enumeration and identification of species/substrate types. Corals and algae were identified to the species level where possible while all other reef components were grouped into categories (e.g. sponges, anemones or gorgonians).

A Fish census was conducted simultaneously along the same transect lines. The species observed were enumerated and ranked using the DAFOR (dominant, abundant, frequent, occasional, and rare) scale.

3.3 SOCIO-ECONOMIC ASSESSMENT

The Socioeconomic Impact Assessment (SIA) identifies the socioeconomic and cultural impacts of the proposed development. The study area for the SIA includes the proposed site and areas within two kilometres (2 km) of the site. Any new development in a community will have both local (micro), and regional national and (macro) impacts. For the purpose of this SIA the local impacts will include the proposed site and the area within 2 km of the site. Regional impacts will be those at the Parish level while national impacts will be island wide. The SIA included desktop research, as well as a socioeconomic and a public perception survey. TEMN previously conducted an EIA on the proposed site and an associated larger parcel located east of the current site in 1997. The SIA component of the 1997 EIA report was also reviewed. A site reconnaissance was conducted on April 24, 2006 and a socioeconomic survey was conducted on May 20-21, 2006. As a part of the 1997 SIA, TEMN conducted a detailed land use survey and analysis of the proposed site and within 2km of the site boundaries. The land use survey for this SIA included a review and analysis of this previous survey as well as a review of IKONOS satellite imagery of the Jamaica. Additionally, a site investigation was conducted on June 18, 2006 to determine any changes to the land use of the area.

The target population for the SEA was people residing within the study area (within 2km of the site). In order to determine the socioeconomic characteristics of the study area and public perception of the proposed development, a questionnaire survey was developed. A random sample of 334 (10 percent of the target population) was targeted for administering the questionnaires. While personal interviews are noted to be associated with high costs and tend to be time intensive, they have the advantages of higher response rates and tend to be more favourable for open-ended questions. Uncertainty about the reliability of mail services in the study area also influenced the choice of survey instrument.

The response rate was 43 percent with non-response being a result of people who refused to participate in the survey and individuals who were not at home on multiple visits.

3.4 HYDROGEOLOGY

This report satisfies hydrological aspects of Task 2 of the Terms of Reference (TOR) for the Fairy Hill Development-Phase II, Portland. These aspects include:

- A definition of the study area, based on the drainage area for which this development is a part. These boundaries were demarcated based on a desktop review of available topography maps and limited field reconnaissance along open and traversable access ways.
- Baseline data collection on the study area (hydrology, geology, hydrogeology, etc) and review of available existing reports and other information relevant to the study area.
- Review of the collected data with a view to determine:
    - Water demand based on population and consumption rate for the proposed site.
    - Pre and post project runoff rates for 25 year return period
    - Possibility for contamination of the coastal waters as a result of the proposed project.
- Identification of Potential Environmental Impacts relating to:

    - Flooding of the site or to adjacent areas as consequence of the development.
    - Slope instability as a consequence of cut-and-fill during the site preparation stage.

- Soil erosion to and from the site.
- Utilization of existing water supply sources and /or the development of new source(s) e.g. well source.

This desktop report was compiled from both limited field reconnaissance, the previous site EIA report done in 1997 and current public domain reports held within various governmental and non-governmental bodies.

The site is located off the main Class A road (accessed by a unpaved dirt road) in the vicinity of the district of Fairy Hill, Portland, Jamaica around N18.196 ° E76.375 ° (see Figure 1, Appendix 6). The site is bound by the Caribbean Sea to the north and by undeveloped dry limestone shrub-lands to the south, east and west. The total area is approximately 13 ha.

The site walkthrough was done on May 12, 2006 to visually verify the geology, ascertain the hydrogeology and investigate any scale-related events that may not have been captured in the previous studies.

The site is for the most part undeveloped with only a few small dwellings on the near shore.

The available data that was referenced for this study is listed below:

All issued material to the site, such as rainfall, groundwater pollution incidents, flooding incidents, mains supply facilities and other critical facilities were reviewed within a 1km radius of the site.

The hydrological assessment was made using WinTR-55 which is a robust, single-event rainfall-runoff small watershed hydrologic model. The model generates hydrographs from both urban and agricultural areas and at selected points along the stream system. The model was developed and is currently used extensively in the USA for catchments of 1 – 6,500 ha.

Written environmental searches were undertaken through the WRA and ODPEM. In addition website searches of the National Environment and Planning Agency (NEPA), and NWC was

undertaken to obtain any further relevant information. Verbal clarification of the Portland Sewage Project was also sought from the NWC's St. Mary Site Office. The results of the written searches are included in Appendix 6.

3.5 COASTAL DYNAMICS

In an effort to gain some understanding of the main driving forces responsible for water movement in the project area, it is necessary to look at both the localised bathymetry as well as the position of the site within the Caribbean Sea. Ultimately, this knowledge will enable the prediction of the movement of various types of effluent which may be intentionally or accidentally discharged into the surrounding waters.

To this end, a review of large scale hydro dynamic modelling of the North Equatorial Current as it flows west through the Caribbean and encounters land masses and very importantly, underwater sea-mounts or 'banks', was undertaken. On a smaller, more localized scale, the bathymetry of the surrounding waters up to half a mile offshore, as well as wave set-up over reef topography, was also examined.

The investigations (see methodology - Appendix 9) indicated that though the movement of water within the bay itself was mostly constant and very predictable, the deeper waters outside were fickle and changed with the tides, passing weather systems, and also with depth.

Modelling indicated the presence of large 'gyres' or 'eddies' which tended to switch the direction of the currents in much the same way that wind blows from the opposite direction as the eye of a hurricane passes.

4.0 THE ENVIRONMENTAL SETTING

4.1 ENVIRONMENTAL CHEMISTRY

4.1.1 Observations and Results

At the time of sampling water in the bay off Winnifred Beach was clear and appeared free of any notable floating matter or turbidity. The springs were also free of any obvious floating or suspended matter. The larger spring (Station 1), which opened on the beach **(**Appendix 7 - Photo 1), was flowing freely to the sea. The other spring further to the east was also active emerging along the rocky shoreline (Appendix 7 - Photo 2). Solid waste heaps showing evidence of previous burning were observed (Appendix 7 - Photo 3).

Results of recent monitoring are presented in Table 4.1.1.

Total suspended solids (TSS) were low for all samples taken. This was supported by **turbidity** levels, which were all <1NTU.

Dissolved oxygen (DO) was 6.0 – 8.0mg/l for all the marine samples (Figure 4.1.1). The springs had a slightly lower DO, being 5.9mg/l in the larger pool (Station 1) and 4.4mg/l in the smaller pool to the east.

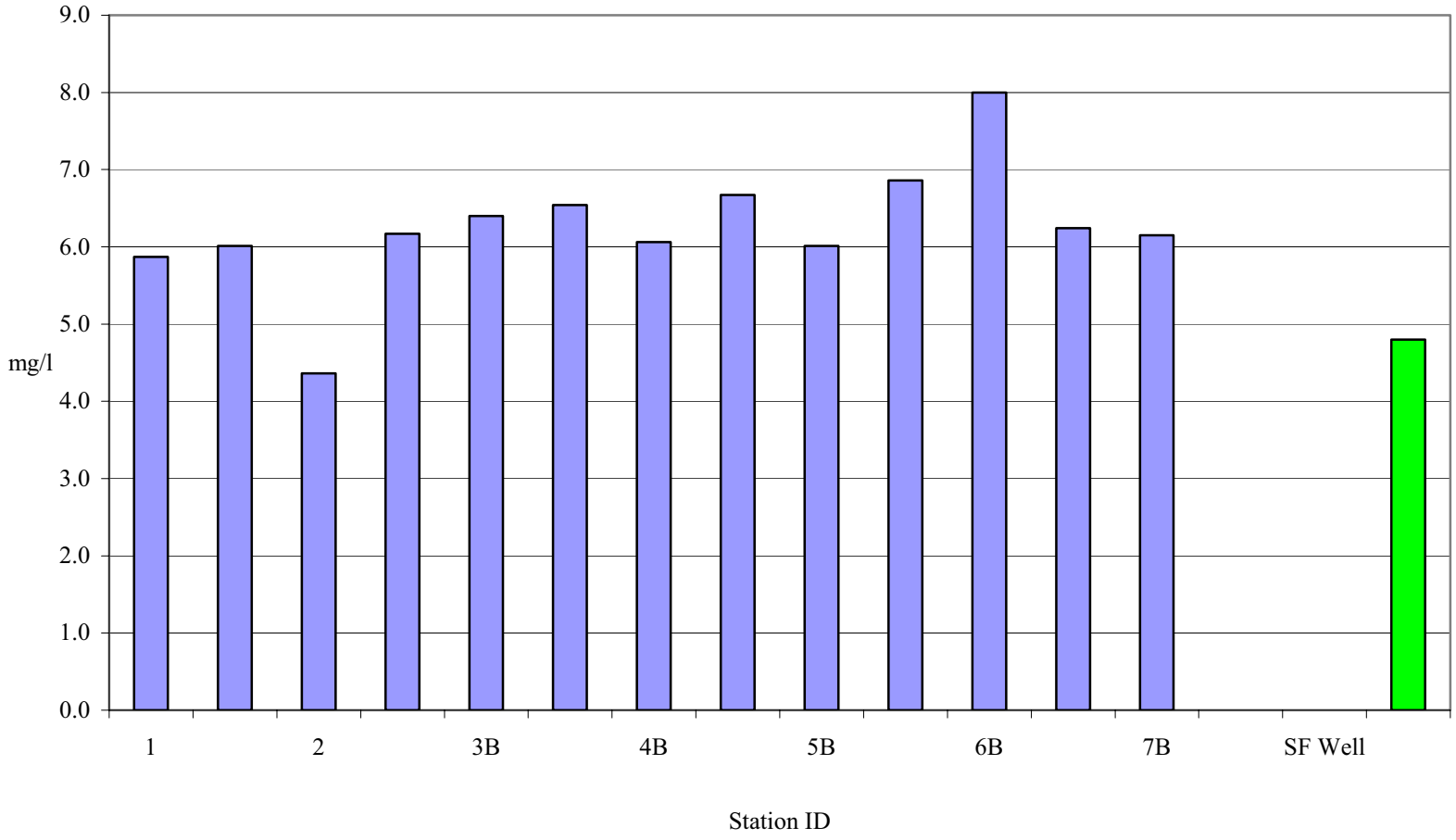
Temperature at the marine sites was in the narrow range 28.4 - 29.4^{o}C. Temperature was slightly lower by 0.1 - 0.8^{o}C at the bottom of the water column for all sites. Temperature of the springs was lower by approximately 2^{o}C being 25.6^{o}C at Station1 and 26^{o}C at Station 2.

Table 4.1.1: Fairy Hill/Winnifred Beach Water Quality May 10, 2006

Station	Time	Depth (m)	Cond. (ms)	T.S.S. (mg/l)	Turb (NTU)	D.O. (mg/l)	Sal (ppt)	PO_4 (mg/l)	NO_3 (mg/l)	TC (MPN)	FC (MPN)
1	9:35	0.3	11.9	0.4	<1	5.9	6.7	0.032	4.118	22000	430
1A	9:44	0.3	10.5	0.8	<1	6.0	5.8	0.028			
2						4.4	4.4		4.299		
3T	10:48 – 11:00		55.9	0.2	<1	6.2	35.3	0.009	0.109	<2	<2
3B		3.0	56.2			6.4	35.6				
4T	11:05 – 11:15		56.2	0.4	<1	6.5	35.4	0.046	0.04	<2	<2
4B		12.5	56.1			6.1	35.8				
5T	11:21 – 11:27		56.8	0.4	<1	6.7	35.7	0.014	0.115	<2	<2
5B		7.5	56.3			6.0	35.7				
6T	11:33 – 11:40		55.7	1.0	<1	6.9	34.7	0.023	0.139	<2	<2
6B		2.5	56.6			8.0	35.8				
7T	11:50 – 11:55		56.5	0.1	<1	6.2	35.7	0.032	0.121	<2	<2
7B		>30.0	55.9			6.2	35.7				
8 (Beach)	12:00								0.111	<2	<2
ZH Well	13:50		1.9	0.1	<1		0.9	0.042	5.251		
STD				10.0		4.8		0.055	0.08		

Phosphate (o-PO4) was low at all sites being in the range 0.009mg/l - 0.046mg/l (Figure 4.1.2 and 4.1.3). Phosphate was also low in the springs where the level was .032 mg/l in the pool (Station 1) and 0.028mg/l at the opening to the beach (Station 1A).

Figure 4.1.1: Fairy Hill (Winnifred Beach) - Dissolved Oxygen (DO)



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Nitrate was in the range of 0.040mg/l - 5.251mg/l for all samples (Figure 4.1.2 and 4.1.3). The highest level was determined for the tap water sample at Zion Hill where the distribution system is supplied by the Zion Hill Well and Turtle Crawle River. The lower levels were all determined in the bay samples. Nitrate levels in the samples taken from the brackish water pools at Winnifred's beach were similar to the level determined for the Zion Hill tap water sample, being 4.118mg/l for the larger source at the beach (Station 1) and 4.299mg/l for the smaller pool to the SE (Station 2).

Total coliform was determined to be 22000 MPN in the larger pool while **faecal coliform** was 400MPN. For all other samples total and faecal coliform were undetected.

Salinity showed little variation in the Bay where the range was 35.3 - 35.8ppt (Figure 4.1.4). Salinity was generally slightly lower at the top or identical at the top and the bottom. The springs had salinity of 7.7ppt (Station 1) and 4.4ppt (Station 2). The Zion Hill domestic sample (ZH Well) had a salinity of 0.9ppt.

Figure 4.1.2: Fairy Hill (Winnifred Beach)
Phosphate and Nitrate, May 10, 2006

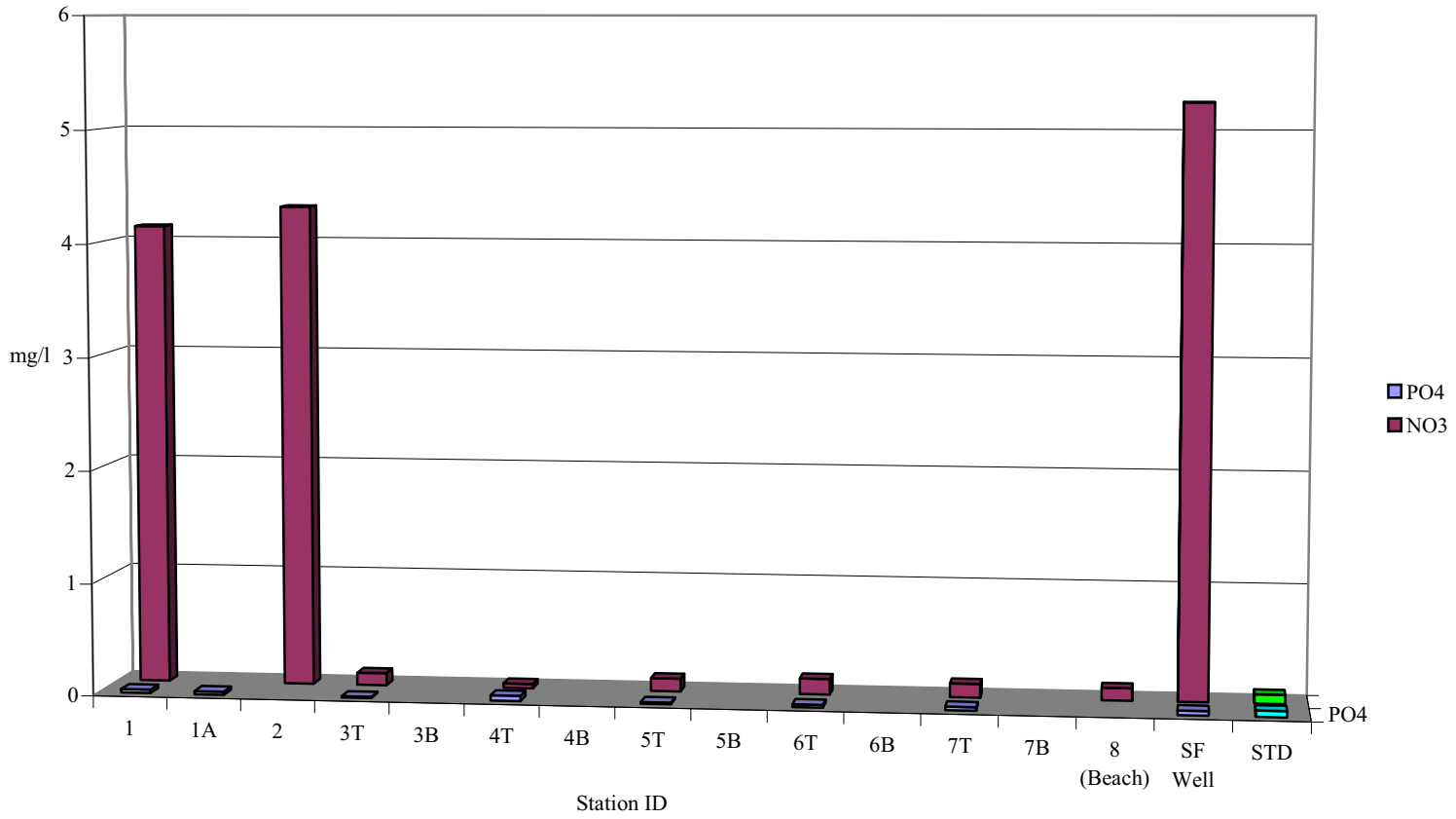

Figure 4.1.3: Fairy Hill (Winnifred Beach)
Phosphate and Nitrate (Sea Water)

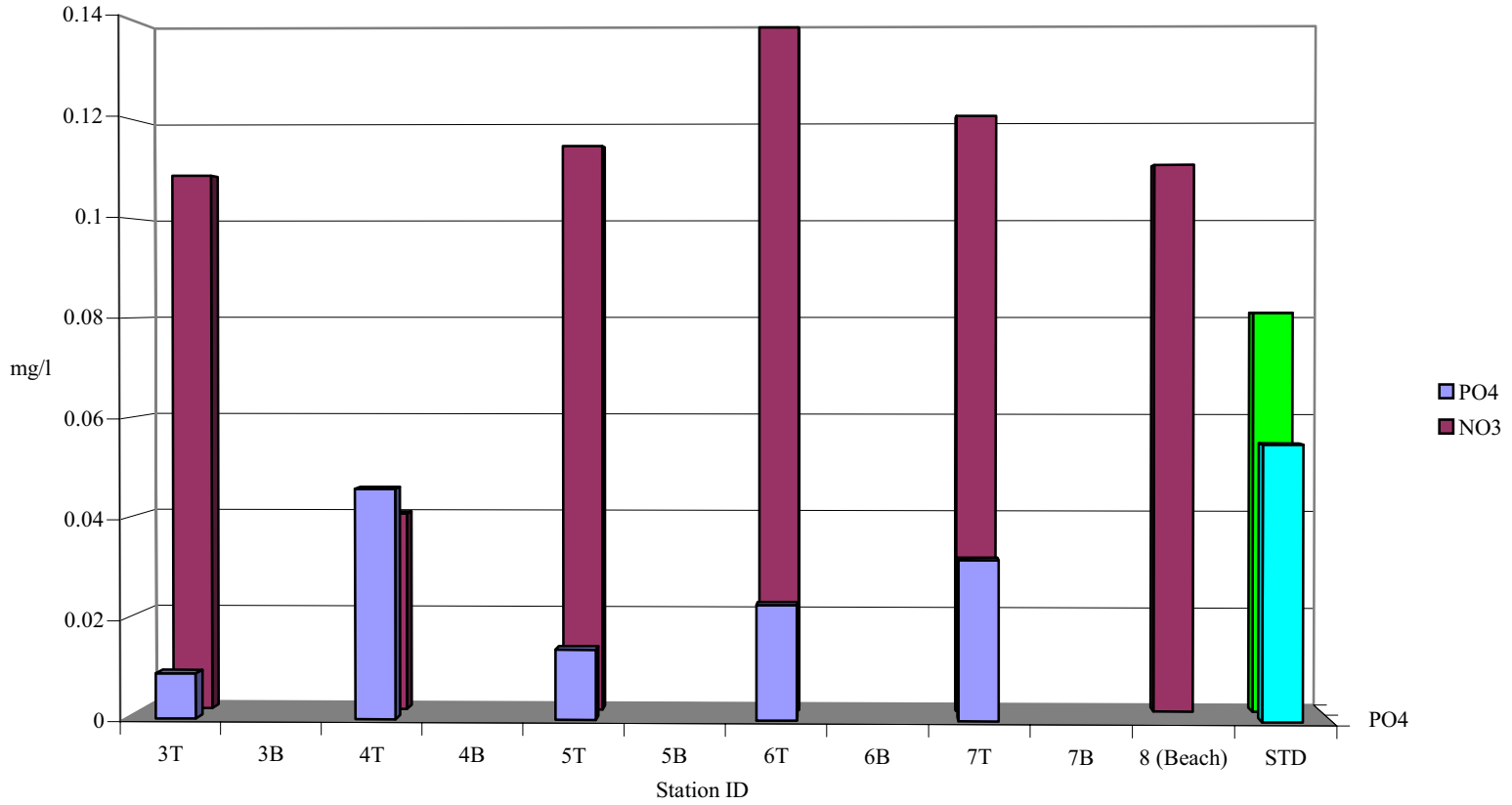

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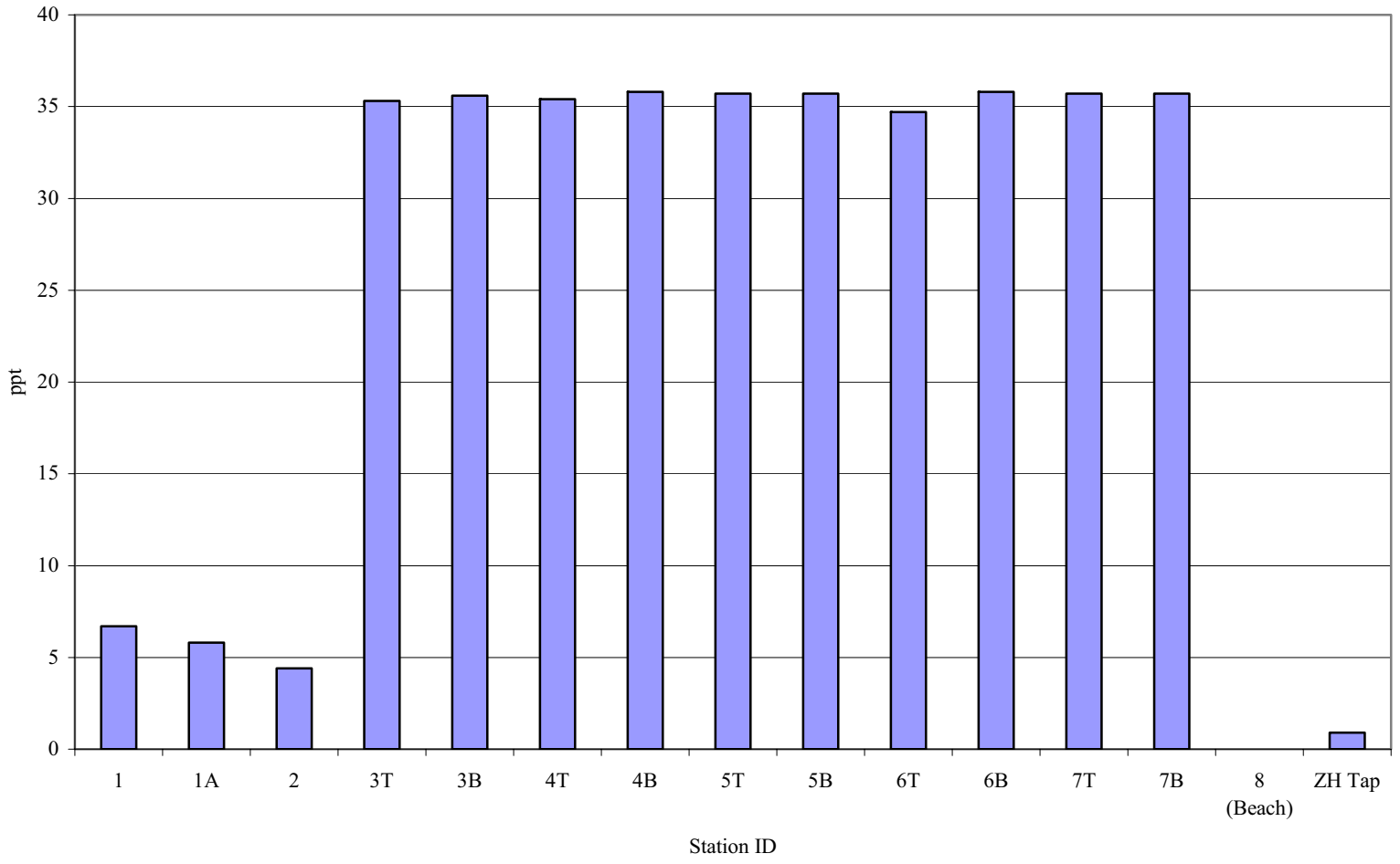
Figure 4.1.4: Fairy Hill (Winnifred beach) Salinity May 10, 2006



4.2 ECOLOGY

4.2.1 Terrestrial Macro Flora and Fauna

The aerial photos (Photos 2, 3) of the proposed development site show a densely forested terrain, with thick shrubs near the rocky bluff, and open areas that were previously cleared presumably for pastures or agricultural uses. The area can best be described as a disturbed woodland area, of fairly low elevation reaching a maximum height of 70m above sea level. A number of well worn paths weave through the study site. Rubbish (burned cars and building debris) was found strewn around the area as were a number of fire pits. A stone ruin, presumably an old agricultural estate, is located on the ridge immediately above the east side of the bay, near the site designated for the wetland conservation area. Parish records should be consulted to determine the possible historical or heritage importance of the ruin.

Photo 2: Aerial photo of proposed development site – view from the south east

Photo 3: Aerial photo of the proposed development site – view from the north east

The floral species identified in the area are typical of a wet limestone forest. The forest is composed of numerous large trees, many exceeding 0.3m diameter and 15m in height e.g. Trumpet trees. The forest floor is soil covered in a thick layer of moist leaf litter. Cleared areas are overgrown with short grasses. The canopy is closed throughout the forest creating a shaded interior providing an ideal habitat for various birds heard in the area (Photos 4 a, b). The under canopy layer is open towards the periphery where the forest gives way to dense shrubs.

Photos 4 a, b: Forested area in development site

Table 4.2.1 Botanical species identified on the proposed development site, Fairy Hill

Common Name	Scientific Name	Econ/Ecol Value	Form	DAFOR
Bird-of-Paradise	*Strelitzia reginae*	Ornamental	Flower	R
Sugar cane	*Saccharum officinarum*	Edible	Grass	O
Banana	*Musa sapientum (hybrid)*	Edible fruit	Herb	F
Broom weed	*Sida acuta*	Craft	Herb	F
Marsh miller	*Blechum pyramidatum*	Ornamental	Herb	O
Pineapple	*Ananas comosus*	Edible fruit	Herb	R
Shame old lady	*Mimosa pudica*	-	Herb	O
Indian corn, Maize	*Zea mays*	Edible fruit	Shrub	O
Night shade	*Urechites lutea*	Ornamental	Shrub	F
Red ginger	*Alpinia allughas*	Ornamental	Shrub	O
Susumber	*Solanum torvum*	Edible fruit	Shrub	O
Wild sage	*Lantana camara*	-	Shrub	O
Sea grape	*Coccoloba uvifera*	Shrub	Shrub	F
Cow tongue	*Eupathorium*	Medicinal	Shrub	F
Ackee	*Blighia sapida*	Edible fruit	Tree	O
Allspice, Pimento	*Pimenta dioica*	Spice	Tree	A
Avocado	*Persea Americana*	Edible fruit	Tree	O
Breadfruit	*Artocarpus altilis*	Edible fruit	Tree	O
Coconut	*Cocos nucifera*	Edible fruit	Tree	O
Dogwood	*Piscidia piscipula*	Furniture, lumber	Tree	O
Guango, rain tree	*Samanea saman*	Shade, animal feed	Tree	O
Guava	*Psidium guajava*	Edible fruit	Tree	R
Guinep tree	*Melicoccus bijugatus*	Edible fruit	Tree	R
June/Jew plum	*Spondias dulcis*	Edible fruit	Tree	O
Logwood	*Haematoxylum campechianum*	Furniture, dye	Tree	O
Maiden plum	*Commocladia pinnatiflia*	-	Tree	O
Mango tree	*Mangifera indica*	Edible fruit	Tree	F
Otaheite apple	*Syzygium malaccense*	Edible fruit	Tree	R
Quickstick	*Gliricidia sepium*	Borders, fencing	Tree	F
Ramoon	*Tropis racemosa*	-	Tree	O
Seville orange	*Citrus vulgaris*	Edible fruit	Tree	R
Silk cotton tree	*Ceiba pentandra*	Ornamental	Tree	R
Sour sop	*Annona muricata*	Edible fruit	Tree	O
Trumpet tree	*Cecropia peltata*	Medicinal	Tree	F
West Indian almond	*Terminalia catappa*	Edible fruit, shade	Tree	F
African tulip	*Spathodea campanulata*	-	Tree	R
Calabash	*Crescentia cujete*	Craft, fibre	Tree	O
Bastard cedar	*Guazuma ulmifolia*	Furniture, medicinal	Tree	O
Starapple	*Chrysophyllum cainito*	Edible fruit	Tree	O
Poor man's orchid	*Bauhinia spp*	-	Tree	R
Noni	*Morinda citrifolia*	Medicinal	Tree	F
Philodendron	*Philodendron lacerum*	-	Vine	O
Monkey comb	*Pithecoctenium echinatum*	Ornamental	Vine	R
Pudding/snake with	*Cissus sicyoides*	-	Vine	F
Red bead vine	*Abrus precatorius*	Art & craft	Vine	R
Sweet cup	*Passiflora maliformis*	Edible fruit	Vine	R

Approximately 46 native and introduced plant species were identified (Table 2.1). Some of the plant species include, Guango, Cotton and Trumpet trees, as well as Guinep, Almond, Guava and other fruit bearing trees. Many of the native plant species (herbs, shrubs, flowering plants) identified have medicinal or artisanal uses, while others, primarily food species such as Banana (*Musa* sp.), Breadfruit, Mango, Sugar Cane, Corn and Red Peas (*Phaseaola* sp.) appear to have been introduced or cultivated.

A unique plant community exists near the freshwater stream on the eastern side of the beach (Table 2.2).

Table 4.2.2 Botanical species identified near the freshwater stream on the East side of Winnifred Beach, Fairy Hill

Common Name	Scientific Name	Econ/Ecol Value	Form	DAFOR
Swamp fern	*Acrostichum aureum*	Ornamental	Shrub	F
-	*Cyperus ligularis*	-	Herb	O
Eucharist lily	*Hymenocallis latifolia*	Ornamental	Herb	R
-	*Ludwigia spp.*	-	Herb	F
-	*Rhabdadenia biflora*	-	Vine	F
Reedmace	*Typha domingensis*	-	Shrub	F

4.2.2 Bird Composition, Distribution and Habitat Usage

A total of twenty-two bird species were observed for the census period (Table 3.1). The breakdown of the bird species total is as follows:

- Twelve **resident** species
- Eight **endemic** species
- One **migrant** species

The species were found to be equally distributed throughout the habitat, with species such as the Black-whiskered Vireo, Bananaquit and White-chinned Thrush being vocally dominant, throughout the survey period.

Anthropogenic factors appear to influence the observed avifaunal composition in the area. The endemic forest species such as White-chinned Thrush and Stripe-headed Tanager are mixed with

urban/cosmopolitan species (i.e. resident species such as Greater Antillean Grackle, Smooth-billed Ani and Northern Mockingbird). This suggests that there is an ongoing change in the species composition, possibly transitioning from a secondary forest-like composition to an urban-like composition.

Despite the negative effects of anthropogenic disturbances on the forest species, the area continues to be used both as feeding and nesting grounds for the species found within. Most trees, shrubs, plants and vines were fruiting, flowering or both at the time of the survey which happens to coincide with the nesting period of most bird species mentioned. This is the case for the summer migrant Black-whiskered Vireo which comes to Jamaica during the summer period to nest and reproduce.

Table 4.2.3 Land birds identified on and near the proposed development site, Fairy Hill

Common Name	Scientific Name
Residents	
Turkey Vulture	*Carthartes aura*
White-crowned Pigeon	*Columba leucocephala*
White-winged Dove	*Zenaida asiatica*
Common Ground Dove	*Columbina passerina*
Vervain Hummingbird	*Mellisuga minima*
Greater Antillean Bullfinch	*Loxigilla violacea*
Bananaquit	*Coereba flaveola*
Northern Mockingbird	*Mimus polyglottos*
Jamaican Oriole	*Icterus leucopteryx*
Greater Antillean Grackle	*Quiscalus niger*
Olive-throated Parakeet	*Aratinga nana*
Smooth-billed Ani	*Crotophaga ani*
American kestrel	*Falco sparverius*
Endemics	
Black-billed Streamertail	*Trochilus scitulus*
Jamaican Woodpecker	*Melanerpes radiolatus*
Loggerhead Kingbird	*Tyrannus caudifasciatus*
White-chinned Thrush	*Turdus aurantius*
Jamaican Vireo	*Vireo modestus*
Jamaican Stripe-headed Tanager	*Spindalis negricephalus*
Yellow-shouldered Grassquit	*Loxipasser anoxanthus*
Jamaican Lizard Cuckoo	*Saurothera vetula*
Migrants	
Black-whiskered Vireo	*Vireo altiloquus*

The area also provides habitat for several other species, such as snails (two types), *Anolis* lizards, butterflies, moths, beetles and other insects.

4.2.3 Marine Flora and Fauna

Winnifred Beach (Fairy Hill Bay) is a sheltered cove 1.6 sq km in area, with a small stream (as well as a shoreline point of freshwater seepage) on the east side of the bay. The bay is sheltered by a modest submerged reef crest formed primarily by a ridge of dense fire coral on the east side and mounds of coral colonies on the west side of the bay. A small, shallow, natural channel on the western side of this protective ridge provides boat access to and from the beach (Photo 5).

Photo 5: Reef crest protecting beach

Lagoon and Reef Crest

Coral species observed on the ridge and on coral patches in the lagoon included Fire Coral (*Millepora* spp.), Smooth Brain Coral (*Diploria strigosa*), Elkhorn Coral (*Acropora palmata*, both mature and recruits) as well as Boulder and Smooth Star Coral (*Montastraea annularis* and *Siderastrea siderea*) (Photo 6 a, b, c, d). Corals were of small to medium size, with an average diameter of 20-30 cm.




Photo 6 a, b, c, d: Coral species observed on the ridge and on coral patches in the lagoon

Coral recruitment on the reef crest and on the substrate sloping seaward is notable and can be attributed to the presence of a relatively abundant population of long spined black urchins (*Diadema antillarum*) (Photo 7 a, b) as well as other species of urchins such as *Echinometra viridis* which remove algae and so create bare space on which juvenile corals can settle. Mature coral recruits (colonies less than 2 cm in diameter) were frequently seen on the reef, occurring at densities of approximately 2-3 per m^2.

Photo 7 a, b: *Diadema antillarum* on the shallow fore reef

- *Diadema antillarum* - patchy distribution in slightly deeper (<5m) water – approx 13 urchins per m^2 from 2 x 10m transects

- *Echinometra viridis* - patchy distribution in shallow (<2m) water - mean of 166 urchins per m^2 from 1 x 10m transect

Coral rubble and mounds on the west side of the bay provide shelter and habitat not only for juvenile fish and urchins, but also for Sun Anemones (*Stoichacts helianthus*) which can be observed forming a mat-like cover on the substrate.

The algal community on the reef crest includes *Sargassum* sp., *Galaxaura* with other species such as *Schizothrix sp.* occasionally spotted on coral rubble with *Penicillus* sp. and *Avrainvillea* sp. on the sandy substrate in the lagoon. The shallow sandy lagoon (~1-1.5m) contains dense Turtlegrass (*Thalsasia testudium*) beds extending to the reef crest. Shoot densities averaged 806 shoots per m^2. The substrate on east side of the lagoon where the stream flows into the bay is overgrown with a pale green filamentous turf (possibly *Lyngbya semiplena* (Photo 8 a, b) which is indicative of localized eutrophication.

Photo 8 a, b: Evidence of possible eutrophication in the lagoon near the stream

Fore-Reef Buttress

The gently sloping substrate on the seaward side of reef crest was primarily barren hard pavement interspersed with mounds of coral and urchins, giving way to the typical spur and groove reef formation common to Jamaican north coast reefs. The main reef buttress (see Photo 9) outside of the bay supported a healthy community of benthic fauna including scleractinian corals, sponges and gorgonians (Fig. 4.2.1).

Photo 9: Seaward of reef crest - barren hard pavement interspersed with mounds of coral and urchins. Main spurs support scleractinian corals, sponges, gorgonians & abundant algae

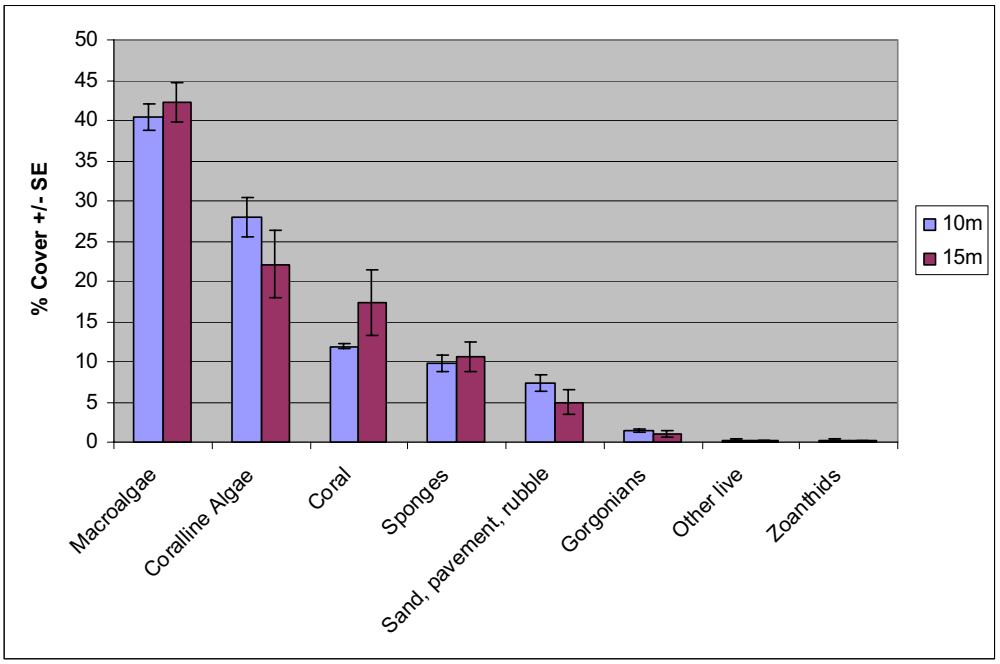


Figure 4.2.1 Percent cover of benthic organisms on the main buttress at 10m and 15m offshore Fairy Hill Bay. Error bars are Standard Errors

Scleractinian (reef-building) coral cover ranged from 12% +/- 0.3 at 10 m to 17% +/- 4 at 15m, with *Porites* sp., *Siderastrea* sp. , *Agaricia agaricites* and *Montastrea faviolata* being the most commonly occurring species at that depth range (Table 4.2.1). Sponges were frequent at these depths, covering approximately 10% of the substrate. Some of the species observed included the Loggerhead sponge *(Spheciospongia vesparium)* as well as the large Tub sponge (*Xestospongia muta*). Gorgonians, which contributed to approximately 2% of the substrate cover, include species such as the Common Sea Fan (*Gorgonia ventalina*) and the Encrusting Gorgonian (*Erythropodium caribaeorum*).

Table 4.2.4 Coral species identified on the main buttress at 10m and 15m in Fairy Hill Bay

Common Name	**Scientific Name**	**T3 10 m**		**T3 15 m**	
	Coral	**Mean**	**SE**	**Mean**	**SE**
Boulder star coral	*Montastrea faveolata*	-	-	5.11	2.11
Massive starlet coral	*Siderastrea sidereal*	2.48	1.03	3.20	1.54
Finger coral	*Porites porites*	0.35	0.22	2.48	1.36
Mustard hill coral	*Porites astreoides*	3.20	1.37	2.22	0.46
Lettuce coral	*Agaricia agaricites*	2.31	0.24	1.03	0.31
Lobed boulder star coral	*Montastraea annularis*	0.96	0.13	0.81	0.25
Yellow pencil coral	*Madracis mirabilis*	0.91	0.77	0.60	0.30
Lesser starlet coral	*Siderastrea radians*	0.15	0.09	0.57	0.38
Grooved brain coral	*Diploria labyrinthiformis*	0.25	0.25	0.40	0.40
Fire coral	*Millipora spp.*	0.15	0.09	0.29	0.16
Maze coral	*Meandrina meandrites*	0.15	0.09	0.12	0.07
Branched finger coral	*Porites furcata*	0.30	0.002	0.12	0.07
Whitestar sheet coral	*Agaricia lamarki*	-	-	0.05	0.05
Smooth star coral	*Solenastrea spp.*	0.40	0.20	0.04	0.04
Great star coral	*Montastraea cavernosa*	0.15	0.09	0.04	0.04
Gofball fragum	*Favia fragum*	-	-	0.04	0.04
Symmetrical brain coral	*Diploria strigosa*	0.15	0.09	-	-
Smooth flower coral	*Eusmilia fastigiata*	0.10	0.05	-	-
Boulder brain coral	*Colpophyllia natans*	0.05	0.05	-	-
Stahorn coral	*Acropora cervicornis*	-	-	0.09	0.09
	Undaria spp.	-	-	0.12	0.12
Total Percent Cover		**12.07**		**17.20**	

The algal community at the 10-15m depth range was dominated by fleshy species including *Sargassum* sp., *Dictyota* sp., *Lobophora* sp. and *Cladophora* sp. which contribute to approximately 40% +/- 1.6 to 42% +/- 2.4 of the substrate cover. Calcareous macroalgae (including Crustose Coralline algae) account for up to 27% +/- 2.4 of the substrate within this depth range and are represented by the green algae, *Halimeda* spp., as well as the red algae *Galaxaura* sp. and *Jania* sp. (Table 4.2.2).

Table 4.2.5 Algal species identified on the main buttress at 10m and 15m in Fairy Hill Bay

Common Name	Scientific Name	10 m		15 m	
Coralline Algae	***Coralline Algae***	**Mean**	**SE**	**Mean**	**SE**
Twig Alga	*Amphiroa sp.*	4.94	1.73	1.86	1.15
Paddle blade alga	*Avrainvillea sp.*	0.05	0.05	0.17	0.05
Tubular thicket alga	*Galaxaura sp.*	3.12	0.50	1.81	0.23
Watercress alga	*Halimeda sp.*	12.57	0.48	7.00	0.97
Pink segmented alga	*Jania sp.*	0.60	0.38	5.15	2.92
Burgundy crust alga	*Peysonellia sp.*	0.05	0.05	0.20	0.14
Pinecone alga	*Rhipocephalus sp.*	0.00	0.00	0.12	0.12
Mermaid's fans	*Udotea sp.*	0.30	0.09	0.08	0.08
Encrusting algae (including Crustose Coralline Alga)		6.29	2.14	5.74	1.58
Percent Cover		**21.63**		**16.38**	
Macroalgae	***Macroalgae***	**Mean**	**SE**	**Mean**	**SE**
Green clump alga	*Cladophora sp.*	2.66	0.44	6.707	1.95
Dead man's fingers	*Codium sp.*	0.25	0.05	0.08	0.08
Derbesia	*Derbesia sp.*	0.71	0.18	0.16	0.16
Y branched alga	*Dictyota sp.*	5.07	0.84	9.17	1.79
Encrusting fan-leaf alga	*Lobophora sp.*	7.90	0.33	5.84	0.89
Sargassum	*Sargassum sp.*	11.48	1.91	8.03	0.25
Leafy flat-blade alga	*Stypopodium sp.*	0.45	0.00	0.04	0.04
Turf	Turf algae	11.45	1.22	11.82	0.97
Percent Cover		**39.96**		**41.84**	

The results of the fish census indicated similar numbers of species (28) to those observed on previous visits to the area (Table 4.2.3). The size of fishes seen however was smaller than those previously noted. Few mature, commercially important fishes (grunts, parrot fish, goatfish, and groupers) were observed. The reef was considered to be heavily over-fished. Discarded fish nets, anchors and fish traps were observed in the area (see Photo 10 a, b, c).

Photos 10 a, b, c: Debris found on the reef: discarded fishing nets, anchor and fish traps

Table 4.2.6 Fish species identified on the main buttress at 10m and 15m in Fairy Hill Bay

Common name	Scientific name	1997 10m	1997 20m	2006 Trap	2006 10m	2006 15 m
Banded Butterflyfish	Chaetodon striatus			2		
Black Banded Snapper	Lutjanus semicinctus			1		
Bicolor damselfish	*Stegastes partitus*	0	7			
Black durgon	*Melichthys niger*	4	0			
Blackbar soldierfish	*Myriprsistis jacobus*				3	5
Blue chromis	*Chromis cyanea*	>40	>100		>100	>100
Blue headed wrasse	*Thalassoma bifasciatum*	>30	>10			
Blue parrot fish	*Scarus coeruleus*	2	4			
Blue tang	*Acanthurus coeruleus*	6	0	5	8	7
Bluestriped grunt	*Haemulon sciurus*	3	16			
Bridled burrfish	*Cyclichthys antennatus*	4	0			
Caesar grunt	*Haemulon carbonarium*					5
Coney, bicolor phase	*Cephalopholis fulva*	3	16		3	
Coney, brown phase	*Cephalopholis fulva*	6	3			
Creole wrasse	*Cepticus parrae*	0	5			
Doctorfish	*Acanthurus chirurgus*	5	11			
Dusky damselfish	*Stegastes dorsopunicans*	0	4			
Foureyed butterflyfish	*Chaetodon capistratus*				2	2
French grunt	*Haemulon flavolineatum*	0	3			
Greater soapfish	*Rypticus saponaceus*	0	1			
Harlequin bass	*Sarranus tigrinus*	0	2		3	2
Indigo hamlet	*Hypoplectrus indigo*	0	1		4	2
King mackerel	*Scomberomorus cavalla*	0	1			
Lane snapper	*Lutjanus synagris*	2	4	1		
Mahogany snapper	*Lutjanus mahogoni*	0	1			
School Master snapper	*Lutjanus apodus*			1		
Ocean Sugeon	*Acanthurus bahianus*				5	11
Redband parrot	*Sarisoma aurofrentum*	0	1	4	7	
Redfin parrot	*Sparisoma rubripinne*	0	2			
Rock beauty	*Holacanthus tricolor*	0	1			3
Sand tilefish	*Malacanthus plumieri*	0	1		3	
Sargent major	*Abudefduf saxatilis*	2	0	7		
Sharpnose puffer	*Canthigaster rostrata*	3	0			1
Slender filefish	*Monacanthus tuckeri*	0	3			
Spanish hogfish	*Bodianus rufus*	1	0			
Spotted goat fish	*Pseudupeneus maculatus*	0	6		5	4
Spotted drum	*Equetus punctatus*					1
Squirrelfish	*Holocentrus ascensionis*	0	6	6		14
Stoplight parrot (f)	*Sparisoma viride*	3	0			6
Stoplight parrot (m)	*Sparisoma viride*					2
Striped Parrot fish (F)	*Scarus iserti*	5	12	8	15	23
Tobaccofish	*Serranus tabacarius*	0	7			
Trumpet fish	*Aulostomus maculates*				2	

Common name	Scientific name	1997 10m	1997 20m	2006 Trap	2006 10m	2006 15 m
Yellow edge chromis	*Chromis multilineata*	0	>100			
Yellow goat fish	*Mulloidichthys martinicus*	12	6	8		
Yellowtail damsel	*Microspathodon chrysurus*	8	0			
Graysby	*Epinephelus cruentatus*					3
Other						
Caribbean Reef Squid					7	

There have been reports of recent sightings of Hawksbill sea turtles (*Eretmochelys imbricate*) on the beach. This seems to suggest that the beach area may be used as a nesting ground by Hawksbill turtles and is deserving of further investigation and monitoring to accurately ascertain the number of individuals and their the seasonal movements, in order to implement appropriate protection and conservation measures. While the habitats of Hawksbills vary by stages in their life cycle, females tend to return to the same nesting beach to lay their eggs. Hawksbill sea turtles are listed as Critically Endangered Species (facing an extremely high risk of extinction in the wild in the immediate future) by the International Union for Conservation of Nature and Natural Resources and are protected under Jamaica's Wild Life Protection Act. Hunting of the animal for its meat or the poaching of its eggs is prohibited and a conviction for either carries a fine of $500,000 or imprisonment.

4.3 SOCIO-ECONOMICS

4.3.1 Land Use

On Site

The site consists of a public beach, Winnifred Beach and a sloped area containing woodland and open space. The existing land use of the site is recreational, commercial and woodland and open space. This use is consistent with the designated land use for the site in the Portland Coast Development Order. A small swamp and a spring are located in the centre of the site, and along the eastern shoreline of the beach. The spring is reportedly used by residents for bathing and for baptisms by local churches and a church from Kingston. Four structures were located on the beach during the site visit. These were a bathroom and shower facility which was out of use, an

empty restaurant, a hut that is in a state of disrepair and a restaurant/bar that is currently in operation. In addition, there were approximately 14 small vending stalls, the majority of which were reportedly being used to sell craft, snacks, fruits and coconut water and food and juices (jerk chicken, soup, corn). There was also a fishing boat located on site. The Winnifred Beach is the only public beach in the community with unrestricted access, and is used by community members, tourists and visitors from other parishes. The number of visitors to the beach is usually higher on weekends and public holidays.

Lands within 0.5km of the Site

There were no significant changes to the land use within 0.5 km of the site boundaries from those described in the 1997 SIA Report. The lands consisted of the western portion of Zion Hill, and the hamlets of Fairy Hill, a high-income residential community which borders the UDC property. The land uses within this area included residential, commercial, agricultural, woodland and open space. The UDC offices, the community centre and two basic schools are also located within this area. The remainder of the area mainly consists of lands owned by the UDC with future plans for the development of residential agricultural lots, community service and residential lots. These lands are currently being squatted on for residential and agricultural purposes. The Portland Main Road (a Class "A" road) along which are several commercial/retail entities, is located within 0.5 km of the site boundaries. Immediately west of the site boundary and north of the existing high income residential development was the site for the future proposed 500-room hotel development.

Lands within 0.5km-2km of the Site

The lands within 0.5 to 2 km of the site stretch from Boston Bay in the east, Sherwood Forest to the south, San San Bay to the west, and the Caribbean Sea to the north. To the east were the Winnifred Rest Home, the Fairy Hill Housing Scheme, Harmony, Friendship, Boston, and Boston Beach. Sherwood Forest in the south was connected to Fairy Hill via Orange Valley Pen by a Class B road. The main land uses within 0.5 to 2 km of the site are residential, commercial, small manufacturing, recreation and institutional uses. Recreational/tourism land uses included the Jamaica Crest Hotel and the Falcon Restaurant. To the west was the noted tourist area which

included the world famous Blue Lagoon, Blue Lagoon Villas and Restaurant (not in operation), the Fern Hill Hotel, San San Tropez Restaurant, Tiamo, Moon San Villa, and the Villas at Dragon Bay (not in operation). The main land uses tended to be concentrated along the roads within the area. All other lands in the area were under agriculture use and/or woodland and open space (See Land Use Map in Appendix 5).

4.3.2 Demography

The population for the Parish of Portland is estimated at 81,393 (STATIN 2005). This represents a 1.5 percent growth from the 2001 population of 80,174. The population of Portland has been characterized by a slow growth rate illustrated by population figures of 67,500, 73,700, 75,500 and 80,174 for the periods 1970, 1982, 1991 and 2001 with corresponding annual growth rates of 0.46%, 0.73%, 0.27% and 0.62% respectively (see Table 4.3.1). Assuming an annual growth rate of 0.4%, it is projected that the population of Portland will be 81,718 by the end of 2006 and 83,034 by 2010 and 85,403 by 2020. The male to female ratio in 2001 census was 1:1.

Table 4.3.1 Population of the Parish of Portland

Census year	Total	Males	Females	Intercensal change %	Annual rate of growth %
1970	67,500	33,500	34,000	4.65	0.46
1982	73,700	33,600	37,000	9.19	0.73
1991	75,500	37,600	37,900	2.44	0.27
2001	80,174	39,951	40,223	6.19	0.62

SOURCE: STATIN, 2002

The population for the SIA study area falls within several Enumeration Districts (see Table 4.3.2). The socio-economic and perception survey results indicted that the average household size for the SIA study area was 4.0 with ranges from one to 14 persons per household. This average is higher than the parish average which was 3.5 in 2002 (Survey of Living Conditions 2002). Seventy four percent of the heads of households who participated in the survey were males while 26 percent were females, 35 percent were in the 40-49 age group, 29 percent in the 30-39 age group, 14 percent in the 18-29 age group, 13 percent in the 50-59 age group and 9 percent over 60 age group.

Table 4.3.2 Population within SIA Study Area

Enumeration Districts (EDs)	Male	Female	Total
Within 0.5 km			
E 53	224	240	464
Within 2 km			
E 46	128	135	263
E 47	61	49	110
E 48	337	371	708
E 49	171	186	357
E50	144	179	323
E52	248	225	473
E54	299	346	645

4.3.3 Employment and Income

Of the respondents interviewed 83 percent had employment outside of the home. Fifty percent were self-employed, 28 percent had full-time jobs, while 12 percent were unemployed. The main occupation types included carpenters, teachers, receptionists, chefs and vendors. There appeared to be no direct correlation between the level of income and employment type or occupation. Twenty eight percent of the respondents earned over $10,000 per week, 21 percent earned $3,000 or less per week, 14 percent had

no response, 12 percent earned between $3,000-$4,000 and the remainder of the respondents earned between $4,000- $10,000 per week.

Twenty-four (24) percent of the respondents interviewed indicated that they worked within 0.62 km (1 mile) from their homes. Twelve percent worked between 0.62-8 (1-5 miles) and 21 percent worked over 8 km (5 miles) from home. The remainder of the respondents reported that they did not work in one fixed location. The places of employment included Fairy Hill, Port Antonio and Ocho Rios. The 1997 SIA reported that 80 percent of respondents worked on site or within 1-2 km of the site during its survey. However, this has reduced significantly. This may be as a result of changes in land use from agriculture to residential on the areas previously developed as residential lots by the UDC. Another possible factor is the closure of two hotels located within 1-2 km of the site, after Hurricane Ivan in 2004, namely, the Villas at Dragon Bay and Blue Lagoon Villas and Restaurant.

4.3.4 Transportation

The SIA area is located approximately 12km east of Port Antonio. The most common mode of transportation was via private vehicles and taxis. There are also mini buses servicing the area. One-way fare from the site to Port Antonio via mini bus was reportedly an average of J$50 and via taxis was J$70.

4.3.5. Social Services

The survey indicated that almost 80% of the respondents shopped within Fairy Hill or in Port Antonio. The respondents obtained health care in Port Antonio and a small number utilized the Health Center in Fairy Hill. The closest hospital to the site is located in Port Antonio.

4.3.6 Education

There are three schools in the SIA study area namely: Fairy Hill Basic School, Boston Primary and Infant School and Drapers All Age School. Infant/Basic and Secondary schools were located beyond the SIA area in Fair Prospect, Port Antonio, Buff Bay, and Happy Grove.

The average family size within the SIA study area was four comprising an average or 1-4 adults ((91%) and 1-4 (47%) children under the age of 18 years old. Approximately 20% of Children attended schools that are located less than 8 km (5 miles) from home. The main schools attended were Boston Primary and Infant School, Port Antonio Primary, Drapers All Age, Happy Grove High and Bethseda Basic School.

According to the 2002 Survey of Living Condition, 38.2 percent of the household heads in the Parish of Portland have attained up to a primary level education; 56.3 percent attained up to secondary/high school level and 3.4 percent up to tertiary level. Of the respondents interviewed 97 (70%) indicated that they were the head of their households. Of these, 33 percent attained up to primary level education, 44 percent up to the secondary/high school level and 20 percent up the college and university levels.

4.3.7 Housing

The survey revealed that 67 percent of respondents own or lease the house in which they live and 57 percent own or lease the land on which their homes are situated. Twenty percent lived on family-owned land while eight percent (8%) indicated that they were squatting on the land on which they live. Sixty-seven percent of respondents' dwellings were constructed of concrete and blocks while 20 percent were constructed of wood. The majority of the roofs of their houses were constructed of zinc (71%) and concrete (16%).

The majority of respondents lived in houses containing 1-2 bedrooms (51%) and bathrooms (61%). Seventy-two percent of houses were equipped with indoor toilet facilities (water closets) and 22 percent had pit latrines. The majority of households had access to public piped water into their houses (70.2%) or their yards (7.8%). Approximately 90 percent of households had access to electricity. There were some residential telephones however the majority of the respondents used mobile phones.

4.3.8 Solid Waste Disposal

There was a regular solid waste collection system. Approximately 82 percent of respondents had their garbage collected by a public garbage trucks operated by the

municipality, while 13 percent burned their garbage. Seventy one percent responded that their garbage was collected once to twice per week.

4.3.9 Community Fabric/Cohesion

Community fabric and cohesiveness may be considered relatively strong in the study area, although there have been some conflicts in the past. There were several small church groups, the Fairy Hill Youth Club and the Fairy Hill Citizen Association and Neighbourhood Watch. The Portland Environmental Protection Association (PEPA), an NGO, was fairly active throughout the Parish including Fairy Hill.

4.3.10 Cultural Heritage

The Jamaica National Heritage Trust indicated that there are no sites of cultural or historical significance within the SIA study area. Jamaica Heritage sites identified beyond the SIA study area include the Port Antonio Court House, the Port Antonio Railway Station and the Titchfield Peninsular. The 1997 SIA Report also identified the Errol Flynn property located in Boston Top as a place of historical significance.

4.3.11 Macro Perspectives

This section will briefly focus on information that is critical in assessing the macro perspectives or 'big picture' of the proposed residential/beach development namely access to land, squatting and housing stock, and tourism development.

4.3.11.1 Squatting

The problem of squatting in Jamaica dates back to the 1830s to the period immediately following the abolition of slavery and the failure of the apprenticeship system. During this period ex-slaves became squatters in the unoccupied crown lands usually of the hilly interior of the island. This was mainly as a result of the high prices placed on lands by the plantation owners in an effort to deny access to land and ensure cheap labour for their plantations. Over time, the squatter problem in Jamaica has become worse. The problem has been exacerbated by several factors including:

1. Rural/urban migration: according to Tindigarukayo (2005), the three major reasons for rural to urban migration in Jamaica are spatially imbalanced development that favour urban areas over rural areas; the lack of a strong peasantry system that encourages small farmers to remain "wedded" to the land, and rural poverty .

2. Housing shortage: housing shortage has been a result of rapid urban growth, unaccompanied by equal growth in housing facilities. Additionally, sale and rental prices for houses have been so high that new urban dwellers are unable to afford them, leaving them no choice but to squat.

3. Economic hardships: most squatters are reportedly either unemployed or underemployed. Therefore, some squatters capture land for residential purposes as well as for commercial and agricultural purposes.

4. Political support: Tindigarukayo reported that the vast number and concentration of squatters in certain areas have made these settlements very attractive for political entities seeking political support.

5. Availability of idle land: according to the Low Income Family Foundation of Jamaica (1994) prevalence of idle land, owned by either the government or absent private property owners, has enticed the needy, the landless and the homeless.

In his contribution to the Sectoral Presentation on June 21, 2005, the Honourable Minister Dean Peart, the then Minister of Land and Environment, stated that squatting in Jamaica remained a "major chronic problem" and that efforts are concentrated on identifying issues relating to squatting and establishing a framework of guidelines to deal with this on-going problem. He further stated that squatting was the result of large development proceeding without simultaneously developing housing solutions for low and middle-income earners, who will work in those developments once they are completed. A Squatter Management Unit, which has been established in the Ministry of Agriculture and Land to address the squatter problem in Jamaica, as launched in June 2006.

The 2002 Survey of Living Conditions indicated that the incidence of poverty in the parish of Portland was 32.3 percent, a figure that is significantly higher than the national average of 19.7 percent at that time. Based on this statistic and the findings of the SIA, it is evident that the squatting on the SIA study site is as a mainly as a result of economic hardship and availability of idle land.

4.3.11.2 Tourism Development

One of the main economic activities of the parish of Portland and the SIA study area is tourism. The tourism product in the area appears to be trending towards Eco-tourism, which is "low density" tourism that focuses on local cultures, wilderness adventures, and attempts to have low impact on the environment and local cultures, while attempting to help generate income, employment and the conservation of local ecosystems.

The Master Plan for Sustainable Tourism Development (the Master Plan), which was prepared for the island of Jamaica in 2002, identified Portland as "Resort Zone" that is rich in culture and heritage. The Master Plan also indicated that Community-Based Organizations (CBOs) and Non-Government Organizations NGOs) and politicians in the parish reflects the people's vision of developing low-density tourism, based on the development of heritage assets in a community setting. The area's ecology reportedly demands environmentally sensitive development. According to the Master Plan, most accommodation in the parish lies within a 12 km (eight-mile) stretch east of the town of Port Antonio. Portland reportedly received 15,302 visitors in 199 and hotel occupancy was 23.4 percent. The low occupancy rate was reportedly a reflection for poor accessibility to the resort zone and "inappropriate" marketing to mainstream markets for visitors to the area. The Resort Board reportedly had 905 rooms, of which 397 were in hotels and the remainder were in guest houses, villas and apartments. The accommodation is reportedly small scale with no hotels more than 100 rooms.

The SIA site and the western portion of the SIA study area is situated within the 12 km (eight-mile) stretch containing most of Portland's accommodations. The site consists of a beach which is a common tourist attraction in Jamaica and is currently being utilized by tourists. The proposed development includes a "Beach Cottage Development" which

constitutes of twenty studio and one-bedroom suites that will be available to visitors to the beach. Based on the aspirations of the local community and the Master Plan, it can be assumed that this development will be appropriate for the area.

The 1997 SIA Report indicated that a 500-room hotel was proposed for an area immediately west of the SIA site, and therefore is a part of the SIA study area. This development would require major investment in physical and social infrastructure to facilitate visitors as well as the expected increased population that would accompany such a development. A development of this nature would also be burden on the sensitive environment of the area (high rainfall, sloped topography, vulnerability to natural disasters such as flooding, land slides and hurricanes).

The 1997 SIA Report indicated that information obtained from tourists during investigations revealed that the tourists visited the area because of its unique and relatively unspoilt beauty and would not have done so if it offered the same recreational activities that they can obtain in Ocho Rios and Montego Bay. The tourists also indicated that they could not envisage that a large hotel would attract more visitors to the area, and this would only serve to provide more competition for the smaller hotels. They consider the lack of improvement to infrastructure especially roads as the major constraint to tourism development in Portland.

4.4 HYDROGEOLOGY

4.4.1 Geology and Hydrostratigraphy

Published geological information (Geological Sheet 14, 1:50,000 Metric Series) indicates the site to be immediately underlain by the coastal aquiclude which consist a soft marly limestone. The overlying superficial deposits in the vicinity of the site comprise a combination of reddish-brown pebbly calcareous sandy/gravelly clay (Jamaica Soil Map - Portland). Abundant coral reef and limestone fragments were observed along the coastline and in the shallow bay at the western end of the property. The coral fragments

are likely be derived from both the elevated limestone reef that comprises the cliffs to the west of the site and the existing reef.

Further south, in the Fairy and Stony Hills, the rocks comprise the Montpelier Limestone Formation which is described as a limestone aquiclude. These formations are described as aquiclude due their relatively low permeability and inability to transmit water in exploitable amounts. Borelogs in the vicinity of the site suggest that the formation is some 12 m (40 ft) thick.

The Gibraltar-Bonnygate Formation functions as the principal limestone aquifer in this area (Figure 2, Appendix 6) and is recorded as outcropping some 10km west of the site. Well logs indicate that the Gibraltar-Bonnygate is at least 37m (120ft) thick and comprise "hard white limestone" and "sandy limestone". The geology suggests that cut-and-filling operations at the site should ensure that no large open fractures daylight into any slopes and any final slopes should be made to safe gradients as determined by the design engineer.

Typical geological profile is as follows (see Table 4.4.1).

Table 4.4.1 – Geological profile (taken from Fairy Hill #3 – N167538 E315685)

DEPTH	GEOLOGY
0 – 1.5m	Brown clay and limestone
1.5 – 7.6m	Limestone boulders with clay-infilled joints
7.6 – 19.8m	Limestone with clay-infilled joints and fractures
19.8 – 53.3m	White Limestone with fractures
53.3 – 57m	Sand-sized limestone fragments

Of the seven abstraction wells located within 3km of the site, none are located within a 1km site-radius. Groundwater data from Fairy Hill 3 in September 1970 indicate rest water level at 2.3m (7.5 ft) (above sea level - ASL) within this formation. No recent

groundwater levels were reported by the WRA or by the NWC. The 1997 hydrogeological study reported groundwater levels at around 1.0 – 1.8 m (ASL) 1.0km from the coast. This suggests that groundwater abstraction during the intervening years had reduced the groundwater levels by approximately 1.3m. Such a reduction in close proximity to the sea is likely to result in salt water ingress in abstracting wells due to the reduction in differential hydraulic heads. Not surprisingly saline intrusion has been noted in at least one municipal supply – Zion Hill.

Given the geometry of the site it is likely that principal groundwater flow direction will be north towards the coast. However, local variations may exist.

The field reconnaissance identified two freshwater springs and several dry natural drainage gullies. The largest of the spring is located at the southern end of the small wetland near the beach (see Figure 3, Appendix 6). It forms a small wading pond approximately 1.4m (4.5ft) deep and 4.5m (15ft) across which then discharges by way of a small rivulet to the sea in the north. The measured surface velocity of the discharge stream was approximately 11 cm/s (0.4 ft/s).

The second, though not immediately obvious, and much smaller, freshwater discharge point was located further northwards along the beach. No discharge measurement could be taken as the pond appeared to be sustained by a slight gradual seepage than a sustained measurable flow. Both streams are perennial features; and could only be sustained by the larger limestone aquifer to the far south and not the coastal aquiclude. Given that both streams are located immediately adjacent to the wetland it is likely that the springs, as well as the wetland, are surface expressions of groundwater seepages along the coast from this larger limestone aquifer.

4.4.2 Hydrology and Hydrogeology

The nearest, named surface watercourse to the site is the Turtle Crawle River, which lies 5km west of the site. Two other unnamed and probable intermittent watercourses are indicated within 2 km south of the site (see Figure 2, Appendix 6). The water quality in not established for these unnamed rivers and hence no data is available. Rainfall

intensity data for the site was obtained from Nonsuch (N166701 E311325) spanning eleven years between 1950 – 1987 The mean maximum 24-hr rainfalls is recorded as 189mm (7.44in). Class A pan evaporation data from the WRA indicate an average of 138mm (5.44in) for the Orange River site in the Blue Mountain North hydrologic basin.

The drainage gullies located across the site correlate well with the drainage lines inferred from the Sheet 24D topographic map (See Figure 4, Appendix 6). The typical natural drainage gully was 0.9m (3ft) across and 0.3 - 0.45 m (1.0 - 1.5ft) deep, discharging northwards toward the Caribbean Sea and emerging from the higher elevations to the south of the site. With approximately 0.3m (1ft) water depth within such a drain the estimated scouring flows are approximately 0.3 - 0.6 m^3/s (10 -20 ft^3/s). However, no water was noted within any of the natural drainage gullies during the site walkover, but evidence of historic water flow was evident (See Figure 5, Appendix 6). Discussions with local residents indicated that the gullies only carried water during precipitation events and that no evidence of flooding and nor ponding within the site has been experienced.

A 2004 report held online at NEPA's website indicates that Winnifred Beach's official status as "closed due to the lack of adequate public facilities". Further, another undated report, "Towards an Ocean and Coastal Zone Management Policy in Jamaica" indicate that the Fairy Hill beaches are considered important habitat areas due to a generic labeling as containing rare and endangered species.

Abstraction from the Zion Hill well, located just over 1500m south of the site, is approximately 227 m^3/day (0.06 million US gallons/day); while surface water abstraction from Turtle Crawle is approximately 1,893 m^3/day (0.5 million US gallons/day. Currently both sites supply Fairy Hill with mains water. However, Zion Hill is currently saline to moderately saline depending on the level of precipitation preceding the pumping event.

4.4.3 Sewerage Facilities

There is only one record of a sewage treatment facility within 1000m (Figure 1, Appendix 6) of the site held by the WRA, however, no additional data as to the type of

facility, its capacity or otherwise is recorded. This private facility is located to the west of the site and is owned by the Dragon Bay Beach Resort.

Currently at Fairy Hill Phase I on-site waste water treatment systems (soak-aways) located within the individual lots is the preferred method by which household sewerage is dealt with.

No central sewerage system is available in the immediate area; however, plans are in progress for the installation of a central sewerage systems for Port Antonio in 2008/2009 which may benefit the site.

4.4.4 Flooding or other disaster incidents

The WRA has no reports of any flooding incidents within 1km of the site. Data obtained from the ODPEM indicate that the site may be vulnerable to storm surges as hurricane Allen in 1980 caused coastline storm surge heights of fifteen feet, with maximum surge distance inland of 100 feet in the vicinity of the Fairy Hill. The complete ODPEM report is located in Appendix B with the recommendations of that document highlighted below.

1. It is recommended that a comprehensive drainage plan be developed for the site to the specifications of the National Works Agency, which should take into account the existing natural pond to the east of the site.

2. All buildings to be situated on the seaward side of the property should maintain adequate setbacks as well as raised floor levels, this to reduce the vulnerability of the site and its occupant to destructive storm surges. The ODEPM report indicates maximum historic inland storm surges of 30m. It would be prudent to ensure that all residential lots are setback from the coastline by this amount.

3. It is further recommended that an evacuation plan be developed for the property, which should incorporate mutual aid agreements with other properties. This plan would be enacted in the event of any major natural disaster.

4.4.5 Pollution Incidents

No groundwater or surface water pollution incidents are recorded within 1000m of the site by the WRA.

However, saline intrusion is demonstrated at the Zion Hill well by saline water emerging from the mains supply to which Zion Hill contributes. Saline intrusion is a form of groundwater pollution as is severely limits the potability and usability of the resource.

The NWC has verbally indicated that the Zion Hill well will be decommissioned following the implementation of improvement work under the Port Antonio Water Sewerage and Drainage Project which is scheduled to commence in 2008/2009.

4.4.6 Hydrological Assessment

Existing and Projected Water Demand

The current mains water is obtained from both the Zion Hill and Turtle Crawle which provide 227 and 1,893 m^3/d to the Fairy Hill area. Water from Zion Hill is often saline, especially during the dry seasons; hence it is unlikely that its supply status will continue into the near future. And given that saline intrusion is a recurrent problem it is unlikely that any new wells will be advanced in the immediate area. Any additional capacity will therefore have to be obtained from surface water and groundwater wells further a field.

Using typical daily water usage per household (assuming 4 persons per 29 lots) and assuming 100 beach patrons (inclusive of staff) the annual water demand was separated into the Fairy Hill Estates and Winnifred Beach demand respectively and presented below (see Table 4.4.2):

Table 4.4.2 – Projected water demand for the proposed development

Area	Projected Water Demand (m^3/yr)	Number of persons
Fairy Hill Estates	6,940	116
Winnifred Beach	705	100 person per day

The soon to be superseded 1990 Water Resources Development Master Plan lists the total domestic demand in the hydrological basin at 11.5 Mm^3/yr. And in 2015 the projected domestic demand is 16.7 Mm^3/yr. But this is a global picture and spans two parishes – St Mary and Portland. A report referenced in the 1997 Hydrogeological Impact Assessment, reduced the site-relevance to the Port Antonio Area and projected the short and long term daily domestic demand at 11,364m^3/d and 22,727m^3/d respectively in 1996. As the project site is considered to lie within the Port Antonio Area, it is probable that the calculated projected demand may not have been incorporated within any of the above demands as the site may have not been considered for development at the time of the projections.

However, the proposed J$120 million Port Antonio Water Supply, Sewerage and Drainage Project is aimed at upgrading and expanding the water supplies in and around Port Antonio as well as to provide modern sewerage and drainage facilities for the town. The project is intended to replace five kilometres of old water main with a new 300-millimetre main between Port Antonio and Williamsfield, install 16,000 household sewer connections, as well as the rehabilitation and expansion of water intake, treatment plant and pumping station in Grant's Level to a capacity of 16,000 cubic metres per day adding some 7,570 m^3/day (2,000,000 gallons/day) to the system. It is expected that "some 6,000 persons in Port Antonio as well as communities such as Burlington, Norwich, Fellowship, Fairy Hill and Fairfield will directly and indirectly benefit from this project."

Given this proposed mains supply development is scheduled to commence in 2008/2009 and be substantially complete by 2010/2012 the proposed Fairy Hill development will not

impact the water demand in the long term. However, short term supply may be an issue as reliability of the Zion Hill mains supply is further restricted due to water quality issues.

Sewerage Facilities

Currently there is no mains sewerage and each household is responsible for discharging its sewage. This is normally done via soak-away systems presumably with septic tanks. At Winnifred Beach, which is used as a public bathing beach, it is understood that the saltwater toilets that service the patrons discharges to a soak-away system dug into the sandy foreshore. The depth, capacity and location of the soak-away system are unknown.

From the site walkover it is highly probably that the water table is at most 0.5 – 1m below ground near the beach. And that the foreshore beach sand is in hydraulic continuity with the large freshwater, wetland pond to the west as well as the sea. Consequently, any pollution arising from the existing on-plot sewage system could eventually emerge in the wetland pond and sea via advection and/or dispersion due to its proximity. The most recent water quality results (19 June 2006 by TEMN) indicate nitrate levels below 1 mg/l in the near-shore coastal seas. Nitrate levels of between 4.1 – 4.2 mg/l were recorded in the coastal freshwater spring. By itself this 300% increase may be indicative of some anthropogenic input to the freshwater spring, however, when compared with the potable water obtained from a Zion Hill residence – which is presumed to have originated from the Zion Hill well – it is clear that the up gradient groundwater is the source with levels around 5 mg/l. All nitrate results are below Jamaica National Drinking Water Standards (JNDWS) of 45 mg/l.

The structured development of the beach would increase the nutrient loading by an order of magnitude and it is unlikely that the current, on-plot disposal system could remain a viable solution. The development of the beach would require that the existing soak-away be appropriately decommissioned by trained professionals and made safe according to international best practices and a modern sewage disposal system capable of tertiary treatment implemented.

Secondary treatment (septic tank and absorption zone) as not a viable option in coastal zone areas and effluent must be treated to a higher standard. This can be achieved by means of an enhanced on-site treatment system, package treatment system or a reed bed system that reduce or limit the nitrate effluent to acceptable limits as well as other pollutants. Given the high technical requirements of a complex tertiary treatment system, prudence would require a tertiary system that would be easy to install, maintain (low skilled labour input) and guaranteed to meet effluent discharge requirements as set out by NEPA and the Parish Council.

Long-term the proposed Port Antonio Water Supply, Sewerage and Drainage Project is intended to provide new sewerage and sewage treatment facilities for Port Antonio and its immediate environs. The projected capacity is 7,570m^3/day (2,000,000 gallons/day). Though Fairy Hill will not benefit immediately from the sewerage facilities the possibility exists for Fairy Hill to be linked to the Port Antonio sewerage system should there be spare capacity and surplus funds available. But this scenario is contingent on many overriding factors that are outside the control of the project and consequently should not be solely relied upon. It is likely that the proposed development will be implemented long before this proposed sewerage system becomes operational.

In areas where connection to mains sewerage is difficult for reasons of both cost and practicality, some form of non-mains sewerage is required. In the short-term, and most likely long-term, Fairy Hill Estates and Winnifred Beach proposed development would have to be satisfied by a combination enhanced - On site Water Treatment Systems (OWTS) with a cluster, tertiary treatment system as outlined above.

The site constraints and its environmental sensitivity require that the sewage disposal system be designed by a wastewater treatment professional with demonstrated experience in coastal zone applications. The options outlined above are viable options based on the site's hydrogeological constraints and should not to be considered a recommendation for design.

4.4.7 Storm Water Runoff

Albeit daily rainfall data actually recorded was available, these records are not immediately useful for determining peak flows from watersheds with times of concentration considerably less than 24 hours. The estimated times of concentration (T_c) of the Fairy Hill watershed is between 6 and 25 minutes (0.1 and 0.4 hrs). The previous report calculated times of concentration within this range. The calculated T_c times fall within the limitation criteria for the use of TR-55 which ranges between 0.1 and 10 hours.

It is therefore necessary to know how the daily rainfall had been distributed over the 24 hours and perhaps divide this daily rainfall into smaller storms having durations that match the estimated times of concentration. Use was made of the standard curves produced by the Soils Conservation Service of the United States.

It has been suggested that for the Caribbean Region, the Type III curve is most adequate. This is the curve used for the southern regions of United States and Puerto Rico – whose precipitation patterns are very similar that of the Caribbean region. A recent project in Trinidad, which is the most southerly of the Caribbean islands, found that data from continuous rainfall recording of several rainfall events fitted the Type III curves best. It does not necessarily imply that all the other islands bounded by the southern United States in the north and Trinidad and Tobago in the south would also have rainfall matching the Type III curves, and indeed, site records are required for verification of the chosen curve.

Nevertheless, in the absence of any other information, the Type III is perhaps the most appropriate starting point.

There is critical minimal storm duration at which all lands within a watershed and upstream of its outlet begins to contribute runoff at the outlet. This duration is related to the time of concentration, which is the time taken for the most remote area of a watershed to contribute to flow at the outlet. At longer times of concentration, the entire watershed contributes to runoff. The time of concentrations were determined for the Fairy Hill

watershed using the sheet flow formula (below), shallow concentrated flow and open channel flow:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} S^{0.4}}$$

Where, T_t = travel time (hr), n = Manning roughness coefficient (for sheet flow), L = flow length (m), P_2 = 2-year, 24-hour rainfall (mm), and s = slope of hydraulic grade line (land slope, m/m). Both shallow concentrated flow and open channel flow use similar equations.

For determining the storm runoff in Jamaica the 24-hour, 25-year return period storm is normally accepted as the design flow period.

The rainfall intensity for the Nonsuch site is as follows and is compared with the rainfall obtained from Sangster International Airport on which the previous study relied (see table 4.4.3).

Table 4.4.3 – Nonsuch, Portland 24hr rainfall intensity (1950-87)

Exceedance Probability	100% (1yr return)	50% (2yr return)	20% (5yr return)	10% (10yr return)	4% (25yr return)	2% (50yr return)	1% (100yr return)
24-hr rainfall (mm) - Nonsuch	189	212	305	387	490	566	642
24 hr rainfall – Sangster (taken from Phase I study)	n/a	n/a	75	88	102	115	129

The rainfall intensity data are more site-specific than that used in the previous Phase I study. In the Phase I study representative data was only available from the Sangster International Airport which is over 150km west of the site. The rainfall intensity used in this document, i.e. from Nonsuch, it is on average 4-6 times greater than that used in the

Phase I study. Consequently, the predicted run-off will increase by a comparative amount over the Phase I determinations.

Total Catchment Storm Runoff

The upper catchment comprise three sub-catchments (see Figure 4, Appendix 6) ranging is size from 36 – 135ha. The total storm runoff due to the three catchments for a storm with a 4% chance of occurring in any one year is $107m^3/s$. This result represents the total catchment storm runoff for the 281ha catchment. Given that the outlet from the total catchment is not concentrated at a single discharge point, but seems distributed across the length of the coastline, it seems unlikely that this will be the total offsite storm runoff that will impact materially on the project site. A large portion of this runoff will be intercepted by existing drainage systems (sinkholes, depressions etc) and especially drainage systems associated with the main coastal highway which traverses catchment. Though the exact proportioning of this discharge is outside the scope of this report, for design purposes it is prudent to assume that on average 5% of this storm runoff may potentially impact on the site.

Site Storm Runoff

Pre-development

The proposed site is approximately 4.5% of the total catchment area at 12.5ha ($124,700m^2$). The Ministry of Agriculture's soil map indicate that the Phase II site soils comprise approximately 40% moderate draining clay, 40% moderate to slow draining clay and 20% moderate to rapid draining clay loam. Using TR-55 and applying the similar criteria as obtained for the total catchment, the predicted storm runoff with a 4% chance of occurrence in any one year is $10m^3/s$.

Post-development

For post development storm runoff land use determinations were obtained from the Fairy Hill Master Plan. The table below presents the modified, lumped land-use (see Table 4.4.4).

Table 4.4.4 - Proposed land-use for the proposed site calculated from the UDC Site Plan

Proposed Lumped Land-use	Area (m^2)
Impervious areas (roads, roofs, parking etc)	20,470
Grassed areas (lawns, kerb green space etc)	31,190
Forest (including conservation area, wetland etc)	73,040

Post-development the predicted runoff with a 4% chance of occurring in any given year is estimated to be 12.5m^3/s. That is a 2.5m^3/s increase over the undeveloped site – approximately 25% increase in storm runoff (see Table 4.4.5).

Table 4.4.5 - Predicted Run-off figures with pre- and post- development comparisons

Site Catchment Area	Storm Runoff with a 4% exceedance probability
Pre-development (i.e. predicted existing)	10 m^3/s
Post-development (i.e. predicted expected)	12.5 m^3/s
Increase above existing	2.5 m^3/s
Percentage increase above existing	25% increase

It is widely accepted best practice to compare this predicted post-development run-off to the pre-development predicted runoff with a 2% chance of occurring in any given year (i.e. 50 yr return) which is predicted to be 12.3 m^3/s. Both runoff figures are generally equivalent suggesting that the post-development runoff will not be significant. Provided the implemented drainage systems are appropriately designed to cope with the predicted 25 yr return storm runoff whilst preventing unacceptable ponding.

Alternative Method

A comparative evaluation of the site using the Rational Equation indicates storm runoff of similar magnitude, though less than that calculated by TR-55.

4.5 COASTAL DYNAMICS

4.5.1 Overview of location

Winnifred beach at Fairy Hill in Portland is one of Jamaica's finest. The combination of swells emanating from the north-east trade winds being shoaled by a large shallow reef just offshore resulted in the deposition and accretion of white coralline sand in the shallow, sheltered waters of the bay.

Flattening of the reef sill on the western side of the bay allowed fishermen access to offshore waters. A fresh water spring entered the eastern corner of the bay, and this along with the use of two-stroke engines by fishermen was the main potential sources of pollution noted.

Reef topography and its associated wave transformations (refraction, diffraction, and shoaling) were responsible for the existence and ideal characteristics of this beach. Any decline in the dimensions and depth of the reef as a result of degradation by pollution factors will result in de-stabilization of the coastal processes at work. It is imperative to the maintenance of this system that pollutants be controlled and if possible eliminated.

4.5.2 Current Regimes

Jamaica lies in the path of a branch of the North Equatorial Current which passes to the west before entering the Gulf of Mexico. It could be assumed that the predominant current around the coast would be from east to west. However, the opposite is true for deep currents in the area around Fairy Hill, Port Antonio and the eastern side of the island in general.

Anecdotal reports from fishermen and particularly spear-fishermen at the site indicated a sub-surface current which heads to the east 'most of the time'.

Such a current which heads into the easterly trade winds is known locally as the 'weather current'. When the current sets to the west with the wind, it is known as the 'lee current'.

Hydrodynamic modelling performed for the Port Antonio Sanitation Project indicated that the offshore banks/shoals and seamounts east of Jamaica have the "profound effect" of disorganizing this flow and producing gyres or large eddy currents (Figure 4.5.1).

Surface currents are directly proportional to wind stress and almost always move with the wind. Rising tidal currents generally set to the west, and ebbing tidal currents to the east. These flows, being somewhat weaker than the main gyres, are superimposed upon the gyres, and the resultant flows become complex on a daily basis, depending on local weather systems.

Inside of the reef at Fairy Hill however, it was wave-setup of water over the reef which was responsible for the constant westerly flow along the beach and out of the channel. The influx of water from the spring also increased the head and the 'excess' water in the bay was forced to leave via the relatively deep channel. This current can become moderately strong on days with high waves breaking on the reef, and the resultant current can theoretically carry one far out to sea."

One of the most important features of the entire development is the existence of the high-quality beach, as it adds great value for aesthetic and recreational purposes.

However the existence of this beach should not be taken for granted, as its presence is the result of a fine balance of coastal processes including wave-climate, current regimes, storm water and river discharges, and also sediment supply.

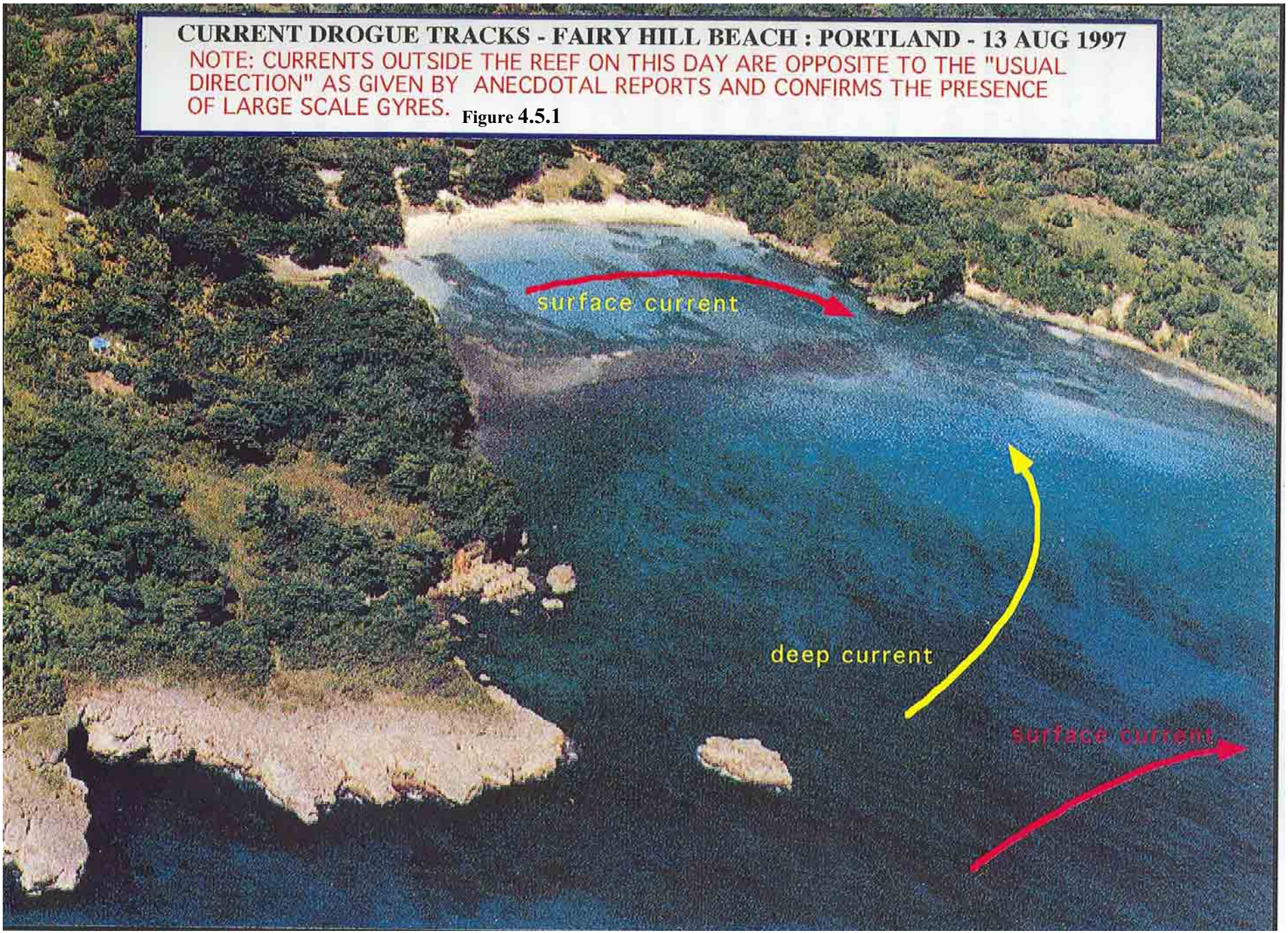

CURRENT DROGUE TRACKS - FAIRY HILL BEACH : PORTLAND - 13 AUG 1997
NOTE: CURRENTS OUTSIDE THE REEF ON THIS DAY ARE OPPOSITE TO THE "USUAL DIRECTION" AS GIVEN BY ANECDOTAL REPORTS AND CONFIRMS THE PRESENCE OF LARGE SCALE GYRES.
surface current
deep current
surface current

Figure 4.5.1

Any significant disturbance to any one of these parameters will result in destabilization and erosion of the foreshore. As such, all attempts should be made to preserve the natural forces at work here. Probably the most significant factor in this equation is the wave-attenuation properties of the existing barrier reef. This feature modifies incoming deep-water ocean swells, and causes them to shoal and accrete sand in its lee

The health of this reef is directly linked to good water quality, and as such any discharges of effluent whether by natural storm water runoff, planned drainage schemes, or discharges into the local streams must be carefully controlled in order to maintain the integrity of the entire coastal system. This reef is also offers major protection from storm-surges associated with tropical storms.

5.0 STAKEHOLDERS AND PUBLIC CONSULTATION

In order to consult the public and obtain perception from the residents who would be directly and indirectly impacted by the proposed development, a random stratified survey was conducted on May 20-21, 2006 within the SIA study area. Additionally, TEMN was provided with personal profiles (including their perception of the proposed development) for the vendors operating on the beach area of the site. Further, information was also obtained from a previous SIA (TEMN: 1997), which included the study area regarding historical developments on the site. The following summarizes pertinent information obtained form the above sources:

5.1 Information/Events Prior to the Proposed Development

As mentioned, TEMN previously conducted a SIA of the study site as a part of a larger associated parcel in 1997. The 1997 SIA Report (the Report) indicated that the SIA study area was formerly a part of a larger associated parcel of land that was then leased by the Government to some 200 tenants, primarily farmers, as far back as 1973. The larger associated parcel of land was reportedly leased by the Rural Agricultural Development Authority (RADA) through its Port Antonio Office at a rate of J$5.00 per parcel/yr regardless of its size. In 1990 the tenants were informed that the Urban Development Corporation (UDC) would be the organization responsible for the management of the

larger associated parcel (and the SIA site). As a result of the new management structure, the tenants of the larger associated parcel created the Fairy Hill Producers Association in 1992. The primary objective of the Association was to acquire the land for continued farming and homestead activities. Subsequently, the Association was given permission to use the land for agricultural and residential uses provided that no permanent concrete structures were constructed. The tenants were allotted five-acre parcels for farming purposes and an additional 0.25 acres for residential use for a period of 10 years. It is important to note that, the allotted parcels were not located on the beach area or adjoining lands identified for the proposed development. Reportedly, no rental or any other rate/cost was specified at the time of allotment, no renewal of the lease was mentioned, and the tenants therefore assumed that the UDC would not consider renewal of the lease.

It was reported that the UDC informed the residents that the current SIA study site (Winnifred Beach and adjoining lands) was planned for private hotel development and that the beach would be fenced hence limiting public access to it. This was reportedly later revised and the proposed area for hotel development was moved to another site. The people were concerned about the proposed development as they considered the beach to be a vital part of their community resource base, a source of drinking water, a recreational area, and an area with existing and potential economic viability. The residents wanted unlimited access to the beach and had actually approached the UDC to assume management of the beach area. A representative of the UDC reportedly requested a Development and Management Plan for the area and the Association was in the process of drafting a plan at the time of the 1997 SIA. The Association was further informed that if their Development Plan was unsuitable, then another group would be invited to manage the area. The Report further indicated that the residents stated that the UDC informed them that they could occupy the beach, and as a result the Association constructed sanitary facilities, placed six garbage collection bins, and set up a donation box for funds to assist in the maintenance of the beach. A local resident (Mr Johnson) was hired by the Association and paid a weekly wage of $350 to look after the sanitary facilities and keep the beach clean.

Before the Development Plan for the beach was completed, a Mr Williams (aka- 'Run') was perceived to have received instructions to break down the signs and donation box put up by the Association. When representatives from the Association went to see the UDC to discuss the matter, they were informed that were seven trustees at UDC with responsibility for the area, and that the group had to speak to all of them.

The 1997 SIA Report further stated that since 1995, the vendors on the beach were no longer interested in the Association managing the beach and were therefore no longer supportive of the Association. The vendors were interested in managing the beach themselves and had proposed that a user fee of $10 per person be charged for access to the beach. The Association did not agree with this and felt that the beach should be a public beach with free access to all. Consequently, the Association gave up any attempt to manage the beach. The majority of vendors from that time still occupy the beach.

Since then, according to the residents, the UDC attempted to hold a meeting in the Fairy Hill community sometime in 1996. From the community=s perspective, the meeting was highly unsuccessful and nothing substantial was achieved. The residents were however informed that the UDC had plans to develop the area but that they would be informed at the appropriate time.

TEMN was provided with reports dating from October 2004 to April 2006, highlighting activities of the Community Outreach Unit of the UDC in the SIA study area. The reports indicated that there continued to be tensions between the UDC and the vendors operating on the beach regarding the proposed development. A demonstration protesting the proposed development was staged in March 2005. The major concerns of the vendors were identified as potential loss of their livelihood after the proposed development and a lack of free access to the beach. Several public forums have been held between 2004 and 2006 in an effort to facilitate dialogue among the stakeholders and to disseminate information on the proposed development.

As a result, the vendors started to cooperate with the UDC and profiles were provided on 14 of the 16 vendors on the beach. There were two female and nine male vendors operating as sole proprietors and three male and female partnerships. The vendors were

reportedly operating on the beach an average of 17 nears with six years being the shortest duration and 35 years being the longest. The items sold included food and beverage, arts and craft, fruits and other agricultural produce, restaurants and snack shops. A fisherman was also located on the beach. The vendors reported that they operate daily on the beach and earn an average income of $3,300 weekly, ranging from $700 to $7,000 per week. The majority of the vendors indicated that they welcomed the development however they expressed concerns about loss of livelihood if they are excluded from the new facilities. Their comments also included pleas for assistance (capital and training) in developing their businesses; construction jobs during the construction phase of the development; and preference in selection of shop/stall operators within the new facilities.

5.2 Perception about the Proposed Development

The perception survey results indicated that 88 percent of all respondents were aware of the proposed development while 12 percent were unaware. The majority of the respondents (54%) heard about the development by "word of mouth" or via public demonstrations opposing the development. Fifteen percent of respondents heard about the proposed development from the UDC representative or public meetings; seven percent heard/read about in the media (television, radio, newspaper) and 11 percent heard from multiple sources. Almost 60 percent of respondents indicated that the proposed development will have a positive impact on the community; 24 percent indicated that it will negatively affect the community; eight percent indicated both positive and negative impacts; and 9 percent responded that they were not sure or did not know what kind of impact the development will have on the community. The respondents were also asked what effects they think the proposed development will have on employment, housing, the environment and them personally. The majority of the respondents indicated that the proposed development would have a positive impact on employment as jobs should be created during construction and afterwards. They also indicated that the on-site vendors might be adversely affected if they were not able to sell on the beach. The impacts on housing was mixed as some respondents indicated that the housing development would not benefit the local community, while others stated that housing would be increased with the new development. The respondents indicated that the environment would benefit as

the area would be cleaner and more attractive; however, the destruction of trees for construction would be an adverse impact. The major personal impact identified was the fact that there would be a cost to use the beach. There were some suggestions for lower access rates for local residents. The comments included expressions of concern for the on-site vendors, the dislocation of squatters as well as the need for development in Portland.

5.3 Stakeholders' Perception

Portland Environmental Protection Association

A perception survey was completed by Mr. Machel Donegan, a representative of the Portland Environmental Protection Association (PEPA). PEPA indicated that they became aware of the proposed development at a public meeting. PEPA believes that the development will have both positive and negative impacts on the community. The following table (5.1) summarizes PEPA's responses:

Table 5.1, showing negative and positive impacts for a survey done by PEPA

	Positive Impacts	Negative Impacts
Community	1. Improvements to the beach 2. Improvements to the access roads 3. Increased security and reduction in illegal nocturnal activities 4. Employment generation 5. Availability of housing lots to the community	1. Environmental degradation as a result of construction 2. Displacement of local community members "hustling" or earning a living on the beach 3. Reduced access to the beach as a result of construction and entry fees after completion 4. Reduced level of community ownership of the property
Employment	1. Short-term employment during construction	1. Displacement of informal vendors 2. Skilled jobs will be outsourced creating ill feelings towards the development in the community
Housing	1. Increased in lots available in the parish	1. Community members will not be able to afford units, hence more resentment to the development

	Positive Impacts	Negative Impacts
The Environment & PEPA	1. Improved sanitary facilities 2. Improved waste collection system 3. Sewerage System 4. An additional "Blue Flag Certified" beach would be an asset for the parish	1. Situation during construction will further damage coral reefs 2. Construction of cottages on the hillside will result in the loss of vegetative cover and potentially land slippage 3. Habitat loss as a result of clearing for construction 4. Further decline of Portland bird species

PEPA further commented that the development would be an asset to both the community and the parish. The development of the beach would result in the creation of an additional attraction and if Blue Flag certified (as promised) would fit in to Portland's tourism efforts. The organization strongly believes that the members of the community must have not only continued access but affordable access to the beach. PEPA is suggesting that the residential lots should be sold through an agency that enables locals to purchase these lots through whatever necessary arrangement that will enable locals to afford the lots. PEPA further noted that the informal vendors must benefit from the improvements to the beach and be afforded the opportunity to continue to earn a living as a result of visitors to the beach, and stressed that the mechanism for ensuring this happens and ensuring that the community members and stakeholders are kept abreast of the activities is key to the successful implementation and acceptance of the project.

Fairy Hill Citizen Association and Neighbourhood Watch

The president of the Fairy Hill Citizen Association (FHCA) Mrs. Linnette Paterson completed a perception survey for the proposed development. Ms. Patterson who stated that she is also a member of PEPA indicated that the development was a very positive step that will enhance development of the community. The following table (5.2) summarizes FHCA's responses:

Table 5.2, showing negative and positive impacts for a survey done by FHCA

	Positive Impacts	Negative Impacts
ɒmmunity	1. Improvements to the beach 2. Employment generation 3. Increased housing 4. Improved roads and parking facilities 5. Great socio-economic benefits 6. Reduction in illegal activities such as sand mining, charging users of the beach and cutting trees and selling lumber	1. Increased garbage generation 2. Threat of denied access
nployment	2. Employment creation for vendors, life guards, security guards, management personnel, maintenance workers in new facility	
g	2. Increase in housing	
The Environment	1. Improved sanitary facilities 2. Cleaner, more aesthetically pleasing beach	1. Increased garbage generation. Need for regular garbage collection

The FHCA also reported that the association had prepared a proposal titled Winnifred Beach Development Project Proposal, dated 2004, and submitted to the UDC. The objectives of the project were to obtain legal control of the beach facilities; protect and enhance the ecology of the beach; provide amenities and physical infrastructure; generate a small income for the community from operating facilities; assist community and cultural development in Fairy Hill and job creation. However, a response was not received from the UDC.

6.0 ENVIRONMENTAL IMPACT

6.1 ENVIRONMENTAL CHEMISTRY

6.1.1 Present Impact

The data collected indicates that water quality at Winnifred Beach and in the bay, met or was better than the requirements for recreation. There are however, signs that could indicate deterioration in water quality since the 1997 assessment.

Most sites monitored had **dissolved oxygen** levels that were better than the USEPA marine standard at the time of sampling. This suggests there is no significant demand on dissolved oxygen from biodegradation of organic waste. The normal levels encountered also indicate the absence of eutrophic conditions. In a eutrophic situation daytime oxygen levels would tend to be very high due to the contribution of photosynthetic oxygen by the large population of algae associated with such conditions.

The presence of **faecal coliform** in the sample taken from the pool (Station 1) suggests contamination from sewage or other mammalian faecal waste. As no sources were seen in the immediate area it is likely that this contamination is occurring up gradient of our sampling site. The absence of faecal coliform from all sea water samples including the bathing area suggests little if any impact from sewage or animal waste on water quality in the bay. The results suggest that though there was faecal coliform present in the pool exiting to the beach, the flow from the stream was so small that there was no measurable impact on water quality.

Nitrate levels in sea water were determined to be slightly higher than the proposed coral reef standard. This suggests some influence from land based sources. No fresh water outflows other than the springs were noted so the existence of subsurface inflows is possible. A comparison of nitrate levels from the 1997 assessment with the present assessment shows an apparent increase in nitrate both in the brackish water samples as well as the sea water samples (Figures 6.1.1 and 6.1.2). The fact that washing of clothes in the spring (Station 1) by the locals, is an ongoing activity, it may be inferred that this could be a major source of nitrates. However, the fact that the Nitrate levels for the potable water from a Zion Hill residence (Sourced from a well) were similar to those

noted in the spring strongly suggests that the source for these elevated Nitrate levels is up gradient groundwater. This, along with the increased faecal coliform in the brackish pool suggests an increase in impact from sewage and/or other mammalian waste on water quality since the 1997 assessment.

Figure 6.1.1: Fairy Hill (Winnifred Beach) - Nitrate 1997 and 2006

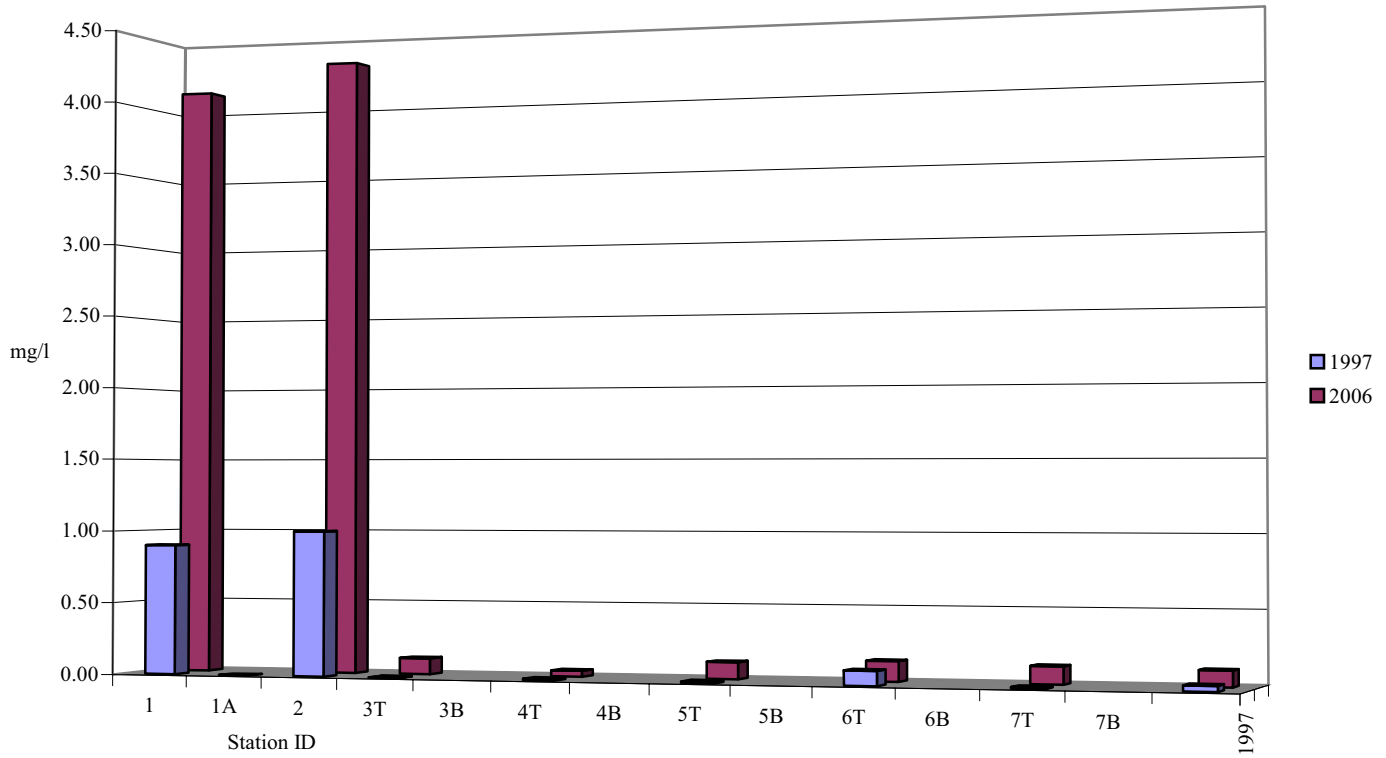


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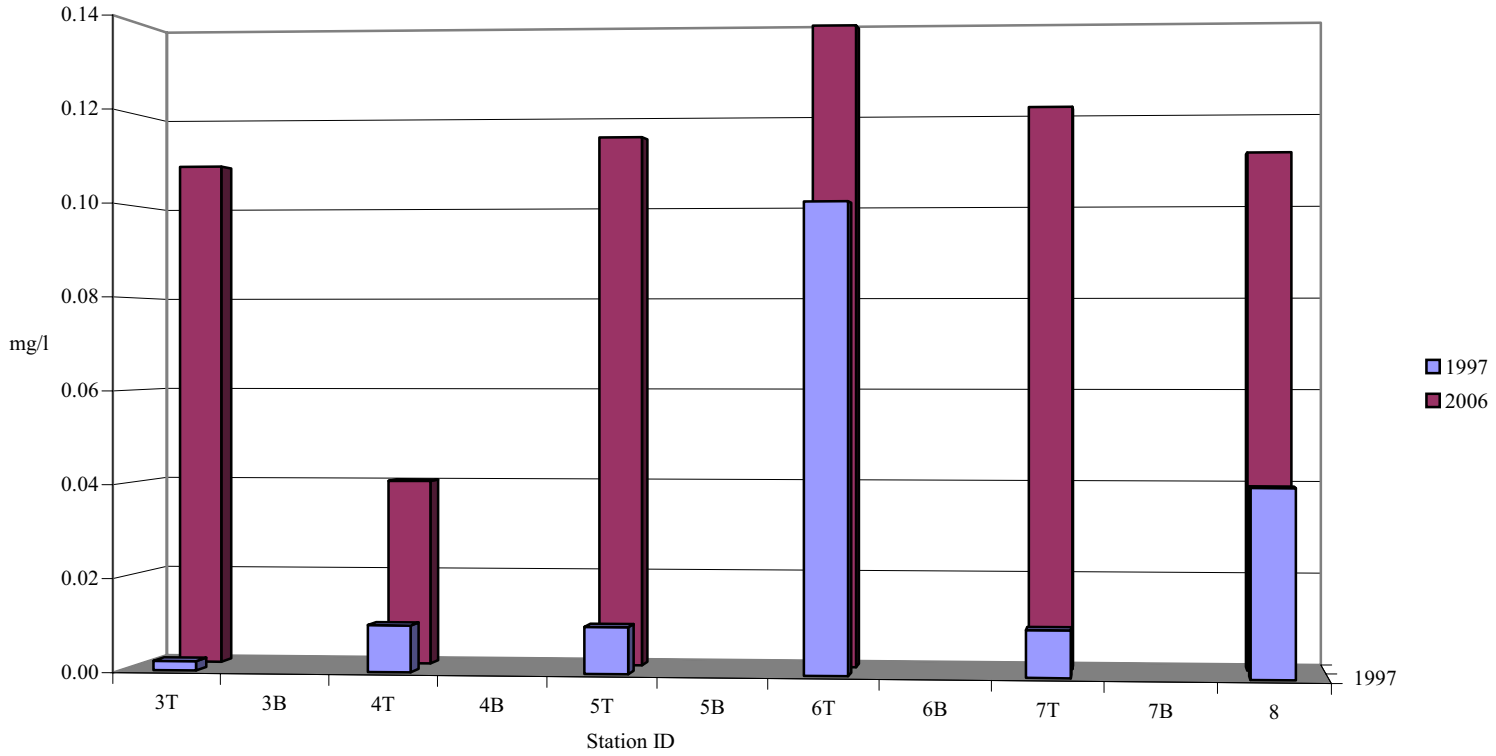
Figure 6.1.2: Fairy Hill (Winnifred Beach)
Comparison of nitrate levels 1997 and 2006
Sea Water



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Phosphate levels were generally below the proposed coral reef standard for all sea water samples. The fact that the higher levels were determined for samples collected close to shore near the eastern and western extremities (Station 4 and 7 respectively) could indicate some impact from land based sources.

Salinity levels at the surface were slightly lower than at the bottom of the water column for the sea water sites suggesting that there is some influence from fresh water inflows though small. The fact that salinity was uniform at the top and bottom for the control sites suggests that the fresh water influence is most likely confined to the nearshore sites.

6.1.2 Projected Impact

Projected impacts from the development are associated with the need to dispose of sewage/grey water and storm water run off. Where the disposal of these is carried out without taking into consideration environmental imperatives the following can result:

- Increased oxygen demand in receiving waters resulting in lowering of dissolved oxygen possibly to critical levels particularly during the night.
- Increased levels of nutrients in receiving waters. This can result in the overgrowth of algae (eutrophic conditions). Eventual die off of these algae result in increased oxygen demand associated with their decay.
- Increased contamination of ground water and coastal water due to seepage of sewage into the aquifer.
- Contamination of receiving waters by fertilizers and pesticides used in the maintenance of green areas.
- Reduced salinity of nearshore water due to increased surface run off.
- Contamination of nearshore water with solid waste e.g. plastics etc.

6.2 ECOLOGY

Possible environmental impacts to the area resulting from Phase II of the Fairy Hill Development include:

6.2.1 Loss of Habitat and Biodiversity

An immediate and most adverse environmental impact to the area would occur during the preparatory phase which calls for clearing of the site for the proposed development. The removal of trees and shrubs would reduce the existing forest cover, resulting in irreversible loss of natural habitat for flora and fauna particular to the area. The proposed development will have negative effects on the composition of the bird community in the area. There will be obvious loss of species from the area, especially of the forest-based endemic species.

6.2.2 Loss or Alteration of Turtle Nesting Grounds

Hawksbill turtles favor nesting on remote, clean sandy beaches, preferably under some type of vegetative cover. Their nesting behavior can be very easily disturbed by beach development, noise and light pollution, litter, disease and many other variables. Construction of buildings and other structures near or on beaches used by hawksbills can alter the beach and destroy the vegetation and other conditions needed for successful reproduction. As such measures must be taken to ensure that the natural state of the beach is not directly or indirectly compromised in a manner that could deter turtles from nesting on the beach.

6.2.3 Airborne and Noise Pollution

The increased traffic to the area, use of heavy equipment during the clearing of the site and transportation of building materials will create noise and raise dust which could

further disturb the habitat of the existing fauna, in particular the birds nesting in the area, as well as the plants and insects they feed on. Dust and emissions from the construction vehicles and heavy machinery are inevitable both during the site clearing as well as during construction phases. Airborne pollution, in particular dust resulting from clearing of the land and from exposed piles of building materials (e.g. sand, cement, etc.) may further stress the local flora and fauna, and may also pose a health risk to construction workers and residents in the vicinity who suffer from asthma or other respiratory ailments.

6.2.4 Soil Erosion and Change in Drainage Patterns

Removal of vegetative cover and the subsequent excavation activities required for infrastructure installation (paving of roads, laying of water/sewage pipes, electrical cables, etc.) will impact the existing drainage patterns in the area. Loss of topsoil due to soil erosion as well as excessive runoff into the bay, are causes for concern which must be addressed prior to the clearing phase. Soil erosion will remain a problem during the clearing as well as during the construction phases of the project. Lack of proper drainage ways could result in localized pooling and flooding, providing ideal conditions for the proliferation of nuisance pests such as mosquitoes. Excessive runoff, especially during heavy rains, could also lead to elevated nutrient loading into the bay, directly or via the stream. The resulting turbidity and sedimentation would negatively impact the inshore water quality and the marine ecosystem in the bay, especially the corals which do not tolerate prolonged exposure to high concentrations of fresh water or particulate matter in the water column.

6.2.5 Beach Erosion

Small scale illegal sand-mining from the beach has been reported in the area. On the west side of the beach, there are exposed hard surface areas in the swash zone of the beach which have presumably been exposed because of the removal of sand from this section of

the beach. The extent of erosion due to sand mining versus natural movement of sand onto or along the beach is unknown and requires additional field work to quantify. Other signs of erosion appear on the seaward promontories on either side of the bay presumably caused by wave action.

Photo 11: Erosion observed on the eastern promontory of the bay

6.2.6 Transportation and Storage of Construction Materials

Transportation of heavy machinery and building supplies/materials implies heavy traffic on the roads leading to the site with possible negative impacts to the surrounding area (dust, spillage, emissions and noise). Use of uncovered trucks for transporting building materials as well as improper storage of building materials, especially gravel, sand and cement on the construction site could lead to inadvertent dispersal of materials during heavy rains or high winds during dry periods. This could have a negative impact on the coastal waters. Improper storage or handling of hazardous or flammable materials, including fuel, paints and solvents) could result in soil contamination.

6.2.7 Disposal of Construction Debris

Each phase of the development will produce solid waste, the disposal of which, if not managed properly could have negative impacts to the site and the surrounding area. Cut vegetation resulting from the clearing of the area could pose a fire hazard and affect air quality if burned on location. Other construction materials including concrete waste, wood, steel, packaging plastics could be dispersed and could end up blocking drainage channels if not disposed of at approved disposal sites.

6.2.8 Sewage and Garbage Disposal

Inadequate provision of portable restrooms and garbage dumpsters at the construction site could lead to unsanitary conditions. Resulting impacts could vary from unsightly littering of the site, fly and vermin infestations to increased nutrient levels in the stream leading into the bay. Reliable sewage treatment systems are a long term concern for the area. It is essential for the villas, cottages and the nearby beach recreation area to have proper sewage treatment systems capable of handling increases in capacity while ensuring that there is no direct discharge of untreated effluent into the porous substrate which drains directly into inshore marine waters.

6.2.9 Impact on Winnifred Beach

Currently the beach is well maintained by local vendors however there are already signs of stress on the local ecology. The stream on the East side of the beach is used for washing (a local was observed washing his horses in the water where the stream enters the bay). The substrate of the stream is overgrown with fleshy algae and the waters in the bay display characteristics of localized eutrophication. The potential increase in runoff from the nearby construction site would compound the nutrient loading into the stream and in the bay which, in turn, would negatively impact on the inshore water quality and the marine life in the area. Increased tourist traffic to the beach if not controlled, could

result in trampling of the Turtlegrass in the shallow waters which provides shelter and feeding habitat to numerous juvenile fish species and other organisms. The beach itself is currently accessible by cars which in addition to compacting the sand on the beach, contribute to the pollution through emissions, noise, as well as potential oil and gas spills, all of which are hazardous to terrestrial and marine life. In the absence of facilities such as proper sanitation, garbage collection, offsite parking and maintenance to support the increased tourist traffic, the state of the beach will deteriorate quickly.

The beach and the surrounding area is small and confined and as such, the proposed construction of the bar and grill would further limit the space available for free movement by patrons of the beach and more importantly, it would destroy the pristine nature of the setting as it now exists. A bar and grill enterprise (with its attendant need for support services) would further increase the pressure on the fragile ecology of the area (seagrass beds, coral reef, turtle nesting grounds, etc). As such, construction of any kind directly on the beach is NOT recommended as it is not consistent with "reserve/conservation area" concept proposed for the beach and its environs.

All of the impacts discussed above represent substantial threats to ecology of the Winnifred Beach area and could result in the degradation of this environment to a point where both its commercial value and ecological appeal are compromised.

6.3 SOCIO-ECONOMICS IMPACTS

Socioeconomic impacts include construction and post-construction impacts. These are summarized in the Impact Matrix Table in Appendix 4.

6.3.1 Construction Impacts

The construction impacts of the proposed development include land use, employment and income, transportation and community development.

Land Use

The proposed development would impact land use in a negative way as between fourteen and sixteen vendors currently operating on the beach area of the study site would be displaced during the construction phase of the development.

Employment and Income

Employment and income would be impacted both negatively and positively by the proposed development. The positive impact is represented by the creation of jobs during the construction phase of the development. The negative impact is the loss of income by the on-site vendors.

Transportation

Transportation impacts are limited to the lack of access routes to the beach during construction. As no major roads within the community will be affected, the impact is short-term and not very significant.

Community Development

The construction impact on the community will be a short-term negative impact. This is as a result of the loss of access to the beach for residents and visitors.

6.3.2 Post-Construction

The post-construction impacts of the proposed development include national/regional impacts, land use, employment, community development and recreational impacts.

National/regional Development

The proposed development of includes the development of a residential estate. This will contribute to the overall housing development and increase housing stock nationwide.

The proposed development includes the development of a beach park. The beach park site also includes a wetland area, which will be preserved and incorporated into the development as a part of an "eco-trail and wetland reserve." In light of the aspirations of

the local community and the nation towards developing a tourism product with low environmental and cultural impacts while attempting to help generate income, employment and the conservation of local ecosystems, the proposed development will have a significant positive impact in the long-term.

Further, the proposed development will have a significant and long-term positive impact on regional and national employment. After construction, the proposed development will generate employment for management, security and maintenance personnel as well as concessionary personnel on the beach. The residential estate also has the potential to generate employment for management, domestics and maintenance personnel. This will contribute to lowering unemployment rates on a regional and national scale.

Land Use

The post-construction land use impact includes the potential for the regularization of the vendors currently operating on site. The development would provide proper facilities for the vendors in the form of shops, concessionary stands, sanitary facilities and adequate parking for visitors to the beach, thus improving working conditions and improving the service/product the vendors are providing. Additionally, the development will provide security, which will stem the use of the site for illegal activities reportedly taking place on the beach such as sand mining, charging for access to the beach by unauthorized individuals/groups and the cutting of trees for sale as lumber.

Employment

As mentioned above in the national/regional impacts, the post-construction phase of the proposed development will provide employment for the local, regional and national scale.

Public Education

The post construction impacts on education includes increase in public education and environmental awareness as the eco-trail and forest conservation components of the proposed development will also include educational tours of these sites for community members and visitors.

Community Development/Recreational

The post-construction impacts on the community/community development and recreation are both positive and negative. The positive impact includes improved recreational facilities and infrastructure for the community. Currently, the beach area of the site is characterized by poor access roads, improper sanitary facilities and lack of security among others. The proposed development would improve and upgrade the access roads, provide clean sanitary and safe environment for the community members and visitor to enjoy while visiting the beach park. However, there may be a charge for utilizing the facilities. It should be noted that research indicates that individuals/groups have occasionally been illegally extorting fees from patrons to the beach; however, the public perception survey identified the anticipated charge for beach access to be a negative impact. This is perceived as a significant and long-term impact as currently access to the beach is largely unrestricted and free

The proposed development has the potential for increasing employment, housing stock and therefore has the potential for increasing the population of the area. Additionally, it is assumed the beach park with its improved facilities will attract more visitors (local, national and tourists). There will be increased vehicular traffic and the need for services (for example, banks and ATMs) will increase. The existing social services and infrastructure may not be able to facilitate the increased activities anticipated in the SIA study area.

6.4 HYDROGEOLOGY

Short term supply may be an inadequate for the proposed development due to the unreliability of the Zion Hill mains supply because of water quality issues. Long term the proposed mains supply improvement, scheduled to commence in 2008/2009, will substantially alleviate this problem.

Sewerage disposal can be a considerable impact if the appropriate sewerage systems are not implemented to protect coastal waters. However, this impact is completely mitigable.

The pre- and post- runoff calculations indicate that the post-development runoff will not be significant provided the implemented drainage systems are appropriately designed to cope with the predicted 25 year return storm runoff, both on and off site, whilst preventing unacceptable ponding.

7.0 RECOMMENDED MITIGATION AND MONITORING

7.1 ENVIRONMENTAL CHEMISTRY

In order to reduce the possible impact of the development on local water quality it is recommended that consideration be given to the following:

- Provision of adequate land area for water management.
- The containment and reuse of storm water as far as possible
- Prevention of seepage areas by using appropriately lined containment areas for treated sewage/storm water
- Treatment of sewage/grey water above ground
- Elimination of local sources of pollution especially those that area a threat to the aquifer
- The provision of adequate arrangements for the containment and disposal of solid waste

7.2 Ecology

Construction of a subdivision such as this represents a permanent and irreversible commitment of land resources. The area in question which was previously used for agricultural purposes will no longer be available for such use. The loss of natural habitat as well as a loss of the option for alternative uses of the land is a considerable negative impact. The following recommendations are based on fundamental principles outlined in The National Land Policy (1996) which acknowledges the direct relationship between the use of land for domestic, commercial, industrial or agricultural purposes, the generation of waste by these uses and the impact on the quality of both surface and groundwater

resources. The land policy addresses specific land use and water resource management issues and speaks to the following:-

- the need to preserve and reforest watersheds to ensure the recharge of aquifers and reduce the problem of flooding and turbidity in rivers
- the institution of programs to eliminate the pollution of river and streams by pesticides, herbicides and other pollutants
- preserving vegetation along water courses.

7.2.1 Loss of Habitat and Biodiversity

Impact mitigation calls for protecting and restoring as much of the original condition on the development site as possible. The planned wetland reserve and forest conservation area partially address the loss of habitat and biodiversity by creating an ecological buffer zone. Additional measures must be considered to further minimize negative impacts on the terrestrial ecology in the area:

7.2.1.1 Protection of Turtle Nesting Grounds

Providing long-term protection to turtle nesting beaches is paramount to protecting the species. The proposed plan calls for total removal of structures, especially concrete buildings, concrete building foundations and hard pavements which in turn will provide suitable areas for sea turtle nesting. Eliminating threats such as beachfront development, beach erosion resulting from sand mining, eliminating vehicles on the beach, working with local authorities (on-site UDC rangers), scientists and volunteer groups to report turtle sightings, nesting activities and poaching activities are critical to the long-term management of this species. Landscaping plans, while favorable, must ensure that native vegetation is protected on the beach area. Existing vegetation can provide additional benefits such as screening out artificial beachfront lighting which can interfere with nesting behavior and disorient hawksbill hatchlings. Landscaping plans must ensure that any introduced plants are not harmful to the development and hatching of sea turtle eggs (e.g. Casaurina and Sea oats (*Uniola)* have been found to be lethal to hawksbill eggs).

Highly visible signs should be posted on the beach at appropriate locations warning of the legal penalties for interfering with turtles and their nests.

7.2.1.2 Landscaping is deemed to be a powerful mitigation activity with a positive impact. Prior to the commencement of site clearing and construction, a qualified landscape manager (hired for the duration of the project) should be tasked with creating a landscape plan, which includes a vegetation map clearly identifying all mature and ecologically valuable trees (trunk diameter >30cm) earmarked for protection**.** The identified trees must be clearly marked and protected. This map can be used to adjust road construction plans as well as individual lots with the goal of minimizing tree removal.

7.2.1.3 A landscape plan includes action items corresponding to each phase of the project ensuring gradual, albeit partial, restoration of the site's ecological characteristics. A landscape plan would ensure that designated trees are protected and/or relocated and that areas suitable for replanting are identified and landscaped using only local tree and shrub species used for feeding by local bird species**.** Selecting appropriate plant species for replanting is essential in determining the types of birds, butterflies and other fauna that will re-inhabit the site upon completion of the project.

7.2.1.4 An integral part of the landscape plan should also address means of protecting and monitoring the wetland reserve and the forest conservation area during site clearing and construction phases to ensure that the ecological integrity of the area is maintained. Landscape conservation and reserve plan should incorporate the following conservation principles:

- Maximizing conservation and reserve areas where possible since larger reserves are better than smaller reserves
- Reserve areas should be close to each other
- Habitat should remain contiguous
- Reserves should be linked with corridors
- Reserves should contain a diversity of physical and environmental conditions

- Reserves should be protected from encroachment
- Reserves should target the conservation of specific species and habitats (birds, turtle nesting grounds)

7.2.1.5 In an effort to preserve the existing biodiversity, naturally occurring plants such as those used primarily by the birds for food and shelter should be harvested during the site clearing phase and relocated to a nursery, to serve as a source of plants for replanting at a later date. This would ensure that primarily native plants are used in the landscape plan thus minimizing the use of imported species and eliminating the introduction of potentially invasive species.

7.2.1.6 Using bird feeders may encourage the displaced avifauna to remain in or return to the general vicinity, thus maintaining the existing biodiversity.

7.2.1.7 The building contractor should be subject to punitive penalties for removal or damage of ecologically valuable trees designated for protection or relocation.

7.2.2 Airborne and Noise Pollution

The site clearing plan should provide for 10-15m wide green buffer zones along roadsides and drainage ways to dampen the noise and dust related to construction. Access roads and exposed terrain should be sprayed by water trucks to minimize the dust. Use of heavy machinery should be restricted to daylight hours in order to minimize the noise pollution arising from the construction site.

7.2.3 Soil Erosion and Change in Drainage Patterns

Site clearing activities should be conducted in stages to minimize the area of exposed soil at any given time. Exposed soil should be seeded with grass or other appropriate cover as soon as possible to minimize soil erosion. Monitoring and maintaining proper storm water drainage systems, use of catchment/settlement areas and screens, as well as redirecting flows during periods of heavy rain are steps that can minimize erosion and surface runoff into the bay.

7.2.4 Beach Erosion and Illegal Sand Mining

Beach erosion may be attributed to both natural and anthropogenic causes. Natural causes such as wave action, storm surges, ocean currents and tides, as well as sediment input through river discharge are responsible for the continuous changes and erosion inherent to coastal areas. Human activities such as removal of sand from beach areas and coastal development expedite the erosion process resulting in increased sedimentation on nearby reefs. The proposed monitoring of access points and restricting car access to the beach during and after the completion of the development would eliminate illegal sand mining and mitigate degradation of the beach area caused by such activities.

7.2.5 Transportation and Storage of Construction Materials

Arrangements should be made with contractors and subcontractors to ensure that the vehicles used for transporting building materials to the site are appropriately sealed and covered to minimize dust. Dust producing building materials such as sand or cement should be stockpiled in low enclosures and covered, away from drainage areas where they could easily be washed away during rainfall.

7.2.6 Disposal of Construction Debris

A site waste management plan should be made the responsibility of the building contractor to provide for the designation of appropriate waste storage areas on the site and a schedule for the timely collection and removal of construction debris to an approved dump site. Organic waste produced during site clearing should be mechanically mulched and composted at the site and used for landscaping at a later date.

7.2.7 Sewage and Garbage Disposal

Providing adequate number of portable restrooms (chemical toilets or dry composting toilets) for the workmen and waste baskets and dumpsters is essential to keeping the construction site clean and pest free. Arrangements should be made for regular garbage

collection and removal of sewage from the construction site. All measures must be taken to ensure that untreated sewage is not directed into the bay waters.

7.2.8 Impact on Winnifred Beach

All of the potential impacts listed above, especially soil erosion, runoff and garbage dispersal; can have a detrimental effect on the beach and the wetland areas. Mitigating actions call for minimizing the impact of construction on the beach, the wetland and forest conservation areas during all phases of the Fairy Hill Development project. Controlling access points and traffic to the beach area is also important.

7.2.8.1 Winnifred Beach Development Phase

This phase of the development includes the building of the beach cottages and the Fairy Hill Beach Park which includes a ticket office, security post, administrative office, changing rooms and toilets, Bar and Grill, Life Guard Stations, picnic area, etc. The true value of the beach park lies in the natural setting of the beach and as such preserving the natural state of the beach is a priority. The most effective mitigation measure for the beach and wetland areas would be to limit the building of permanent structures on or immediately near the beach to the necessary infrastructure such as functional toilets with running water, changing rooms and refreshment kiosks. Other buildings such as the administrative office and bar and grill could potentially be relocated closer to the cottage or residential unit areas. Building the bar and grill on or immediately near the beach is neither recommended nor desirable especially if measures toward turtle conservation are being taken seriously.

The beach itself requires only proper sanitation facilities and restricted access to further conserve the area. The bar and grill is neither a necessary nor a unique convenience, but is one which with time, would only deface an otherwise pristine, naturally beautiful beach area. In the case of the Winnifred Beach Development, less could easily be made into more. The natural state of the beach is more of an attraction and in keeping with the tenor of the rest of the parish's attractions than an overly developed recreational area would be.

The development of the area will result in increased tourist traffic to the beach park. In addition to providing appropriate sanitation facilities such as toilets, running water, garbage disposal facilities on the beach to accommodate the increased number of visitors to the beach, it is also recommended that car access to the beach be restricted by providing adequate parking spaces at a nearby area. Other recommendations address issues such as regular garbage collection, ongoing beach cleaning, maintenance and protection, as well as safety and security measures, all of which are necessary for the long-term ecological viability of the beach area.

Presently, the local vendors take a great deal of pride in their operations and are quick to remove any garbage generated by their activities. This attitude which reflects a form of "pride of ownership" despite the fact that they do not own the facility should be encouraged.

7.2.8.2 Wetland reserve and Forest Conservation Area

The proposed eco-trail, wetland reserve and forest conservation is a positive measure in mitigating the loss of habitat and maintaining biological diversity in the area. In addition to the conservation benefits, the proposed wetland and conservation area also lends itself to public education activities, not only for the immediate community, but for visiting groups outside of Portland. Input from the Portland Environmental Protection Association (PEPA) should be sought during the planning and implementation of these areas.

The freshwater stream and brackish pond on the east side of the beach are used for washing clothes/animals which is deemed to be a contributing factor to the algal growth in the surrounding water. Establishing the area as a wetland reserve will discourage such activities and reduce the associated nutrient loading. The planting of dense native vegetation along side the stream and pond and the installation of a wetland boardwalk across the stream to allow land access to the eastern side of the bay should be considered.

7.3 SOCIOECONOMICS

Mitigative measures for the socio-economic impacts are summarized in the Impact Matrix Table in Appendix 4. Mitigative measures are recommended to off-set the negative impacts of the proposed development.

7.3.1 Land Use

The negative land use impact is a short-term construction impact, which includes the displacement of the vendors currently operating on the beach. It is recommended that the development plan for demolition, land preparation and construction activities on site be geared towards creating minimal displacement. The community and especially those persons who will be displaced should be included in the development activities whether by providing jobs or through compensation for lost income.

7.3.2 Employment

Negative employment impacts are also short-term though significant. It is recommended that the persons whose sources of income are disrupted by the proposed development be compensated through employment opportunities during and after construction or by monetary compensation.

7.3.3 Community Development/Recreation

Mitigative measures for the negative impacts on community development include the upgrading of infrastructure and the increased provision of social services for current and future residents as well as visitors to the SIA study area. Additionally, community participation in the proposed development may increase community pride and understanding, which would possibly increase the willingness of community members to pay for access to the beach. The community and the developers/manager may also work together in deciding on a mutually acceptable rate.

7.4 HYDROGEOLOGY

7.4.1 Impact mitigation

The proposed drains should be designed to accommodate a rainfall event that has a 4% chance of occurring in any one year.

The proposed drains should incorporate upgraded natural drainage routes to avoid blockages and potential flooding. Sinkholes and depression, should not be backfilled or used as drainage outfalls but maintained as green spaces within the development.

Swales and or retention ponds can be incorporated into the overall drainage design to provide areas of temporary storage and percolation. Areas for locating retention ponds could be within kerb-side green spaces or other landscaped ponds as well as infiltration devices along walkways in order to improve amenity value.

All storm drain outlets should have strategically placed oil/water interceptors to prevent deleterious substances discharging to the sea. Surface water run-off can contain contaminants such as oil, organic matter and toxic metals. Although often at low levels, cumulatively they can result in poor water quality in rivers and groundwater, affecting biodiversity and amenity value. After heavy rain, the first flush is often highly polluting. Given the proposed site end-use, incorporating oil/water interceptors within the drainage system should be a primary design criterion. This will allow effective management of the contamination risks associated with storm runoffs. Storm water should NOT be allowed to discharge to the on-site wastewater treatment system as this effectively reduces the design capacity and can cause solids to be flushed out of the treatment system.

Source control techniques such as harvesting roof runoff, permeable pavements and infiltration devices are proven techniques in a complete and comprehensive and sustainable drainage plan. Dealing with the water locally not only reduces the quantity that has to be managed at any one point, but also reduces the need for conveying the water off the site.

7.4.2 Environmental Monitoring Plan

The aqueous environment should be monitored both during and post construction to ensure that national water quality objectives for beaches and freshwater are achieved and demonstrated to be achieved. Sites for monitoring shall include both coastal springs and the sea.

7.4.2.1 Construction Phase

Precautionary engineering measures (such as cut-off trenches, etc) should be implemented to reduce run-off and prevent it from reaching, existing drains, natural gullies, springs and sea. Nothing which could cause pollution, including silty water, should enter such any watercourse.

All temporary fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Storage at or above roof level should be avoided.

Leaking or empty oil drums must be removed from the site immediately and disposed of via a licensed waste disposal contractor.

Washings from concrete mixers, paint or paint utensils should not be allowed to flow into any drain or watercourse.

7.4.2.2 Post construction

The costal springs and beach should be monitored at least twice yearly and the analysis shall include faecal and total coliforms, BOD_5, turbidity, nitrates, sulphur, pH, oils and grease.

7.5 Monitoring Programme and Management plan

A draft Monitoring plan for this development is located in Appendix 2

A draft Environmental Management Plan is located in Appendix 3

8.0 ASSESSMENT OF ALTERNATIVES TO PROJECTS

8.1 Alternative 1: Without Project Scenario

The without project scenario from a socioeconomic perspective would mean that the use of the site continues in a marginal manner with substantial underutilisation of resources. Without the proposed development project, the site would continue to be a public beach with no proper sanitary facilities, no security, no proper parking facilities, poor access roads and improper waste disposal practices. Additionally, potential for employment during and after construction of the proposed development would also be lost. The illegal use of the site for commercial purposes would continue and the residential lots would not be available. This alternative was the least favourable.

8.2 Alternative 2: With Project Scenario - Mixed Development

The 'with project scenario' contributes toward a national goal to expand the opportunities for tourism development, add to housing stock, provide for a diversified recreational product, and a foreign exchange earner. This development would also be compatible with the existing and future planned land uses. Significant forward and backward linkages associated with the local sourcing of construction material and employment opportunities during construction would be created. Other advantages include the maintenance of and woodlands by the creation of forest conservation areas and wetland reserves. This alternative was acceptable

8.3 Alternative 3: Agriculture

Another alternative use of the site would be agricultural. However, the land is characterised by thin, clayey soil in patches between extensive limestone outcrops. This would not support any major agricultural endeavour. Some small stock rearing takes place on a subsistence level. This alternative was not as favourable.

8.4 Alternative 4: Enhanced Habitat Conservation

Habitat conservation is essential for mitigating decline in biodiversity due to development. The establishment of conservation areas is an important mechanism for achieving this aim. In addition to protecting biodiversity, conservation areas hold economic value: supporting local livelihoods, protecting watersheds from erosion, harbouring flora and fauna, supporting thriving recreation and tourism industries, providing for science and education. These benefits will continue to grow in importance as more and more green area is developed with time.

Habitat conservation plans developed in Florida and California call for habitat conservation at a ratios ranging from 1:1 to 3:1(conserved/developed) depending on the ecological sensitivity, including the presence of endangered species, in the area under consideration. These ratios were used as general guidelines, in the formulation of the alternative presented below.

The analysis looks at the relationship between the proposed development and the conservation areas indicated on the Fairy Hill Estates and Beach Development Master Plan (Appendix 5). The assumptions used in calculating the conservation ratios are included in Appendix 8.

The Winnifred Beach Development plan designates a development area of 14,011 m^2 which includes the beach cottages, parking and 50% of the Beach Park and associated structures. The eco-trail, the wetland reserve, forest conservation area along with 50% of the beach occupies 39,290 m^2. The resulting ratio (conserved to developed) for this part of the development plan is 2.8. Similar analysis for the Fairy Hill Estates yields a much lower ratio of 0.45 which is based on a developed area 46,213 m^2 and a conservation area of 20,566 m^2. Despite the proposed forest conservation area, this low ratio is indicative of a high density development area which is not in line with habitat conservation principles. The high density of residential lots in such close proximity to a conservation area could exert immediate and long-term negative impacts on the ecology of the area which the plan sets out to protect.

Some of the negative impacts resulting from the proposed residential development can be minimized by reducing the number of residential lots currently contemplated from 29 to 23, in favour of expanding the forest conservation area to facilitate the creation of unique ecotourism attraction. Decreasing the number of residential lots by 6 represents a potential increase of 31% (resulting in a ratio of 0.8) to the forest conservation area contemplated for the immediate vicinity of the Fairy Hill Estates. This increase in the forest conservation square footage represents an 8% increase in the overall habitat conservation area for Phase 2 of the development, increasing the ratio of conserved / developed land from 0.99 to 1.27 which is consistent with habitat conservation criteria. Eliminating development lots closest to the proposed forest conservation area would increase the ecological buffer zone between the development and the more fragile (and minimal) wetland reserve. This alternative is acceptable and recommended.

8.5 Alternative 5: Creation of Nature Reserve

The most environmentally friendly alternative to the current proposal would be to declare the area a Nature Reserve to be used primarily for eco-tourism (snorkelling, diving and bird-watching), research and education. The extent of infrastructure near the beach area would be limited to sanitation, garbage disposal, and off-site parking facilities. Access to the beach area would be fee-based and would be restricted to pedestrian traffic only. Car access to the beach would not be permitted. Revenues generated through entrance fees would support a beach maintenance crew as well as environmental wardens to monitor the conservation area. This scenario would protect the current state of the marine and terrestrial ecology and offer long-term protection from future development initiatives.

The present uncontrolled conversion of forested lands to pasture or agricultural use would also be curtailed by this alternative while maintaining the integrity of the site for use by endemic resident and migrant species of avifauna. This alternative does not provide for residential lots, or for the level of economic benefits attendant on Alternatives 2 and 4. This alternative although attractive is not the most recommended.

9.0 LEGISLATIVE AND REGULATORY FRAMEWORK

9.1 Responsible Authorities

The responsibility for regulating and facilitating environmentally sound development lies with several authorities. The principal agency responsible for environmental matters is the National Environment and Planning Agency (NEPA) of the Ministry of Land and Environment. This agency administers the Natural Resources Conservation Authority Act (1991), which allows the Authority, the Board to which NEPA reports, to request an environmental impact assessment in addition to the requirements of the Permit and Licensing System for development or construction considered likely to have an adverse effect on the environment. Failure or refusal to submit the documents is an offence under the law.

The Environmental Health Division (ECD) of the Ministry of Health administers the Public Health Regulations (1976) under which air; soil and water pollution control standards are established and monitored. A full application for approval of sewage treatment plans may be made to the EHD, which will input into the detailed application to be approved by the NRCA before authorizing any development. The EHD and local planning authorities monitor construction work to ensure that all development restrictions and requirements are properly adhered to.

In addition, there are Parish Acts and guidelines of local significance, including the Local Improvements Act (1944). However, whereas general approval under the Parish Councils Act is needed for building permits, the UDC Act supersedes all other legislation in the UDC designated areas. The construction of all buildings must comply with the Building Code. The Ministry of Environment and Housing (developed by ASCEND, 1996) and the Town Planning Department have manuals which provide guidelines and planning standards for housing developments. The national planning enforcement authority is the Town and Country Planning Authority (TCPA) which is now part of the NEPA.

9.2 Planning and Environmental Legislation

Natural Resources Conservation Authority (NRCA) Act

The Natural Resource Conservation Authority (NRCA) Act allows the Authority to request an Environmental Impact Assessment for development or construction considered likely to have an adverse effect on the environment. A permit is required from the NRCA for the undertaking of any activity within certain prescribed categories. A permit to operate is required by any new development, construction or modification of any works enabling the discharge of trade or sewage effluent into the environment under Sections 9, 10 and 12 of the NRCA act. This Legislation referred to includes:

- The NRCA (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order.

- The NRCA (Permit and Licence) (Forms, Processing and Fees) Regulations

Failure or refusal to submit the required documentation shall constitute an offence. In general, planning permission must first be sought from the NRCA.

Public Health Act (Air, Soil, and Water Regulations)

The Public Health Act (1974) specifies that persons responsible for any construction, repair or alteration and grit removal facilities, treatment ponds, sludge handling and disposal, and outfalls have to seek the approval of the Ministry of Health. It also deals with issues such as emergency power facilities, fencing and appropriate signage around treatment ponds.

The Watershed Protection Act

The Watershed Protection Act (1963) was enacted to provide protection for watersheds and adjoining areas and by that means promote the conservation of water resources. The Fairy Hill development is located within the Drivers River Watershed Management Unit, one such designated watershed area. The Watershed Protection Commission, established by the Act, can make relevant regulations restricting the planting of crops, the felling and destruction of trees, and the clearing of vegetation within watershed areas.

The Town and Country Planning Act

The TCPA formulates and coordinates strategic plans for area development in the form of Development Orders consistent with the Town and Country Planning Act (1975). This act is now administered by NEPA, and the NRCA board functions as the Town and Country Planning Authority

The Housing Act

The Housing Act (1973) requires that any proposal for the subdivision of land and the construction of houses thereon be accompanied by a plan of the area inclusive of, but not restrictive to, the following: the manner in which it is intended that the area shall be laid out, in particular, the land intended to be used for the provision respectively of houses, roads and open spaces for public and commercial purposes;

the approximate area of the land;

the approximate number and nature of the houses and other buildings to be provides;

the average number of houses to be constructed per acre;

particulars relating to water supply, drainage and sewage disposal.

The Beach Control Act

The Beach Control Act (1956) states that no person shall be deemed to have any rights in or over the foreshore of the island or the floor of the sea and all rights over the foreshore of the island and the floor of the sea are declared to be vested in the Crown. Additionally, no person shall encroach on or use, or permit any encroachment on or use of, the foreshore or the floor of the sea for any public purpose or for or in connection with any trade or business, or commercial enterprise without a licence granted under this Act. This act is administered by NEPA.

The Tourist Board Act

This Act states that no person shall operate or maintain any tourism enterprise unless such person is the holder of a licence.

Other Significant Legislation and Policies

Other significant legislation includes the Tree Preservation Order which provides for the protection of all trees from destruction or mutilation of any kind, except with the express permission of the local planning authority. The Wildlife Protection Act (1981) and the Forestry Act (1983) are also relevant to the proposed undertaking.

National Land Policy (1996)

This policy establishes the framework to enhance the efficient planning, management, development and use of land. It is comprehensive in order to achieve complementary and compatible development which is in harmony with economic and socio-cultural factors.

Chapter 3 of the National Land Policy includes rural development and the protection of watershed and fragile areas, exploitation of mineral resources, and crop and livestock production.

Section 3.5.2 (Tourism) states that Government has adopted policies to:

1. Improve physical planning and infrastructure development in resort areas;

6. Ensure the preservation and or development as well as access by all to public open spaces and recreational areas.

Section 4.2.2 (Land Access) states that Government will seek to:

1. Reduce the incidence of squatting by eviction, relocation, regularization and upgrading of infrastructure where necessary.

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APPENDIX

Appendix 1 – Terms of Reference

Appendix 2 – Monitoring Plan

Appendix 3 – Environmental Management Plan

Appendix 4 - Impact Matrices

Appendix 5 – Maps

Appendix 6 - Hydrogeology

Appendix 7 – Photographs (Environmental Chemistry and Ecology)

Appendix 8 - Ecology

Appendix 9 - Coastal Dynamics

Appendix 10 - Project Personnel

Appendix 1

Terms of Reference

These Terms of Reference have been approved by the National Environment and Planning Agency.

Task I

Description of the Proposed Project

Provide a full description of the project and its existing setting, using maps at appropriate scales. This is to include;

(a) General layout, (subdivision plan, road access, type & size of buildings etc)

(b) Pre-construction activities (including vegetation clearance)

(c) Construction methods and works

(d) Duration of construction phase

(e) Plans for providing utilities

(f) Waste disposal and other services

(g) Sewage treatment system maintenance

(h) Storm water collection and disposal, etc.

Task 2

Description of the Environment

Assemble, evaluate and present baseline data on the relevant environment characteristics of the area studied. These should give consideration to the following;

(a) Physical Environment:

Geology, topography, soils, climate and meteorology, surface and groundwater hydrology and natural hazard vulnerability

(b) Biological Environment:

Flora, fauna, rare or endangered species, sensitive habitats, trees worthy of protection, species of commercial importance and species with the potential to become nuisances, vectors or dangerous. Location or distribution maps must be used where appropriate.

(c) Socio-cultural Environmental:

Present and projected -: Population, land use, other planned development, and distribution of income recreation, water supply, public health, cultural and historical properties and any unusual local customs.

Task 3

Legislative and Regulatory Considerations

Describe the pertinent regulations and standards governing sitting and land use control environmental quality, health and safety, protection of sensitive areas and endangered species.

Task 4

Determine the Potential Impacts of the Proposed Project

Distinguish between significant:

a) Positive and negative impacts
b) Direct and indirect impacts
c) Impacts that are unavoidable, irreversible and cumulative.

Task 5

Analysis of Project Alternatives

Describe the alternatives examined for the proposed project that would achieve the same objective, within the same time frame or earlier. One of these alternatives must be the examination of no action taken. Hence, the most environmentally friendly alternative must be highlighted.

Task 6

Mitigation and Management of Negative Impacts

Recommend feasible and cost effective measures to prevent or minimize negative impact to acceptable levels.

Task 7

Environmental Impact Monitoring Plan

Prepare a draft plan for monitoring the implementation of mitigating measures and the impacts of the project during the construction phase.

Task 8

Assist in Inter - Agency Coordination and Public/NGO Participation

If and when required by NEP A, assist in coordinating the review of the environmental assessment by the relevant government agencies and in obtaining the views of local NGO's and affected groups.

5. Report

The environmental assessment report will be concise. and limited to significant environmental issues. The main text will focus on findings, conclusions and recommended actions, supported by summary of the data collected and citations for any references used in interpreting these data. The environmental assessment report will be organized according to but not necessarily limited by those outlined below:

- Executive Summary
- Description of the Proposed Project
- Policy, Legal and Administrative Framework
- Description of Environmental Impact
- Significant Environmental Impacts
- Analysis of Alternatives
- Mitigation Measures
- Impact Monitoring Plan
- List of References

Appendix 2
Monitoring Plan

APPENDIX 2 - DRAFT MONITORING PLAN

SCOPE OF STUDY AND METHODOLOGY

The monitoring programme is designed to ensure that the requirements of the Permit granted by the NEPA are met. Monitoring and mitigation of impacts during the implementation of the project will also require co-ordinated scheduling of activities between The Urban Development Corporation and the consultants, as well as regular reports required by the NEPA. Water quality and ecological parameters that may be affected by construction and operation of the development will be monitored with the necessary fieldwork component to provide the data as needed.

Field observations and measurements will be correlated simultaneously with weather prevailing conditions, so that any change in weather can be compensated for, and unwanted impacts can be avoided. In order to abide by the terms of the Permit set by the authorities, and certify satisfactory completion of the project, it will be necessary to perform the following:

a. **The monitoring of water quality parameters**, specifically, Turbidity, Total Suspended Solids (TSS), and Dissolved Oxygen (DO) during the implementation and post construction phases of the project. Samples will be collected at various locations (approved by the NEPA) twice during the first week of operation, weekly and then at fortnightly, depending on the nature of the activities being carried out at the time. Monitoring will be carried out more frequently as required if the results of initial monitoring suggest that there is a potential threat to the environment.

b. **Random photographs** (and aerial surveys) will be taken at regular intervals to determine whether the project is being carried out according to the stipulations of the Permit.

c. **A suite of ecological observations** would be required to observe any changes in the composition of marine, benthic and terrestrial flora and fauna If required, as above, monitoring will be carried out more frequently if the results of initial monitoring suggest that there is a potential threat to the environment.

d. Final monitoring will be carried out at least three weeks after the works are complete.

It is understood that the contractor will provide the soundings noted in service (a).

3. OUTPUT

The information from the monitoring exercise will be used by the consultant to guide the UDC regarding the efficacy of the mitigation measures being implemented. Any changes required to enhance the effectiveness of existing mitigation actions would then be recommended. Monitoring reports will contain the results of water quality and ecological examinations, as well as photographic monitoring carried out, in the period preceding the report, as well as recommendations for action, if required, for improving the construction process from an Environmental perspective. Data will be presented in both tabular and spatial form on maps prepared for this purpose. The maps will carry background, average and current data on each site of monitoring as well as coordinates. Monitoring reports would be produced according to the following schedule, in hard copy and electronic format:

1. Monitoring Report No. 1 - within one week following commencement of construction.
2. Monitoring Reports No. 2 onwards - within one week following the monitoring period (fortnightly or monthly) as determined, unless there is an unforeseen situation which could negatively affect the environment.
3. Post Project Monitoring will take place three weeks after the works are complete and the Final Monitoring Report will be submitted within week four after completion of the post project monitoring.

Depending on the length of the construction process, the NEPA may require monitoring reports on a schedule different from the intervals proposed.

Monitoring Plan Appendix

Appendix 1 - Water Quality

Appendix 2 - Ecology

Monitoring Plan Appendix 1: Water Quality

1.0 BACKGROUND

This plan is developed to satisfy the water quality monitoring component of the UDC Construction project at the Fairy Hill Development. The water quality component is required to evaluate impacts on critical parameters as a result of the proposed construction. In order to evaluate immediate and short term effects of the project, the monitoring plan will be carried out in two parts as follows:

- Water quality monitoring during construction
- Post development monitoring

RATIONALE FOR SELECTION OF WATER QUALITY INDICATORS

Our experience in this area has allowed us to determine that parameters of significance to the monitoring programme are **Total Suspended Solids** (**TSS), Turbidity, Biological Oxygen Demand** (**BOD)**, and **Dissolved Oxygen** (**DO).**

2.0 METHODOLOGY

Initial sampling will be carried out prior to the commencement of construction, to compare current conditions with data previously collected in order to confirm the baseline water quality for comparison with data collected during the project. Sampling will be carried out twice during the first week of construction. If the results are satisfactory, then sampling will be done weekly thereafter. As the project progresses there may be the request to change the frequency to fortnightly. Sampling will be increased to three times per week if a potential threat to the environment is identified.

At least six sampling stations will be established to enable comparison with data collected for the targeting areas slated for development ·and the closest sensitive area(s) potentially affected by the development.

2.1 Sample Collection

Surface and sub-surface water samples will be collected at all sites established using a Van Dorn sampler or similar device. Sampling will be carried out on several occasions during the development project as follows: Twice in the first week after commencement of infrastructure construction and then weekly thereafter. Final monitoring will be three weeks after completion of the project.

2.2 Sample Analysis

Laboratory analyses will be carried out by local facilities in accordance with Standard Methods for the Analysis of Water and Wastewater to determine levels of TSS and BOD. Dissolved Oxygen (DO) will be determined in situ using portable instrumentation.

Total Suspended Solids will be determined by filtration and gravimetry.

Biological oxygen demand (BOD) will be determined by the bottle dilution method.

Dissolved oxygen (DO), will be determined using the YSI Model 51B Oxygen meter, and Model 5739 Field Probe. The probe uses a Clark-type gas permeable membrane that covers polarographic electrode sensors. The system has a built in thermistor for temperature compensation, and temperature measurement. Measurement range of the instrument is 0-15mg/l, and accuracy is better than .2mg/l when calibrated within +/- 5^{o}C of actual sample temperature. Readability is better than 0.1mg/l.

3.0 OUTPUT

Monitoring reports will be produced according to the following schedule:

1. Monitoring Report No. 1 - within one week after commencement of construction
2. Monitoring Reports No. 2 onwards - within one week after the monitoring period (fortnightly or monthly) as determined, unless there is an unforeseen situation which could negatively affect the environment.

3. Post Project Monitoring will take place three weeks after the works are complete and the Final Monitoring Report will be submitted within week four after completion of the post project monitoring.

Monitoring Report Appendix 2: Ecology

1.0 BACKGROUND

The Ecological component of the environmental monitoring plan will clearly identify the mitigating actions to be taken, including tree surveys, development of drainage systems, dust control and waste disposal. The implementation of a regular schedule of sampling (e.g. on a fortnightly basis) of the area during the various phases of the development will ensure that negative impacts are identified and addressed in the earliest stages, thus preventing further deterioration of the environment. The monitoring program designed for the construction phase of the project will focus on:

- Collecting data and providing ongoing feedback on the state of the environment in the affected area
- Monitoring the state of the wetland, the designated forest conservation area, the state of trees marked for protection and other landscape activities
- Looking for signs of soil erosion and runoff especially after significant rainfall
- Monitoring the marine community, as well as sedimentation rates and water quality in the bay
- Turtle monitoring program in association with conservation biologists from NEPA, PEPA and other organizations such as the Caribbean Conservation Corporation & Sea Turtle Survival League
- Assessing transportation, storage and disposal of construction materials
- Assessing waste management practices
- Implementing the long-term post-development Environmental Management plan

RATIONALE FOR SELECTION OF ECOLOGICAL PARAMETERS

Particular emphasis will be placed on possible impacts to near shore mangrove stands, coral reefs, seagrass beds as well as other flora and fauna that may be affected (fall within the predetermined area of influence). The indicator parameters considered relevant to the assessment of significant impacts to the ecosystems include physical environmental data and the species composition and density of individuals comprising particular stands or habitats as well as mobile species that may inhabit them. The parameters of significance

are considered to be ambient light levels, suspended sediments and the density of occurrence of reef building corals, seagrass shoots and the extent of these habitats located in close juxtaposition to site modification activities.

2.0 METHODOLOGY

An examination of the ecology of the area of influence of the project will be carried out at sites previously established to define baseline conditions before construction commences. Sampling will then be carried out initially, at two week intervals. Maintenance of or deviations from the status quo regarding the parameters being investigated would determine whether or not the sampling period would be increased or decreased.

At least six sampling stations will be established in concert with the water quality monitoring stations if possible or appropriate so as to allow comparison with data collected from the ecological assessments made in previous studies

2.1 SAMPLE COLLECTION & ANALYSIS

Sampling of the habitat component species will be carried out by direct visual count (using chain or quadrat transects of appropriate length; by use of grab samplers for benthic infauna or by videotaping of the substrate for later analysis (random dot matrix analysis) in the laboratory - as appropriate.

Sediment rates & levels will be measured with appropriately sized and positioned sediment samplers while light levels will be evaluated with the aid of a secchi disc Initial sampling exercises are expected to occur at the commencement of the project; two weeks after commencement then at two week intervals. Final monitoring will be three weeks after completion.

Random aerial photography re influence of project on the overall environment will take place at monthly intervals if appropriate.

3.0 OUTPUTS

Monitoring reports will be produced according to the following schedule:

Monitoring Report No. 1 - One week after commencement of the project. Subsequent reports every two weeks. Post Project Monitoring will take place three weeks after construction is complete and the Final Monitoring Report will be submitted three weeks after completion of the post project monitoring.

Appendix 3
Environmental Management Plan

ENVIRONMENTAL MANAGEMENT PLAN

This plan has been prepared in accordance with the requirements of the National Environment and Planning Agency as it pertains to the Fairy Hill Phase 2 Development. This plan is being prepared to ensure effective management of the environment during the operational phase of this project.

This plan aims to provide:

- An integrated plan for the comprehensive monitoring and control of impacts.
- Auditable commitments displaying practical, achievable strategies for management to ensure that environmental requirements are specified and complied with

The Environmental Management Plan (EMP) defines a process wherein the managers of the Resort Development will:

1) Establish its commitment to improving the environment

To this end an Environmental Management Policy must be laid out by the management

Suggested Policy:

The management of the Urban Development Corporation (UDC) will work towards protecting the environment by ensuring that its activities do not contribute to its degradation. We will seek to lead by example in the national imperative of maintaining a healthy environment. To this end, The UDC will strive to operate in a safe, responsible manner within the country's environmental standards to secure a healthy environment for employees, visitors, and the wider society.

All employees are expected to understand, promote and assist in the implementation of this policy. This can be done by scheduling lectures, preparation of printed material etc to assist the decision makers of the management team as well as ordinary employees to be sensitive to the environmental character and vulnerabilities if the Fairy Hill Phase 2 Site, and the potential of their routine activities to impact on the environment.

2) Review its activities and identify those that have a significant impact on the environment.

This would involve a familiarity with the provisions of the NEPA Environmental Permit and Licences, particularly with the mitigation required and NRCA/NEPA Standards. Activities for the management of the waters in the ponds and lakes set up to provide water for the fairways and greens should be part of the management routine.

3) Put programmes in place to eliminate or reduce these impacts.

Monitoring programmes should be in place for the sewage effluent as well as the quality of the coastal waters to identify changes from the background, baseline conditions.

The environmental management plan must clearly identify the mitigating actions to be taken, including tree surveys, development of drainage systems, dust control and waste disposal. Retaining the services of a third party monitor to carry out regularly scheduled sampling (e.g. on a monthly basis) of the area during the various phases of the development would ensure that negative impacts are identified and addressed in the earliest stages, thus preventing further deterioration of the environment. A monitoring programme designed for the construction phase of the project should focus on:

- Collecting data and providing ongoing feedback on the state of the environment in the affected area
- Monitoring the state of the wetland, the designated forest conservation area, the state of trees marked for protection and other landscape activities
- Looking for signs of soil erosion and runoff especially after significant rainfall
- Monitoring the marine community, as well as sedimentation rates and water quality in the bay
- Assessing transportation, storage and disposal of construction materials
- Assessing waste management practices

The Products of the EMP will be:

- Specific targets and actions to reduce the impact of the development's activities on the environment;

- The establishment of a system of monitoring the activities of the development identified above.
- A data base, preferably digital of the development's activities and data collected to track the effect of the management programme
- An increase the awareness and knowledge of the staff at all levels of the environmental impacts of the decisions and activities that they undertake, and of the standards requited by NEPA.
- Placing a caveat on purchasers of lots in the development requiring their commitment to the management plan.
- A communications programme to encourage environmental stewardship among the resorts residents and businesses.

The outcome of the EMP will be an improvement of the environment in and around the development.

Appendix 4
Impact Matrices

WEIGHTING FOR IMPACT MATRIX

+10
] Positive, Long term, New, Very significant, Direct
+8
] Indirect, Positive, Very significant, New, Long term
+6
] Positive, Direct, Short term, Very significant, Incremental
+4
] Indirect, Positive, Short term, Very significant, Incremental
+2
] Positive, Direct/Indirect, Insignificant, Short term, Incremental
0
] Indirect, Negative, Short term, Incremental, Insignificant, Mitigable
-2
] Indirect, Negative, Short term, Very significant, Mitigable, Incremental
-4
] Direct, Negative, Long term, Very significant, Mitigable, Incremental
-6
] Indirect, Negative, Long term, Very significant, New, Unmitigable
-8
] Direct, Negative, Long term, Very significant, New, Unmitigable
-10

IMPACT MATRIX						
ENVIRONMENTAL CHEMISTRY						
FAIRY HILL						
PRE-MITIGATION						
	I	**M**	**P**	**A**	**C**	**T**
INDICATOR	**TYPE**	**EXTENT**	**MAGNITUDE**	**MITIGATIVE MEASURES**	**COMMENTS**	**WEIGHT**
COASTAL WATER QUALITY:						
Organic Pollution Indicators:						
BOD	NEG	LONG TERM	SIGNIFICANT		DUE TO SEWAGE/STORM WATER DISCHARGE	-6
Nitrogen	NEG	LONG TERM	SIGNIFICANT		DUE TO SEWAGE/STORM WATER DISCHARGE	-6
Pesticides	NEG	LONG TERM	SIGNIFICANT		USED IN MAINTENANCE OF LANDSCAPE	-6
TSS	NEG	SHORT TERM	SIGNIFICANT		DUE TO SEWAGE/STORM WATER DISCHARGE	-6
Coliform	NEG	LONG TERM	SIGNIFICANT		MAINLY FROM SEWAGE/STORM WATER	-4
D.O.	NEG	LONG TERM	SIGNIFICANT		DUE TO HIGH LEVEL OF BOD IN SEWAGE	-6
Inorganic Pollution Indicators:						
Phosphate	NEG	LONG TERM	SIGNIFICANT		FROM FERTILISERS USED IN MAINTENANCE OF LANDSCAPE	-6
Nitrate	NEG	LONG TERM	SIGNIFICANT		DUE TO BREAK DOWN OF SEWAGE, AND USE OF FERTILISERS	-6
Salinity	NEG	LONG TERM	SIGNIFICANT		REDUCED SALINITY OF COASTAL WATER DUE TO INCREASED STORM WATER RUN OFF	-6
TSS	NEG	LONG TERM	SIGNIFICANT		DUE TO SEWAGE DISCHARGE, EROSION.	-6

Organic Pollution Indicators:						
INDICATOR	**TYPE**	**EXTENT**	**MAGNITUDE**	**MITIGATIVE MEASURES**	**COMMENTS**	**WEIGHT**
BOD	NEG	LONG TERM	SIGNIFICANT		CONTAMINATION OF AQUIFER BY SEWAGE,	-6
Nitrogen	NEG	LONG TERM	SIGNIFICANT		DISCHARGE OF SEWAGE TO AQUIFER, SEEPAGE OF NUTRIENT RICH WATER	-6
Pesticides	NONE	NA	NA		USE OF PESTICIDES IN MAINTENANCE OF LANDSCAPED AREAS, SEEPAGE OF NUTRIENT RICH IRRIGATION RETURN WATER	0
TSS	NEG	LONG TERM	SIGNIFICANT		DISCHARGE OF SEWAGE TO AQUIFER, SEEPAGE OF NUTRIENT RICH IRRIGATION RETURN WATER	-6
Coliform	NEG	LONG TERM	SIGNIFICANT		DISCHARGE OF SEWAGE TO AQUIFER, SEEPAGE OF NUTRIENT RICH IRRIGATION RETURN WATER	-4
D.O.	NEG	LONG TERM	SIGNIFICANT		DUE TO HIGH LEVEL OF BOD IN SEWAGE	-6
Inorganic Pollution Indicators:						
Phosphate	NEG	LONG TERM	SIGNIFICANT		SEEPAGE OF NUTRIENT RICH IRRIGATION RETURN WATER	-6
Nitrate	NEG	LONG TERM	SIGNIFICANT		DISCHARGE OF SEWAGE TO AQUIFER, SEEPAGE OF NUTRIENT RICH IRRIGATION RETURN WATER	-6
Salinity	NEG	LONG TERM	SIGNIFICANT		ABSTRACTION OF GROUND WATER	-6
Conductivity	NEG	LONG TERM	SIGNIFICANT		ABSTRACTION OF GROUND WATER	-6
TSS	NEG	LONG TERM	SIGNIFICANT		DISCHARGE OF SEWAGE TO AQUIFER	-6

POST-MITIGATION						
COASTAL WATER QUALITY						
INDICATOR	**TYPE**	**EXTENT**	**MAGNITUDE**	**MITIGATIVE MEASURES**	**COMMENTS**	**WEIGHT**
Organic Pollution Indicators:						
BOD	NEG	SHORT TERM	INSIGNIFICANT	TREATMENT OF SEWAGE TO ENSURE COMPLIANCE WITH TRADE EFF. STDS.		0
Nitrogen	NEG	SHORT TERM	INSIGNIFICANT	TREATMENT OF SEWAGE TO ENSURE COMPLIANCE WITH TRADE EFF. STDS., CONTAINMENT OF SURFACE RUN OFF	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
Pesticides	NONE	NA	NA	CONTAINMENT OF SURFACE RUN OFF AND IRRIGATION RETURN WATER	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
TSS	NEG	SHORT TERM	INSIGNIFICANT	CONTAINMENT OF SURFACE RUN OFF AND TREATMENT OF SEWAGE TO ENSURE COMPLIANCE WITH TRADE EFF. STDS	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
Coliform	NONE			TREATMENT OF SEWAGE TO ENSURE COMPLIANCE WITH TRADE EFF. STDS.		0
D.O.	NONE			TREATMENT OF SEWAGE TO ENSURE COMPLIANCE WITH TRADE EFF. STDS.,		0
Inorganic Pollution Indicators:						
Phosphate	NEG	SHORT TERM	INSIGNIFICANT	CONTAINMENT OF SURFACE RUN OFF	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
Nitrate	NEG	SHORT TERM	INSIGNIFICANT	TREATMENT OF SEWAGE TO ENSURE COMPLIANCE WITH TRADE EFF. STDS., CONTAINMENT OF SURFACE RUN OFF	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
Salinity	NEG	SHORT TERM	INSIGNIFICANT	CONTAINMENT OF SURFACE RUN OFF	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2

Conductivity	NEG	SHORT TERM	INSIGNIFICANT	CONTAINMENT OF SURFACE RUN OFF	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
TSS	NEG	SHORT TERM	INSIGNIFICANT	CONTAINMENT OF SURFACE RUN OFF	OVERFLOW MAY OCCUR IN EXTREME EVENTS	-2
GROUND WATER QUALITY						
Organic Pollution Indicators:						
BOD	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0
Nitrogen	NONE					0
Pesticides	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0
TSS	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0
Coliform	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0
Inorganic Pollution Indicators:						
Phosphate	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0
Nitrate	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0
Conductivity	NONE			AVOID USE OF GROUND WATER FOR IRRIGATION		0
TSS	NONE			USE OF APPROPRIATE LINER IN CONTAINMENT AREA		0

Ecological Impact Matrix

	FAIRY HILL ECOLOGICAL IMPACT INDICATOR	Impact Type	Significant	Not significant	Direct	Indirect	Short-term	Long-term	Unavoidable	Irreversible	Cumulative	Mitigation Required	Comments	Weight
During Construction	Loss of natural habitat	NEG	x		x			x	x	x	x	x	Maximizing forest and wetland conservation area is needed to lessen impact of lost habitat.	-9
	Decreased biodiversity	NEG	x		x			x	x	x	x	x	Landscaping select plant species in green areas to maintain species diversity of flora. Keeping food trees for birds & using feeders would encourage them to remain in the area.	-9
	Degradation of marine environment	NEG	x			x		x			x	x	Monitor development activities to reduce sedimentation on reef and trampling of seagrass.	-7
	Soil erosion	NEG		x	x		x					x	Completion of one area and its landscaping could be carried out before commencing work on another section.	-5
	Noise pollution	NEG		x	x		x		x			x	Noise barriers. Restricting construction to daylight hours.	-4
	Dust pollution	NEG		x	x		x					x	Proper transportation and storage of building materials on site.	-4
	Disposal of construction debris	NEG		x		x	x		x			x	Need for comprehensive construction site disposal plan.	-2
	Sewage	NEG		x		x	x		x			x	Provision of appropriate sanitation for workers.	-2
	Garbage	NEG		x		x	x		x			x	Provision of appropriate sanitation for workers.	-2
	Change in drainage patterns	NEG	x			x		x	x			x	Ensure that cleared open areas are replanted with vegetation.	-6
													Cumulative Post- Construction Impact	**-50**
	Increased human activity on beach	NEG	x			x		x	x		x	x	Increased tourist traffic to the beach if not controlled, could result in trampling of the Turtlegrass. Need for controlled access to the beach park area and implementing security measures.	-5
	Landscaping and replanting	POS	x		x			x			x		Landscaping plan to use local species in green areas to maintain species diversity of flora. Keeping food trees for birds & using feeders would encourage them to remain in the area.	7
	Wetland and forest conservation	POS	x		x			x			x		Maximizing habitat conservation area essential to maintaining diversity and long-term ecological value of area.	8
	Protection of turtle nesting ground	POS	x		x			x			x		Removal of structures, especially concrete buildings, concrete building foundations and hard pavements on and near the beach will provide suitable areas for sea turtle nesting. Monitoring is essential during and upon completion of development.	6
	Controlling use of beach area	POS		x		x		x					Controlled access to the beach and maintenance are essential to protecting the beach area and the associated marine & terrestrial ecology. Avoid building permanent structures on the beach.	4
	Reducing/Eliminating sand mining	POS	x		x			x					Monitoring of access points to the beach during and after the completion of the development would eliminate illegal sand mining and mitigate degradation of the beach area.	7
	Eliminating car access to the beach	POS	x			x		x					Reduce compacting of sand and pollution of beach area.	4
	Eco-tourism, education, outreach	POS		x		x		x					Opportunity for public education.	3
													Cumulative Post- Construction Impact	**34**

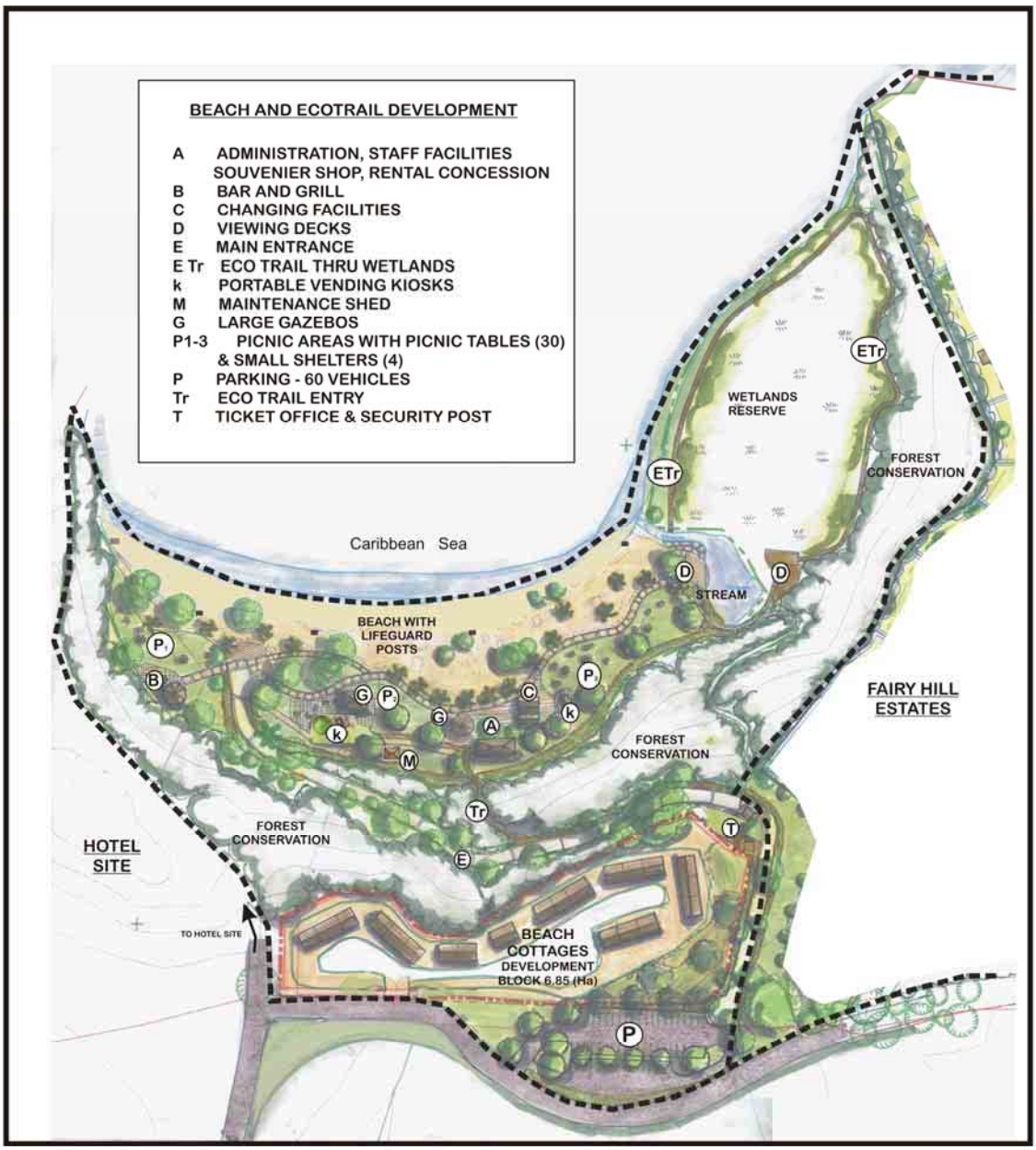
SIA IMPACT MATRIX

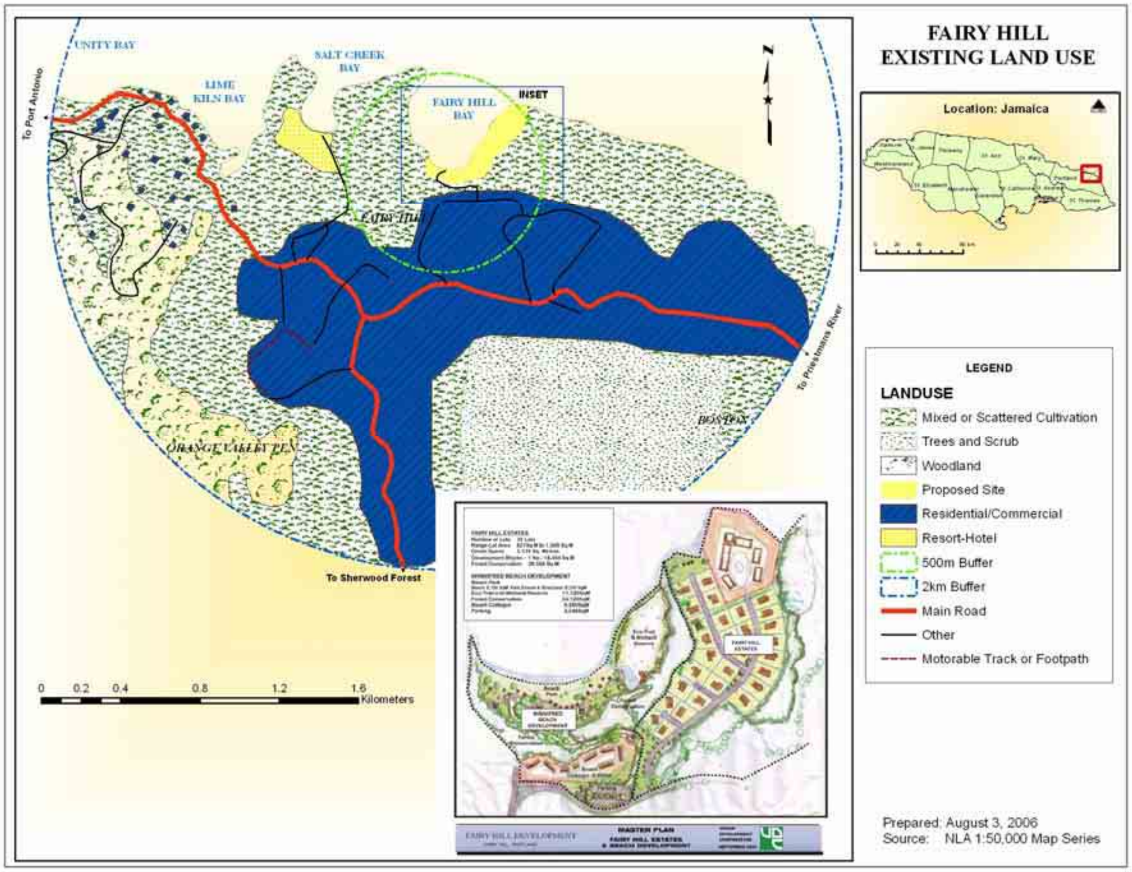
Factor	Indicator	Type	Extent	Magnitude	Mitigative Measures	Comments	Weight
Socio-economic Construction (Micro)	Land Use	Negative, direct	Short-term	Significant	Develop a plan for demolition, land preparation and construction activities to create minimal displacement. Include the community especially, displaced persons in activities whether by providing employment or other compensation for loss of income	14-16 vendors will be displaced during construction	-4
	Employment and Income	a) Positive, direct	Short-term	Very significant	N/A	Jobs will be created during construction. Vendors may be employed during construction of roads, and structure on site	+6
		b) Negative, direct	Short-term	Very significant	Compensate for loss of income and/or provide employment for vendor on the beach to offset loss of income		-4
	Transportation	Negative, direct	Short-term	Not very significant	N/A	Access routes to the beach will be unavailable during construction	-2
	Community Development	Negative, direct	Short-term	Significant	Include the residents in the planning of the development	Loss of access to the beach during construction	-2

Factor	Indicator	Type	Extent	Magnitude	Mitigative Measures	Comments	Weight
Socio-economic Post-Construction (Macro)	National/Regional	Positive, direct	Long-term	Very Significant	N/A	Contribute to housing supply Contribute to sustainable development in the tourism sector Contribute to employment	+10
(Micro)	Land Use	Positive, indirect	Long-term	Significant	N/A	Regularization of on-site vendors would improve working/selling conditions and provide proper sanitary facilities etc.	+8
	Employment	Positive direct	Long-term	Very Significant	N/A	Beach Park operation and management will provide employment	+10
	Community Development	a) Positive, indirect	Long-term	Significant	N/A	Improved community infrastructure and recreational facilities Contribute to employment and housing in the community	+8
		b) Negative, indirect	Long-term	Significant	Upgrade infrastructure and provide social services/facilities for current and future residents of the community	Existing social services and infrastructure may not be able to facilitate increased activities in the SIA study area	-8 +9
	Recreation	a) Positive, direct	Long-term	Very significant	N/A	Improved recreational facilities for the community members and visitors	-6
		b) Negative, direct	Long-term	Significant	Include the community in the planning and provide discounted rates for community member to use the beach	There will be a charge for using the beach	

Appendix 5
Maps


FAIRY HILL ESTATES
Number of Lots 29 Lots
Range Lot Area 821Sq M to 1,505 Sq M
Green Space 5,135 Sq. Metres
Development Blocks - 1 No.- 14,454 Sq M
Forest Conservation
WINNIFRED BEACH DEVELOPMENT
Beach Park
Beach 8,100 SqM, Park,Stream & Structures 8,230 SqM
Eco-Trail and Wetland Reserve 11,120SqM
Forest Conservation 24,120SqM
Beach Cottages 6,850SqM
Parking 3,046SqM
FAIRY HILL ESTATES
WINNIFRED BEACH DEVELOPMENT
FAIRY HILL DEVELOPMENT
FAIRY HILL, PORTLAND
MASTER PLAN
FAIRY HILL ESTATES & BEACH DEVELOPMENT
URBAN DEVELOPMENT CORPORATION
SEPTEMBER 2004


BEACH AND ECOTRAIL DEVELOPMENT
A ADMINISTRATION, STAFF FACILITIES SOUVENIER SHOP, RENTAL CONCESSION
B BAR AND GRILL
C CHANGING FACILITIES
D VIEWING DECKS
E MAIN ENTRANCE
E Tr ECO TRAIL THRU WETLANDS
k PORTABLE VENDING KIOSKS
M MAINTENANCE SHED
G LARGE GAZEBOS
P1-3 PICNIC AREAS WITH PICNIC TABLES (30) & SMALL SHELTERS (4)
P PARKING - 60 VEHICLES
Tr ECO TRAIL ENTRY
T TICKET OFFICE & SECURITY POST
ETr
WETLANDS RESERVE
FOREST CONSERVATION
Caribbean Sea
STREAM
BEACH WITH LIFEGUARD POSTS
FAIRY HILL ESTATES
HOTEL SITE
TO HOTEL SITE
BEACH COTTAGES DEVELOPMENT BLOCK 6.85 (Ha)
FAIRY HILL DEVELOPMENT
FAIRY HILL, PORTLAND
WINNIEFRED BEACH DEVELOPMENT
URBAN DEVELOPMENT CORPORATION
SEPTEMBER 2004



Telephone: (876) 920-6012
Email: temn@cwjamaica.com
www.temnetwork.com

Appendix 6 – Hydrogeology

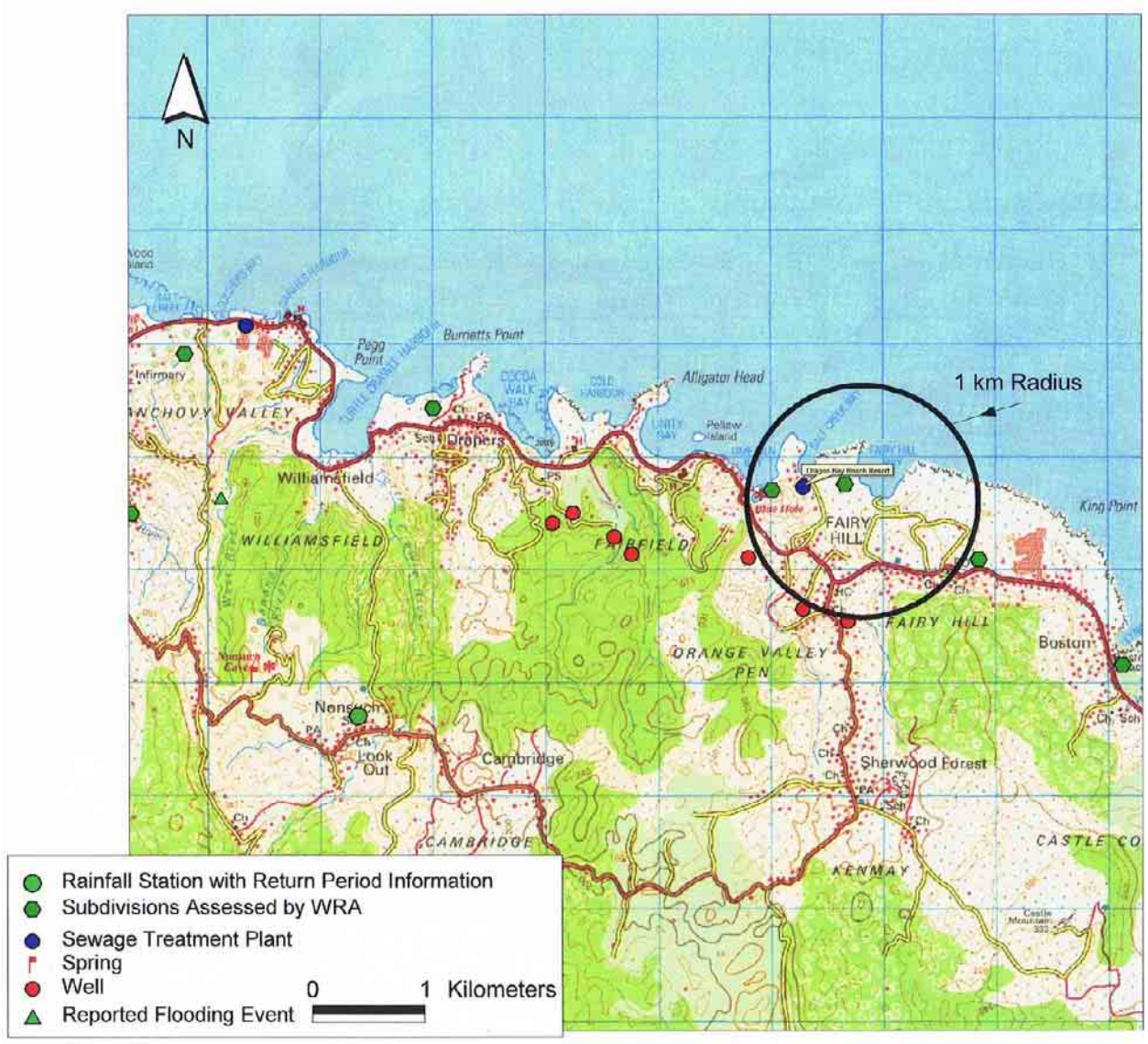


Figure 1 - Fairy Hill Location Plan showing infrastructure points, water features and other point of interest within 1km of the site (obtained from the WRA)

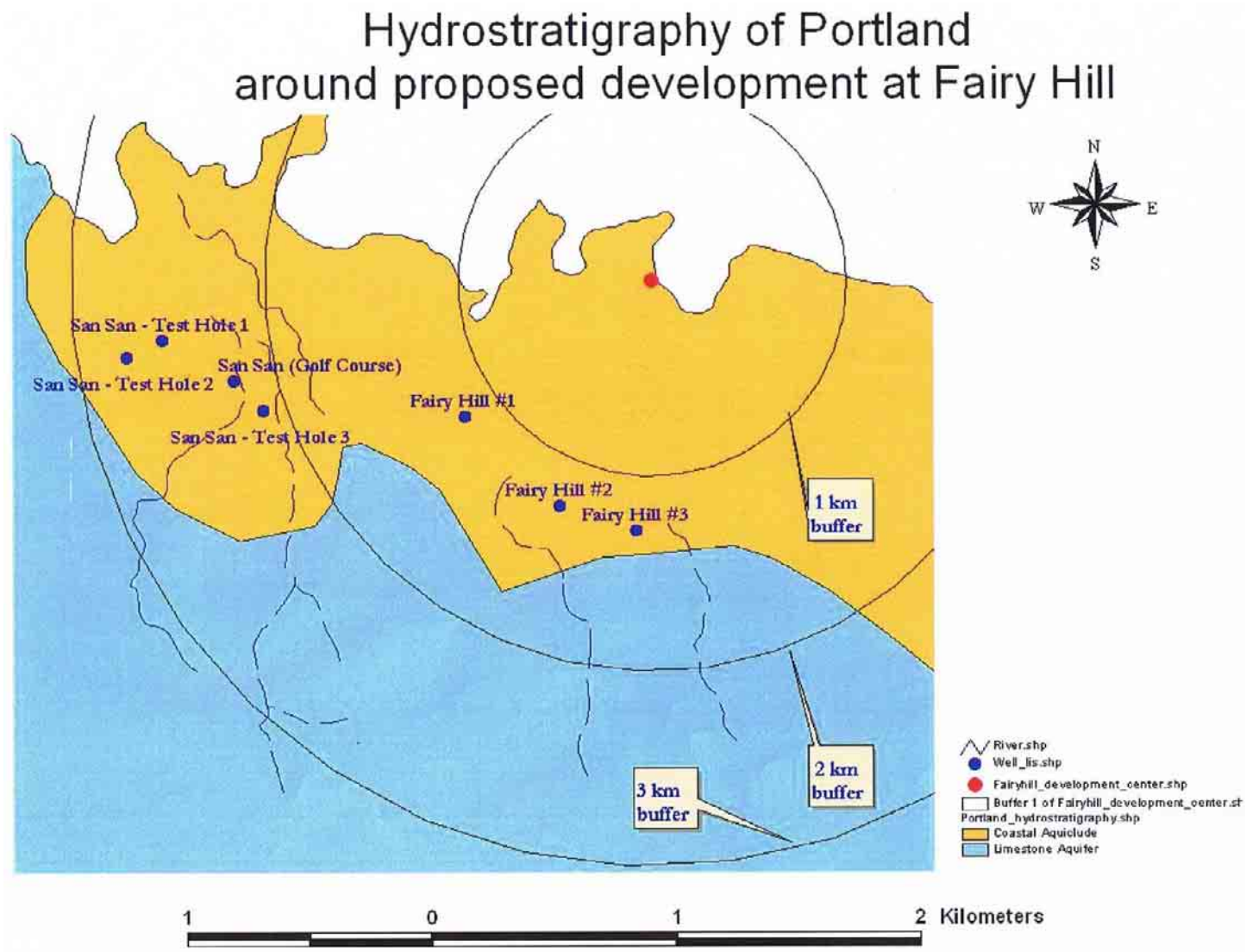


Figure 2 – Hydrostratigraphy around Fairy Hill, Portland showing rivers and well locations within 1 km buffer (obtained from the WRA)

Photo 6.1 - Coastal freshwater spring with head waters in the foreground and its discharge stream leading to the sea in the foreground (May 12, 2006)

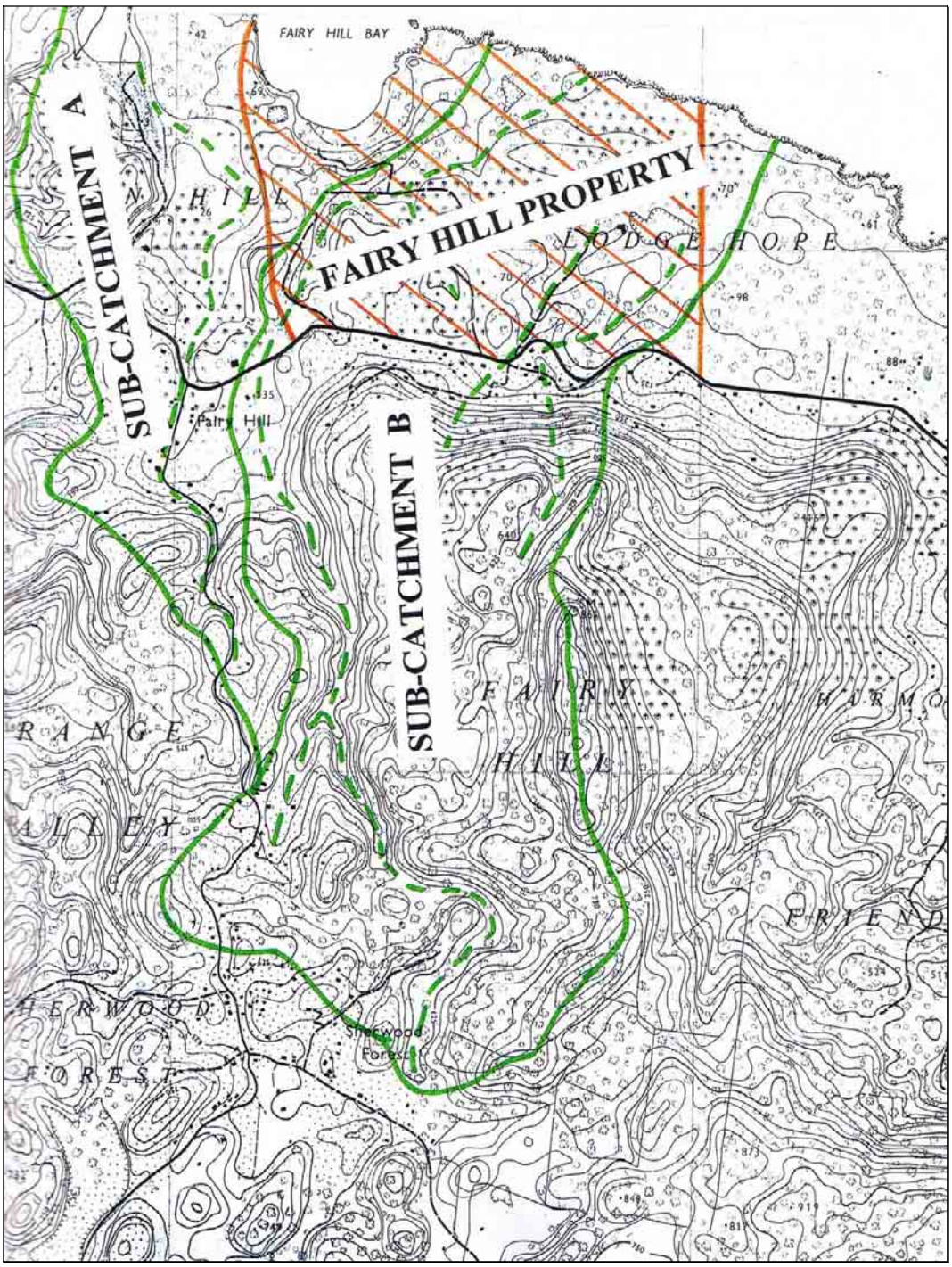


Figure 3 - Proposed Fairy Hill Catchment outline (modified from Fairy Hill Phase I, Hydrogeological Assessment Report, c. 1997)

Photo 6.2 - Natural Gully showing evidence of hydraulic scouring (May 12, 2006)

APPENDIX 7
PHOTOGRAPHS

Environmental Chemistry and Ecology

Photo 7.1-Larger spring opened to the beach, flowing to the sea.

Photo 7.2-Smaller spring, emerging along rocky shoreline.

Photo 7.3-Solid waste heaps on beach.

Photo 7.4-Aerial photographs of proposed site showing forested terrain.

Photo 7.5-Aerial photographs of proposed site showing forested terrain.

Photo 7.6-Aerial photographs of proposed site showing forested terrain.

Photo 7.7-Under canopy layer open towards periphery, giving way to dense shrubs.

Photo 7.8-Naturally occurring channel leading to lagoon and beach.

Appendix 8

ECOLOGY
Calculation of Habitat Conservation Ratios

Appendix 8
Calculation of Habitat Conservation Ratios

Table 7.1. Fairy Hill Development Habitat Conservation Ratios

	Proposed				Alternative			
(A) Fairy Hill Estates	Master Plan Parameters	Developed area (m ²)	Conservation Area (m ²)	Ratio Conserved/ developed	Master Plan Parameters	Developed Area (m ²)	Conservation Area (m ²)	Ratio Conserved/ developed
Number of lots (#)	29				23			
Small Range Lot Area	821	23,809		0.86	821	18,883		1.57
Large Range Lot Area	1,505	43,645		0.47	1,505	34,615		0.86
Green space (m ²)	5,135	2,568			5,135	2,568		
Forest conservation (m ²)	20,566		20,566				29,596	
Total:		46,213	20,566	**0.45**		37,183	29,596	**0.80**
(B) Winnifred beach development								
Beach	8,100		4,050					
Park, stream & structures	8,230	4,115						
Eco-trail and wetland reserve	11,120		11,120					
Forest conservation	24,120		24,120					
Beach cottages	6,850	6,850						
Parking	3,046	3,046						
Total:		14,011	39,290	**2.80**		14,011	35,240	
Habitat Conservation Ratio Fairy Hill Development Phase 2:		60,224	59,856	**0.99**		51,194	64,836	**1.27**

Assumptions:

1. In both the Proposed and Alternative scenarios, Developed Areas include all cottage and/or residential development and in the case of Fairy Hill Estates 50% of Green space, to account for the partially diminished habitat value of land relative to pristine habitat.

2. Given the figures provided in the proposed master plan, the difference between the small and large Range Lot Areas is not reflected by commensurate changes in Green Space and Forest Conservation areas depending on the option being used (ie the green space and conservation areas remain static). As such, square footage of large lot areas was used to calculate the conservation ratios to represent the maximum usage of land in terms of ecological impact based on conversion of the land area.

3. Conservation Areas include the eco-trail and wetland reserve and/or forest conservation sites.

4. Park, stream and structures: 50% of the area is deemed to be a developed area to account for the structures and the partially diminished habitat value of the park area relative to the pristine habitat.

5. Beach: Despite the heavy use of the beach, 50% of the beach is deemed to be a conservation area primarily due to mitigating impacts on turtle populations.

APPENDIX 9

COASTAL DYNAMICS

COASTAL DYNAMICS

Hydrodynamic Modelling

It was initially planned that a two-dimensional depth-average finite element model be set-up and calibrated for the area surrounding Port Antonio. The purpose of this modelling program was to gain an increased understanding of the current patterns and circulation within the projected area. This information could then be used to evaluate different outfall locations and their impacts.

Coming out of the field data collection program, it became obvious that complex, oceanic current patterns were equally as important in this area as tidally generated currents. It was thus deemed necessary to also investigate the far-field current patterns. A mesh was therefore generated to simulate flow conditions surrounding Port Antonio. The mesh covered a wide area which stretched from the Morant Cays in the south, covered the entire north-eastern half of Jamaica, and extended north midway to Cuba. The purpose of this mesh was to investigate the occurrence of large-scale eddies on the North Coast of Jamaica generated by the dominant westward flow of the North Equatorial Current.

Description of the Model

Hydrodynamic modelling of the current patterns in the vicinity of Port Antonio was undertaken using a depth-averaged finite element model called Fast TABS. Fast TABS is actually a Windows based pre- and post-processor for a suite of finite element models developed by the US Army Waterways Experiment Station, called RMA.

A finite element model was chosen in favour of a finite difference model because of the greater freedom in the creation of the mesh, which is used to represent the flow boundaries. A finite element model allows virtually any shaped water body to be modeled, whereas a finite difference model is restricted to a uniform rectangular grid.

Fast TABS was developed by the Engineering Computer Graphics Laboratory at Brigham Young University in cooperation with the US ARMY Corps of Engineers Waterways Experimental Station (WES). It is essentially a pre- and post-processor, specifically designed

to be used in conjunction with the TABS - MD suite of two-dimensional finite element hydrodynamic programs used by WES. The TABS- MD code was originally developed by Resource Management Associates Inc. Of Davis, California (RMA). The heart of the TABS SYSTEM is the program RMA-2 which is a two dimensional, depth averaged, free surface, finite element program for solving hydrodynamic problems.

Model Set-up Procedure

In creating a mesh to properly model the hydrodynamics, it was important to set boundaries sufficiently far from the area of interest that any undesired boundary effects would be minimized. In addition, it was important to include sufficient detail so that factors which may affect overall flow patterns were properly represented. For the large scale mode, this meant that the boundaries were set well away from the sea mounts and cays which occur east of Jamaica, and for the smaller finite element mesh the boundary was extended northward to deep water.

Depths inside the mesh were taken from existing hydrographic charts as well as detailed hydrographic data collected during the field program of this study. Fast TABS was used to generate and refine the finite element mesh. A cut-off depth of 150m was used to represent the model bottom for both the large and small scale meshes. This depth was chosen based on depth of surface waters and location of the thermocline. The final mesh that was used consisted of 3529 nodes and 1037 elements.

Far-field Model Representation

The results of the far-field model simulations are shown in the figure 9.1 below. This simulation represents an oceanic current approaching the water around Jamaica from the east with a velocity of 10 cm/sec. Depth contours are represented in the diagram in a colour coded manner with a legend (in feet). The north-eastern shoreline of Jamaica is represented in the bottom left-hand corner of the diagram from Morant Point (on the lower axis) to

Annotto Bay (on the left-hand model axis). The shoals/banks east of Jamaica can be seen as a series of three sea mounts with shoaling depths. Moving from shallow to deep water, these are: Henry Holmes Bank, Grappler Bank and Formigas Bank. The simulation shows that these shoals have a profound effect on the flow pattern of the North Equatorial Current as it sweeps to the west.

In summary, this flow is seen to become disorganised and is characterised by the formation of a number of large gyres and shear zones. In the area offshore Port Antonio, the flow appears to approach the shoreline from a north-east direction and there is some evidence of a bifurcation in flow.

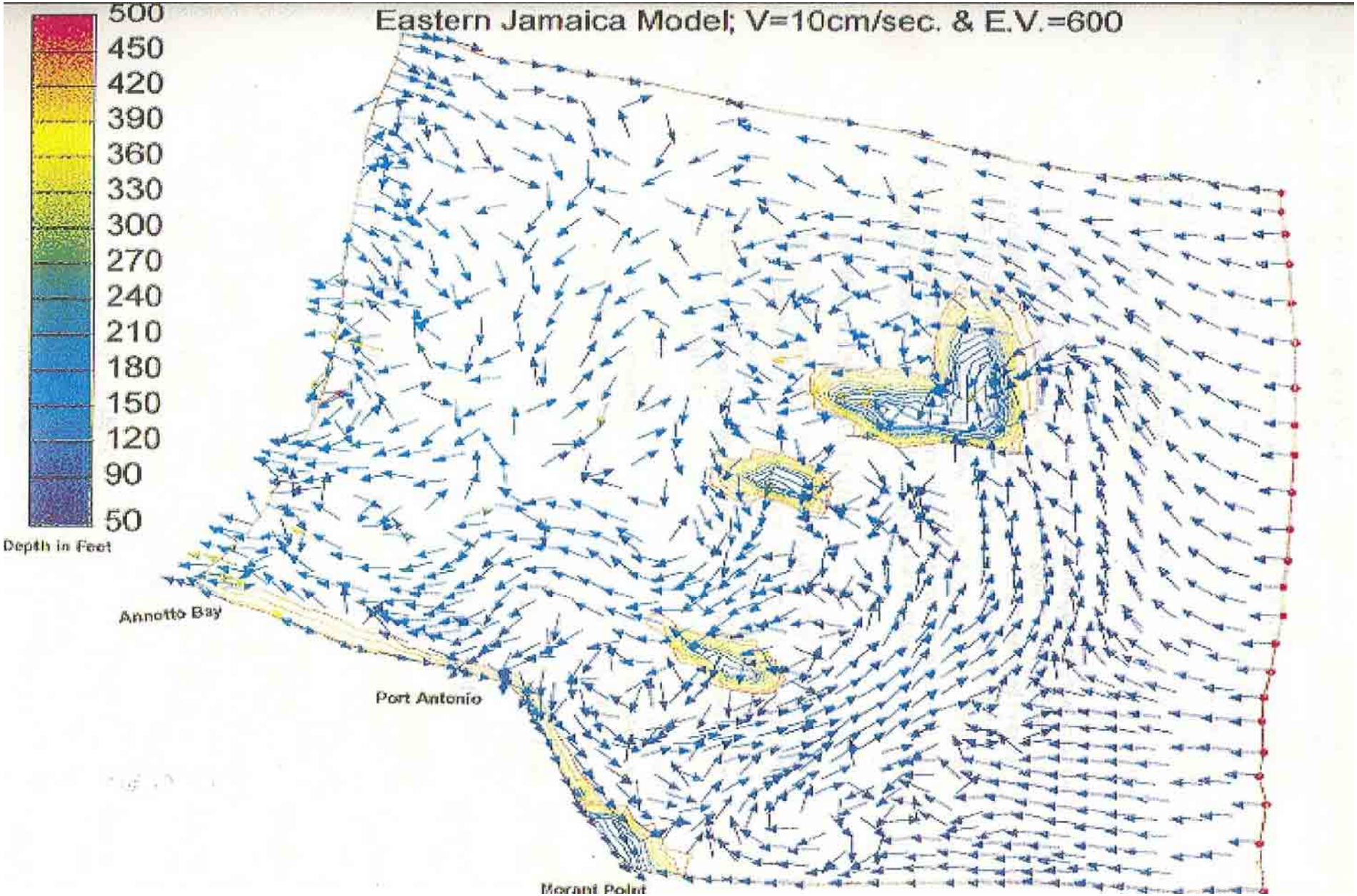


Figure 9.1-Far – Field Model Representation

APPENDIX 10

PROJECT PERSONNEL

The following persons were involved in the study:

Donovan Rose MSc	-	Project Coordinator, Impact Assessment
Peter Gayle BSc	-	Ecology
Paul Carroll MSc	-	Water Chemistry
Allison Richards MSc	-	Socio- Economics
Brian Richardson MSc	-	Hydrology
Pierre Diaz BSc	-	Oceanography
Michelle McNaught BSc	-	Research Assistant